इरिसेट IRISET

S 15

PANEL INTERLOCKING WITH METAL - METAL RELAYS (SIEMENS)

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

S15

PANEL INTERLOCKING

WITH

METAL TO METAL RELAYS (SIEMENS)

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

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

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CHAPTER 1
INTRODUCTION

1. In this system for clearing a signal the route has to be correctly set by operating the points individually to the required position with the help of concerned point button and the common point buttons. As the points are electrically operated, the range of operation is extended. This results in less no
2. . of cabins and thus bringing economy of man power and reducing human elements in signalling.

3. This system is generally provided at way side stations or small installations or for end cabin operations.

4. Multiple Aspects colour light signalling is provided with this system though it is not mandatory.

5. Combined type (operating cum indication) domino pattern control panels along with self restoring type of push buttons are generally used.

6. In order to prevent unauthorized operation of the panel a Station Master Key is provided for locking all the operations except putting back a clear signal to danger in case of emergency.

7. Rational method adopted for numbering of various components enable the system to be more informative.

8. System is more flexible and transparent due to the provision of more number of facilities such as emergency operations and recording the same through counters.

9. Sectional route release facility and Signal aspect cascading arrangements are in built feature for this system.

10. Out of correspondence of signal and points are indicated by suitable flashing indication with audible alarm.

11. Grouping of relays, fuses and circuits makes the system more economical, reliable and flexible.

12. Relay groups used for Non-Route setting type Relay Interlocking (PI) / Route setting type Relay Interlocking (RRI) are the same except the point control group as individual operation of point are only possible. For Non-Route setting type installations Minor Point group is used. In route operation of the point adopted in RRI, this Minor Point group will not be able to operate the point by route setting. Therefore a Major Point group has to be used to facilitate this feature along with point chain group.

CHAPTER 2

TABLE OF CONTROL, ROUTE SECTION PLAN

2.1 Selection Table/Control Table is a tabular representation of Signalling arrangements provided in a particular Signal layout taking into consideration about the safety requirements, operational requirements and flexibility of train moves. It comprises of several columns and furnishes the details about various operating conditions for clearing the signals concerned, for holding the routes and also for cancellation of a cleared signal or a set route. The selection table for a station is helpful for designing the circuits of that station and also is used for undertaking functional test of various signalling functions existing in the yard. The details given in the selection table is the basis of Interlocking provided in that particular yard. Different Railways have different formats for the Selection Table. The columns provided in selection table and details to be furnished are discussed below.

Separate columns for each sub route and overlap for the same signal movements are written. If a signal path has more than one overlap then separate row for each overlap are written. (Refer to Route section plan and Table of control)

Column Number 1: **Serial number**

This Column details the Serial Number of Signal routes in the control table.

Column Number 2: Signal and Route

This is written as the signal number and the route to which it is being cleared. The route can be identified as the signal to which it is leading, the road to which it is leading or the track to which it is leading. For example road to which it is leading or the track to which it is leading.
Example:

(a) S1 to S13 (ahead signal number) or

(b) S1 to U/D Loop1 (Road number) or

(c) Signal S4 to 204 (Track number) or

The information about alternative overlaps is also given.

Column Number 3: Description of Main and Calling ON signal routes

This Column details the description of the Signal Movement given in column number 2.

Column Number 4 & 5: Push Buttons (Entry and Exit buttons)

These columns give the details of Signal button and the Route button to be operated for clearing a route. For example S1 Signal button GN and LP1 route button UN.

In case of calling on signals where three buttons such as Signal button GN, Calling ON Signal button COGGN and Route button UN are involved in clearing 'Calling ON' signal, in the GN column it is written as Signal button GN and Calling ON Signal button COGGN and in the UN column LP2T UN.

For example S1 Signal button GN and Calling ON Signal button COGGN are to be written in column no. 4 and LP2T UN is to be written in column no. 5.

Column Number 6 and 7: Route Sections Set and eliminated in Route

Column number 6 refers to the Route Sections to be set for clearing a signal. Column number 7 refers to the route sections conflicting to the required set route section. These are to be proved NOT SET before setting the route section written in Column.6

Col No. 8 and 9: Points set in the Route/Overlap/Isolation

These columns refer to the points requires to be set and locked in route section, overlap section portions and also for isolation purposes.

These are written for the Route section and overlap section written in Col. No. 6 and Col. No 12 respectively.

Column Number 10 and 11: Track circuits free in the route and overlap

Column number 10 refers to the track circuits should be clear for signalled movement in the route.

Column number 11 refers to the track circuits to be proved clear for signalled movement in the overlap section.

Column Number 12 and 13: Overlap Set and Eliminated

Column number 12 refers to overlap sections required to be set for the signal given.

For example: Overlap OV14 or in case of alternate overlaps OV1 13, Overlap OV2 13.

Column number 13 refers to the Overlaps directly conflicting to the set route sections written in Column number 6.

Column Number 14: Signal to Danger Track Circuit

This column refers to the first track circuit in advance of a signal and occupation of which will replace the concerned signal to ON aspect.

Column Number 15: Approach Locking Track Circuits

In this column the track circuits provided for approach locking are to be proved, guidelines regarding approach locking distances are as follows:

For Main line Home in absolute Block	Dead approach
For Main line starter	From the berthing track to first control track circuit of the Home signal, if Points are set to Main Line for the Home signal otherwise Berthing track. Dead approach if Main Home is cleared for Main Line.
For loop line starter	Berthing track
Shunt signal	Track circuit just in rear of shunt signal
For LSS (Advanced Starter)	Free (No approach locking required as there are no points ahead of LSS)
For signals which do not have track circuits behind the signal or the track circuited portion behind the signal is does not cover full approach locking distance	Dead approach

Column Number 16, 17 and 18: Aspect of Signal ahead to be proved

Before any main signal is cleared it is important to prove that the Signal ahead is in lit condition. The aspects of the signal ahead are written in this column. This is generally taken from the aspect control chart of the station as shown in the signaling plan.

Column Number 19: A marker or CO

This column caters for information about 'A' marker or CO-ON signal to be locked to assume signal to "OFF' aspect.

Column Number 20: Position of Route Indicators

This column caters for information about Route indicators to be cleared / lit for a diverging signal to assume 'OFF' aspect. In case of junction type route Indicators for diversion movement, it is mandatory to prove that the route Indicator is lit before the signal control relays are picked up.

Column Number 21: Locked by Crank Handle group

This column caters to the information about Crank Handle groups to be locked for the points involved in the Signalled route that is Route, overlap and isolation portions.

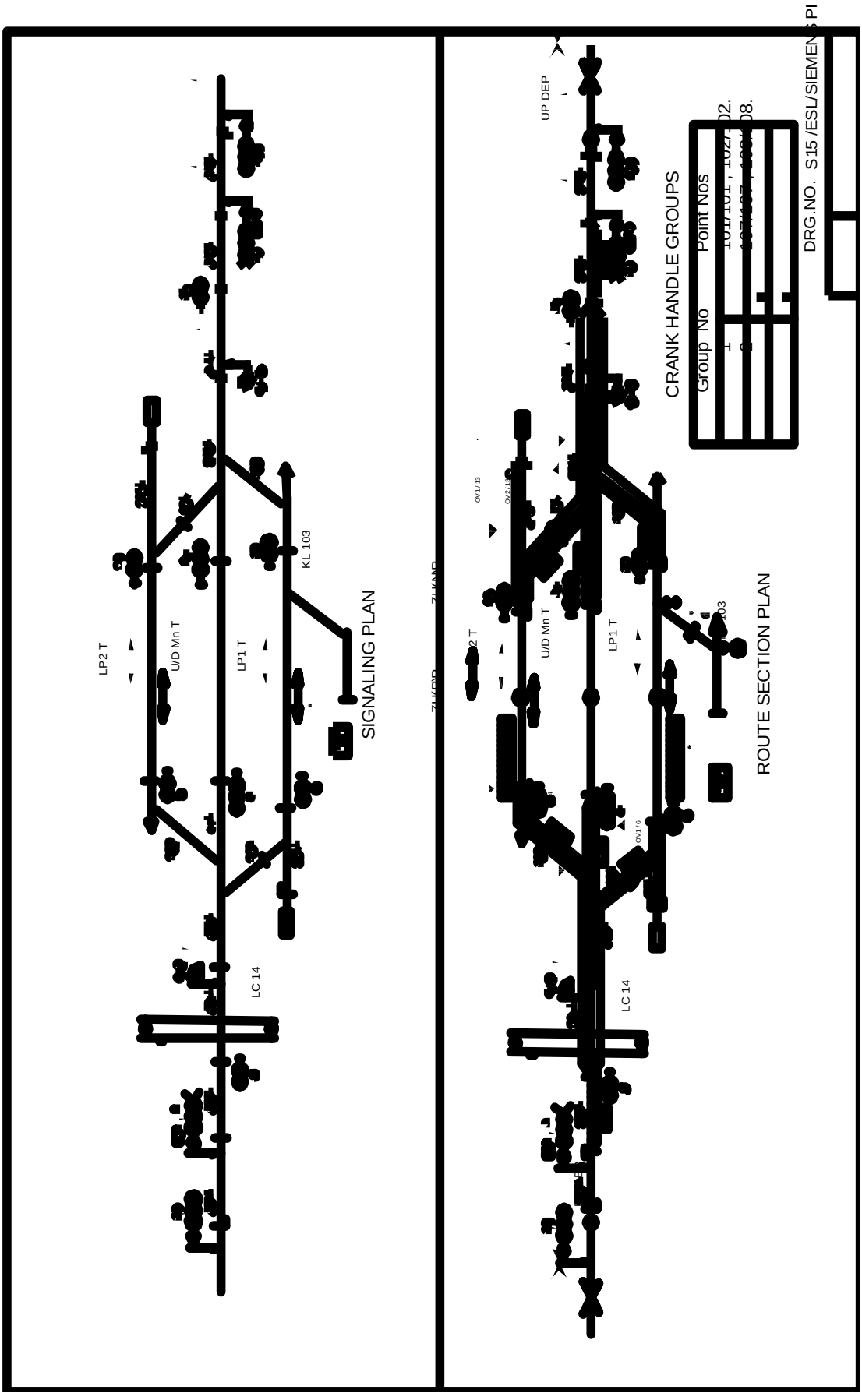
Column Number 22: Remarks

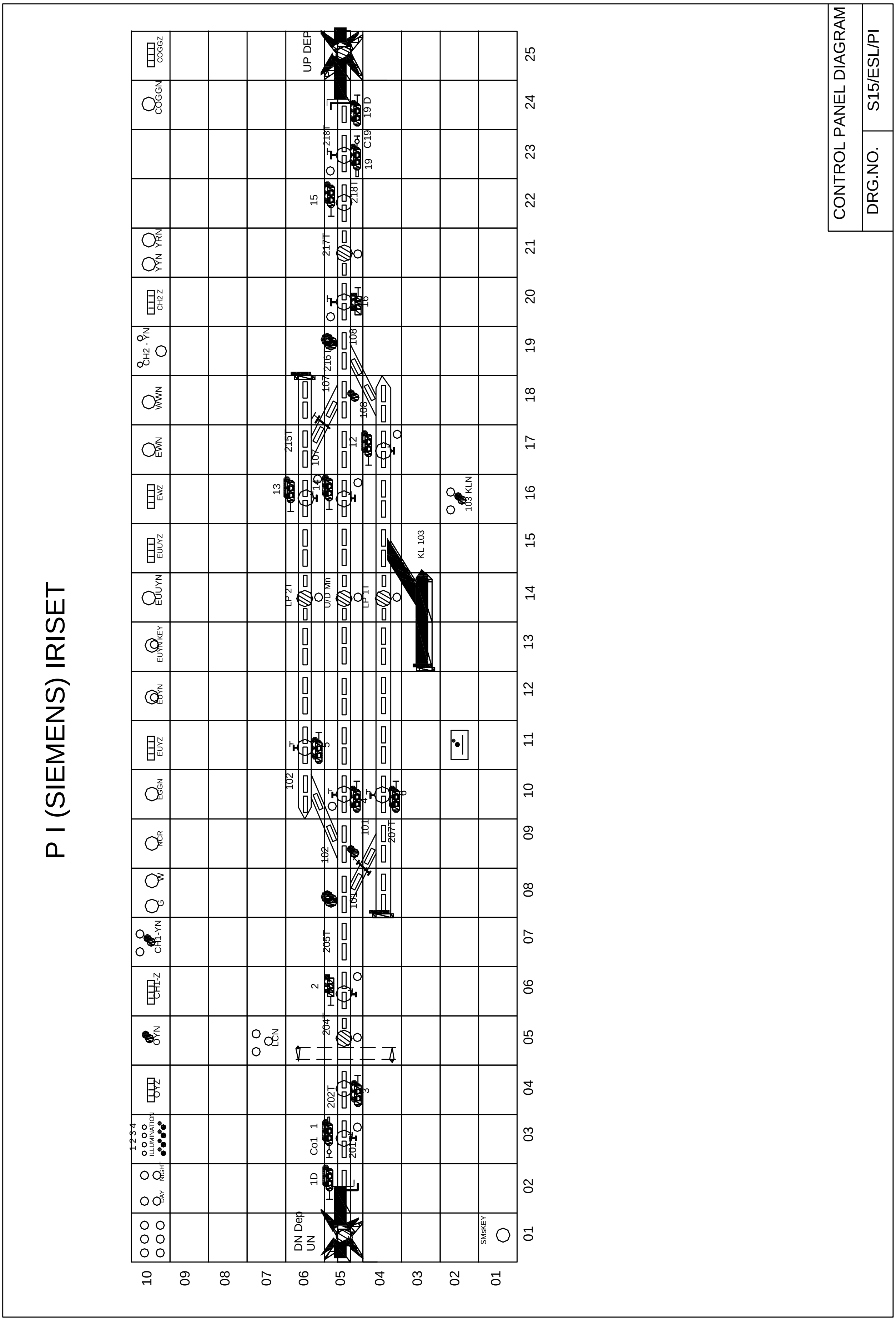
This column contains the slots to be received before the signal could be cleared.

The slots can be from the next cabin, Station Master, from Ground frames that may be controlling some points in the path of the route, Line Clear, Level Crossing gate, etc.

In case of Last Stop Signal, which depends upon the receipt of Line clear from the next station, it is mentioned as "Line clear" in this column.

Any details not covered in the preceding columns can be written in remarks column conflicting simultaneous movements still possible to be locked, Level Crossing gate to be locked, timer release etc. can be mentioned.


SIGNALING PLAN
LP2 T
U/D Mn T
LP1 T
KL 103
LC 14
ROUTE SECTION PLAN
UP DEP
CRANK HANDLE GROUPS
Group No
Point Nos
DRG.NO. S15 /ESL/SIEMENS PI


P I (SIEMENS) IRISET
CONTROL PANEL DIAGRAM
DRG.NO.
S15/ESL/PI
UP DEP
DN Dep
UN

CONTROL TABLE – PI (SIEMENS) IRISET

Sl. No	Sig. Route	Description of Main & CO Routes.	Push Buttons		Route Sections		Points		Track Circuits Free in		Overlap		Signal to Danger	App. Locking 120sec.	Sig. Aspect			'A' Marker / CO	Route Indication	Locked by CH. Group No.	Remarks
			GN	UN	Set	Eliminated in Route	in Route	in OV	Route	OV	Set	Eliminated			'Y' if	'YY' if	'G' if				
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
1	S1 (1)	Up Main Home to UP LP 2	S1	LP 2	101C, S1/3 U(R)S	101A, 101B	101/101 N 102/102 R	107/107N OR (107/107R, 108/108N)	202T, 204T, 205T LP2 T	215T(216T,217T W 107/107R)	$OV_1$13 0R $OV_2$13	OV4, OV5, $OV_2$6	202T	Dead Approach	S13 ⊖ ⊘	-	-	CO	LH	Gr.1, 2	1) LC Closed 2) Locks Sh16, Co19 Move on U/D Mn
2	CO1 (1)	Calling on from up Mn to UP LP 2	S1	COGGN LP2	101C,S1/3 U(R) S	101A, 101B	101/101 N 102/102 R	-	-	-	-	OV4, OV5, OV_2 6	201T↑	-	-	-	-	-	-	Gr. 1	1) 201T↓ 2) LC Closed 3) Locks Sh16, CO 19 Move on U/D Mn 4) Locks S13
3	S1 (2)	UP Mn Home to UP Mn	S1	U/D Mn	101A, S1/3 U(R) S	101B, 101C	101/101 N 102/102 N	107/107N, 108/108N	202T, 204T, 205T, Mn T	216T, 217T	OV14	OV4, OV5, OV_2 6	202T	Dead Approach	S14 ⊖ ⊘	-	S14 ⦶	CO	-	Gr. 1, 2	LC Closed
4	CO1 (2)	Calling ON from UP Mn to UP Mn	S1	COGGN U/D Mn	101A,S1/3 U(R)S	101B, 101C	101/101N, 102/102 N	-	-	-	-	OV4, OV5, OV_2 6	201T↑	-	-	-	-	-	-	Gr. 1	1) 201T ↓ 2) LC Closed 3) Locks Sh16, CO19,S12, S13, S14,S19
5	S1 (3)	UP Mn Home to UP LP 1	S1	LP 1	101B,S1/3 U(R)S	101A, 101C	101/101R 102/102N	107/107N, 108/108R	202T, 204T, 205T, 207T, LP1 T	216T,217T	OV 12	OV4, OV5, OV_1 6, OV_2 6	202T	Dead Approach	S12 ⊖ ⊘	-	-	CO	RH	Gr. 1, 2	1. LC Closed 2. Sdg Pt. Normal
6	CO1 (3)	Calling ON from UP Mn to UP LP 1	S1	COGGN LP1	101B,S1/3 U(R)S	101A, 101C	101/101 R 102/102 N	-	-	-	-	OV4, OV5, OV_1 6, OV_2 6	201T↑	-	-	-	-	-	-	Gr. 1	1) 201T ↓ 2) LC Closed 3) Sdg Pt Normal 4. Locks Sh16, CO 19 Move on U/D Mn 5) Locks S12
7	S3	Dn Adv Stg.	S3	DN Dep.	S1/3 U(R)S	-	-	-	201T, 202T	-	-	-	202T	-	-	-	-	-	-	-	Controlled through Block inst.
8	S4	Dn Mn Stg.	S4	204	101 A	101B, 101C	101/101 N 102/102 N	-	204T, 205T	-	-	OV5, OV_2 6	205T	Mn T, (216T, 217T, 218T W107N,108N, 107A Not set) (D. Approach W 107A Set)	S3 ⊖	-	S3 ⦶	-	-	Gr.1	1) LC Closed 2) Locks CO 19 on U/D Mn and LP2 3) CO1 on U/D Mn
9	S5	Dn LP 2 Stg.	S5	204	101C	101A 101B	101/101 N 102/102 R	-	204T, 205T	-	-	OV4, OV_2 6	205T	LP2 T	S3 ⊖ ⦶	-	-	-	-	Gr.1	1)Locks Sh16 Moved on U/D Mn 2) LC Closed
10	S6	Dn LP 1 Stg.	S6	204	101B	101A 101C	101/101 R 102/102 N	-	204T, 205T 207T	-	-	OV4, OV5, OV_1 6	207T	LP1 T	S3 ⊖ ⦶	-	-	-		Gr.1	*1) Locks Sh16 Moved 0n U/D Mn 2) LC Closed 3) Sdg Pt Normal*
11	S12	UP LP 1 Stg.	S12	217	108B	107A, 107B	107/107 N 108/108 R	-	216T, 217T	-	-	$OV_2$13. OV14	216T	LP1 T	S15 ⊖ ⦶	-	-	-	-	Gr. 2	1) Locks Sh 2 Moved on U/D Mn 2) Sdg Pt Normal
12	S13	UP LP 2 Stg.	S13	217	107B	107A, 108B	107/107 R 108/108 N	-	215T, 216T 217T	-	-	OV_1 13, OV14, OV12	215T	LP2 T	S15 ⊖ ⦶	-	-	-	-	Gr. 2	Locks Sh 2 Moved on U/D Mn
13	S14	UP Mn Stg.	S14	217	107A	107B, 108B	107/107 N 108/108 N	-	216T, 217T	-	-	OV12 OV_2 13	216T	MN T, (202T, 204T, 205T W 101N 102N, 101A Not Set) (D.App.W101A set)	S15 ⊖	-	S15 ⦶	-	-	Gr. 2	Locks CO1 on U/D Mn and LP1
14	S15	UP Adv Stg.	S15	UP Dep.	S15/19 U(R)S	-	-	-	218T, 219T	-	-	-	218T	-	-	-	-	-	-	-	Controlled through Block inst.
15	S19 (1)	Dn Mn to Dn LP 1 Home	S19	LP1	S15/19 U(R)S, 108B	107A, 107B	107/107 N 108/108 R	101/101 N OR 101/101R, 102/102N	LP1 T, 216T, 217T, 218T	207T(205T,204T W 101R)	OV_1 6 OR OV_2 6	OV12, OV_2 13 OV14	218T	Dead Approach	S6 ⊖ ⊘	-	-	CO	LH	Gr.1, 2	1)Locks Sh 2 and CO1 Move on U/D Mn 2) Sdg. Pt Normal 3) LC Closed W 101 R
16	CO19 (1)	Calling ON from DN Mn to DN LP1	S19	COGGN LP1	S15/19 U(R)S, 108B	107A, 107B	107/107 N 108/108 R	-	-	-	-	OV12, $OV_2$13, OV14	219T↑	-	-	-	-	-	-	Gr. 2	1) 219T↓ 2) Locks Sh 2 and CO1Move on U/D Mn 3) Sdg. Pt. Normal 4) Locks S6
17	S19 (2)	Dn Mn Home to DN Mn	S19	U/D Mn	S15/19 U(R)S, 107A	107B, 108B	107/107 N 108/108 N	101/101 N 102/102 N	216T, 217T, 218T, Mn T	204T, 205T	OV4	OV12, OV_2 13, OV14	218T	Dead Approach	S4 ⊖ ⊘	-	S4 ⦶	CO	-	Gr.1, 2	LC Closed
18	CO19 (2)	Calling ON from DN Mn to DN Mn	S19	COGGN U/D Mn	S15/19 U(R)S, 107A	107B, 108B	107/107 N 108/108 N	-	-	-	-	OV12, OV_2 13. OV14	219T↑	-	-	-	-	-	-	Gr. 2	1) 219T↓ 2) Locks Sh2, CO1, S4, S5, S6
19	S19 (3)	DN Mn Home to DN LP2	S19	LP 2	S15/19 U(R)S, 107B	107A, 108B	107/107 R 108/108 N	101/101 N 102/102 R	215T, 216T, 217T, 218T, LP2 T	204T, 205T	OV5	OV12, $OV_1$13, OV_2 13, OV14	218T	Dead Approach	S5	-	-	CO	RH	Gr.1, 2	LC Closed
20	CO19 (3)	Calling ON from DN Mn to DN LP 2	S19	LP 2	S15/19 U(R)S, 107B	107A, 108B	107/107 R 108/108 N	-	-	-	-	OV12, OV_1 13, OV_2 13, OV14	219T↑	-	-	-	-	-	-	Gr.2	1) 219T↓ 2) Locks S5 3) Locks Sh2, CO1 on U/D Mn
21	Sh2 (1)	UP Mn to UP LP 2 Shunt	Sh2	LP 2	101C	101A 101B	101/101 N 102/102 R	-	205T	-	-	OV4, OV5, $OV_2$6	205T	204T	-	-	-	-	-	Gr.1	1) LC Closed 2) Locks CO19 on U/D Mn
22	Sh2 (2)	UP Mn to UP Mn Shunt	Sh2	U/D Mn	101A	101B, 101C	101/101 N 102/102 N	-	205T	-	-	OV4, OV5, $OV_2$6	205T	204T	-	-	-	-	-	Gr.1	1) Locks Signal Route S19, CO19, S12, S13 2) LC Closed
23	Sh2 (3)	UP Mn to UP LP1 Shunt	Sh2	LP1	101B	101A, 101C	101/101 R 102/102 N	-	205T, 207T	-	-	OV4, OV5, $OV_1$6, $OV_2$6	205T	204T	-	-	-	-	-	Gr.1	1) Sdg Pt. Normal 2) LC Closed 3) Locks CO19 on U/D Mn
24	Sh16 (1)	Dn Mn to DN LP1 Shunt	Sh16	LP 1	108B	107A, 107B	107,107 N 108/108 R	-	216T	-	-	OV12, $OV_2$13, OV14	216T	217T	-	-	-	-	-	Gr. 2	1) Sdg Pt. Normal 2) Locks CO1 on U/D Mn
25	Sh16 (2)	Dn Mn to DN Mn Shunt	Sh16	U/D Mn	107A	107B 108B	107/107 N 108/108 N	-	216T	-	-	OV12, $OV_2$13, OV14	216T	217T	-	-	-	-	-	Gr. 2	Locks S1 move on LP2, CO1, S5, S6
26	Sh16 (3)	Dn Mn to DN LP2 Shunt	Sh16	LP 2	107B	107A, 108B	107/107 R 108/108 N	-	216T, 215T	-	-	OV12, $OV_1$13, $OV_2$13, OV14	216T	217T	-	-	-	-	-	Gr. 2	Locks CO1 on U/D Mn

CHAPTER 3
BUTTON RELAYS AND BUTTON CHECKING RELAYS

Self-restoring type push buttons are used for operation. Each push button is provided with one relay, which energises when concerned push button is pressed. Button relay circuit enables a single operation from a panel at a time.

3.1 GNR : Signal push Button Relay.

GNCR : All Signal push Button Normal Checking Relay.

GNR relay is provided in the respective Signal group. When a signal button GN is pressed, GNR picks up in the respective signal group. EGNR back contact is proved in this circuit to ensure that one operation (clearance or cancellation) is possible at a time.

Each GNR is repeated by a GNPR. The GNPR circuit entire station zone is grouped together in a cascading way that only one 'GNPR' will pick up at a time. SM's control is proved in GNPR circuit to prevent unauthorized clearing of Signals.

A common relay GNCR is picked up proving all Signal buttons are Normal (GNRs down). This relay drops immediately when any one the GN is pressed and its repeater GNPR has energised.

GNR and EGNR relays in the Signal group pick up even though SM key of the panel is taken out. This is to facilitate restoration of cleared signal to 'ON' aspect in case of emergency. But GNPR relay picks up by proving the SM's key is 'IN' and turned.

A front contact of WNCR and back contact of WWNR, EWNR is proved in the GNPR circuit to ensure that the point operation does not take place along with signal clearance .

For Relay Control Circuit (Refer Fig No. 3.1, 3.2)

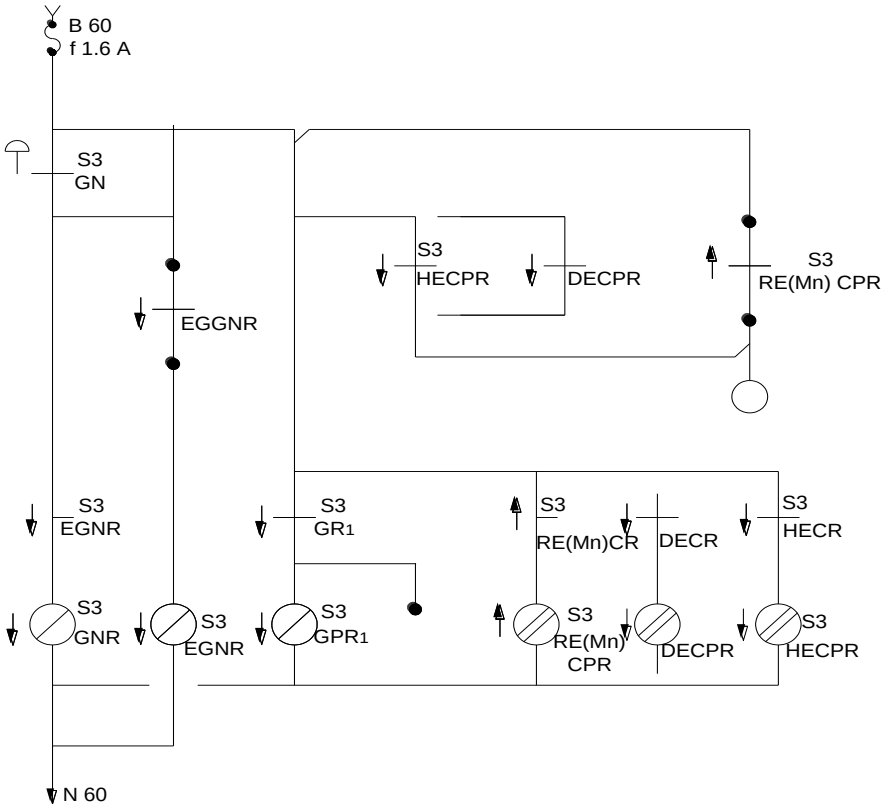


Fig : 3.1 GNR/EGNR CIRCUIT

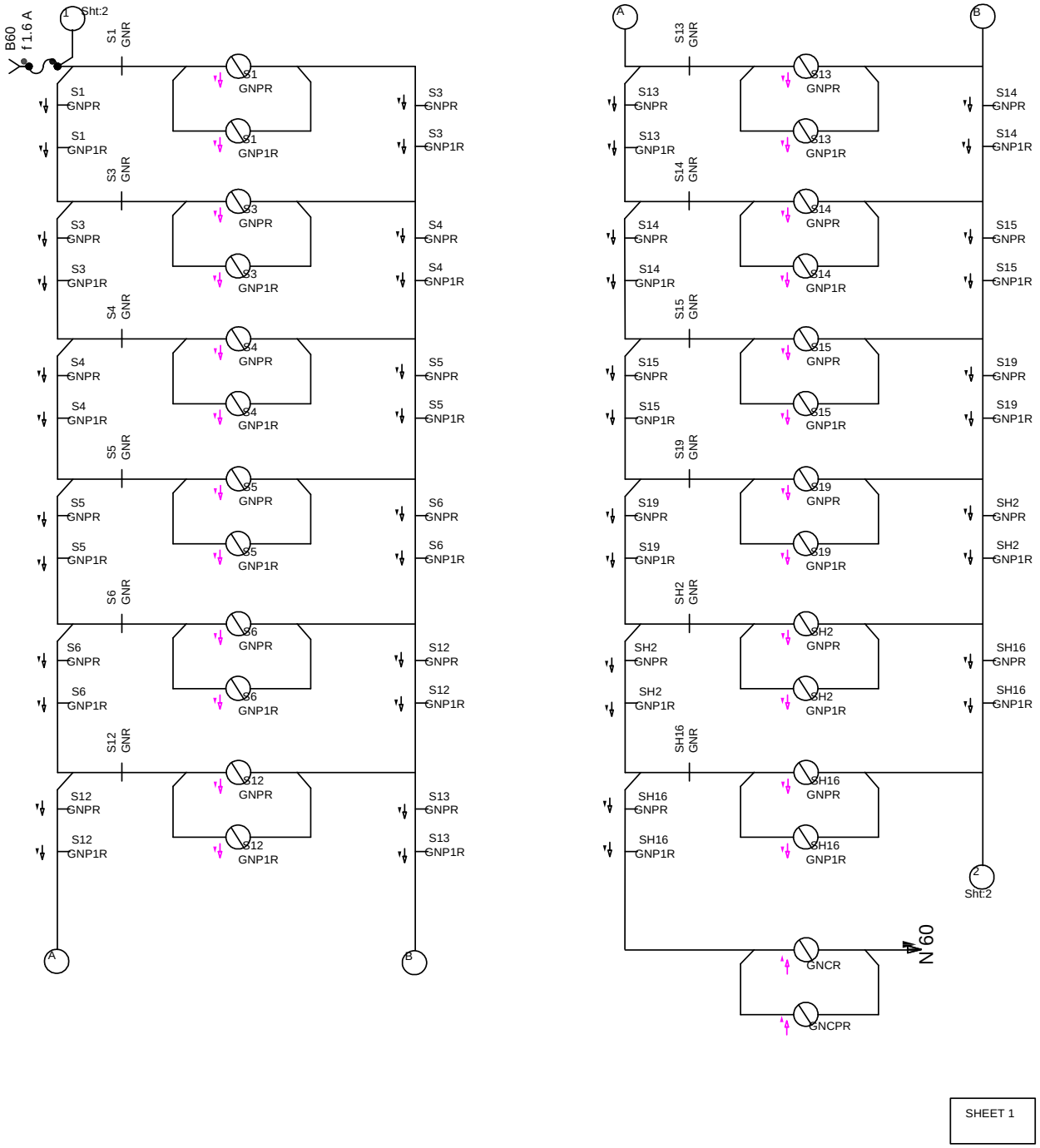


Fig : 3.2 GNPR, GNCR CIRCUIT

3.2. UNR : Route push Button Relay.

UNCR: All Route push Button Normal Checking Relay.

The UNR relays are provided separately in a K-50 Mini groups, which picks up when the respective Route button is pressed on the panel. The UNRs are repeated by UNPRs as required.

The UNRs are grouped in the same way as GNPRs such that only one route button relay picks up at a time.

A common relay UNCR remains in the energised condition through the back contacts of all the UNR and UNPR relays in series. This relay drops immediately when any one of the route buttons is pressed on panel and UNR has energised.

A front contact of WNCR and back contact of WWNR, EWNR is proved in the UNPR circuit to ensure that the point operation does not take place with signal clearance.

The SM key contact is proved in the pickup circuit of UNR, UNPR relays to ensure authorized operation.

For Relay Control Circuit (Refer Fig. No. 3.3)

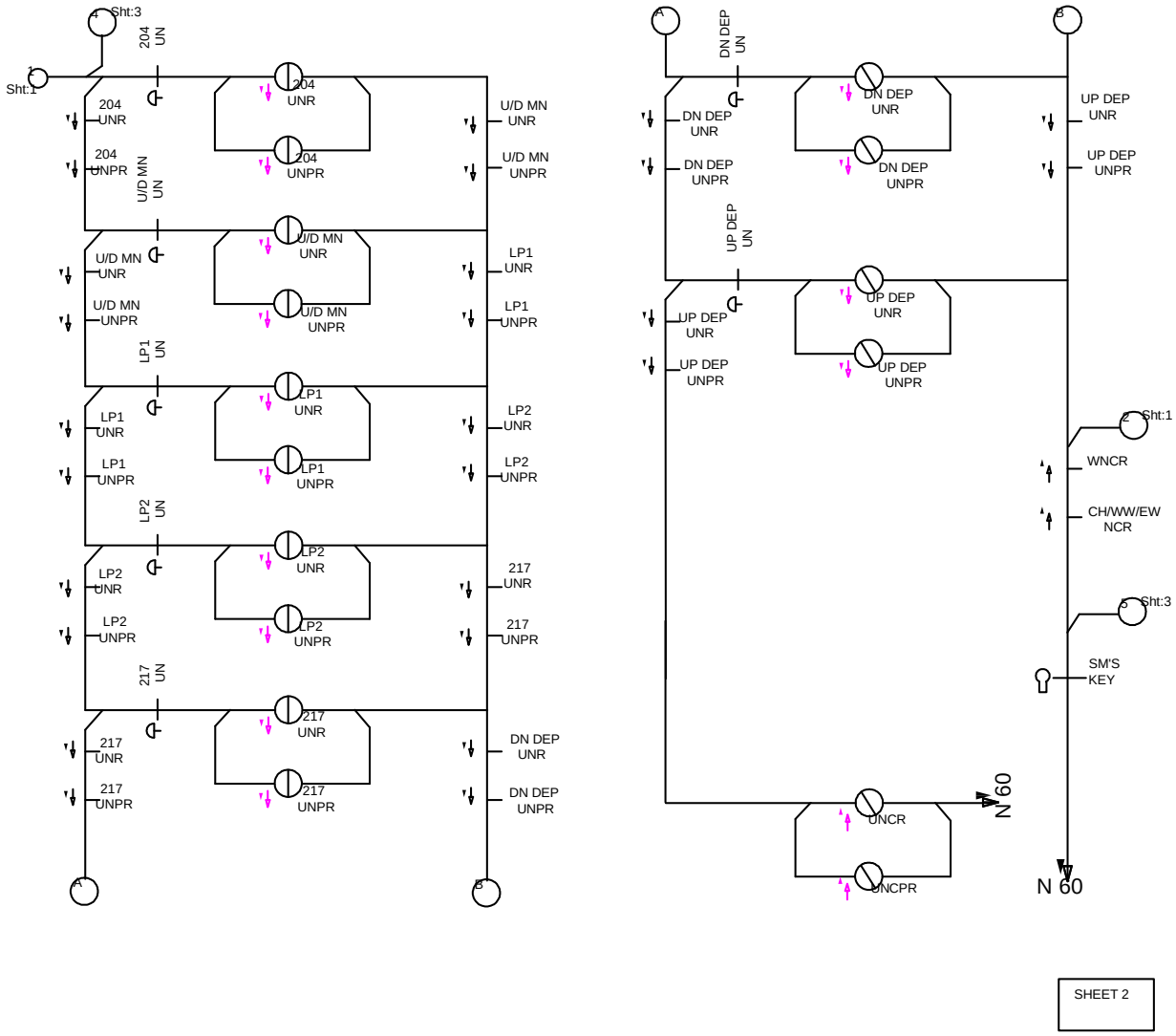


Fig : 3.3 UNR/UNPR/UNCR CIRCUIT

3.3. WNR : Point push Button Relay.

WNCR : All Point Button Normal Checking Relay.

The WNR relays are provided separately in a K-50 Mini group, which picks up when respective push button is pressed on a panel and proved that SM's key is 'IN' and turned.

The WNR relays are grouped in the same manner as the GNPRs and UNRs such that only one WNR picks up at a time.

A common relay WNCR remains in the energised condition through the back contacts of all the WNRS in series proving that no point button is pressed on panel. When any one of the button is pressed WNCR drops.

A front contact of GNCR and UNCR is proved in the WNR circuit to ensure that signal clearance operation does not take place along with point operation.

For Relay Control Circuit (Ref. No.3.4)

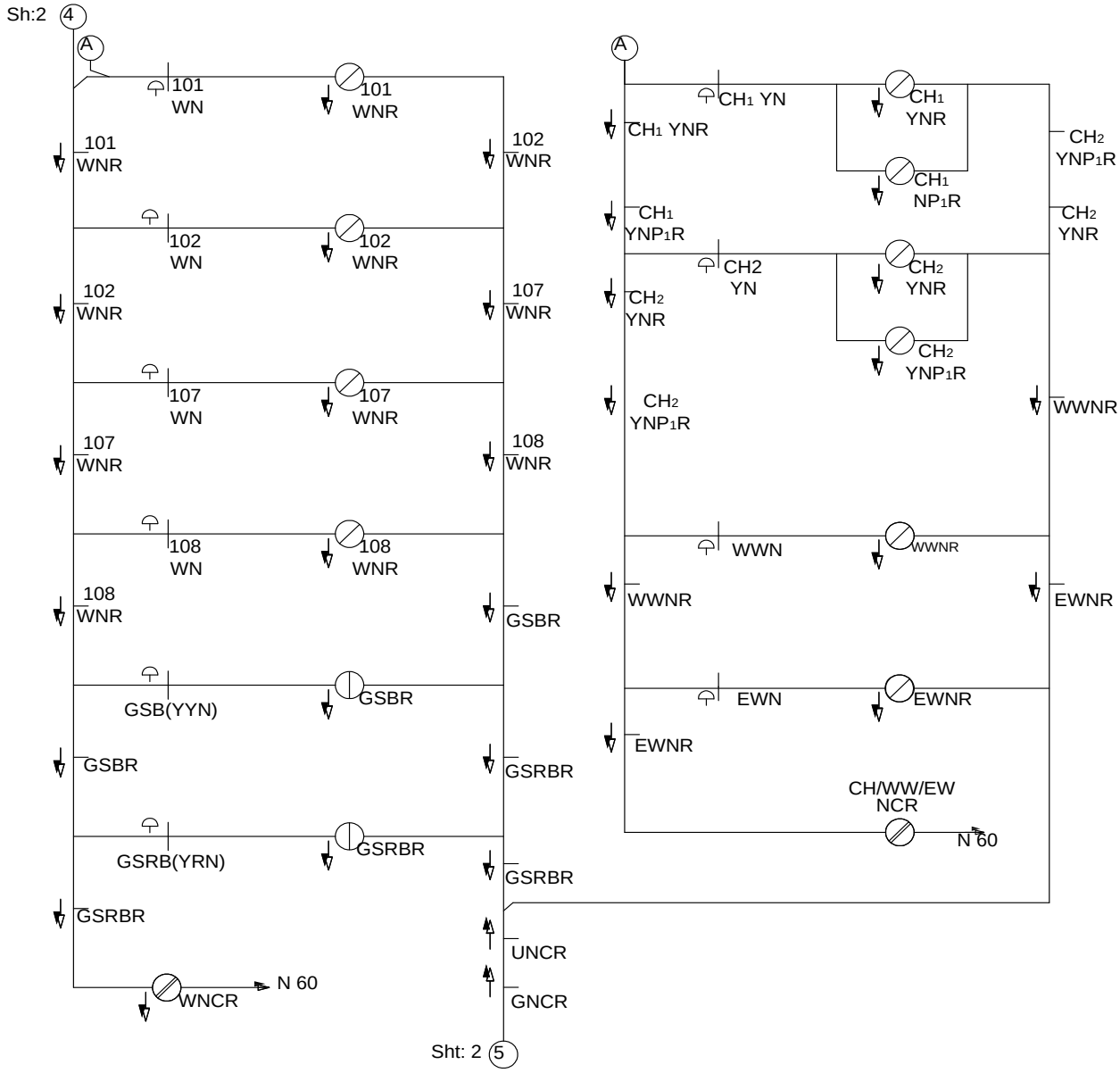


Fig : 3.4 WNR/WNCR CIRCUIT

3.4 . ALARM CIRCUIT

NNCR :- All (NNCR) Button Normal Checking Relay :

When all the button checking relays (GNCR, UNCR, WNCR), EUUYNR, EUYNR, EGGNR, ZDUCR, EWNR, WWNR and their repeater relays are in dropped condition then the Button Normal Checking Relay NNCR relay energizes. This relay is made slow to release by the provision of 3000μfd condenser in series with 100 Ω resistance across the relay coil. Releasing time of NNCR is about 15 Seconds.

When any button is pressed, the button relay energized the button checking relay drops. This in turn breaks the circuit for NNCR relay. NNCR now holds for 15 seconds and then drops if the button is not released or in case the button got stuck up in the pressed condition.

The de-energised condition of this relay gives a visual indication on panel and also audible indication to draw the attention of the operator. Both these failures indications continue till the fault is set right.

Illuminated indications for GNCR, UNCR and WNCR are also provided on the panel.

Note: GNCR, - ‘S’ indication
UNCR - ‘R’ indication
WNCR - ‘P’ indication

For relay control circuit: Ref. Fig. No 3.5 & 3.6

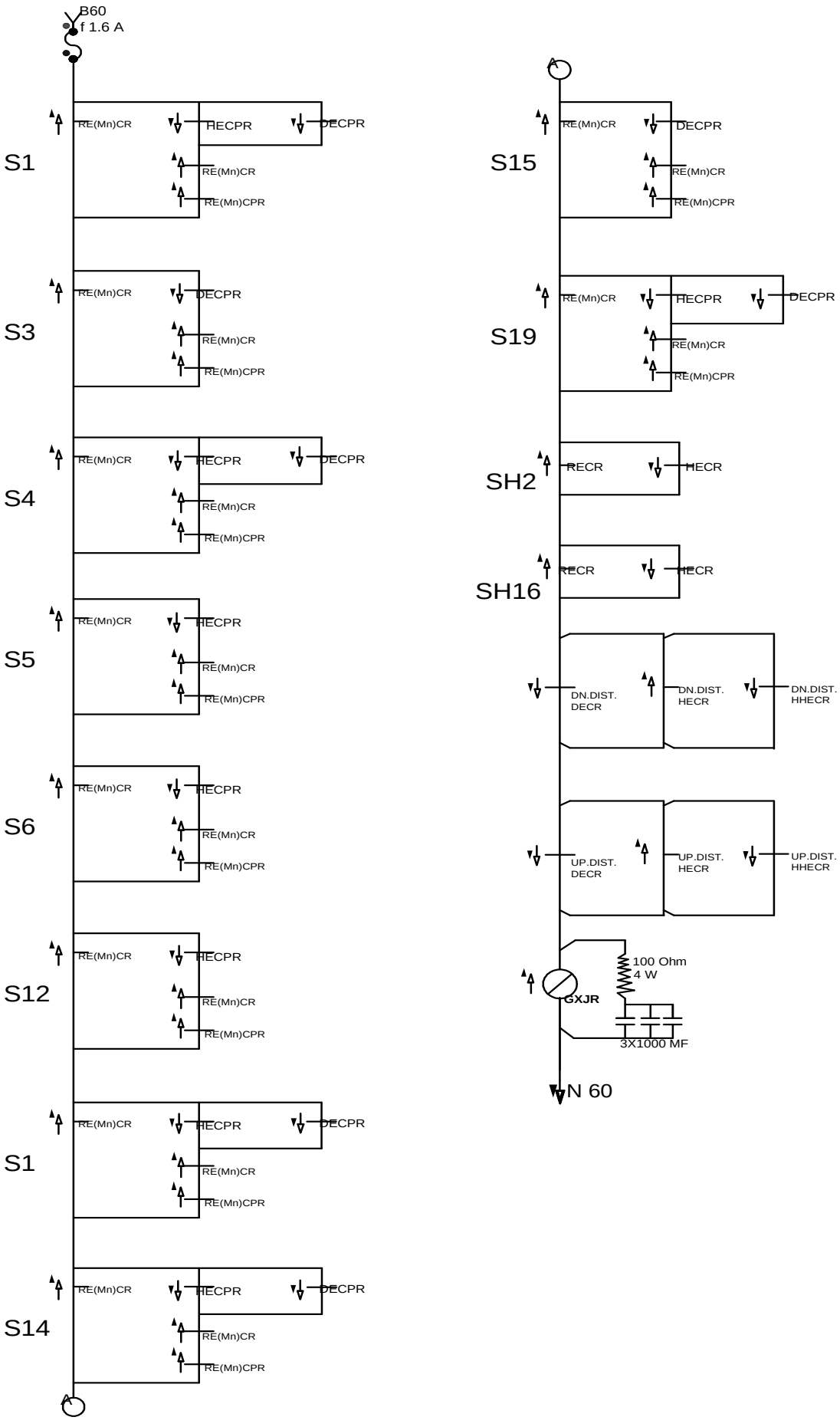


Fig: 3.5 GXJR - ALARM CIRCUIT

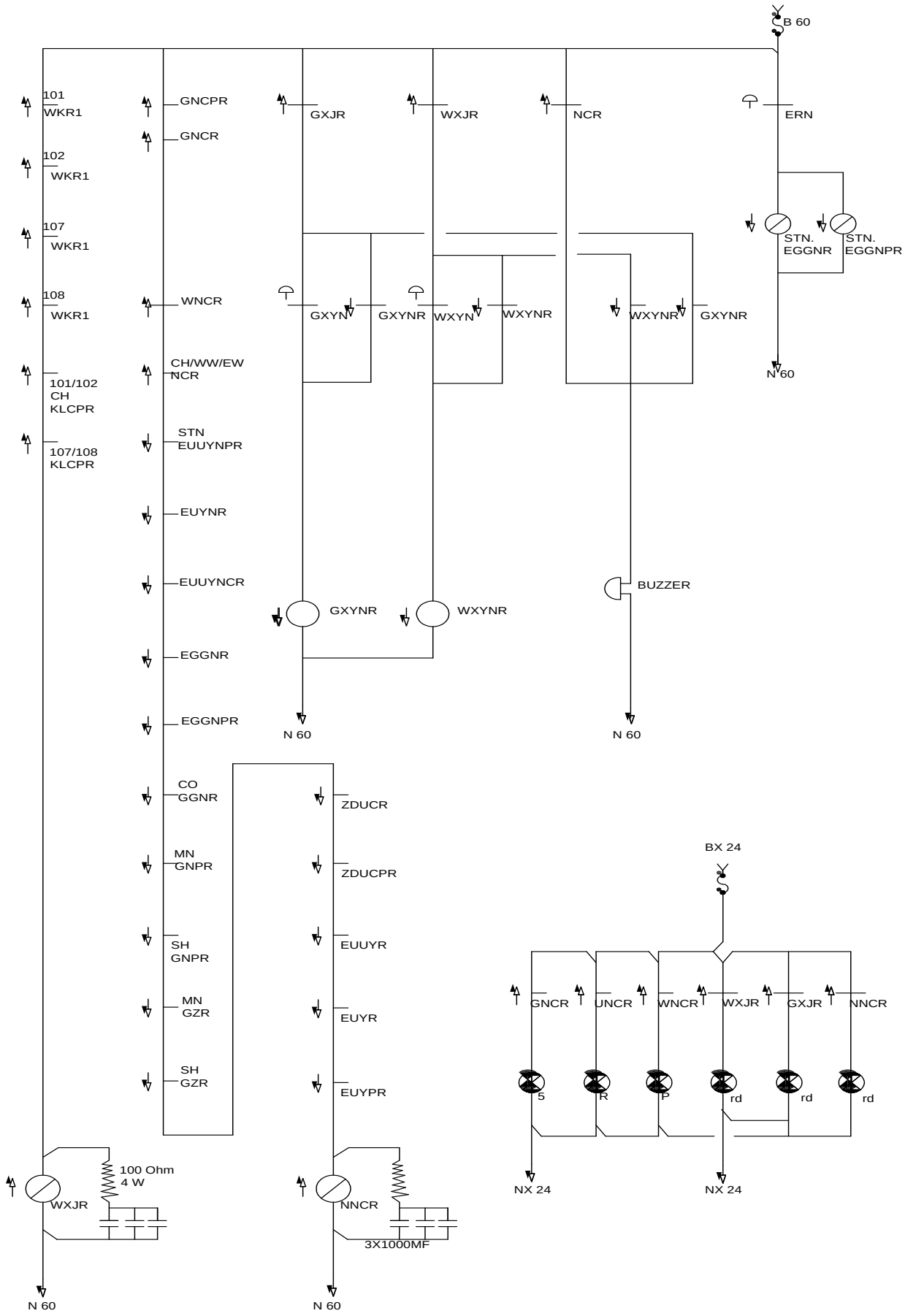


Fig: 3.6 WXJR, NCR - ALARM CIRCUIT

CHAPTER 4
SIGNAL OPERATION

4.0 After ensuring that:

a) All Points in the Route, Overlap and Isolation as necessary are correctly set, locked and detected.

b) All relevant Slots including Point Crank Handle controls are withdrawn after previous release, the concerned GN and UN buttons are pressed together, and released.

This causes sequentially: -

1) Route and Signal Initiation.
2) Route Setting, Checking and Locking.
3) Signal Clearance.

4.1 ROUTE & SIGNAL INITIATION

During Route and Signal initiation, it is verified whether the route to be set is free from any other on going or completed movement.

In the case of Main and Shunt signals, Signal Initiation takes place followed by Route Initiation whereas only Route Initiation takes place for Calling on signals. Route Initiation also takes place for identifying the Route sections to be normalised during Manual full Route Release operation in emergencies of traffic management.

Route and Signal initiation or cancellation takes place in stages.

In the first part directly opposing/conflicting moves are verified, whether it is signal clearance or cancellation.

In the next part free availability of Route Sections to be set for the intended move is verified along with overlap or isolation requirements.

4.1.1 The Relays involved in this process are:

Sl. No	Relay Nomenclature	Location	Description	Purpose
1	GNR	Signal Group	Signal Button Relay	Represents Signal button operation in circuits.
2	GNPR	Mini Group	Repeater of the above	Represents Signal button operation in circuits.
3	GNCR	Mini Group	Signal Button relays Normal proving Relay	Drops to prove a Signal button operation for the route to be initiated.
4	UNR	Mini Group	Route Button Relay	Represents Route button operation in circuits.

Sl. No	Relay Nomenclature	Location	Description	Purpose
5	UNCR	Mini Group	Route Button Relays Normal proving relay	Drops to prove a Route Button operation for Signal initiation.
6	UNCPR	Mini Group	Repeater of the UNCR	Drops to prove a Route Button operation for Signal initiation.
7	WNCR	Mini Group	Point Button Relays Normal proving relay	Proved energised in GNPR and UNR circuits to prevent Signal operation when a Point button relay fails to drop.
8	MN - GNPR	Mini Group	Common relay to repeat the operation of any Main Signal Button relay	Used to separately initiate the Route sections for Main Signal operations and Shunt Signal operations providing interlocking between them initially.
9	SH - GNPR	Mini Group	Common relay to repeat the operation of any Shunt Signal Button relay	Used to separately initiate the Route sections for Main Signal operations and Shunt Signal operations providing interlocking between them initially.
10	SH- G(R)R G(N)R	Mini Group (Interlocked)	Shunt Signal selection relay	Initiates Shunt Signal and Route when Reversed.
			Main & C.O. Signal selection relay	Initiates Main /CO Signal and Route when Normal.
11	Road- ZU(R)R ZU(N)R	Mini Group (Interlocked)	Direction determining relay to set Reverse direction of movements (Right to Left)	Provided to interlock the Signals in opposite direction on a road. Initiates Route for 'Right to Left' movement normally.
			Direction determining relay to maintain Normal direction of movements (Left to Right)	Provided to interlock the Signals in opposite direction on a road. Initiates Route for 'Left to Right' movement normally.
12	Road - ZU (R)PR ZU(N)PR	Mini Group	Repeaters of the above	Provided to interlock the Signals in opposite direction on a road.
13	Road - G(R)LR G(N)LR	Mini Group (Interlocked)	Signal Locking Relay	Proved dropped in Signal initiation to ensure that no conflicting Main Signal is operated.
			Signal Un-locking relay	Latches when Route is normalised after previous Main Signal operation.
14	Slotted point KL(R)R KL(N)R	Mini Group (Interlocked)	Point Key Lock Release Relay	To release slot for key lock point.
			Point Key Lock Normal relay	Proved normal in Signal initiation circuit for Point to Signal locking.

Sl. No	Relay Nomenclature	Location	Description	Purpose
15	KLNPR	Mini Group	Relay checking the condition of Key Lock at site and its Slot in the cabin.	Proved normal in Signal initiation circuit for Point to Signal locking.
16	COGGNR	Mini Group	Common Calling ON Signal Button relay	Repeats Button operation in circuit.
17	$COULR_2$	Mini Group	Calling ON Signal Control relay-2	Proved in CO-ON off aspect control circuit.
18	Z_1UR	Mini Group	Sub Route initiating relay (common for all Route sections in a sub route)	Proves normalisation of the previous setting of Route sections. Enforces interlocking with conflicting Route sections.
19	EUUYNR	Mini Group	Emergency Route Release Button relay	Proved dropped in Route initiation for setting and proved energised in Route initiation for manual release.
20	EUYNR	Mini Group	Emergency Route Section Release Button relay	Proved dropped in Route initiation.
21	STN EUYR	Mini Group	Emergency Route release relay.	Proved dropped in Route initiation.
22	$\underline{OVZ_2U(R)R}$ $OVZ_2U(N)R$	Mini Group (Interlocked)	$\underline{\text{Overlap Setting relay}}$ Overlap Release relay	Proved normalized after previous Main Signal movement on the concerned Route or its cancellation.
23	$\underline{OVZ_2U(R)PR}$ $OVZ_2U(N)PR$	Mini Group (Interlocked)	Repeater of the above	Proved normalized after previous Main Signal movement on the concerned Route or its cancellation.
24	NWKR	Mini Group	Normal Point Detection Relay	Proved energized to interlock conflicting Route sections during initiation
25	RWKR	Mini Group	Reverse Point Detection relay.	Proved energized to interlock conflicting Route sections during initiation
26	MN-GZR	Mini Group	Main Signal Initiating Relay (Common for all signals in a yard)	Initiates the Main Signal to be cleared.
27	SH-GZR	Mini Group	Shunt Signal Initiating relay (Common for all signals in a yard)	Initiates the Shunt Signal to be cleared.
28	ZDUCR	Mini Group	Route Permissibility checking relay Common for all sub-routes in a yard / zone	Ensures availability of all required conditions for setting a route.

Sl. No	Relay Nomenclature	Location	Description	Purpose
29	EUUYNCR	Mini Group	Relay checking EUUYN operation with Route initiation for full route release in emergency. Common relay for all Routes.	Initiates Emergency full route release operation.

4.2 Initiation for Signal Clearance and emergency cancellation

4.2.1 INITIATION

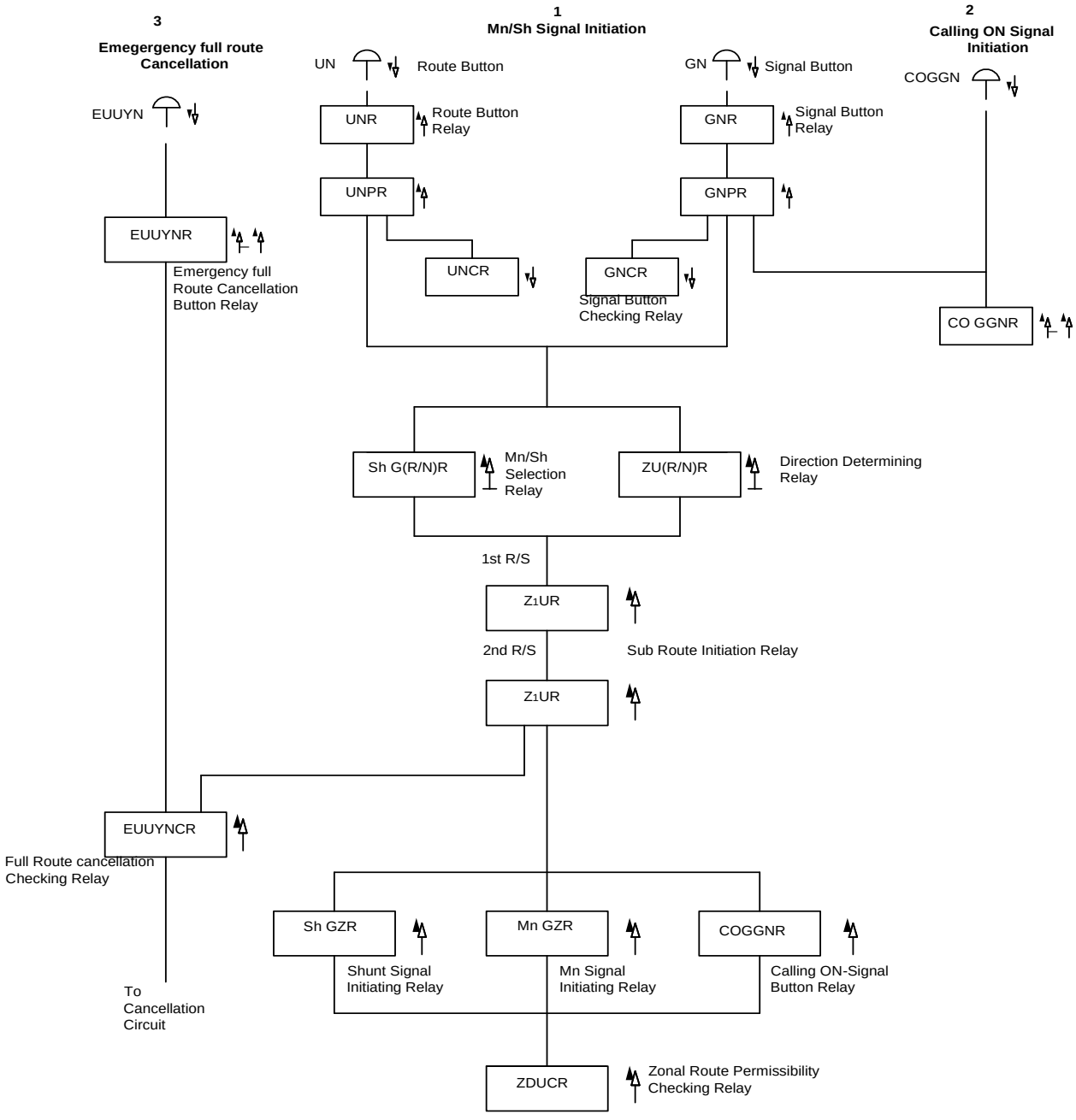
(a) Route and Signal Initiation for shunt & Main Signal

(b) Route Initiation for calling ON Signal

(c) Route initiation for emergency full route cancellation by operator.

Initiation stage Continuous till ZDUCR ↑

Sequence of Relay operation



(To Fig 4.10 page 35)

Fig.4.1

4.2.1.1: ZU(R/N)R : This is an interlocked relay and is designated after destination /Berthing track. Normally for Right to Left movement ZU(R)R is operated and Left to Right movement ZU(N)R is operated. This is used to establish the direction of traffic and avoids initiation of directly opposite conflicting movements one interlocked relay is provided for each Berthing Track Circuit or exit track circuit.

Following conditions are proved:-

ZU(R)R: (i) Concerned signal button & Route buttons are pressed simultaneously.

(ii) Concern route sections and overlaps on either side of berthing track or exit track circuit are Normal.

(iii) ZU(N)R front contact is used as economizer contact.

ZU(N)R: Latches automatically after the designated movement is completed and all signal and Route buttons are normal.

After the previous train has completely arrived on the road or has left the road in the reverse direction, Route section and Overlap immediately next to the road are released behind it.

GNPR and UNR relays have dropped after previous operation as proved by the energisation of GNCR and UNCR.

Proving these conditions soon after the release of last route section and overlap behind the train passed in reverse direction ZU(N)R operates and remains so normally.

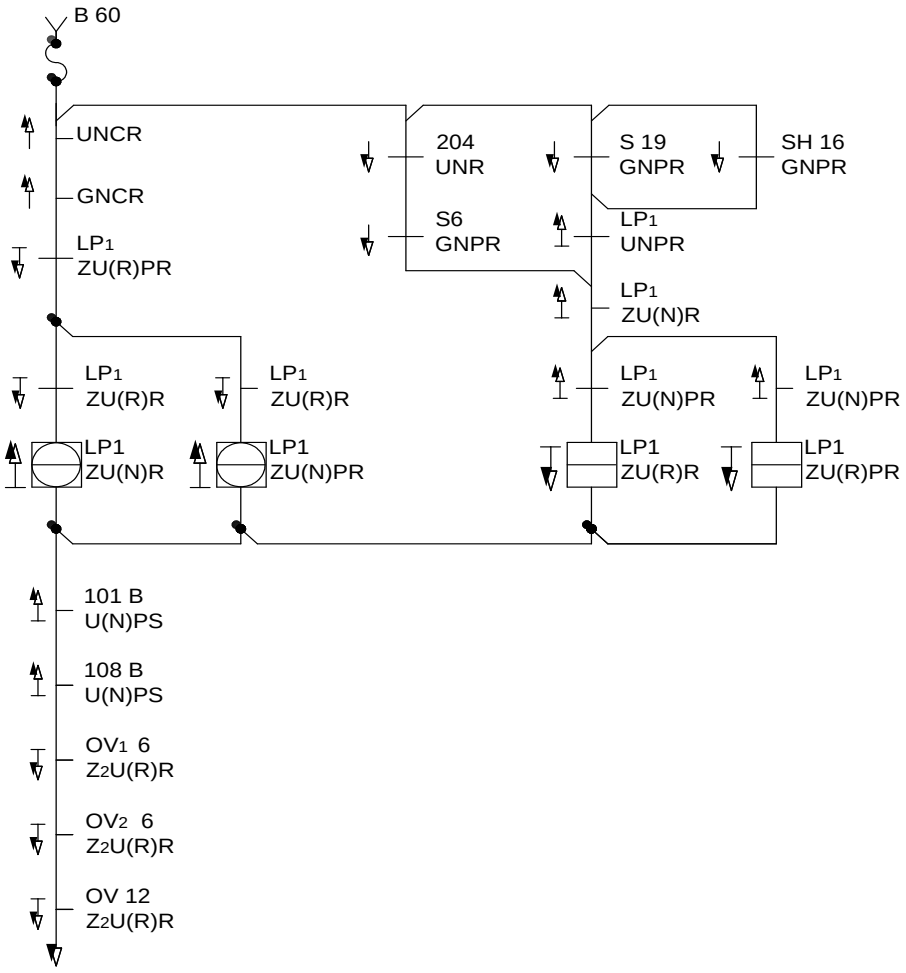


Fig 4.2: ZU(R)R & ZU(N)R Circuit

4.2.1.2 SH G(R/N)R (Shunt Signal/ Main Signal selecting Relay) :

This is an interlocked relay provided to achieve an interlocking between Main signal & Shunt signal leading towards the same direction. When SH G(N)R picked up, it permits Main signal/Calling ON Signal route initiation and when SH G(R)R picked up, it permits Shunt signal route initiation.

Sequence of relay operation

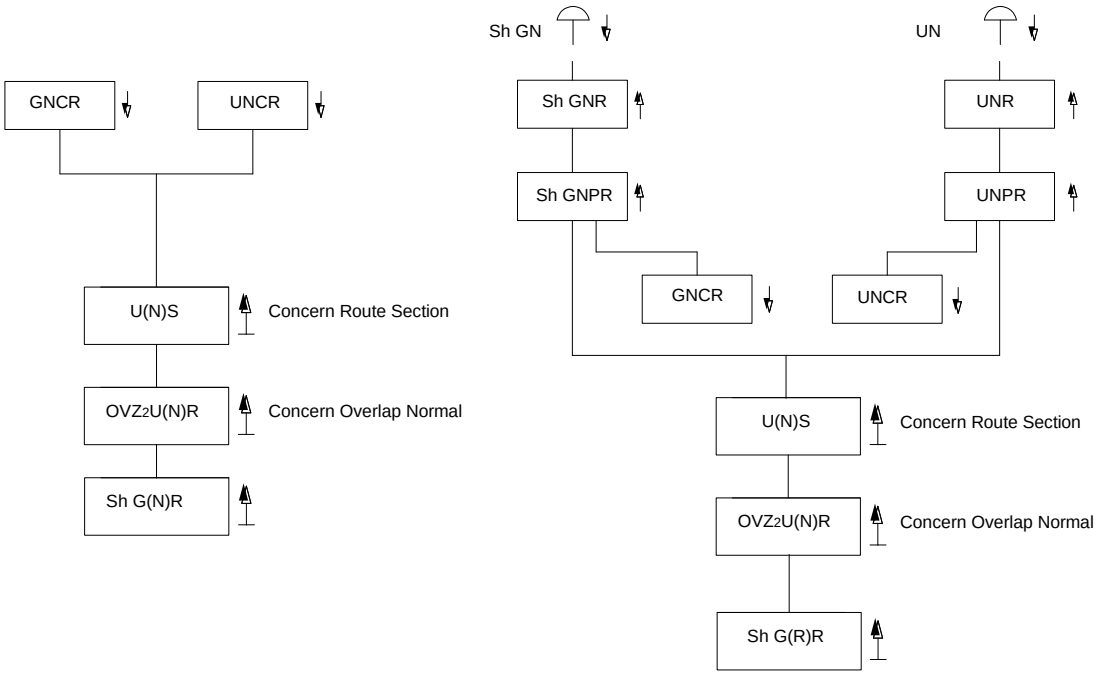


Fig No: 4.3

Following Conditions are proved in SH G(R/N)R:

(a) **SH G(N)R:**

(i) Ensures that no Signal buttons and route buttons are in pressed condition.

(ii) All the route sections & overlaps falling in the SH-signal route are Normal.

(iii) SH G(R)R front contact is used as a economizer contact.

(b) **SH G(R)R :-**

(i) Shunt signal button and concerned route button is pressed.

(ii) All the route sections & overlaps falling in the SH-signal route are Normal.

(iii) SH G(N)R front contact is used as a economizer contact.

(c) Common Conditions for SH G(R/N)R:

(i) Concerned route sections are proved normalized after previous operation.

(ii) Over laps falling in the Shunt signal route are proved normal. This prevents initiation of Main signal / Calling ON Signal in Single line section of the road in same direction and opposite direction.

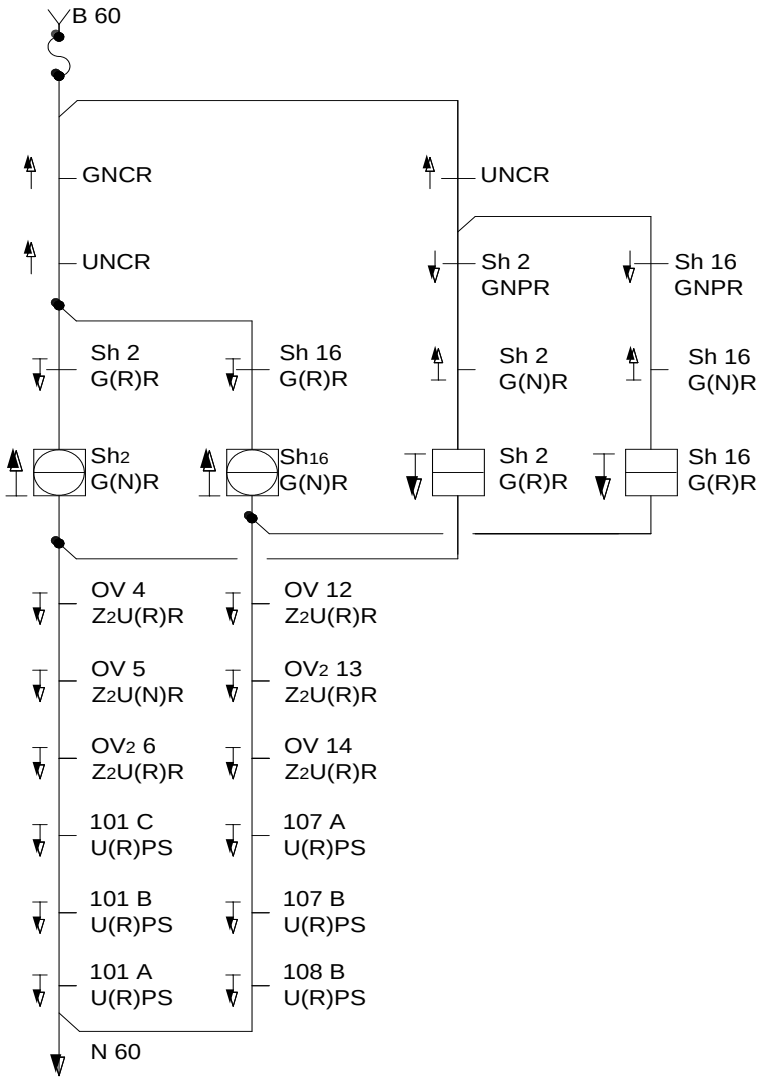


Fig. No. 4.4: SH G(R)R & SH G(N)R relay control circuit

4.2.1.3 Z1UR Sub route initiating relay:

For each sub route one relay is provided if the signal governed by a route have more than one sub route. The sub route initiating relay of each sub route operates in cascade manner commencing from the last sub route. i.e. Z1UR of all sub routes operate in succession.

This relay energises during route initiation for signal clearance and also during emergency full route cancellation. The energisation of this relay during cancellation ensures that the relevant sub route only will get released, as the cancellation relay “EUYR” is a common relay for the entire yard.

In this process, individual Route sections are initiated with the operation of their Z1URs.

Following conditions are proved: -

(i) ZU(N)R or ZU(R)R operated to interlock Signals of the road in opposite direction.

(ii) SH G(N)R operated to interlock Shunt Signals of the same road.

(iii) GNCR and UNCR dropped to prove the operation of Signal and Route buttons.

(iv) Points in the sub route and isolation, if any, are correctly set and detected.

4.2.1.4 Signal and Route Permissibility Checking:

Main GZR : Main Signal Initiation relay.

Sh GZR : Shunt Signal Initiation relay.

ZDUCR : Zonal Route permissibility checking relay.

These are neutral and common relays for entire station or zone. If the station is divided into two or more zones then each zone will have one such relay.

Main GZR or SHGZR relay operates when any Main / Shunt Signal is initiated and only when the entire route including the overlap is free for setting. Even when any one of the point in the route to be initiated is engaged by a conflicting movement this relay does not operate and makes the push button operation ineffective. When it is operated it permits the initiation of route setting and signal clearance circuits.

Whenever Main signals are to be cleared, ZDUCR relay operates only after the energisation of Mn GZR and for Shunt signal after the energisation of Sh GZR. But in case of Calling ON signal clearance ZDUCR relay energises directly as there is no GZR for Calling ON Signal. A common relay is used for the entire yard / zone so that only one Signal Route can be initiated at a time.

Relay control circuit (Ref Fig.: 4.5).

Now Signal Initiation takes place with the operation of Mn GZR or Sh GZR or COGGNR and ZDUCR.

(i) Initiation of Route sections in a cascade manner.

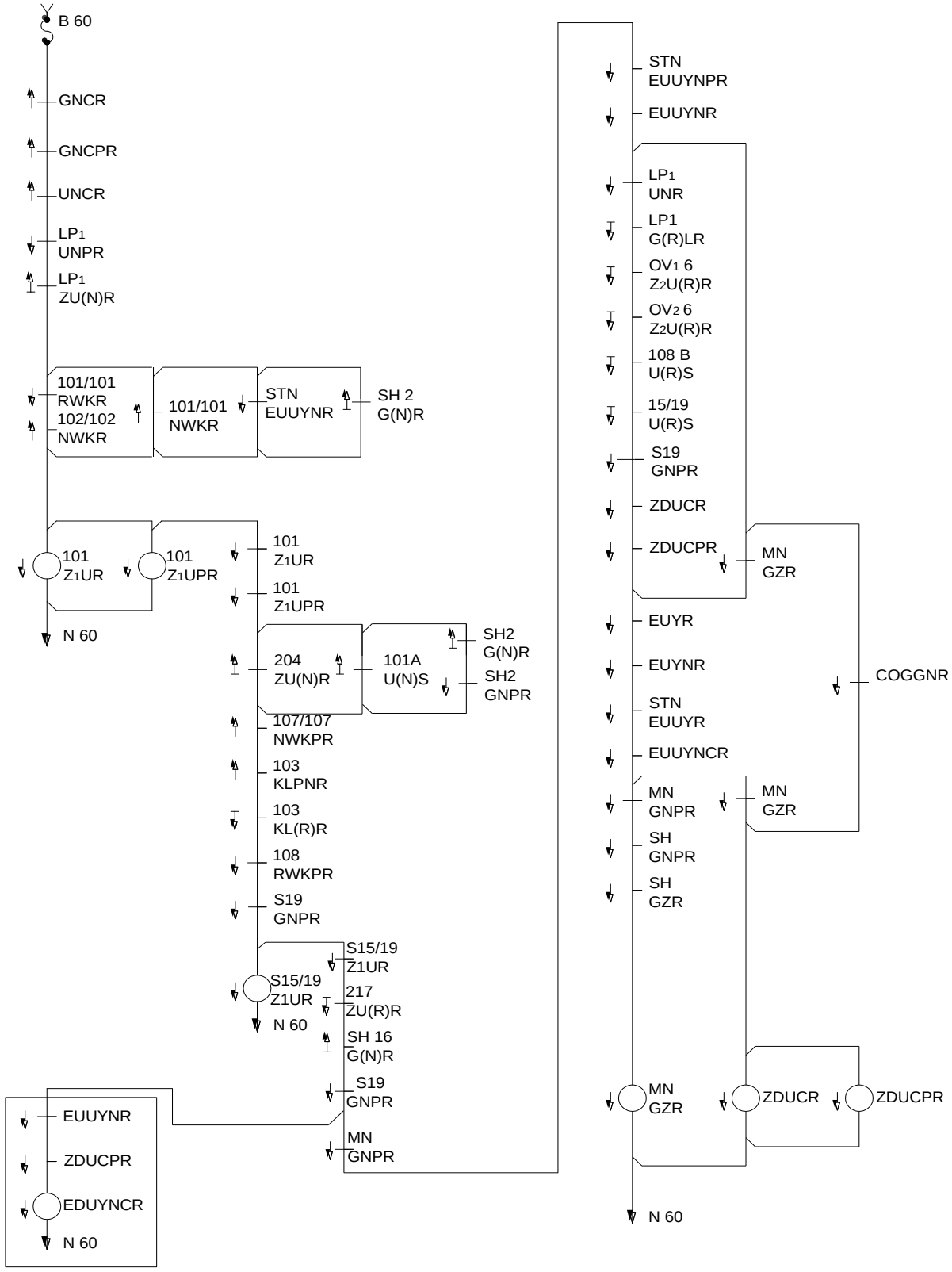
(ii) Detection of Route section and Overlap Points.

(iii) Conflicting Route sections and overlaps are normalised after the previous operation.

(v) Conflicting Main Signal of the road is not cleared.

(vi) Emergency cancellation is not in progress.

This leads to the operation of ZDUCR.



ROUTE PERMISSIBILITY CHECK FOR MAIN & CALLING ON SIGNAL CLEARANCE AND ITS EMERGENCY RELEASE (SH19 to Loop1)

Fig. 4.5 : Mn GZR and ZDUCR Circuit

4.2.2 Route permissibility check for Shunt Signal clearance and its emergency route release (S19 to Loop1):

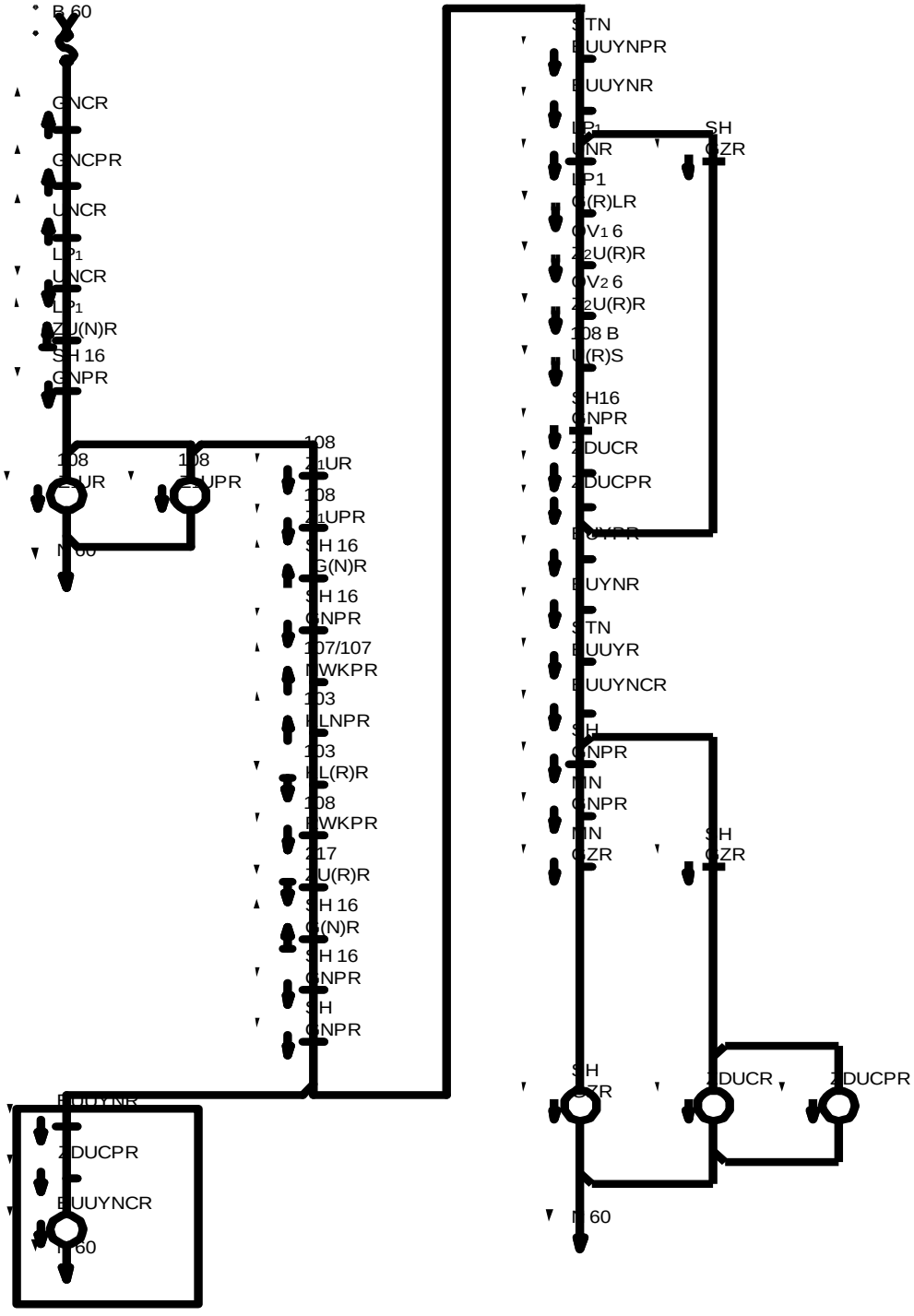
In this process

(a) SH-G(R)R operation is proved instead of SH-G(N)R

(b) Overlap Point detection is not proved

(c) SH-GZR operates instead of MN-GZR

Relay Control Circuit: (Refer to Fig.4.6)



ROUTE PERMISSIBILITY CHECK FOR SHUNT SIGNAL CLEARANCE AND ITS EMERGENCY RELEASE (SH16 to Loop1)

Fig 4.6 : Sh GZR and ZDUCR Circuit

4.2.2 RELEASE OF SIGNAL LOCKING PROVED IN INITIATION

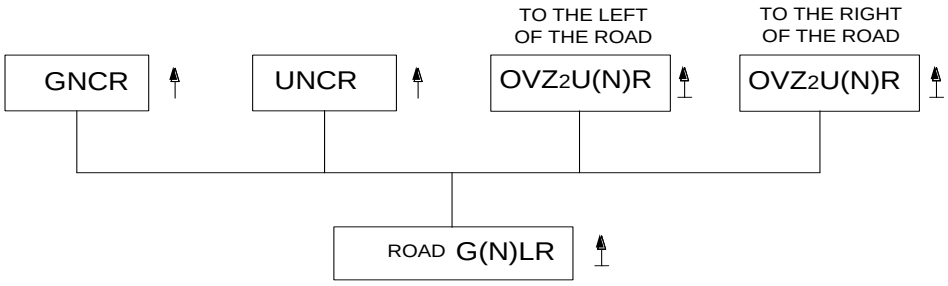


Fig.4.7

Before any Main Signal is cleared, a Signal Locking Relay for the road, G(R)LR latches for locking all conflicting Signals of the road. Its normalisation is proved during initiation of any Signal of the road to provide for its direct interlocking with other Signals of the same road.

This relay latches in normal as soon as a concerned S*ignal Overlap* is normalised following the concerned route release as shown below.

$OVZ_2U(N)R$ contacts prove normalisation of Main Signal Routes on either side of the road after the signalled train has reached its destination.

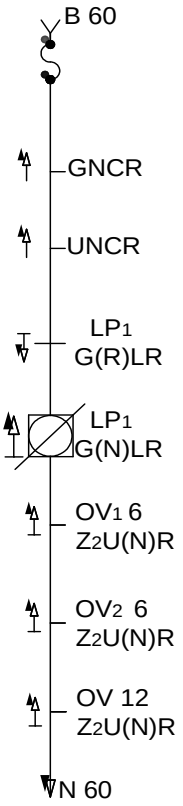


Fig.4.8: G(N)LR Control Circuit

4.2.4 Combined Signal & Route Section Initiation Circuits of the Yard

Refer to Fig. 4.9 (1 to 8)

1. Initiation circuits for all Routes and Signals are combined and made in a geographical format similar to the yard layout.
2. For signals in opposite direction involving the same Route sections, their Z_1URs are energized in the same chain circuit with different button relay contacts proved in parallel.
3. For Shunt Signal selection, the OVZ_2U(R)R contacts are bypassed with SH G(N)R dropped contacts.
4. As initiation for Shunt Signal Route setting and Emergency Route Release do not prove Overlap Point detection, their NWKR /RWKR operated contacts are bypassed with SH GNPR and STN EUUYNPR operated contacts in parallel.
5. Since MN GZR and SH GZR conflicting Signals, their Back contacts are proved in each other's circuits. COGGNR back contact is proved in MN GZR and SH GZR circuits for interlocking purpose.
6. As Route initiation has to take place for Route Setting as well as Manual Route Release in emergency, the Z_1UR chain circuit is extended in two different paths. One of these paths leads to GZR and ZDUCR proving EUUYNR and other concerned relays dropped. The other path leads to EUUYNCR proving ZDUCR dropped.

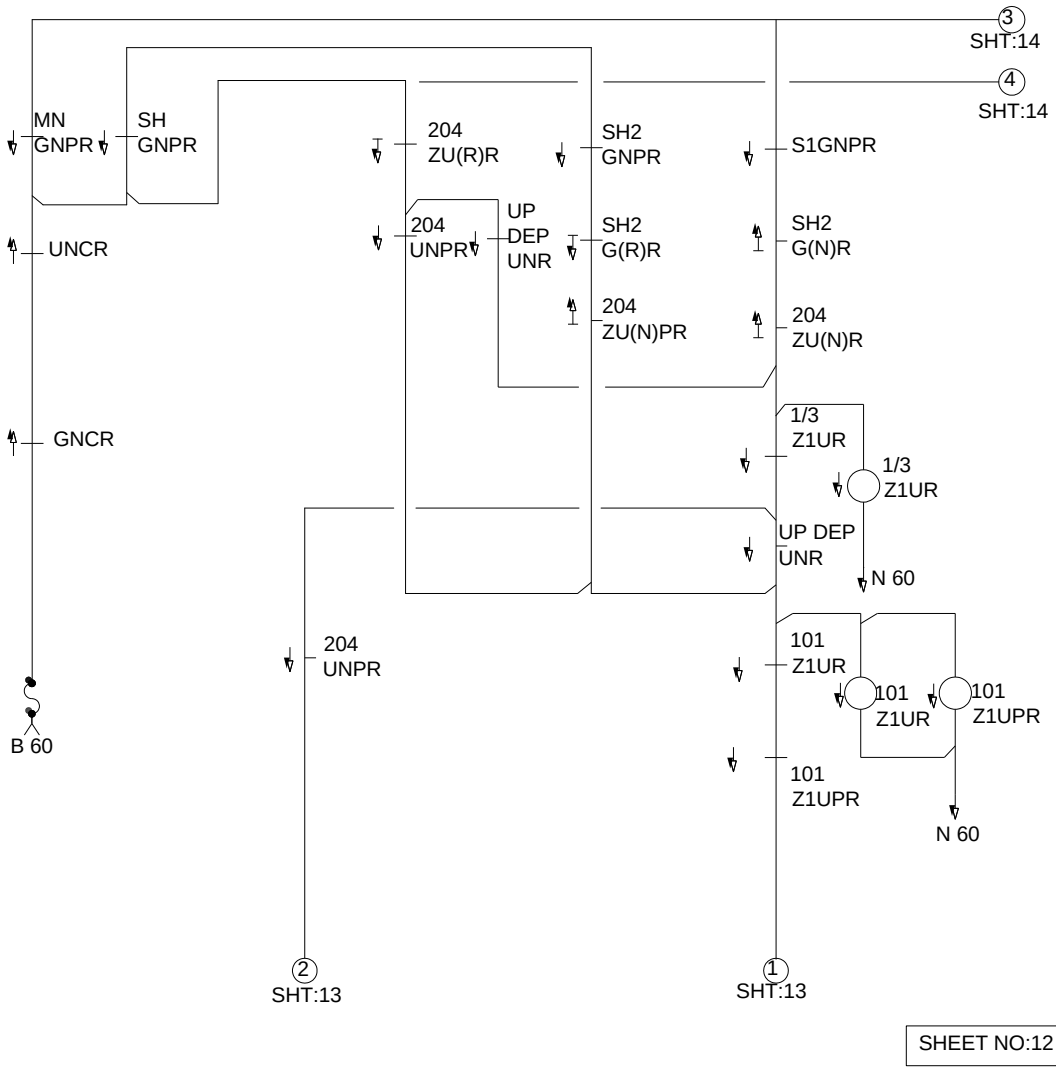


Fig: 4.9 (1)

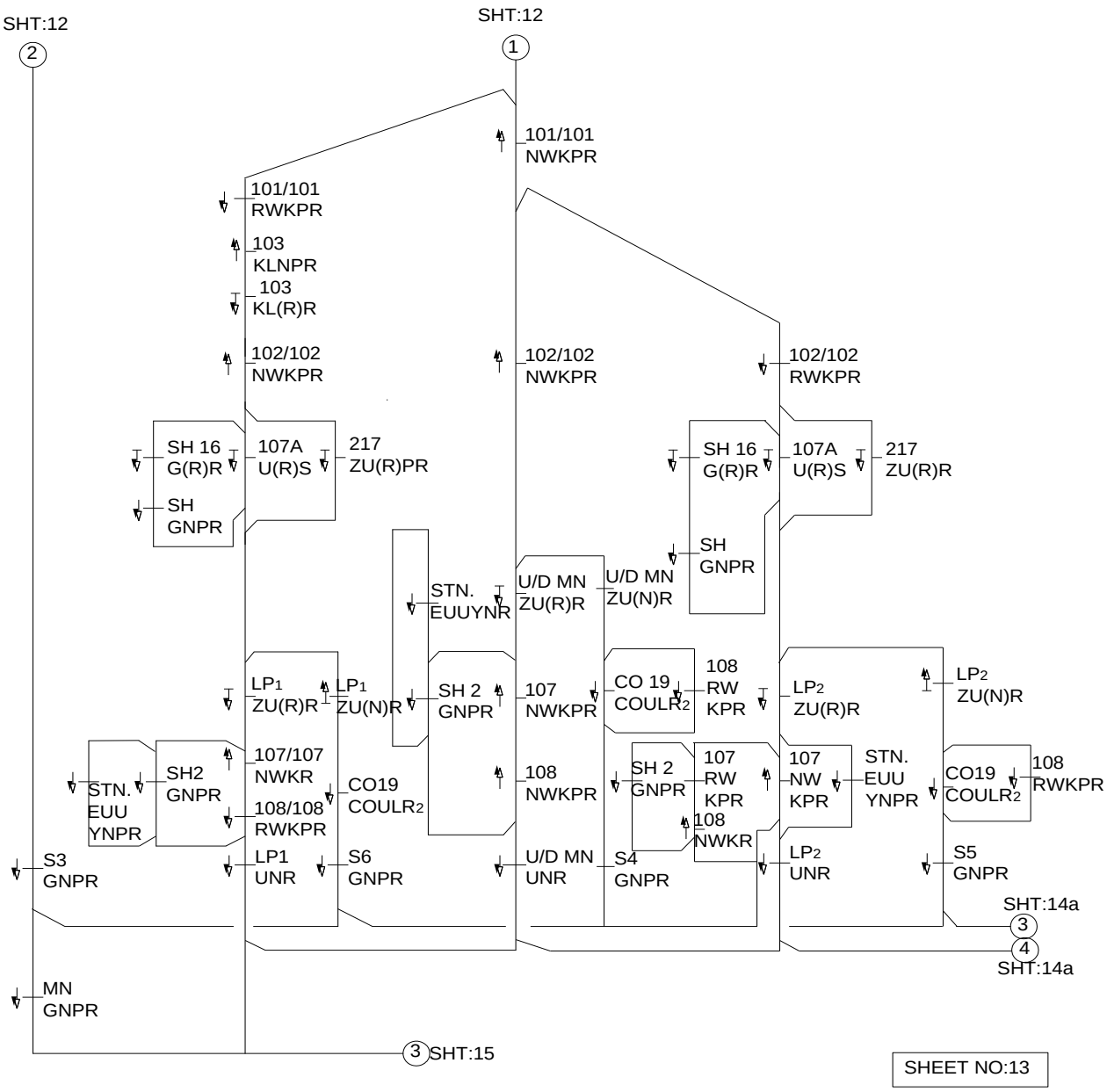

SHT:12
2
SHT:12
1
101/101
NWKPR
101/101
RWKPR
103
KLNPR
103
KL(R)R
102/102
NWKPR
102/102
NWKPR
102/102
RWKPR
SH 16
G(R)R
107A
U(R)S
217
ZU(R)PR
SH
GNPR
SH 16
G(R)R
107A
U(R)S
217
ZU(R)R
SH
GNPR
STN.
EUUYNR
U/D MN
ZU(R)R
U/D MN
ZU(N)R
LP1
ZU(R)R
LP1
ZU(N)R
SH 2
GNPR
107
NWKPR
CO 19
COULR2
108
RW
KPR
LP2
ZU(R)R
LP2
ZU(N)R
107/107
NWKR
108
NWKPR
SH 2
GNPR
107
RW
KPR
107
NW
KPR
STN.
EUU
YNPR
CO19
COULR2
108
RWKPR
STN.
EUU
YNPR
SH2
GNPR
CO19
COULR2
108/108
RWKPR
108
NWKR
S3
GNPR
LP1
UNR
S6
GNPR
U/D MN
UNR
S4
GNPR
LP2
UNR
S5
GNPR
SHT:14a
3
4
SHT:14a
MN
GNPR
3
SHT:15
SHEET NO:13

Fig : 4.9 (2)

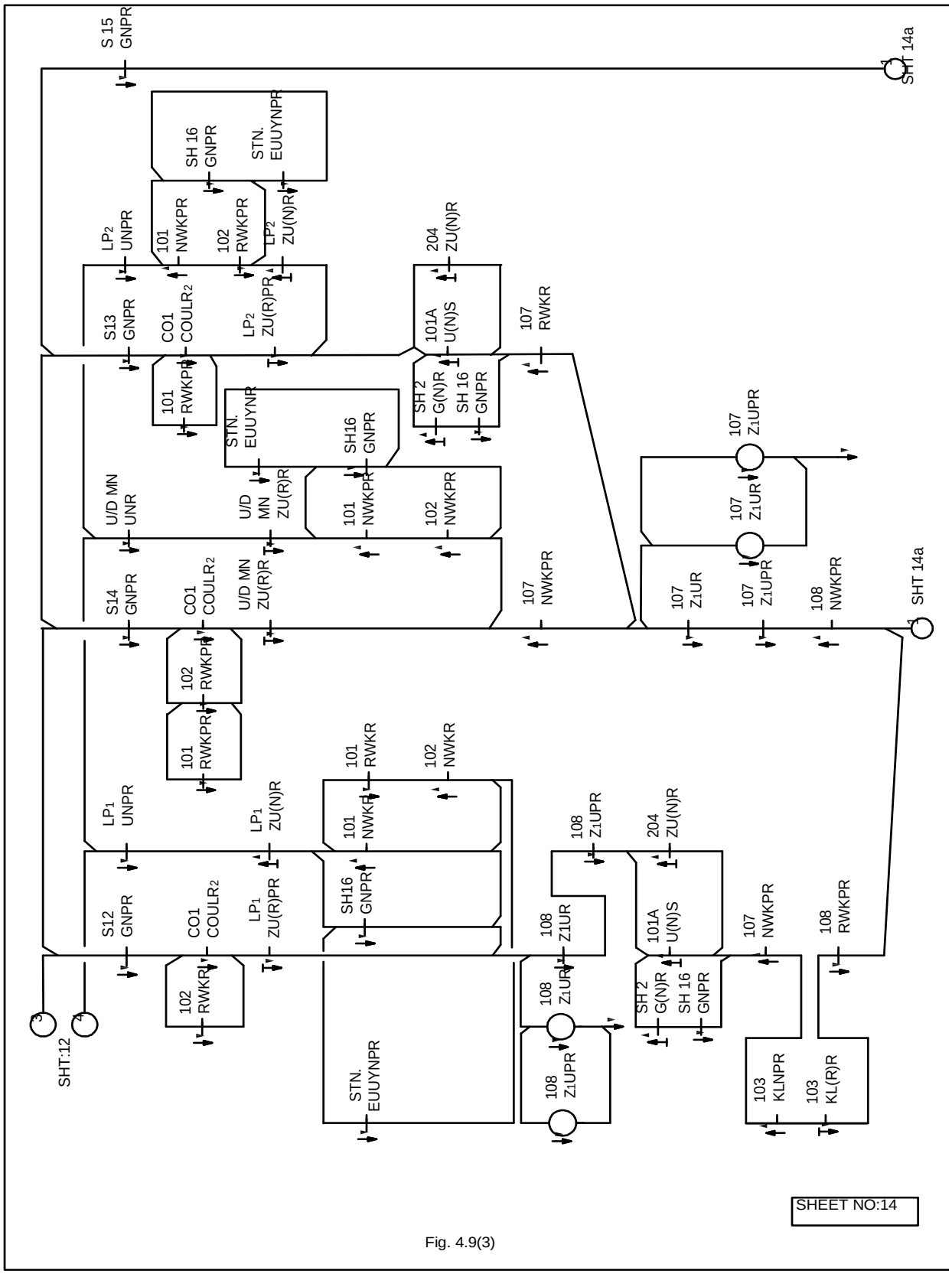


Fig. 4.9(3)

Fig : 4.9 (3)

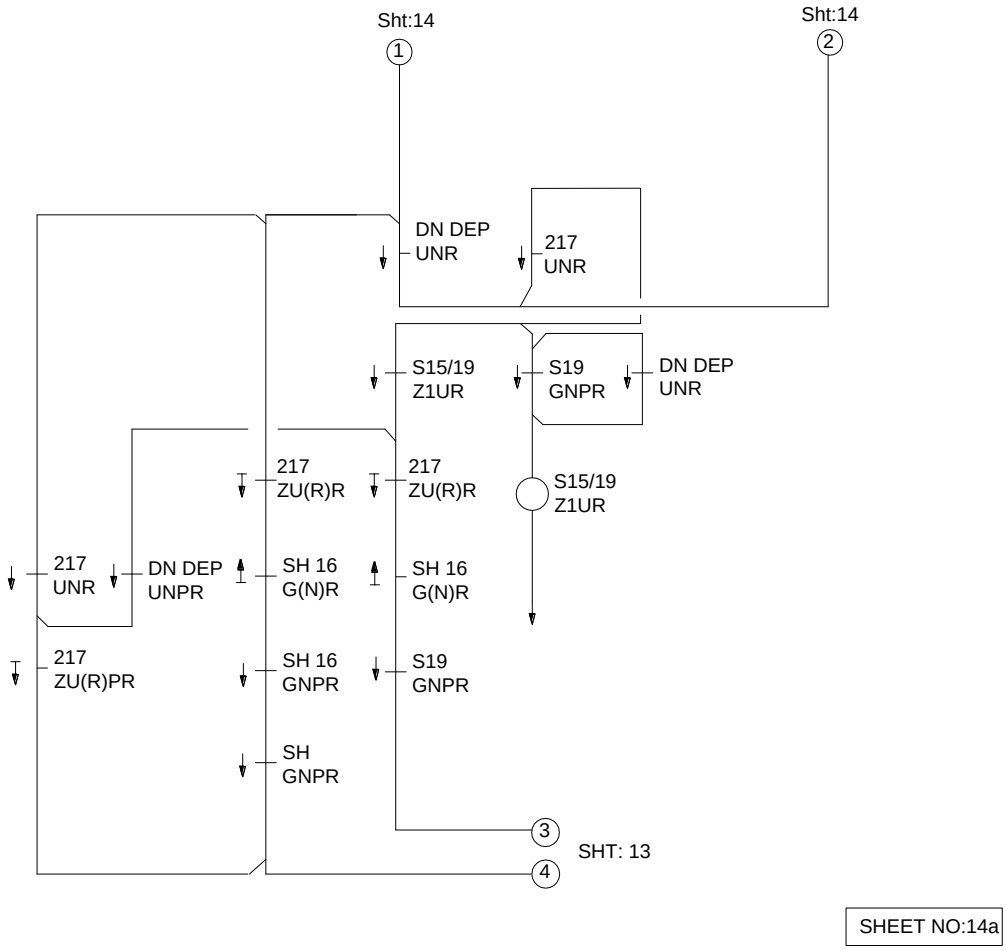

Sht:14
1
Sht:14
2
DN DEP
UNR
217
UNR
S15/19
Z1UR
S19
GNPR
DN DEP
UNR
217
ZU(R)R
217
ZU(R)R
S15/19
Z1UR
217
UNR
DN DEP
UNPR
SH 16
G(N)R
SH 16
G(N)R
217
ZU(R)PR
SH 16
GNPR
S19
GNPR
SH
GNPR
3
SHT: 13
4
SHEET NO:14a

Fig : 4.9 (4)

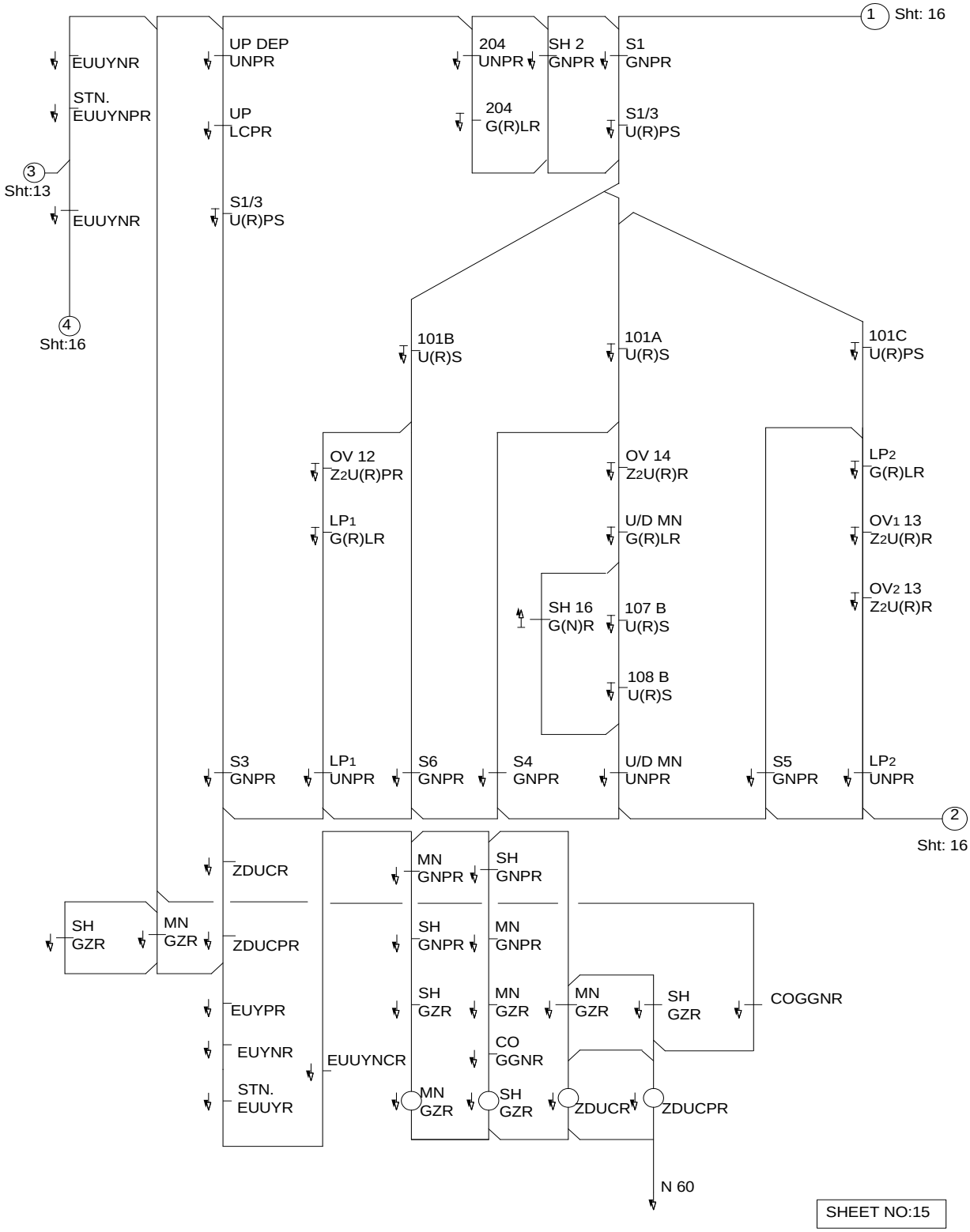

1 Sht: 16
EUUYNR
STN. EUUYNPR
3 Sht:13
EUUYNR
4 Sht:16
UP DEP UNPR
UP LCPR
S1/3 U(R)PS
204 UNPR
204 G(R)LR
SH 2 GNPR
S1 GNPR
S1/3 U(R)PS
101B U(R)S
101A U(R)S
101C U(R)PS
OV 12 Z2U(R)PR
LP1 G(R)LR
OV 14 Z2U(R)R
U/D MN G(R)LR
SH 16 G(N)R
107 B U(R)S
108 B U(R)S
LP2 G(R)LR
OV1 13 Z2U(R)R
OV2 13 Z2U(R)R
S3 GNPR
LP1 UNPR
S6 GNPR
S4 GNPR
U/D MN UNPR
S5 GNPR
LP2 UNPR
2 Sht: 16
ZDUCR
SH GZR
MN GZR
ZDUCPR
EUYPR
EUYNR
STN. EUUYR
EUUYNCR
MN GNPR
SH GNPR
SH GNPR
MN GNPR
SH GZR
MN GZR
MN GZR
SH GZR
COGGNR
CO GGNR
MN GZR
SH GZR
ZDUCR
ZDUCPR
N 60
SHEET NO:15

Fig 4.9(5)

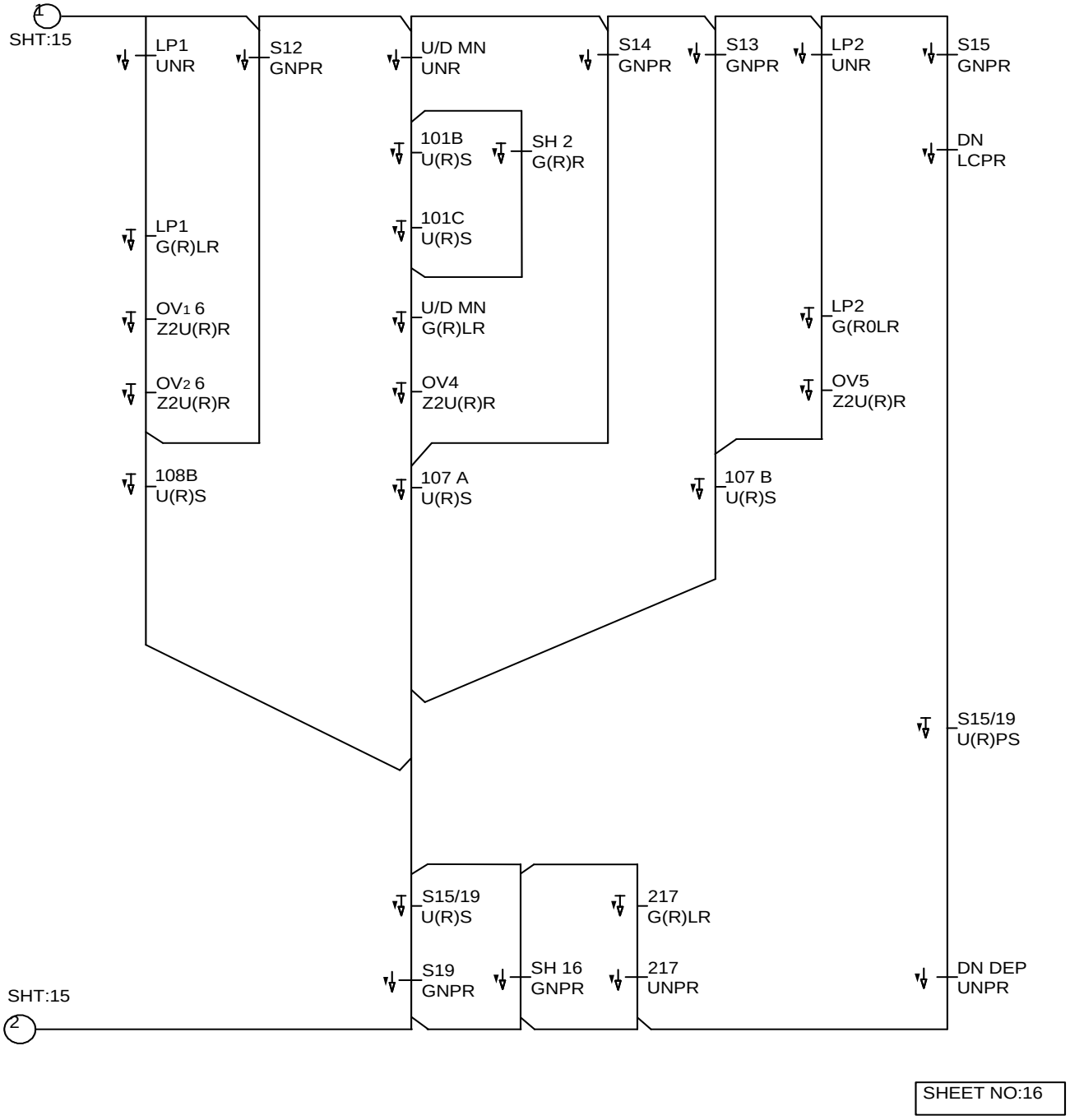

1
SHT:15
LP1
UNR
S12
GNPR
U/D MN
UNR
S14
GNPR
S13
GNPR
LP2
UNR
S15
GNPR
101B
U(R)S
SH 2
G(R)R
DN
LCPR
LP1
G(R)LR
101C
U(R)S
OV1 6
Z2U(R)R
U/D MN
G(R)LR
LP2
G(R0LR
OV2 6
Z2U(R)R
OV4
Z2U(R)R
OV5
Z2U(R)R
108B
U(R)S
107 A
U(R)S
107 B
U(R)S
S15/19
U(R)PS
S15/19
U(R)S
217
G(R)LR
S19
GNPR
SH 16
GNPR
217
UNPR
DN DEP
UNPR
SHT:15
2
SHEET NO:16

Fig 4.9(6)

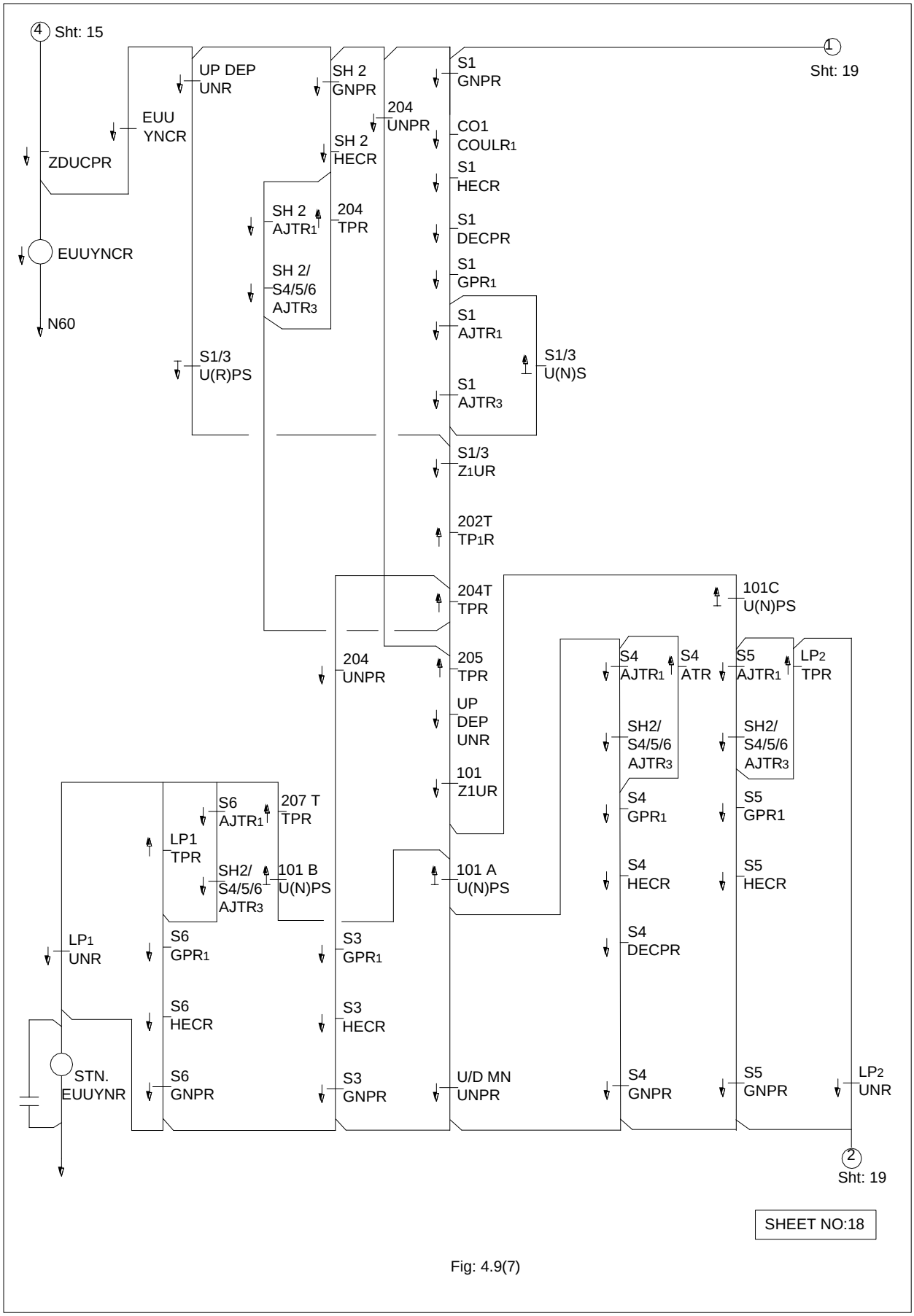


Fig: 4.9(7)

Fig 4.9(7)

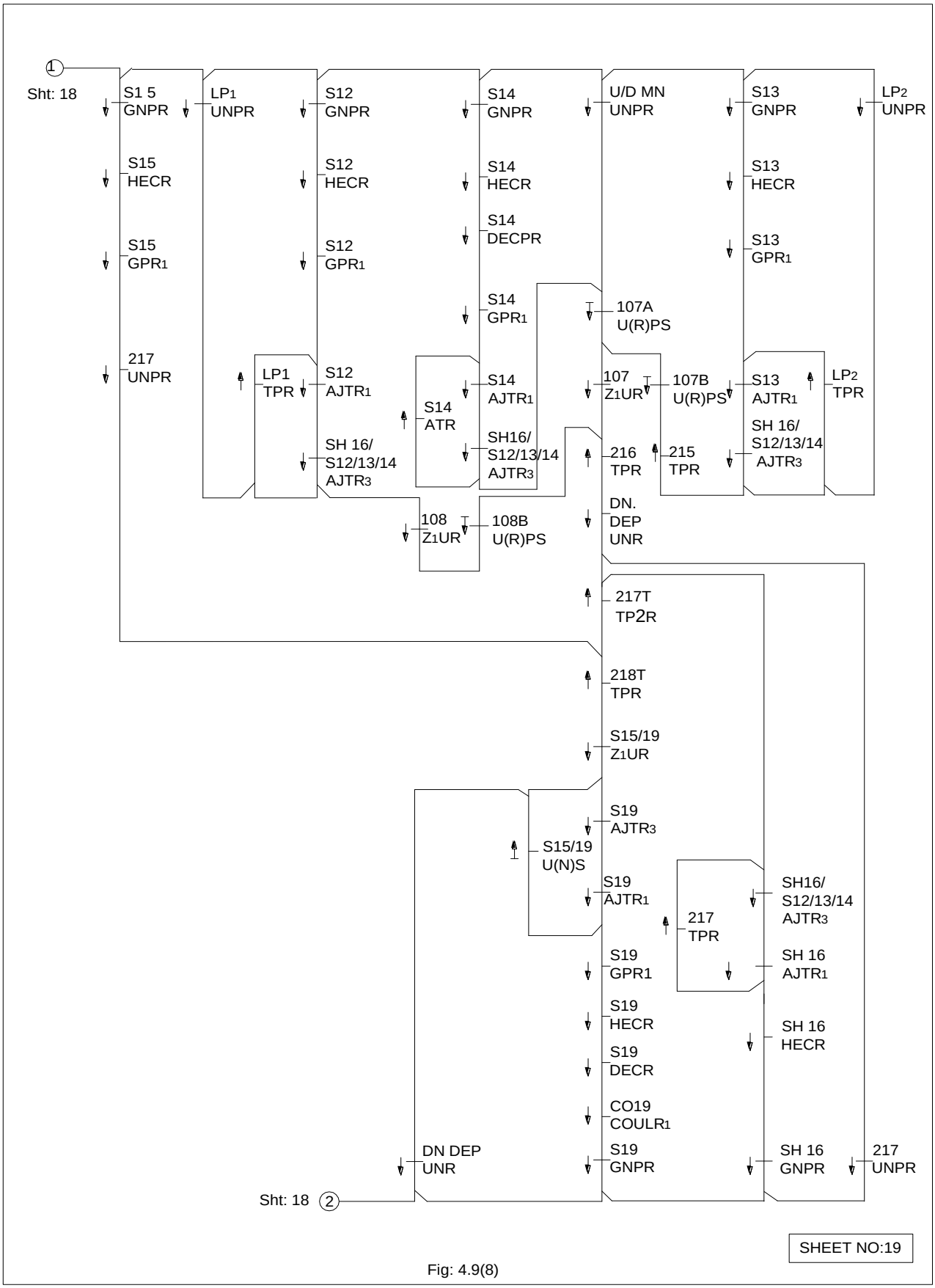


Fig: 4.9(8)

Fig 4.9(8)

4.3 Route setting Checking and locking and overlap setting

Once the Route and signal is initiated, all the route sections in the route and overlap will get set, checked and locked.

(From Fig.4.1 page 19)

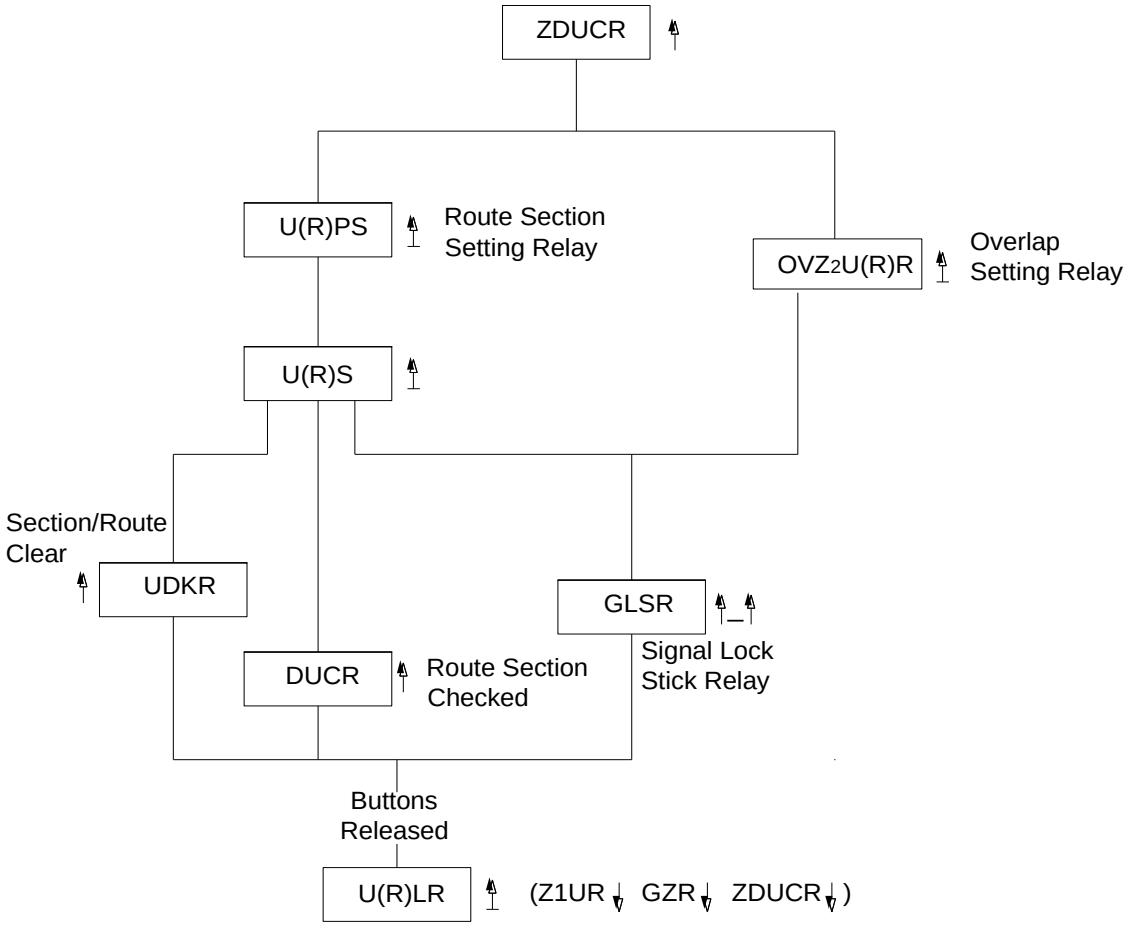


Fig. 4.10

4.3.1 OVERLAP SETTIING RELAY: OVZ$_2$U(R)R

After Route Initiation, overlap setting takes place. It is an interlocked relay. When the Main signal is initiated overlap setting relay operates and latches to lock the overlap points. One such relay is provided for each overlap.

The energisation of this relay proves that:

1. The Route initiated is for Main signal.
2. Concerned Signal and Route buttons are pressed simultaneously.
3. Points in the overlap are set and detected to the required position correctly.
4. Conflicting overlaps are Normal and not set some times two conflicting overlaps of a signal may require points in the same position.
5. OV Z$_2$U(N)R front contact is used as a economizer contact

Sequence of relay operation:

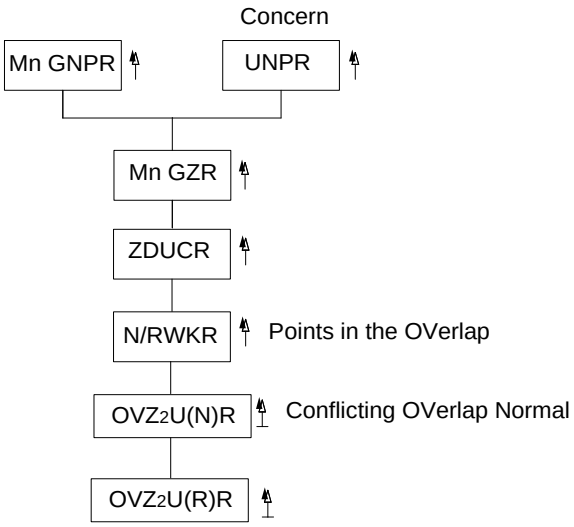


Fig : 4.11

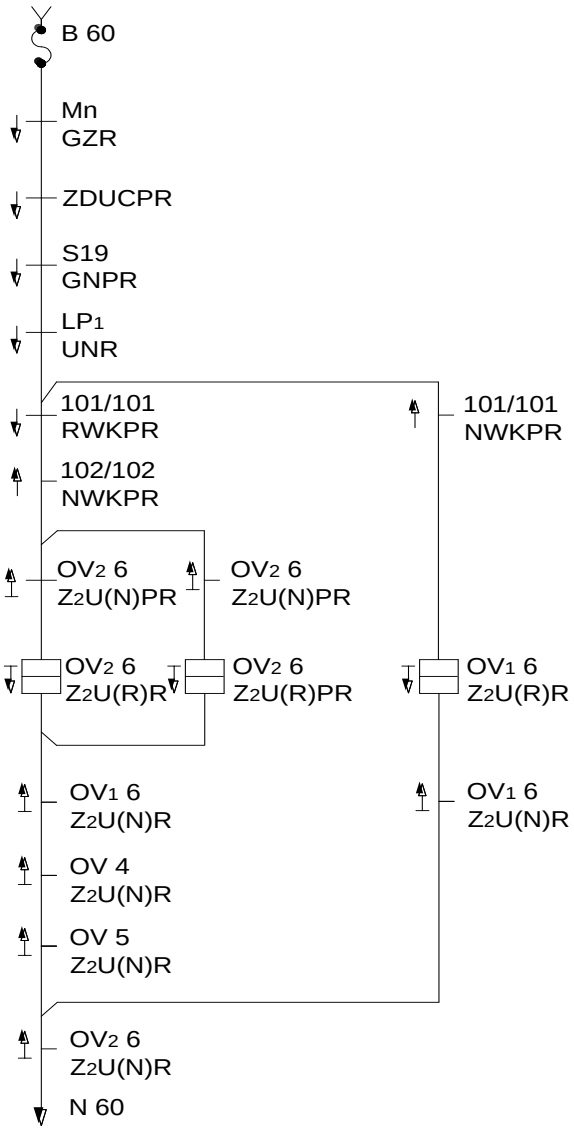


Fig. 4.12 : OVZ$_2$U(R)R Circuit

4.3.2 ROUTE SETTING, CHECKING AND LOCKING

After route initiation, route setting takes place section wise to lock Points and Slots in each section.

Then Route checking takes place in each section, proving Route Setting along with Route section Point detection and its track circuit vacancy.

This is followed by *Route Locking,* section wise to hold the Route Setting, enforcing on it for Indication, Approach and Back locking.

Relays involved in Route Setting, Checking & Locking are:

Sl. No.	Relay Nomenclature	Location	Description	Purpose
1.	A/B/C/a - U(R)S U(N)S (Interlocked)	Route group	Route Section setting Relay	Operates to lock Route Section Points and Slots as required in set position. Drops to prove the above Signal movement is completed or cancelled.
			Route Section normalizing Relay	
2.	A/B/C/a - U(R)PS U(N)PS (Interlocked)	Route group	Repeaters of the above	Unlike other relays the repeater relay operates earlier than the main relay.
3.	A/B/C/a - DUCR	Route group	Route section Clear Checking Relay	Proves that Route Section is set, its points are correctly detected and its tracks are not occupied. Proved dropped in R/S setting to check for proper working.
4.	Z_1UR	Mini Group	Sub route Initiating Relay	Prove that the concerned Sub Route is initiated along with other required conditions.
5.	ZDUCR	Mini Group	Zonal Route Permissibility checking Relay	Proves that the concerned Sub-Routes are initiated along with other conditions.
6.	OV - Z_2U(R)R Z_2U(N)R (Interlocked)	Mini Group	Overlap Setting Relay Overlap Release Relay	Interlocks the R/S being set with Main Signals of this road in opposite direction.
7.	**ROAD** ZU(R)R ZU(N)R (Interlocked)	Mini Group	Reverse direction Setting Relay for the road	Interlocks R/S being set with all Signals of opposite direction on the road.
			Normal direction Setting Relay for the road.	
8.	S/SH- AJTR$_1$	Mini Group	App. lock Release Timer relay No.1 (concerned with the R/Section)	Proved dropped after previous operation in Route Setting and Checking to check for its proper working.
9.	R/S Point - N/RWKRs	Mini Group	Point position Detection Relays	Proved for interlocking conflicting Route sections.

Sl. No.	Relay Nomenclature	Location	Description	Purpose
10.	UYR_1	Route group	Route Section Approach lock Release Relay No.1	Proved dropped in DUCR circuit to check for their dropping after previous operation.
11.	UYR_2	Route group	Route Section Approach lock Release Relay no.2	
12.	UDKR	Route group	Route section Clear Indicating relay (for releasing back locking).	Proved energised before occupation of R/S to check for its working.
13.	EUYR	Mini Group	(Common) Emergency R/S Release Relay.	Proved dropped after previous operation during the locking of R/S.
14.	MN-GZR	Mini Group	Main Signal Initiating Relay	Proved dropped with the release of GN and UN before locking the Route section.
15.	SH-GZR	Mini Group	Shunt Signal Initiating Relay	
16.	R/S - U(R)LR U(N)LR (Interlocked)	Route group	R/S Locking Relay R/S Release Relay (common for a Sub Route)	Effects Indication, Approach & Back locking on Route Section. Releases the above locking on Route section. Proved normal during R/S setting to check for its proper working.

4.3.2.1 SETTING OF ROUTE SECTIONS

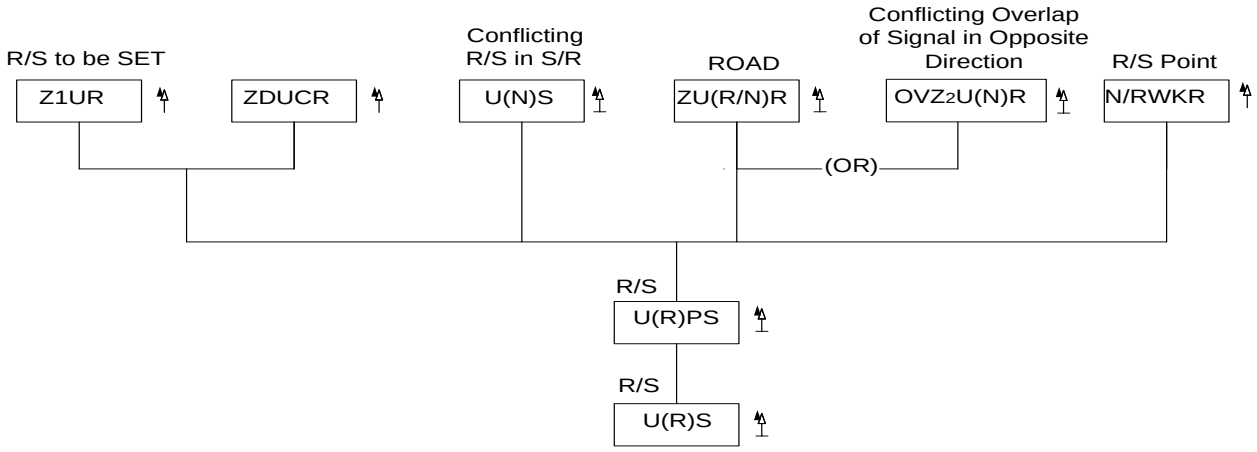


Fig.4.13

Setting a route section engages it for movement of traffic after making its Points and Slots inoperative until after its Normalization.

U(R)S operation proves that:

(a) The Route section to be set is initiated along with all other required sections.

(b) Conflicting Route sections of the Sub-route and overlaps are normal.

(c) Either the Route section to be set is in advance of a Signal in the same direction or Overlap of Signals in rear falling in the Route section are normal.

(d) The concerned Route-section Points are correctly detected so that conflicting Route sections of the Sub-route are indirectly locked.

(i) All the required route sections of the Route will set simultaneously.

(e) U(R)S / U(R)PS circuit is combined with Route section Checking, Locking and Release circuits as most of the concerned relays are located and interconnected in a Minor group.

(f) OVZ2U(R)R normal contacts of Signal Overlaps falling in the Route section are cut over by ZU(R/N)R contacts of the same direction. This facilitates a train 'run through' in a direction.

(g) U(R)PS operates first then U(R)S operates. This is to ensure possibility of all further operations before a Route section is set as some of them are controlled by the repeater.

(h) In the U(R)S circuit, U(N)S operated contact is used as an economizer contact. Also in this, U(N)PS dropped proves the operation of its repeater first. U(R)PS operated contact is not used for this purpose, as the operation of this interlocked relay is completed only with the dropping of its counterpart.

Relay Control Circuit (Ref. to Fig. No. 4.15)

4.3.2.2 : ROUTE CHECKING

Sequence of relay operation

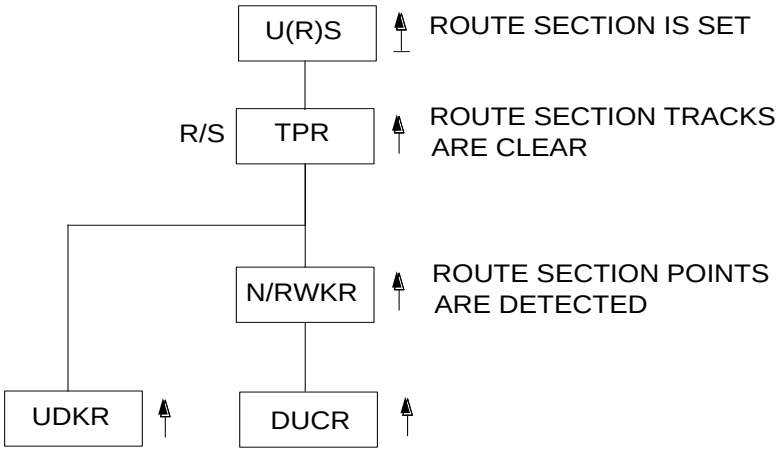


Fig: 4.14

Each Route section gets checked for its correct setting simultaneously with other concerned route sections, when its DUCR picks up, proving that -

(i) Concerned Route Section is set and Route Section Track circuits are clear.

(ii) Route Section Points are correctly detected and Crank Handle is inside the unit.

(iii) UYR1 and UYR2 back contacts are proved to prevent energisation of DUCR once UYR1 and UYR2 picks up.

Simultaneously in each Sub route, UDKR is checked for its operation at this stage. In this circuit any one of the Route Section in that sub route is set and the set Route Section Track circuits are clear are proved and point detection is not proved. This UDKR is required to be operated for releasing back locking on Route Section when a train passes over it even though the route section points are failed.

Relay control circuit (Fig 4.15)

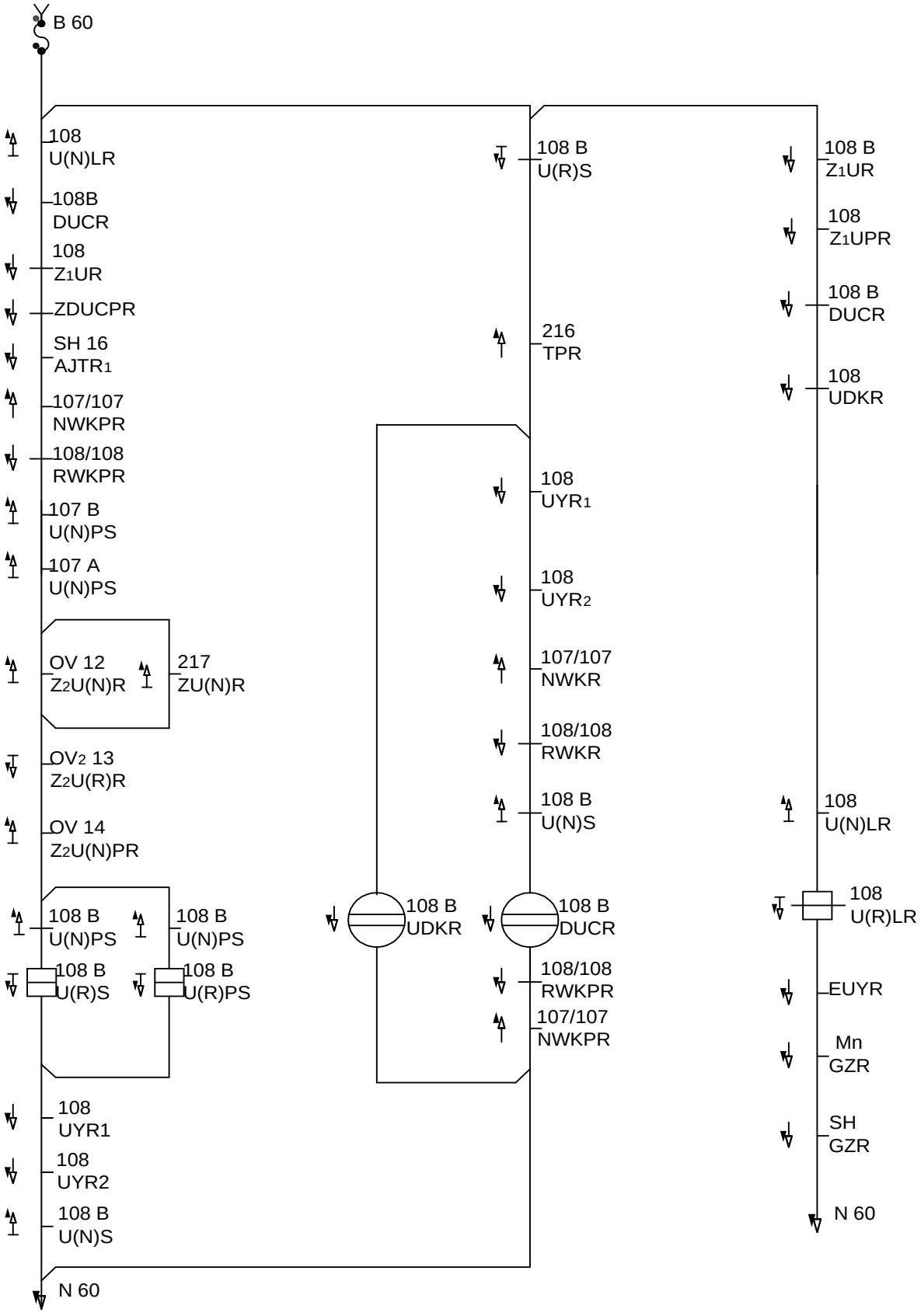


Fig. 4.15 : ROUTE SECTION SETTING, CHECKING & LOCKING

4.3.2.3 ROUTE LOCKING

Sequence of relay operation

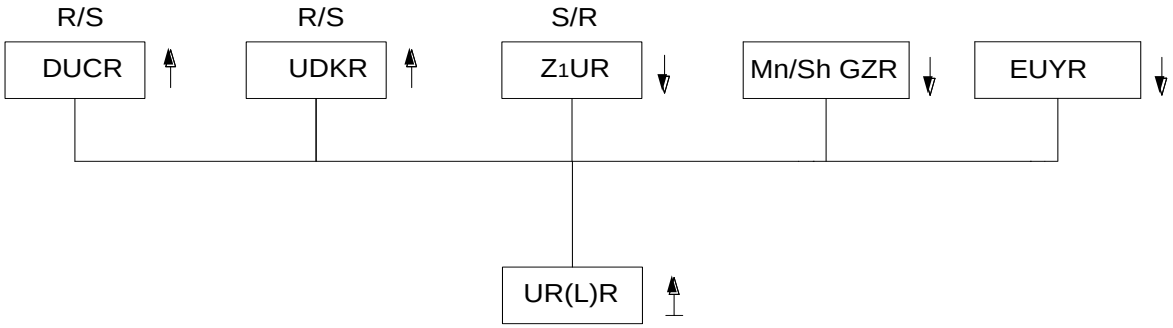


Fig: 4.16

After this, the Signal and Route Buttons have to be released for locking of the set Route sections.

For U(R)LR operation, it is proved that -

i) The Sub Route initiating relays and Signal initiating relays could drop only when the pressed buttons are released. Then locking of the set Route Section takes place.

ii) UDKR pick up proves that the route section is set and its tracks are clear.

iii) The set Route section points are checked is proved by the relevant DUCR.

iv) EUYR back contact is proved to check for its dropping after previous operation

Relay control circuit (Fig 4.15)

4.3.2.4 ROUTE SECTIONS WITHOUT POINTS.

Generally Route Sections are formed to hold Points and Slots in them until after a train movement over them. But sometimes, one may come across Route sections without a point in them as in between an Advance Starter and Home signal of an Absolute Block station in single line section. The later Route sections are formed to achieve interlocking between conflicting signals on either side of them directly.

Alternately, direct interlocking between the signals is achieved through a Direction Determining Relay provided for the Advance starter track circuit.

An example of such a Route section, viz S15/19 U(R)S and S1/3 U(R)S can be found in route section plan given in this notes. Checking and Locking of this route section does not take place as no points are involved in this. UDKR relay is provided for proving the back lock condition.

Relay control circuit (Fig 4.17)

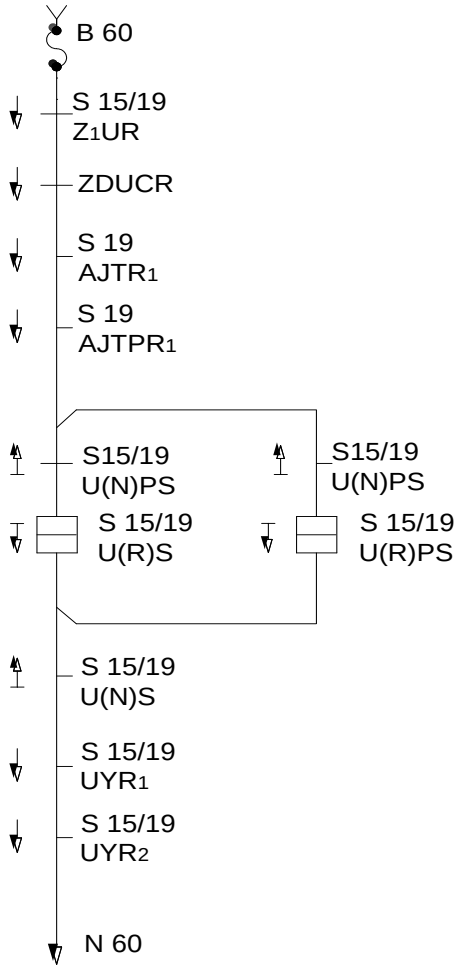


Fig. 4.17 : U(R)S CIRCUIT FOR THE ROUTE SECTION WITHOUT POINTS

4.4 MAIN SIGNAL CONTROL

4.4.1 One Train only on One Signal Clearance

Soon after Route setting and before buttons are released, GLSR picks up to enforce a Signal operation on panel for every train. GLSRs also provide interlocking between Main and Shunt Signals of the same route. This is because a Main signal GLSR proves Route sections set for picking up while a Shunt Signal GLSR proves Route sections Normal and Sh GLSR is remains normally energised. This interlocking is in addition to that provided by SH G(R/N)R and Main G(R/N)LR. The relays involved in Main Signal GLSR operation are:-

Sl. No	Relay Nomenclature	Location	Description	Purpose
1.	GLSR	Signal Group	Signal Lock Stock Relay.	1. Picks up after route setting to allow Signal clearance. 2. Drops before signal clearance to enforce all conditions again in the next signal operation.
2.	EGNR	Signal Group	Relay proving operation of Signal Button along with EGGN.	Proved dropped after previous operation in GLSR circuit.
3.	GPR_1	Signal Group	Repeater for Signal Aspect control Relay-1	It serves to drop GLSR by picking up later.
4.	$COULR_1$	Mini Group	First relay to prove locking of Route Points for Calling ON Signal control.	Proved dropped in GLSR hold circuit as it controls a conflicting Calling ON signal.

GLSR picks up proves that:-

Route and Signal initiating relays operated to ascertain that the route sections are not lying set from the previous operation.

(i) Signal and route buttons are kept pressed.

(ii) The concerned Route sections are set.

(iii) GPR_1 dropped after previous operation, to disconnect GLSR stick feed supply when it picks up.

(iv) EGNR back contact is proved to drop GLSR relay during manual cancellation effected when the signal control relay GR1 fails to pick up, after a route is set & locked.

GLSR remains picked up until the operation of G(R)LR when buttons are released to lock route.

This includes first Route section U(R)S condition, not to let GLSR remain energized without Route setting if it is picked up by hand. The stick circuit is maintained till the GPR_1 is picked up. The signal lock relay G (R)LR is made to operate after GPR_1 picks up but before GLSR drops. For this reason the GLSR is made slow to release.

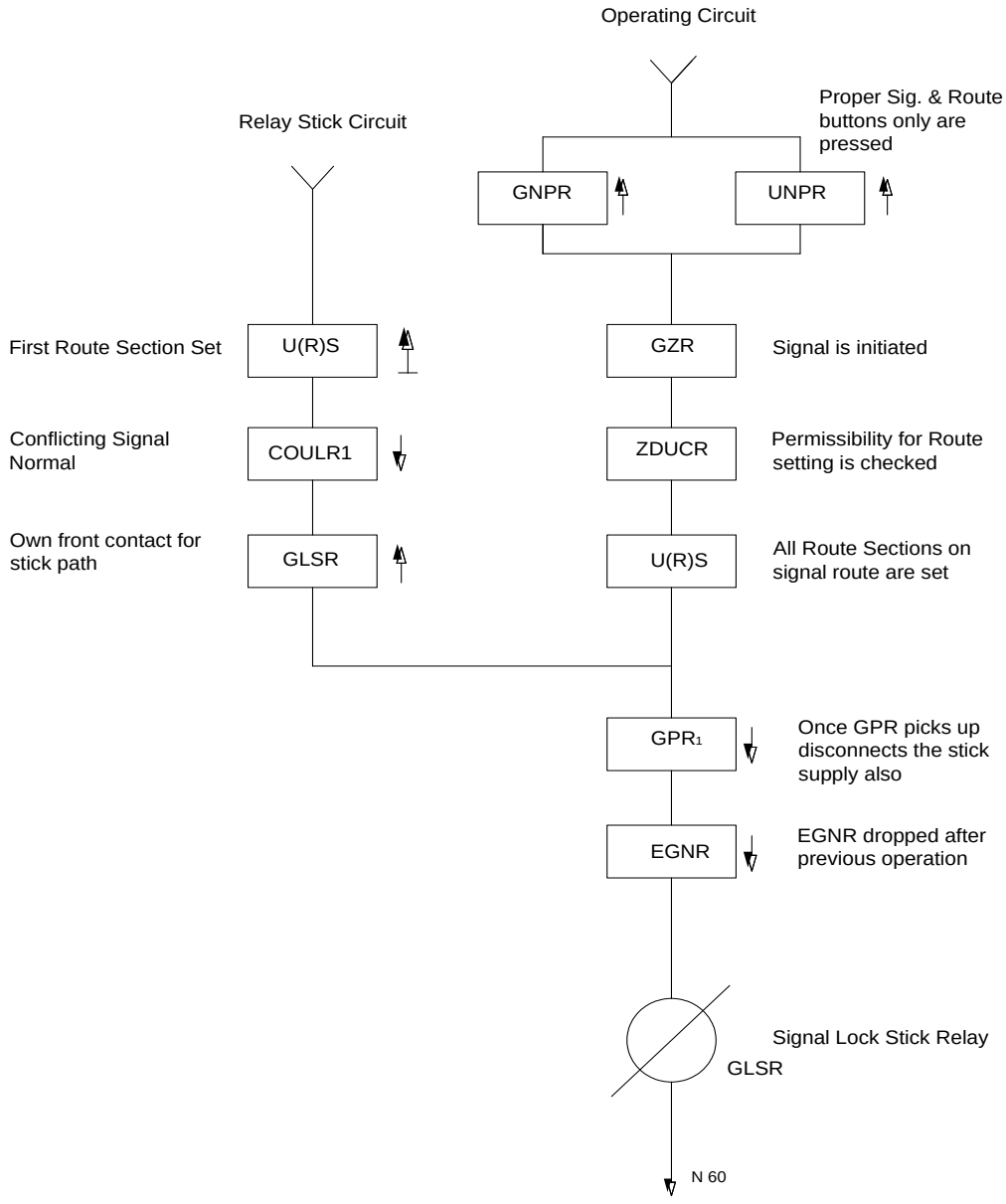


Fig 4.18

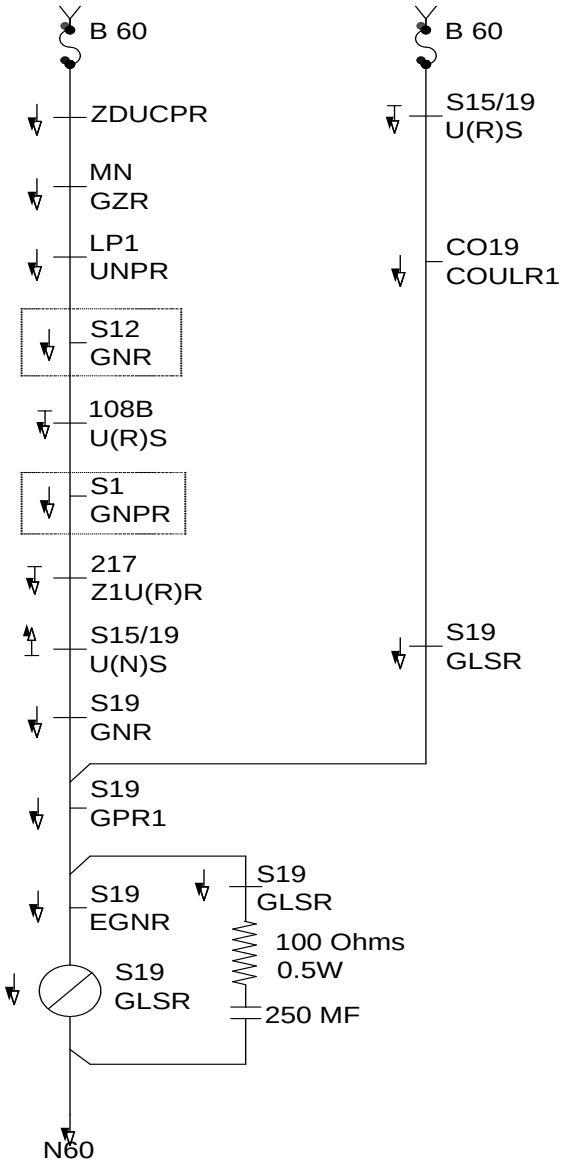


Fig 4.19 – Mn GLSR circuit

4.5 MAIN SIGNAL CONTROL AND SIGNAL LOCKING

Relays involved in this are:

Sl. No.	Relay Nomenclature	Location	Description	Purpose
1.	GR_1	Signal group	Signal Aspect control relay-1	Proves all Signal clearance conditions directly and controls its 'OFF' aspects along with GR_2
2.	GPR_1	Signal group	Repeater of the above.	i) Feeds route indicator where provided. ii) Cuts off feed to GLSR to prove its dropping in GR_2 circuit.
3.	Signal in Advance RECPR	Concerned Signal group	Repeater of Red Aspect Proving relay of Signal in advance.	Proved in parallel to prevent clearing of a Signal in case the Signal in advance of it is blank.
4.	Signal in Advance HECPR	Concerned Signal group	Caution Aspect Proving relay of Sig. in advance.	
5.	Signal in Advance DECPR	Concerned Signal group	Clear Aspect Proving relay of Sig. in advance.	
6.	LX(R)R LX(N)R (Interlocked)	Mini Group	Level crossing Release relay.	Releases Gate when signal is at ON.
			Level crossing control Normal relay.	Locks Gate control normal for clearing Signal.
7.	LXCPR	Mini Group	Level Crossing 'closed' Proving relay	Detects that Gate is closed for clearing a concerned Signal.
8.	KLNPR	Mini Group	(Point) Key Lock Normal Proving relay.	Detects that Key Lock is not released while a concerned Signal is being cleared.
9.	GR_2	Signal group	Signal Aspect control relay-2	i) Proves dropping of GLSR after GR_1 picked up. ii) Controls 'Off' aspects along with GR_1.
10	Road - G(R)LR G(N)LR (Interlocked)	Mini Group	Signal locking relay Signal unlocking relay.	Locks conflicting signals by preventing another initiation on the route.
11.	GR_3	Signal group	Signal Aspect control relay-3	Controls DG aspect along with GR_1 & GR_2
12.	GR_4	Mini Group	signal Aspect control relay-4	Controls HHG along with GR_1 & GR_2.

4.5.1 After locking all the sub routes in the signal route, Signal locking and Signal clearance will take place.

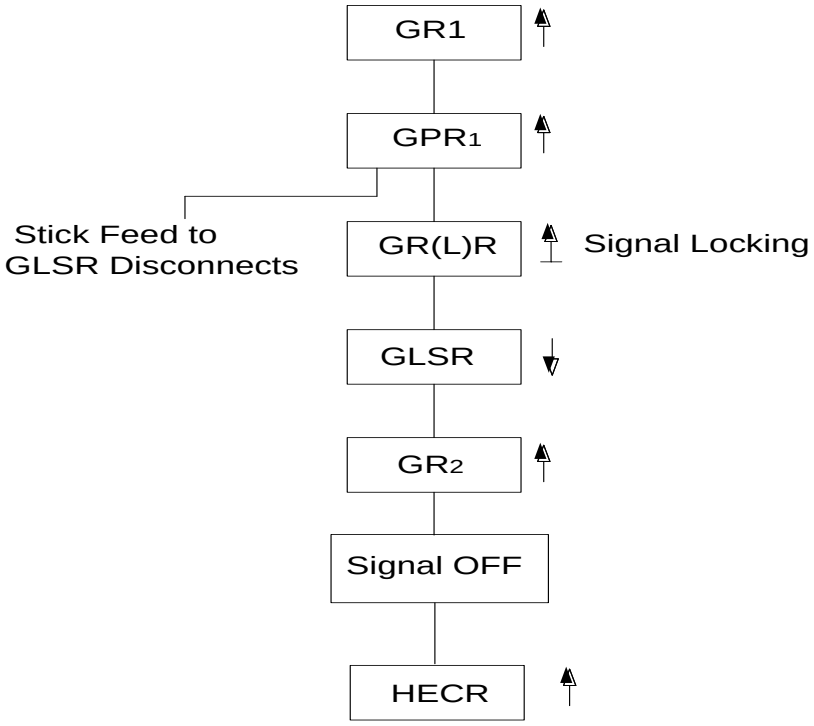


Fig : 4.20

1. GR1 picks up proving the following conditions:
   (i) Signal in advance is not blank
   (ii) Interlocking with conflicting Main Signals on the road and with all conflicting Shunt signals is ensured.
   (iii) Overlap is set, its Point and Track detections are continuously available.
   (iv) Route and Berthing tracks are clear Route sections are checked and locked.
   (v) Signal button is released (This condition is again proved as Route locking relays do not get feed continuously)
   (vi) Only one train can pass on one cleared Signal.

   GR1, sticks through its own energised contact across GNR de-energised and GLSR energised contacts.

   GR1 stick circuit is necessary because it shall not drop -
   (i) When GLSR drops subsequently.
   (ii) Even if signal button is pressed unintentionally later.
2. GR1 also has a condenser discharge circuit across its coil to prevent its dropping in times of momentary failure of power supply or track circuits.
3. EGNR dropped contact is proved in GR_1 circuit so as to drop it and put back the Signal to 'ON' aspect by an emergency operation.

Relay control circuits: (Refer to Fig. 4.21 & 4.22)

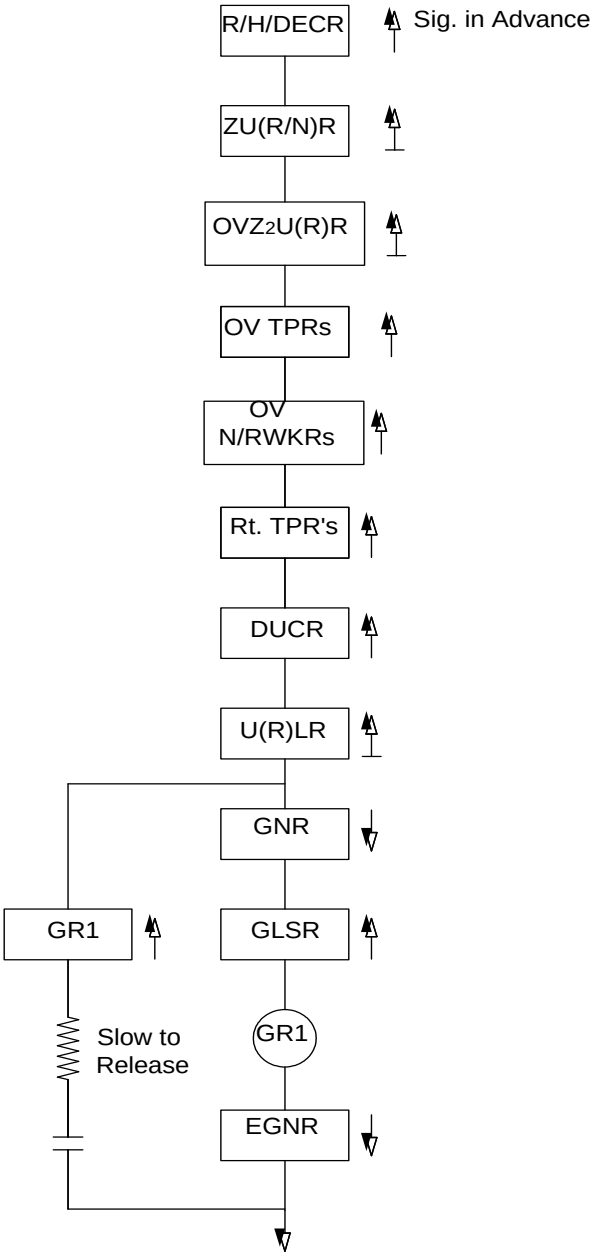

R/H/DECR
Sig. in Advance
ZU(R/N)R
OVZ2U(R)R
OV TPRs
OV
N/RWKRs
Rt. TPR's
DUCR
U(R)LR
GNR
GR1
GLSR
Slow to
Release
GR1
EGNR

Fig 4.21

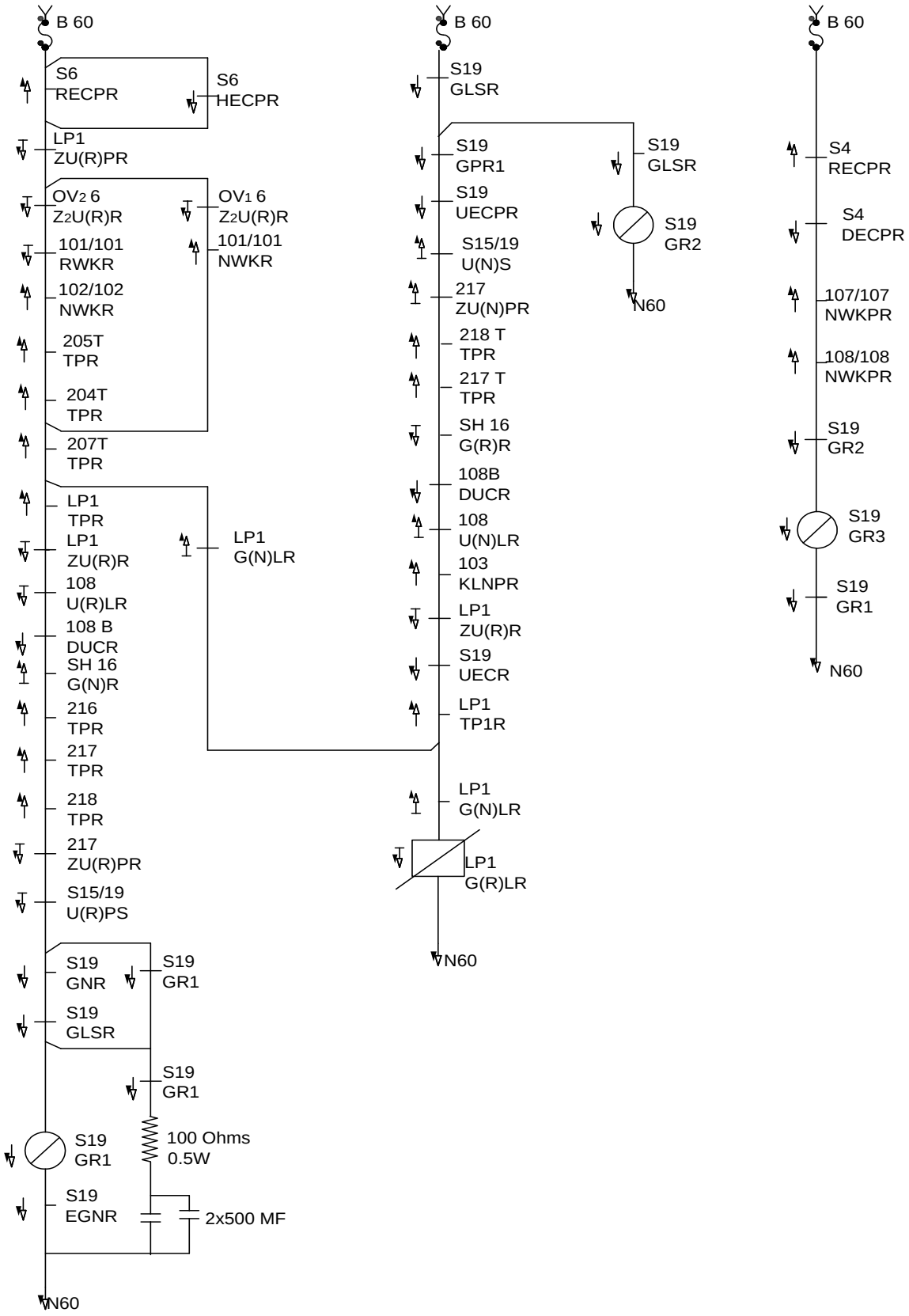


Fig .4.22 : S19 GR1, G(R)LR, GR2 Circuits for LP1
S19 GR3 Circuit for Mn Line

4.5.2 Route Indicator Control:-

In UG lamp control, not only GPR_1 but also the detection of Route points detection (with double cutting) is proved

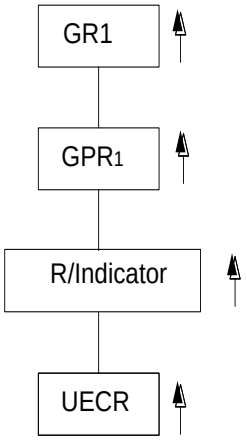


Fig.4.23

Route Indicator lamp Control Circuit (Refer Fig. 4.24)

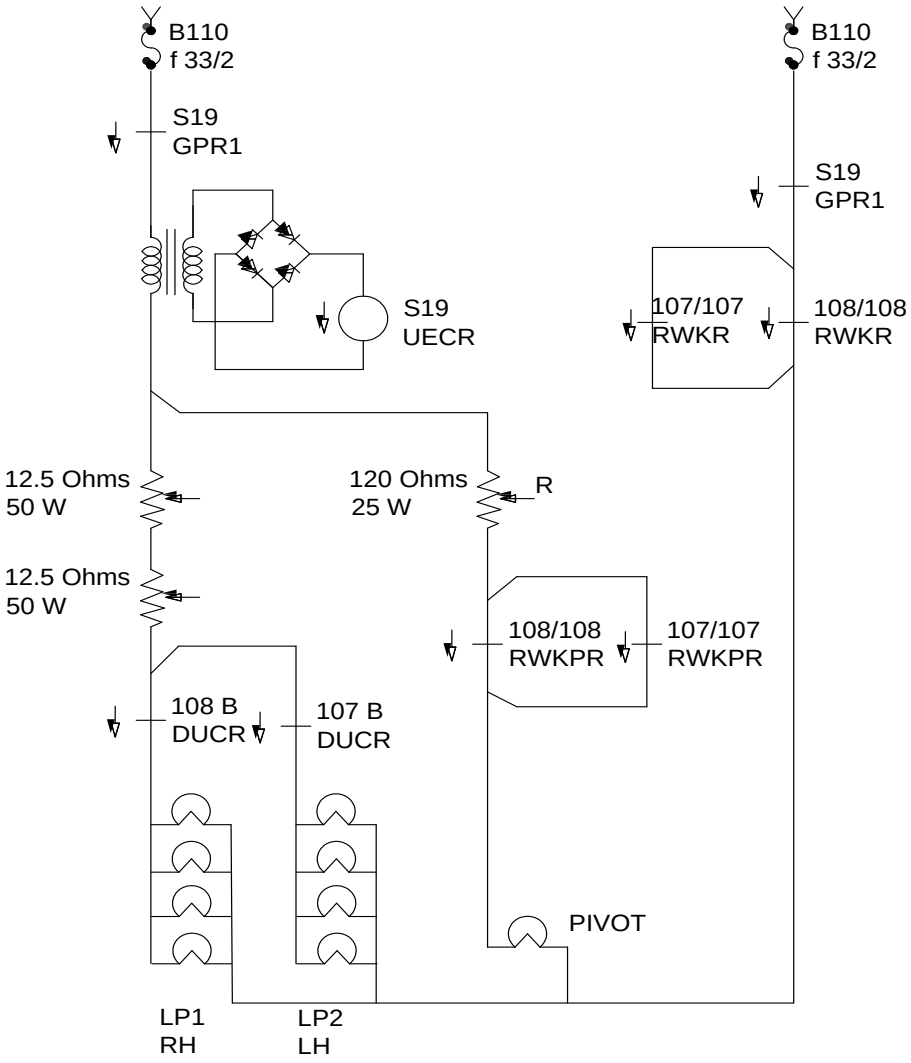


Fig.4.24

4.5.3 : G(R)LR :- Signal locking Relay :

This relay is an interlocked relay. The energisation of top relay G(R)LR locks the signal and bottom relay G(N)LR unlocks the signal.

The signal locking relay is provided one for every exit track and is common for both directions. It prevents the clearance of any other signal for that line from any direction after a signal has been cleared. This relay is named after the Exit or Berthing track.

The relay G(R)LR energizes once GPR1 is energised but before the de-energisation of GLSR.

It proves –

(i) One train on one Signal clearance condition (proved a second time in this stage).

(ii) GPR_1 operated.

(iii) Either Route indicator is lit (this condition is required only for Signals with Route Indicator) or Route Points are in Normal.

(iv) Conflicting Main and Shunt Signals are interlocked (proved a second time in this stage).

(v) Route tracks are clear, Route sections are checked and locked (proved a second time in this stage)

Feed to GLSR is cut off when GPR_1 de-energised contact is broken soon after GR_1 picks up. But both GPR1 energized and GLSR energised are proved to latch G(R)LR. Hence GLSR is made slow to release.

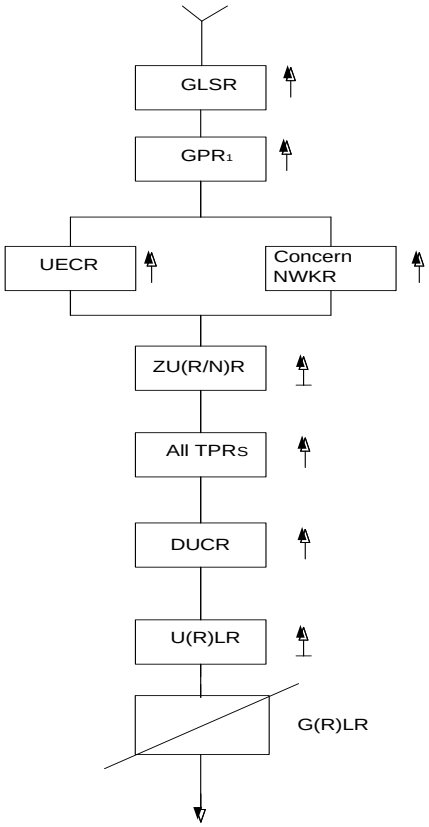


Fig 4.25 : G(R)LR Flow Chart

G(R)LR CONTROL CIRCUIT Ref: Fig. 4.22

4.5.4 The third relay to operate now is GR2 to clear the Signal along with GR1:-

GR_2 proves the following conditions: -

(i) Signal in advance is not blank. (a second time)

(ii) Interlocking with conflicting, Main and Shunt Signals is ensured. (a third time in this stage)

(iii) Overlap is set, its Points and Tracks are detected. (a second time).

(iv) G(R)LR is operated to lock all conflicting Signals of the road.

(v) Route and berthing tracks are clear, Route sections are checked and locked. (a third time)

(vi) Route Indicator is lit or Route Points are in Normal. (a second time)

(vii) GLSR dropped after the operation of GR_1.

Signal clearance conditions are proved by two relays at the final stage, at the same time economizing on relay contacts. (Refer Fig.4.22).

Sequence of relay operation:--

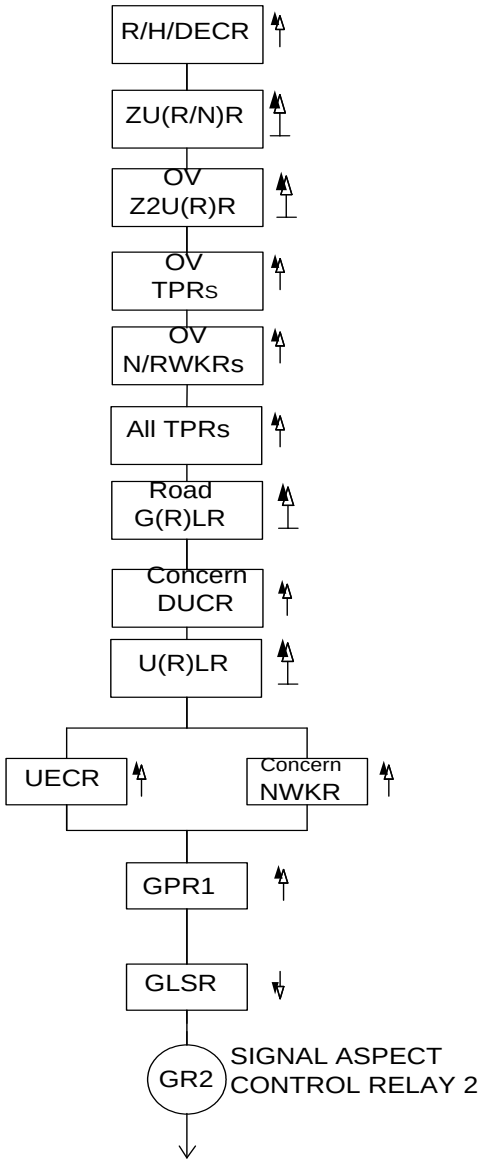


Fig 4.26

4.5.5 CLEAR ASPECT CONTROL: GR3

Route points are proved Normal in this so that, for a train being received on diversion line, clear aspect shall not be displayed if Main line Starter is taken off for another departing train.

Relay control circuit : (Refer Fig.4.22)

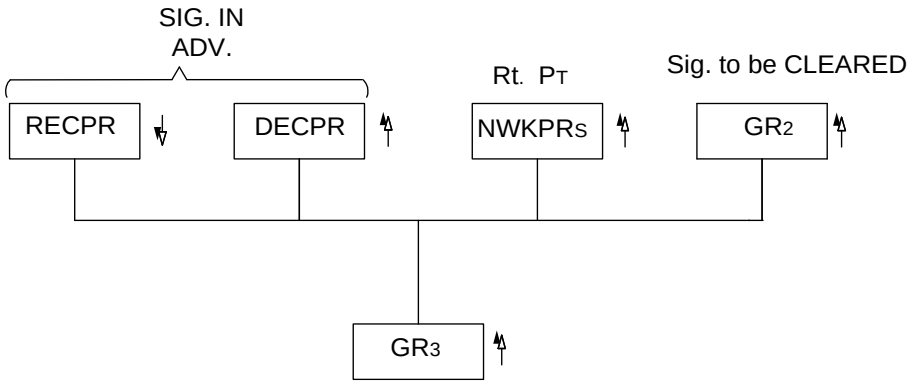


Fig.4.27

Main Signal Lamp Control Circuit. (Refer to Fig.4.28)

Both GR_1 and GR_2 contacts are proved in HG aspect control.

While GR_3 (with double cutting) is proved to light DG lamp, GR_4 (with double cutting) is proved in HHG lamp control in addition to GR_2.

RG lamp circuit proves only GR_2 back contact or OFF ECR back contacts.

An 80 Ω, 50W resistance regulates the ECR current in all lamp circuits.

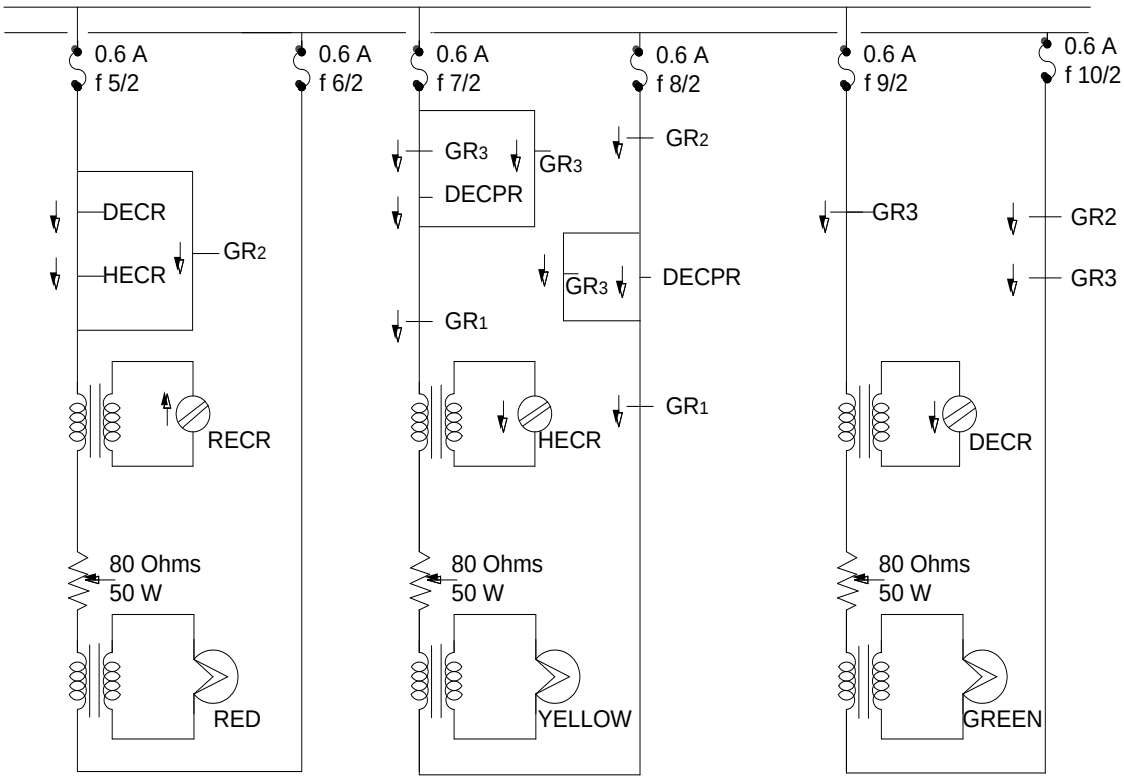


Fig.4.28

4.6 SHUNT SIGNAL CONTROL

4.6.1 One Train only on One Signal Clearance

The relays involved are:-

S. No	Relay Nomenclature	Location	Description	Purpose
1.	SH-GLSR	SH-Sig. Group	Shunt Signal Lock Stick Relay.	1. Normally remains energised. 2. Drops as the route is set & SH button is released. 3. Picks up again after its Route is normalised.
2.	SH-GZR	Mini Group.	Shunt Signal Initiating Relay.	Proved operated after Shunt Signal operation to hold SH-GLSR until the buttons are released.
3.	SH-GNR	Sh Sig Group	Shunt Signal Button Relay (common).	

SH-GLSR is normally kept energised proving that:

(i) The concerned Route sections are normalised after previous operation.

(ii) Overlaps of Signals in opposite direction falling in the Shunt Signal Route are normal to interlock them with the Shunt Signal to be taken off.

(iii) GR_1 dropped after previous operation.

When buttons are pressed to set the route for Shunt Signal, GLSR is held until the buttons are released. This is required to hold until GR_1 picks up. This drops when buttons are released to pick up again after the route is normalized.

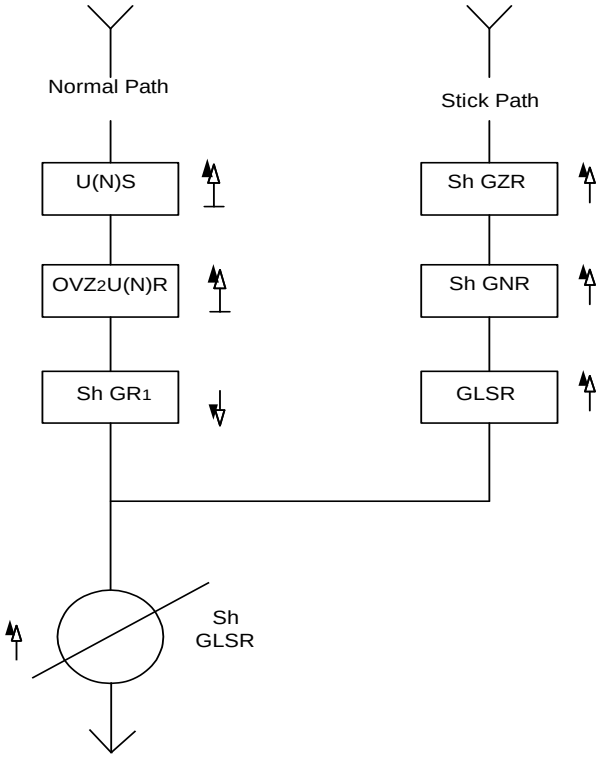


Fig : 4.29

SH GLSR Relay control circuit: (Refer Fig. 4.30 Circuit 1)

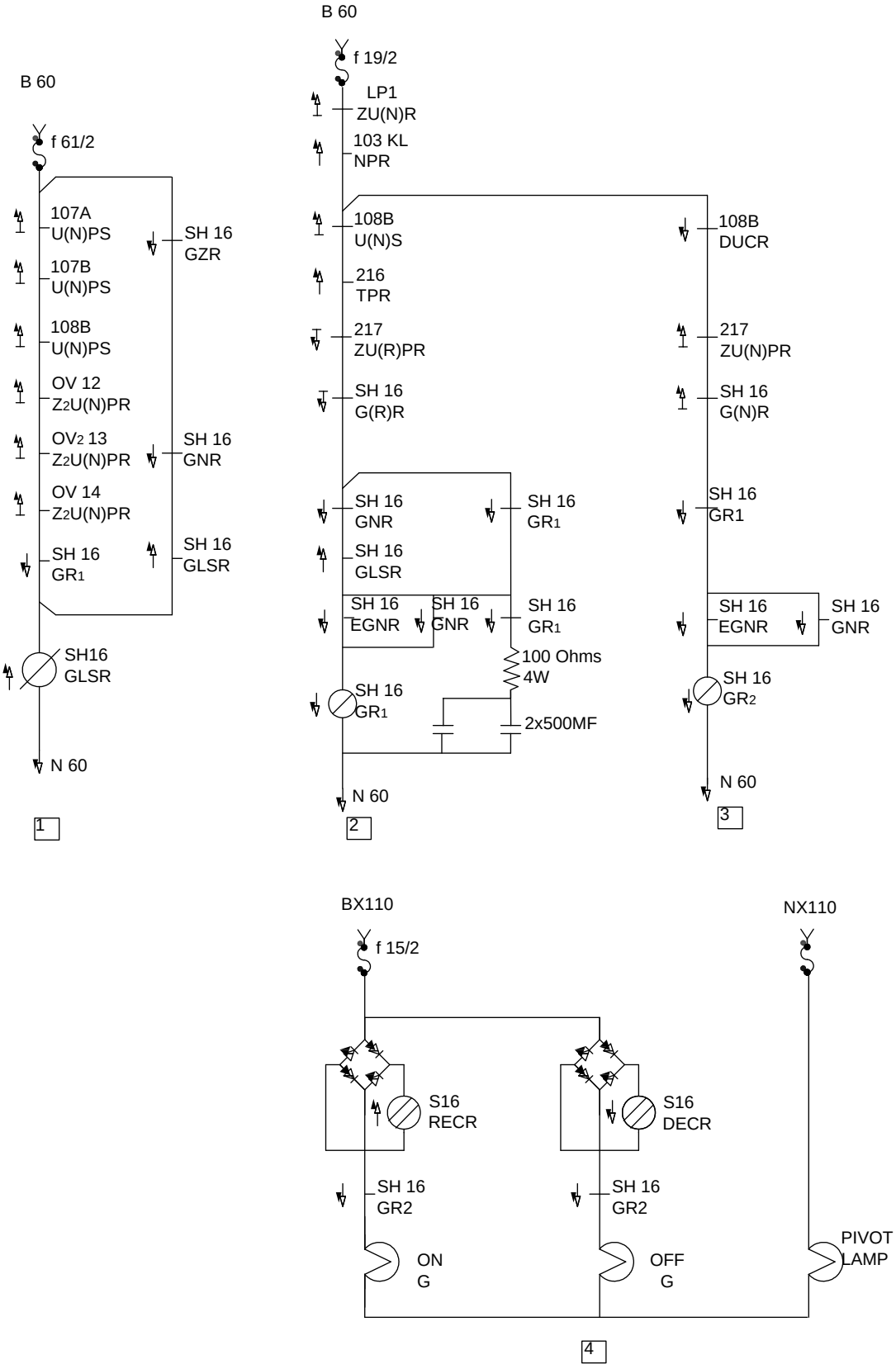


Fig. 4.30 : SHUNT SIGNAL CONTROL RELAYS

(1) SH GLSR Circuit
(2) SH GR1 Circuit
(3) SH GR2 Circuit
(4) SH SIGNAL Lamp Control Circuit

4.6.2 SHUNT SIGNAL CLEARANCE

The relays involved are:-

S.No.	Relay Nomenclature	Location	Description	Purpose
1.	SH-GR_1	Sh- Signal group	Shunt Signal aspect control Relay-1	Proves Shunt Signal Clearance conditions like GNR & GLSR operations Shunt Signal selection and Route setting.
2.	SH-GR_2	Sh- Signal group	Shunt Signal aspect control Relay-2	Proves GR_1 operation with the above conditions.

Buttons are not released before clearance of a Shunt Signal because-

(i) GLSR shall not drop before GR_1 picking up.

(ii) One cannot mark the time between operations of GR_1 and GR_2.

Since the buttons are not released early, U(R)LRs of the route do not operate and hence cannot be proved for Shunt Signal clearance. Due to this G(R)LR of the road also does not operate.

4.6.2.1 Shunt Signal GR_1 GR2 Picks up as below :

In this, U(R)S is proved instead of DUCR because Shunt Signal GR1 need not to be dropped even when a Route Point indication is lost after Signal clearance. But signal will fly back to 'ON' position since DUCR front contract is proved in GR2 Circuit.
As in the case of MN-GR_1, Shunt Signal GR_1 also is made slow to release.

In this, Key lock Point control Key 'IN' condition is also proved along with Route Section U(R)S.

In GR_1 and GR_2 circuits, EGNR dropped and GNR dropped are proved in parallel as both pick up during emergency signal replacement. (In the present circuit DUCR contact is proved for GR2 instead of U(R)S).

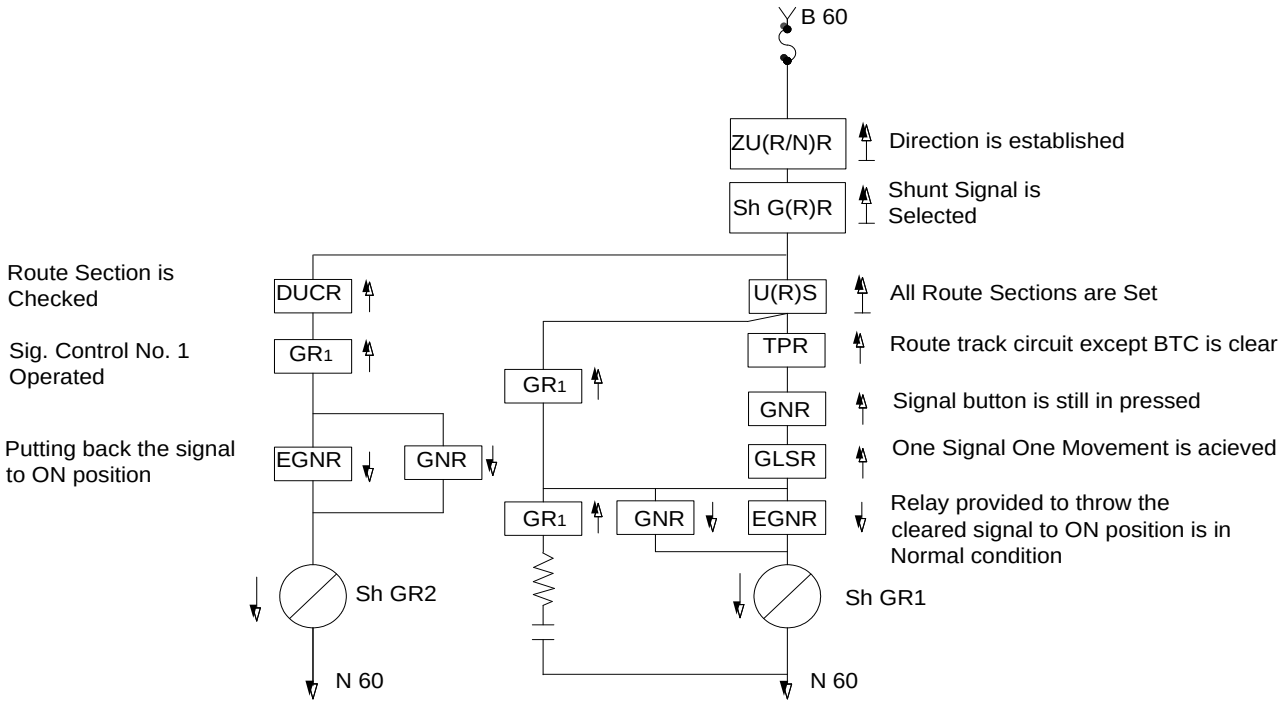


Fig : 4.31

SH GR1, SH GR2 Relays and Shunt signal lamp control circuit
[Ref. Fig. No. 4.30(2), 4.30(3), 4.30(4)]

4.7 CALLING ON SIGNAL CONTROL

4.7.1 Relays involved in this are:

Sl. No	Relay Nomenclature	Location	Description	Purpose
1.	COATR	Mini Group	CO Signal Approach Track Relay	Proves train halting at the CO Signal before its clearance.
2.	$COULR_1$	Mini Group	CO Signal Route Locking relay - 1	Proves CO Signal Route setting and its interlocking to set time for its clearance.
3.	$AJTR_1$	Mini Group	App Lock Release Time control relay - 1	Proves the operation of $COULR_1$ for setting time to clear CO Signal.
4.	$AJTPR_1$	Mini Group	Repeater of the above.	Proves the operation of $COULR_1$ for setting time to clear CO Signal.
5.	$AJTR_2$	Mini Group	App. Lock Release Time control relay - 2	Proves dropping of Time Setting relay AJTR after previous operation.
6.	$AJTPR_2$	Mini Group	Repeater of the above	Proves dropping of Time Setting relay AJTR after previous operation.
7.	AJTR	Mini Group	App. Lock Release Time Setting relay.	Sets a pre-determined time for CO Signal clearance as well as for App. Lock Release.
8.	$AJTR_3$	Mini Group	App. Lock Release Time control relay - 3	Proves the operation of AJTR for clearance of a particular signal.
9.	$AJTPR_3$	Mini Group	Repeater of the above	Proves the operation of AJTR for clearance of a particular signal.
10.	$COULR_2$	Mini Group	CO Signal Route Locking relay- 2	Clears C.O. Signal after necessary time lapse.

First, $COULR_1$ operates, when Calling ON Signal approach track is occupied and the concerned panel buttons are pressed proving the necessary conditions like Route setting and interlocking, as below:-

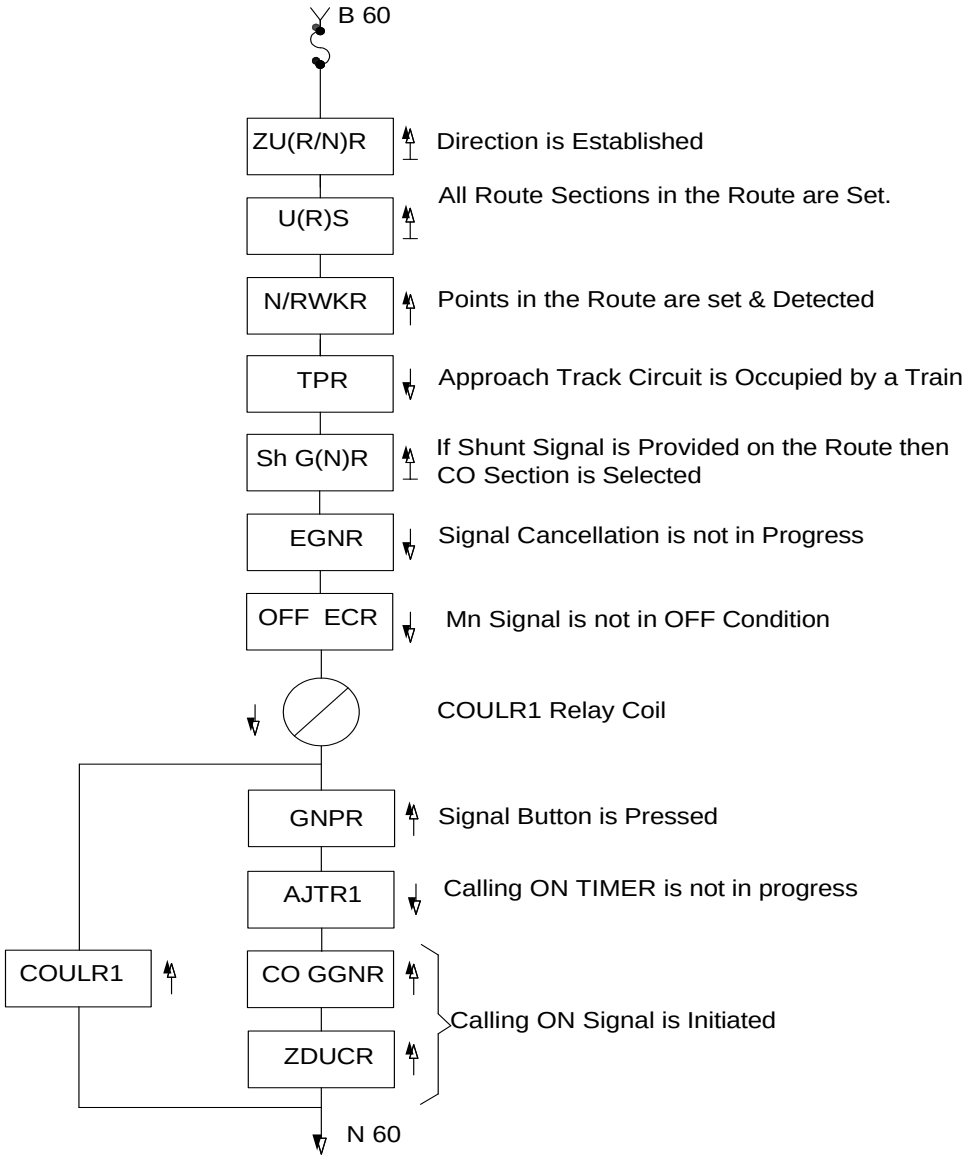


Fig : 4.32

Since there is Automatic Signalling section in approach of CO Signal and the next train may be following closely behind.

To set time for clearing a CO Signal as well as for releasing Approach Lock on Route in emergency, a set of Time Setting relay AJTR and its control (or helper) relays $AJTR_1$, $AJTR_2$ and $AJTR_3$ are provided as already stated.

The sequence of their operation in this case is –

First, $AJTR_1$ picks up proving that:

(i) MN Signal Button is still pressed condition.

(ii) MN Signal GR_1 and MN Signal GLSR are dropped.

(iii) Route sections concerned are set.

(iv) $COULR_1$ is operated.

(v) $AJTR_2$ and $AJTR_3$ dropped after previous operation.

This relay remains picked up even as $AJTR_2$ and $AJTR_3$ pick up afterwards until the time of $COULR_2$ picking up as shown below through a holding arrangement.

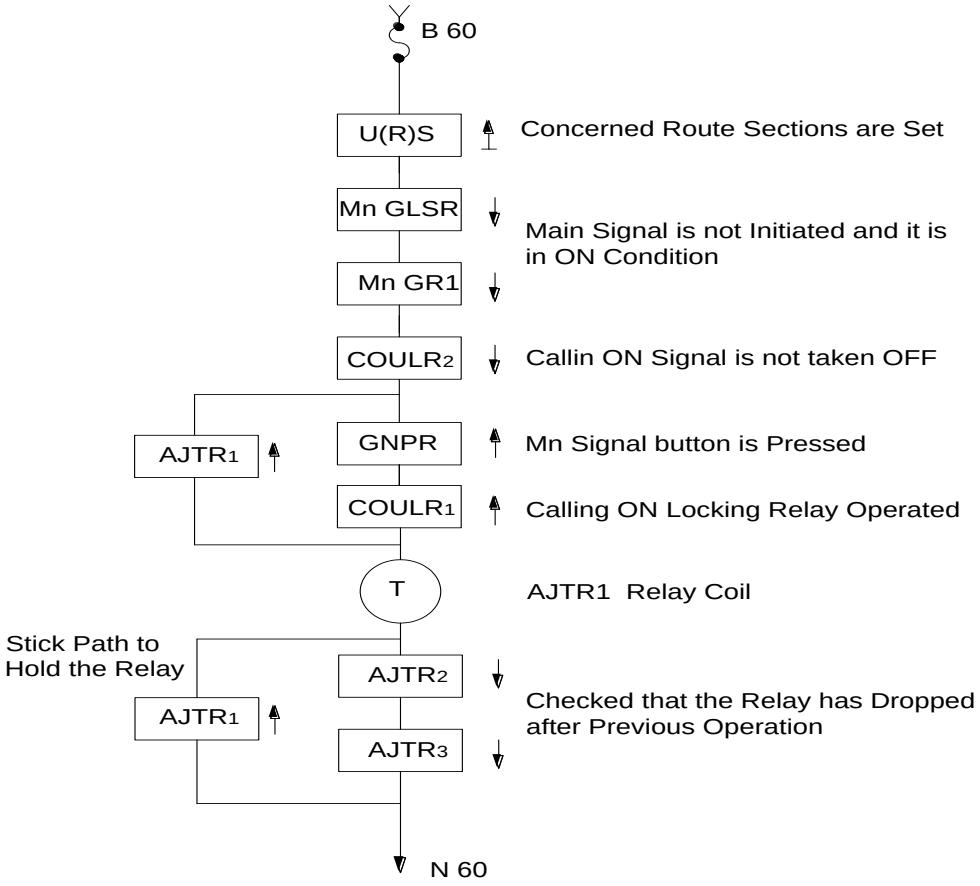


Fig. 4.33 ($AJTR_1$ Flow Chart)

In the second stage, $AJTR_2$ picks up to operate AJTR and sticks until after the operation of $AJTR_3$ as below:

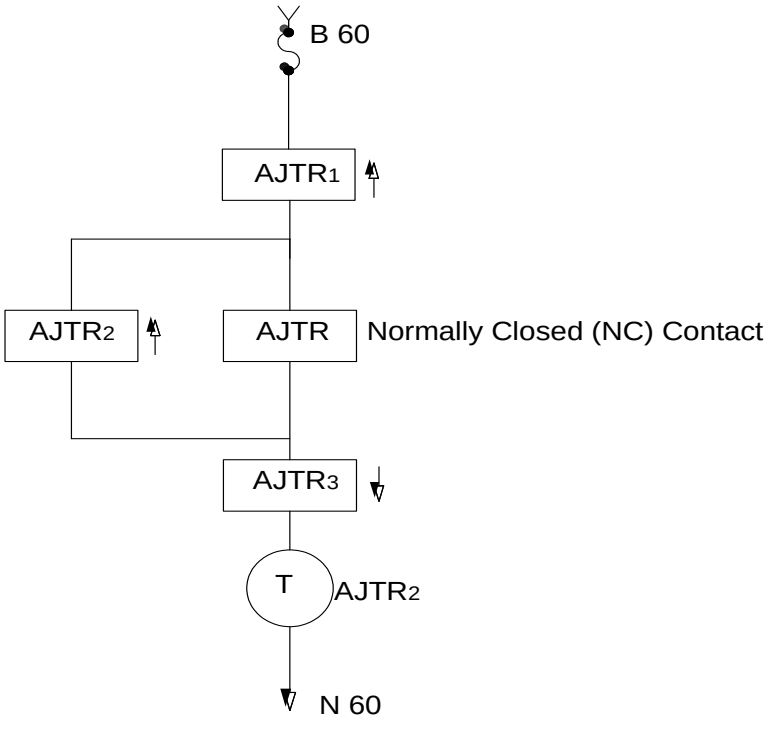


Fig.4.34(a) $AJTR_2$

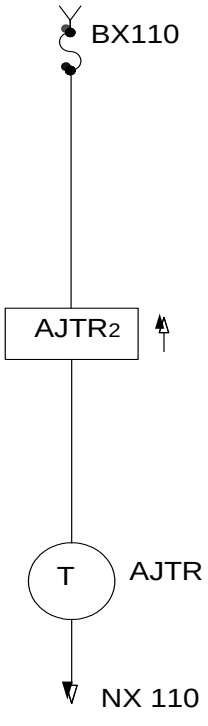


Fig.4.34(b) (AJTR)

Finally AJTR$_3$ picks up through the operated contact of AJTR and sticks until the dropping of AJTR$_1$ as below:

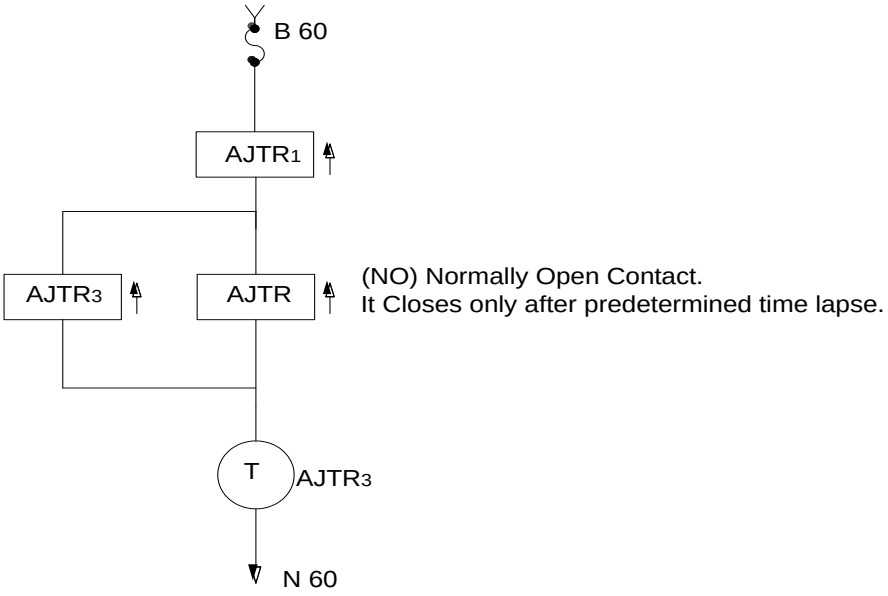


Fig.4.35 (AJTR3)

Even as AJTR$_2$ drops with the picking up of AJTR$_3$, AJTR$_1$ and AJTR$_3$ remain picked up until the time of COULR$_2$ operation.

Now, COULR$_2$ picks up getting feed through a counter as below:

The counter COGGZ registers the number of CO Signal operations progressively.

With COULR$_2$ picking up AJTR$_1$, AJTR, AJTR$_2$ and AJTR$_3$ drops.

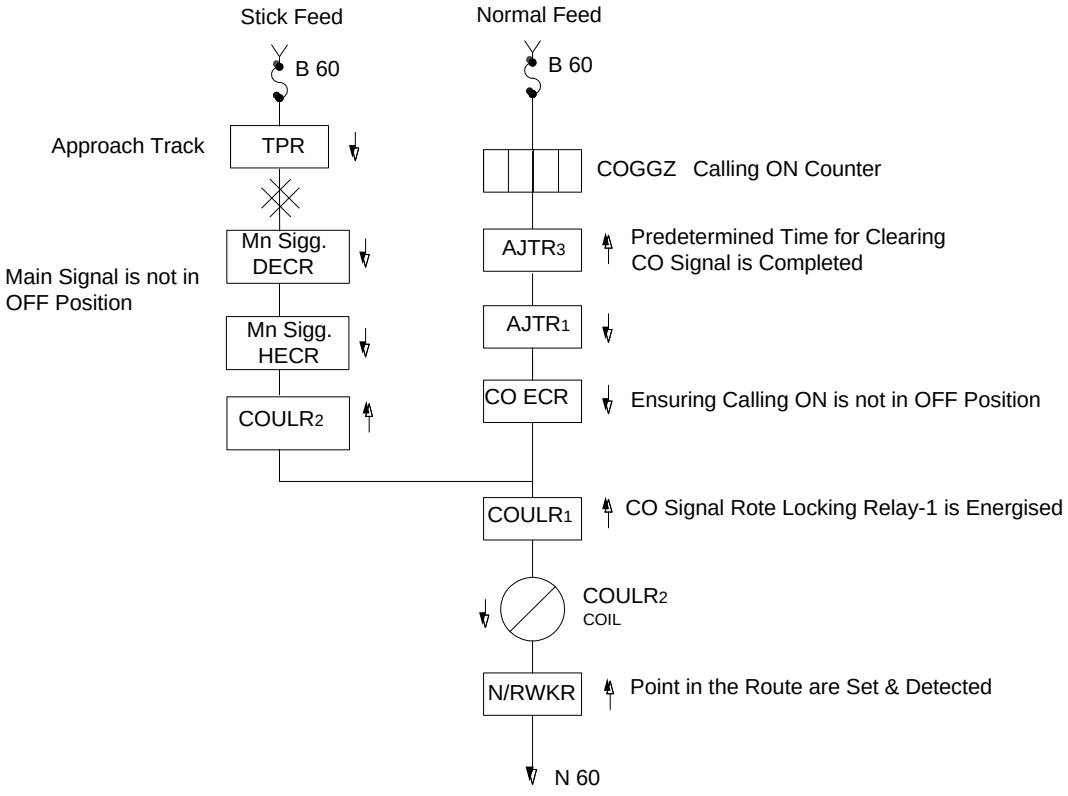


Fig.4.36 (Flow Chart of COULR2)

Now CO Signal comes OFF and COECR picks up as below:

$COULR_1$ and $COULR_2$ drop when COAT is cleared by the train to enter the route and COATR picks up

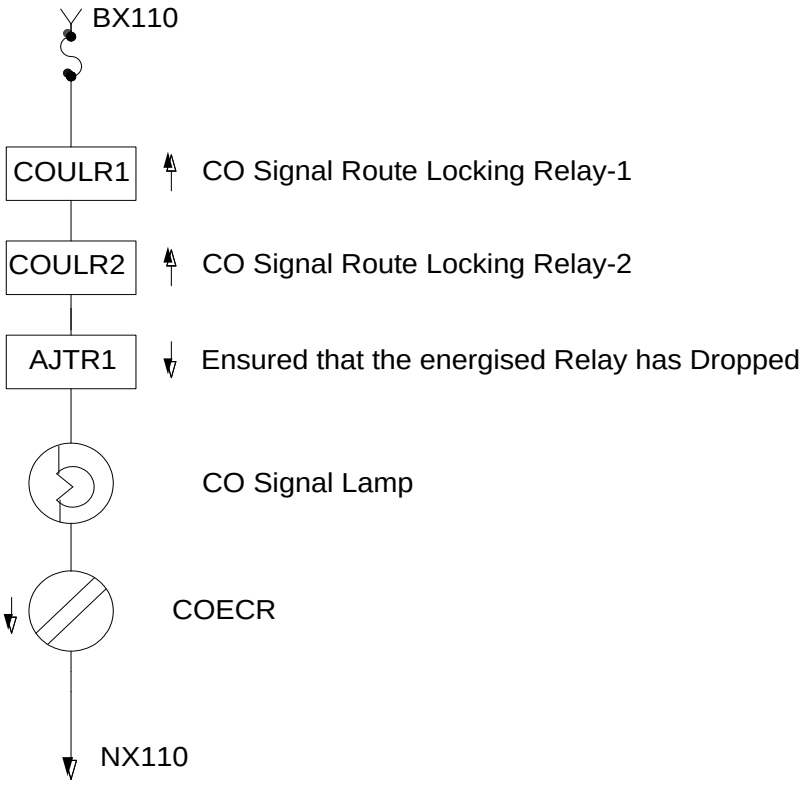


Fig.4.37: COECR Flow Chart

Relay and Lamp control circuits: Refer Fig.4.38 (A) & 4.38 (B)

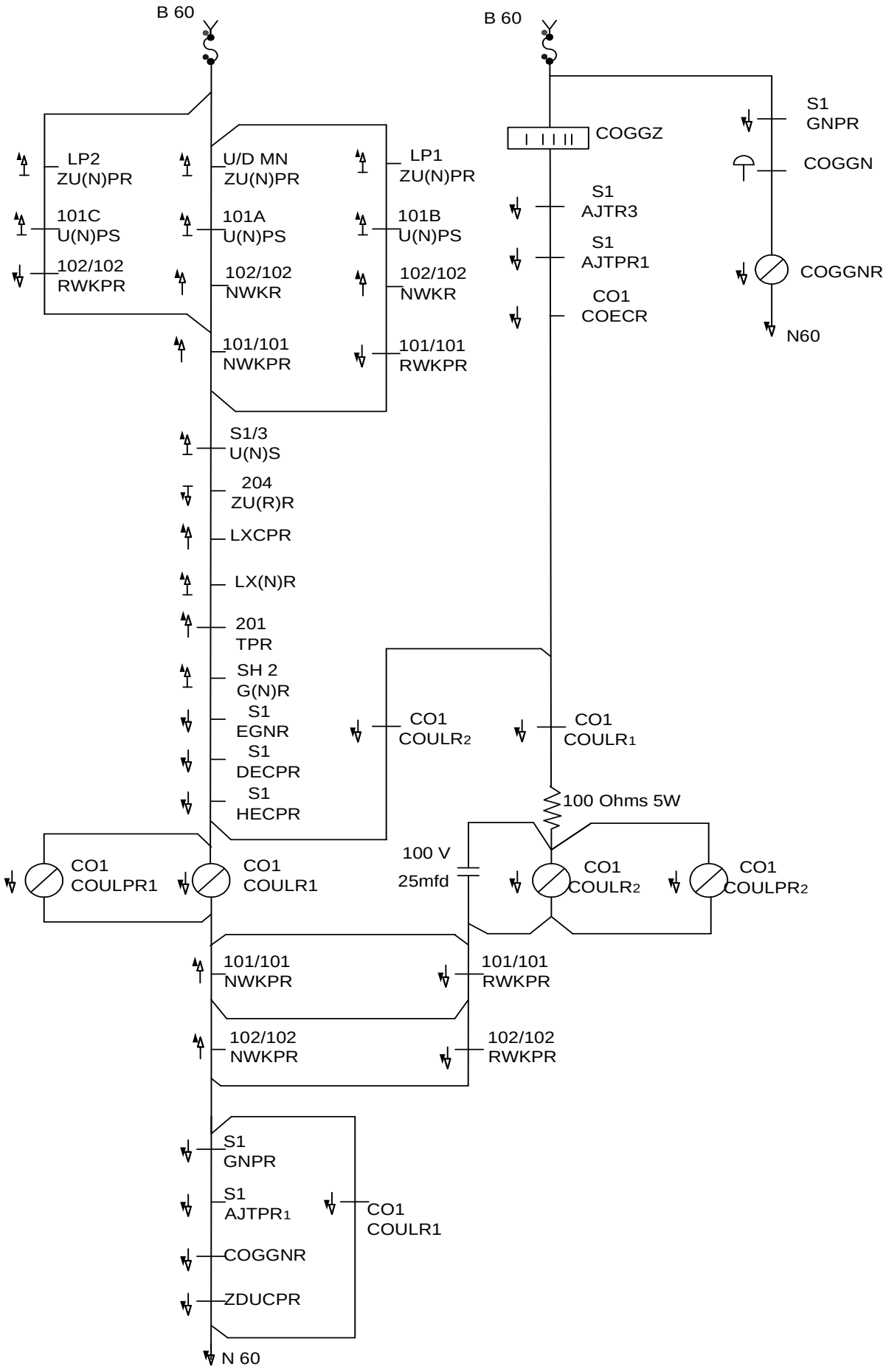


Fig.4.38 (A) CALLING ON SIGNAL RELAY control circuits

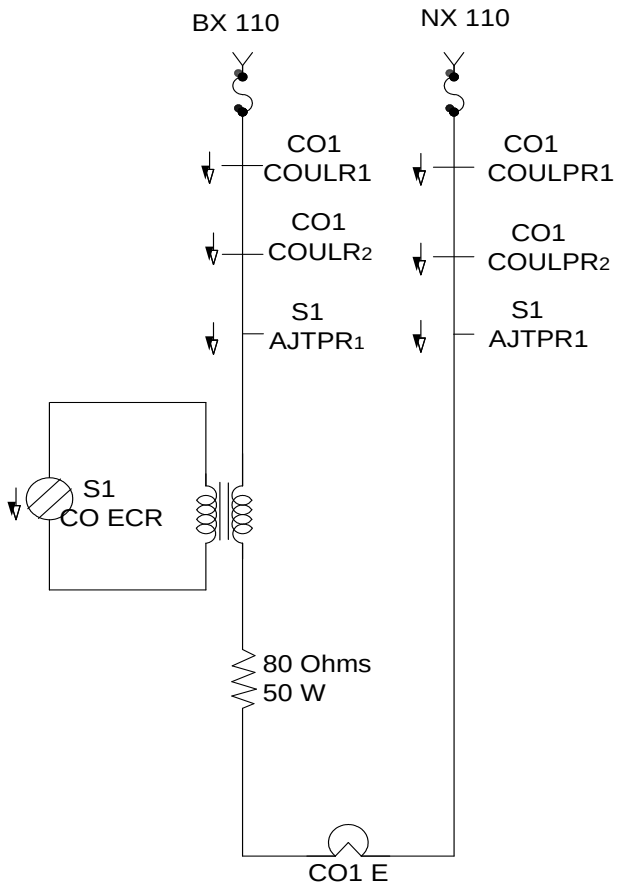


Fig.4.38 (B) CALLING ON SIGNAL LAMP CONTROL CIRCUITS

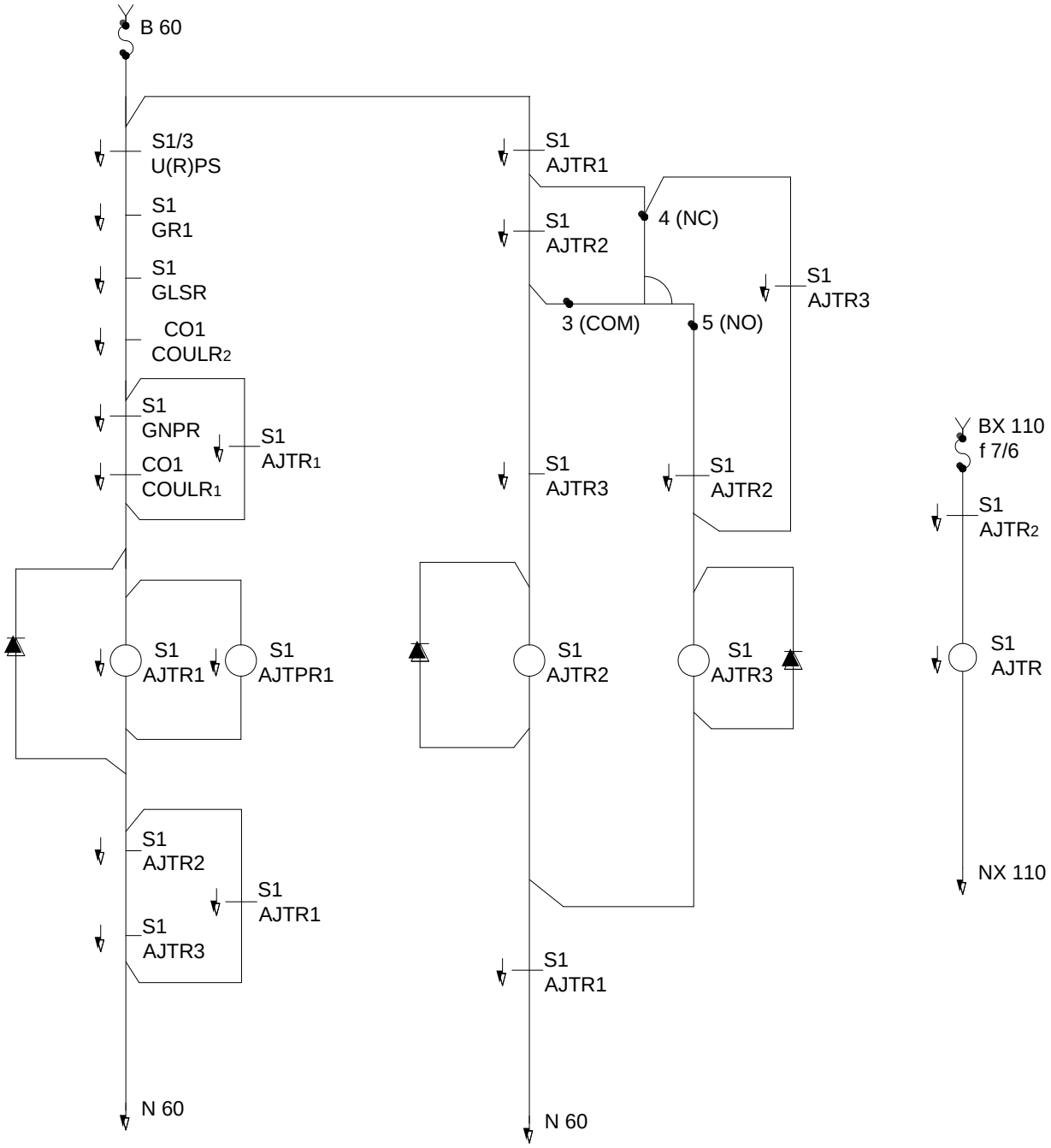


Fig. 4.39 : CALLING ON SIGNAL APPROACH TIME RELAY CIRCUITS

CHAPTER 5
AUTOMATIC ROUTE RELEASE

5.1 The relays involved in the process are:-

Sl. No	Relay Nomenclature	Location	Description	Purpose
1.	UYR_I (common for a Sub Route)	Route group	Sub Route Release Relay - 1	Operate sequentially as the train moves ahead in the R/S to release it from approach locking
2.	UYR_2 (common for a Sub Route)	Route group	Sub Route Release Relay - 2	
3.	UDKR (common for a Sub Route)	Route group	Route Clear Indicating relay	Operates to release back locking on R/S when the train completely passes out of it.
4.	ZR	Mini Group	Track Circuit Power Supply Checking relay.	Proved energised during app. lock release to ensure that TPRs drop only with train movement.
5.	U(R)LR U(N)LR (interlocked)	Route group	S/R Locking relay S/R Releasing relay (common for a S/R)	Normalised to release locking on a set Route Section.
6.	R/S U(R)S U(N)S	Route group	R/S Setting relay R/S Normalising relay	Normalised to make Points and Slots in the Route Section free.
7.	Road - G(R)LR G(N)LR	Mini Group	Signal Locking relay Signal Unlocking relay	Normalised to release locking on Signals conflicting, with the cleared Main Signal.
8.	OV- $AJTR_2$	Mini Group	Overlap Release Time Control relay no.2	Proves necessary conditions for Overlap release before setting time.
9.	OV AJTR	Mini Group	Overlap Release Time Setting relay	Provides for time lapse before an Overlap is released.
10.	$OV\text{-}AJTR_3$	Mini Group	Overlap Release Time control relay No.3	Proves time lapse for releasing overlap.
11.	OV $Z_2U(R)R$ $Z_2U(N)R$	Mini Group	Overlap Setting relay Overlap Release relay	Releases Overlap either after 2 min. on train stopping at the Signal in advance or soon after the train run through.

As a train passes over each set Route section, the Route section gets released automatically behind the train and its setting gets normalized. This results in locking getting released on Signals conflicting with the Signal cleared for the train.

5.2 RELEASE OF INDICATION LOCKING:-

With the occupation of first control track, GR_1 and GR_2 drop to release indication locking as below:-

5.2.1 On Route section set for a Main Signal

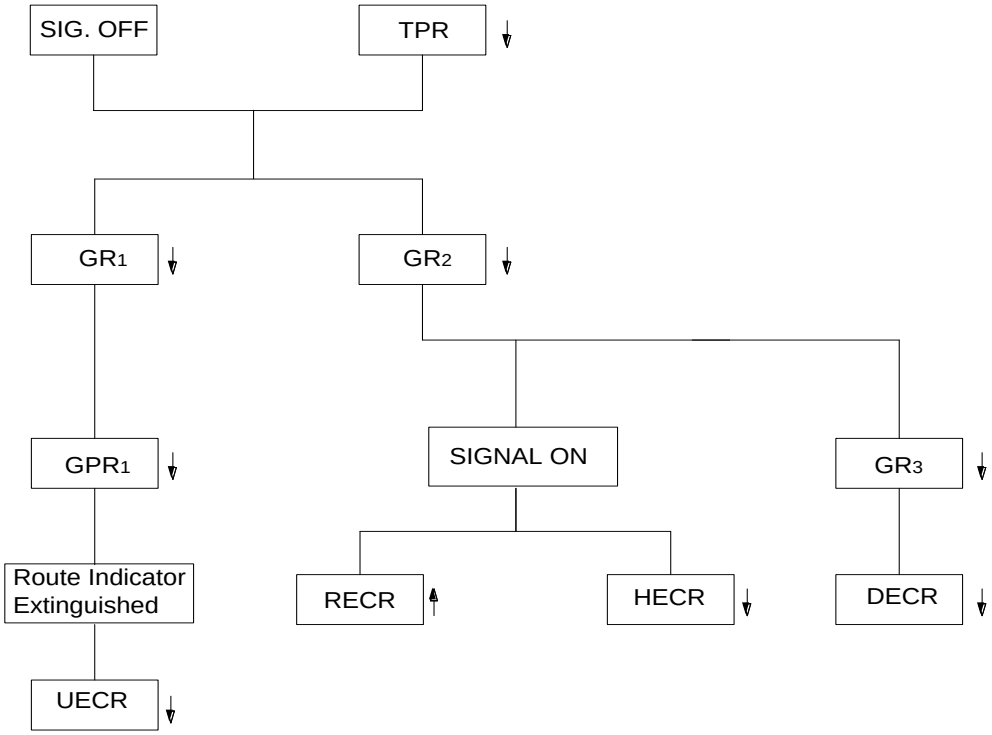


Fig.5.1

5.2.2 On Route Section set for a Shunt Signal.

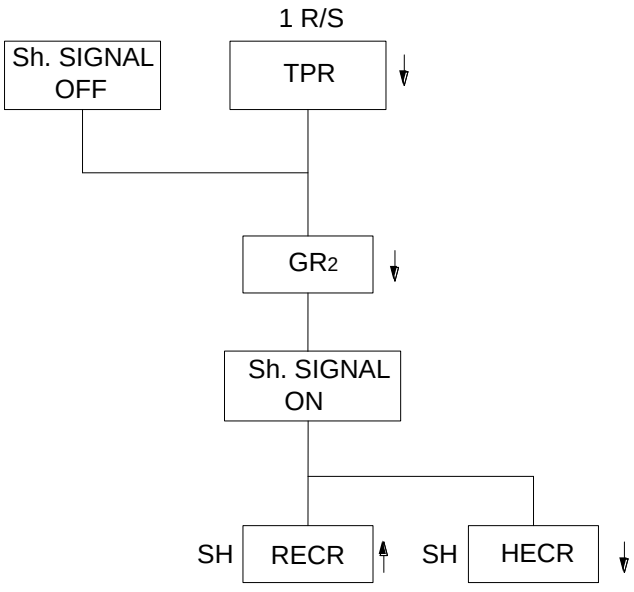


Fig.5.2

5.2.3 On Route section set for a Calling 'ON' signal

As train enters the Route, clearing CO Sig. Approach track,

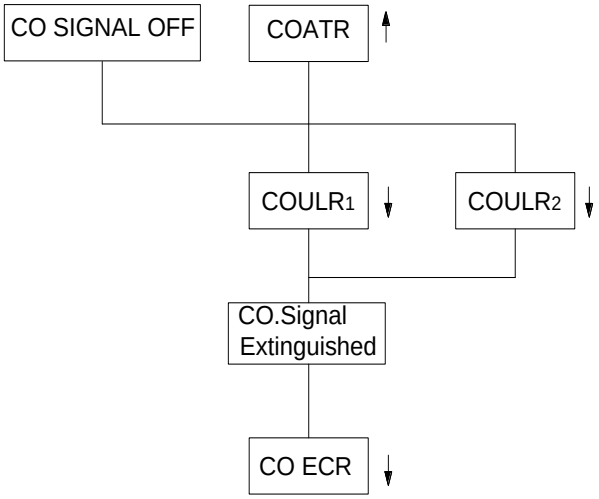


Fig.5.3

5.3 Route Release Circuit

5.3.1 As train moves in the route section, UYR_1 operates first proving that the train occupied the first two R/S track circuits as below:-

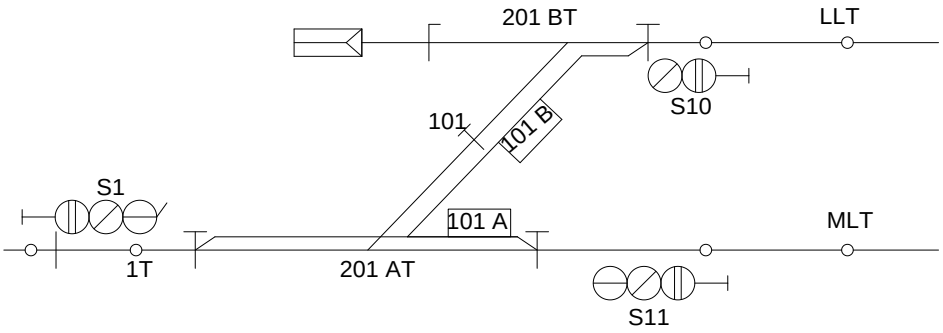


Fig.5.4

UYR_1 also proves ZR energised to ensure that TPRs dropping caused by track circuit power supply failure does not release the locking.

Also, at this stage UDKR is proved de-energised after previous operation during Route checking, so that it can pick up again when the train passes out of Route section later.

UYR_1 sticks first through its own operated condition and then through UDKR de-energized condition until the operation of UYR_2.

Later, it sticks through the operated condition of UYR_1 and UYR_2 until the Route section is normalised, even as UDKR picks up.

i) UYR_2 picks up after UYR_1 as the train progresses and clears the first control track of the route section as below:

   Berthing track is proved occupied for operating UYR_2 of the last section of Route.

ii) UYR_2 also sticks in two stages just as UYR_1 sticks after operation until the Route section is normalized as below:-

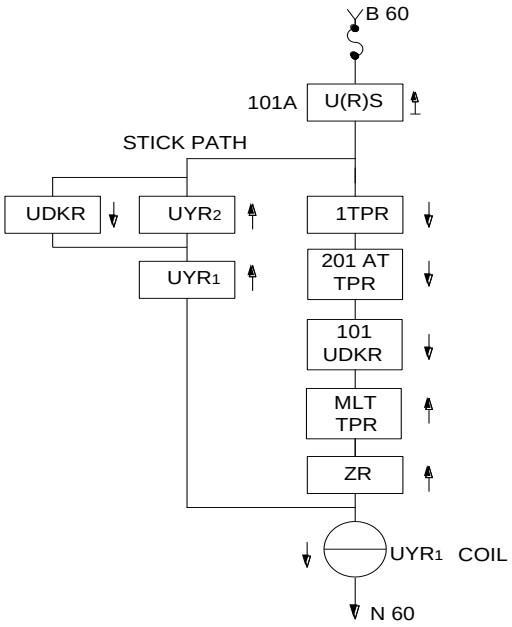


Fig:5.5

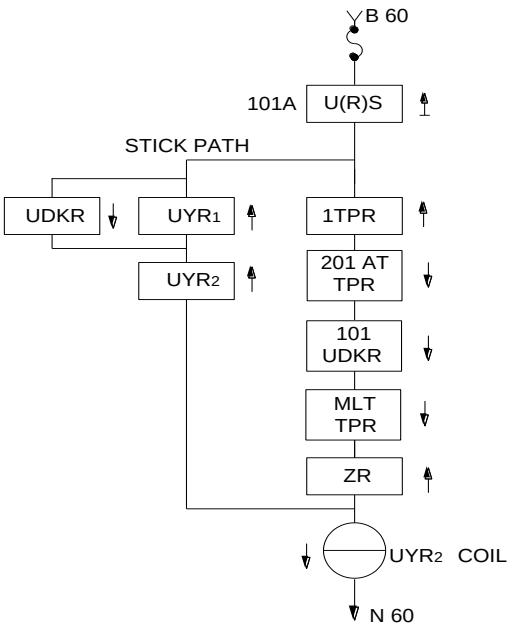


Fig:5.6

5.4 Back locking release

As the train clears all the concerned Route section track circuits

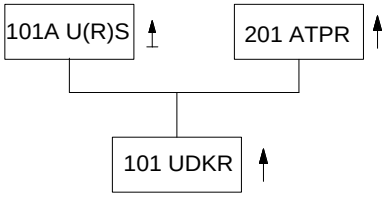


Fig. 5.7

5.5 ROUTE SECTION RELEASE AND NORMALISATION:-

Proving all the three above lockings free on each R/Section, its U(N)LR and U(N)S operates as below:-

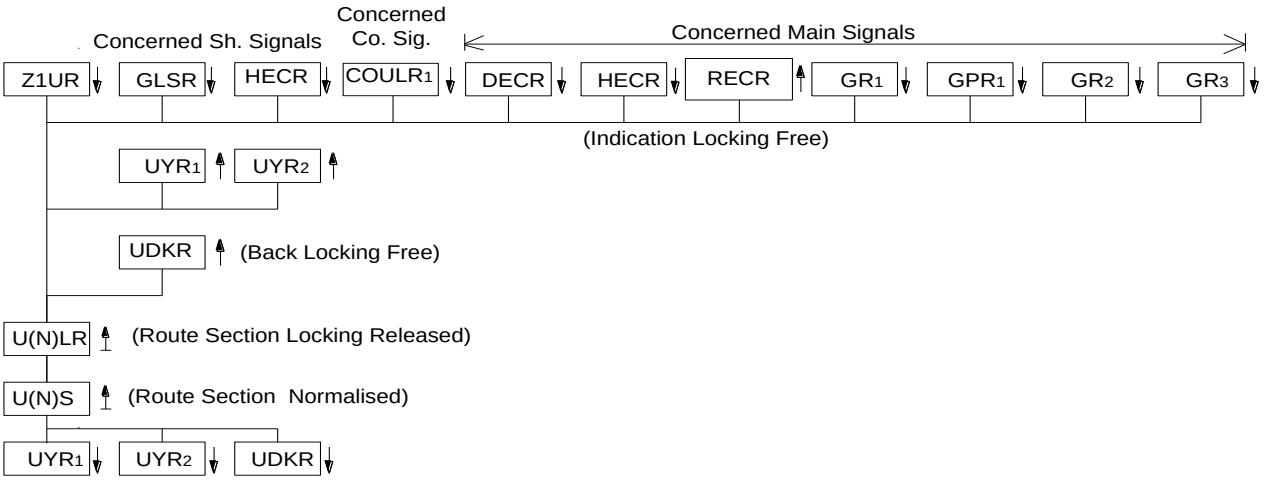


Fig. 5.8

ROUTE SECTION RELEASE WITH POINT

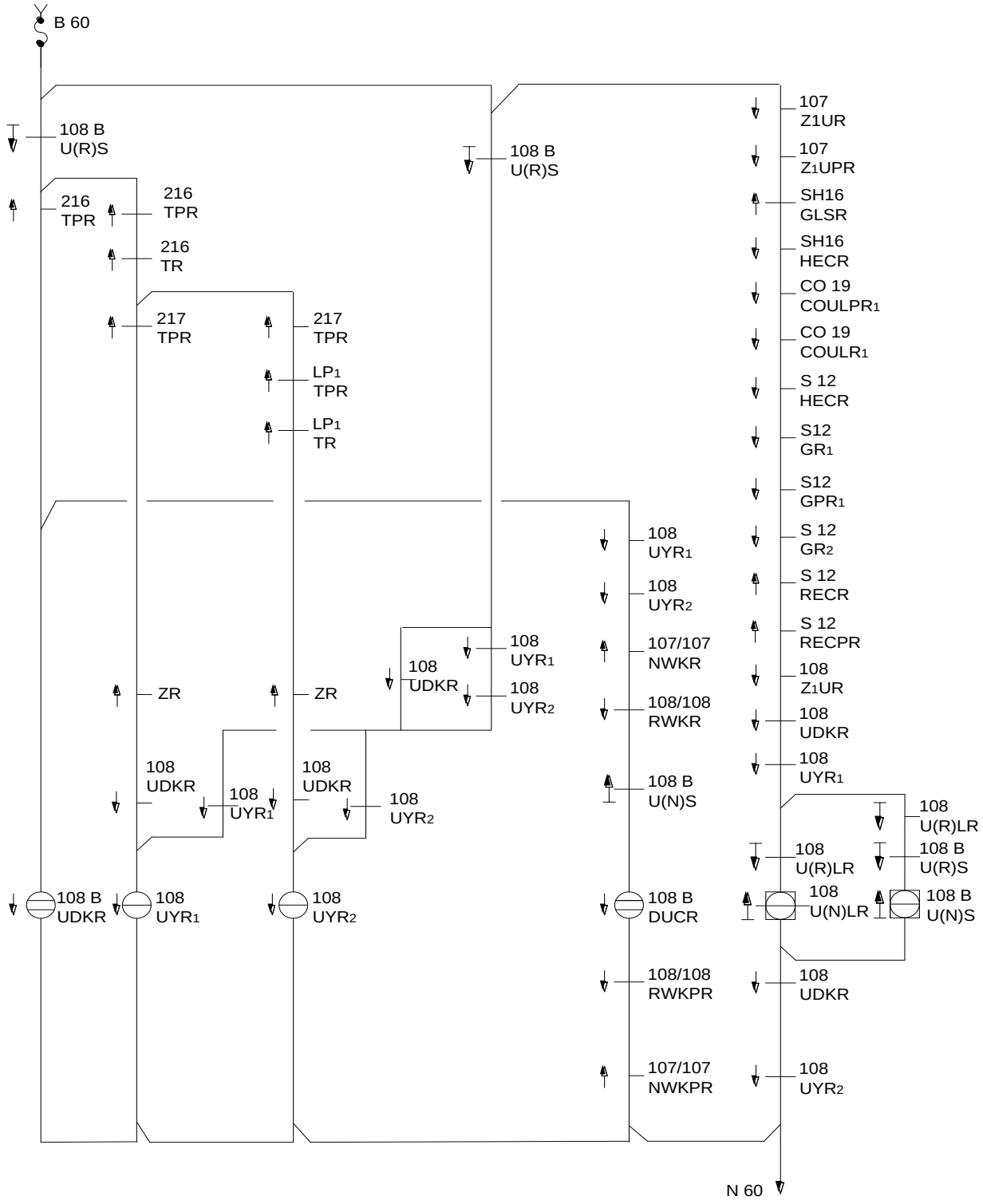


Fig. 5.9 : ROUTE SECTION RELEASE AND NORMALISATION CONTROL CIRCUITS

IN CASE OF ROUTE SECTION WITHOUT POINTS U(N)S DIRRECTLY OPERATES AS :

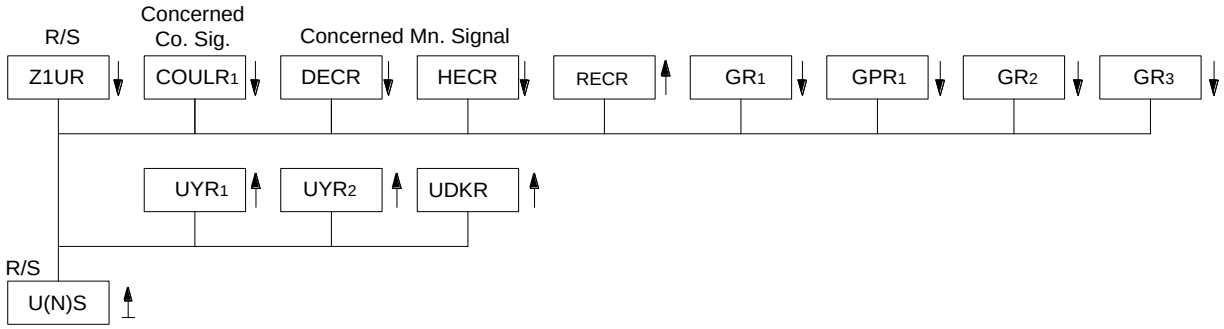


FIG. 5.10: ROUTE SECTION WITHOUT POINTS NORMALISATION FLOW CHART

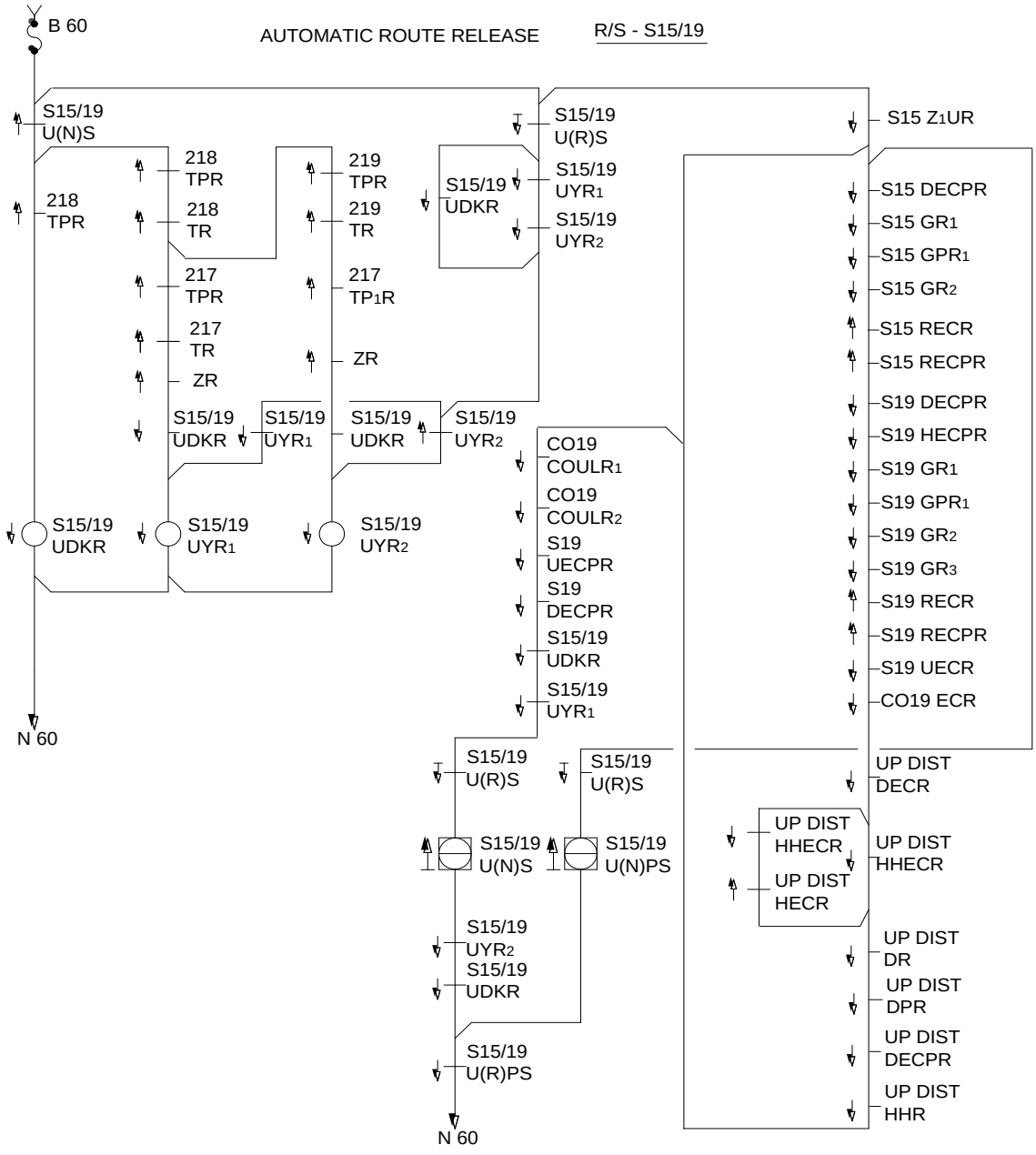


FIG. 5.11: ROUTE SECTION WITHOUT POINTS NORMALISATION RELAY CONTROL CIRCUITS

5.6 OVERLAP RELEASE FOR MAIN SIGNAL ROUTES

In Siemens practice, the Overlaps are numbered after the Signal in advance of the Route.

5.6.1 For stopping trains, the Overlap gets released after a time lapse of 2 minutes on the train occupying berthing track provided the last Route section is released.

To set time for Overlap release, OV-AJTR and its controlling relays OV-$AJTR_2$ and OV-$AJTR_3$ operates. $AJTR_1$ is not provided to prove the necessary conditions as in the case of Approach Lock Release on routes. A common set of these relays is used for releasing Overlaps on either side of the road.

First $AJTR_2$ picks up to operate AJTR as below:-

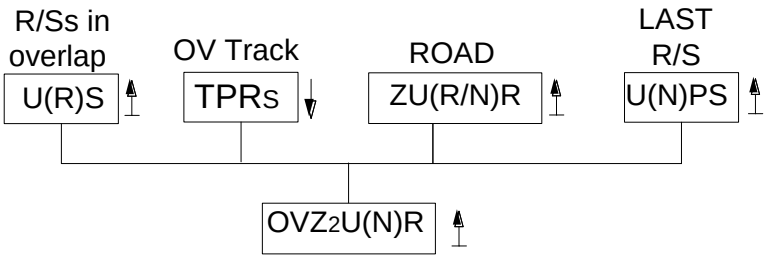


Fig.5.12: OVERLAP RELEASE FLOW CHART

OV-$AJTR_3$ operates after OV-AJTR and then feed to $AJTR_2$ & AJTR gets cut off.

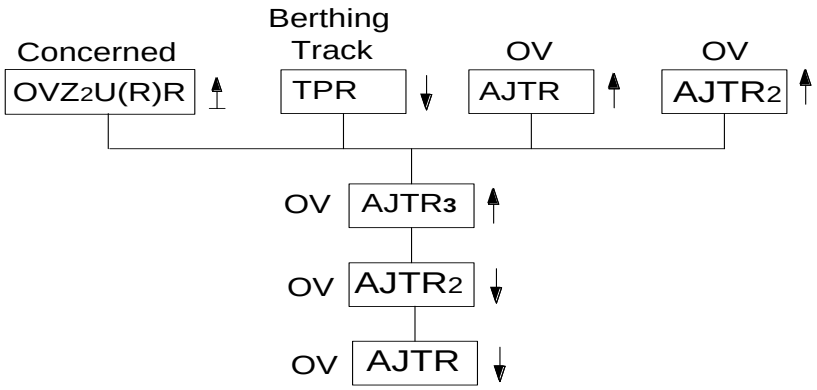


Fig.5.13: OVERLAP TIMER FLOW CHART

OV-$AJTR_3$ is held in its energised position through its own pick up contact, even as $AJTR_2$ drops and AJTR operated contact breaks, until the time OV-Z_2U(N)R operates.

Now OV-Z_2U(N)R operates to normalise the Overlap setting. In the OV-Z_2U(N)R circuit, MN-GZR and SH-GZR back contacts are proved to ensure their dropping after previous operation.

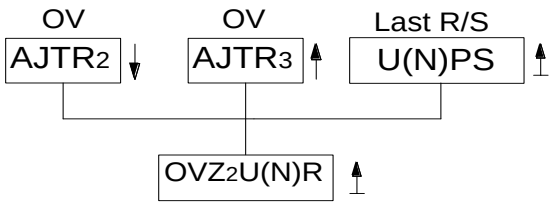


Fig.5.14: OVERLAP NORMALISATION WITH TIMER FLOW CHART

5.6.2 In case of a train running through on a set Route ahead, the Overlap gets released without time delay, as soon as the last Route section of signal route is released, Route section of signal in advance falling in the overlap is set and its track is occupied with the passage of train over it:-

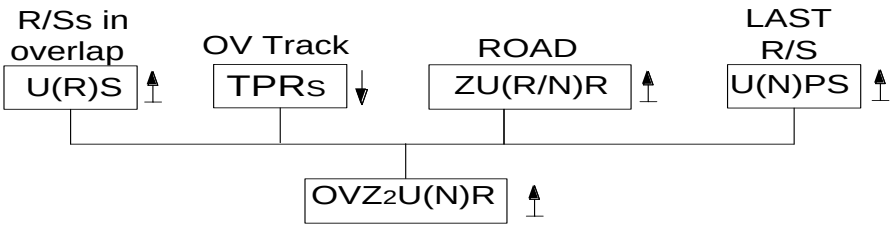


Fig.5.15: OVERLAP NORMALISATION IN CASE OF RUNTHROUGH FLOW CHART

5.6.3 Emergency overlap release with the help of OYN button.

In the regular process, a Main Signal Overlap gets released only after two minutes on train occupying berthing track, if the train is not running through.

But in case of failure of this process, an Emergency Overlap Release facility can be utilised to release Overlap instantly. For this OYN or EUYN, if OYN is not provided shall be pressed along with the concerned UN on the panel.

Then OV-Z2U(N)R operates to release the Overlap instantly, if the last Route section concerned is normalised before.

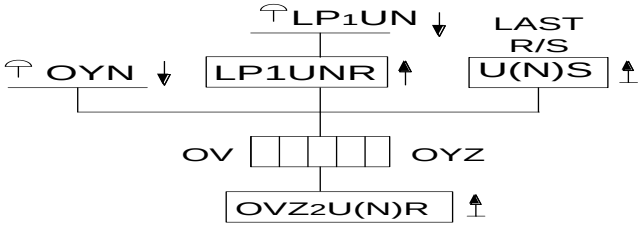


Fig.5.16: OVERLAP CANCELLATION FLOW CHART

5.6.4 Overlap will get released automatically when the operator initiates emergency full route cancellation. This cancellation will be register in EUUYZ counter only.

Sequence of relay operation:

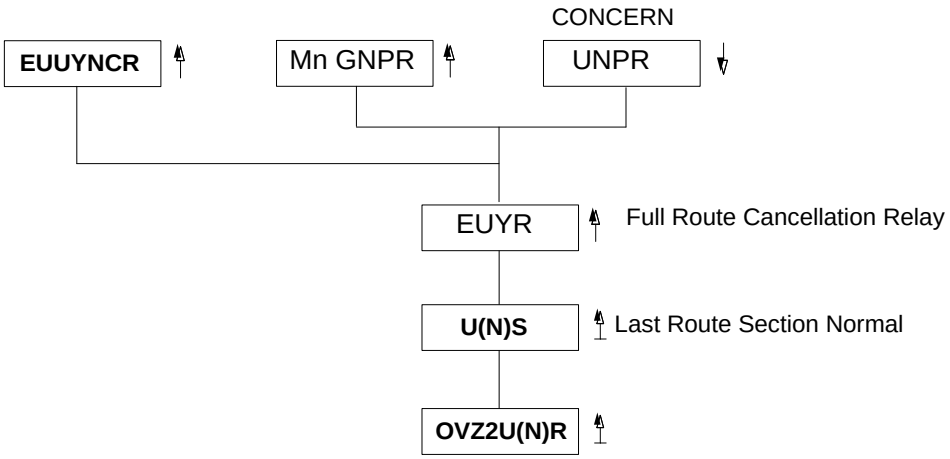


Fig.5.17: OVERLAP NORMALISATION WITH FULL ROUTE CANCELLATION FLOW CHART

Relay Control Circuit : Refer Fig. 5.18.

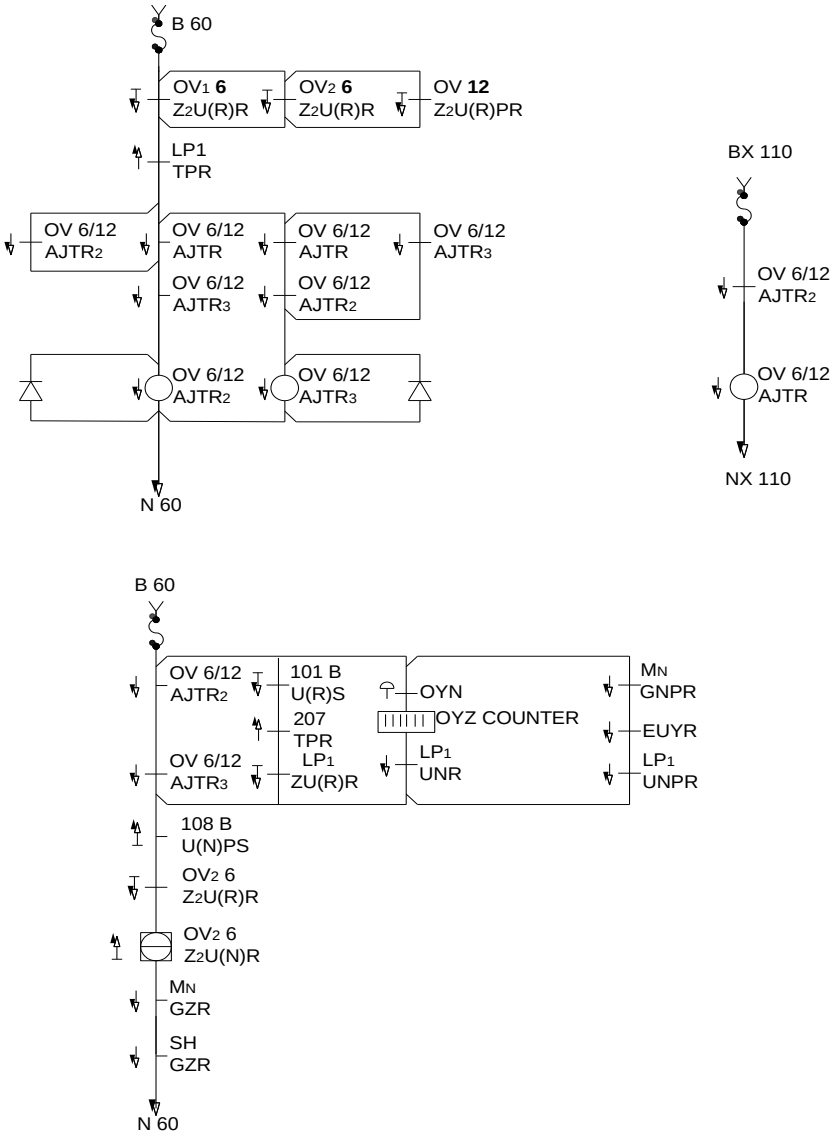


Fig.5.18: OVERLAP NORMALISATION CONTROL CIRCUIT

SIGNAL LOCKING RELEASE:

When route is set for a Main Signal, a Signal Locking relay operates to lock all conflicting Signals. This relay gets normalised when the set Route and Overlap are normalised as below:-

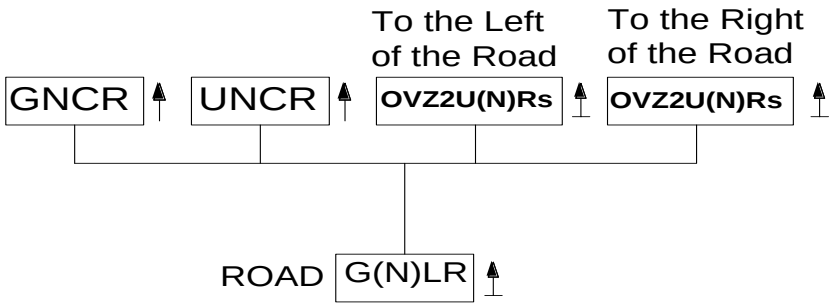


Fig.5.19 : G(N)LR NORMALISATION FLOW CHART

Relay control circuits: (Refer Fig.5.20)

In G(N)LR circuit, OV-Z_2U(N)R normal contacts proves normalisation of the route set on either side of the road after the signalled train has passed.

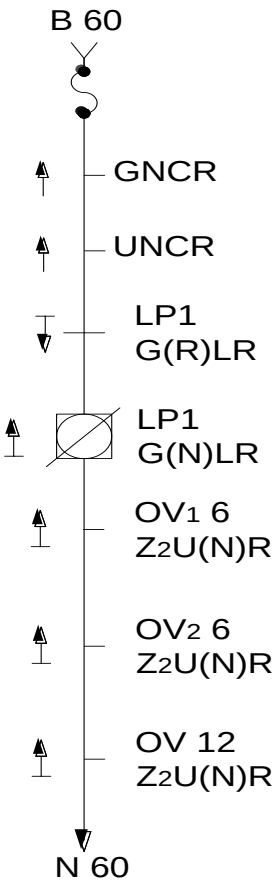


Fig.5.20 : G(N)LR CONTROL CIRCUIT

* * *

CHAPTER 6
EMERGENCY OPERATIONS
MANUAL ROUTE RELEASE DUE TO TRAFFIC EMERGENCY

6.1 The relays involved are:-

Sl. No.	Relay Nomenclature	Location	Description	Purpose
1.	GNR	Signal group	Signal Button Relay	Proves Signal Button operation.
2.	EGGNR	Mini group	Emergency Signal Replacement Button relay	Proves Button operation in circuits.
3.	EGNR	Signal group	Emergency Signal Replacement control relay	Cuts off GR_1 circuit to replace Signal at 'ON'
4.	STN-EUUYNR	Mini group	Emergency Route Release Button Relay (common for the station yard.)	Proves Button operation in circuits.
5..	STN-EUYNR	Mini group	Emergency Route Section Release Button relay (Common for the station yard)	Proved dropped in EUUYNR circuit to allow only one operation at a time.
6.	EUUYNCR	Mini group	Relay proving Route Initiation during Emergency Route Release.	Identifies the route sections to be released during emergency.
7.	MN-GNPR	Mini group	Common relay to prove the operation of any MN-GNR.	Provided to save individual GNR contacts while proving their operation in circuits.
8.	SH-GNPR	Mini group	Common relay to prove the operation of any SH-GNR	Provided to save individual GNR contacts while proving their operation in circuits.
9..	STN-EUUYR	Mini group	Emergency Route Release Relay (common for station yard)	Releases all route sections of the Route with manual operation in emergency.
10.	STN-EUYR	Mini group	Emergency Route Release relay (common for a station yard).	Releases concerned R/Sections both during full Route release and Individual R/S release operations.

If there are no Track Circuits in approach of a Signal, Dead Approach locking will be effective on it during Emergency release of the Route. If there are Approach Track Circuits for the Signal and they are occupied before Emergency Route Release operation, the Route gets released only after two minutes, after the first Emergency Route Release operation, the operation is repeated. If the approach tracks are not occupied, immediate release of Route is possible. Operation of GN, EUUYN and UN after Signal is replaced to 'On', releases the Route in this case.

Back locking is not effective so long as the train has not entered the Route.

Before Manual Route Release operation, to release Indication locking on the route, first GN and EGGN are pressed together and released.

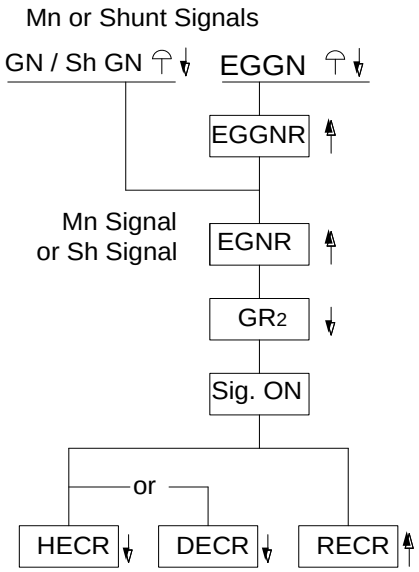


FIG. 6.1

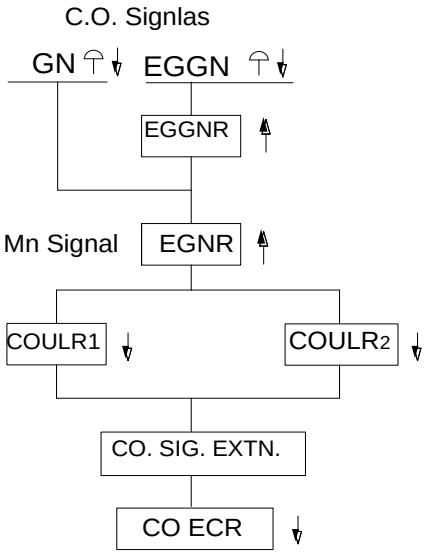


FIG.6.2

Now to release the Route, GN and EUUYN are pressed. Then releasing EUUYN and keeping GN pressed, UN is pressed.

With this, first, EUUYNR operates and sticks. Then as GN and UN are pressed, Route sections get initiated to operate EUUYNCR as below:-.

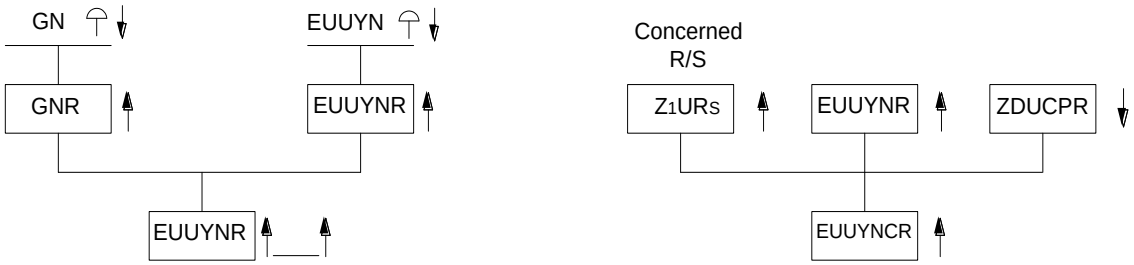


Fig.6.3:

6.1.1 For releasing Main & CO Signal routes provided with Dead Approach locking:

Time Setting and its control relays $AJTR_1$, $AJTR_2$, AJTR and $AJTR_3$ operate in succession as shown below. Proving the operation of GNPR and EUUYNCR and other conditions, $AJTR_1$ picks up and sticks, even as $AJTR_2$ and $AJTR_3$ pick up and buttons are released later.

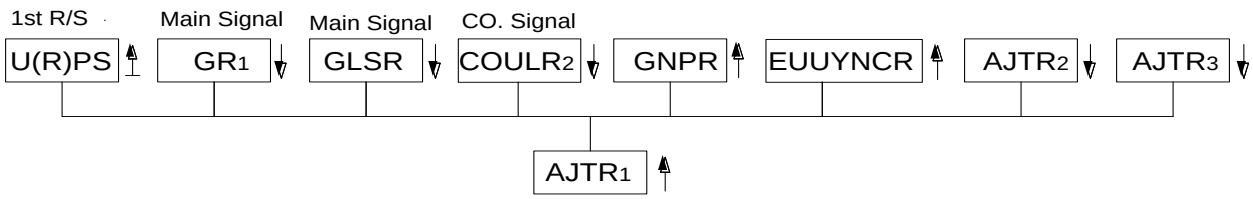


Fig . 6.4: FULL ROUTE CANCELLATION FLOW CHART

With $AJTR_1$ picking up, a *flashing white spot indication* appears near Signal demarcation on the panel. Now, $AJTR_2$ picks up proving the de-energised condition of AJTR and $AJTR_3$ to stick until the pickup of $AJTR_3$, even as AJTR operates after $AJTR_2$.

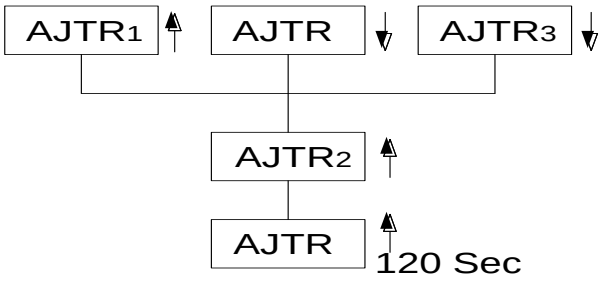


Fig.6.5: AJTR FLOW CHART

Now, finally $AJTR_3$ picks up and sticks until the dropping of $AJTR_1$.

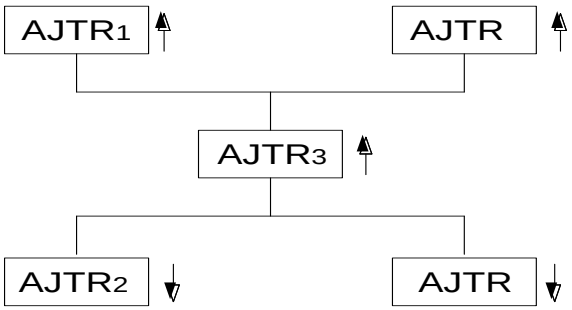


Fig.6.6: AJTR3 FLOW CHART

With $AJTR_3$ operating, the *white* indication near Signal demarcation on the panel becomes *steady*. Now as the necessary time lapsed, STN-EUUYR operates when the 3 button operation is repeated as below.

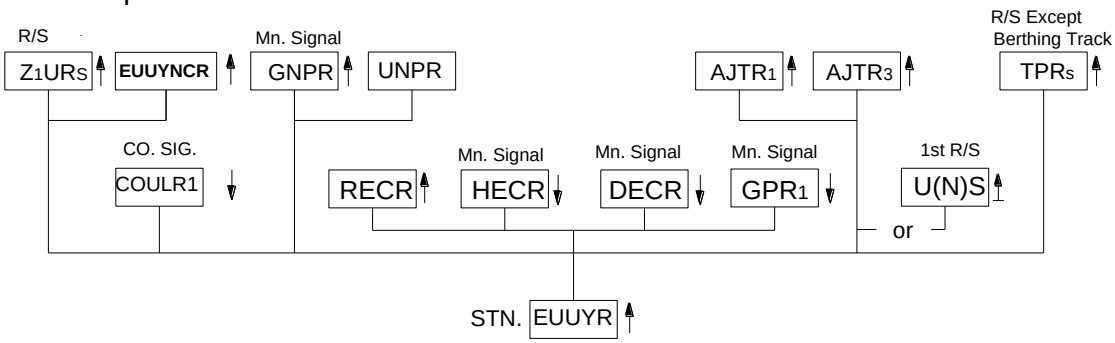


Fig.6.7: EUUYR FLOW CHART

Following the operation of STN-EUUYR, STN-EUYR is energised (which operates both during Manual Route Release as well as Individual Route Section release in emergency. This relay operates through EUUYZ counter, which registers the operation as evidence.

Now all sections of the set Route get released and normalised as below:-

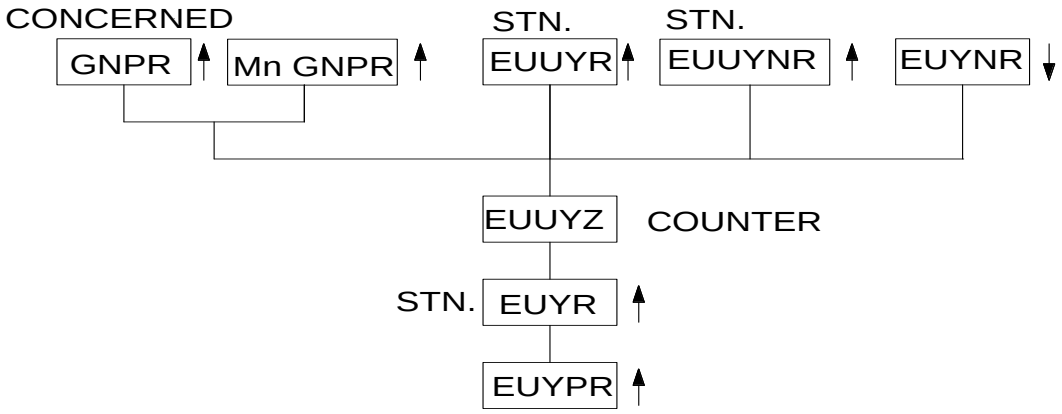


Fig.6.8: EUYR FLOW CHART

With the last Route section is normalized. MN Sig. Overlap is released with full route cancellation

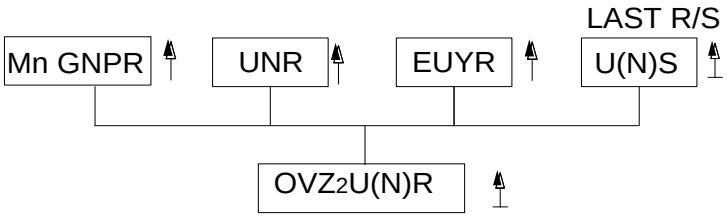


Fig.6.9: OVERLAP RELEASE WITH FULLROUTE RELEASE FLOW CHART

Signal Locking gets released, as below

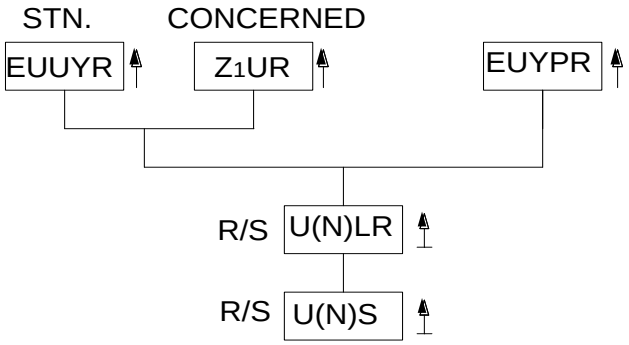


Fig.6.10: ROUTE SECTION NORMALISATION FLOW CHART

Relay control Circuits Refer to Fig. 6.14

6.1.2 FOR RELEASING SHUNT SIGNAL ROUTES PROVIDED WITH APPROACH TRACK CIRCUITS

If approach track is occupied, time release of Approach Locking takes place as in the case of Main Signals.

If approach track is not occupied, Route gets released with the first three button operation itself provided Indication Locking is free as below:-

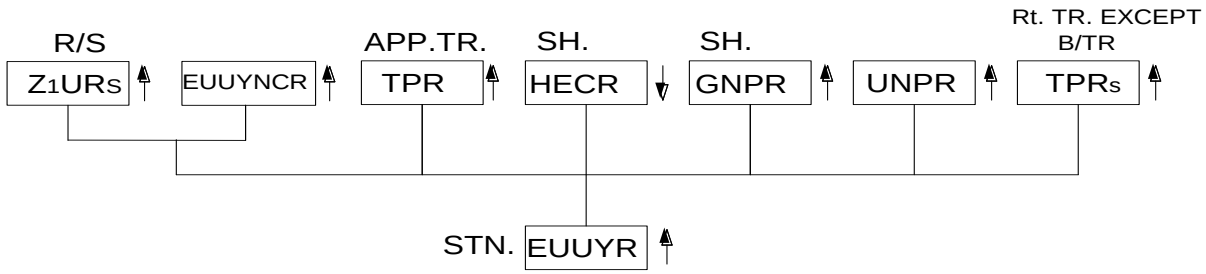


Fig.6.11: FULL ROUTE CANCELLATION RELAY FLOW CHART

Relay control Circuits Refer to Fig. 6.12 & 6.13

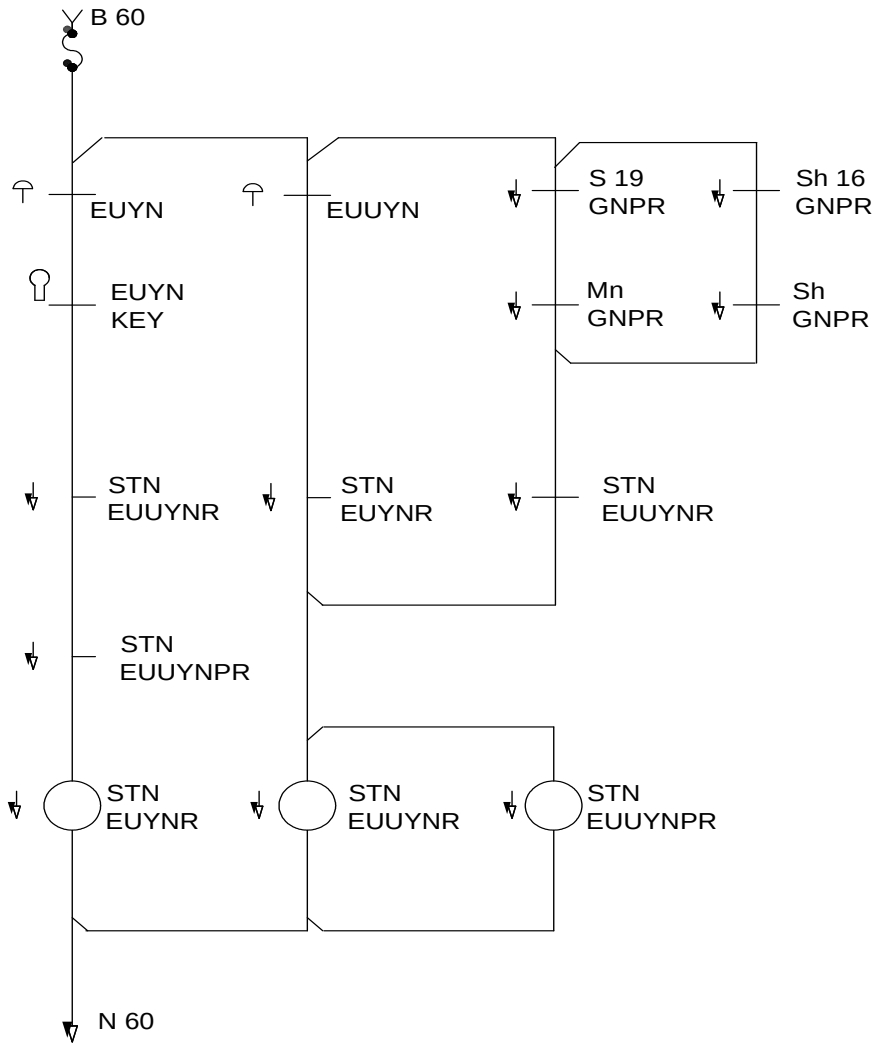


Fig.6.12: FULL ROUTE CANCELLATION BUTTON RELAY CIRCUIT

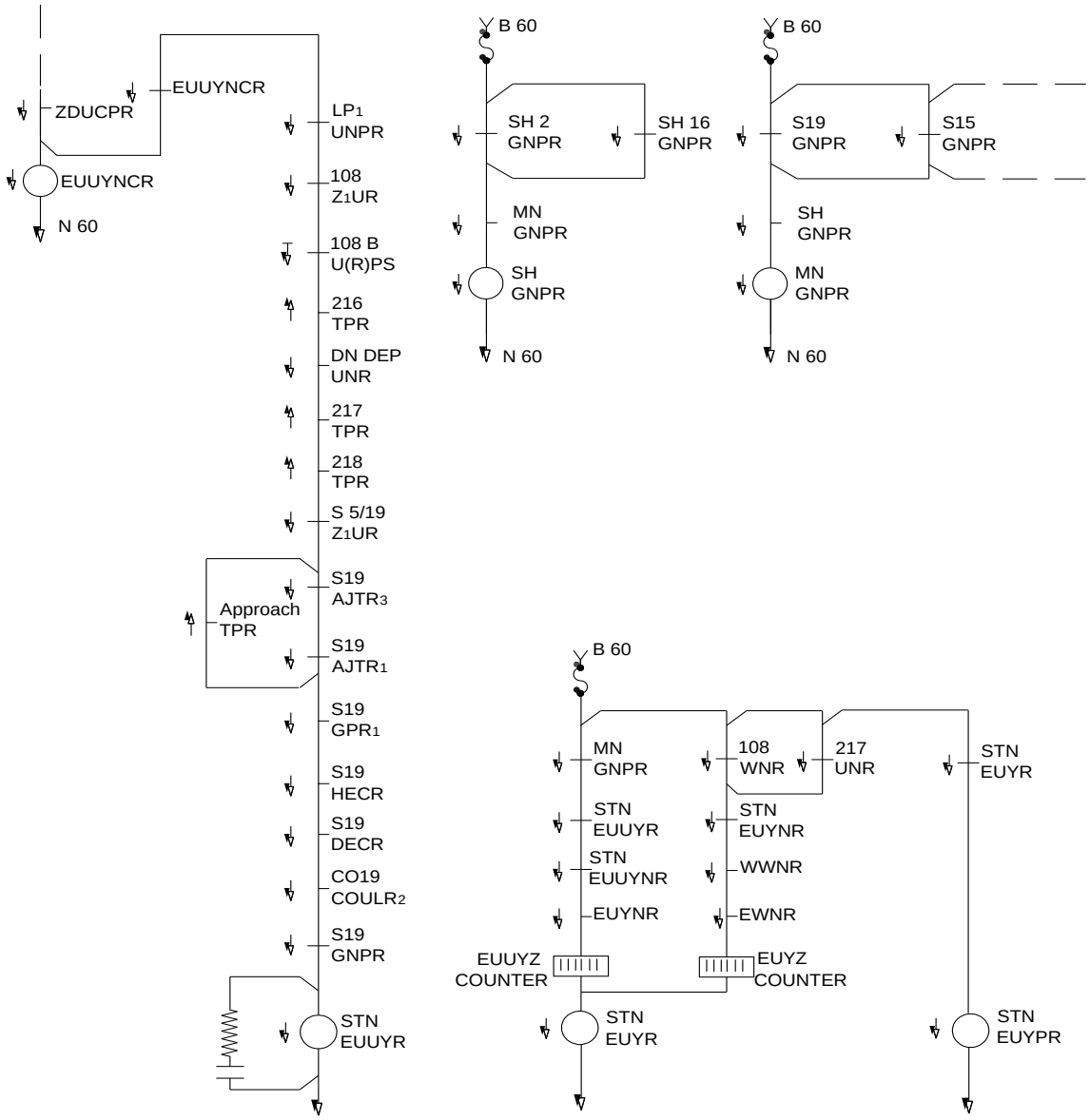


Fig.6.13: FULL ROUTE CANCELLATION RELAY CONTROL CIRCUIT

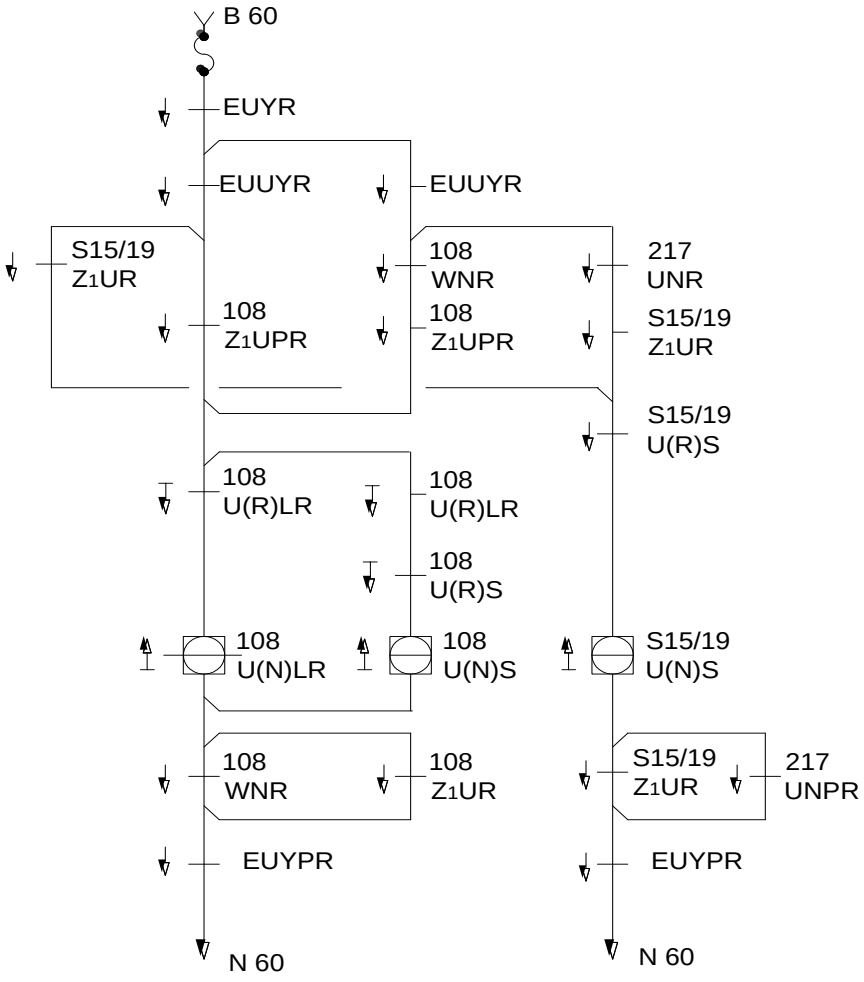


Fig.6.14: ROUTE SECTION NORMALISATION CONTROL CIRCUIT

6.2 EMERGENCY ROUTE SECTION RELEASE

6.2.1 The relays involved are:-

Sl. No.	Relay Nomenclature	Location	Description	Purpose.
1.	WNR	Mini group	Point Button Relay	Proves the concerned Point Button operation.
2.	UNR	Mini group	Route Button Relay	Proves the concerned Route Button operation
3.	STN-EUYNR	Mini group	Emergency Route Section Release Button Relay	Proves the button operation.
4.	STN-EUUYNR	Mini group	Emergency Route Release Button Relay	Proved dropped in EUYNR circuit to allow only one operation at a time.
5.	STN – EUYR	Mini group	Emergency Route Section Release Relay	Releases the concerned Route.

In this process, EUYR directly operates to release the Route section and normalise it when the concerned WN and EUYN are operated together and released, as below:-
To release Route sections without a point, the concerned 'UN' is operated instead of 'WN' along with EUYN.

WWNR and EWNR de-energized contacts in STN-EUYR circuit prove the normalization of Common Point control Buttons before releasing the Points from Route setting.

Relay Control Circuits: **Refer Fig.6.13**

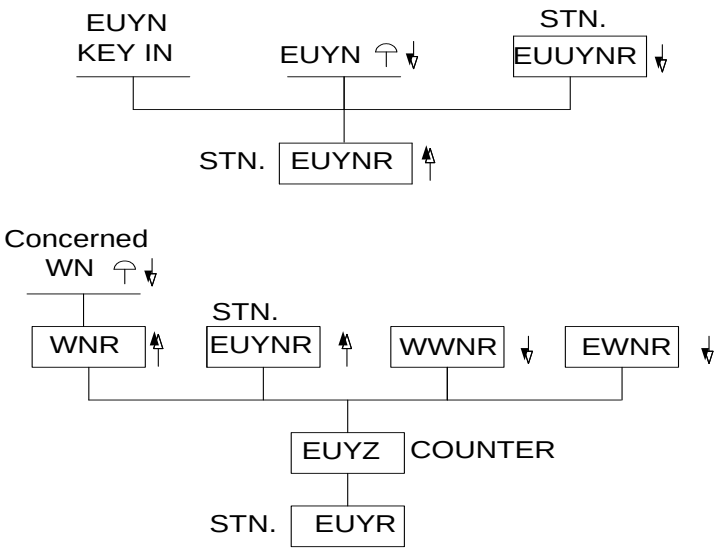


Fig.6.15: SUROUTE CANCELLATION FLOW CHART

CHAPTER 7
PANEL AND RELAY GROUP INDICATION CIRCUITS

7.1 Function and Control conditions are indicated on the 'Operating Panel' and Signal / Point / Route Relay groups, as detailed below: -

7.1.1 Point Position indications are displayed permanently through slits of domino strips nearer to the Point demarcation.

Points Normal indications on straight track and Points Reverse indications on diversion. Each slit has two lamps, the one close to the junction gives White indication (when track is clear) and the one away from the junction gives Red indication (when track circuit is occupied or failed).

Steady indications are controlled by WKR_1 front contact and flashing indications are controlled by WKR_1 back contact in series with (R/N)WLR operated contact.

In the layout given in Fig 7.1, there are A(White), B(Red), C(White), D(Red) for Normal position and E(White), F(Red), G(White), H(Red) for Reverse position of Pt.No.107/107 and there are A_1 (White), B_1 (Red) for Normal position and C_1(White), D_1(Red) for Reverse position of Pt.No.108/108.

Note: *'White' or 'W' stands for White indication lamp and 'Red' or 'R' stands for Red indication lamp.*

7.1.2 Point Track indications other than the Position indications form part of Route set indications:

They are controlled by Z_2WR_1 or Z_2WR_2 in addition to the concerned TPR energised /de-energised contacts.

It may also be noted that U(R)S or $OVZ_2U(R)R$ of a straight road energises Z_2WR_1 whereas U(R)S or $OVZ_2U(R)R$ of a diversion road energises Z_2WR_2. These relays directly control Point track indications and WKR_1 energisation is indirectly proved in U(R)S and $OVZ_2U(R)R$ circuits.

Point track indications of the given layout are:

1. On 216T:-

I(W), J(R), K(W),L(R), M(W), N(R), P_1(R) and Q_1(W).

(a) I and J are called NKEs as they are lit only with Points in Normal.

(b) K, L, P_1 and Q_1 are called CKEs as they are lit both with Points in Normal and Reverse.

(c) M and N are called RKEs as they are lit with Points in Reverse.

2. On 215T:

O(W), P(R) , Q(W) and R(R)

Of these, O and P are CKEs and Q and R are NKEs.

7.1.3 Points locked (in route) indication, viz. L_1 and L_2 of Pts. 107/107 and L_3 and L_4 of Pts 108/108 are controlled through Z_2WR_1/Z_2WR_2 operated contacts of concerned Route sections.

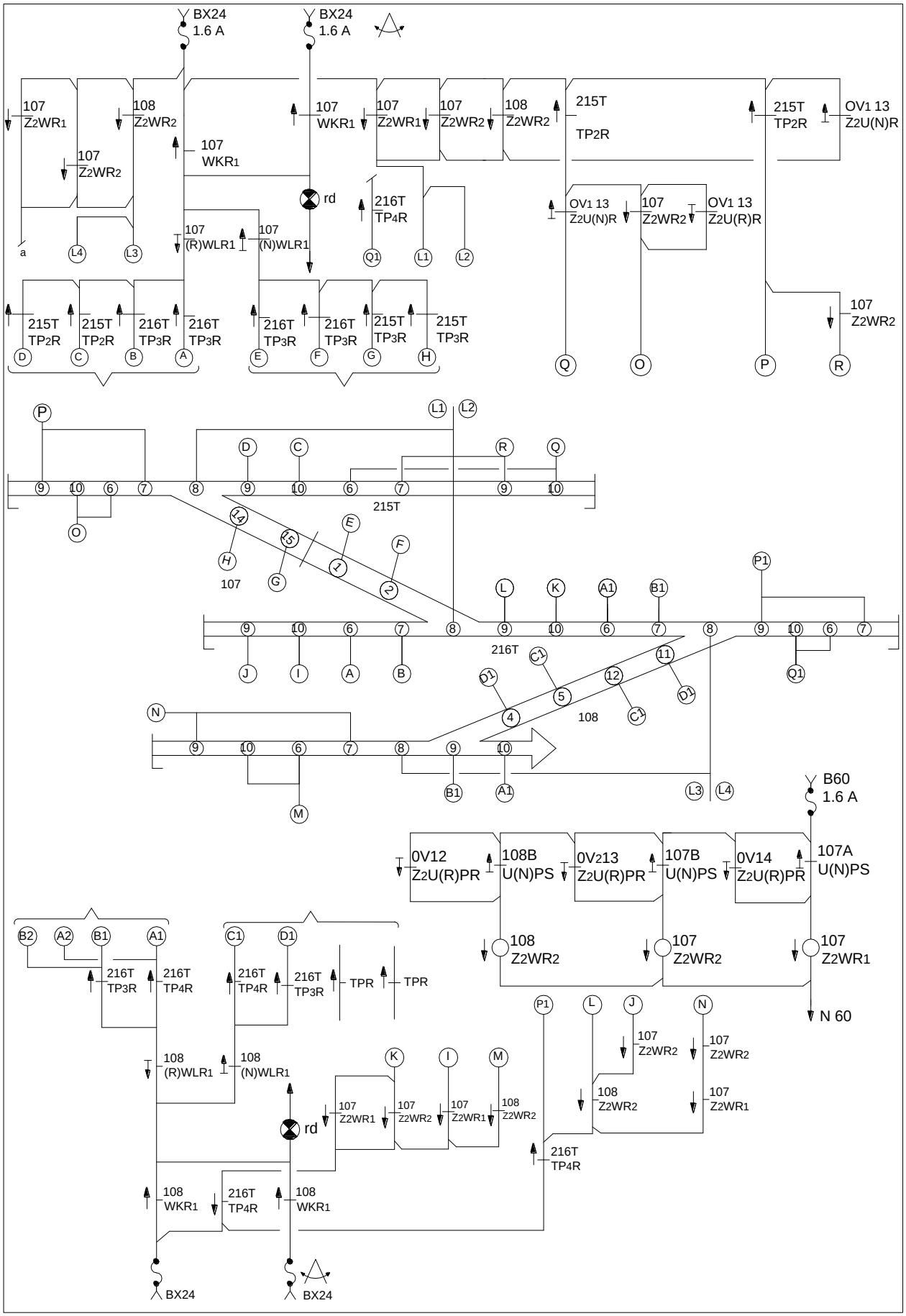


Fig.7.1: POINT PANEL INDICATION

7.1.4 Berthing and other Track indications:-

As can be seen in Fig. No 7.2, 7.2a, 7.3 and 7.3a

(i) On CO. Signal approach tracks, viz. 201T and 219T, the white lamps are lit through Sig. R/S U(N)S back and the nearest berthing track ZU(N)R reverse contacts in series.

(ii) On the first control track of Home Signals, viz.202T and 218T, the white lamps are lit through the concerned U(N)S back contacts.

(iii) On the Starter Signal control tracks in approach of Shunt Signals, viz 204T and 217T, the white lamps are lit through their G(R)LR front contacts or through the adjacent R/S U(N)LR reverse and SH G(R)R normal contacts in series. The first selection is for Starter Signal route and the second selection is for Home Signal route.

(iv) On berthing tracks, viz LP1T, LP2T & MN/LT, white (route locked) indication lamps are lit through G(R)LR front and TPR front contacts. (These lamps are lit only when a Main Signal is operated on the Route. They are not lit when a Shunt or CO. Signal is operated).

The red lamps of all those track circuits are lit only through TPR back contacts.

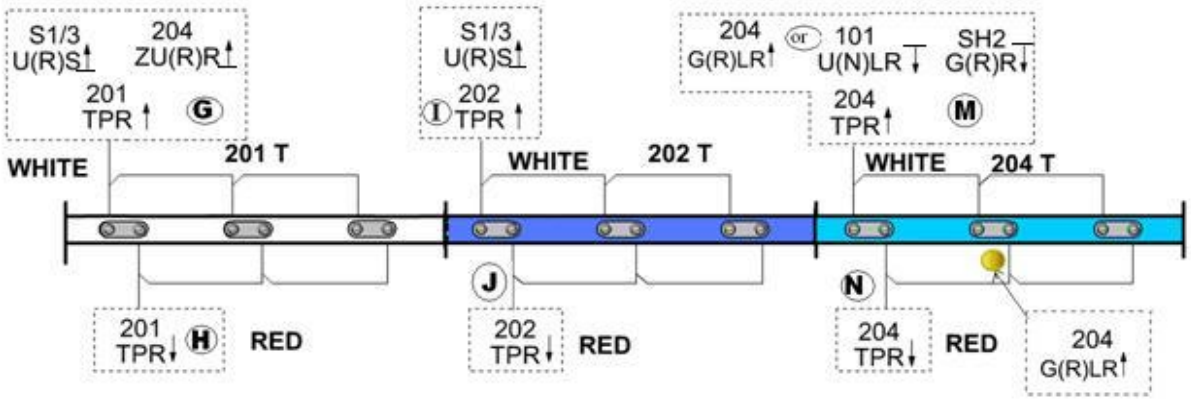


Fig 7.2: PANEL INDICATION

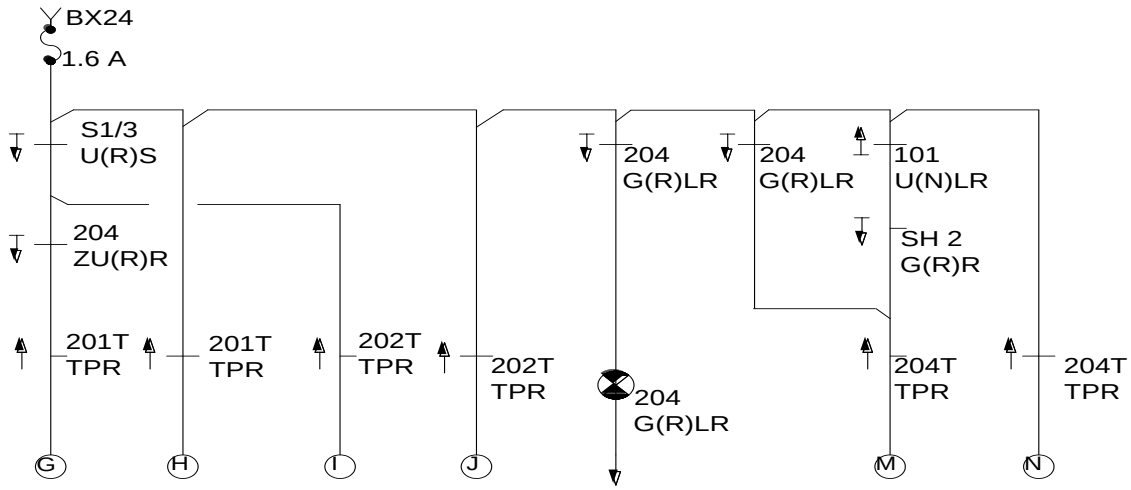


Fig 7.2a: PANEL INDICATION CIRCUIT

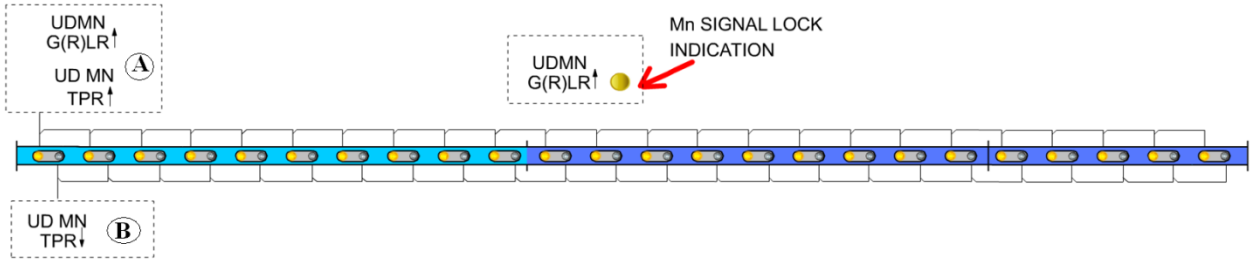


Fig 7.3

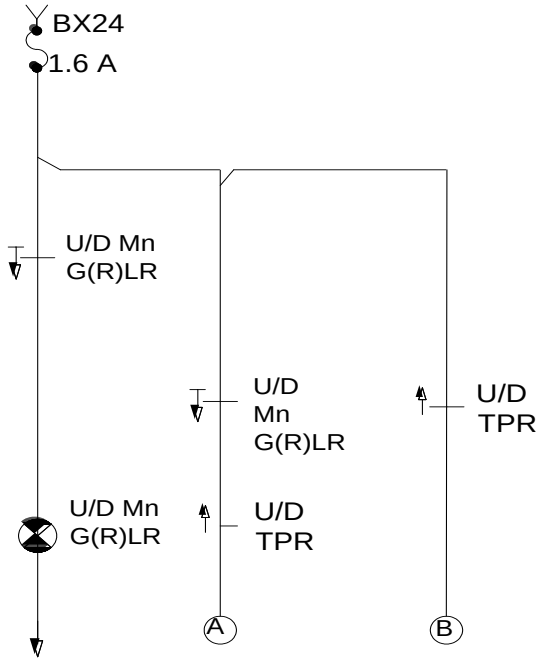


Fig 7.3a: Mn G®LR INDICATION CIRCUIT

7.1.5 Main Signal lock indications near the UN button on panel are controlled by the concerned G® LR front contacts. (Refer Fig.7.3 and Fig.7.3a)

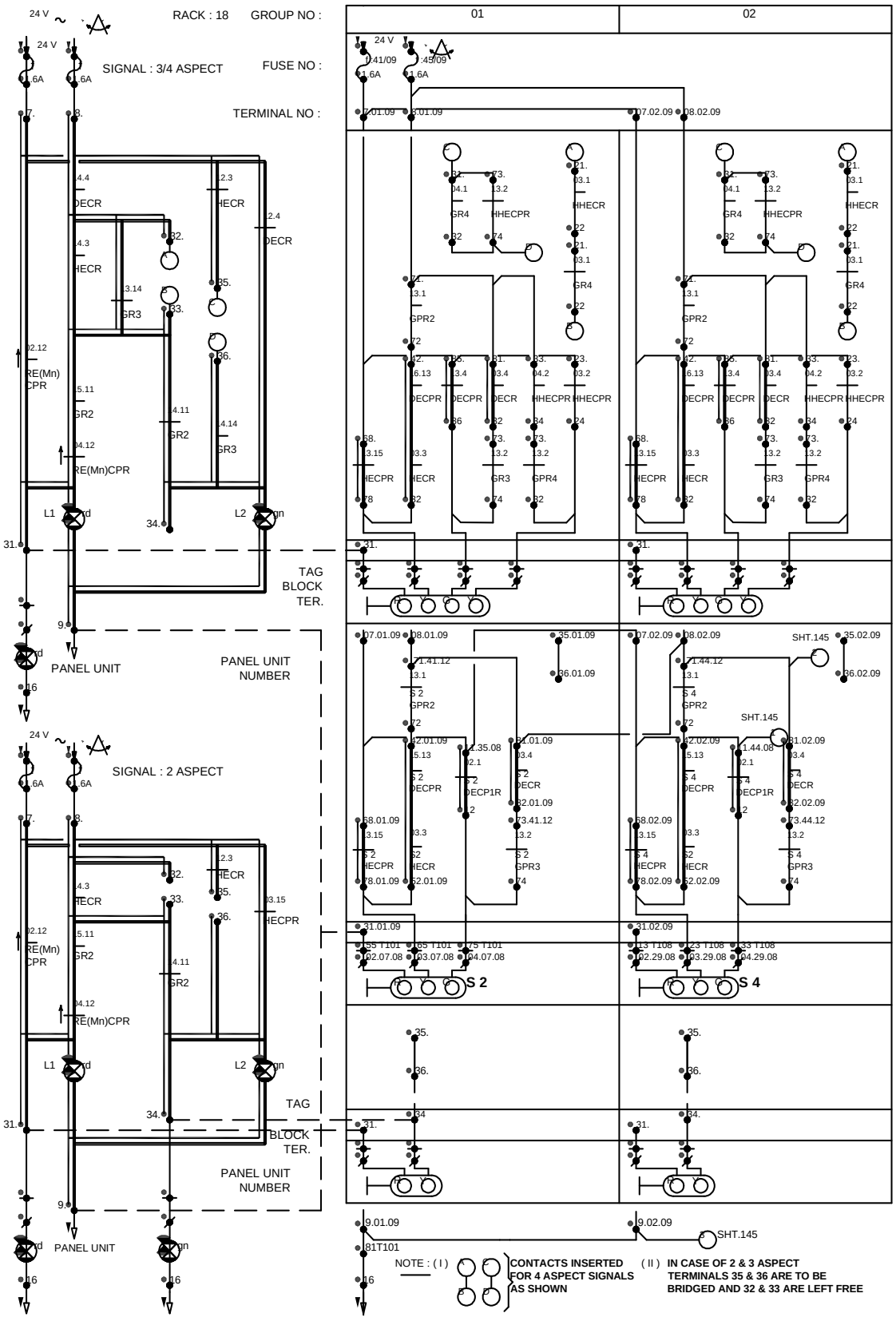
7.1.6 Signal aspect indications:

8.. For Main Signal aspect indications, refer Fig 7.4. DGKE, the common 'OFF' aspect indication is controlled by not only the respective ECR operated contacts but also the control relay contacts in series.

(ii) For Route indicator indications, refer Fig 7.5.

(iii) For Shunt Signal aspect indications, refer Fig 7.6

(iv) For Calling ON Signal aspect indications, refer Fig 7.7



MAIN SIGNAL PANEL (2/3/4-ASPECT) INDICATION

Fig:7.4

Fig 7.4: 4/3/2 Aspect Main Signal Panel Indications

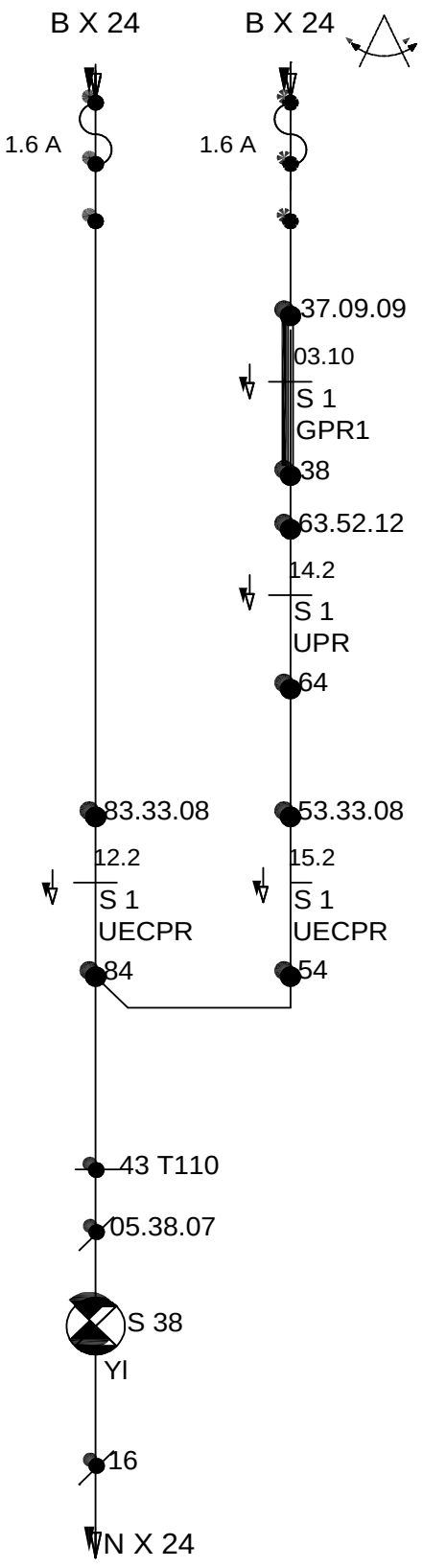


Fig 7.5: Panel Indications of Route Indicator

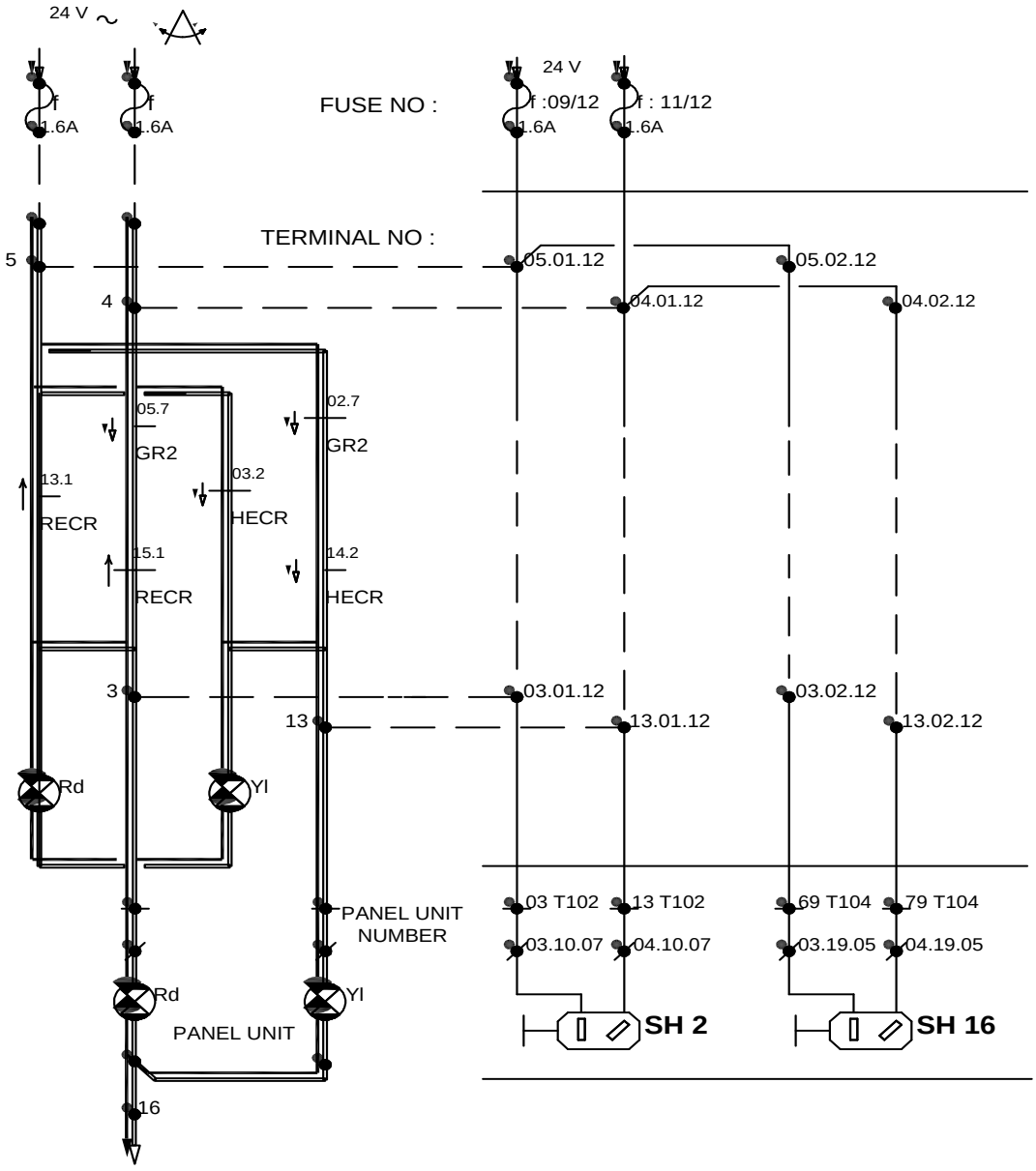


Fig 7.6: SHUNT SIGNALS – GROUP AND PANEL INDICATIONS

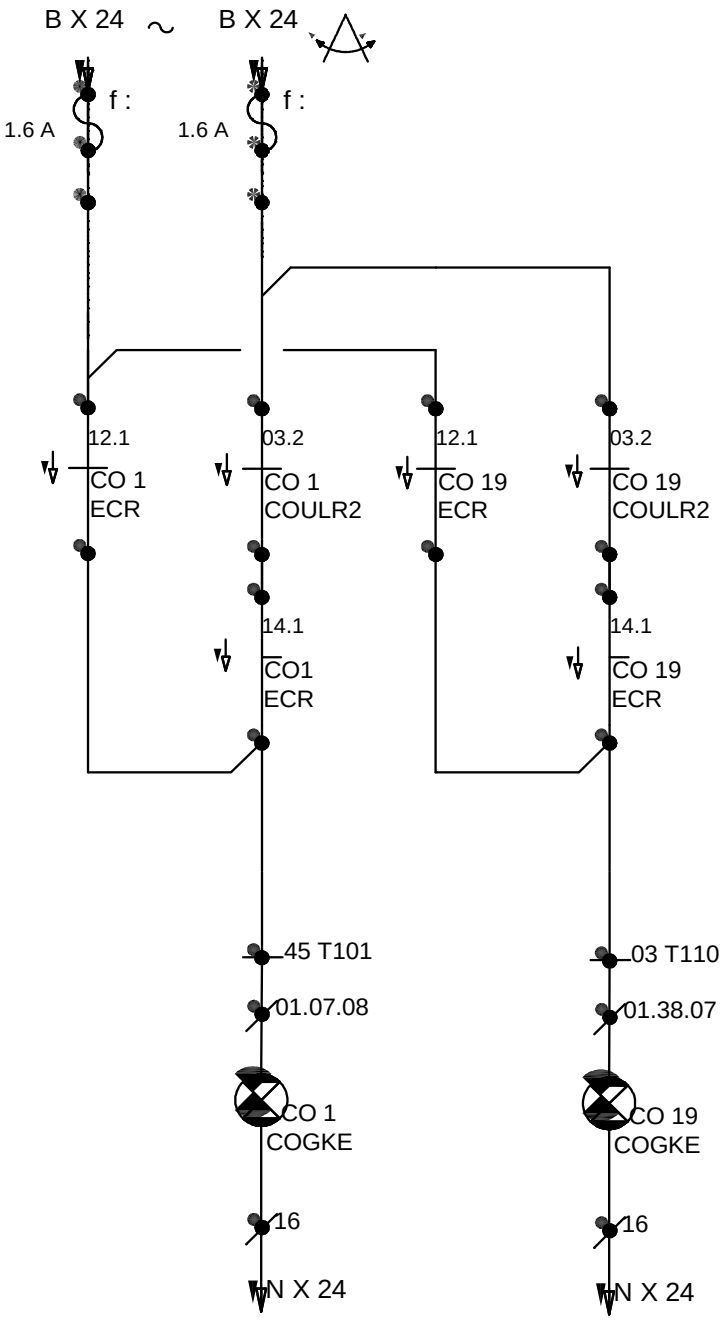


Fig 7.7: CALLING ON SIGNAL ASPECT INDICATIONS

7.1.7 Approach lock time relay indications near Signal demarcations:

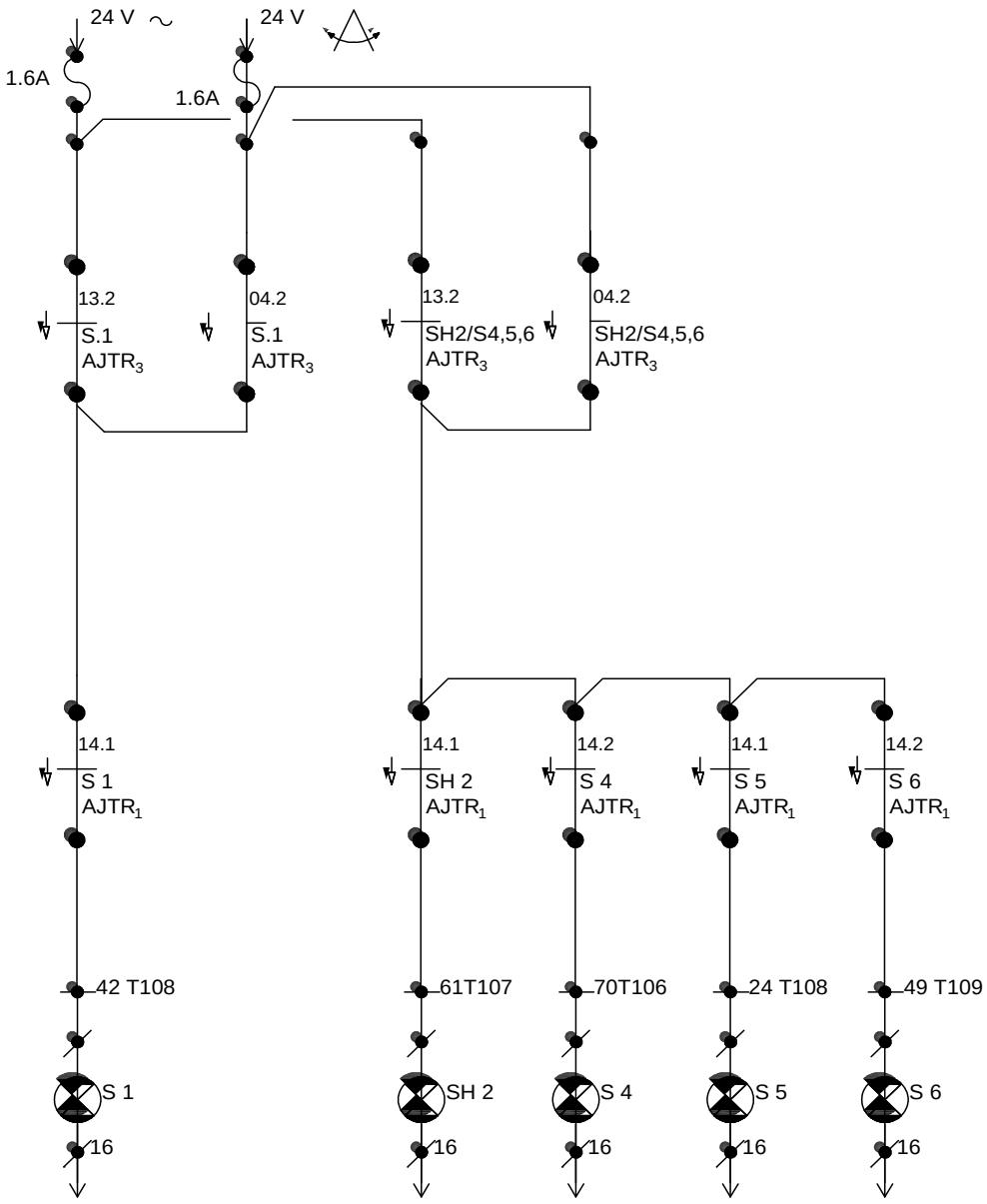


Fig 7.8: APPROACH LOCK TIME RELAY INDICATIONS

7.1.8 Crank handle control indications:

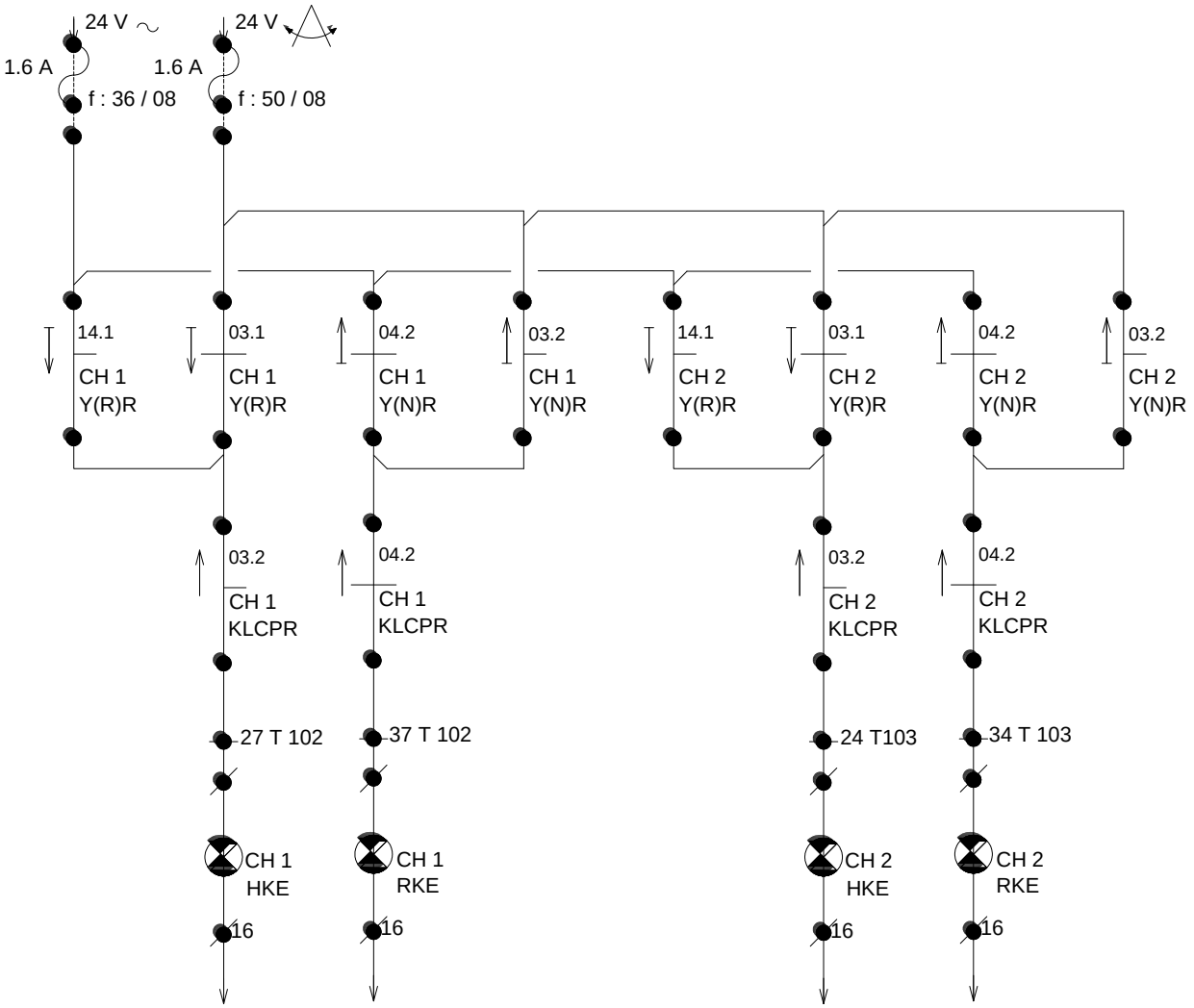


Fig 7.9: CRANK HANDLE CONTROL INDICATIONS

7.1.9 LC GATE INDICATIONS:

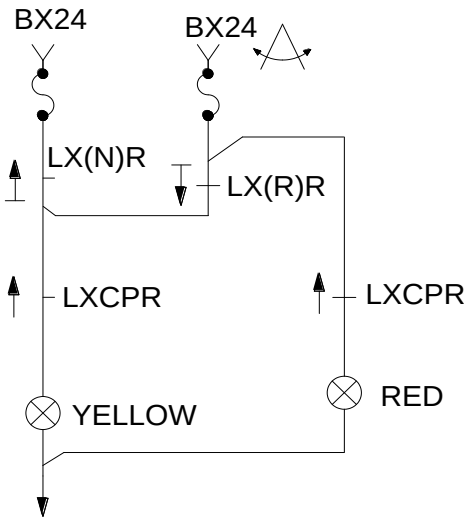


Fig 7.10: LC GATE SLOT INDICATIONS

Alarm buzzer & indication circuits:

(a) Signal lamp failure alarm is actuated by the dropping of GXJR which is normally kept 92uthorize through any one ECR picked up contact of all Signals proved in series. When any Signal goes blank, GXJR circuit is interrupted. With the pressing of GXYN on panel, GXYNR picks up and cuts off buzzer supply. Failure indication lamp is extinguished only when the failure is rectified as the concerned ECR picks up.

(b) Point detection failure is proved similarly in a WXJR circuit and the alarm buzzer is silenced by WXYNR.

(c) NCR is a common Button Checking relay which proves the normally energized condition of GNCR, UNCR, WNCR, CH/WW/EWNCR relays and dropped condition of Common control Button relays, Signal and Route Initiation relays as well as Route Release relays. Dropping of this relay activates the alarm buzzer and *red* indication lamp continuously. This relay can pick up again to stop the buzzer and extinguish the lamp only when 'NCR' is re-energised with the removal of fault.

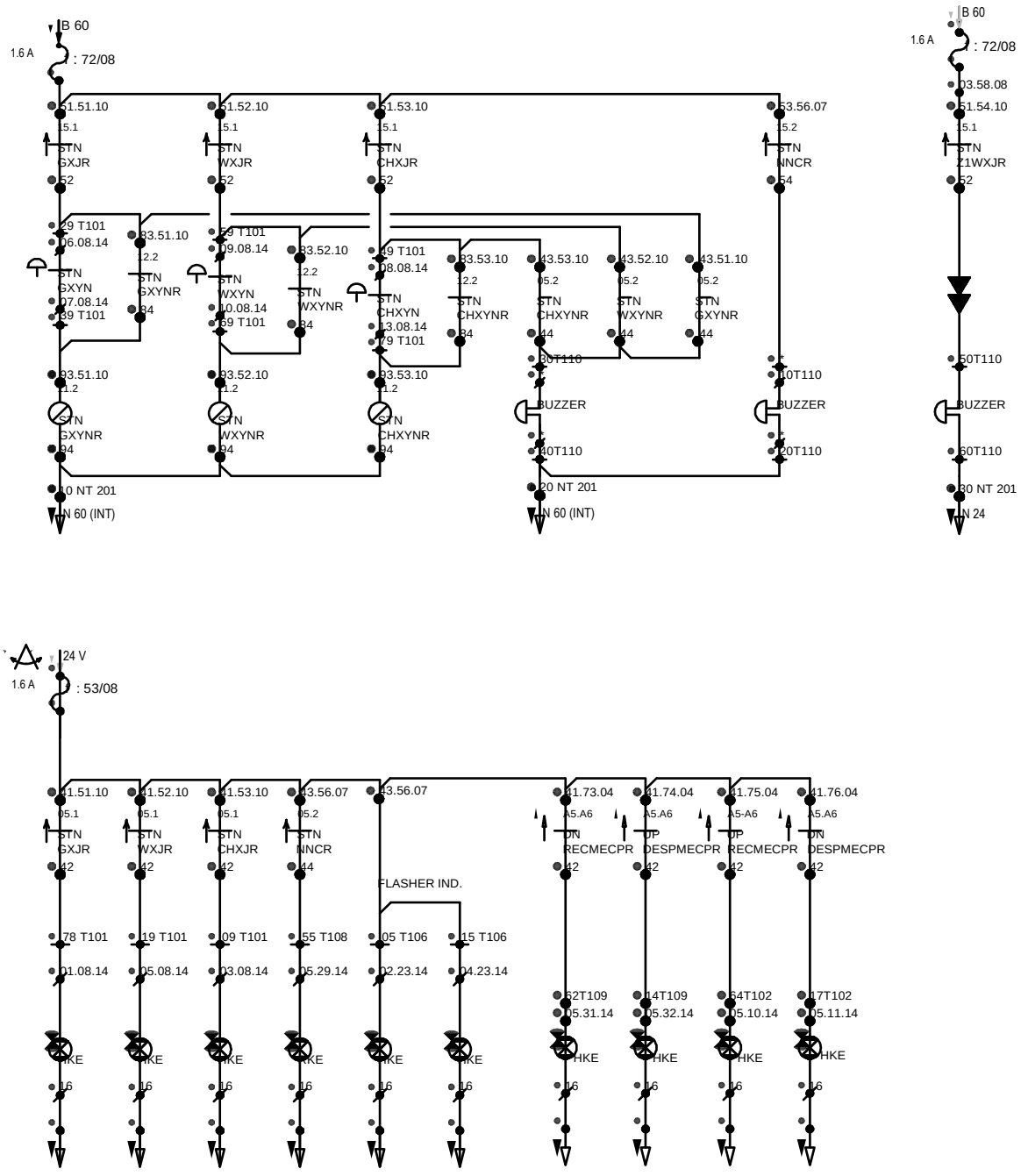


Fig 7.11: ALARM & BUZZER INDICATIONS

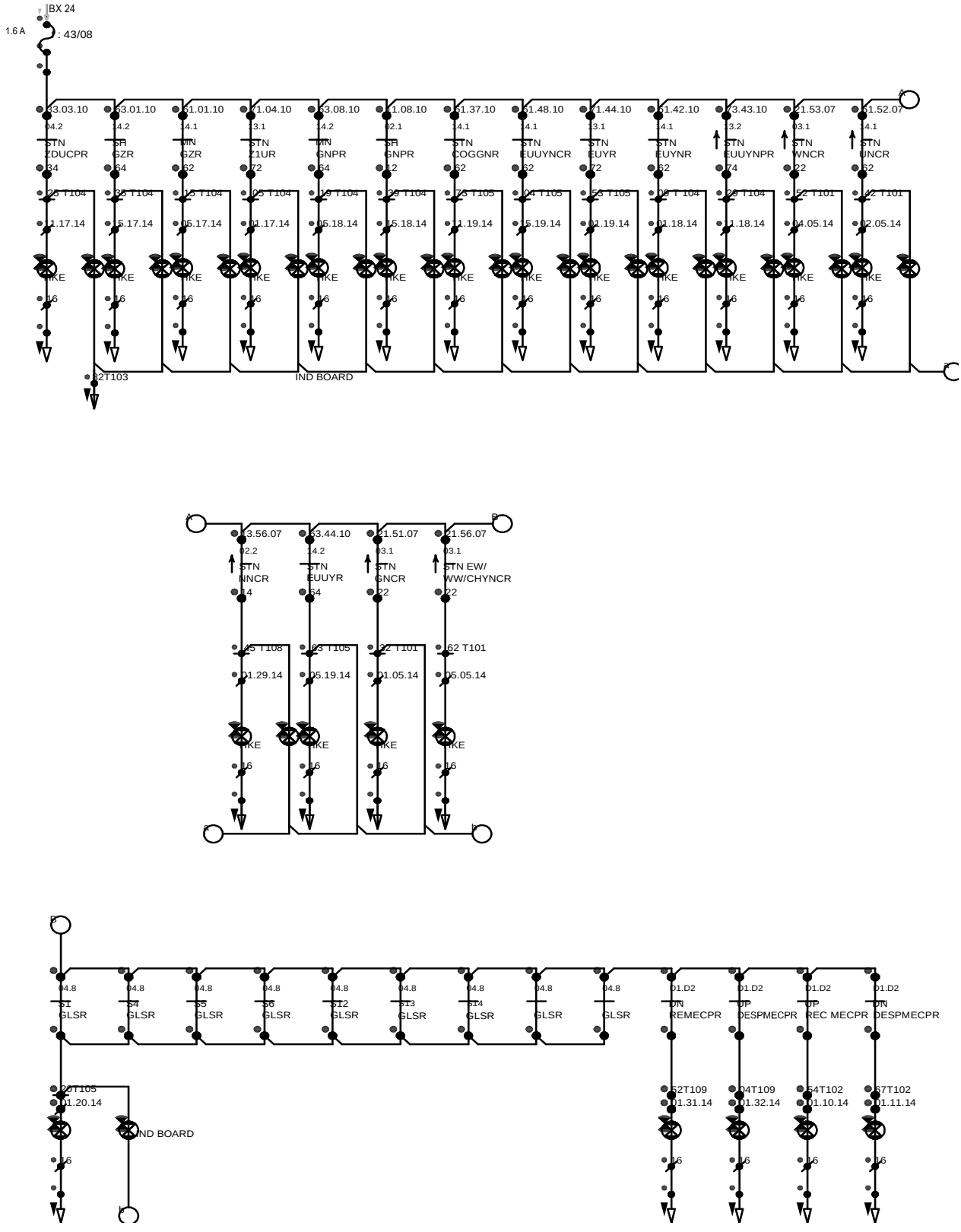


Fig 7.11a: ALARM & BUZZER INDICATIONS

7.1.10 Relay Group indications:

(a) Signal Relay Groups: Refer Fig No. 7.4

(b) Shunt Signal Relay Group: Refer Fig No. 7.6

(c) Point Relay Group: As can be seen in Fig. 7.12 below, WKR_1 picked up contact controls the steady red indication whereas WKR_1 de-energised contact controls the flashing red indication.

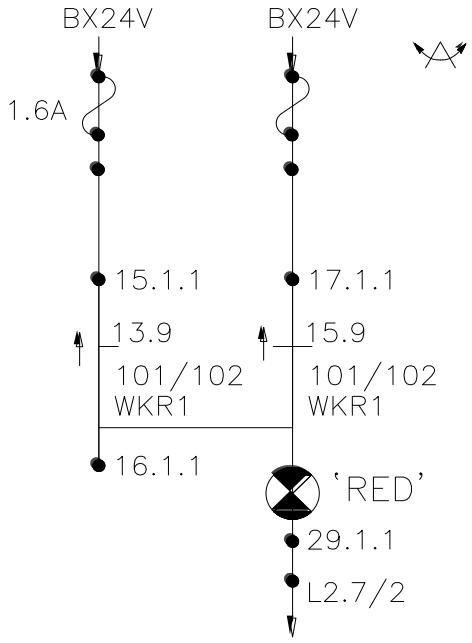


Fig 7.12: POINT GROUP INDICATIONS

a) Route Relay Group: As can be seen in Fig. 7.13 below, the Route Set indication is steady red, the Route Checked and Locked indication is steady yellow.

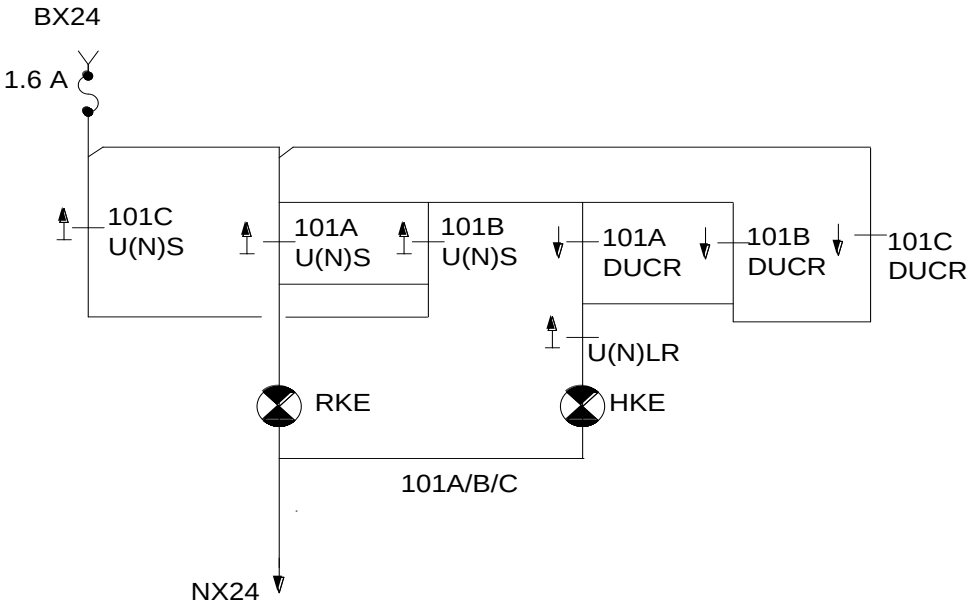


Fig 7.13: ROUTE GROUP INDICATIONS

* * *

CHAPTER 8
SLOT CONTROL

8.1 POINT CRANK HANDLE KEY RELEASE

The relays involved are:-

Sl. No.	Relay Nomenclature	Location	Description	Purpose
1.	CH1- YNR, CH2- YNR etc.	Mini group (in cabin)	Point Group-1 Crank Handle Release Button relay etc.	Represents button operation in circuits.
2.	YYNR	Mini group (in cabin)	Common Slot Release Button Relay.	Represents button operation in circuits.
3.	YRNR	Mini group (in cabin)	Common Slot Return ack. Button Relay.	Represents button operation in circuits.
4.	CH1KLCR, CH2KLCR etc.	Mini group (in cabin)	Crank Handle key locked 'IN' Proving relay for Pt.Group1, 2 etc.	Proves the condition of CH key at site. This is provided in the cabin.
5.	CH1-KLCPR, CH2-KLCPR etc.	Mini group (in cabin)	Repeaters of the above.	Proves the condition of CH key at site. This is provided in the cabin.
6.	CH1-KLR, CH2- KLR etc.	Mini group (at site)	Crank Handle Key Lock Relays.	Mechanically lock the point CH key when inserted to release it on receiving slot from the cabin.
7.	Gr1, 2 etc. CH –Y®R Y(N)R (Interlocked)	Mini group (in cabin)	Crank handle Slot Release relay. Crank handle Slot Normal Relay	Releases key at site when latched in reverse Withdraws slot after key is reinserted at site.

A common Key with a specific ward controls the entry of Crank Handle in a group of Point machines. Normally this Key remains locked mechanically in a Key Lock Relay kept in a location box at site close to the concerned Points. The key locked 'In' condition at site is proved in the cabin by CH-KLCR. CH KLCR in the cabin and CHKLR at site are connected to feed from either end by a common pair of lines. A two wire circuit is in use between cabin and the location at site.

OPERATION:

After reaching the site, the 95uthorized person presses a Push Button on the CHKLR box so that CHKLCR drops in the cabin**.** This causes a *red* indication to *flash* near CHYN button and the existing *yellow* indication to its left to disappear on the panel. On seeing this, the Panel Operator presses CHYN and YYN, provided no route is set involving the Points concerned. This makes CH-Y®R to operate and the relevant panel counter to progress by one number.

Due to this, at site, CHKLR operates even as the P.B. on the box is still kept pressed to light a *red* indicator on the box. Then the key is extracted from the relay and taken for use on the Points.

On completion of the work on Points, the C.H. key is reinserted in the CHKLR unit and turned to drop it. This makes CHKLCR in the cabin to pick up. On the panel, the relevant *red* indication disappears and a *yellow flashing* indication appears.

On seeing this, the panel operator presses CHYN along with YRN. This operates CHY(N)R so that the Slot gets withdrawn, causing the *white* indication on panel to become *steady*.

CH/EW/WW-NCR dropped contact in the CH-Y(R/N)R circuits checks for its proper working.

Relay & Indication circuits: (Refer Fig.8.2 & Fig 8.3)

8.1.1 Sequence of Relay operation : –

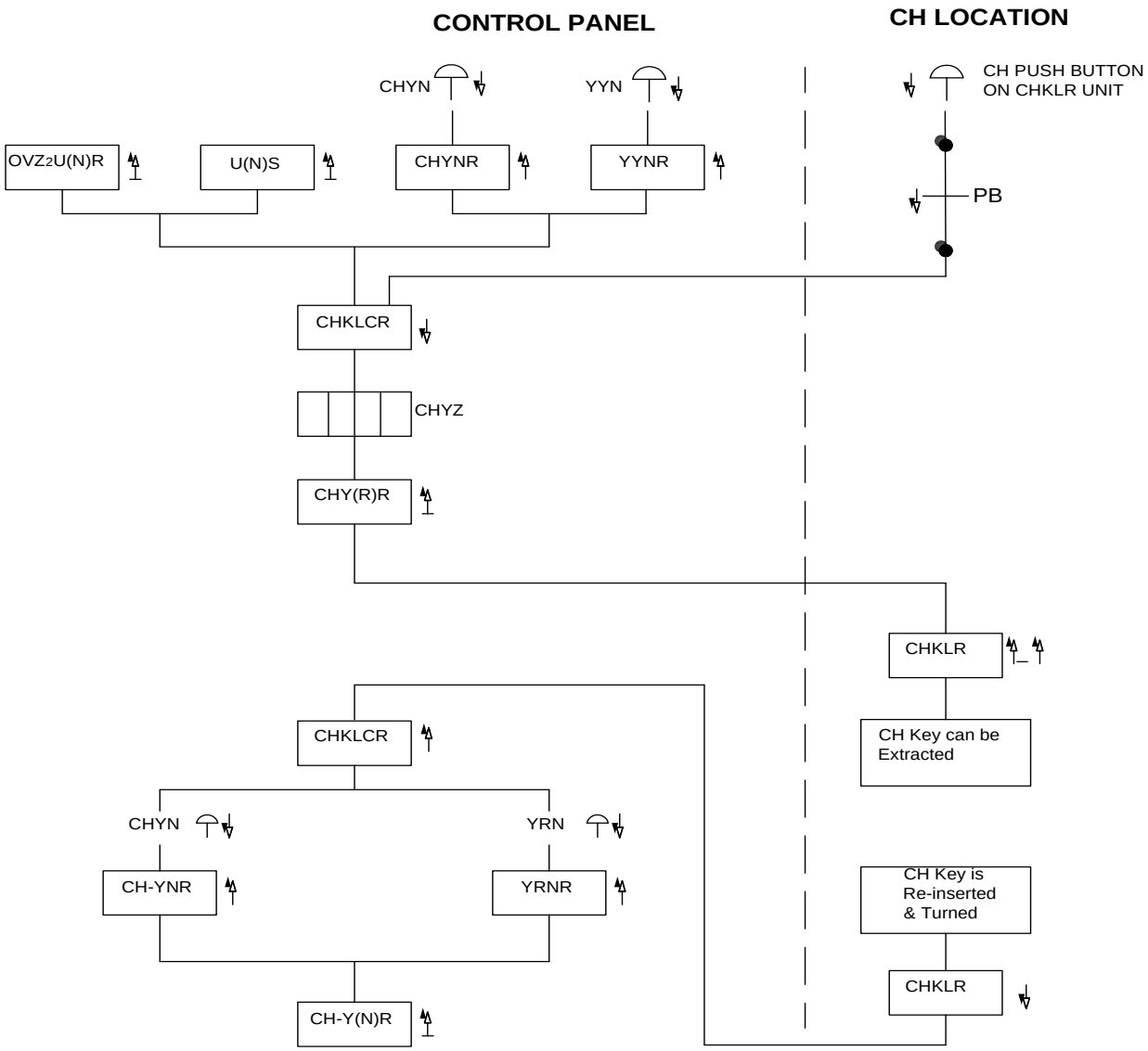


Fig. 8.1: CRANK HANDLE CONTROL FLOW CHART

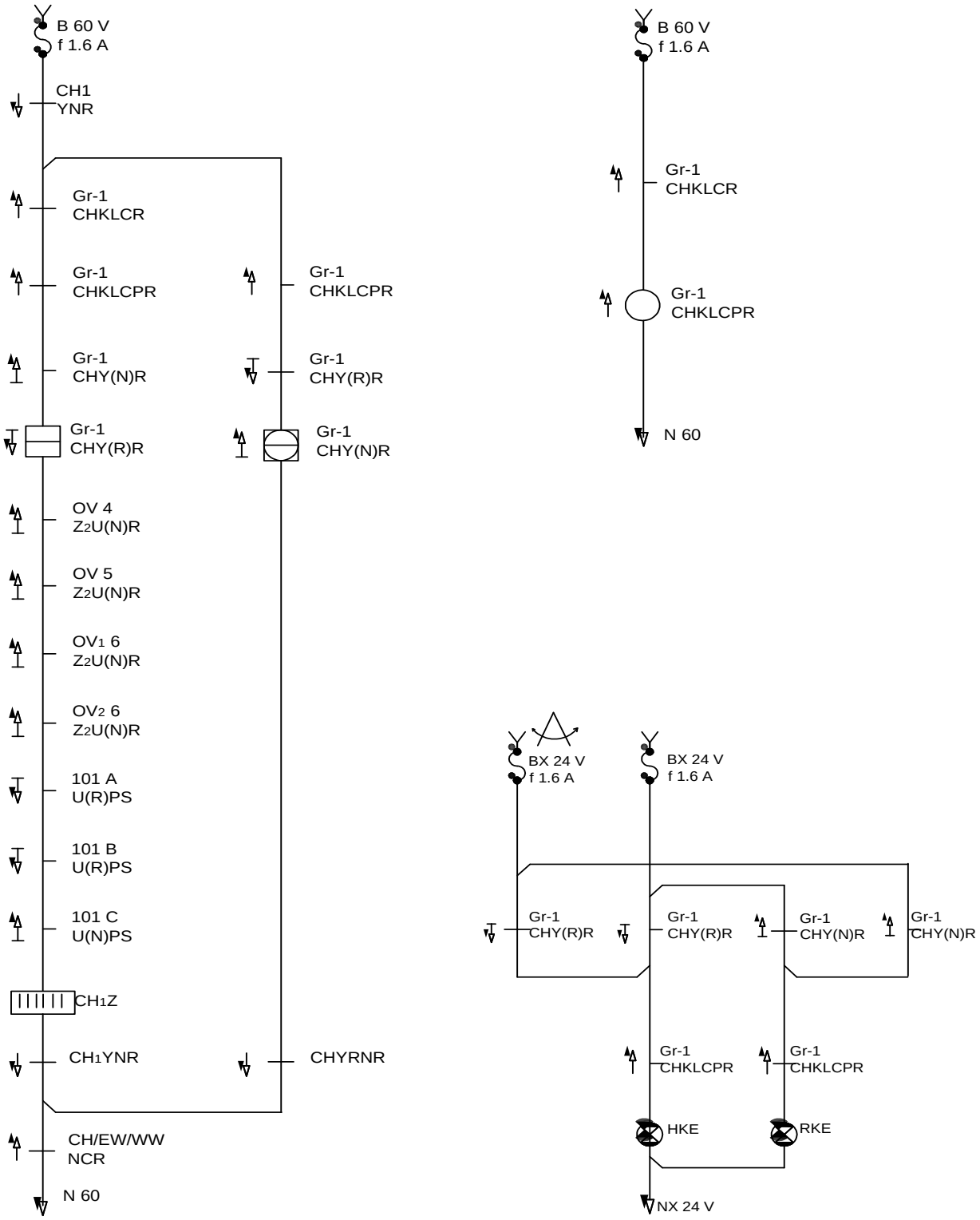
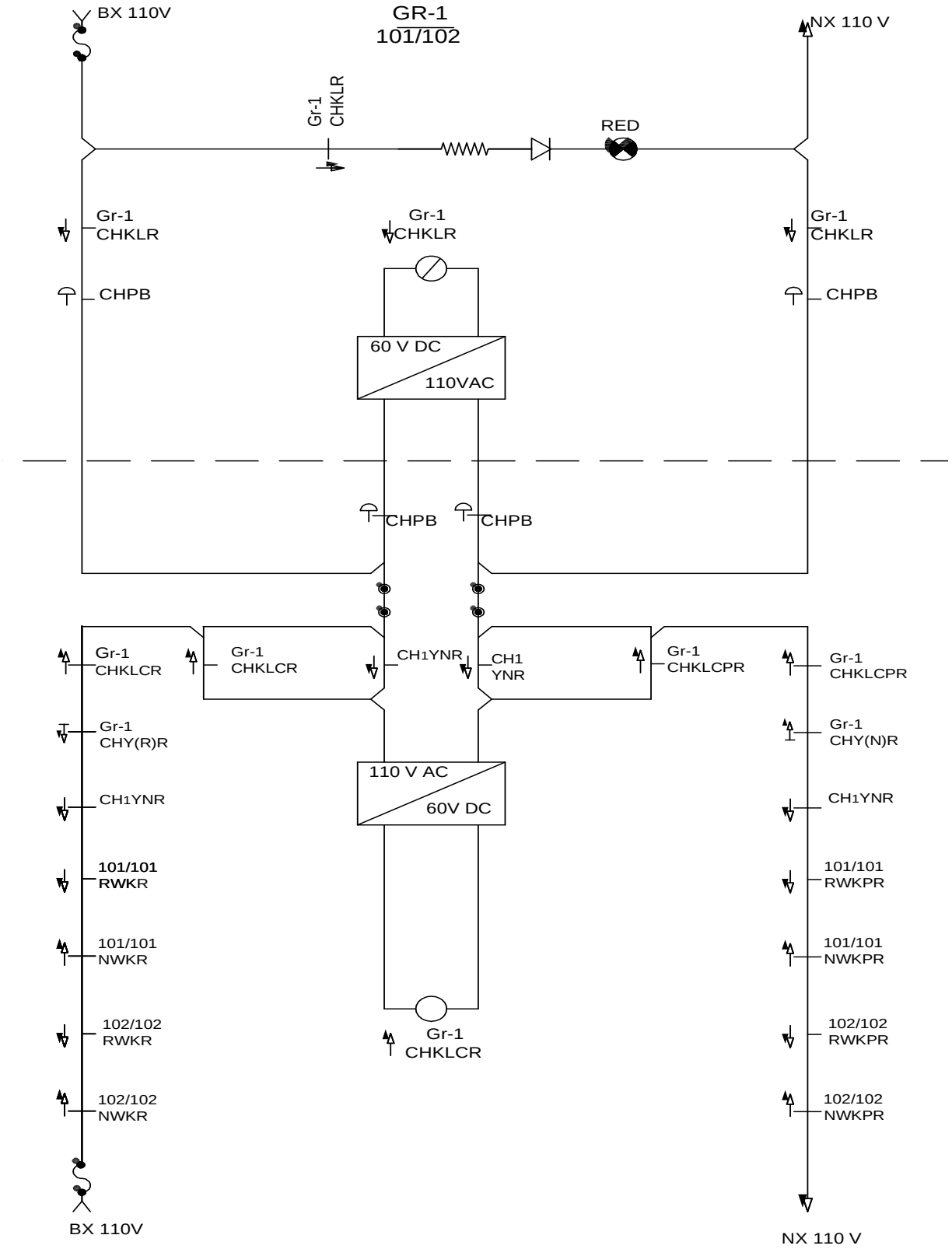


Fig. 8.2: CRANK HANDLE CONTROL AND INDICATION CIRCUIT



CHKLR - KEY LOCK RELAY REMAINS IN PICKED UP CONDITION MECHANICALLY AFTER EXTRACTION OF THE KEY. THE RELAY IS DISENGAGED AFTER THE REINSERTION AND TURNING OF THE KEY WHICH LOCKS THE KEY.

Fig. 8.3: CRANK HANDLE KLCR CIRCUIT

8.2 LEVEL CROSSING GATE CONTROL

The relays involved are :-

Sl. No.	Relay Nomenclature	Location	Description	Purpose
1.	LXNR	Mini Group (in cabin)	Level Crossing control Button Relay	Represents button operation in circuits.
2.	YYNR	Mini Group (in cabin)	Common Slot Control Button Relay	Represents button operation in circuits.
3.	YRNR	Mini Group (in cabin)	Common Slot Return ack. Button Relay	Represents button operation in circuits.
4	LXCPRS	Mini Group (in cabin)	Level Crossing Slot key in Proving relays.	Prove the condition of Gate key at site. Provided in the cabin.
5.	LXPR	Mini Group (at the gate)	Level Crossing Key Lock Relay	Mechanically locks the Control Key normally and releases it when Slot is received from the cabin.
6.	LX(R)R LX(N)R (Interlocked)	Mini Group (in cabin)	Level Crossing control Release relay Level crossing control Normal relay.	Releases Key at site when latched in Reverse. Withdraws slot after key is reinserted at site.

Unlike in the case of Crank Handle Key release, a Gateman is always present at the gate to receive control whenever conditions are favourable. Hence, the Gate Slot is released directly from the panel without asking for co-operation from the Gate end. A Six wire circuit is provided between cabin and the location with no separate feed at site.

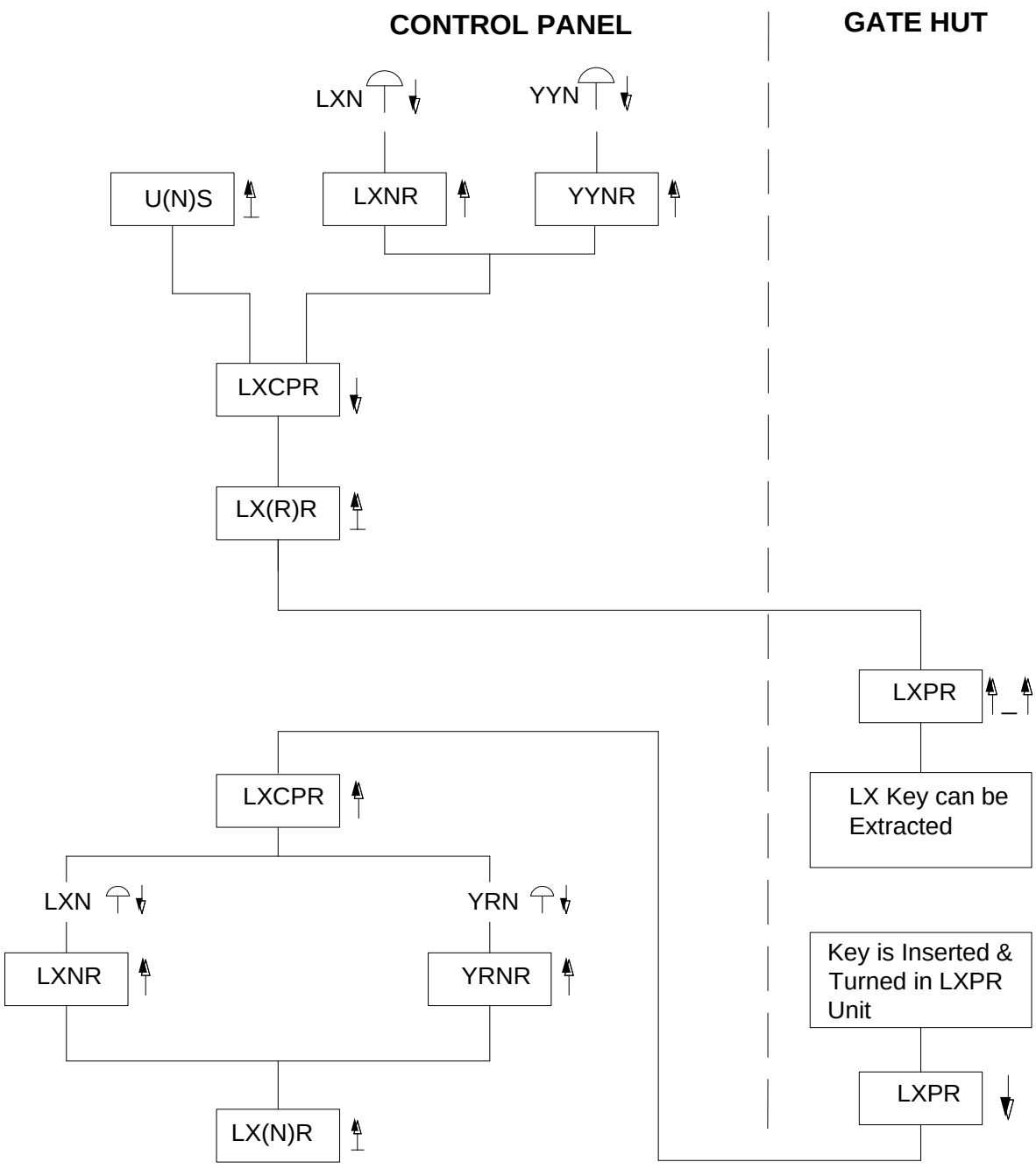
Normally the gate slot key is locked up in LXPR at the gate hut. 60V DC feed is taken on lines No.3 & 4 from cabin to the Gate hut and proving LXPR dropped there, it is carried back on lines No.5 & 6 to energise LXCPR at the cabin. When Gate Slot is not released and LXCPR is energised, a *steady yellow* indication is displayed near LXN on the panel.

With no Route set in the Gate region, when LXN is pressed along with YYN on the panel, LXCPR drops and LX(R)R operates at the cabin. This causes *yellow* panel indication to *flash* and 60V DC to be sent on lines No. 1 & 2 to the Gate hut where an 'LED' is lit to give slot received indication. On seeing this, the Gateman presses a push button on the relay box and takes out key from LXPR. With the dropping of LXCPR, the *yellow* indication disappears and a *red* indication is displayed near LXN on the panel.

After clearing the road traffic, when the Slot key is re-inserted in LXPR and turned, it gets locked and the relay drops. This picks up LXCPR in the cabin causing *'red'* indication to disappear and '*yellow'* indication to *flash* near LXN on the panel. On seeing this, the panel operator presses LXN along with YRN to withdraw control. LX(N)R operates and the *'yellow'* indication on the panel becomes *steady.*

For sequence of relay operation and control circuit ref fig. 8.4 & 8.5

8.2.1 Sequence of relay operation



SEQUENCE OF RELAY OPERATION

Fig. 8.4: LEVEL CROSSING CONTROL FLOW CHART

Relay Control circuit: Fig 8.5

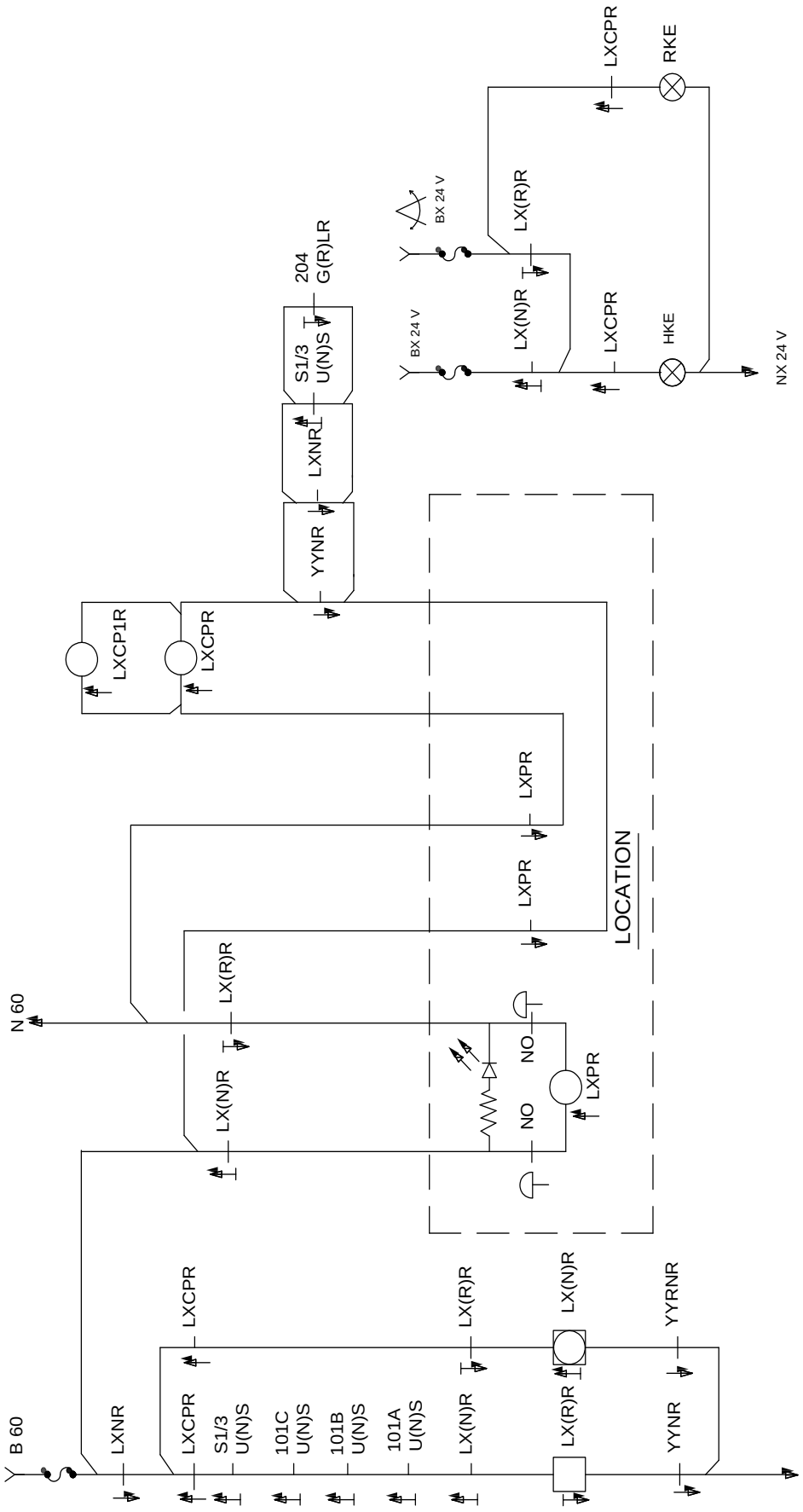


Fig. 8.5: LEVEL CROSSING CONTROL CIRCUIT

8.3. POINT KEY LOCK CONTROL

The relays involved are:--

Sl. No.	Relay Nomenclature	Location	Description	Purpose
1.	KLNR	Mini Group (in cabin)	Key Lock control Button relay	Represents the button operation in circuits
2.	YYNR	Mini Group (in cabin)	Common Slot Release Button relay	Represents the button operation in circuits.
3.	YRNR	Mini Group (in cabin)	Common Slot Return ack. Button relay	Represents the button operation in circuits.
4.	KLCR	Mini Group (at site)	Key locked 'In' Proving Relay	Mechanically locks the key when dropped. Releases key when slotted from the cabin.
5.	NP1R NP2R NP3R etc.	Mini Group (in cabin)	(Key Lock) Normal proving relays	Prove the condition of point lock release key at site. Provided in the cabin.
6.	KL (R) R KL(N)R Interlocked	Mini Group (in cabin)	Key lock release relay Key lock normal relay	Releases key at site when operated. Withdraws control after key is inserted and turned at site.

Its working is similar to that of Level Crossing Gate control. A 4-wire circuit is used between cabin and location with a 60V feed source at site. (Refer Fig.8.7)

Normally the Point lock control Key is held in KLCR when it is de-energised. Proving this condition at site, when no Route is set involving the Key Lock points, NPRs are energised in the cabin. A steady *yellow* indication is displayed near KLN button on the panel.

When no Route or Overlap is set involving the Key Lock Point and when the concerned loop line is connected ahead to the arrival or departure road, KLN and YYN are pressed together on the panel to release slot. KL(R) R operates in the cabin and the concerned *yellow* indication *flashes* on the panel. This makes KLCR at site to be energised and a *red* LED indication displayed on the Box.

On seeing this, the man at site presses a Push Button on the relay box and takes out the key. NPRs drop in the cabin. *Yellow* indication disappears and a *steady red* indication appears on the panel.

After the traffic into or out of the Siding is passed, and the Key is reinserted in the KLCR, the relay drops. This makes NPRs to pick up in the cabin. On the panel, the *red* indication disappears and a *flashing yellow* indication appears.

Now the panel operator presses KLN and YRN together to withdraw the slot KL(N)R operates in the cabin. This makes the *yellow* panel indication *steady.*

8.3.1 Sequence of relay operation

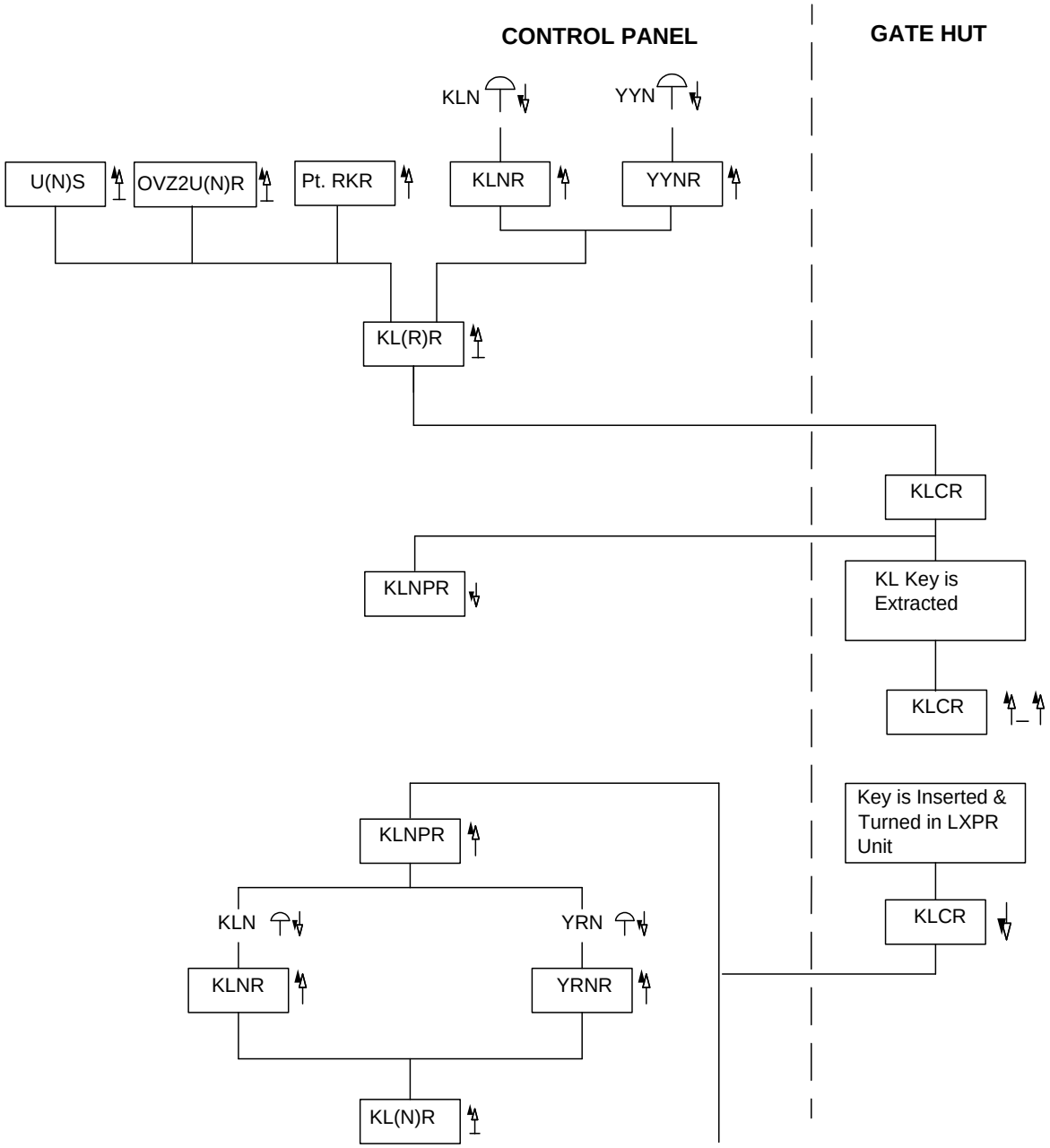


Fig 8.6: KEY LOCK POINT SEQUENCE OF RELAY OPERATION FLOW CHART

Relay Control circuit: Fig 8.7

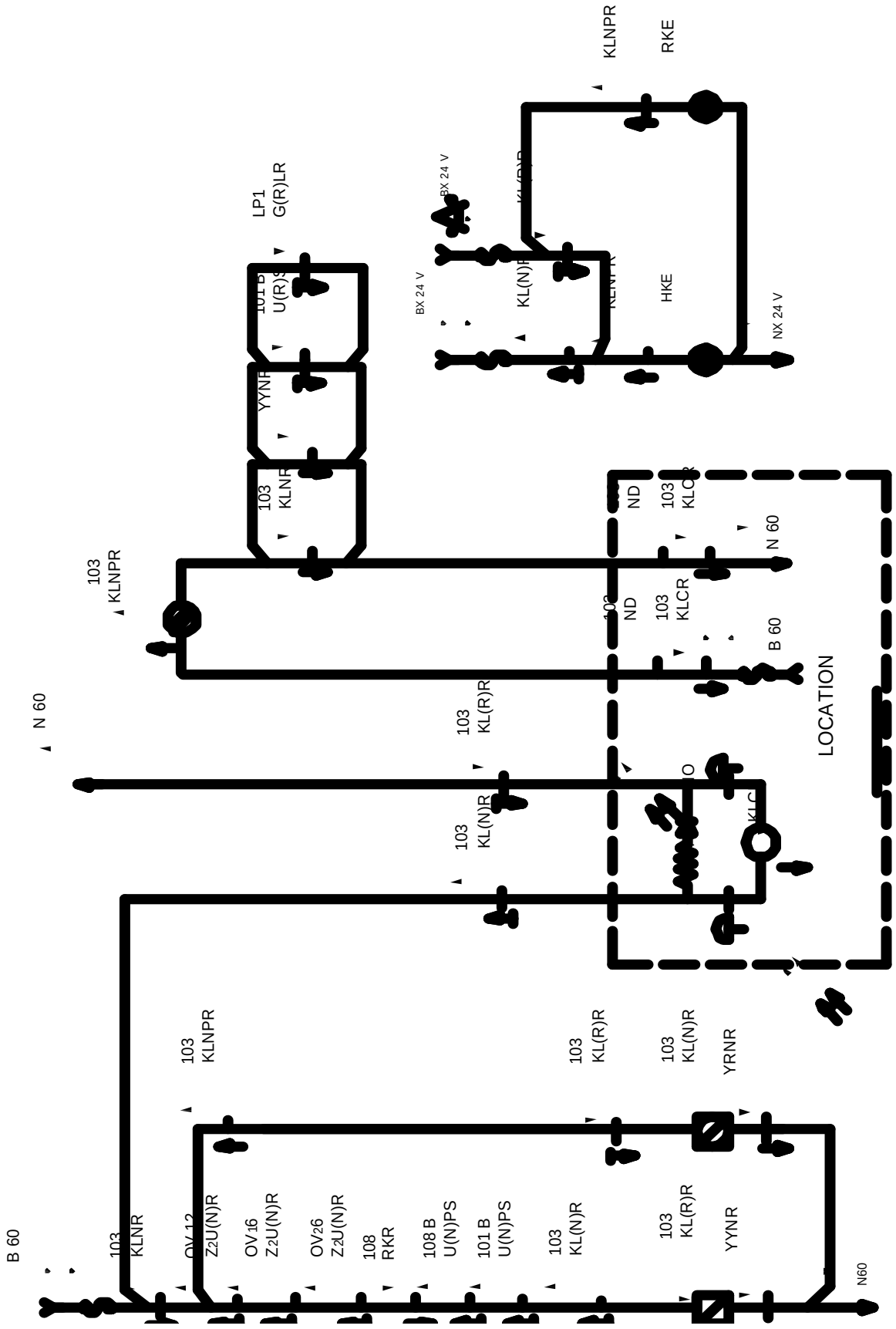


Fig 8.7: KEY LOCK POINT CONTROL CIRCUIT AND INDICATION

CHAPTER 9
POINT OPERATION

In this system, Points shall be operated individually before any Route can be set involving them.

9.1 The relays involved in point control initiation are:-

Sl. No.	Relay Nomenclature	Location	Description	Purpose
1.	WNR	Mini Group	Point Button Relay	Represents button operation in relevant circuits.
2.	GNCR	Mini Group	Signal Button Repeater Relays Normal Proving Relay.	Proved energized in WNR circuit to prevent any Point operation when a Signal button repeater or Route button relay is picked up.
3.	UNCR	Mini Group	Route Button Relays Normal Proving relay.	
4.	WWNR	Mini Group	Common Point Button Relay for regular operation.	Represents button operation in circuits.
5.	EWNR	Mini Group	Common Point Button Relay for emergency operation.	Represents button operation in circuits.
6.	$Z_1WR_1(1)$	Point Group	Pick up coil of Point control Initiating Relay-1 (common for 'N'& 'R' operations)	Proves Route and Track locking conditions of the point to be operated.
	$Z_1WR_1(2)$		Holding coil of the above relay.	
7.	$WKR_3(1)$	Point Group	Pickup coil of Point Detection Relay-3.	Detects Normal condition of Point control disconnects detection supply for initiating its Reverse operation.
8.	WJR	Point Group	Point operation Time limiting Relay.	Proves Reverse condition of point control for initiating its Normal operation
9.	WKR_1	Point Group	Point Detection Relay-1.	Drops to remove Point detection before initiating its operation.
10.	W(R)R W(N)R (Interlocked)	Point Group	Points Operating circuit switching Relay. Points Detection circuit switching Relay.	Latches in Reverse to connect the operating feed to motor when final control relay (WR) is energised.
11.	Z_1NWR	Point Group	Point Normal control Initiating relay	Energises when normal point control is established and remain in energised condition as long as the buttons are in pressed condition.
12.	Z_1RWR	Point Group	Point Reverse control Initiating relay	Energises when Reverse point control is established and remain in energised condition as long as the buttons are in pressed condition.

9.2.1 Point Normal and Reverse Control Initiation:-

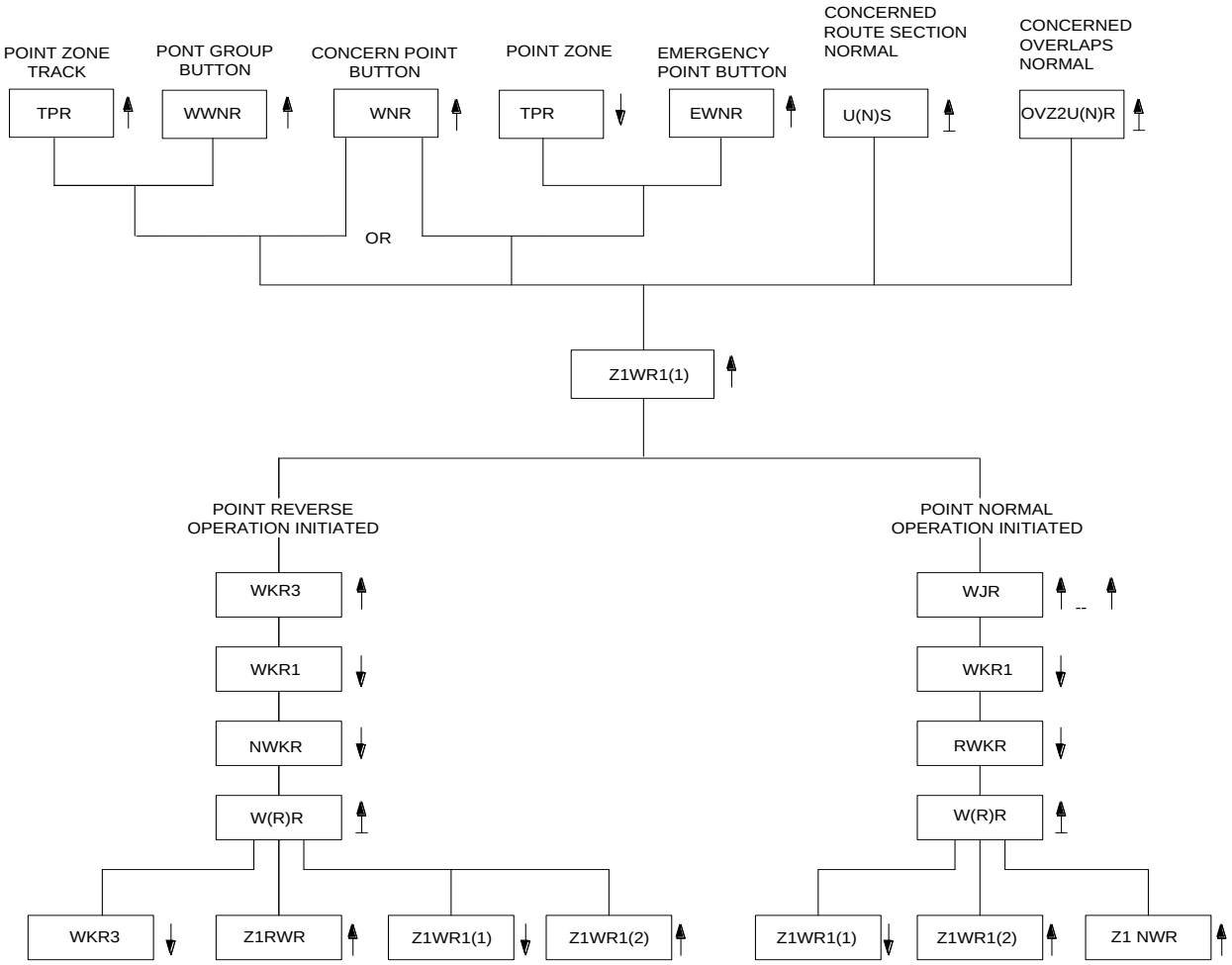


Fig.9.1: POINT OPERATION FLOW CHART

There are two stages in point control initiation.

1. In the first stage which is common for normal and reverse initiations. Z1WR1 picks up proves that.

   (a) When the point zone track circuits are clear, the point operation can be initiated by the operation of, concern point button WN and common point button WWN simultaneously. This operation is called as normal point operation.

   (b) When the point zone track circuit is in failed condition, the point operation can be initiated by the operation of concern point button WN and Emergency point button EWN simultaneously. This operation is called as emergency point operation.

   (c) The point is not engaged by any signal move for any route or overlap or isolation.

2. In the second stage, since (N) WLR is in latched condition from the previous operation, the group is not disturbed until the current operation when Z_1WR_1 picks up, WKR_3 picks up to drop WKR_1. When this relay drops, Normal Detection of the Point is removed due to the dropping of NWKR and its repeaters.

   Now W(R)R latches to switch over the point from detection mode to operation mode. The Inter locked relay W (R) (R) and W (N) R enables to provide super imposed detection facility in seimen's Point.

This completes the Reverse control Initiation process with Z_1RWR picking up and holding. As soon as W (R) R has latched, WKR_3 drops so that it can pick up again to detect the completion of Point operation.

3. Z1WR1 relay PU coil and Hold coil circuits: - (Refer Fig.No.9.2 circuits 1(1) & 1(2)

   (a) WR dropped contact in the circuit of Z1 WR1 proves that WR has dropped after the previous operation.

   (b) W (N)R normal contact is proved in the PU coil circuit to check for its proper working during the last operation.

   (c) The Hold coil is fed through W(R)R operated contact to keep Z_1WR_1 energised until the last stage of control and ensure initiation conditions throughout.

4. Only the P.U. coil of WKR_3 is energised during the Reverse control Initiation as its operation here is momentary.(Refer Fig.9.2 Circuit No.2(a))

5. WKR_3 contact in WKR_1 circuit makes it drop during the Reverse control initiation and WJR contact makes it drop during the Normal control initiation, as can be seen in the detection circuit of points.(Refer Fig.4.2 Circuit No.3(a)).

6. W(R)R operates proving the initiation conditions a second time to reinforce safety.(Refer Fig.4.2 Circuit No.1(1)).

7. Z_1RWR & Z1 NWR P.U. coil is energised proving the initiation conditions a third time. It is energised only so long as the buttons are pressed. Its second (Hold) coil is energised to ensure that this relay does not drop if buttons are released prematurely. (Refer Fig.9.2 Circuit No.6(a)).

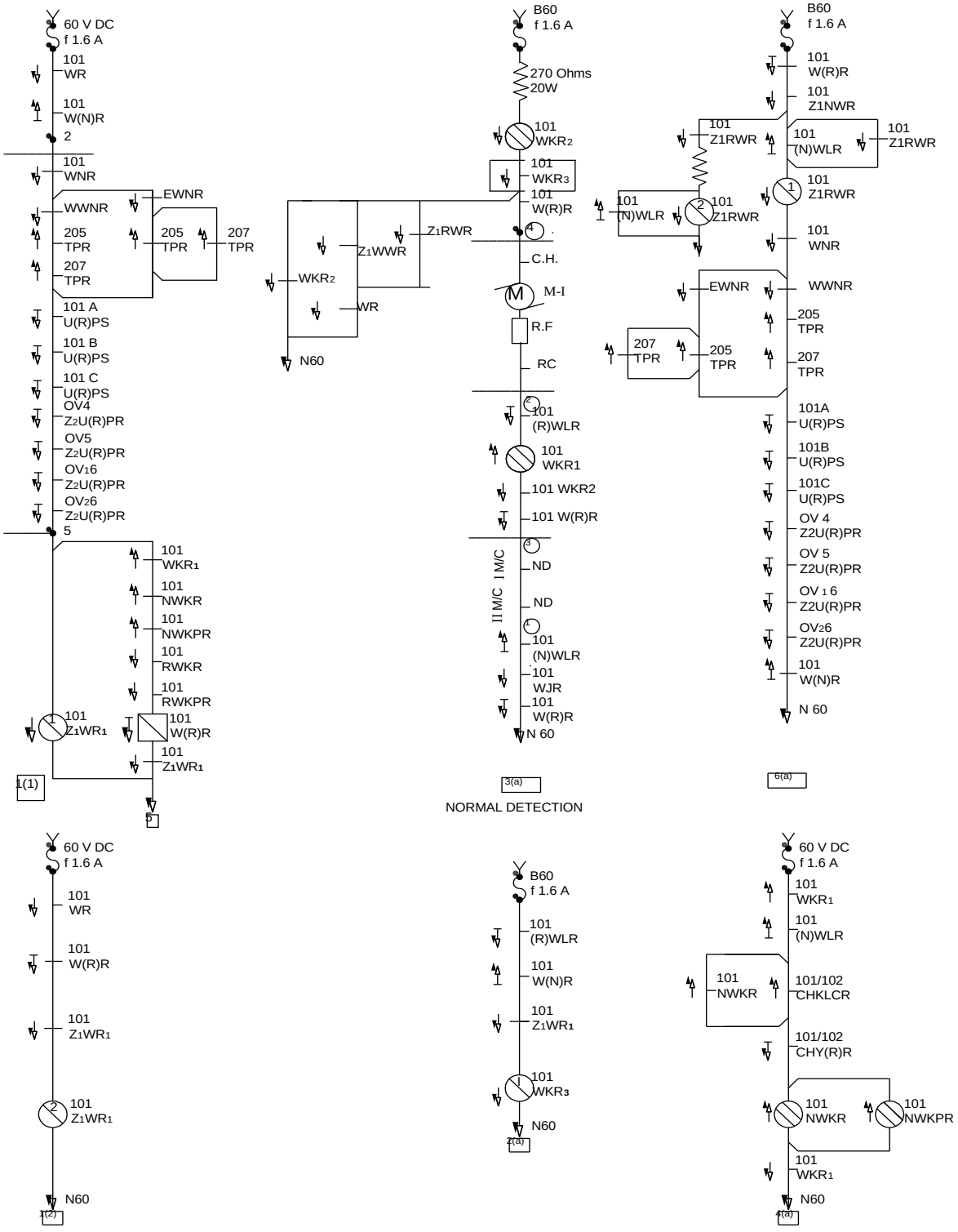


Fig. 9.2 : REVERSE INITIATION & NORMAL DETECTION

9.2.2 Normal Initiation and Reverse Detection:

The sequence is similar to that in reverse control initiation. In this, WJR picks up instead of WKR_3 to drop WKR1 and RWKR. At the end Z_1NWR operates in place of Z_1RWR.

For relay control circuits (Refer Fig.no.9.2 Circuit No.1(1) & 1(2) & Fig.9.3 circuit No.2(b))

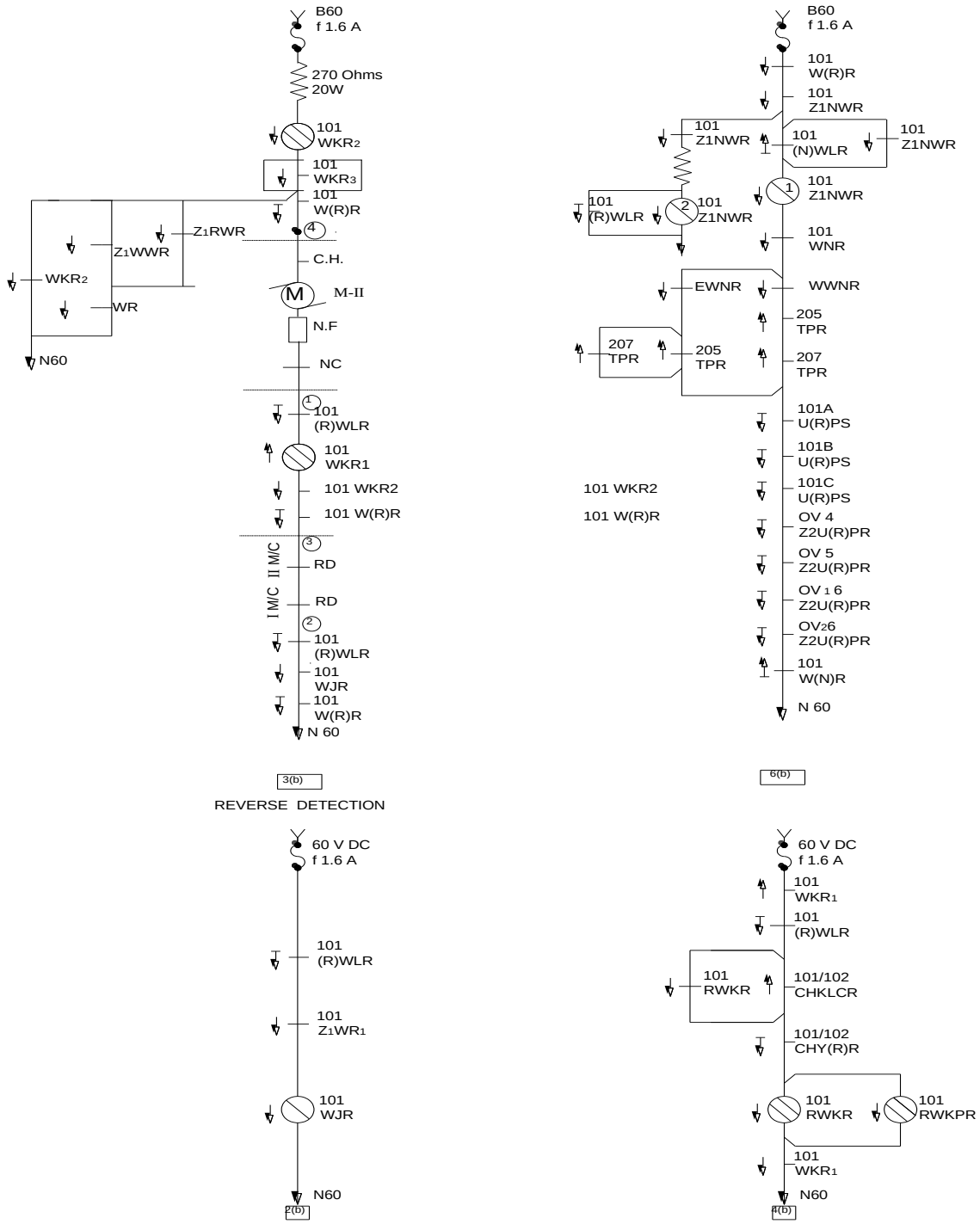


Fig 9.3: NORMAL INITIATION & REVERSE DETECTION

9.3 The relays involved in the Point Operation control and Detection is:

Sl. No.	Relay Nomenclature	Location	Description	Purpose.
1.	(R)WLR (N)WLR (Interlocked)	Point Group	Relay locking Point control in Reverse Relay locking Point control in Normal.	Establishes Reverse operation control and locks Establishes Normal operation control and locks it
2.	WKR2	Point Group	Second Point Detection Relay.	Detects disturbance of correspondence between Point and Control during operation or at any other time. Also detects Machine circuit Cable faults.
3.	WJR	Point Group	Point operation Time limiting Relay.	Affords overload protection to Point motor by cutting off operation feed when point fails to operate in time.
4.	WR	Point Group	Point control Contactor Relay.	Used for switching heavy starting current of Point motor through its front contacts.
5.	WKR3(1)	Point Group	Third Point Detection Relay P.U.coil	Detects establishment of correspondence at the end of operation if the machine circuit and switches in detection .
6.	W(R)R (W(N)R (Interlocked)	Point Group	Points Operating circuit switching Relay Points Detection circuit switching Relay.	Latches in normal to connect the Detection feed to cable when the Operation is completed. (Super imposed detection facilitating relay)
7.	WKR1	Point Group	First Point Detection Relay	Detects correspondence of Point and Control continuously for indication and further operations.
8.	CH-KLCR	Mini group	Point Crank Handle Key Lock ‘In’ Proving Relay.	Proves in cabin the locking ‘In’ of Crank Handle at site
9.	CH- Y(R)R Y(N)R (Interlocked)	Mini group	Crank Handle Key Slot Release Relay Crank handle Key Slot Normal Relay	Proves Key Slot Normal condition in Points Detection circuit.
10.	NWKR	Mini group	Normal Point Detection Relay	Detects Points Normal in various control circuits.
12.	RWKR	Mini group.	Reverse Point Detection Relay	Detects Points Reverse in various control circuits.

9.3.1 POINT OPERATION CONTROL

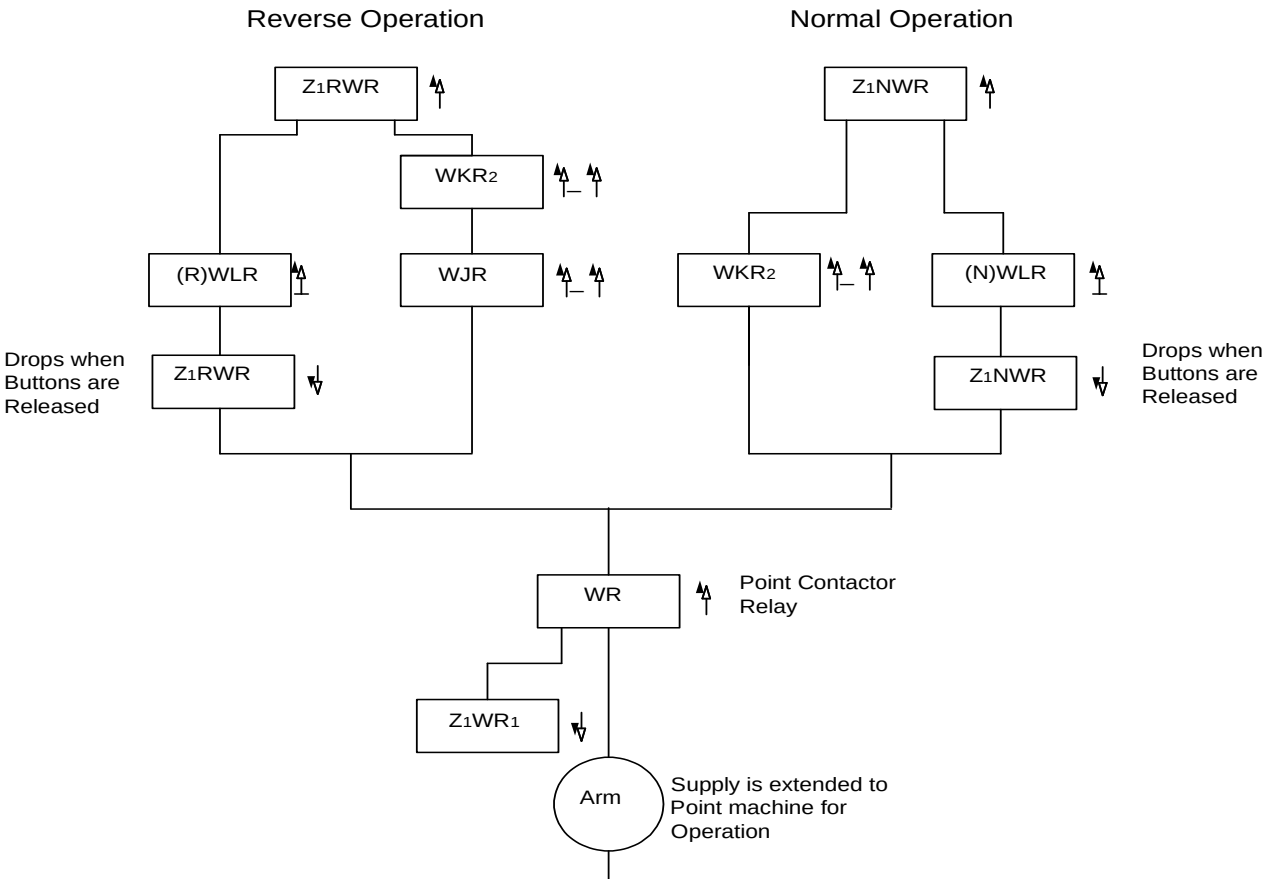


Fig. 9.4: Point Normal and Reverse Operation Control

9.3.1.1 Reverse Operation Control :

(a) At this stage, WKR_2 picks up and remains so to keep WKR_1 circuit open during Point operation.

(b) Then WJR picks up and is held through a condensor discharge circuit for a maximum period of 10 seconds, in case of Point failing to operate fully. Otherwise, it drops as soon as WKR_3 picks up at the end of operation.

(c) Z_1RWR drops after latching (R) WLR and releasing the point buttons so that Normal Initiation will be possible during the next operation.

(d) WR is the last relay to operate at this stage and drop Z_1WR_1 to keep it ready for next Initiation.

9.3.1.2 Normal Operation Control

The sequence is similar as in the case of Reverse control. In this case, WJR is already picked up during Initiation but it drops only after WKR_3 picks up or after 10 seconds. Instead of Z_1RWR relay, Z_1 NWR relay picks up.

Relay control circuits:- Refer Fig.9.5 & Fig.9.6

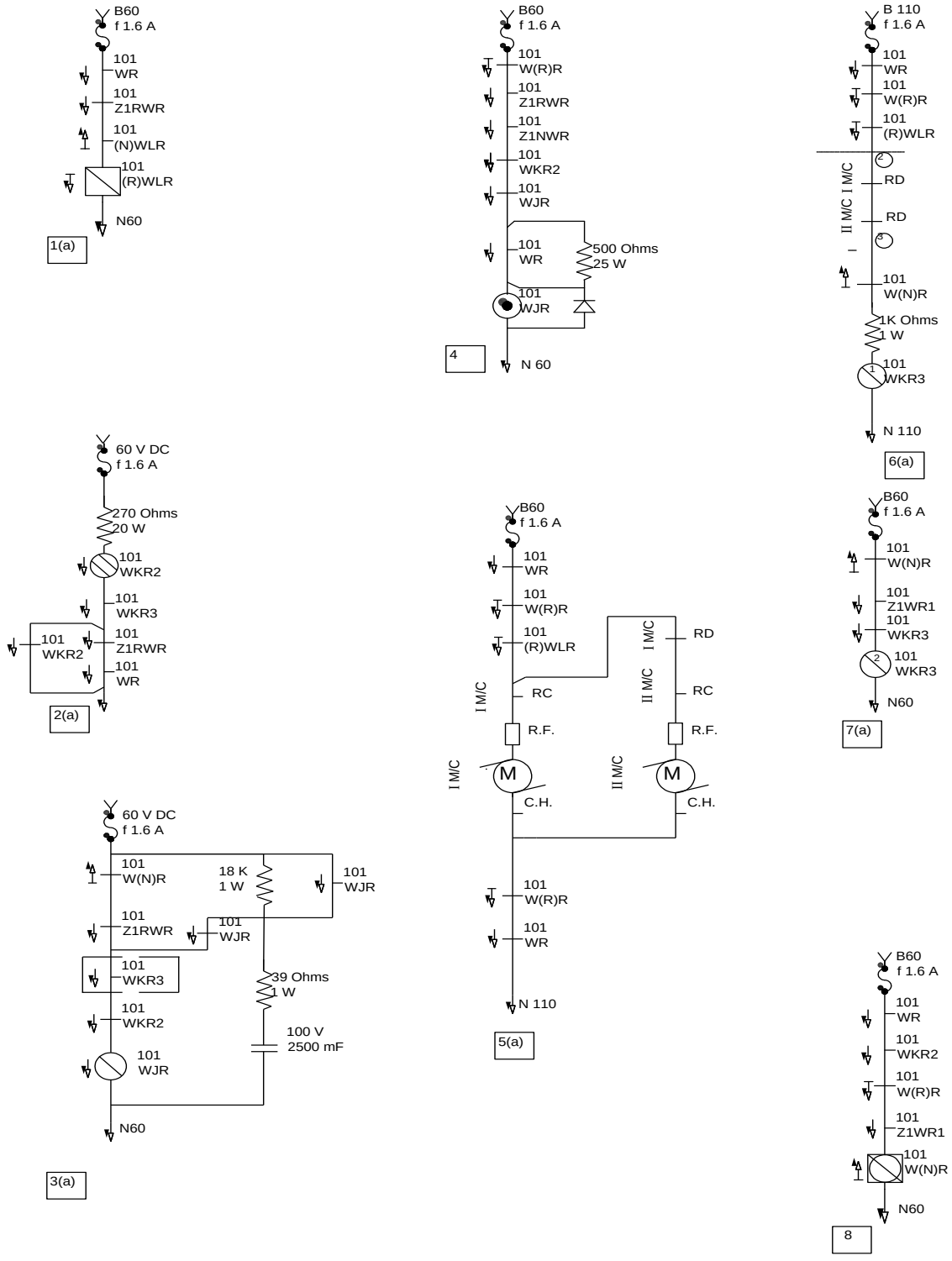


Fig : 9.5 REVERSE OPERATION

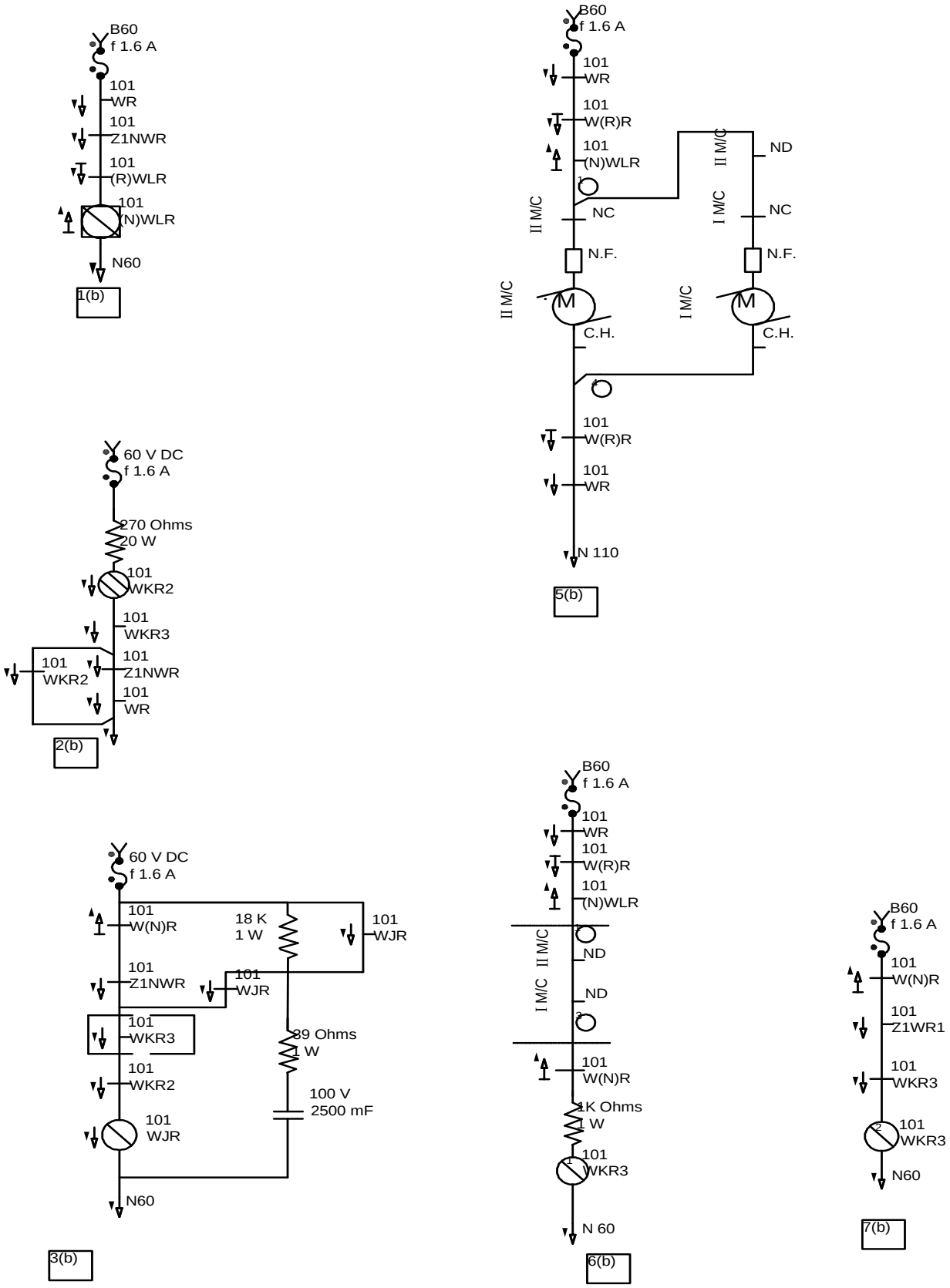


Fig: 9.6 NORMAL OPERATION

(a) (R) WLR or (N) WLR latches proving a second time that WR dropped after previous operation and that Initiation has taken place (Z_1RWR / Z_1NWR operated). (Refer Fig.9.5 Circuit 1(a) & Fig.9.6 Circuit 1(b)).

(b) WKR_2 picks up proving Initiation a second time and sticks through its own Front contact as Z_1RWR/ Z_1NWR drops soon. It proves WR dropped after previous operation a third time during its pick up.(Refer Fig.9.5 Circuit 2(a) & Fig.9.6 Circuit2(b)).

(c) WJR proves -

(i) W(R)R reversing a third time

(ii) Reverse or Normal initiation a third time and

(iii) WKR_2 picking up.

WJR Holding condenser is normally kept charged through its own back contact. The 18 KΩ resistance across this contact is for spark quenching and protection. WJR operated contact across the two limbs provides isolation between the relay pick up circuit and the condenser charging circuit.(Refer Fig.9.5 Circuit 3(a) & Fig.9.6 Circuit 3(b)).

(d) **WR Circuit::** Due to the high inductance of WR coil, caused by its initial pick up current surge , the back e.m.f generated causes a high current to be discharged through a rectifier across it. To avoid interference of this current with other circuit contacts, a WR back contact is included in the circuit with a 500 Ohm resistance across it for protection. This resistance also keeps the relay circuit closed after its NC (back) contact is opened. .(Refer Fig.9.5 Circuit 4).

(e) **Point Machines operating circuit*:*** Four feed lines are connected between the control relay group and the first end Point Machine. Five feed lines are between the first Machine and the second Machine where provided.

Reverse Operation: 110V D.C Operating Feed is switched to the first machine through line No.2 by W(R)R reverse contacts in series with WR and (R)WLR operated contacts. The negative is connected through line No.4. The first machine circuit is opened at the end of its operation when its reverse control contacts open to close reverse detection contacts.

Now, the Operating circuit is extended to the second machine through the Reverse detection contact of first machine to close through line No.4 as before. When the operation of second machine is completed, its Reverse Control contacts open and Reverse Detection contacts are closed, with the point operation supply WKR3 relay picks up and disconnects a supply to WR relay thus WR drops and disconnects a supply to point machine. In case of any machine failure to complete the operation, the feed gets cut off with the dropping of WR caused by the dropping of WJR after 10 seconds.(Refer Fig. 4.5 Circuit 5(a)).

Normal Operation: This operation takes place in a similar way except that lines No.1 & 4 connect feed to the machines.(Refer Fig.9.6 Circuit 5(b)).

9.3.2 POINT OPERATION AND DETECTION

DETECTION OF CORRESPONDANCE BETWEEN POINTS & CONTROL:

This takes place in the same manner after both Normal and Reverse operation.

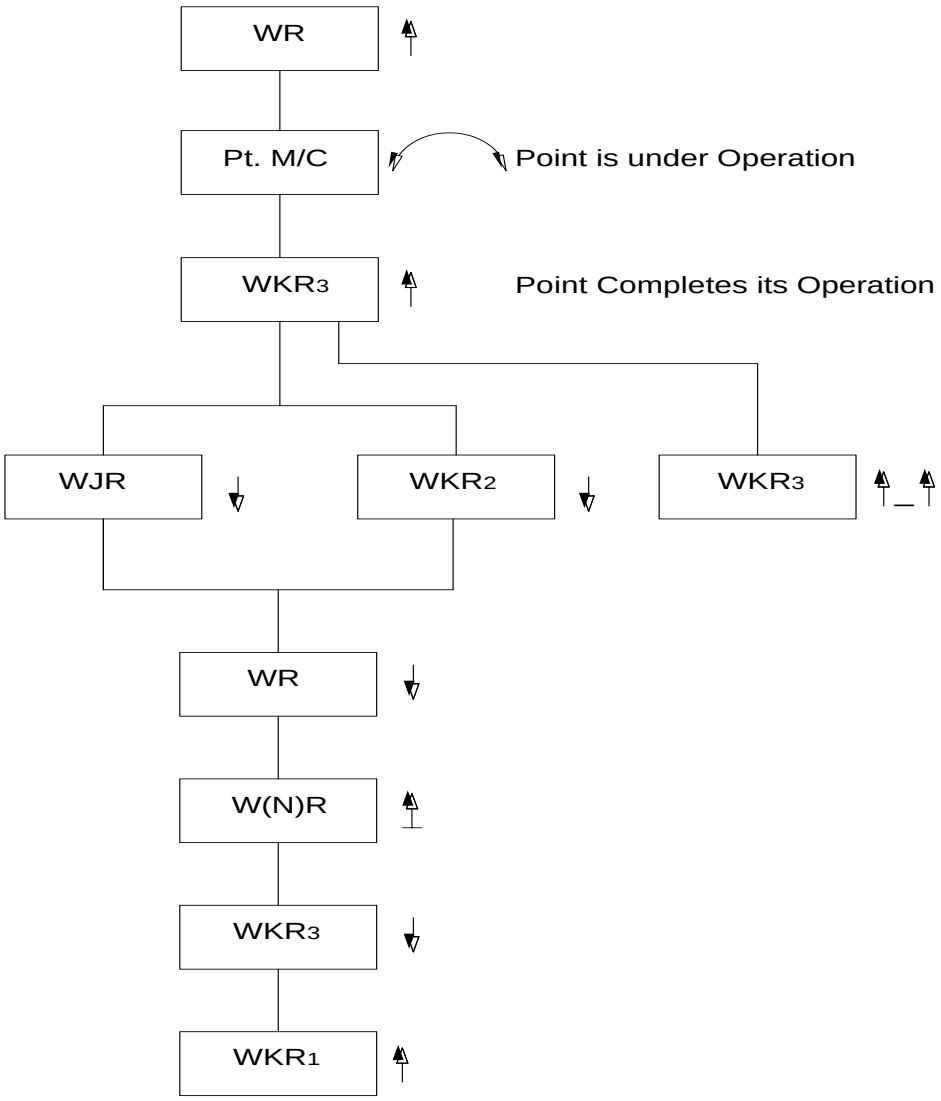


Fig.9.7: POINT OPERATION & DETECTION FLOW CHART

9.3.2.1 WKR3 circuits: When the operation of last point machine is completed, 110V operating feed is diverted through its Reverse or Normal Detection contact (as the case may be) and line No.3 to the first (PU) coil of WKR3 relay with a 1000 Ohm resistance in series. WKR3 picks up to drop WJR and WKR2 relays.(Refer Fig.9.5 Circuit 6(a) & Fig.9.6 Circuit 6(b)).

Then the second coil of WKR3 gets 60V feed through its own N.O (front) contact as this relay shall not drop prematurely during the latching of W (N) R. (Refer Fig.9.5 Circuit 7(a) & Fig.9.6 Circuit 7(b)).

9.3.2.2 W(N)R circuit:

(a) WR back contact ensures that the operation supply is disconnected.

(b) WKR2 back contact ensures that the point is in correspondence.

(c) Z1WR1 back contact to check the integrity of the relay.

(d) W(R) R front contact is the economiser contact

9.3.2.3 WKR1 circuit:

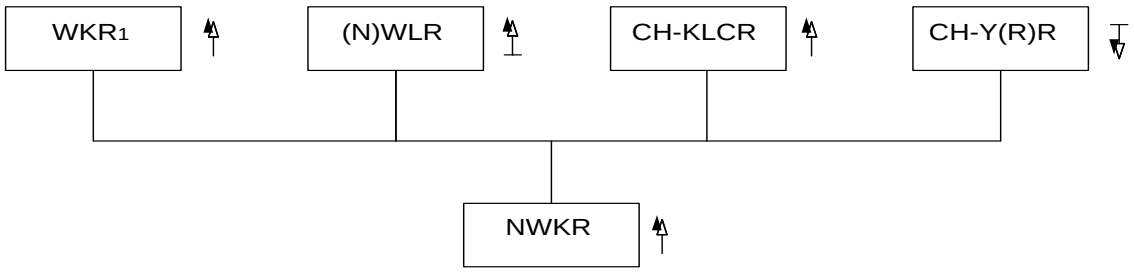
(a) The circuit current is so limited by a 270 Ω resistance in series that WKR2 of 52.3 Ohm coil resistance cannot pick up but WKR1 of 1840 Ohm coil can pick up. This is because the voltage drop across the relays is such for the given circuit current that only WKR1 can pick up. WKR_2 is connected in WKR_1 circuit so that it can pickup with rise in circuit current caused by cable short or earth faults and drop WKR_1.

(b) WKR_1 circuit is completed through all the 4 lines between control and the first Point machine, and through 3 lines between the first and second machines. (5 lines are there between 1st & 2nd m/c)

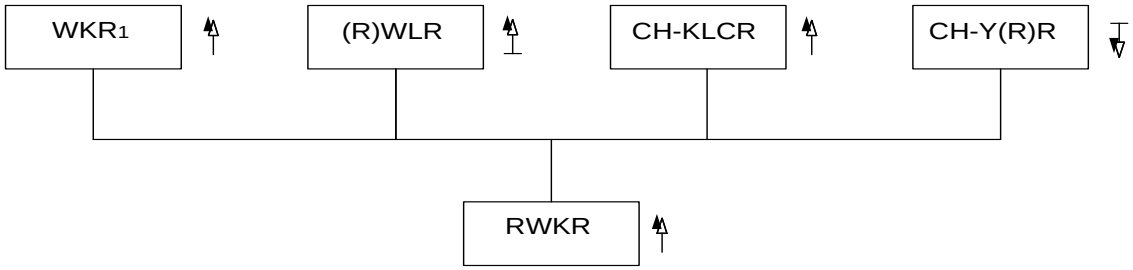
With Point in Reverse, the circuit can be traced through line no.4, II M/c motor & NC contact, Line No.1, WKR_1 relay, Line No.3, RD contact of II M/c, RD contact of I M/C and line No.2.

(Refer Fig.9.3 Circuit 3(b)).

With point in normal, the circuit can be traced through line no.4, I M/c motor & RC contact, line no.2, WKR_1 relay, Line No.3, ND contact of I M/c, ND contact of II M/c and line no.1.(Refer Fig.9.2 Circuit 3(a)).



NORMAL DETECTION



REVERSE DETECTION

Fig.9.8

9.3.2.4 Relay control circuits: Refer Fig. 9.2 Circuit 9(a) & Fig.9.3 Circuit 9(b)).

For **NWKRs and RWKRs**, holding circuits are provided through their own front contacts across CHKLCR pick up. This is because they shall not drop as soon as CHKLCR is disturbed from site by pressing CHKLR button until after the release of crank handle key from cabin. The condition may not be favourable for releasing crank handle key immediately on demand from site.

Combined Circuit diagrams of Point Relay Group, Machine Operation & Detection.

Combined Circuit Diagrams of point Relay Group, Machine Operation & Detection is shown below. (**Refer Figs.9.9, 9.10)**

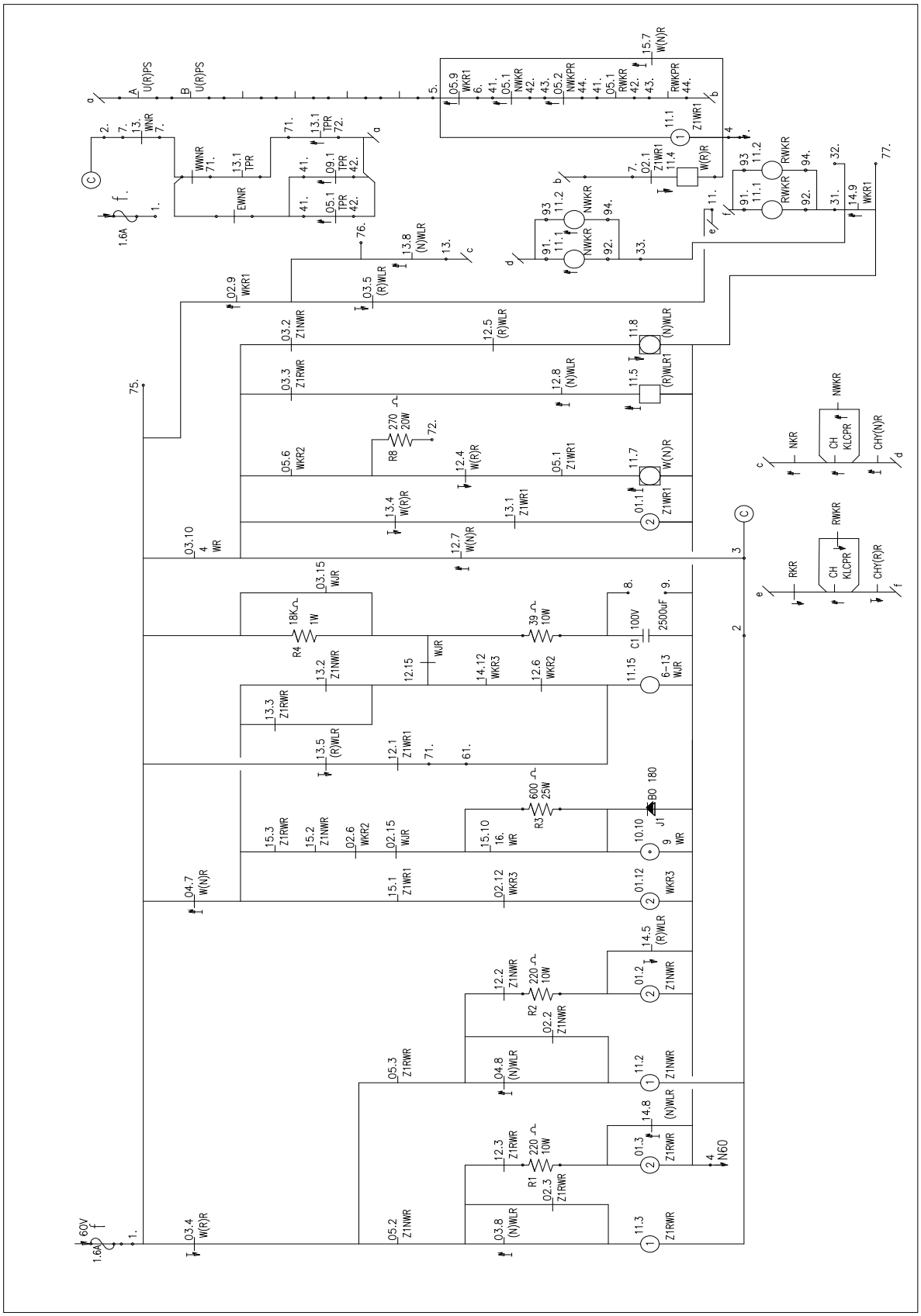


Fig. 9.9: POINT OPERATION CIRCUIT

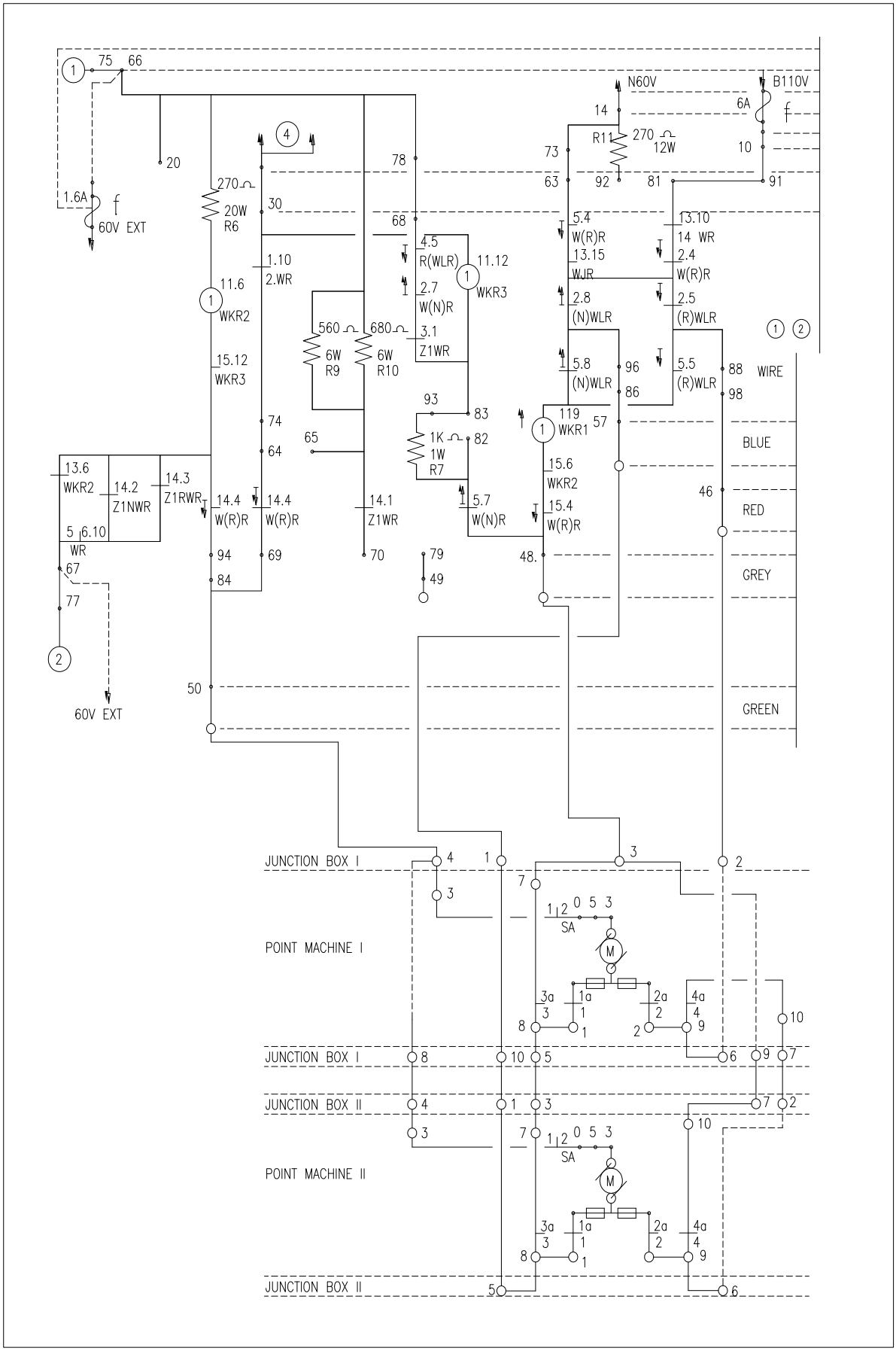


Fig. 9.10: POINT OPERATION CIRCUIT AND DETECTION CIRCUIT

9.4 Sequence of Relay operation for Point operation and its detection:

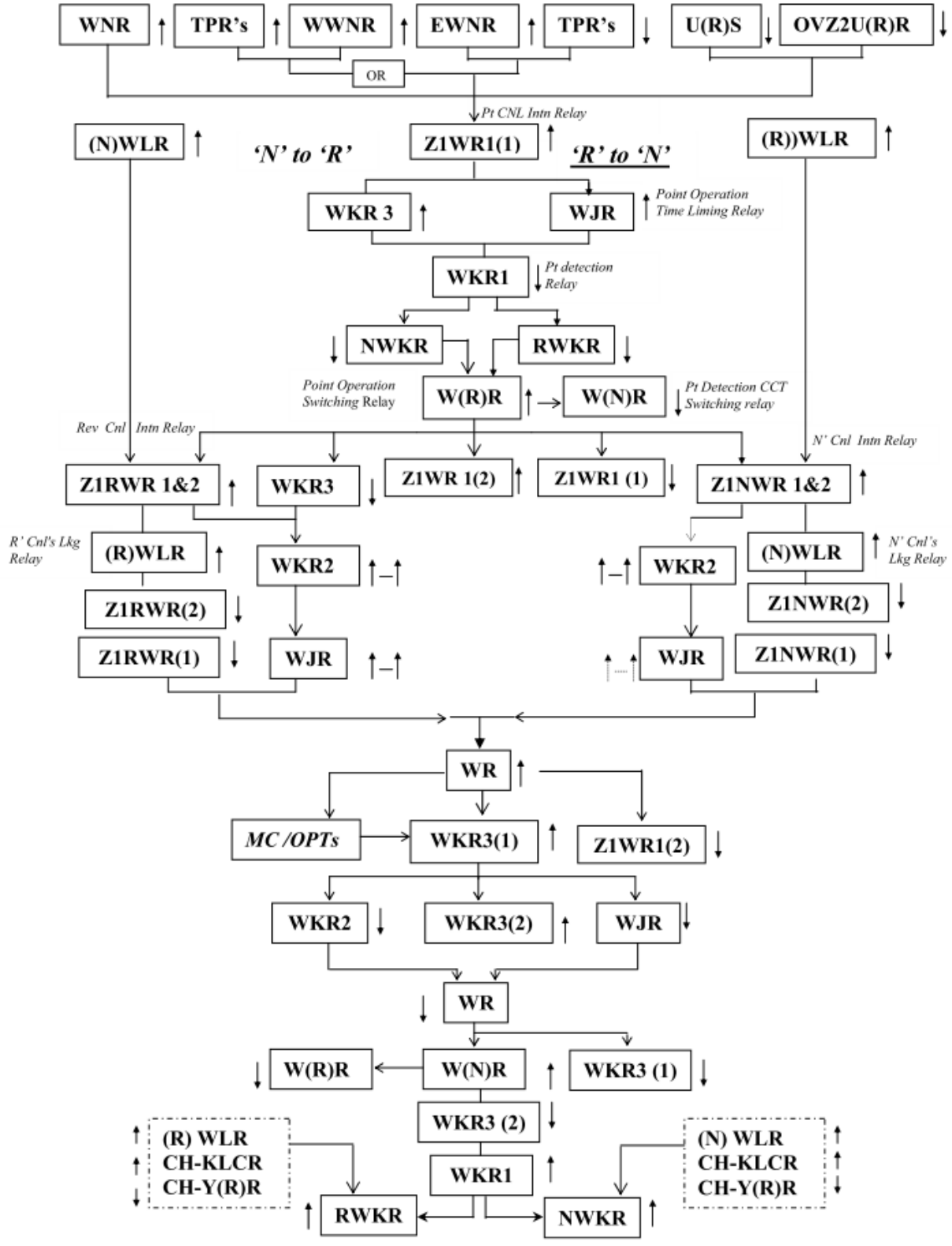


Fig. 9.11: POINT OPERATION SEQUENCE FLOW CHART

* * *