इरिसेट IRISET

S 23

TOKENLESS BLOCK INSTRUMENTS FOR SINGLE LINE

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

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FOR SINGLE LINE

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INDIAN RAILWAYS INSTITUTE OF
SIGNAL ENGINEERING & TELECOMMUNICATIONS
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CHAPTER 1: INTRODUCTION

HANDLE TYPE TOKENLESS BLOCK INSTRUMENT FOR SINGLE LINE IRS SPECIFICATION NO. IRS-S-98-2001

1.0 Introduction

Due to various steps involved in extracting Token, handing over of token to Loco Pilot, handing over of token to Station Master (SM) at Receiving station and sometimes token loss causes train delay. Hence Token block working is not suitable for heavy traffic and high-speed sections. In this context, Token less block working is introduced in Indian Railways.

1.1 The Signal Standards Committee (SSC) in the 29th Report recommended the introduction of Tokenless Block working on the Indian Railways to increase the line capacity and the same was accepted by the Railway Board. Accordingly, trials were conducted on the instruments supplied by the Daido Signal Company of Japan, which was accepted, and the first pair of Tokenless instruments was introduced in 1959-60 on the Khurda Road - Ratang Section of the South Eastern Railway. There were certain defects in the design of the Instruments and the circuit adopted in the instruments supplied by the company. The Signal Standards Committee examined these in 1962, which recommended certain modifications by the Railway Board. All the modifications could not be introduced in the instruments already in use of the South Eastern Railway for which only certain minimum alterations, which are essential for safety, were made. However, in the instruments supplied by the company, later on all these modifications were approved by the Railway Board and subsequently incorporated. In this chapter, the modified design and circuits are described.

1.2 The modified instruments are designed to work either on 1800Hz or 2700Hz Carrier frequencies. The Modulating frequencies are 85 Hz and 65 Hz and these are common for all the instruments. As per the recommendations of SSC the frequencies used should be such that the band pass filters can effectively discriminate them.

The codes used in the instrument are

(a) 1800Hz or 2700Hz modulated by 85Hz with DC +ve, to permit operation of block handle from Line Closed to Train Coming from (TCF), TCF to Line Closed and Train Going To (TGT) to Line Closed.

(b) 1800Hz or 2700Hz modulated by 65Hz with DC +ve, to permit operation of Block handle from Line Closed to TGT.

(c) 1800Hz or 2700Hz modulated by 65Hz, to set the other end instrument to Train on Line (TOL).

(d) DC -ve for exchanging bell code signals.

Note: (i) DC +ve refers to line battery +ve connected to line 1 and -ve to line 2

(ii) DC -ve refers to Line battery -ve connected to Line 1 and +ve to Line 2.

1.3 System configuration

The external appearance of the instrument is shown in Fig: No. 1.1.

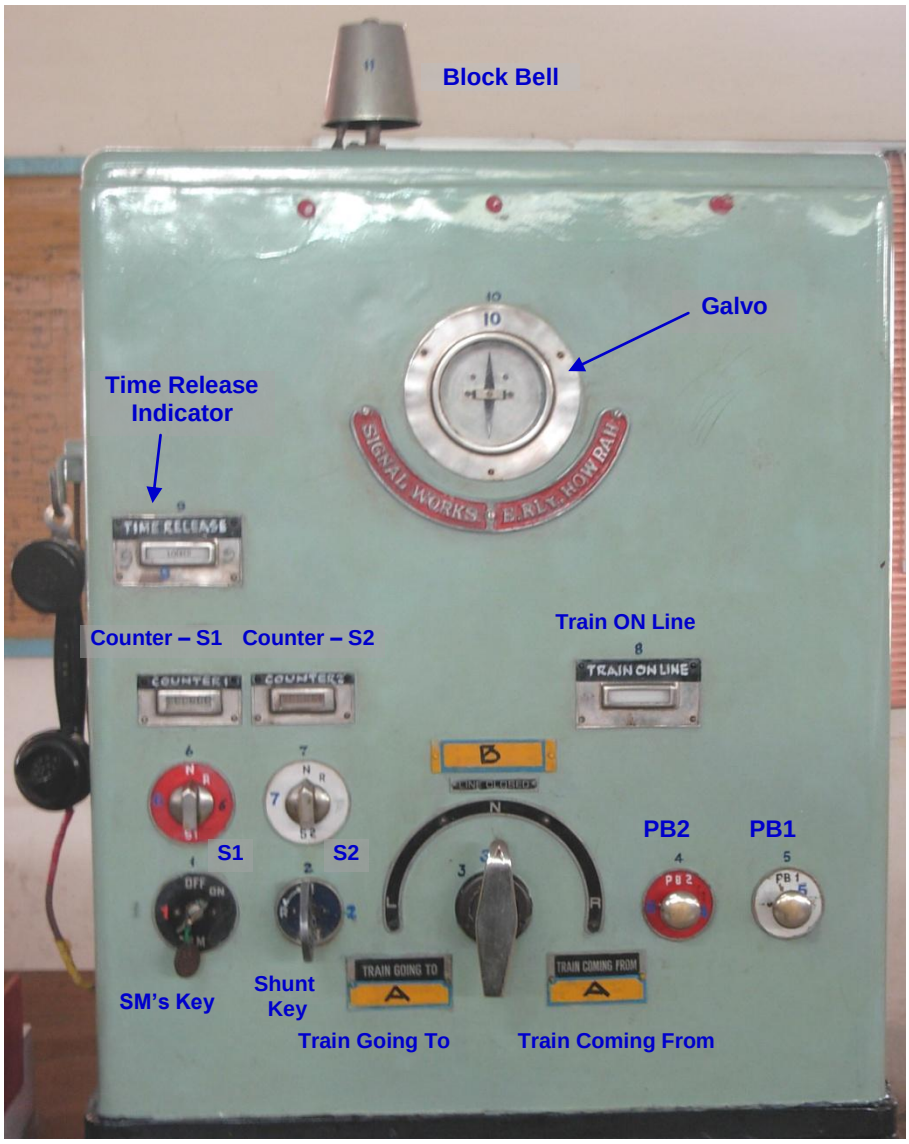


Fig: No.1.1

The instrument consists of the following parts

(a) Galvanoscope: This indicates incoming and outgoing DC currents. The resistance of the coil is 18.2 Ohms.

(b) Time Release Indicator (TEK): This indicator is operated during cancelling line clear operation when the required time delay has taken place. This is operated by 3R relay. Normally the indicator displays white with caption LOCKED and changes over to green with caption FREE when operated. The resistance of the coil is 200 Ohms.

(c) Switch S1 with counter: It is used for cancellation of Line Clear. The counter registers the number of such operations.

(d) Switch S2 with counter: It is used for normalizing the instrument in the event of a train pushing back to the starting station. The counter registers the number of such operations.

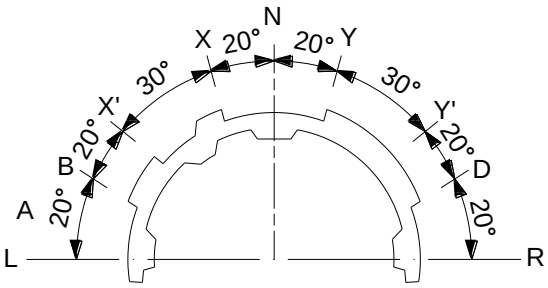
(e) TOL Indicator (TOLK): This indicator normally displays a white indication and displays red indication with caption TRAIN ON LINE when a train enters the block section. This is magnetic latch type indicator. It consists of normal and release coils wound to a resistance of 500 and 200 ohm respectively. The normal coil is energized via front contact of TOLR. The release coil is energized via XX' and YY' contacts of block handle.

(f) Push Button PB1: This is a push button used to transmit DC pulses for exchanging bell code signals.

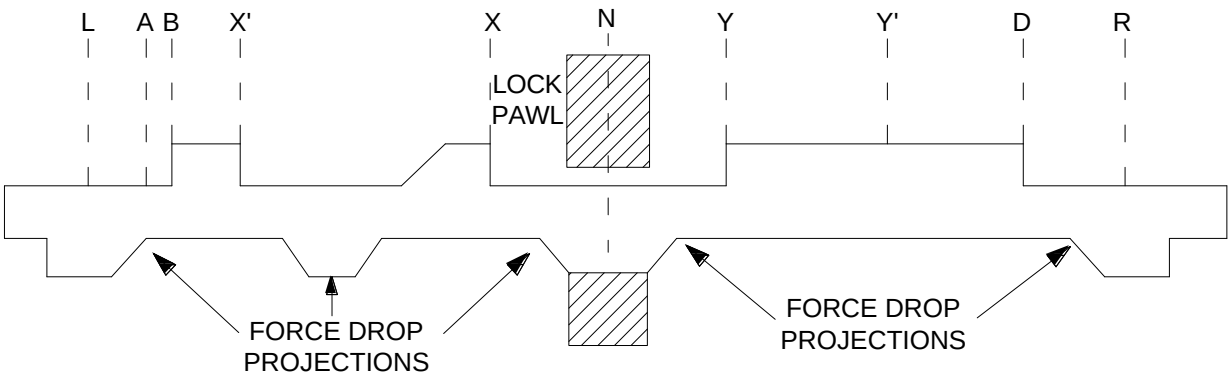
(g) Push Button PB2: This is a push button used in conjunction with PB1 to transmit Frequency modulated signal.

(h) Block Handle: This is located in the front on the lower part of the instrument and can be turned from Normal (N) i.e., Line Closed to TGT (L) or TCF (R) position and back to N position. Different contact positions of the handle are as shown in Fig.1.2. The handle is free to be turned between X & Y, R & D and also between L & B. Movement of the handle to TCF, TGT and back to Normal position from TCF or TGT is controlled by an electrical lock and this lock is required to be energized at Y position for turning the handle to TCF and at D or B position for turning from TCF or TGT to Normal respectively. For turning to TGT, the lock is initially energized at X position but gets force dropped before X' and is actuated at X' position for further movement to TGT. The locking effective at X' is termed as check locking and is provided to ensure the conscious co-operation of the operator at the other end. This locking is however, not effective while turning the handle from TGT to normal even though the lock is force dropped. This is because of the beveled edge of the notch concerned, on which the lock just slides over and does not cause an obstruction to the movement of the handle.

The block handle assembly consists of 24 sets of spring contacts actuated during the course of handle operation.



POSITION OF BLOCK HANDLE



FORCE DROP LOCKING ARRANGEMENT

Fig: 1.2 CONTACT POSITIONS AND LOCKING POSITIONS OF BLOCK HANDLE

(i) Single Stroke bell: This is mounted on top of the instrument and is used for exchanging bell codes. The bell coil is wound to a resistance of 310 ohm and requires about 70 mA for operation.

(j) Buzzers: There are two transistorized buzzers inside the instrument. Buzzer BZ1 operates when a train enters block section, i.e., along with the appearance of TOL indication. The buzzer BZ2 operates when the train clears the block section, i.e., when last vehicle track circuit (LVT) is cleared. The output of both the buzzers is connected to a common speaker.

(k) SM's Key: When this key is removed, the instrument is inoperative for all functions except for the reception of bell codes or reception or transmission of TOL code.

(l) Shunting Key: This normally remains inserted in the instrument and can be removed only if the block handle is in Line Closed/TGT position. If the key is removed, the instrument handle is locked mechanically. The insertion and extraction of key can be done only when SM's key is inserted and turned to ON. Provision shall be made for a shunting key suitably interlocked with the instrument for use as authority for the loco pilot to pass the LSS at ON for shunting up to the opposing FSS. The key shall be robust and so designed that the key of one instrument cannot be inserted in any other instrument

(m) Transmitter: This gives a Frequency Modulated (FM) output when the DC feed is connected to the transmitter by different selections. The transmitter selects the modulating frequency by an external loop completed through the relevant selections according to the condition of the Block Instrument.

(n) Receiver: This receives the FM signals transmitted from the other end and gives DC output for energizing either CR1 or CR2 depending on the modulating frequency of the code received. The receiver is switched on when the DC feed is connected through the relevant selections.

(o) Level Adjust Switch: It is a Three-position switch associated with the transmitter. It selects the level of the signal output from the transmitter

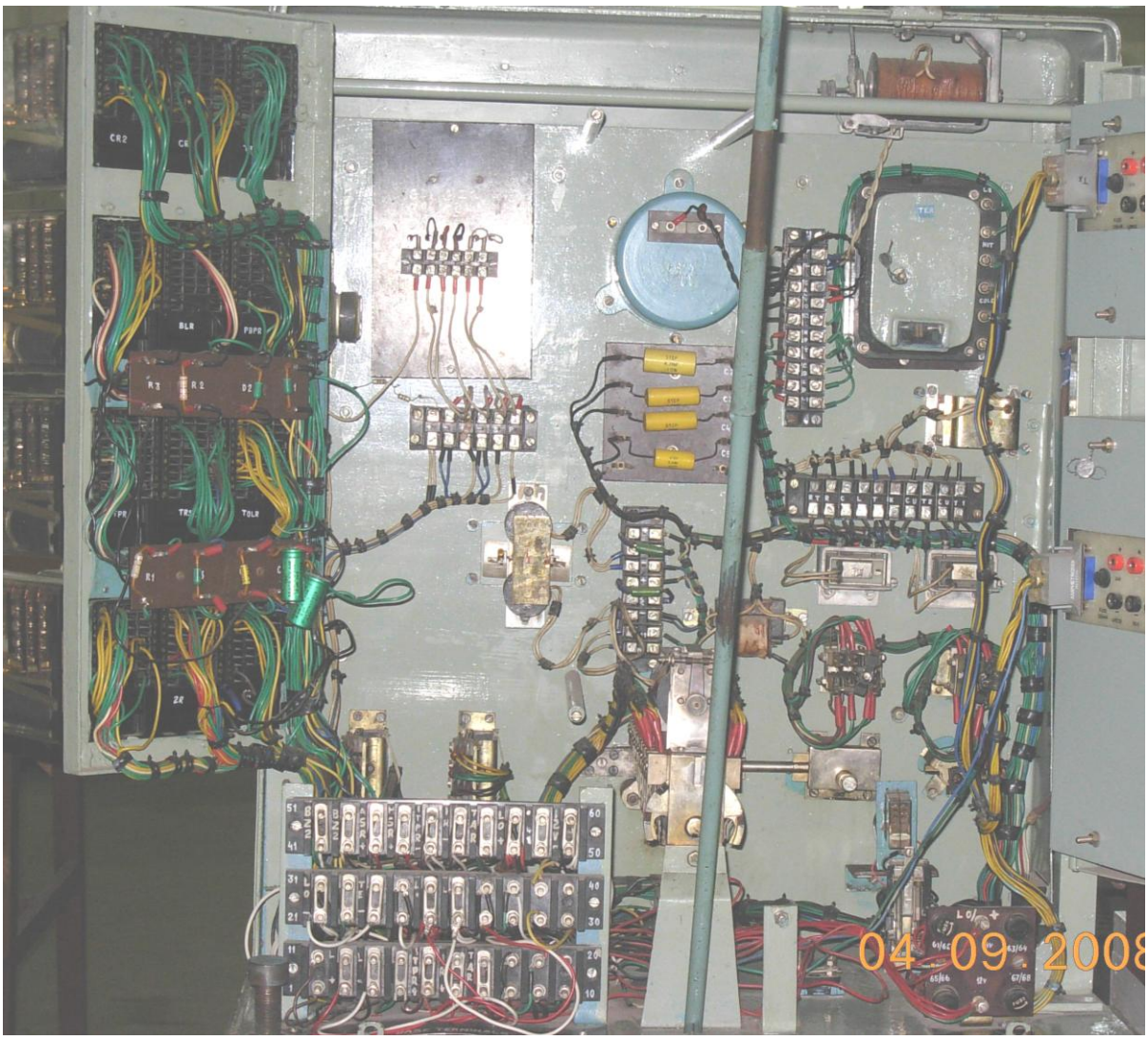
(p) Attenuator: This is associated with the receiver. Attenuator switch having various positions can be set to introduce the required db loss on the received signal. For DCC make receivers the attenuator switch is not available.

(q) Impedance Switch: This is a switch having three positions for 600, 1120 and 1300 ohm. When the instruments are connected with overhead lines, the switch is put on 600 ohm side and when connected with underground cables, the switch is put on to the 1300 ohm side to obtain proper impedance match and to 1120 ohm when the instrument connected through RE cables. For DCC make Transmitter and receiver the impedance switch is having only two positions i.e. 600 & 1120 ohm.

(r) SNR indicator: shall be provided to indicate normal condition of all the signal controls pertaining to reception and dispatch of trains.

(s) Siding key: To be provided if outlying siding exists between two stations.

(t) Telephone: For communication between two stations



INTERNAL VIEW OF FM BLOCK INSTRUMENT

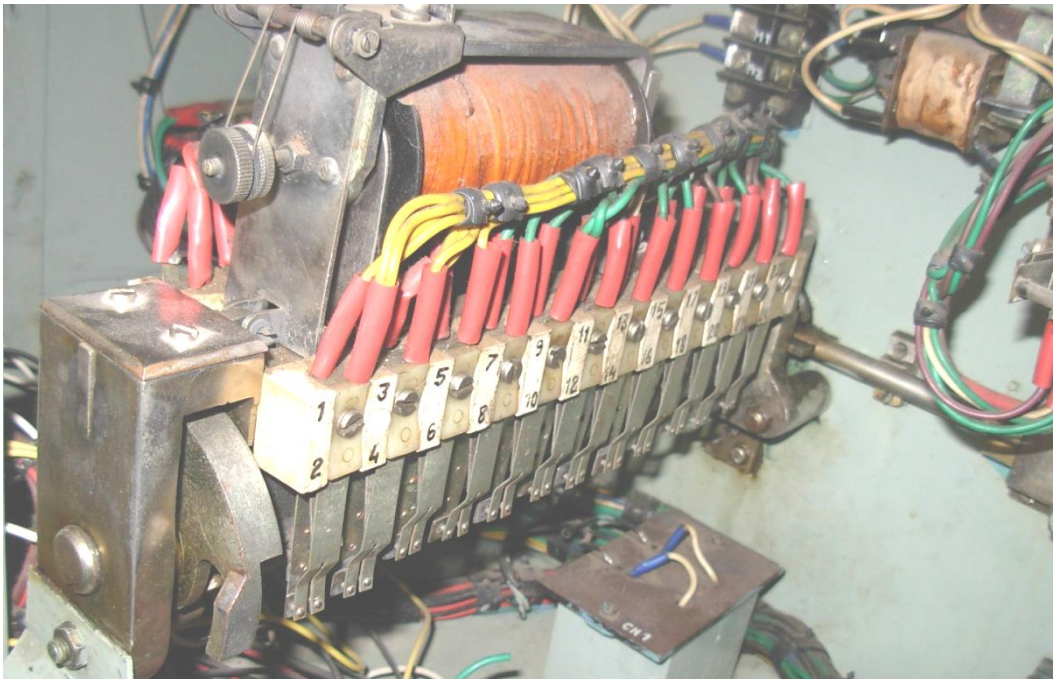


Fig: 1.3 Inside View of the Block Handle with spring contacts

1.4 Sequence of operation for sending train from station A to Station B

(a) Station A Presses PB1 button and transmits bell code signal to station B.

(b) Stn B acknowledges and also advises Stn A on telephone of his willingness and repeating the bell code signal for 'Is line clear' sent by Stn A.

(c) Stn A now presses PB1 & PB2 buttons then a Carrier (1800/2700Hz) modulated by 85Hz FM signal along with a DC +ve code is transmitted.

(d) Stn B turns his block handle to TCF position.

(e) Stn B now presses PB1 & PB2 buttons then a Carrier (2700/1800Hz) modulated by 65Hz FM signal along with a DC +ve code is transmitted.

(f) Stn A turns his block handle to TGT position.

(g) Stn A clears the Last Stop Signal (LSS) and a train departs from Stn A. On passing the LSS, the First Vehicle Track (FVT) circuit is actuated, LSS is automatically restored to ON position and a Carrier (1800/2700Hz) modulated by 65Hz FM signal is automatically transmitted to stn B. TOL indication along with a buzzer appears at stn A. The LSS knob is restored to normal at stn A.

(h) Simultaneously TOL indication along with a buzzer appears at Stn B as the train entered the block section at Stn A. Stn B acknowledges the TOL buzzer by pressing PB1.

(i) At Stn A, transmission of the Carrier modulated by 65Hz FM signal ceases and buzzers at Stn A & Stn B stop sounding but TOL indications at both stations persist.

(j) Now Stn B Clears FSS (First Stop Signal). After passage of FSS the Train duly actuates the block overlap track circuits and clears the block clearance point causing a buzzer to sound continuously. After ensuring complete arrival of train, Stn B normalises FSS knob. Then train arrival buzzer stops sounding. Then Stn B transmits Train out of section signal by pressing PB1 & PB2, thereby a Carrier modulated by 85Hz FM signal along with a DC +ve code is sent to Stn A.

(k) At Stn A the FM signal and DC +ve is received. Stn A turns block handle to Normal (Line Closed) position. TOL indication disappears at Stn A. Stn A now acknowledges the signal by pressing PB1 & PB2 buttons, then a Carrier modulated by 85Hz along with a DC +ve code is transmitted to Stn B.

(l) Stn B turns block handle to normal. TOL indication also disappears at Stn B. Now both the block instruments are normalized.

1.5 Cancellation of Line Clear before allowing a train in to the Block Section.

(a) To (f) Same as in 1.4

(g) Stn A clears LSS (If line clear cancellation is warranted)

(h) Stn A informs Stn B that Line Clear obtained is to be cancelled and reverses switch S1, immediately LSS becomes ON, with LSS knob in reverse. After normalizing LSS knob, S1 counter registers a higher number half way. After a delay of 120 seconds, S1 counter registers a higher number, time-release indicator changes from LOCKED with white background to FREE with green background. Stn A puts switch S1 to normal, and presses PB1 & PB2 buttons then a carrier modulated by 85Hz FM signal is transmitted to B along with DC +ve.

(i) On receipt of the signals, Stn B turns block handle to normal position and in turn presses PB1 & PB2 buttons to transmit a carrier modulated by 85Hz FM signal to Stn A along with DC +ve.

(j) A turns block handle to normal position, and both the instruments are normalized.

1.6 Closing the Block Section when a train pushes back to the same Station from which it had left.

(a) To (f) Same as in 1.4

(g) Stn A clears LSS, train enters into block section and goes beyond opposite FSS.

(h) Stn A reverses switch S2 and clears FSS. S2 counter registers higher number. Train on passing FSS, restores FSS to ON position automatically. When train operates block overlap track circuits, a buzzer sounds continuously at Stn A, which stops when FSS knob is normalized. SM, after ensuring complete arrival of the train operates S2 to normal and presses PB1 & PB2 buttons, and then an FM signal along with DC +ve is transmitted to Stn B.

(i) Stn B turns block handle to Line closed and then presses PB1 & PB2 buttons. Then an FM signal along with DC +ve is transmitted to Stn A.

(j) Stn A turns block handle to Normal position, and both the instruments are normalized.

1.7 The following relays are housed inside the block instrument

(a) PBPR: This is a DC neutral relay (QN1) energized when PB1 & PB2 are pressed together or PB1 is pressed, when TOLR relay is energized with Block handle in R position. This relay when energized connects the line battery positive to L1 and negative to L2 to pick up NR relay at the other end. PBPR, when dropped, connects NR relay to line. In addition the local battery 24V is connected to the transmitter of the same instrument.

(b) NR relay: This is a DC QBA1 line relay energized when +ve is received on L1 and -ve on L2. A rectifier is used in series with this relay to regulate the line current.

(c) BLR: This is a DC QBA1 line relay energized, when -ve is received on L1 and +ve on L2. A rectifier is used in series with this relay also. This relay is used for exchange of Bell Codes.

(d) TEPR Relay: This is a DC neutral relay (QN1) energized when the prescribed time delay is lapsed after TER or Electronic Timer is operated.

(e) TELR: This is a telephone type (miniature) relay having a resistance of 70 ohm, which is energized when the pressel switch of hand micro telephone (HMT) is pressed. This relay connects the telephone circuit to the line through its front contact and isolates the transmitter and receiver from lines as they are connected to lines through its back contact.

(f) 3R: This is a DC neutral relay (QN1) used for line clear cancellation. It also operates the time release indicator. It operates after 120 seconds on operating switch S1, when the train has not entered the block section and the instrument is in TGT position.

(g) 1R: This DC neutral AC immunized relay (QNA1) proves the normal condition of the signals concerned to the block section. It remains normally energized to prove the LSS and FSS knobs are in normal position in addition to other selections if any.

(h) TRSR: This is a DC neutral relay (QN1). This Train sending relay picks up when operating handle is being turned to L position, and sticks in the LX' position. It releases when the train passes the FVT circuit and can pick up again only when the handle is restored to normal, and the above sequence is repeated. This is the relay, which complies the 'one train one line clear' principle.

(i) TOLR: This is a DC neutral relay (QN1). Train on line relay operated when the train occupies the FVT circuit when the operating handle is in L position or on receipt of the TOL code when the handle is in R position. TOLR when operated gives TOL indication and sounds buzzer BZ1. This picks up only after CR2 picks up at train receiving station.

(j) TER: Electronic Timer, having a resistance of 50 ohm at 20° C that causes a time delay in cancelling Line Clear. When the switch S1 is operated to reverse and LSS knob normalized, hot contact is made first and later on cold contact is made once again. The time delay is about 120 second. In the latest version the relay TER is being replaced by approved type of Electronic Timer.

(k) CR1: This is a DC neutral relay (QN1). Code Relay1 picks up when a carrier (1800/2700 Hz) modulated by 85 Hz is received from the distant station. When energized releases electromechanical lock on the block handle through other relevant selections for the operation of the handle from 1) N to R 2) R to N & 3) L to N.

(l) CR2: This is a DC neutral relay (QN1). Code Relay2 picks up when a carrier (1800/ 2700Hz) modulated by 65 Hz. is received from the distant station. When energized releases electromechanical lock on the block handle for the operation of the handle from N to L only. It also energizes TOLR in the other end instrument during TOL code transmission.

(m) 2R: This is a DC neutral relay (QN1) used for proving the arrival of the train.

(n) 1TPR: This is a DC neutral AC immunized relay (QNA1) used as LSS TPR.

1.8 In addition to the relays housed in the instrument, two line relays HSR and ASR are also required for controlling the FSS and LSS respectively. HSR relay when energized extends the feed to FSS. ASR relay picks up when block handle is in TGT position with TRSR energized, and with other relevant selections. The front contact of the relay controls the feed to the LSS

1.9 There are two track circuits, with associated relays, which operate in conjunction with the movement of the train. The track circuit associated with the LSS is normally a closed track circuit and its relay is normally energized and it controls the operation of relay TRSR through its repeater relay 1 TPR in the instrument.

There are total 14 number of relays used. Details of which are shown in the table below

S.No.	Type	Description	Contacts	Total Relays
1	QN1	Neutral Relay	8F-8B	8
2	QNA1	Neutral AC Immunized Relay	8F-8B	2
3	QBA1	Biased AC Immunized Relay	8F-8B	2
4	TELR	Telephone Relay	8F-8B	1
5	TER	Electronic Timer	--	1

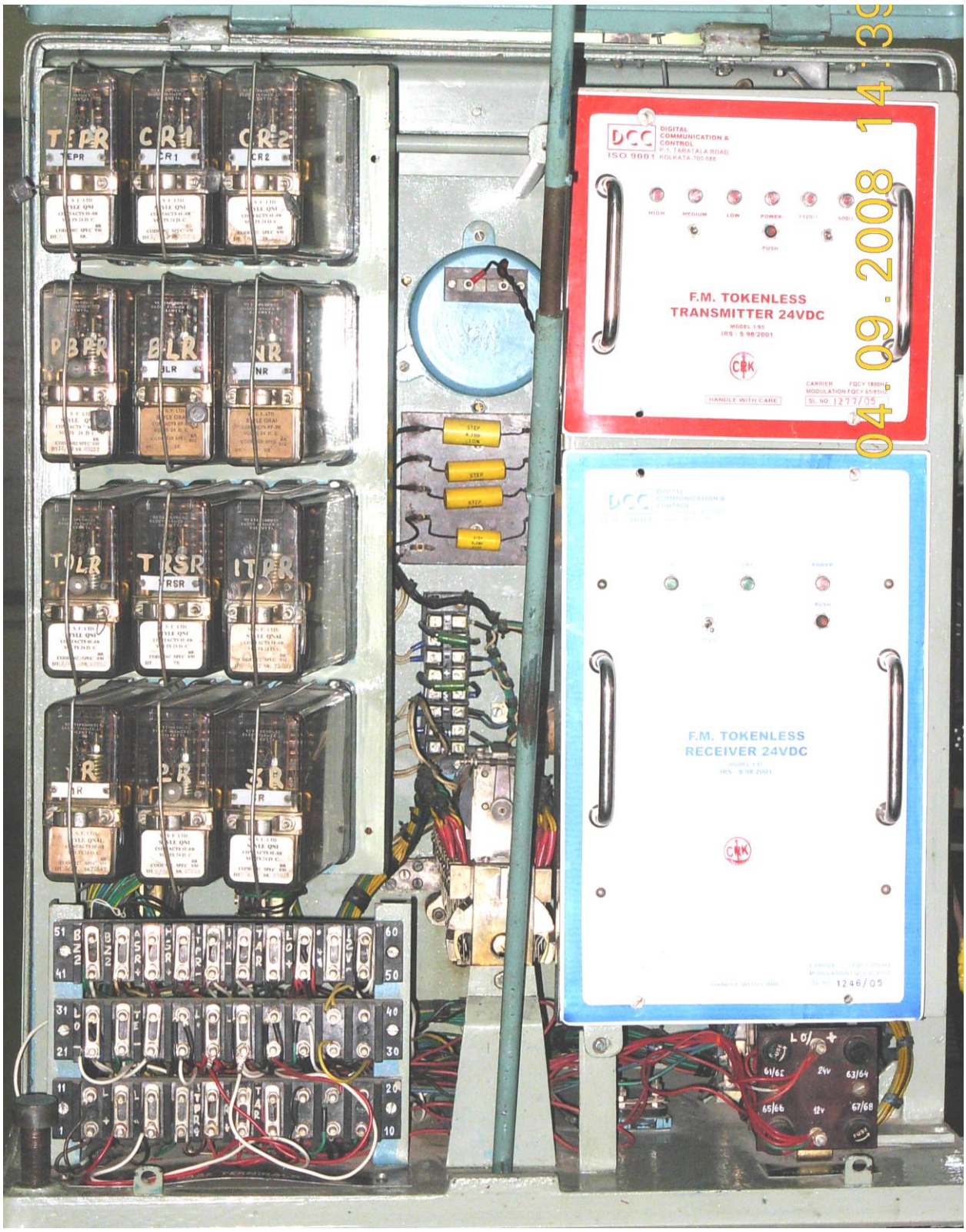


Fig: 1.4 INTERNAL VIEW WITH RELAYS AND TX & RX

The track circuit associated with the FSS consists of two adjacent track circuits T1, T2. The two track circuited sections T1 and T2 have the corresponding relays T1R and T2R with their repeater relays T1PR and T2PR respectively. These relays are normally energized as they are meant for closed track circuits and control the operation of train arrival relay 2R. This relay 2R will be energized only when the train passes in the direction T1 to T2 and not vice versa. See Fig.1.5. When a train entering the station on proper reception signals T1R and T1PR are first de-energized and create a condition to pick up the relay UYR1. Subsequently when the train comes on T2 track both the track relays T1R, T1PR and T2R and T2PR are de-energized to create a condition for UYR2 to pick up. Later on when the train clears the first track T1, a

condition is created to pick up the block section release relay UYR3 and finally with the other relevant pick up contacts the relay TAR will pick up and energises the 2R relay in the block instrument. The relay 2R once picked up it remains in the picked up position through its own front contact till the block instrument is normalized.

For a train passing in the direction T2 to T1 the relay 2R will not be operated since the sequential operation of the T1 and T2 will not be available to pick up the other relays UYR1, UYR2, UYR3 as would be seen from the following:

Train movement	Track	Track relay	Block release relay	TAR ↓
T_1 to T_2	T_1 T_2	T_1R↑ T_2R↑		
	UO UO	T_1R ↑ T_2R↑	UYR1 ↓ UYR2↓ UYR3↓	
	O UO	T_1R↓ T_2R↑	UYR1 ↑	
	O O	T_1R↓ T_2R↓	UYR2 ↑	
	UO O	T_1R ↑ T_2R↓	UYR3 ↑	
	UO UO	T_1R↑ T_2R↑	UYR3 ↑	TAR ↑

Note: UO - Un-occupied, O - Occupied

↑ *- Energized* ↓ *- De-energized*

Both T_1 and T_2 track circuits are assumed to be closed track circuits

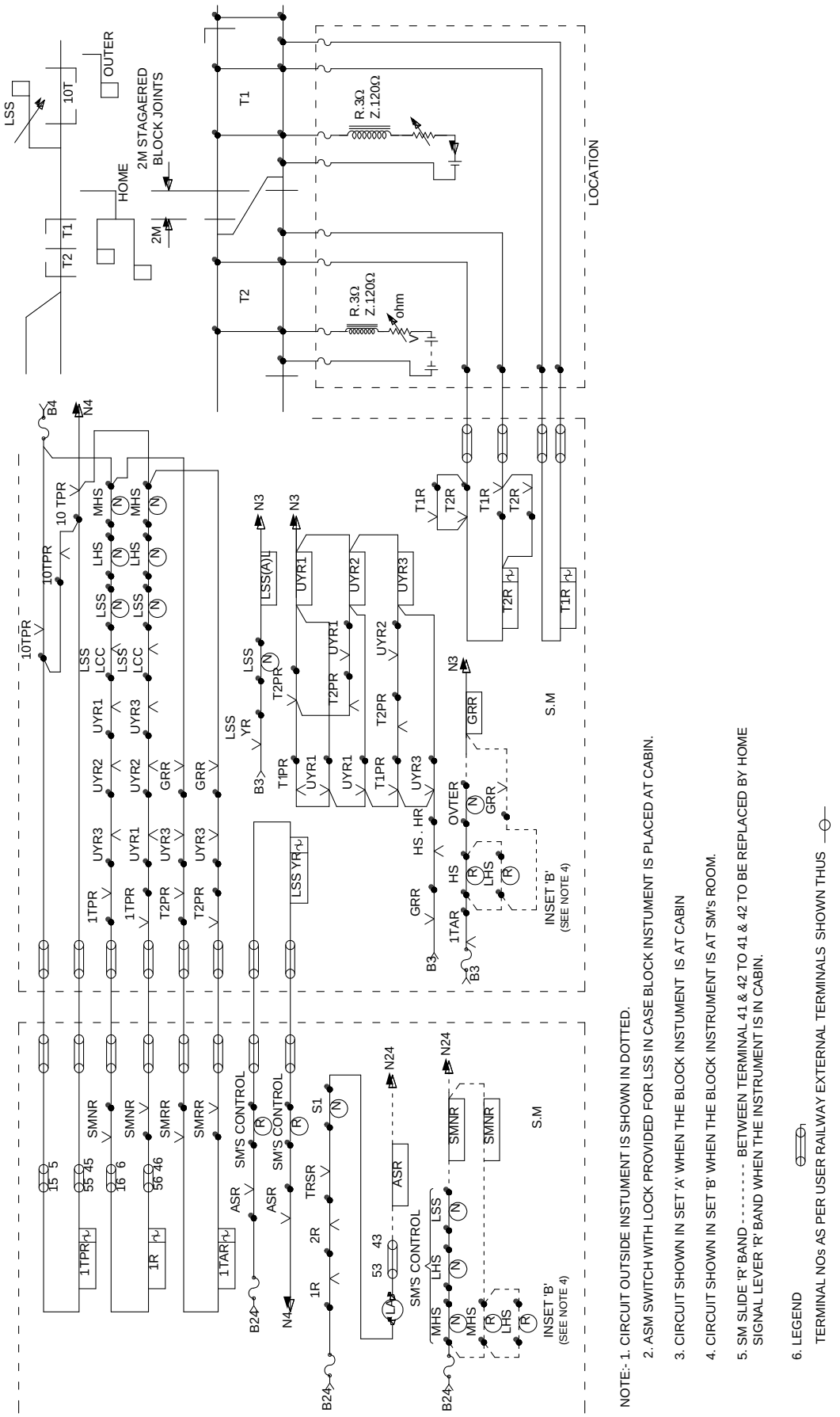
1.10 Power Supply

There are three sets of batteries required namely Line Battery, Local Battery and External Battery.

Line battery is normally of dry cells or DC-DC converter or Dual bank battery. The voltage is varying from 24V depending on the length of the block section in order to get a working current of 100 mA on line. This battery is connected on line whenever the DC is required to be sent either for exchanging the bell signals or as a part of the operational code.

Local battery is of 24 V and is used for giving the supply to the transmitter and receiver and also operating relays, indicators, lock magnet etc. of the instrument. Since the current drain on the battery is high, secondary cells are generally used.

Another set of battery is also used for external circuits to repeat the external conditions to the instrument according to the requirements of the circuits.



NOTE:- 1. CIRCUIT OUTSIDE INSTUMENT IS SHOWN IN DOTTED.

2. ASM SWITCH WITH LOCK PROVIDED FOR LSS IN CASE BLOCK INSTUMENT IS PLACED AT CABIN.

3. CIRCUIT SHOWN IN SET 'A' WHEN THE BLOCK INSTUMENT IS AT CABIN

4. CIRCUIT SHOWN IN SET 'B' WHEN THE BLOCK INSTRUMENT IS AT SM's ROOM.

5. SM SLIDE 'R' BAND - - - - - - - - BETWEEN TERMINAL 41 & 42 TO 41 & 42 TO BE REPLACED BY HOME SIGNAL LEVER 'R' BAND WHEN THE INSTRUMENT IS IN CABIN.

6. LEGEND

TERMINAL NOs AS PER USER RAILWAY EXTERNAL TERMINALS SHOWN THUS

- LHS - LOOP HOME SIGNAL
- MHS - MAIN HOME SIGNAL

Fig: 1.5 TRAIN ARRIVAL PROVING CIRCUIT

* * *

CHAPTER 2: DETAILED CIRCUIT DESCRIPTION

2.1 Reference

Method of handling - I.R.S.S-98-2001 Appendix 'B'.

2.2 Normal position: Normally, the block handle is in 'Line Closed' position, the SM Key, shunting key (SH), cancellation switch (S1) and push back switch (S2) are all in normal position, the TOL and time release indicator are white, and the needle indicator indicates zero position. In this case, all the relays except for 1TPR and 1R are in de-energized position, with no current flowing in the block line and all the concerned signals and levers are in normal position (Fig.2.1)

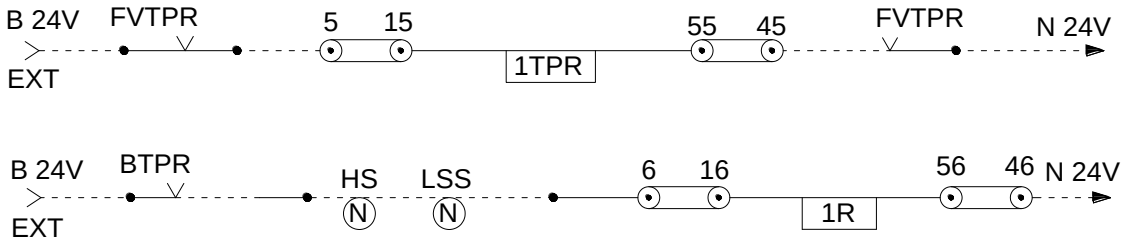


Fig: 2.1

2.3 When a Train is leaving station A for station B

(a) Turning the SM key to ON position at Station A completes a circuit while push button PB1 is pressed to give an audio call attention signal to B station. A direct current (-) flows to station B through the following circuit to pick up the BLR. (Fig.2.2 & 2.3).

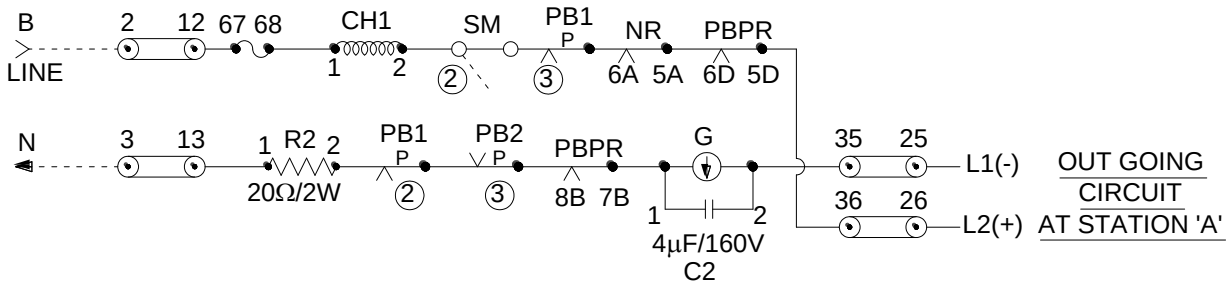


Fig: 2.2

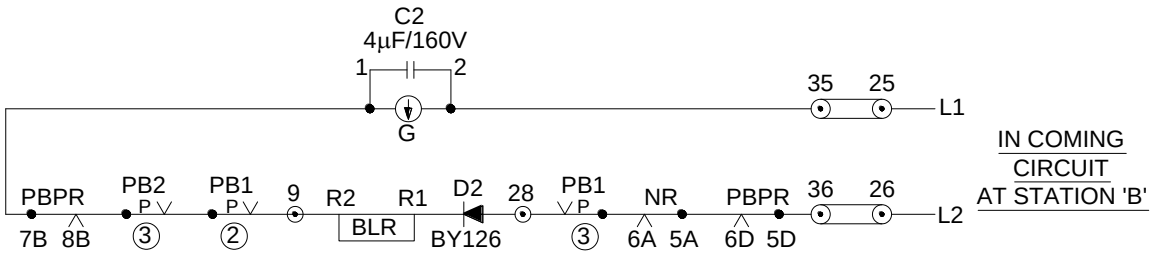


Fig: 2.3

B-Terminals(2-12)-fuse(67-68)-CH1-SMK(ON)-PB1(R)-NR(B)-PBPR(B)-L2toB Station-PBPR(B)-NR(B)-PB1(N)-Diode D2-BLR-PB1 (N)-PB2(N)-PBPR(B)-G-L1 & to Station-G-PBPR(B)-PB2(N)-PB1 (R)-Resistor (R2) Terminal(13-3)-N. Now with the BLR picking up, current flows through a circuit. (See Fig.2.4) B 24V- fuse (61-62) Terminals

(48, 58)-BLR (F)-Bell -Terminal 21-N24V to ring the bell. (The bell rings even if the SM key at B station is in off position).

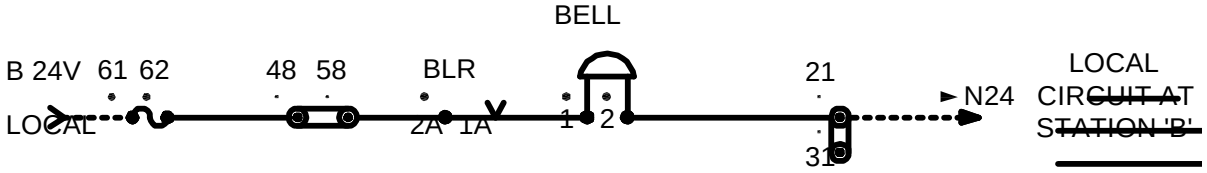


Fig: 2.4

(b) Upon receipt of a call attention signal, the SM's key is turned to ON at Station B. Then the PB1 at Station B is pressed to issue an answering call to station A. The same circuit as described in Fig 2.4 above operates to ring the bell at station A.

(c) Arrangements for 'Line Clear' are made between station A and B over the telephone.

(d) Push buttons PB1 & PB2 are pressed together at station A to send a code of signal, with both buttons being pressed, current flows in the following circuit to pick up the PBPR (See Fig.2.5). B24V- fuse (61-62)-SMK (ON)-CR1 (B)-PB1 (R)-PB2 (R)-CR2 (B)-1R (F)-PBPR-NR (B)-N24V. With the PBPR picking up at Stn A, NR at B station picks up through the line circuit. (See Fig.2.6 & 2.8). B-Terminals (2-12) – fuse (67-68)-CH1-PBPR (F)-G-Terminals (35-25)-L1 to B station. Terminals (25-35)-G- PBPR (B) Terminals (8.18) - diode D1-NR-XY-PBPR (B)-Terminals (36-26) and back to A Station-L2-Terminals(26-36)-PBPR (F) resistor (R2) - Terminals (13-3) - N. In this instance the BLR at B station does not pick up for the current is in the opposite direction. On the other hand with the PBPR at Station A picking up, a source voltage is applied to the transmitter (TX) through the following circuit (See Fig.2.7) B24V - Fuse (61-62) SMK (ON)-1R (F)-PBPR(F)-PB2(R)- TOLR (B) CR1(B)-CR2(B)-TX(3 to 4)-N24V. With a circuit TX (5) and TX(6) being completed in the keying circuit of TX a modulated current F1 flows to terminals 34, 37 to line side isolation transformer (in this case the input circuit of the receiver at station A is broken by PBPR(B) getting disconnected).

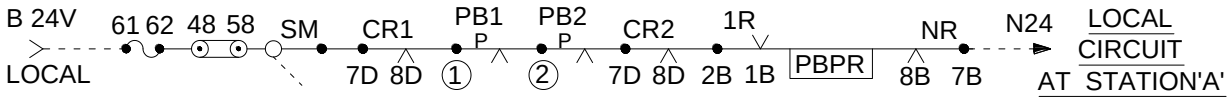


Fig: 2.5 PBPR CIRCUIT

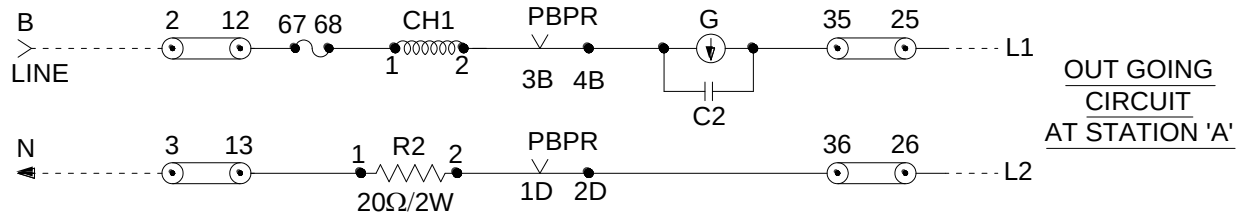


Fig: 2.6 NR LINE CIRCUIT

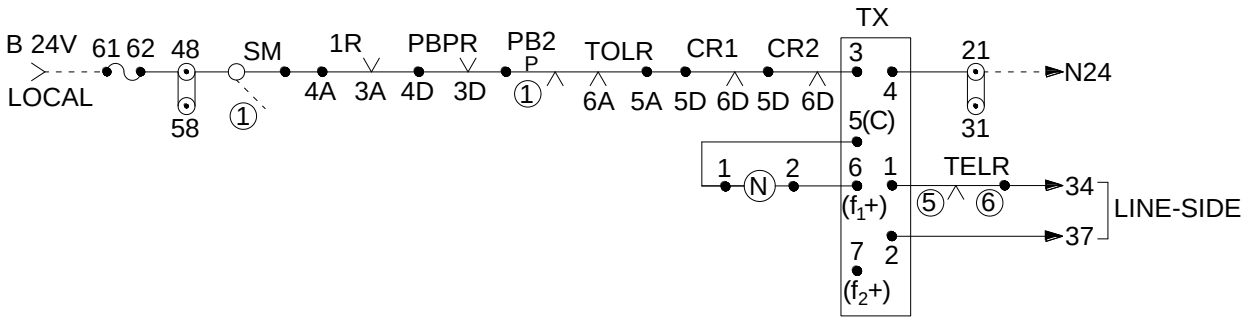


Fig. 2.7

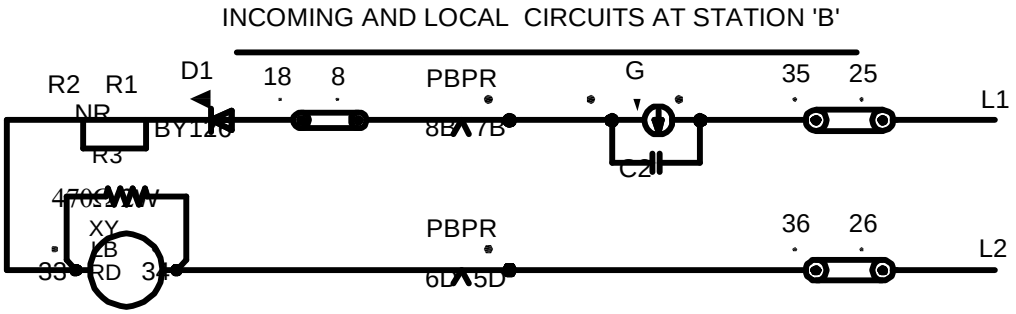


Fig. 2.8

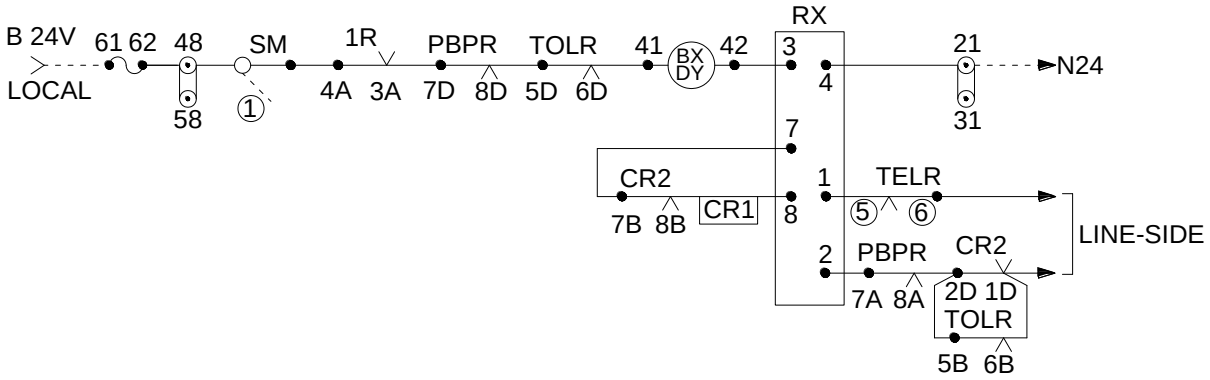


Fig. 2.9

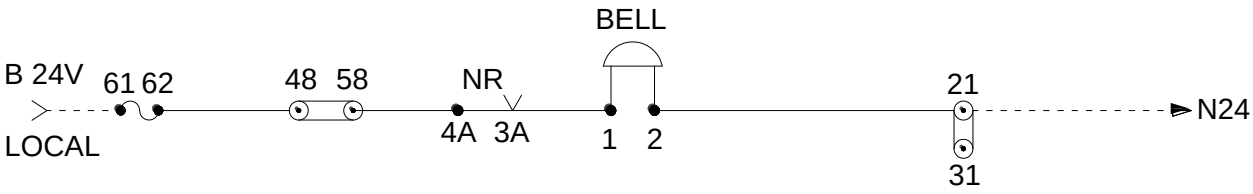


Fig. 2.10

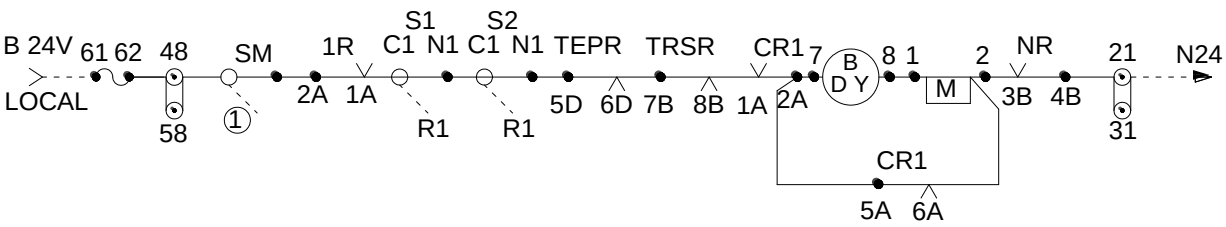


Fig : 2.11

(e) Upon receipt of a modulated current F1, the receiving relay CR1 at Station B picks up (Fig.2.9). As the bell rings one time at station B because of the NR picking up as aforementioned (Fig.2.8,2.9,2.10) turning the block handle as far as to Y point releases the block handle, to be turned to right position (TCF Position), through the following circuit (Fig.2.11) B24V Fuse (61-62)-terminals (48-58) SMK (ON)-1R (F)-S1 (N)-S2 (N) TEPR (B) - TRSR (B)-CR1 (F)-BDY-M-NR (F)-Terminal 21-N24V. While the block handle is being turned from normal position to right position, the contact of the handle which is in series with the relay NR is opened between the Y and D points, causing a resistance R3 to be added in series to the NR circuit (Fig2.8) with a resultant reduction in the volume of line current which remains substantially greater than the drop away current of NR. This causes the pointer of Galvanometer (G) to click making it possible to learn that the block handle has been turned to right position (R) at station B. Then PB1 & PB2 at station A may be released. (The same procedure is followed in operating the handle as described later)

LOCAL AND OUTGOING CIRCUITS AT STATION 'B'

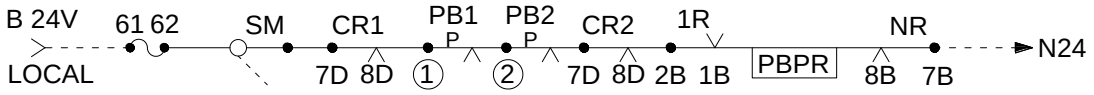


Fig. 2.12

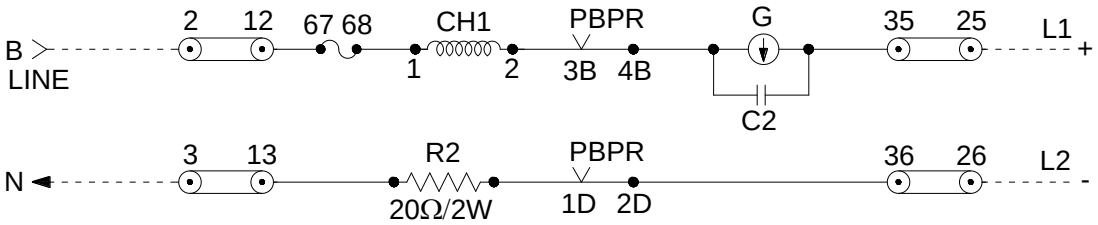


Fig. 2.13

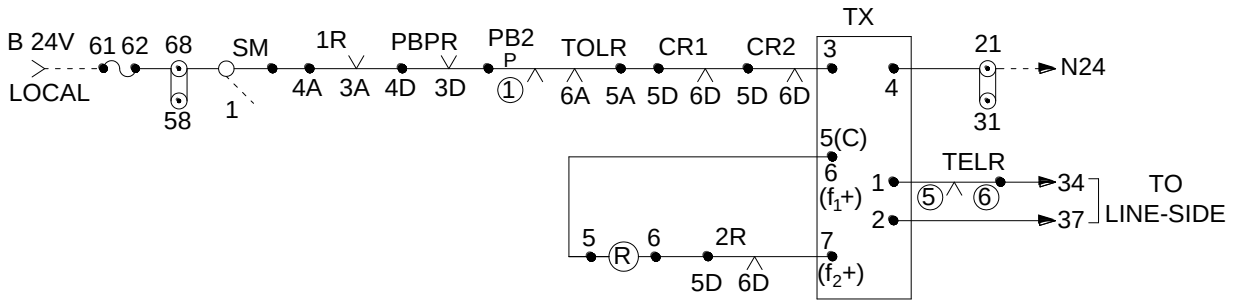


Fig. 2.14

LOCAL AND INCOMING CIRCUITS AT STATION 'A'

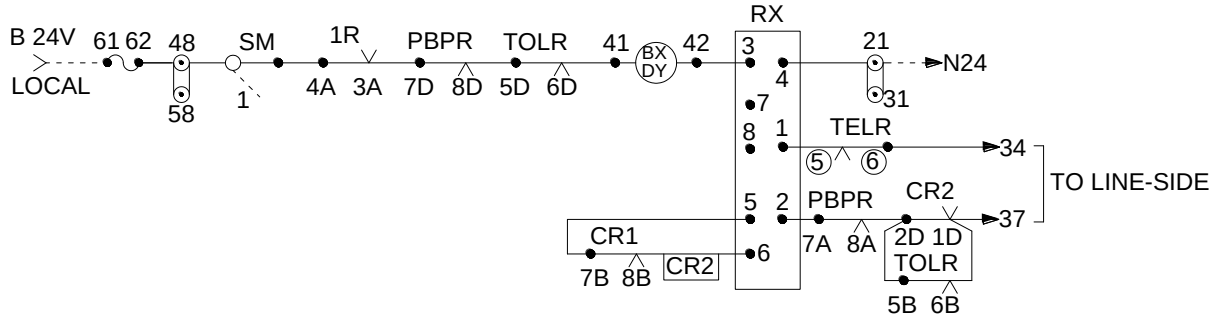


Fig: 2.15

(f) After confirming that the pointer of Galvanometer G has returned to zero position, PB1 & PB2 are now simultaneously pressed at B station to send a code of signal to A station. As the block handle is in R position, the keying circuit of TX5-R-2R(B)-TX7 is completed, so that a modulated current F2 and a direct current (+) flow to L1 and L2 (Fig. 2.12, 2.13, 2.14 & 2.16).

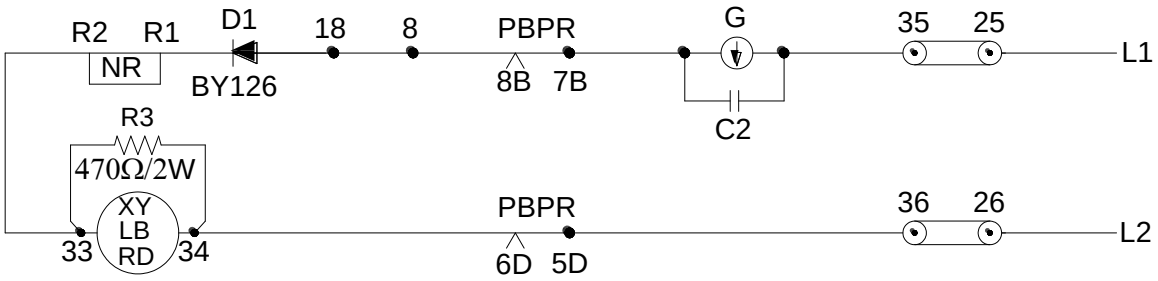


Fig: 2.16

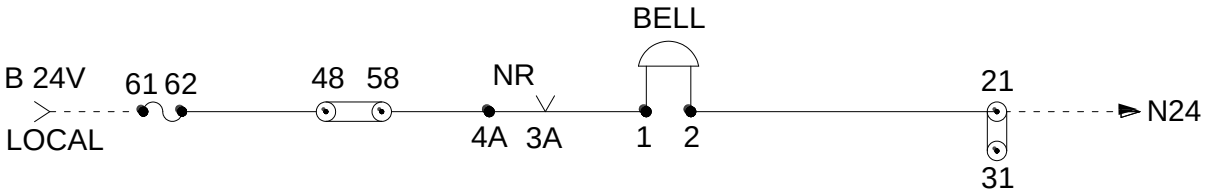


Fig: 2.17

(g) Upon receipt of a DC(+) the NR at station A pick up, with the bell ringing one time because of the NR picking up. And upon receipt of modulated current F2 and Turning the block handle as far as to the X point causes CR2 to pick up which in turn causes TRSR to pick up through the following circuit (Fig.2.18) B24V-fuse (61-62) terminals (48-58) 3R (B)-CR2(F)-NR (F)-1TPR(F)-XX'-TRSR-Terminals 21 -N24V. With the TRSR picking up, the handle can be released and turned to TGT position through the following (Fig.2.19) B24V - fuse (61-62) - terminal 48 - SMK(ON) -1R(F)-S1(N)-S2 (N) TEPR(B)-TRSR (F)-2R(B)-3R(B)-CR2(F)-XX'-M-NR(F)- Terminal 21-N 24V. In this state, the TRSR sticks through the circuit of B24-fuse- terminals (48-58)-3R (B)-TRSR (F)-1TPR (F)-LX'-TRSR-Terminal 21-N24V.

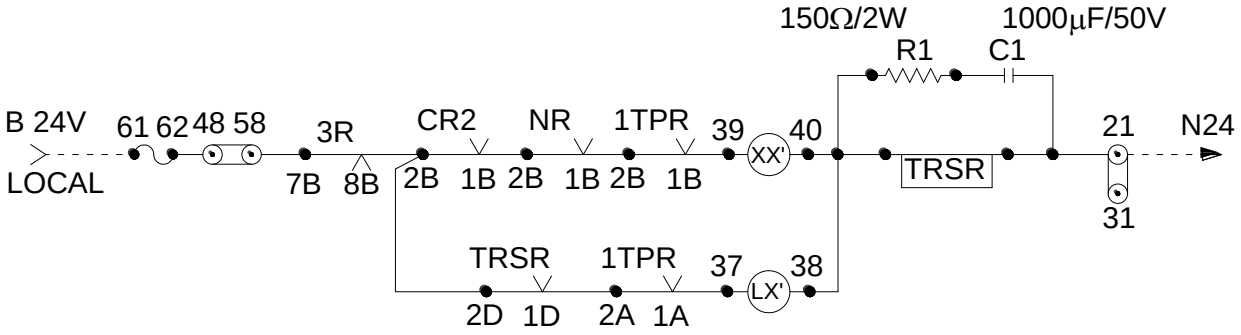


Fig: 2.18

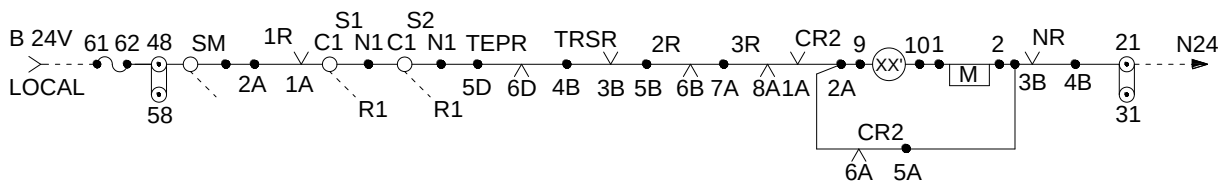


Fig: 2.19

(h) Putting the LSS knob in reverse position after turning the block handle to left position causes a relay 1R to drop away. Advanced starter control relay ASR picks up through the following circuit (Fig.2.20) B24V-fuse (65-66) - 1R (B) - 2R (B) -TRSR (F) - S1(N) - LA -Terminals (53-43) - HSR (B) - ASR - N24V. With the ASR picking up, a circuit outside the instrument is completed making it possible to take off the LSS.

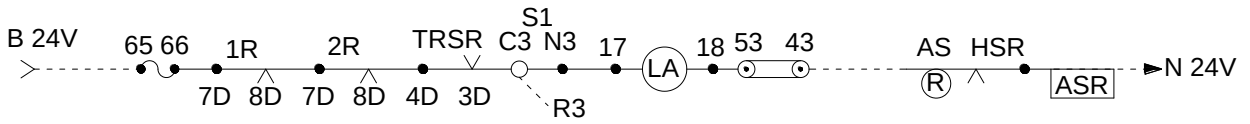


Fig: 2.20

(i) When a train leaves the station and enters the 1T, the 1TR and 1TPR drop away, releasing the stick circuit of TRSR and causing the TRSR to drop away. Dropping away of the TRSR causes the ASR to drop away and bring the LSS to ON position automatically.

(j) With the 1TPR dropping away, the TRSR also drops away (Fig.2.18). The TRSR having slow to release characteristic, however, picks up TOLR through the following circuit (Fig.2.21) B24-fuse (61-62)-Terminal (48-58) 3R (B)-TRSR (F)-1TPR (B)-LB-TOLR-Terminal 21 - N24. When TRSR drops after the time lag, TOLR sticks through the following circuit B24-fuse (61-62) terminal (48-58)-3R (B)-TRSR (B)-NR(B)-TOLR(F)-S2 (N)-LB-TOLR-terminal 21-N24. With a circuit for energizing the TOLR being completed, the indicator TOLK and buzzer BZ1 are actuated through a branch of the contact LB, indicating a train departure (TOL). At this time, the LSS knob is restored to normal position.

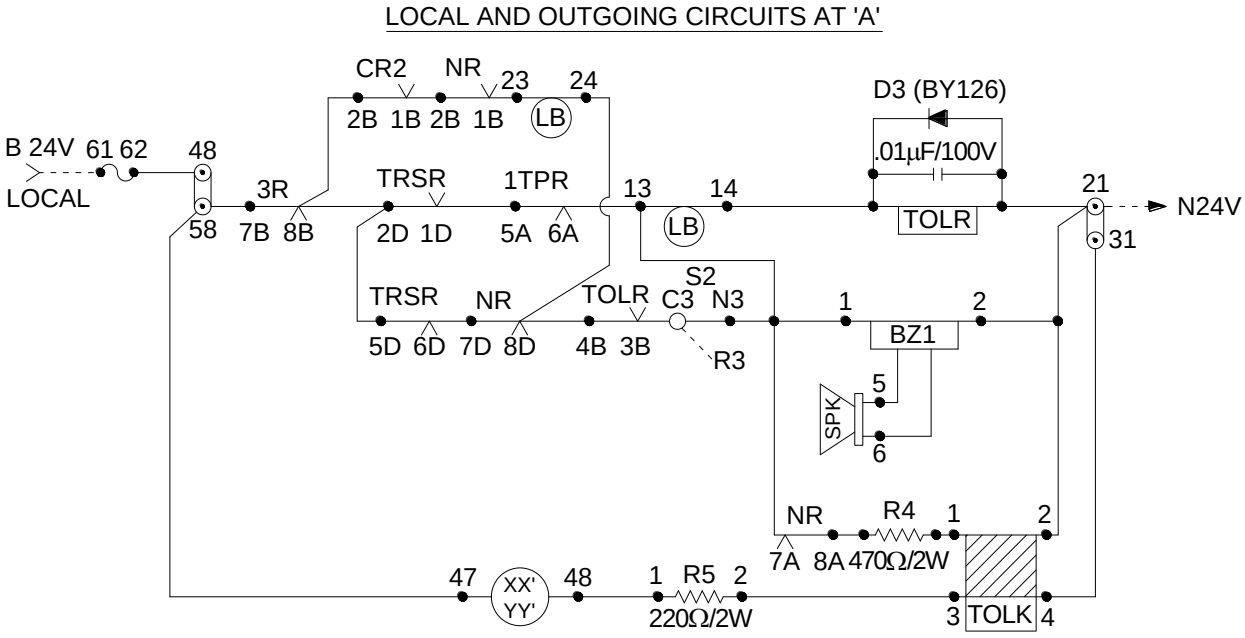


Fig: 2.21

(k) With the TOLR picking up, a source voltage is applied to the TX through the following circuit (Fig.2.22) B24-fuse (61-62) - terminal (48) - L-NR (B)-TOLR(F)-CR1 (B)-CR2 (B)-TX(3) - TX (4)-terminal 21-N24. With a keying circuit TX (5)-L-TOLR (F)-3R (B)-TX (7)-being completed, a modulated current F2 flows to the line. (Direct current does not flow in this instance).

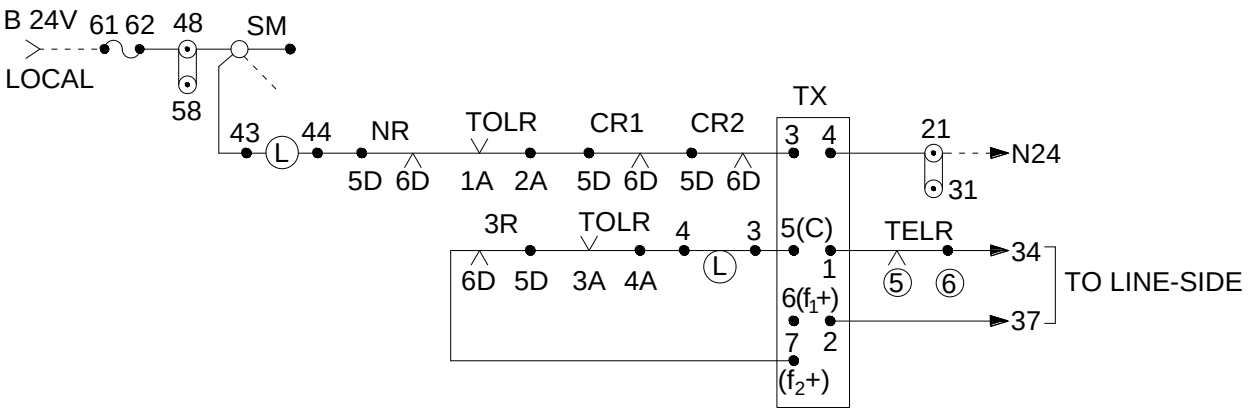


Fig: 2.22

(l) With a modulated current F2 being received at station B, the CR2 picks up (Fig.2.23) because the RX power source is connected through B24-fuse (61-62). Terminals (48-58)-2R (B)-R-RX(3)-RX(4)-(21-31)-N24, causing the TOLR to pick up (Fig.2.24) through a circuit B24-fuse (61-62) - Terminals (48-58)-3R(B)-CR2(F)NR(B)-RD-TOLR-Terminal 21-N24, with the TOLK and BZ1 operating through the same circuit as in station A to give an indication of train departure.

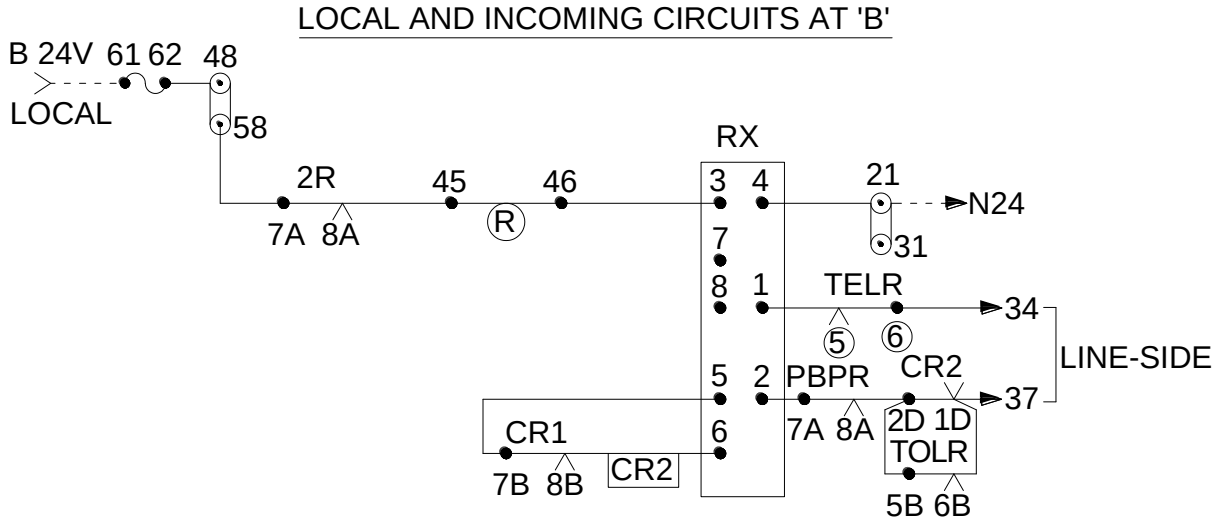


Fig: 2.23

(m) For acknowledging the TOL Buzzer push button PB1 is pressed at station B. The PBPR at station B picks up through the following circuit (Fig.2.25) B 24-fuse (61-62) Terminal (48)-SMK (ON)-CR1(B) –PB1(R) - PB2(N)- TOLR (F)-RD-PBPR-NR(B) - Terminal 21-N 24. With the PBPR picking up a DC (+) flows to station A through the same circuit as described in. (Fig.2.6) causing the NR at station A to pick up, (Fig.2.8) .

(n) With the NR at station A picking up a stick circuit for the TOLR is broken. With the TOLR dropping away buzzer BZ1 stops buzzing (Fig.2.21). As the TOLK is a magnetic latch type, it is not restored to normal position. On the other hand, when the TOLR drops away, the circuit for TX is broken (Fig.2.22) and no modulated current F2 flows to station B thereby de-energizing CR2 at B (Fig.2.23) and causing the TOLR to drop away at B (Fig.2.24). With the TOLR dropping away buzzer BZ1 stops buzzing (Fig.2.24). As the TOLK is a magnetic latch type, it is not restored to normal position at B.

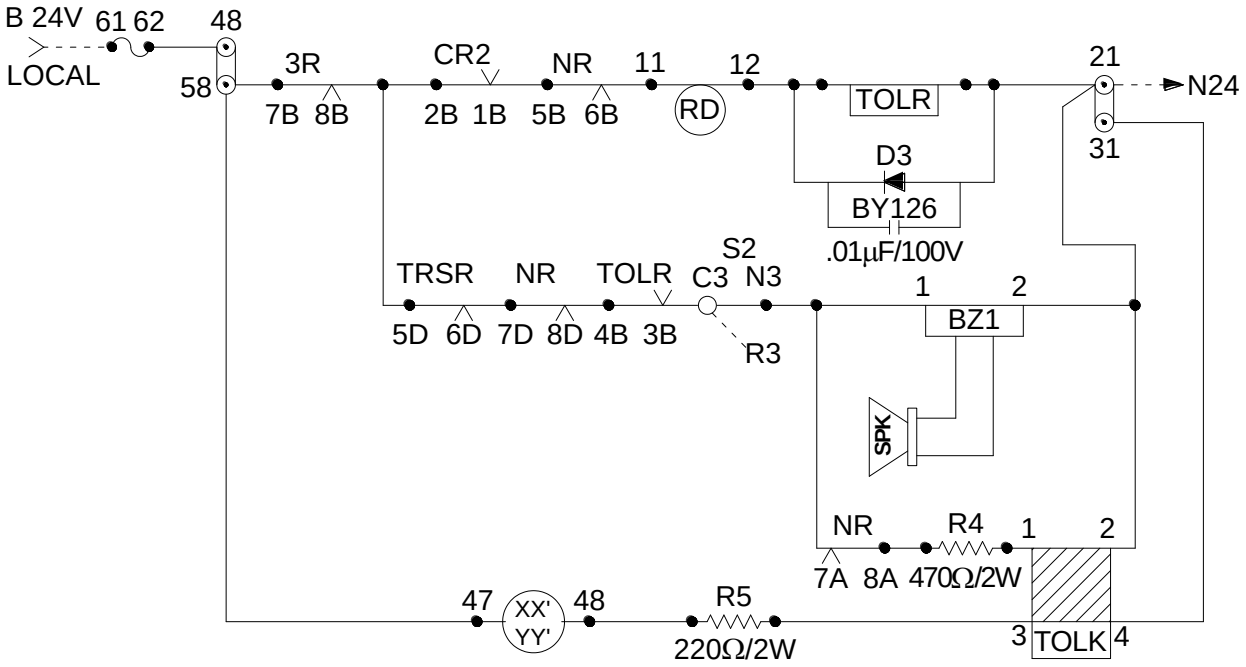


Fig: 2.24

(o) A bell code signal for 'Train entering Block Section' is issued from Station A and an acknowledging signal is issued from station B.

(p) The FSS is taken OFF at station B. With the FSS knob being in reverse position and the 1R dropping away (1R back contact is looped in instrument in HSR & ASR circuits if SM's normal contact is not proved in 1R relay circuit), the HSR picks up through the following circuit (Fig.2.26) B24V-fuse (65-66) 1R (B) or looped 2R (B)-TRSR (B)-S2 (N)-RD/XY terminal (54-44)-ASR (B)-HSR-N24V.

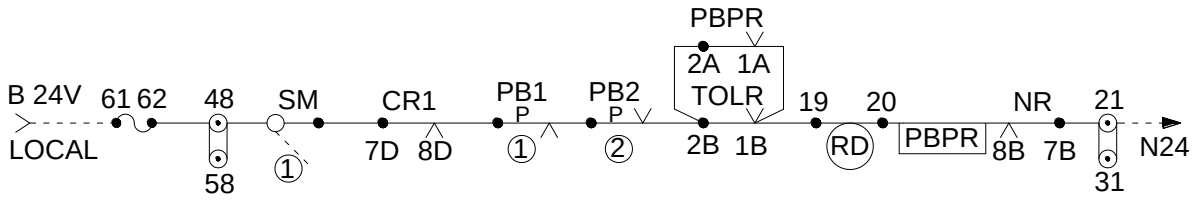


Fig: 2.25

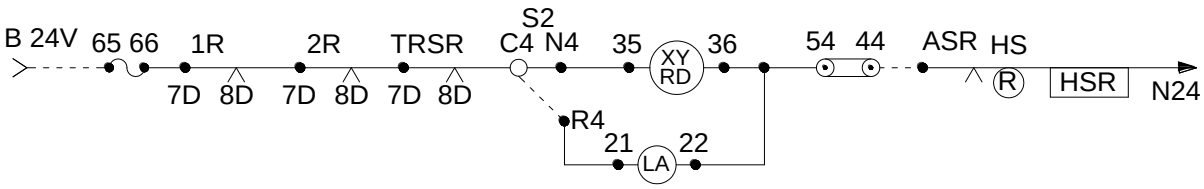


Fig: 2.26

(q) When a train reaches station B, the T_2R picks up and a relay 2R picks up through the following circuit (Fig.2.27) B24 - fuse (61-62) - terminals (48-58) - (7-17) - TAR (F) - Terminals (57- 47) LX'/RY' - 2R - Terminal 21 - N24. With the relay 2R picking up, the HSR drops away. At the same time, a Buzzer BZ2 sounds, informing the train arrival. Restoring the FSS knob to normal position causes the BZ2 to stop buzzing.

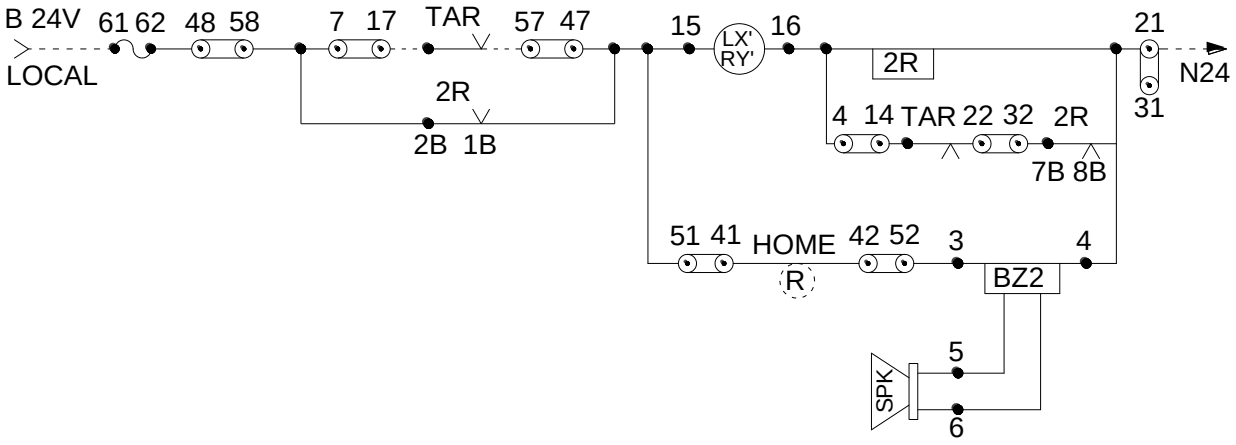


Fig: 2.27

(r) A 'Call attention'signal is issued to station A and an answering signal is issued from Station A. Station B transmits a message to station A by pressing the PB1 & PB2 simultaneously. In this instance, the PBPR picks up at station B in the same manner as described in Fig.2.5.

(s) As the keying circuit for TX (Fig.2.28) which is TX5-R-2R (F)-TX6 is for a modulated current F1, a DC (+) and a modulated current F1 flow to station A. NR picks up through the same circuit as described in Fig2.16 earlier at station A, causing a bell to ring (Fig.2.8 & 2.10). Returning the handle to the B position supplies a source voltage to the receiver through the following circuit (Fig.2.29) with the CR1 picking up; B24 fuse-(61-62) - Terminal (48) - SMK (ON)-1R (F)-PBPR (B) -TOLR (B)-BX/DY RX3-RX4- Terminal (21)-N24.

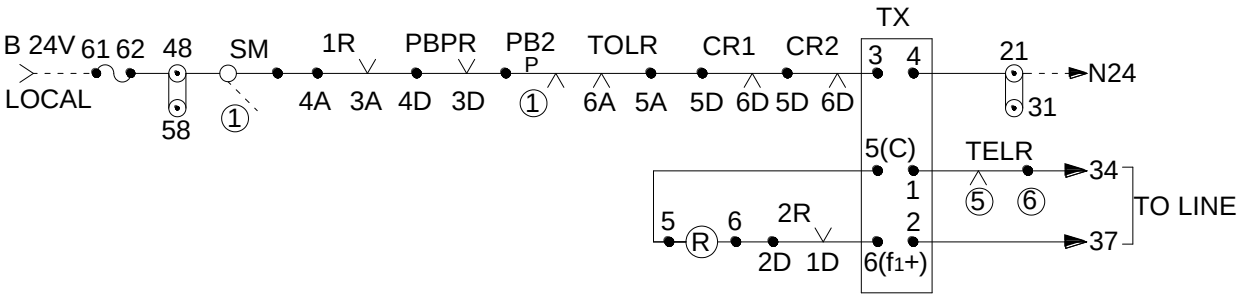


Fig. 2.28

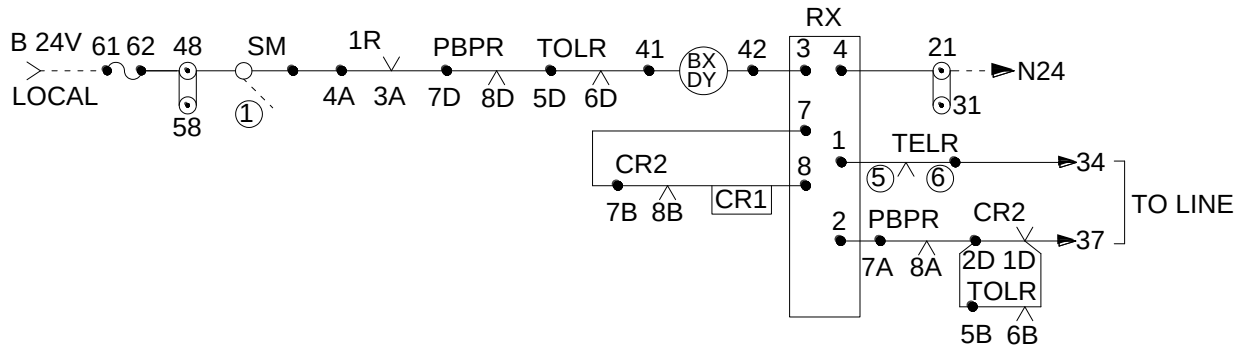


Fig: 2.29

(t) With the NR and CR1 picking up, Lock Magnet M is energized the handle lock magnet circuit … B24V-Fuse-(61-62)-Terminal (48)-SMK (ON)-1R(F)-S1(N) S2(N)-TEPR (B)- TRSR (B)- CR1 (F)-BDY- M-NR(F) Terminal 21- N24V (Fig2.30) making it possible to restore the handle to normal position. TOLK in turn is energized and restored to normal (Fig.2.31).

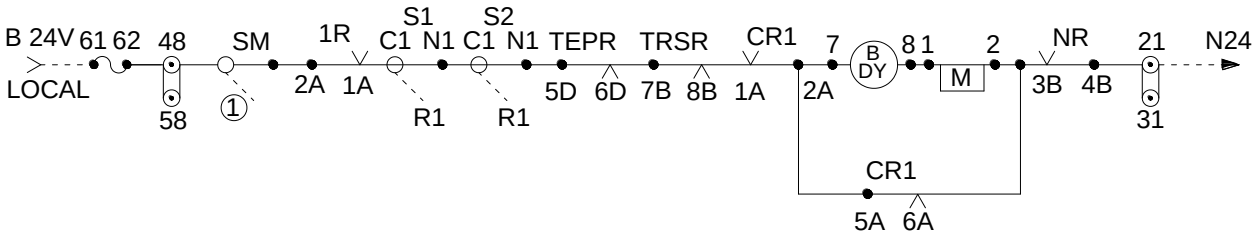


Fig: 2.30

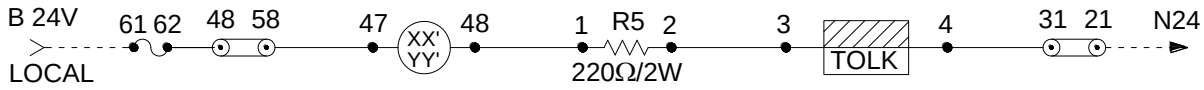


Fig: 2.31

(u) Pressing down PB1 & PB2 at station A causes a DC (+) and modulated current F1 to flow to station B. NR picks up at station B, causing a bell to ring (Fig.2.8 & 2.10). Returning the handle to the D position applies a source voltage to the receiver RX, causing the CR1 to pick up (Fig2.9). With NR and CR1 picking up it is possible to restore the handle to normal position. The same procedure is followed when a train leaves station B to station A.

2.4 Cancellation of Line Clear before a Train enters the Block Section

(a) The block handle at station A is in TGT position with all the signal knobs concerned being in normal position. Block handle at station B is in TCF position with all the signal knobs concerned being in normal position.

(b) Station A calls station B to make arrangement for Line Clear cancellation over the telephone.

(c) The cancellation switch S1 is put to reverse position at station A. Putting the S1 to reverse position at A energizes the timer through the following circuit because the TRSR has already picked up. B 24 fuse (61, 62) Terminal (48)-SMK (ON)-1R (F)-S1 (R)-TRSR (F)-3R (B) timer terminals 21-N 24 Fig.2.32. The counter S1 is operated simultaneously. Upon the lapse of predetermined time, the TEPR is energized through the output lead of the timer and is made to stick.

(d) With the TEPR picking up, the 3R is energized and made to stick and disconnect the timer circuit. It being so arranged that the time elapsing before the energization of the 3R is two minutes i.e. it takes two minutes for relay 3R to pick up after operation of switch S1 through a circuit B24-Fuse (61, 62) Terminals 48 SMK (ON)-1R (F) S1 (R)-TEPR (F) - 3R-LX-Terminal (21)-N 24 (Fig.2.32) and completion of a stick circuit with 3R picking up. Time release is indicated through a circuit B24-fuse (61-62) terminals (48-58) -3R (F)-TEK-(FREE) - Terminal 21-N 24.

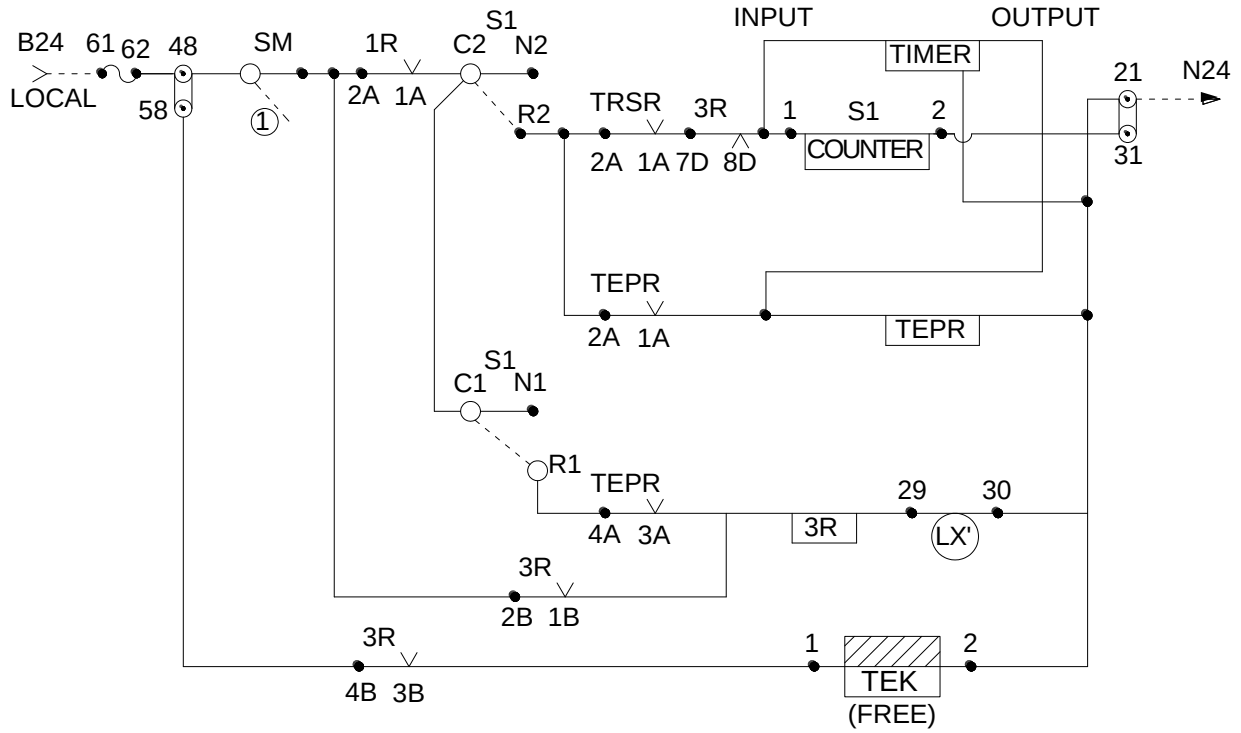


Fig: 2.32

(e) A cancellation signal is issued from Stn A to Stn B. Push button PB1 & PB2 are pushed at station A to send a signal of cancellation. With 3R picking up, a modulated current F1 flows through the key circuit of TX5-L-TOLR (B)-3R (F)-TX6 Fig.2.33.The performance of other circuits are as described herein before. DC (+) and a modulated current F1 flow to station B.

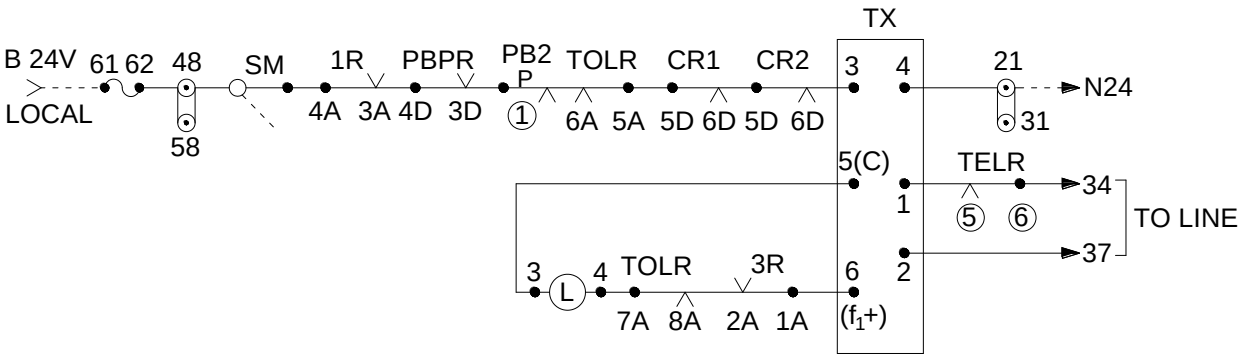


Fig: 2.33

(f) Upon receipt of the fore mentioned signal, the block handle is turned from right position to normal position (in the same manner as described in Fig 2.19. Push buttons PB1 & PB2 are pushed down at station B to issue a code signal to station A. The signal sent in this case, which is the same as aforementioned, is DC (+) and a modulated current F1. Upon receipt of the signal at station A after the cancellation switch S1 has been restored to normal position, the block handle is restored to normal position at station A.

2.5 When a train in the block section pushes back to departure station

In this instance, the block handle at station A and station B are in L position and R position respectively with the TOL buzzer stopped following confirmation.

(a) Putting the push back switch S2 to reverse position at station A actuates the counter S2 through a circuit of B24 fuse-(61-62)-Terminal (48)-SMK(ON) -S2(R)counter-LX' Terminal 21-N24 (Fig.2.34).The home signal knob is put to reverse position at Stn A. At this instance the home signal is taken off through the control circuit of HSR which is as follows: B24-fuse (65-66)-1R (B) - 2R(B)-TRSR(B)-S2(R)-LA-Terminal (54,44)-ASR (B)-HSR-N24 (Fig.2.26).

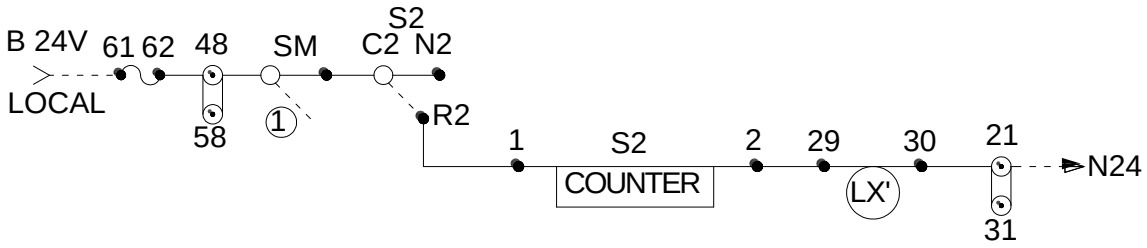


Fig: 2.34

(b) On arrival of the pushing back train to station A, the FSS is restored to normal position automatically. With 2R picking up and the arrival buzzer BZ2 producing a buzzing sound, putting the FSS knob to normal position causes the buzzer to stop buzzing.

(c) The signal indicating 'Train out of Block section' is issued from station A to B and buttons PB1 & PB2 are pressed. Then a modulated current F1 flows from station A through the keying circuit of TX at station A which is TX 5-L TOLR (B) 3R(B)-2R(F) TX6 (Fig.2.35) Upon receipt of a DC (+) and modulated current F1, the block handle can be turned from right position to normal position at station B. This is done through the same circuit as in the case of cancellation.

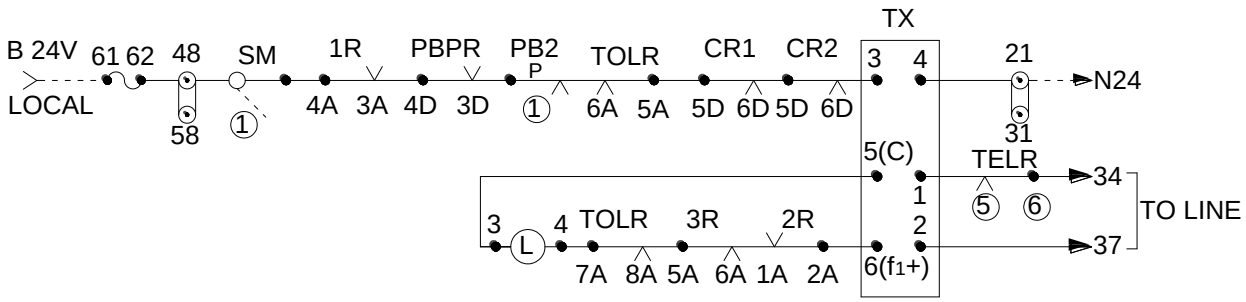


Fig: 2.35

(d) Push button PB1 & PB2 are pressed at station B to send a DC (+) and a modulated current F1 to station A. After restoring the switch S2 to normal position, the block handle is turned to normal position from left position at station A. Then the 'Train out of Block section' acknowledgement signal is issued to station B.

2.6 Telephone Circuit

While modulated signal is being transmitted or received, telephone circuit is isolated from power line.

While telephone is used, transmitter and receiver are isolated from the line. To explain in detail, telephone relay TELR is inserted in series connection with relays CR1 (B), CR2 (B) and TOLR (B) in the circuit (Fig.2.36). Also TELR (F) is connected in series with the telephone circuit. Thus telephone circuit is isolated from signal circuit while modulated current is transmitted and received and transmitter/receiver is isolated from signal line while telephone is used.

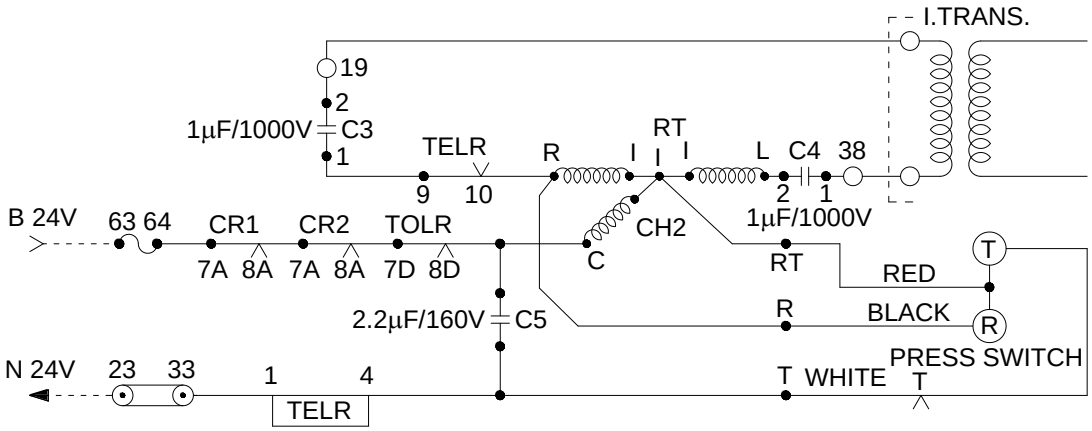


Fig: 2.36

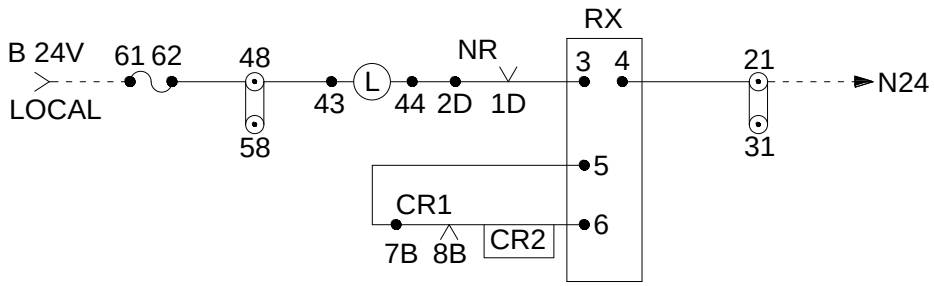


Fig: 2.37

2.7 Salient features of the circuit

(a) To ensure that relays NR & BLR are not picked up simultaneously due to failure of rectifiers, back contact of NR relay is proved in BLR circuit. Similarly, in the PBPR circuit, back contacts of CR1 and CR2 relays have been proved to ensure that PBPR relay will not be energized, while receiving modulated frequencies.

(b) Front contact of PBPR relay has been proved in the DC feed circuit of Transmitter, where as back contact has been proved in the Receiver circuit to guard against receiving its own FM output, transmitted by the same instrument. Similarly, back contacts of CR1 & CR2 relays have been proved in the DC feed circuit for transmitter to ensure that no code except the code of bell signals can be generated, unless the code relays are de-energized. During the transmission of TOL Code PBPR remains de-energized. In order to prevent the Receiver to receive the FM Signal transmitted by the transmitter of the same station, remedial path is provided by the back contact of TOLR bypassed by the front contact of CR2 and in series with the back contact of PBPR in the Receiver FM Input Circuit. Vide Fig .2.29.

(c) Since TOL code has to be transmitted automatically as soon as a train occupies FVT, front contact of PBPR relay is not provided in DC feed circuit to the transmitter but the same is taken via TOLR front contact and NR back contact with the block handle at L position.

(d) Similarly, for the Receiver to be in readiness to receive the TOL code the DC feed circuit is taken via 2R relay back contact with the block handle at R position.

(e) Press contacts of the PB2 button in the DC feed circuit of the Transmitter proves the positive action taken to energise PBPR relay for Transmitting modulated frequency along with DC and also to prevent DC feed to TX while acknowledging TOL code.

(f) Block handle contact (BX) and (DY) are included in the DC feed circuit to the receiver so that the DC feed to the Receiver is switched ON only when the block handle operation is initiated thus minimizing battery consumption.

(g) SM's key contact has not been proved in the DC feed circuit of Transmitter for transmitting and receiving of automatic TOL code to ensure that the TOL indicator will display, immediately the block section is occupied irrespective of the position of SM's key.

(h) To ensure that relays CR1 and CR2 are to be energized one at a time, back contact of CR1 relay is proved to energise CR2 relay, and similarly back contact of CR2 relay is provided to energise CR1 relay.

(i) Cross protection to the lock magnet coil is given through CR1 & CR2 back contacts.

(j) Transmitter and Receiver are connected to line through the back contact of TELR relay to ensure that during conversation on telephone, no code is transmitted or received by the Transmitter and Receiver respectively at either end. Similarly the telephone set is connected to the lines through the front contact of TELR and TELR feed is taken through the back contact of CR1 & CR2 and TOLR relays to ensure that during transmission and reception of code the telephone is disconnected. The back contact of TOLR is included in the TELR pick up circuit to ensure that the telephone circuit is disconnected the moment TOLR picks up to transmit TOL code.

(k) TOLR is made slow to release, since its energizing circuit is through the front contact of TRSR and stick circuit is through the back contact of TRSR.

(l) TRSR is made slow to release to provide the conditions required for the energized circuit of TOLR in which the front contact of TRSR and back contact of 1TPR are included so that this condition shall not be available to energise TOLR again after the acknowledgement which is effected by breaking the stick circuit of TOLR.

(m) It may so happen that PB1 & PB2 are pressed by the receiving station just when the train enters the section, causing NR to pick up at the sending end thus opening the stick feed of TOLR resulting in TOL transmission being prematurely stopped. To prevent this possibility stick feed to TOLR is also taken through NR and CR2 pick up contacts so that TOLR is held in such an eventuality. To energise CR2 in this case without the handle being turned the DC feed is given to the receiver through (L) contact of the handle and NR pick up contact the moment NR at the sending station is energized. When push buttons are released at the receiving station, usual stick feed to TOLR is established.

(n) Switch S1 normal contact has been included in the ASR circuit to ensure the LSS, if cleared already, to fly back to danger when S1 is operated to effect cancellation of Line Clear.

(o) To ensure thermal circuit of the TER not to be kept no longer than what is necessary. TER relay is energized through the back contact of TEPR relay. TEPR on energization through TER hot contact held by its own front contact. Thus as soon as TEPR relay is energized TER relay de-energizes. Cold contact of TER relay is proved in the Lock magnet coil circuit and 3R circuit to prove the full cancellation delay being available for next operation. Electronic timer also is being used in place of thermal type TER.

2.8 Special Circuit arrangement to establish TOL Indications

Special circuit is designed to prevent failure in establishing TOL indications under certain specific conditions.

Vide item (m) under 2.7 pressing of PB1 & PB2 at station B immediately before Train enters the FVT of station A does not interfere with the display of TOL indications which is affected through the operations as described herein below:

(a) While PB1 & PB2 are being pressed at station B a DC (+) and a modulated current F2 are transmitted as aforementioned to station A. In this state, the NR at station A picks up

(b) When a train enters the FVT of station A, the TOLR at station A picks up through the circuit described in Fig 2.21.The stick circuit of TOLR is not completed because of the NR picking up in this instance (Fig.2.21).

(c) As NR has already picked up at station A, the power circuit of RX is completed as follows causing the CR2 at station A to pick up (Fig.2.37) B24-fuse(61-62)-Terminal (48) - L-NR(F)- RX3-RX4 -terminal (21)- N24. With CR2 picking up there is still TOLR circuit operating as follows: (Fig.2.21). B-24-fuse(61-62)- Terminals (48-58)-3R (B)-CR2(F)- NR (F) - LB-TOLR(F)-S2 (N)-LB-TOLR - Terminal (21)- N24 consequently, as soon as a train enters the FVT then the TOL indication is displayed at station A.

(d) The TOL code signal is not transmitted, as the power circuit for Transmitter at station A is broken because of the NR picking up and the TOLK is not displayed at station B because of the TOLR dropping away while PB1 & PB2 are being pressed.

(e) Releasing the PB1 & PB2 at station B results in the PBPR dropping away, causing the transmission of a DC (+) to be stopped, so that the NR at station A drops away. With the NR dropping away, the stick circuit for TOLR is completed with a concomitant completion of the power circuit for transmitter at station A so that a modulated signal F2 is transmitted to affect a display of TOL indication at station B.

(f) Upon receipt of a modulated current F2, CR2 picks up at station B because of PBPR having been dropped away. Then TOLR picks up and the TOL indication is displayed.

* * *

CHAPTER 3: FREQUENCY MODULATION

3.1 Modulation

The instrument works on FM current Coding System. Modulation is the process in which the amplitude or frequency or phase of a high frequency wave, usually called the carrier is changed in accordance with the instantaneous amplitude of the low frequency wave called the modulating signal.

There are three types of modulation:

(a) Amplitude modulation (AM)

(b) Frequency modulation(FM)

(c) Phase modulation (PM)

In **Amplitude modulation**, the amplitude of the carrier wave is changed in accordance with the amplitude of the modulating signal.

In **frequency modulation**, the frequency of the carrier wave is changed in accordance with the amplitude of the signal. However, the amplitude of the modulated wave remains the same i.e. carrier wave amplitude. The frequency variations of carrier wave depend upon the instantaneous amplitude of the signal as shown in fig 3.1(iii). When the signal voltage is zero as at A, C, E and G, the carrier frequency is unchanged. When the signal approaches its positive peak as at B and F, the carrier frequency is increased to maximum as shown by densely spaced cycles. However, during the negative peaks of the signal as at D, the carrier frequency is reduced to minimum as shown by the widely spaced cycles. The wonder in FM is that the information or the intelligence signal to be transmitted is in the frequency variations of the carrier. The carrier frequency varies at the rate of signal frequency, the frequency deviation being proportional to the instantaneous amplitude of the modulating signal.

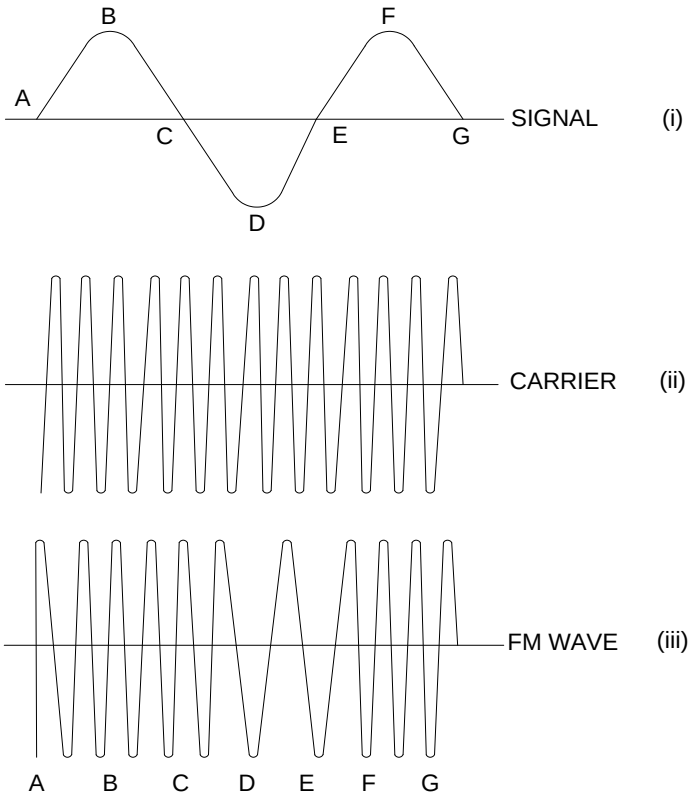


Fig: 3.1

In **Phase modulation**, the phase of the carrier wave is changed in accordance with the amplitude of the modulating signal. Frequency modulation is used in this equipment.

3.2 Generation of frequency modulation

When the reactance of the tank circuit of an oscillator is raised, then the frequency of oscillation changes. There are a number of devices whose reactance can be varied by the application of voltage, like bipolar transistor, tube, FET, reactor diodes etc. When any one of the above devices is earmarked to the tank circuit, then the reactance of the tank circuit can be varied by application of an external voltage, thereby frequency of oscillation is varied.

3.3 Transmitter & Receiver for FM Tokenless Block Instrument

Tx & Rx for FMBI as per Drawing No's: 103/68A & 103/67A respectively are used.

INTRODUCTION:

The transmitter and receiver unit is designed to work at 24V DC with input supply variation between 19.2V and 28.8V with the carrier frequency 2700/1800Hz. and modulated frequency 65/85Hz. The maximum power consumption of transmitter and receiver are 1.2W and 8W at 24V DC respectively. Test points are provided in the back of the equipment to monitor the necessary test parameters. With 1 mw output power the receiver is designed to work with 28dB attenuation inclusive of line loss.

The equipment is designed to work satisfactorily with temperature variation from 0^0 C to 55^0 C with Relative Humidity (RH) of 95% at 35^0 C. The equipment is also available with operating temperature range from 0^0 C to 70^0 C at 95% RH at 35^0 C.

For distinctive identification, the TX & RX for 2700 Hz are provided with blue colored spotting even Nos. and those for 1800 Hz are provided with Red colored spotting odd numbers.

During the climatic tests conducted under the said type approval, the AKGEI make Transmitter/Receiver were tested by RDSO/ERTL (Electronics Regional Test Laboratory) and worked satisfactorily with Temperature variation of 0^0 C to 55^0 C at 95% RH.

3.4 Specification

3.4.1 TRANSMITTER

Supply voltage	24 V DC, ± 20%
Carrier frequency	1800Hz, 2700Hz ± 2%
Modulation frequency	65Hz or 85Hz ± 1.5Hz
Output impedance	600ohm, 1120ohm ± 10%
Shift frequency	160 Hz ± 15%
Power consumption	1.2W or less at 24 V DC

3.4.2 RECEIVER

Supply voltage	24 V.DC, ± 20%
Carrier frequency	1800 Hz, 2700 Hz, ± 2%
Input impedance	600ohm,1120ohm ± 10%
Sense level for receiving	More than – 19 dBm
No sense level for receiving	Less than – 22 dBm
Power consumption	8 W or less at 24 V DC

3.4.3 General operating conditions

Output level of transmitter	1 mW/3mW/5mW, +10%, - 5% in three ranges.
Line impedance of transmitter	600\1120 Ohms in three ranges
Receiver output	The DC output voltage of the receiver is suitable to drive CR1 and CR2 relays (plug in type Q series relays 8F/8B) coil resistance 340 ohms.+ 5%
Sensitivity of the Receiver	With minimum 1 mW transmitter output power, The receiver is workable with 28 db attenuation
Rejection voltage at the relay end	Modulation frequency 65 Hz CR2 No voltage minimum 21V. Modulation frequency 85 Hz Minimum 21V. No voltage.
Operating temperature range	0^0 C - 55^0 C
Overall dimensions	Transmitter - 150 x 222 x 175 mm (+ 5%) Receiver - 150 x 225 x 325 mm (+ 5%)
Weight	Transmitter - 4.5 Kg.(Approx.) Receiver - 6.5 Kg.(Approx.)

3.4.4 Protection: Protection to the power supply against overload and short circuit is provided. Gating circuits have been provided in the receiver unit to render it immune to noise impulse received either from supply source or from line so that CR1 & CR2 do not have unsafe side failure.

3.4.5 Dielectric strength: Withstand 1 KV AC for 1 minute

3.4.6 Insulation: Minimum 10 MΩ at 500V DC.

3.5 Description

3.5.1 Input & Output terminals

Standard 8 way polarized rack and panel couplers are provided in both the transmitter and receiver for external connections as follows:

Terminal No. of coupler	Transmitter
1	Output signal
2	Output signal
3	+ve DC input
4	- ve DC input
5	Common
6	85Hz
7	65Hz
8	Spare

Terminal No. of coupler	Receiver
1	Input signal
2	Input signal
3	+ve DC input
4	- ve DC input
5	O/P Voltage (+) for CR2
6	O/P Voltage (-) for CR2
7	O/P Voltage (+) for CR1
8	O/P Voltage (-) for CR1

3.5.2 Test terminal for external connections: Test points are provided in the back of the equipment to monitor the necessary parameters of transmitter & receiver as follows. These are provided exclusively for measurement purpose and not for drawing any external connections and are provided with cover and sealing facility.

Transmitter:	1	2	3	4	5	6
	O	O	O	O	O	O
	24V	11.5V	65 Hz	85 Hz		
	O	O	O	O	O	O
	Un Regulated	Regulated	Modulating frequency	Modulating frequency	Carrier frequency	Tx Output

Receiver:	1	2	3	4	5	6
			+	+		
	O	O	O	O	O	O
	24V					
	O	O	O	O	O	O
	Un Regulated	Regulated	Input	Demodulated Signal	Input to CR1	Input to CR2

CHAPTER 4: RE MODIFICATION AND ACCEPTANCE TEST

RE Modification: Filters along with X & Y relays in the line circuit of Tokenless block instrument handle type may be removed with reference to railway board letter no. STS/E/SLTLBI Date 02/01/2004. Circuits of F.M. handle type tokenless block instrument with RE modification i.e along with filters and X & Y relays is placed in annexure-I for reference.

Acceptance test: This test shall be carried out by inspecting authority on each equipment before accepting the delivery. The acceptance test shall include the following:

(a) Visual inspection

(b) High voltage test

(c) Insulation resistance test

(d) Coil resistance test

(e) Wire Count & Continuity test

(f) Performance test (except input/output impedance measurement)

(g) AC immunity test

Some remedial actions to avoid failures:

(a) Use DC – DC converters to get regulated voltage.

(b) Line battery chargers preferably charged on solar.

(c) Testing of quad cable, checking of joints, checking of dB loss and insulation resistance.

(d) Check earth and maintain low earth resistance.

(e) Check the loop resistance of line wires and record the readings.

(f) In electro mechanical installations checking of circuit controller bands for 2R/TAR circuits.

(g) For TELR relay OEN type relay may be used instead of miniature relay.

(h) Check back contacts of 1R, 2R, 3R & TOLR used in frequency selection.

(i) When quad cables are used, voltage to be increased suitably to contain line drop.

(j) It is observed that block handle spring contact number 7 & 8 and 9 & 10 fail frequently because of their frequent usage. These contacts are to be observed for their tension and pitting during maintenance.

(k) Receiver unit to be kept spare in every station as it fails frequently when compared to transmitter unit.

(l) The side screws of ebonite blocks of PB1 & PB2 in the instruments to be checked for intactness and proper working as it fails frequently Check nut of the block handle inside the instrument to be observed and tightened to avoid slackness of the ebonite segments.

(m) The lock magnet armature spring nut should not be disturbed and paint marking is to be done on the nut and its stud to observe intactness.

(n) Tx & Rx couplers should be firm and it is to be ensured by tightening the nuts on the studs.

(o) Testing of relays for their PUV, DAV and contact resistance once in a year and discard defective relays.

CHAPTER 5: SPECIAL REQUIREMENTS AND GENERAL MAINTENANCE

Special requirements of Single Line Token Block Instruments

5.1 Fixed Indications: The instruments shall be provided with visual indication clearly giving the following indications: (SEM 7.141)

(a) When the instruments are normal and there is no train in the block section, 'Line Closed' at both the stations.

(b) When Line Clear for a train to leave the Block station in rear has been given, TCF at the receiving station.

(c) When Line Clear for a train to leave a Block station has been received from the Block station ahead, TGT at the sending station.

5.2 Current Indicator: An indicator, indicating the polarity of current, shall be provided to indicate incoming and outgoing line currents. (SEM 7.142)

5.3 Operation: (SEM 7.143)

5.3.1 Train Going To and Train Coming From: The instruments shall be such that the cooperation of the SM at the other end of the section shall be necessary. Even with the cooperation of the SM at the other end, the SM has to go through one or more definite moving operations on the instrument in addition to working of bell plunger (SEM 7.143.1)

5.3.2 Line Closed: Both the instruments shall be restored to normal before a further operation of setting the instrument to TGT/TCF can be carried out. It shall not be possible for the instruments at either end of the section to be restored to normal without the cooperative features indicated in SEM 7.143.1 (SEM 7.143.2)

5.4 Operation of 'Line Clear' receiving and granting mechanism: It shall not be possible for the mechanism which permits a 'Line Clear' to be received and that which permits a 'Line Clear' to be granted to be in operation at the same time. (SEM 7.144)

5.5 The instrument that is set to TGT for initiating a train movement shall be first one to be restored to Line Closed on complete arrival of the train at the receiving station. (SEM 7.145)

Special requirements of Single Line Tokenless Block Instruments

5.6 Fixed Indications: In addition to the fixed indications. The instrument shall be provided with means to indicate TOL at both the sending and receiving stations when a train has entered the block section. (SEM 7.149)

5.7 Immunity from extraneous currents: Single Line Tokenless Block Instruments shall work on coded pulse/frequency modulated current system so as to be immune from the effects of extraneous currents. (SEM 7.150)

5.8 Operations - Handle type Tokenless Block Instruments: (SEM 7.151)

5.8.1 TGT and TCF: The instrument shall be such that even with the cooperation of the SM at the other end of the section, the SM has to go through one or more definite moving operations on the instrument in addition to the working of bell plunger

(a) before he sets his instrument to TCF

(b) Before he sets his instrument to TGT. (SEM 7.151.1).

5.8.2 TOL: Means shall be provided to ensure that the instruments are set to TOL automatically by the entry of the train into the block section and maintained in that position until the train has cleared the block section. This indication shall be in addition to the TGT or TCF indications of the handle. (SEM 7.151.2)

5.8.3 Line Closed: Both the instruments shall be restored to normal before a further operation of setting the instrument to TGT/TCF can be carried out. It shall not be possible for the instruments at either end of the section to be restored to normal without the cooperative features enumerated in SEM 7.151.1 (SEM 7.151.3)

5.9 General maintenance

(a) Each part shall always be kept clean so that its proper working may not be affected due to dirt.

(b) Terminals, bolts and plugs of Transmitter and Receiver shall always be kept well tightened so as to prevent any looseness of fixtures and consequent poor contact.

(c) All Contacts in Block Handle, PB1, PB2 buttons S1, S2 switches are clean and free from grease or dirt.

(d) All springs are in good condition and kept properly adjusted.

(e) Contact and switches are under appropriate pressure. The Contacting Portion should be maintained smooth as they wear out at the time of sliding.

(f) All mechanical moving parts inside the token less Instrument work freely and are well lubricated. Special Care to be taken during rainy weather to prevent rusting and sticking of parts.

(g) Locking piece and locking segments inside the Tokenless instrument shall be cleaned regularly specially during rainy weather.

(h) No oil or grease should be applied in the locking piece and locking segment.

(i) At respective handle stops, there shall not be more than 0.5 mm clearance between locking piece and the projection of locking segment.

(j) Between locking piece and the upper edge of the locking segment when the former is in locked condition and between the Locking piece and the lower edge of locking segment when the former is in unlocked condition there shall be a slight clearance and there shall be no possibility of the locking piece being lifted up.

(k) The lock armature works freely and the locking portion is properly forced down for each locking portion.

(l) There is no undue tendency for the Lock Magnet to be held when electrically de-energized.

(m) The magnet coil does not retain any Magnetism.

(n) Switches S1 and S2 should be checked regularly. Check the register that counter numbers are recorded serially.

(o) Number in every case is clear and visible.

(p) Connecting rod with shunt key and Block Handle assembly shall be checked frequently.

(q) The minimum line battery voltage should be maintained at 21.5 V.D C.

(r) The minimum line battery voltage should be maintained and ensure operating voltage at the other instrument at 21.5 V D.C.

(s) The output voltage of receiver for operating CR1 or CR2 shall be 19. 2 V min.

(t) Transmitter - Source voltage - 24V DC

(u) Receiver - Source voltage - 24V DC

Input voltage - 0.2 V to 1.0 V (with VTVM, Vacuum Tube Volt Meters)

(v) TOLK armature should be checked for its placement in the center channel putting the finger tip at the edge of the armature on both sides lightly to check easy play and full operation of parabolic indicator.

(w) When the input voltage is in the range of 0.2 V to 1.0 V (by VTVM) the output terminal voltage should be 19.2 V min.

5.10 DO's for operating staff

(a) SM Shall always see that when putting back signals to ON the Signal should correspond to the knob otherwise the Block Instruments at both ends may get locked.

(b) All signal knobs must be at Normal position before any operation is started.

(c) After pressing PB1 & PB2 at every time, it should be ensured that these buttons come back to normal when released.

(d) The Block Handle can be operated trouble free if it is initially turned with a slow movement. Hasty or jerky attempt at the beginning may not release the handle.

(e) The Block handle and the arrow on it should be kept perfectly in N or L or R position as the case may be and never be in any intermediate position other than the three mentioned above.

(f) In case of cancellation by switches it must be ensured that signals concerned at both ends are put back to ON if already cleared to make the cancellation effective.

(g) Always see that the HMT is on the Hook before PB1 & PB2 are pressed.

(h) The FSS knob must be kept in reverse for reception of a train even in case of failure of FSS. Non compliance will result in unnecessary failure.

5.11 DON'T s for operating staff

(a) Before starting any operation of the instrument does not fail to see that the SM's key, S1 & S2 switch are in proper normal position. All relevant signal knobs are at normal.

(b) Do not reverse Signal knobs concerned before either granting or receiving line clear.

(c) Do not try to turn the Block Handle to any position in a hasty manner.

(d) Do not fail to acknowledge the TOL bell and indication promptly.

(e) In case of operation of switch S1 & S2 do not forget to put the switch back to normal before trying to normalize the block handle to line closed.

(f) Don't forget that the procedure of closing the block by the stations after cancellation operation by S1 or S2 is just the reverse of the sequence for normal operation.

Normal Operation (without S1 or S2switch)	Sending station Normalizes first.	Receiving station Normalizes last.
Operation (With S1 or S2 switch).	Receiving Station Normalizes first	Sending Station Normalizes last

(g) Do not keep the Telephone hand set off the hook when not talking with the other end

5.12 Salient features of Transmitter and Receiver Units

1. Handle type Tokenless block Instruments using frequency modulated system are suitable for use in 25 KV 50Hz AC Traction area.
2. The frequencies are: Carrier frequencies - 1800Hz or 2700Hz
   Modulating frequencies - 65Hz & 85Hz

CONDITION	CODE
(i) To turn Block Handle from Normal to TGT	65Hz - DC 24 V
(ii) Normal to TCF (iii) TCF to Normal (iv) TGT to Normal	85Hz - DC 24 V
(v) Automatic TOL Indication and buzzer	65Hz - only
(vi) ADDITIONAL CODE	
TOL Acknowledgement	+ 24V DC
Bell Code ringing	- 24V DC

3. The Electronic Equipment: Transmitter and Receiver Operates between 21.6V to 28V DC
4. The Coding Relays CR1/CR2 Operate from the rectified feed from the receiver unit.
5. The stabled operation of the equipment has been achieved by working the receiver stages from 20V regulated supply and 12V regulated supply derived from 24V DC source.
6. To protect the Transmitter output and receiver input stages from Excessive induction Voltage, Varistors have been provided at both ends across the output transformer of the transmitter unit and input transformer of the receiver unit to limit the voltage to safe limits.
7. The Transistors used are of silicon type with higher ambient temperature (0 to 70^0 C).
8. Suitable indigenous ferrite cores have been used in all the transformers and tropicalised to suit weather conditions.
9. The condensers, resistors and diodes used are of superior grade, precision type for accuracy and printed circuits have been used.
10. The equipment is rated for continuous working. It is protected against heat, generated within the equipment, in such a manner that the temperature of the transistors used does not exceed the maximum permissible operating condition.

5.12.1 A.C. induction immunity

1. The equipment both transmitter and receiver are immunized from the adverse affects of 650 V AC 50 Hz induction voltage due to power parallelism from high tension transmission lines.
2. Induced Voltage of 600V AC 50Hz on the line circuit for 300ms within the receiver energized will not break the back contact of signaling relays CR1/CR2 (Q series relays)
3. Induced Voltage of 600V AC 50Hz on line circuit of 300ms with transmitter and receiver energized from a source voltage of 24V DC will not affect CR1/CR2 and will not cause break in back contact.

4. A general application of 350V AC 50Hz injected on the line will not have effect on the relays CR1/CR2 connected to receiver unit in energized condition.

5. The transmitter and receiver withstands a dielectric strength test of 1 KV between all current carrying parts and other parts insulated, therefore the insulation of current carrying parts with respect to other parts insulated are above 10 M ohm with a 500V DC Megger.

5.12.2 General

1. The connectors are of the plug in type sockets fixed at rear of the equipment.

2. The transmitter is provided with level switch in three ranges, Viz. Low, Medium and High. A change over switch provided for matching line either on 600 ohm or 1120 ohm.

3. The Receiver unit is provided with attenuator switch ranging from 0 to 28 dB. In DCC make attenuator switch is not provided. It is provided with test plugs for the measurement of the following output.

   Carrier frequency – input source voltage

   Keying frequency – regulated supply voltage.

4. Sensitivity of Receiver with 1mw transmitter output power, Receiver will operate with 28db line attenuation. Receiver consists of an attenuator, band pass filter and impedance switch.

5. Accuracy of frequencies:

keying frequency	–	65Hz + 5%, 85Hz + 5%
Carrier frequency	–	2700 or 1800Hz + 2%
Shift frequency	–	160Hz + 15%

6. Rectified output of the Receiver unit is suitably designed for operation of Q Series Relays whose drop away and pick up voltages have been accepted as follows:

   PUV – 19.2 V : DAV – 13.6 V (min).

7. In the AC Electrified areas the Token less Block Instruments are suitably connected to the under-ground cable between the stations. The screened Telephone cable laid for the communication circuit have pair of polyethylene insulated quad for Block working. The Token less Block Instruments are connected in the Polyethylene insulated quad to the VF Transformer.

8. The Token less Block Instrument manufactured as per IS – 98 – 2001 with modifications (1) Rated current value for normal operation up to 1 A (2) Variation of the source supply voltage 21.6V DC to 28.8V DC (3) The time release 120 s.

* * *

CHAPTER 6: METHOD OF OPERATION AND FAILURES

6.1 Method of Operation

(A) Dispatching train from Station A to Station B.

Sl. No	Station A	Station B
	Normal Status: Block indicator of the instrument in 'Line Closed' position. All relevant signals and their controls are normal.	**Normal Status**: Block indicator of the instrument in 'Line Closed' position. All relevant signals and their controls are normal.
1	Inserts SM's Key and turns.	
2	Presses PB1 and sends 'call attention' code of bell signals.	
		Bell sounds for 'call attention' code of bell signals.
		Inserts SM's Key and turns.
		Acknowledges the 'call attention' code by pressing PB1.
	Bell Sounds as acknowledgement of 'call attention' code of bell signals.	
3	Sends 'Attend Telephone' code of bell signals by pressing the PB1.	
		By pressing the PB1 to Acknowledge the 'Attend Telephone' code and attends on Telephone.
	Asks for 'Line Clear' on telephone, giving name of station on the telephone.	
		Accepts the 'Line Clear' enquiry.
4	Sends 'Is Line Clear' enquiry code of signals by pressing PB1 & PB2 until Galvo needle gives a kick	
		On receiving 'Is Line Clear' code turns Block handle to TCF Position
		Answers back the 'Is Line Clear' code of bell signals by pressing PB1 & PB2 until Galvo needle gives a kick.
	On receiving answer back to its 'Is Line Clear' code. turns Block handle to TGT Position	
5	(a) Takes OFF the LSS. Train enters Block Section. (b) LSS return to ON position. (c) TOL Indication appears automatically and Buzzer starts operating. (d) Instrument sends automatic TOL code. Replaces LSS knob to Normal	
		TOL indicator appears on receiving the TOL Code and Buzzer sounds.

		Sends ‘Call attention’ code of signals by pressing PB1.
	The instrument stops automatic TOL code.	
	TOL buzzer stops.	
		TOL buzzer Stops
	Acknowledges 'Call attention' code of Signals by pressing PB1.	
	Sends TOL code of bell signals.	
		Acknowledges TOL code of bell signals.
6		a) Takes OFF the reception signals b) Train enters the station. c) Reception Signal return to ON position d) Train arrival Buzzer sounds. e) Replaces FSS knob. f) Train arrival buzzer stops
		Sends ‘Call attention' code of bell signals.
	Acknowledges 'Call attention' code of signals.	
		Sends 'Train arrived' code by pressing PB1 & PB2 until Galvo needle gives a kick.
	On reception of 'Line Closed' code turns Block handle to Line Closed indicator. TOL indicator turns OFF	
	Answers back the ‘Line Closed’ code of bell signals by pressing PB1 & PB2 button until Galvo needle gives a kick	
		On reception of ‘Line Closed’ code turns Block handle to Line Closed.

(B) To cancel a 'line clear' before the train enters the Block Section.

Sl. No	Station A	Station B
	Handle at TGT position.	Handle at TCF position.
1.	Calls the attention of station B and takes his consent on telephone	
		Gives consent on telephone and ensures all signal knobs concerned at normal.

Sl. No	Station A	Station B
2.	a) Operates Cancel switch S1 to reverse b)Puts back all relevant signals to ON and ensures signals concerned are at normal c) Counter registers next higher number d) Waits for 2 minutes for FREE indication. e) FREE indication appears. f) Turns switch S1 to normal	
3.	Sends 'Call attention' code of signals	
		Acknowledges 'Call attention' code of signals.
4.	Sends 'Cancellation' code of Bell signals and Presses PB1 & PB2 until Galvo needle gives a kick	
		On reception of Cancellation code, turns Block handle to Line Closed Position
5.		Answers back the Line Closed code of bell signals by pressing PB1 & PB2 until Galvo needle gives a kick
	On reception of answer back Cancellation code, turns Black handle to Line Closed Position	

(C) Closing of Block Section after the train pushes back to the dispatching station.

Sl. No.	Station A	Station B
	Handle at TGT Position, TOL Indicator ON	Handle at TCF Position TOL Indicator ON
1	Calls the attention of Station B on Telephone and takes his consent.	
		Gives consent on telephone and ensures signal knobs concerned at normal.
2	a) Operates switch S2 to reverse. Takes OFF the reception signals b) Train enters the station. c) FSS returns to ON position d) Train arrival Buzzer sounds. e) Replaces FSS knob f) Train arrival buzzer stops. g) Counter registers next higher number. h) Turns switch S2 to normal i) Ensures knobs concerned at normal.	
	Sends 'Call attention' code of signals	

Sl. No.	Station A	Station B
		Acknowledges 'Call attention' code of signals.
3	Sends ‘Cancellation’ code of Bell Signals Presses PB1 & PB2 until Galvo needle gives a kick.	
		On reception of Cancellation code turns Block handle to Line Closed Position. TOL indicator turns white.
4		Answers back the Line Closed code of bell signals by pressing PB1 & PB2 until Galvo needle gives a kick.
	On reception of answer back Cancellation code, turns Block handle to Line Closed. TOL Indicator turns white.	

(D) Shunting between LSS and Opposing FSS

Sl. No	Station A	Station B
	Handle in Line closed position. Signals Concerned at normal. Reception signal shall not be taken OFF for shunting.	Handle in Line closed position. Signals Concerned at normal. Reception signal shall not be taken OFF for shunting.
1	Calls the attention of Station B and obtains his consent on telephone.	
2		Gives consent on telephone.
3	(a) Inserts SM's key and takes out the shunting Key (b) Hands over Shunting Key to the Driver (c) Driver completes shunting and returns Key to SM. (d) Inserts SM's key and also shunt key.	
4	Informs the SM at station B on telephone	
5		Acknowledges on telephone.

(E) Shunting between LSS and Opposing FSS behind a departing train with Block indicator in TGT position with or without TOL indication

Sl. No	Station A	Station B
	Handle in TGT position. Reception signals at normal. Reception signal shall not be taken OFF for shunting	Handle in TCF position.
1	Calls the attention of Station B and obtains his consent on telephone for shunting behind the train.	
2		Gives consent on the telephone.

3	(a) Applies SM's key and takes out the Shunt Key. (b) Hands over Shunt Key to the Driver. (c) Driver completes shunting and returns key to SM (d) Inserts SM's key and Shunt key.	
4	Informs the SM at B on telephone.	
5		Acknowledges telephone. Initiates the procedure for closing of the block section to 'Line Closed' position in case the train has already been received. In case the train has not been received prior to completion of shunting at Station A initiates procedure for closing of the Block section after the reception of the train.

6.2 FAILURE OF INSTRUMENTS OR APPARATUS

6.2.1 Handle Type Tokenless Block Instrument shall be considered to be interrupted and their working suspended in the following circumstances.

(a) When attention cannot be obtained direct on the Block Instrument.

(b) When signals on the Bell are received indistinctly or fail together.

(c) If the LSS fails to return to ON position as a train passes it.

(d) If the TAR buzzer does not sound even after the complete passage of the train inside the FSS over the LVT Circuits (This may be due to failure of, the LVT Circuits.)

Note: Though FSS may go automatically to ON by passage of the train, FSS knob shall not be put back to Normal Position unless the whole of the train has arrived inside the FSS. Failure to adhere to this will result in a Block Failure and the TAR buzzer will not sound under such circumstances

(e) When, there is reason to believe that, there is contact between the Block wire and any other circuit.

Note: (i) If a contact exists between the Block wire and any other circuit, there is a possibility of irregular beats on the bell. A contact between two block wires would cause signals given on one instrument to be repeated on the neighbouring instrument.

(ii) The Telephone connected with the instrument for train signalling, also shall be considered as having failed and working by means of the telephone would not be resumed until authorised by the Signal Engineer or any other authorised person.

(f) If the Instrument or its battery counter is found unlocked or seal missing.

(g) When TOL buzzer fails to give the alarm for any reason at the receiving station, even after display of TOL indication on the Block Instruments.

Note: (i) If a following train in the same direction working on paper line clear ticket actuates the TAR bell, block working may be resumed.

(ii) If there is no following train but there is a train to proceed in the opposite direction the same will be dispatched on paper line clear ticket. The SM at other end should use S2 switch and as in the case of a train pushing back and receive the train on proper signals after which block working may be resumed without waiting for S&T staff.

(h) When a Material Train etc. is required to be taken into a Block Section after Line Block has been imposed in accordance with Appendix V, to the G & SR.

Note: Block working (with Line Clear exchange by any means) shall he suspended and the Material train etc. started on an Authority to proceed without Line Clear. After the Line Block has been removed the SMs themselves shall resume block working.

(i) When a train is required to enter block section which is obstructed by an accident or any other reason.

Note: Block Working (with line Clear Exchange by any means) shall be suspended and trains started on an authority to proceed without Line Clear on the obstruction being removed, the SMs themselves shall resume block working.

(j) If it is known that the Instrument is defective in any way not specified above.

6.2.2 Other failures

(a) If the Galvanometer needle fails to move, when bell signals are given or received.

(b) If the TOL indication fails to appear on the Instrument after the train has entered the Block Section.

(c) If the LSS failed when the Block Handle is turned to the TGT position.

(d) If the LSS cleared even when the Block Handle is not turned to the TGT position.

(e) When the train arrives at a station without Line Clear having been given for it.

Note: This occurrence must be reported as an accident.

(f) Whenever the Block Handle is not free to be turned from one of the positions even after the correct sequence of operations.

(i) If the Block handle can be turned from TOL to Line Closed position before arrival of the train.

(ii) If the Block handle can be turned to any of the three positions without a prolonged beat from the station at the other end.

6.2.3 FAULT LOCALISING

Sl. No.	Fault Condition	Cause/How to rectify
1	Bell Beats failed from Stn.A to B	1. Line Battery low or disconnection at A 2. PB1 contact develops disconnection at A 3. Line open circuit/short circuit/high resistance. 4. PB1 contact develops disconnection at B 5. Local battery disconnection or weak at B. It shall be 24 volts. 6. BLR relay not picking up at B when PB1 pressed at A due to some fault. 7. Diode in series with BLR/NR punctured. 8. Relay contacts NR,BLR ,PBPR offering high resistance at A or B 9 When PB1 pressed at A, BLR shall pick up at B. Suppose BLR is not picking up, check up the incoming line voltage at B across L1, L2 (Terminal No.25, 26) working voltage 24 volts. If voltage is available and relay is not picking up, check up for current (Working current 110 mA).

Sl. No.	Fault Condition	Cause/How to rectify
2.	Failure of lock magnet	Ensure the following: 1. SM`s key ON contact is making. 2. 1R front contact is making (checking up the block signals ON) 3. TER cold contact in TER. 4. Switch S1 in N. 5. Switch S2 is N. 6. Relay 2R back contact is making. 7. Relay 3R back contact is making. 8. Relay TRSR front contact is making in case of turning the Block Handle from N to L including check lock. 9. Relay TRSR back contact is making in case of turning of Block handle from N to R, R to N & L to N. 10. Block handle contact XX' in case of turning Block handle from N to L 11. Block handle contact BDY in case of turning Block handle N to R, R to N & L to N respectively. 12. Relay NR front contact is making 13. CR2 front contact is making for turning the Block handle from N to L. 14. CR1 front contact is making for turning the Block handle from N to R, R to N & L to N. 15. Local battery voltage 24 Volts 16. Ensure cross protection contact viz. CR1/CR2 breaking during the respective operations.
3	Failure of relay 1R	1. Ensure voltage of location battery at 24 V 2. All block signals concerned are at ON
4	Failure of relay 2R	1. TAR picks up while train arrives. If TAR is not picked up check TAR circuit. 2. TAR front contacts making properly. 3. Stick circuit is taken through Block handle contact LB/RD. Check Block handle contacts.
5	Failure of relay 3R	Check up TER circuit. Check up the SM's key contact, switch S1 R contact. TER hot contact. TEPR circuit. TER cold contact, Block handle LX' contact.
6	Failure of PBPR relay	Check up the PB1 & PB2 contacts, 1R front contacts. When Block handle is in RD, check up Block handle contact, TOLR front contact. Check up SM's key contacts.
7	Failure of TRSR at sending end	1. Check for CR2,NR & 1TPR front contacts 2. Block handle contacts XX' & LX' 3. Local voltage 24V including fuses. 4. 3R back contacts 5. If stick feed is not available check TRSR front contacts, make before break of XX'/LX' 6. Check up the condenser across TRSR.

8	Failure of TOLR at Stn A	a. Pick up circuit for TOLR 1. Ensure TRSR slow to release feature with condenser. 2. Ensure TRSR front contacts making 3. Ensure 1TPR back contacts making 4. Ensure block handle contacts LB making 5. Ensure 3R back contacts making b. Ensure stick feed to TOLR 1. Ensure S2 normal contacts making 2. Ensure TOLR front contacts making 3. NR back contacts making 4. TRSR back contacts making 5. 3R back contacts making
9	Failure of TOLR at Stn B	1. CR2 front contact making 2. Ensure NR back contact making 3. Ensure Block handle, RD contacts 4. Ensure local voltage 24 V
10	Failure of CR1/CR2	Check at the receiver test terminals for 1. Input 24 V DC to receiver. If DC input is absent check the Block handle Contact XY/LB/RD. 2. FM input. If FM input is present check up the level. If the level is Not OK, adjust in the attenuator. If the level is low at the Tx, check the level Low/High/Medium. If the level is OK, check the carrier frequency 1800/2700Hz and Modulating frequency 85Hz for CR1 and 65Hz for CR2. If the Level and frequency OK check the FM input path in to Rx. At the Tx end check DC input to Tx, frequency loop circuit for FM, which includes Block handle contacts N,R & L.
11	Failure of LSS	Check for ASR: TRSR front contacts, S1 normal contact , LA contact of Block handle and 1R back contacts
12	Failure of FSS	Check for HSR: S1 normal contact & RD/LB or S2 reverse contact and contact L of Block handle for push back operation
13	Premature TOL	Stick feed to TRSR cut off due to 1 TPR momentarily dropped due to reason not known before train enters into the section. Check up the 1 TPR circuit. If OK, check up track circuit. Block handle LX' contact is to be checked up.
14	Normal cancellation not possible	TRSR dropped due to momentary dropping of 1TPR or 3R circuit LX' contact is not making. Check S1 switch R contacts in TER and 3R circuit are making properly. Check 1R front contact and SM's key contact.

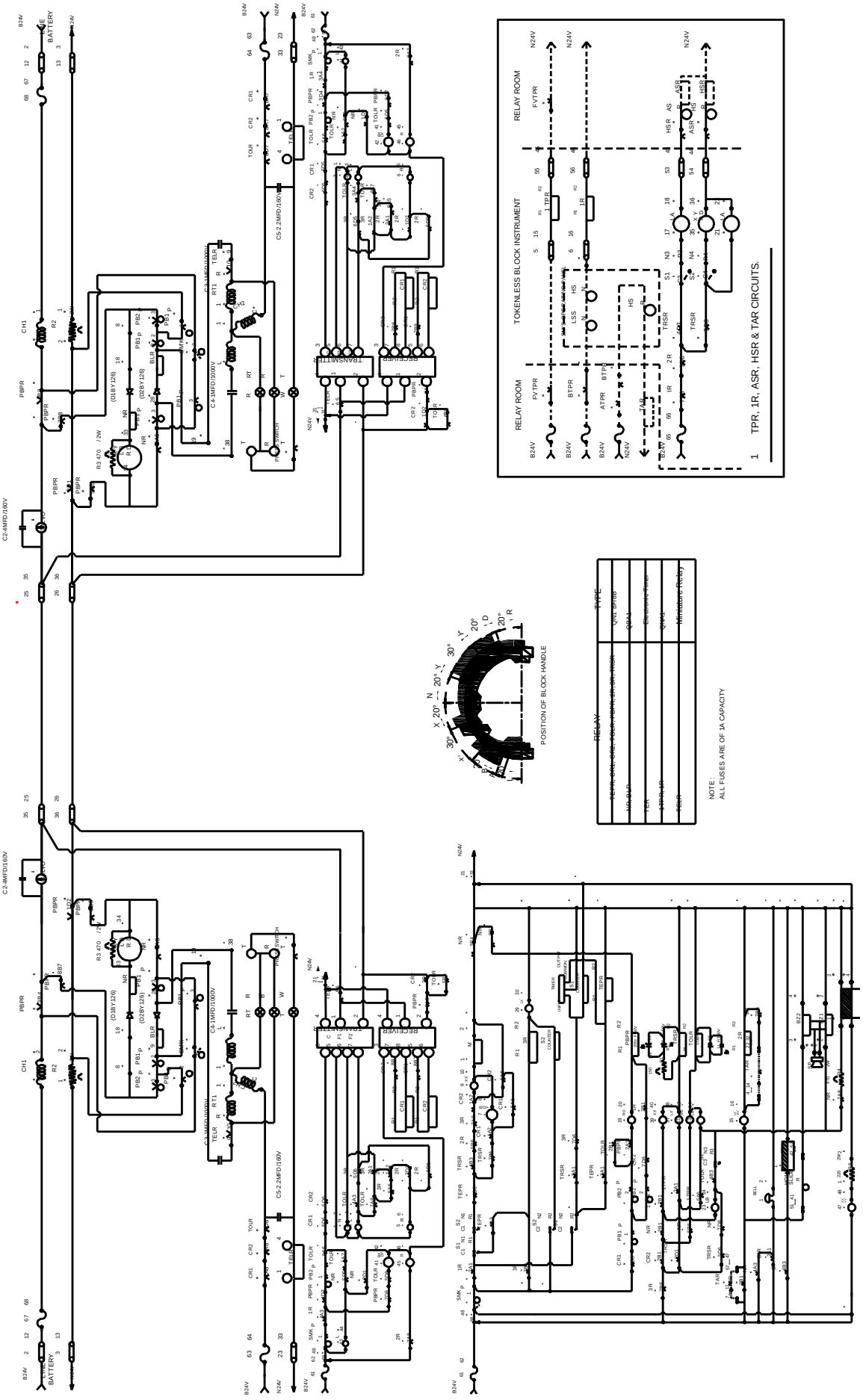


Fig: 6.1 CIRCUITS OF F.M. HANDLE TYPE TOKENLESS BLOCK INSTRUMENT

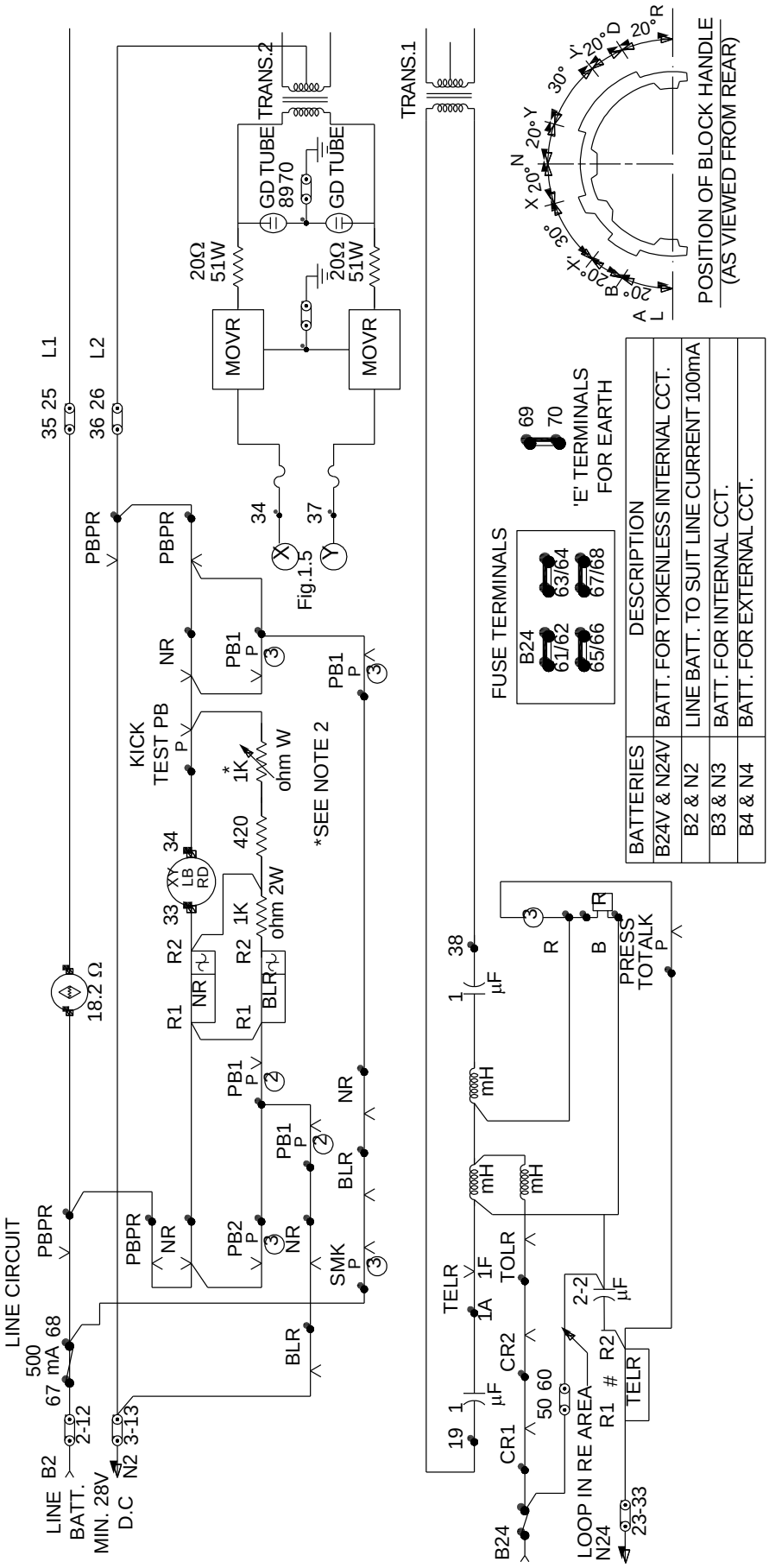


Fig : 6.2 CIRCUIT ELIMINATING DIODES AND FILTER UNITS

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CHAPTER 7: INTRODUCTION TO PUSH BUTTON TOKENLESS BLOCK INSTRUMENT

IRS SPECIFICATION S 32/66; Ref: Circuit Drg.STS. S.1082/94.

7.1 INTRODUCTION

The main purpose of introducing Tokenless Block working is to reduce the block operating time and to increase line capacity by 1. Eliminating the tangible authority 2. Introducing the non-cooperative feature without changing the basic requirement of absolute block working. This could be achieved up to a limited extent only in the instruments of the handle type. The co-operation of the other station at the time of obtaining line clear even though it is established that the section is clear or at the time of closing the Block Section after the arrival of the train is still needed in the handle type of instruments. To obtain the full advantage of Tokenless block working, a new type of Tokenless block instruments of the push button type have been evolved and now introduced on the Indian Railways where the above drawbacks are eliminated. And this block instrument is not suitable for RE area.

7.2 System: Push button type Tokenless Block Instrument consists a set of push buttons provided on a control panel and relays provided in a cabinet. For a block section one instrument is installed at each end of the block section and the instruments are connected with two line wires. In this instrument there is no mechanical interlocking and the interlocking is purely by relays. Merely by operating push buttons on the control panel, various operations can be done.

7.3 To set the instrument to TGT condition push buttons BCB (Bell Code Button) and TGB (Train Going to Button) are pressed simultaneously at the train sending station. This operation transmits the TCF code to the instrument at the other end and if the conditions for granting of 'Line Clear' are satisfied, sets the instrument to TCF condition. After the instrument at the receiving end is set to TCF, TGT code is automatically generated and transmitted back to set the instrument at the dispatching end to TGT condition.

7.3.1 Similarly, when the train arrives at the receiving end, operation of push buttons BCB and LCB (Line Closed Button) simultaneously at the receiving end results in transmission of the 'Line Closed' Code to the other end instrument and setting that instrument to Line Closed Condition. The instrument at the dispatching end after setting to Line Closed generates Line Closed Code automatically and transmits Line Closed Code to set the Train receiving Instruments to Line Closed Condition.

7.3.2 Three step polar impulse coding is employed in these instruments as follows:

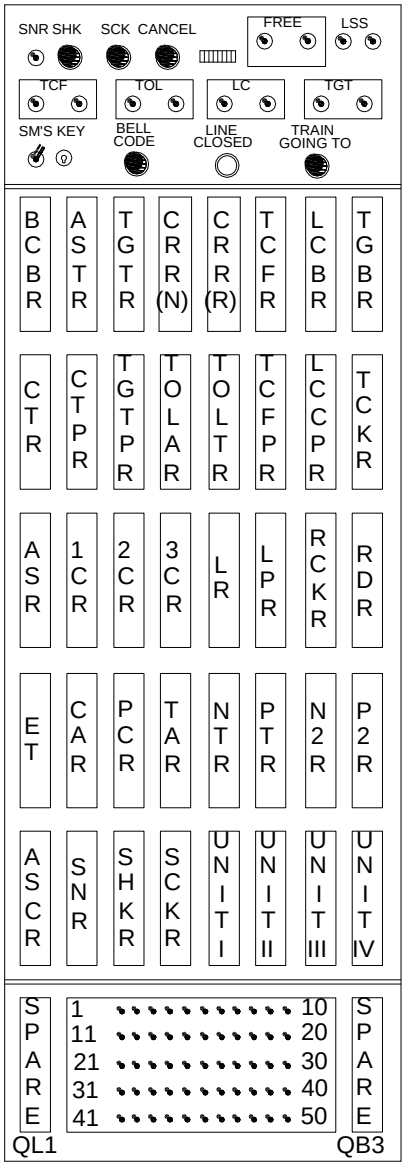
TCF Code	For setting the instrument to TCF	-	+	-
TGT Code	For setting the instrument to TGT	-	-	+
TOL Code	For setting the instrument to TOL	-	-	-
Line Closed Code	For setting the instrument to normal	-	+	+
Bell code	To send the bell code signals	+		

7.3.3 Construction: The instrument consists essentially of two parts

(a) A relay cabinet housing all relays, and

(b) A dash board called Block Panel containing push buttons, indicators, bell, telephone, etc.

These two are manufactured as a compact unit with the control panel coming on top of the relay cabinet. The overall height renders the indicators to be at the eye level and the buttons within comfortable reach of a man of normal height.



RELAY CABINET (Front view)

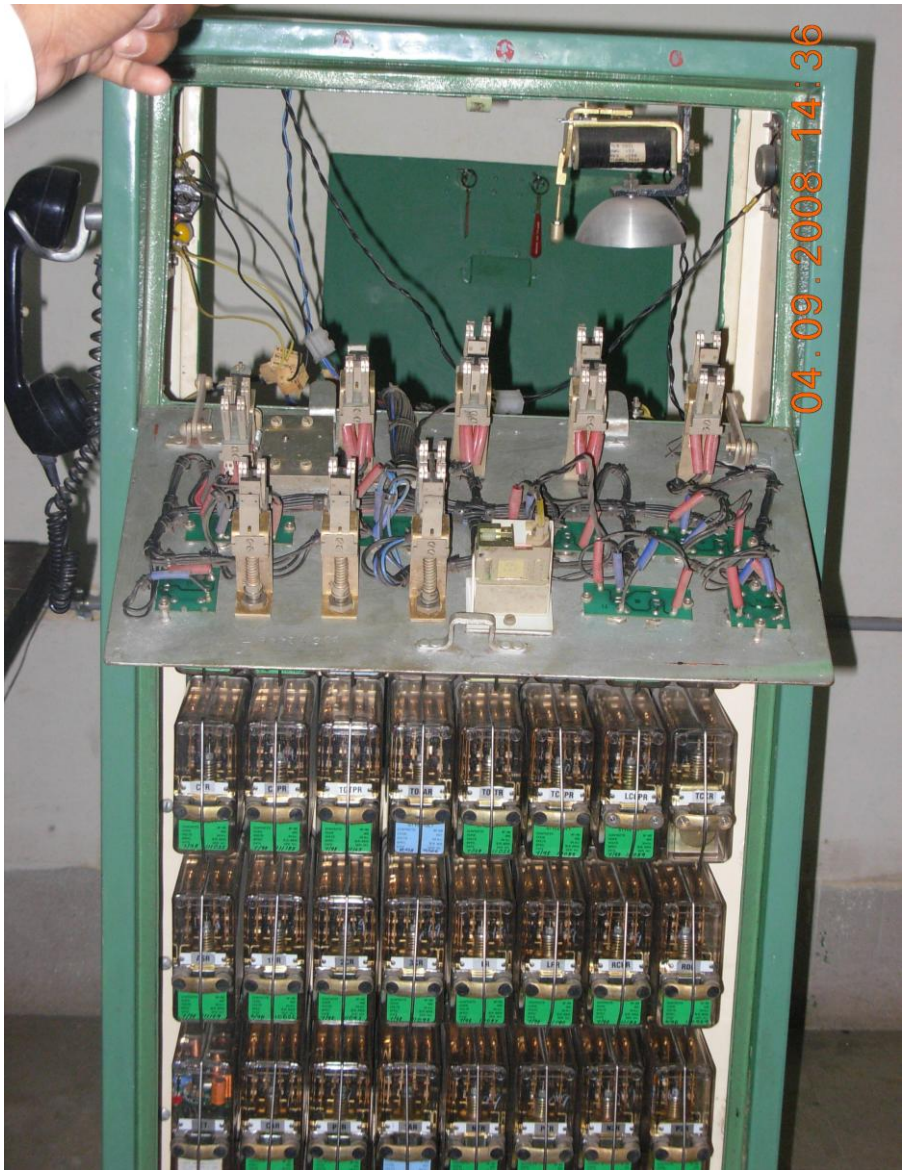
Relay Cabinet: Height is 141 cm. The base measures 56 cm x 31 cm. There are two doors one on each of the broader sides. These doors are removable type and do not swing out. This reduces the area required for maneuvering. The panel and 36 number of relays and four resistance & condenser units are on the front side, while the button contacts and jack board terminals of the relays are on the rear side. The space between the later and the nearest wall or any such obstruction should be enough for the Maintainer to sit comfortably and attend to repairs or measurements. Floor mounting is adopted for fitting the instruments.

ARA (American Rail Associates) terminals totalling 50 numbers are housed below the relays to take on external connections including sources of power line etc. Necessary contacts and coil terminals of relays are brought out to these terminals. Cables for batteries, line and external circuits are brought to the terminals from the opening at the bottom on the instrument.

Wiring is done as per a color code for easy identification.

The user has to provide EKT instruments for shunt key and slip/catch siding control key where required as these are not supplied by the Manufacturers.

Block Panel: This is surfaced with a black colored laminated sheet on the front that is recessed to receive the push buttons, indicators etc.



Though the relay case and control panel are mounted on the same frame, only the relays are exposed for observation when the front door is removed and the panel remaining in position. A special latch is provided to hold the panel in that position. It can be opened out on hinges when this latch is pulled down, lugs unscrewed and the panel drawn out. The panel swings out. The button contacts, indicator lamps etc., come within easy reach of the Maintainer.

Another feature is the stenciled indicating arrows provided between the engraved Perspex sheet and the lamps of TCF and TGT panel. These are of reversible type. This provision freely allows positioning of the instruments parallel to the track and does not make the instruments direction oriented.

Push Buttons

(a) Bell Push Button: Colour- Black, Code - BCB. This is the most often used button. This is used to call the other SM's attention and for exchange of bell code. For cancellation operation, and for transmitting a TCF or Line Closed Code, this button has to be pressed along with the relevant button. Whenever BCB button is pressed, the panel also lights up to give an indication to the operator of the condition of the instrument.

(b) TGT Button: Colour- Green, Code - TGB. This button is pushed along with BCB for setting the instrument to TGT. This button is also pressed to interrupt the TOL transmission to facilitate the train sending operator to exchange bell code of signals and contact other station on phone which is otherwise not possible during the transmission of TOL code.

(c) Line Closed Button: Colour- White, Code - LCB. To be pushed along with BCB for setting the instrument to Line Closed.

(d) Cancel Button: Colour- Red, Code - Cancel. To be pushed along with BCB for cancelling a Line Clear. The action advances the number in the counter by one.

(e) Panel Lamp Button: Colour- Yellow, Code - PLB. The indicators except - TOL & FREE are lit when BCB or PLB button is pressed. This is to be pressed when the condition of the instrument is to be verified. Using BCB for this purpose alone will unnecessarily transmit a pulse on the line and call the other SM. Lighting up of indicators, only when required, minimizes the drain on the power source. Presently this PLB is dispensed.

(f) Shunting Key Button: Colour- Blue, Code - SHK. To be pressed when it is required to remove the key from the shunting EKT instrument which can be extracted in line closed, TGT-TOL. Shunt key cannot be extracted from EKT in TCF condition and also only with TGT condition.

(g) Slip/Catch Siding Key Button: Colour- Blue, Code - SCK. To be pressed to extract the key from EKT instrument. The key is used to operate Slip/Catch siding points.

Panel Indicators

(a) TCF (Green): when lit, indicates that the instrument is in TCF condition.

(b) Line Closed (White): when lit, indicates that the section has been closed.

(c) TGT (Green): when lit, indicates that the instrument is in TGT condition.

(d) LSS Indications: When lit, red means the LSS is at ON and green means that the signal is at OFF.

(e) SNR (Green): This is an indication to the SM to verify if all the relevant controls etc. are normal.

(f) TOL (Red): When lit, indicates that the train has entered into the Block Section on 'Line Clear'. Remains lit till the section is closed.

(g) FREE Indication (Green): Indicates that the prescribed time interval has lapsed and the cancellation of Line Clear can commence, when the train has not left the station and Line Clear has to be cancelled.

(h) Counter: This registers the number of times cancellation of Line Clear has been initiated on the instrument. When the cancel and BCB buttons are pressed, the counter number jumps by one digit. The new number is required to be lodged and explained by the Operator.

(i) SM's Key: Code - SMK. This is used by the SM to prevent unauthorized operation. When the instrument is locked by the SM, it is not possible to set the instrument to TGT or initiate Line Closed Code or send bell code, while it is still possible for the instrument to transmit and receive TOL code, transmit TGT code, receive TCF code or Line Closed code, transmit Answer Back Line Closed Code, and receive Bell Code. Thus, the 'Non-co-operative' feature is not destroyed by locking up of the instrument. Communication between the stations is still possible with the key OUT.

(j) Single stroke bell: This bell operates every time when bell code is received to call the attention of the SM as per the bell code of signals.

(k) Buzzer: This sounds intermittently at the receiving station when TOL code is received and continuously when the train arrives at the station.

(l) Telephone: This is provided on the left side of the instrument. A push button on it has to be pressed while speaking. This is electrically isolated from both local and line circuits.

7.4 Features

7.4.1 No mechanical moving parts, hence no overhauling required.

7.4.2 This instrument consists of a set of push buttons and relay circuits, and operates on DC pulse codes. By eliminating transistors and diodes from the line circuit, this instrument can withstand high surge voltage accidentally encountered in the line.

7.4.3 The code employed in this system consists of three step polar pulses and first step of operational code, is set at negative so that they can be separated from bell signal which consists of a single positive pulse. Therefore, in receiving bell signal, only the polarized relay is energized while other relays are de-energized.

7.4.4 To cancel TGT condition before the train enters the Block Section or to set the block instruments to Line Closed when the train pushes back to the dispatching station, LCB & BCB must be pressed at both stations concurrently.

7.4.5 Except TOL code, all other codes are transmitted only when LCB or TGB is pressed along with BCB at the transmitting station.

7.4.6 No error can result in received code by improper operation of keys or switches while a code is being received.

7.4.7 The TOL buzzer operates intermittently only at the receiving station until the acknowledgement operation is done by the train receiving station.

7.4.8 When TGT condition is to be cancelled, before the train leaves the station or when the train is pushed back to the station, the CANCEL button is to be pressed along with BCB.

7.4.9 The TOL code can be temporarily suppressed by the sending station by keeping the TGB pressed. Then, it is possible to transmit Bell signals by pressing the BCB.

7.4.10 All relays as well as signal control relays are contained in the relay cabinet. Therefore, no other relay rack is required.

7.4.11 Circuit is so designed as to minimize power consumption.

7.5 Categorisation of relays

The relays of the block instrument are categorized as follows.

7.5.1 Relays energized from external battery

(a) SNR

(b) ASTR

(c) TAR

SNR-SIGNAL NORMAL RELAY

This relay proves the normal position of all the signals and their knobs concerned. It picks up by pressing BCB along with TGB/LCB or automatically on receipt of all 2nd functional pulse except on TOL code and drops at the end of 3rd pulse. However, if the Instrument is set to TGT, it drops only on releasing LSS control. Picking up of this relay indirectly proves that shunt key and slip/catch siding keys are IN Position. Pick up condition of FVT & LVT etc. are also proved in this relay circuit. For all functions except TOL and Bell transmission this relay working is a must. Though feed to this relay from the external circuit is available, it does not pick up due to 'No drain circuit' feature. However, SNR indication is available.

TAR-TRAIN ARRIVAL RELAY

It is a magnetic latch relay and used for registering the arrival of a train on line clear. It picks up through the external battery while receiving a train on signals with Instrument in TCF-TOL/TGT-TOL condition and de latches to normal through local battery once the instrument assumes to line closed position.

ASTR-ADVANCED STARTER TRACK RELAY

It is a repeater for the FVT relay and can pick up whenever the TGB is pressed and sticks once TGT is established. It drops once FVT is actuated. Dropping of this relay in TGT position initiates transmission of automatic TOL code along with TOL indication. It also picks up and sticks while initiating push back cancellation. Non energization of this relay will not permit the Instrument to change to TGT even on receipt of Answer back TGT code.

7.5.2 Relays energized from Line Battery

(a) CRR - Code Receiving Relay. Type QB3 as CRR (N) & CRR (R)

(b) TCKR - Transmission of code checking relay. Type QB3

The polarized relay CRR in the other instrument and TCKR in this instrument comes under this category. The line battery in transmitting instrument energizes the TCKR in its own instruments and CRR at the other end, when the code is transmitted.

The instrument has a coding circuit as its core. This circuit progresses step by step (i) while the instrument is transmitting to generate pulse one by one and (ii) while the instrument is receiving to receive pulses one by one, store, use them and terminate each thereafter. When

Pulse is terminated by the coding circuit at the receiving end, the one at the transmitting end steps up by one to generate the next pulse, if any or normalizes only to reactivate, if necessary to revert to the role of receiving.

CRR is a QB3 or polarized relay that receives the pulses from line and picks up to the Normal or Reverse direction depending upon the potential on one line wire with respect to the other. Its N and R contacts close accordingly.

TCKR picks up while the instrument is transmitting. TCKR thus checks the code transmission, TCKR at transmitting and CRR relay at receiving end are in series through the line with the line battery at the transmitting end. Back contacts of another relay called RCKR at receiving end is also in this circuit.

When a pulse has been received by the CRR, it reacts on the coding circuit. RCKR picks up after the storing or fulfillment of the purpose and opens its back contacts. This action opens the series circuit of TCKR at the other end, CRR at this end. This marks the termination of a pulse. Thus, the generation and transmission of a pulse is done at the transmitting end while the termination of a pulse is ordered by the circuit at the receiving end.

The picking up and dropping of CRR and TCKR at their respective ends energizes and de-energizes another relay called LR, which in turn activates the coding circuit.

The coding circuits at both ends are firmly bonded together each monitoring the regular functioning of the other at each stage, by employing time lags of certain relays. Any irregular functioning of one of the coding circuits will reset all the relays of both the coding circuits and restart the transmission of code afresh. This process will go on till the circuits function correctly or till the attempt to transmit the code by pressing of button is withdrawn.

When bell code is transmitted, the line battery is taken through a resistor of resistance equal to that of TCKR and not, through the coil of TCKR. Hence, it does not pick up. So, the coding circuit does not operate.

When the bell code is received, CRR operates to N but LPR not being up, LR does not energize while the single stroke bell gets feed and strikes once. If a positive pulse is received as part of a code, LPR would have been up and hence, LR will pick up while the bell is isolated. Thus, the coding circuit does not operate for bell code. This prevents transmission of an apparently genuine code by skilful manipulation of BCB.

7.5.3 Relays energized from local battery

RCKR - Code reception checking relay – This senses the progress of the coding circuit at the receiving end and when picked up, terminates the pulse that is being received by opening the line circuit. This relay prepares the instrument for automatic answer back.

RDR - Receiving delivery relay –This stores the first pulse of any code when it is negative and remains energized till code reception is complete and relay 3CR de-energizes.

CTR - Code Transmitting relay –This relay by its state of energization or de-energization decides whether the instrument is transmitting or receiving respectively. Its front contacts connect the line battery to line while its back contacts connect CRR (N) / CRR(R) to line. There is a time delay circuit which checks the duration of a pulse on line. If due to any trouble at the receiving end, the coding circuit functions irregularly, CTR de-energized, resets all relays and re-initiates the code afresh.

Picking up of this relay proves that all the required conditions for transmission of a code are available i.e.

(a) All signals and their controls concerned pertaining to an instrument are normal.

(b) No shunting is being carried out in the face of an approaching train and

(c) SM is keeping the BCB along with TGB or LCB in the pressed condition with the SM switch is in normal.

(d) The conditions are favorable for answering back.

CTPR - Repeater of CTR. This repeats the CTR while the instrument is transmitting code, but remains energized till the complete answer back code is received. A time delay circuit measures the time taken by the other instrument to answer back. If the instrument does not respond within a definite time, CTPR releases and reset all relays and code transmission is initiated all over again.

LCCPR - Line Closed Code Reception Relay. This picks up when Line Closed code is received from line. When picked up this enables the TGTR or TCFR to release and switches on CTR for answer back when necessary. This allows line closed code transmission as an automatic reply code only when the enquiry code is line closed code and not otherwise.

PTR & NTR - Positive & Negative Transmitting Relay. These relays switch on positive and negative pulse on line by connecting the line battery to line appropriately. Stick feed to these over TCKR front contact ensures the presence of pulse on line till the line circuit is opened. These relays are used respectively to connect positive/negative of the line battery on line at the transmitting instrument. Only one relay can pick up at a time and this depends on the condition of the coding relays 1CR, 2CR, 3CR and the Instrument Position deciding relays TCFR and TGTR provided the relay CTR is in energized conditions. Once TCKR is picked up the relay PTR/NTR sticks through its front contact to ensure the presence of a pulse on line till the line circuit is opened either by the receiving instrument or by the transmitting instrument itself by dropping of the relay CTR. The 2nd case takes place only if the receiving Instrument fails to open the line circuit at the end of a pulse.

LR - Coding Relay. This is the relay that is reacted on first by CRR(R) or TCKR while the instrument is receiving or transmitting respectively. By picking up and dropping alternately as required it activates progresses and terminates the functioning of the coding circuit. So, the feeding circuits to this relay consists of two branches, one with TCKR and PTR/NTR contacts and the other CRR(R), CRR(N) contacts.

LPR - Repeater of LR. This repeats LR, but with a difference. This sustains itself even during the release period of LR by means of a time delay circuit to monitor the duration of space period. If the appearance of the next pulse on line or closing of the line circuit after formation of pulse is delayed due to irregular functioning of circuits, LPR releases to reset all coding relays, even if the code progress is halfway. This relay virtually by its state indicates the activity or otherwise of the coding circuit. During reception of an isolated positive pulse not as part of a regular code, its back contact connects the battery to the bell, while during reception of a regular code its front contact connects it to LR.

1CR, 2CR & 3CR - Coding Relays. These relays pick up and drop in a pre-determined manner to progress coding. The energization or otherwise of these mark the various stages of coding. As said earlier, commencement of a pulse is decided by the transmitting coding circuit and the termination by the receiving coding circuit.

Among these relays 1CR is having two branches circuits one with TCKR and other with RDR respectively effective during transmission and reception of code. Zener diode is provided across the condenser of 3CR relay to have a constant time delay irrespective of the voltage variation.

The following table shows the various stages being marked and Condition of the relay at transmitting and receiving end

	1CR	2CR	3CR
1st ON	Up	DN	DN
1st OFF	Up	Up	DN
2nd ON	Up	Up	UP
2nd OFF	Up	DN	UP
3rd ON	DN	DN	UP
3rd OFF	DN	DN	DN
Energized	UP	-	-
De-energized	DN	-	-

The time delay circuits of 1CR and 3CR and the short time delay circuit of 2CR provide for varied durations of pulses and pauses.

P2R & N2R - Second positive and second negative pulse receiving relays. These store the polarity of the second pulse of a code that is received. Front contacts of these are used in the circuit of the final relay.

TOLTR - TOL code transmitting relay. At the sending station, this relay picks up when the ASTR and ASR drop successively due to the train occupying the FVT while entering the block section. Consequently, CTR picks up to transmit TOL code. At the receiving station, this picks up in response to TOL code received from line. The buzzer sounds intermittently, when the SM acknowledges the TOL code by pressing BCB to transmit a bell code, the TOLAR at the sending station drops and causes TOLTR to drop to stop the transmission of TOL Code.

TOLAR - TOL Acknowledgement Relay. In the Tokenless system of working, a train entering a block section on Line Clear initiates its own protection arrangement. This relay comes into play from the time Line Clear is obtained till the receiving station acknowledges the TOL code.

At the sending station, this picks up during reception of the second pulse of TGT code and releases when receiving SM transmits a positive pulse while acknowledging TOL code. At the receiving station, this picks up during reception of second pulse of TCF code and releases when the second pulse of the TOL code is received.

PCR - Pole Changing Relay. All operative codes begin with a negative pulse. Positive and Negative pulses are interchanged in TGT and TCF codes. To reset these conditions, Line Closed code with positive alone as second and third pulse is employed. This relay generates these pulses. It picks up at the end that initiates Line Closed operation.

TGTR - Train Going To Relay. Type - QL1. This is a magnetic latch relay, latching its armature in the operated position only. The relay has two coils (i) Operating and (ii) Releasing. When the operating coil is energized, the back contacts break and front contacts make. Once operated thus, the armature is latched in that position. Thus, the front contacts are made till the release coil is fed with current in the appropriate direction. The back contacts are designated as ‘Normal’ while the front contacts as 'Reverse'. This picks up on successful reception of TGT code and releases when Line Closed code is received. Its reverse contacts are proved in the LSS control circuits.

TCFR - Train Coming From Relay -Type - QL1. This is also a latch relay like TGTR. It picks up when TCF code is received and releases on reception of Line Closed Code.

TGTPR & TCFPR - Repeaters of reverse conditions of TGTR & TCFR respectively.

TER - Time Element Relay. Before Line Clear is cancelled when the train has not left the station, a time interval of the order of 2 minutes is required to elapse. To achieve an Electronic Timer is used

CAR - Cancellation Relay. This picks up for cancellation of Line Clear when the BCB and cancel buttons are pressed. This pushes the counter by one digit.

ASCR - Advanced Starter Control Relay. This relay proves that conditions for dispatching a train on Line Clear are fulfilled and that TOL condition can be established subsequently when the train passes the LSS. Also, it drops and locks the signal when cancellation is initiated. Front contacts of this are inserted in the signal control circuits.

SHKR - Shunt Key Checking Relay. This relay can pick up only when the key is in the transmitter and locked. Picking up of this relay is a pre-requisite for activation of CTR, TCFR and TGTR Relays

SCKR – Slip/Catch Siding Control Key Checking Relay. Low voltage monitoring relay. Connected to the key transmitter of slip/catch siding control where necessary. This can pick up only when the key is inside the transmitter and locked. This is also used as a Low Voltage Monitoring Relay. By means of setting of a Rheostat this relay is adjusted to pick up only when the local battery voltage is not less than 24 V and to drop when supply voltage on load falls to 21 V. While replacing this relay, the Rheostat shall be checked and readjusted, if necessary, and sealed to obtain the rated values.

7.5.4 Condenser & resistor units

The condensers and resistors required in the time delay circuits of various relays are conveniently integrated into a plug in base, which goes into a jack board. Connections are made to the terminals on the jack board. This type of construction allows spares to be kept ready for quick replacements at site in the event of a failure without affecting train services.

7.6 Details of the Circuits

7.6.1 Transmission and reception of bell signals

As BCB is pressed at Station A positive polarity of the Line Battery is connected to L1 and -ve polarity to L2 through BCBR (F) contact.

At Station B the relay CRR (N) is operated. Consequently, the single stroke bell is actuated in the local circuit by local battery. (Fig. 8.3 & 8.2).

7.6.2 To send a train from Station A to Station B

7.6.2.1 Transmission of Train Coming From Code:

The sequence of relay operation for this code is as follows.

Station A presses BCB & TGB. The relays BCBR, TGBR, ASTR, SHKR, SCKR & SNR picks up one by one provided their controlling conditions are satisfied. The relay CTR is now energized which in turn energizes the relay NTR. (Fig. 8.1, 8.19, 8.4, 8.5, 8.6, 8.7 & 8.8).

Consequently, the -ve polarity of the line battery is connected to L1 and the +ve polarity of the line battery to L2.

At Station B the relay CRR (R) is energized receiving the negative first pulse. When relays TCKR and NTR are picked up at Station A relays LR, LPR and ICR are picked up and relays LPR and 1CR remain up by stick circuits. (Fig. 8.9, 8.10, 8.11 & 8.12).

With the picking up of relay TCKR, relay NTR, which has already been picked up, gets its stick feed. And also with the picking up of relay 3CR relay CTPR picks up (Fig. 8.13).

When relay CTPR is picked up, the circuit through first coil of relay CTR is opened, but relay CTR remains energized for sometime, due to its slow releasing character. The second coil of relay CTR becomes energized during the pause period which follows the first pulse through the back contact of TCKR and LR. And also the condenser connected across the 2nd coil is charged to keep the relay CTR in picked up condition by its discharge current during 2nd and 3rd pulses since TCKR and LR will remain pick up during 2nd and 3rd pulses. Consequently, relay CTR remains up throughout for the transmission of code. Relay CTPR is picked up through 1CR and remains up during the periods of transmission and reception of codes by its stick circuits and also due to its slow release characteristics.

In the meantime with the operation of relay CRR(R) at Station B, relay RDR is picked up and remains up over its stick circuit until the reception of TCF Code is completed. Further, relays LR and LPR are successively picked up and as a consequence relay 1CR is also picked up and sticks and further relay RCKR is picked up through 1CR front contact. (Fig. 8.14 & 8.15)

When relay RCKR is picked up the line circuit is opened by RCKR back contacts and the transmission of first negative pulse from Station A to B is stopped.

Accordingly, relays TCKR at Station A and CRR(R) at Station B are simultaneously released, with the release of relay TCKR, relays NTR and LR are released successively at Station B and with the release of relay CRR(R), relay LR drops at Station B, but relay LPR at both stations does not drop in OFF period due to its time delay characteristics. It is to be noted that the relay LPR remains energized throughout transmission and reception of a code.

Relay 1CR remains energized due to the stick circuit through LR back contact. The relay 2CR at both the stations is now picked up by completing the circuit through the LR back contact and 1CR front contact. The relay ICR now forms its stick circuit through 2CR front contact. (Fig. 8.16)

Consequently, relay PTR is energized at Station A (Fig.8.20)

Picking up of 2CR at Station B causes release of RCKR thus the line circuit is kept ready for receiving the next pulse. The line circuit for 2nd positive pulse is now closed and TCKR at Station A and CRR (N) at Station B are picked up. (Fig.8.9)

Energizing TCKR at Station A causes LR to pick up which in turn energizes 3CR. The relay 3CR in turn energizes the relay CTPR (Fig. 8.13)

At Station B picking up CRR (N) causes LR and P2R to pick up and LR in turn energizes 3CR. P2R, the second positive pulse register relay, once picked up gets a stick feed through 1CR front contact when P2R is energized. In the meantime relays TOLAR, SHKR, SCKR and SNR are also picked up and remains so till the transmission of answer back code is completed. Relay TOLAR remains up by a stick path controlled by N2R back contact. (Fig. 8.22)

On energization of 3CR the circuit for RCKR is completed at station B and this causes opening of the line circuit and transmission of second pulse is terminated. (Fig. 8.15)

As soon as relay RCKR is picked up at Station B relays TCKR at Station A and CRR(N) at Station B are simultaneously released. Consequently, relays PTR and LR at Station A and LR at Station B are released. Releasing of LR causes 2CR to drop at both the stations. Dropping of 2CR at Station B de-energizes RCKR relay and thus the line circuit is again kept ready for receiving the 3rd pulse. At Station A dropping of 2CR completes the circuit of NTR over the front contact of TGBR relay for sending 3rd negative pulse.

Since the line circuit is closed relays TCKR and LR at Station A are again picked up and relay 1CR is released as a result of opening of its stick circuit by LR back contact. At Station B relay CRR(R) is now operated receiving the third negative pulse. With the operation of CRR(R)

relay, magnetic stick relay TCFR is operated and magnetically held in reverse position and the relay TCFPR is picked up. Relay TCFR maintains the TCF condition of the instrument. (Fig. 8.18 & 8.27)

By the actuation of relay TCFR, line closed indication circuit is operated to disappear and TCF indication circuit is made to give the TCF indication when the panel lamp button is pressed. (Fig. 8.32)

When relay LR is picked up for the third pulse relay 1CR is released since its stick circuit through LR back contact is opened. Consequently, P2R is released and RCKR is picked up, opening the line circuit and the third negative pulse is terminated.

Consequently, relays TCKR, NTR, LR & LPR are released successively at Station A. Release of relay LPR further causes CTR and 3CR to release.

However, the relay CTPR do not drop due to their slow to release arrangement, and before the release time is over, these relays get their feed through 1CR, LPR and 3CR front contacts, when the first pulse of answer back code is being received and then subsequently maintained by stick feed with the result CTPR are kept energised through the answer back code reception, so that the front contacts of CTPR - bypasses the normal contacts of BCB in line circuit, hence, even if TGB and BCB are in pressed condition, the incoming circuit for relay CRR(R) is completed to receive answer back TGT code from B. In the meantime incidentally RCKR also gets momentarily energised and then drops.

7.6.2.2 Transmission of Answer Back TGT Code:

At Station B the circuit should be prepared for sending the TGT code, which is accomplished and explained below:

RCKR, which is energized with 3CR up for terminating the third pulse also does an additional function of causing the energization of CTR relay, when 3CR drops. (Fig. 8.7)

Dropping of 3CR disconnects the feed to RCKR, but the relay still remains energized on account of its slow release characteristic.

When RCKR drops after its release time lag, NTR picks up as CTR is already up, for sending the first negative pulse. It may be noted here that CTR does not drop with dropping of RCKR since (Fig. 8.7) the holding path of CTR will keep the relay CTR energized throughout the transmission of code.

In the meantime, relay RCKR at Station A which had picked up momentarily over 1CR drop and 3CR up contact, is released, the receiving circuit for code is also completed and the first negative pulse of TGT code is transmitted from Station B to A. (Fig. 8.9)

As the first negative pulse current flows, relays TCKR at Station B and CRR(R) at Station A pick up. This causes operation of LR, LPR, 1CR & CTPR at Station B and RDR, LR, LPR, 1CR and finally RCKR at Station A. The circuits for the above are similar to the circuits shown for sending TCF code earlier.

In this condition, as relay RCKR is picked up at Station A the line circuit is opened. As a result, relays TCKR at Station B and CRR(R) at Station A are released at the same time. At Station B by the release of relay TCKR, relays NTR and LR are released and relay 2CR is picked up. With relay 2CR picked up relay NTR is again picked up, closing the line circuit at sending end. (Fig. 8.8)

On the other hand, at Station A by the release of relay CRR(R) Relay LR is released, Relay 2CR is picked up and relay RCKR is released successively closing the line circuit at receiving end. (Fig. 8.9)

Therefore, the negative second pulse is again fed to the line circuit, relay TCKR at Station B is picked up again and relay CRR(R) of Station A is also operated. As relay TCKR is picked up at Station B relay LR is again picked up, and successively relay 3CR is picked up. At Station A as relay CRR(R) is operated relay N2R is picked up, relay TOLAR is picked up over the circuit including N2R front contact and simultaneously relays LR and 3CR are picked up (Fig. 8.22)

By the pickup of relay 3CR, relay RCKR is picked up again causing line circuit to open. Then, relays TCKR at Station B and CRR(R) at Station A, are released simultaneously.

As relay 2CR releases, relay PTR is picked up at station B. In the meantime, at Station A by the release of relay CRR(R), relay LR, 2CR & RCKR are released successively. (Fig.8.20)

As a result, the line circuit is closed, at both ends and the third positive pulse current flows. Then, relay TCKR at Station B is again picked up, and relay CRR (N) at Station A is now picked up. As relay TCKR is picked up, relay LR is picked up and relay 1CR is released at Station B. At Station A because CRR (N) is operated, ASR picked up and consequently relay TGTR is operated to reverse side and then relay TGTPR is picked up through TGTR reverse contact. With relay TGTR operated to reverse side. Line Closed indication disappears and TGT indication appears on panel (Fig. 8.32)

Furthermore, after operation of relay CRR (N), relay LR is picked up and relays 1CR and N2R are released. By the releases of relay N2R, relay RCKR is picked up at Station A interrupting the code current. Therefore, relays TCKR at Station B and CRR (N) at Station A are dropped, and relays CRR (N), LR, LPR & 3CR are successively dropped. Consequently relays RCKR, CTPR & RDR are also dropped finally at Station A. At Station B all relays concerned to coding action are also restored to normal position successively, by the release of relay TCKR. However, SNR at Station A remains in picked up condition even after the buttons are released and will drop only when the concerned knob is reversed.

Thus, a series of relay operation for setting the block instrument to TCF & TGT conditions are completed. After TGT indication is turned ON, the push buttons BCB and TGB kept pressed so long at Station A are released. After TGT indication has turned on, concerned SM's slide is operated to reverse. Then relay SNR is dropped which will cause ASCR relay to pick up. With ASCR up the LSS can now be cleared. (Fig. 8.25)

7.6.2.3 Transmission of TOL code and its acknowledgement.

The sequence of relay operations for this code is shown.

When a train leaving Station A enters the block section, it occupies LSS track. Then relays ASTR is released and relay ASR is also released. Relays ASTR & ASR remain dropped since their stick circuit is cut off.

At the same time, with relay ASTR de-energized, relay ASCR is also de-energized and thereafter remains released by the released condition of relay ASR. Dropping of ASCR causes LSS to return to ON position automatically. Dropping of ASR causes

1. TOL indication to appear (Fig. 8.33)
2. TOLTR to pick up. (Fig. 8.28)

TOL indication will remain lit till the instrument is normalized. Picking up of TOLTR relay now causes energization of CTR relay for initiating the automatic TOL code transmission. All the three pulses in this case are of -ve polarity (Fig. 8.7)

Picking up of CTR at Station A causes relay NTR to pick up over the previously traced circuit for the transmission of first pulse which is always -ve. With both relays CTR & NTR picked up, the first negative pulse current flows, the relay TCKR is picked up. By the pickup of TCKR, relays LR, LPR & 1CR are successively picked up over the previously traced circuit. In addition as relay 1CR is picked up, relay CTPR is picked up and remains up over its stick circuit.

At Station B relay CRR(R) is operated concurrently with pick up of relay TCKR. Accordingly relays RDR, LR, LPR, ICR & RCKR are successively picked up. (Fig. 8.9)

With relay RCKR picked up at Station B the line circuit is opened and relays TCKR at Station A and CRR(R) at Station B are de-energised simultaneously. As previously described, relays NTR & LR are released by the release of relay TCKR. Relay 2CR is picked up and relay NTR is picked up at Station A. With relay NTR picked up, a second negative pulse is transmitted. In this condition, the sequence of relay operation during the second pulse is similar to that previously described. At Station B during reception of the second negative pulse, relay N2R is picked up, and thereby relay TOLAR which has been picked up earlier is de-energised. TOL indicator is now lit. (Fig. 8.8, 8.9 & 8.33)

When the transmission of the second pulse has been completed, the relay NTR is picked up again and the third negative pulse is transmitted to Station B. With relay CRR(R) operated, relay TOLTR is picked up at Station B. When relay TOLTR is picked up once, it remains up by the stick feed, until relay RCKR is released afterwards. (Fig. 8.8, 8.9 & 8.28)

At the same time, when relay CRR(R) is operated for the third time on receiving TOL code TOL bell rings intermittently giving the audible warning of train entering section.

In case of TOL code, no answer back code is transmitted when TOL code is received.

Relays concerned to coding action at both stations are released successively. Finally, with relay CTPR released, relay CTR is again picked up because relay TOLTR remains up at Station A. Then transmission of TOL code is reinitiated and completed in the same manner mentioned above. Transmission of TOL Code is thus repeated and relay TOLTR at Station B picks up intermittently and causes bell to ring intermittently till the acknowledgement is done by Station B.

Acknowledgement operation is made by pressing the BCB. During the space period of the third pulse, when relay RCKR at both stations are released and relay CTPR at Station A still up, Bell code current flows to operate relay CRR (N) at Station A. With relay CRR (N) operated TOLAR circuit for energization of its 2nd coil is completed. Since the direction of current in the 2nd coil is opposite to that of the first coil, flux produced by 2nd coil will neutralize the effect of the flux of the 1st coil resulting in the relay getting released. Inclusion of its own front contact in both the coil circuits prevents the possibility of the relay getting picked up again after its release. With relay TOLAR released, relay TOLTR is also released by front contact of TOLAR and transmission on TOL code is terminated. As a result, at Station B relay TOLTR remains released, and the TOL bell is stopped. (Fig. 8.9 & 8.22)

As mentioned above, when the transmission of TOL code has been completed, relays TOLAR & TOLTR get released. However, TOL indicators at both stations remain lit.

When the train approaches Station B the FSS is taken OFF. The movement of the train, within the FSS will operate, the track circuits provided for the detection of train arrival, and will cause TAR relay to pick up. TAR relay once operated gets a stick feed controlled by TCFR and causes the train arrival bell to ring and also causes picking up of PCR relay. The train arrival bell stops ringing when the SM puts back his FSS knob to Normal. (Fig. 8.29 & 8.30)

7.6.2.4 Transmission and reception of Line Closed codes

Transmission of Line Closed Code: After verifying the complete arrival of the train, the SM at B now presses BCB & LCB simultaneously for transmitting the line closed code.

CTR relay now energizes by the circuit given below. With the picking up of relay CTR, Line Closed code is transmitted from Station B to A. This code consist of negative, positive and positive pulses allotted to the first, second and third steps. When Line Closed code is received at Station A the block instrument is restored to Normal. As a result, an answering Line Closed code is transmitted back to Station B and the block instrument at B is restored to Normal. At this time, the answering code is also similar to the above mentioned code. (Fig.8.32, 8.7 & 8.9).

The sequence and circuits for transmission and reception of codes between both stations in case of Line Closed code are almost similar to those as described previously in TCF & TGT conditions.

As the first pulse is always negative, the sequence of relay operation is the same as in the other cases. In this case second and third pulses transmitted are positive by energizing PTR through the front contact of PCR relay at Station B.

At Station A on receiving the positive second pulse, relay P2R is picked up. (Fig.8.21)

Operation of CRR(N) relay on receipt of 3rd pulse, complete the circuit of the relay LCCPR, the final pulse register relay of Lined Closed Code. (Fig. 8.24 & 8.9)

Where LCCPR is picked up proving the receipt of Line Closed Code, the circuit for normalizing the TGTR relay, which has so far been held magnetically, is completed. Operation of TGTR to Normal side will cause the TOL indication to disappear. TGTPR relay to drop and the instrument at A now comes to Line Closed condition. (Fig.8.25).

7.6.2.5 Transmission of answer back Line closed code

At Station A when RCKR relay picks up at the end of the 3rd ON period, it causes CTR to pick up after the relays CRR(N), LR, LPR & 3CR have been released. It may be noted that the LCCPR which was energized earlier is still kept energized by the stick circuits available.

On RCKR relay dropping, NTR picks up for sending the first negative pulse the circuit of which is same as given earlier for the first pulse of other codes.

The answering Line Closed code is the same as initial Line Closed code, and consists of negative, positive & positive pulses. Accordingly, the operations of relays during the first and the second pulses are similar to that initial Line Closed Code. Consequently relay P2R is picked up and remains up due to the ON period automatically of the 3rd positive pulse at Station B. The circuit for the relay PTR at Station A for the 2nd positive pulse transmission is same as that of second pulse of TCF code. (Fig. 8.9 & 8.20).When the third positive pulse is received, relay CRR (N) is operated and the relay LCCPR is energized to register the receipt of the Line Closed Codes. Subsequently relay TCFR is returned to Normal position as shown in the circuit given. (Fig. 8.18).By the restoration of relay TCFR, relay TCFPR is dropped, TCF indication is turned off, and Line Closed indication lights on (Fig. 8.32).

Furthermore, by the release of relay TCFR & TCFPR relays PCR & TAR are released and TOLK indication is extinguished.

When the reception of answering Line Closed code has been completed, all relays concerned with coding action are released at both stations.

Through the above explained series of operations, the block instrument and relays at both Station A & B are now returned to the original Line Closed condition. At this condition both LCB & BCB are released at Station B.

7.6.2.6 To cancel TGT condition before the train enters the Block Section.

Following explanation applies to the case when cancellation is made at Station A.

As all concerned signals are returned to ON aspect, relay SNR is picked up through the front contact of relay ASR. In this condition, after SM's key is inserted and turned, Cancel and BCB are pressed concurrently and released. Then relays TER & CAR are energized, and remain stick fed as shown in the circuit diagram 8.30 & 8.31

At this time, Call Attention code is transmitted to Station B. Receiving this code, Station B inserts SM's key, turns and further acknowledges intention to cancel TGT condition on telephone. If the signals had been taken OFF, reception signals knobs are replaced to Normal at Station B. In the meantime, after a time delay of about 2 minutes relays TER & PCR are picked up and remaining up over stick circuit and another relay CAR is held through holding path of relay CAR, as shown in the circuit diagram 8.31.

Relay PCR on energizing de-energizes the relay ASR and completes the circuit for FREE indicator shown in the circuit diagram 8.31.

At this time, buttons LCB & BCB are pressed concurrently at both Stations. At Station A, relay CTR picks up causing Cancellation code to be transmitted to Station B. The cancellation codes are similar to Line Closed code and consist of negative, positive & positive pulses.

Therefore, the condition in transmission and reception of Cancellation code are similar to those of Line Closed Code.

At Station B when the third positive pulse is received, during reception of Cancellation code, relay CRR (N) is operated relay LCCPR is energized and relay TCFR is returned to Normal. Consequently, the block instrument is set to the initial Line Closed condition. Seeing the line closed indication appearing, the Station B operator can release the buttons.

After relay TCFR has been reset to Normal an answering Cancellation code is transmitted back to Station A automatically. The answering code is identical to initial Cancellation Code.

At Station A when the third positive pulse is received during reception of answering Cancellation code relay LCCPR is energized to register the Line Closed Code reception and the relay TGTR is returned to Normal as given in the circuit below. Accordingly, the block instrument at Station A is also set to normal condition.

Through the series of operations mentioned above, the block instruments at both stations are reset to the Line Closed condition at both Stations. At this condition, LCB & BCB are released at both stations.

7.6.2.7 To set the block instruments to Line Closed when the train pushes back to the dispatching station.

The FSS is taken OFF for the pushing back train as in normal reception and the relay TAR is picked up and remains up over its stick circuit. With relay TAR picked up, Train Arrival bell rings. FSS knob turned to Normal, and the bell stops. After verifying the complete arrival of train, the Cancel button & BCB are pressed and released. Relay CAR picks up and remains up through a stick circuit, as shown in the circuit 8.31.

With relay CAR picked up, the counter registers the next higher number, and relay PCR picks up over a front contact of CAR and sticks.

By the pickup of relays CAR and PCR the condition becomes similar to the case of cancellation of TGT condition before the train enters the Block Section, excepting that the relay PCR in this case picks up without a time delay. Then BCB & LCB are pressed at both stations concurrently. Relay CTR at Station A is picked up and then initiates to transmit Cancellation Code. According to the exchange of Cancellation code between both stations, the block instruments at both stations are set to the original Line Closed condition.

The block diagram explaining the principle of working during a code exchange is given in Diagram 7.1

7.6.2.8 In the latest version of the instrument the code receiving relay CRR (Kyosan Co., Japan Make) is replaced by 2 biased relays of QB3 type as CRR (N) and CRR (R) respectively. In addition to this three more relays namely BCBR (QN1), TGBR and LCBR operated by push buttons, BCB, TGB and LCB respectively are also provided in the modified instruments. These relays are used to substitute the push button contact. The modified arrangement given in the circuit diagram is given in. STS-S1082 / 94

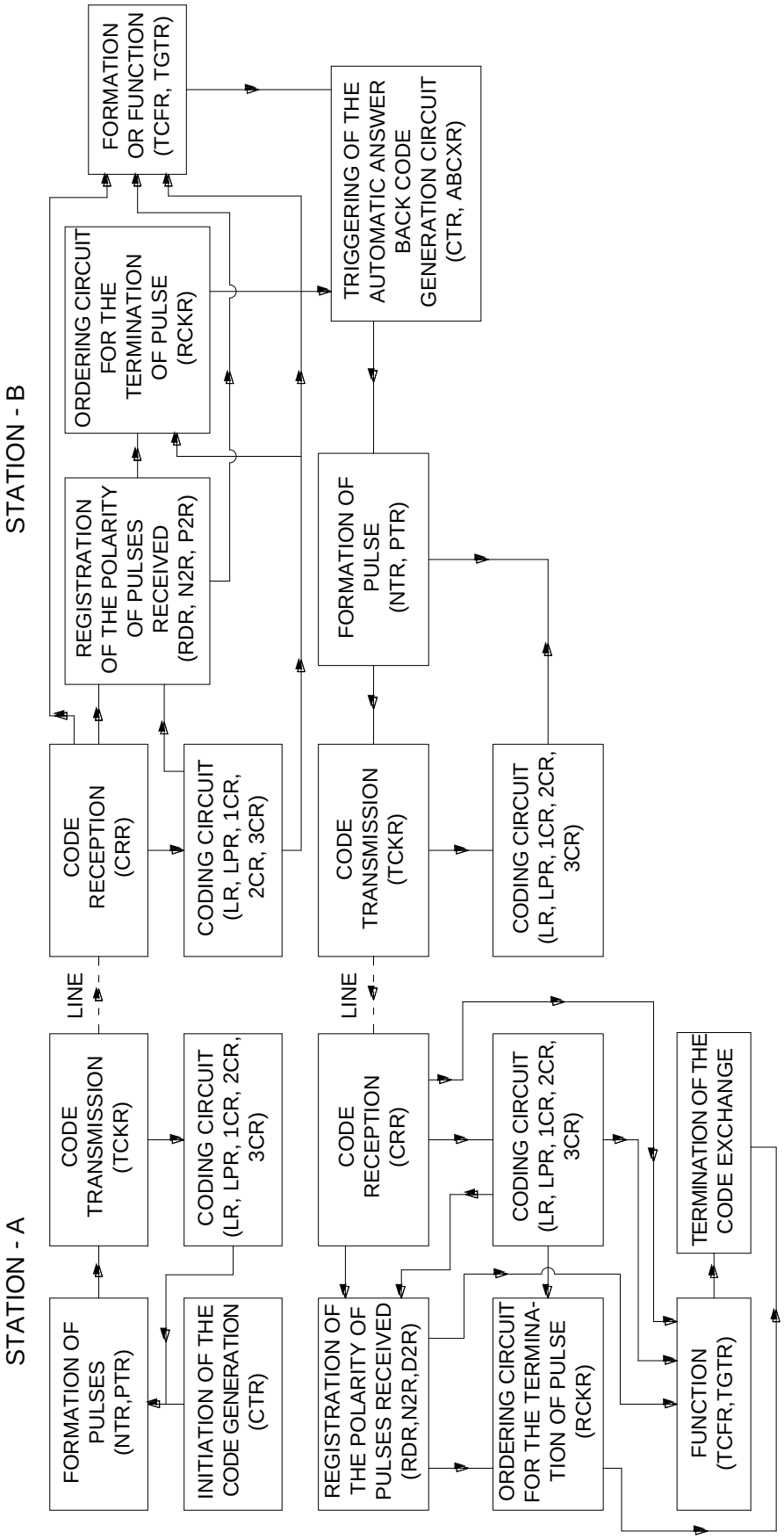


Fig : 7.1 BLOCK DIAGRAM SHOWING THE PRINCIPLE OF WORKING DURING A CODE EXCHANGE BETWEEN TWO CONNECTED INSTRUMENTS

* * *

CHAPTER 8: PUSH BUTTON INSTRUMENT WITH Q STYLE RELAYS

8.1 This single line Tokenless push button block instrument is developed by Podanur workshop using Q series relays without changing the size and shape. Total 36 Nos. of relays provided with Button relays TGBR, LCBR, BCBR and one electronic timer of 120 sec time lag, which is accommodated in Q relay base.

In recently manufactured instruments panel lamp button is eliminated, indications are lit by LEDs. Block Section Condition and LSS aspect indication are available on the block operating panel.

Shunt key can be extracted from EKT only in Line Closed and TGT & TOL Condition but not in TGT & TCF Condition.

The Q series relays employed are

S.No.	Type	Description	Contacts	Total Relays
1	QN1	Neutral Line Relay	8F-8B	28
2	QL1	Latch relays	8F-6B	4
3	QB3	Biased relays	4F-2B	3
4	ET	Electronic Timer	--	1
5	Condenser units with Q relay base (U-I, U-II, U-III & U-IV)			4

According to the supplier, in case of panel interlocked or RRI station external battery can be dispensed and relay room battery supply can be used by taking the external battery supply to location of LSS & FSS. The relays energised by external supply are SNR, ASTR and TAR.

All relay functions are same as earlier versions except the following relays in Q series type.

ASR: Advanced starter Relay. QN1 8F-8B

The function of this relay is to monitor FVT track from the time of setting an instrument to TGT and also to ensure positive display of TOL indication as well as transmission of auto TOL code on occupation of FVT. Dropping of this relay on occupation of FVT displays TOL and initiates transmission of TOL code. This relay picks up only on receipt of 3rd TGT code pulse provided CTPR is up and BCB & TGB kept in pressed condition.

(a) CTPR up ensures timely reception of answer back TGT code

(b) BCBR & TGBR up ensures continuous pressing of these buttons – proving intentional operation.

Its front contacts are used in the TGTR latching circuit. Once dropped it will not pick up unless the instrument receives a fresh TGT Reply code, which is possible only after setting the instrument to line closed condition either by complete arrival of train at TCF end or cancelling line clears at TGT end. This relay ensures one line clear one train.

TAR- Train Arrival Relay QL1 8F-6B

It is a magnetic latch relay and used for registering the arrival of a train on line clear. It picks up through the external battery while receiving a train on signals with Instrument in TCF-TOL/TGT-TOL condition and de-latches to normal through local battery once the instrument assumes to line closed position.

TOLAR: TOL Acknowledgement Relay QL1 8F-6B

It is a magnetic latch relay having two different functions

(a) To initiate automatic transmission of TOL code and to stop the same on receipt of its acknowledgement in TGT instrument.

(b) To display TOL indication on receipt of TOL code. In TCF instrument. It picks up on reception of 2nd pulse of TCF code at TCFR instrument and 2 nd pulse of TGT code in TGT instrument. This relay de latches on reception of 2nd pulse of TOL code in TCF instrument and on receipt of TOL acknowledgement in TGT instrument.

If the instrument does not change to TCF or TGT on receipt of the respective codes, it assumes its normal position automatically at the end of 3rd pulse.

Introduction of its front contact in CTR circuit. Initiates transmission of answer back TGT code. Its front contact in TOLTR circuit initiates transmission of TOL code.

8.2 POWER SUPPLY ARRANGEMENT

The power supplies used for working this instrument Relays etc. are furnished below.

1.	Telephone Circuit	3 V Battery
2.	Local Circuit	24 V Battery with each battery 2 V 120 AH cells 13 nos. are preferable as minimum 24 V on load is required for its reliable working.
3.	Line circuit	Battery to supply minimum of 60 mA Line current.
4.	External circuit	24 V battery

This external circuit battery is generally provided at FSS or LSS location in Mechanical signalling Yards and in case of power signalling. Relay room battery itself is used.

8.3 GUDELINES FOR INSTALLATION & MAINTENANCE

Note: Line Circuit with EARTH RETURN shall not be used:

Local Battery voltage at the Instrument terminals on load should not be below 24 Volts. Secondary cells of sufficient capacity may be used, as the maximum working current per Instrument is about 1.2 Amps.

The Local battery voltage on load should not exceed a maximum of 29 V as it may affect the Zener diode working.

The difference between the local battery voltages of the interconnected instruments on load should be kept to a maximum of 4 volts. i.e. between 24V & 29V.

The line battery shall be capable of supplying a minimum current of 60 mA on line but not more than 70 mA.

The Line current shall be measured both at the transmitting and receiving ends. There shall not be appreciable variations.

Separate line battery should be provided for each instrument. Whenever the line battery is changed the line current should be checked.

Wherever dual bank batteries are used for line circuit, the current should be measured before and after every change over. This is to assess the level of charging required for the discharged battery bank.

While installing these instruments, care shall be taken to ensure that the Relay plug boards and the Relay contact springs are not damaged. (Keep the Relays parallel while plugging/removing the Relays). Maintain correct polarity while connecting HOOTER leads.

HMT cord should be connected to the respective terminals to ensure that no current is drawn from the telephone battery when the HMT button is not pressed.

Whenever the instrument fails, interchanging of relays and units shall not be resorted to, without ascertaining the actual cause and this change may be effected only if it is warranted.

Relays and timer units shall not be left without the relay retaining clip.

Whenever the resistance or condensers are replaced in the units correct values have to be selected and soldered properly.

Oiling of TLB switch contacts shall be avoided.

During periodical maintenance/Inspection, the charger shall be switched off and the working of the relays has to be observed for few operations. The terminal voltage should also be monitored during the working in order to ensure the condition of the battery.

All Instruments should be paired with similar type only.

The entire latch relays should be in de-latched condition while commissioning the equipment.

Ensure all the removable connectors are locked perfectly in the plug board.

Terminal No.	Circuit voltage Description	Terminal No.	Circuit voltage Description	Terminal No.	Circuit voltage Description
1	Line voltage +ve	12	Telephone battery -ve	29	LSS (RGK)
4	Line voltage -ve	13	TAR buzzer	30	LSS (DGK)
6	Line 1	15,16	Local battery -ve	31	LSS (K) -ve
7	Line 2	17	SNR +ve	43	SNR -ve
9,10	Local battery +ve	19	ASTR +ve	45	ASTR -ve
11	Telephone battery +ve	23	TAR +ve	46	TAR -ve

8.4 SPLIT CIRCUITS

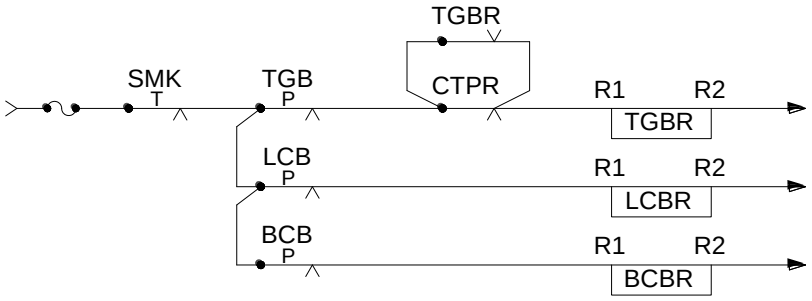


Fig: 8.1 PUSH BUTTON CIRCUIT

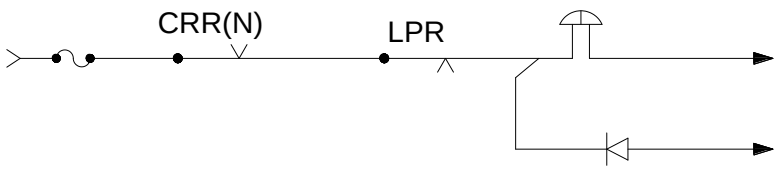


Fig: 8.2 BELL CIRCUIT

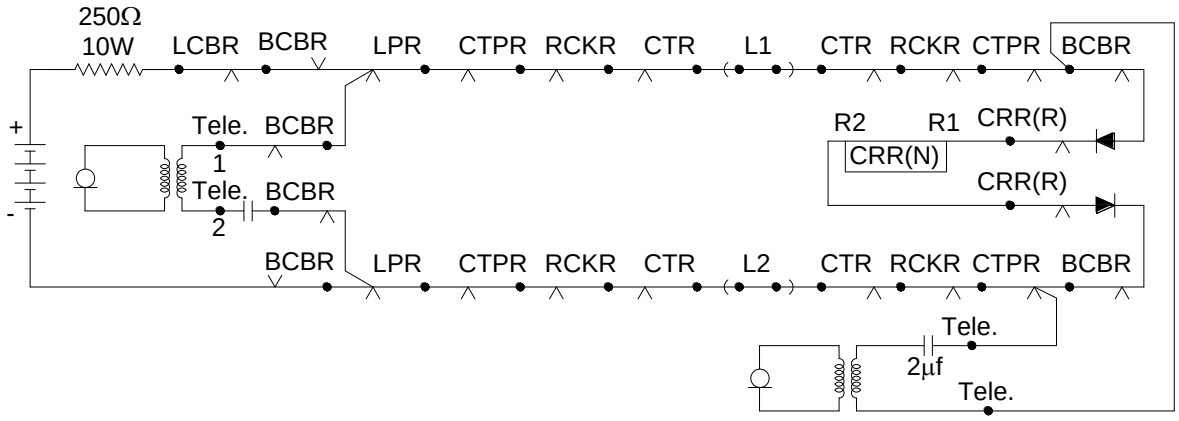


Fig: 8.3 LINE CIRCUIT FOR BELL AND TELEPHONE

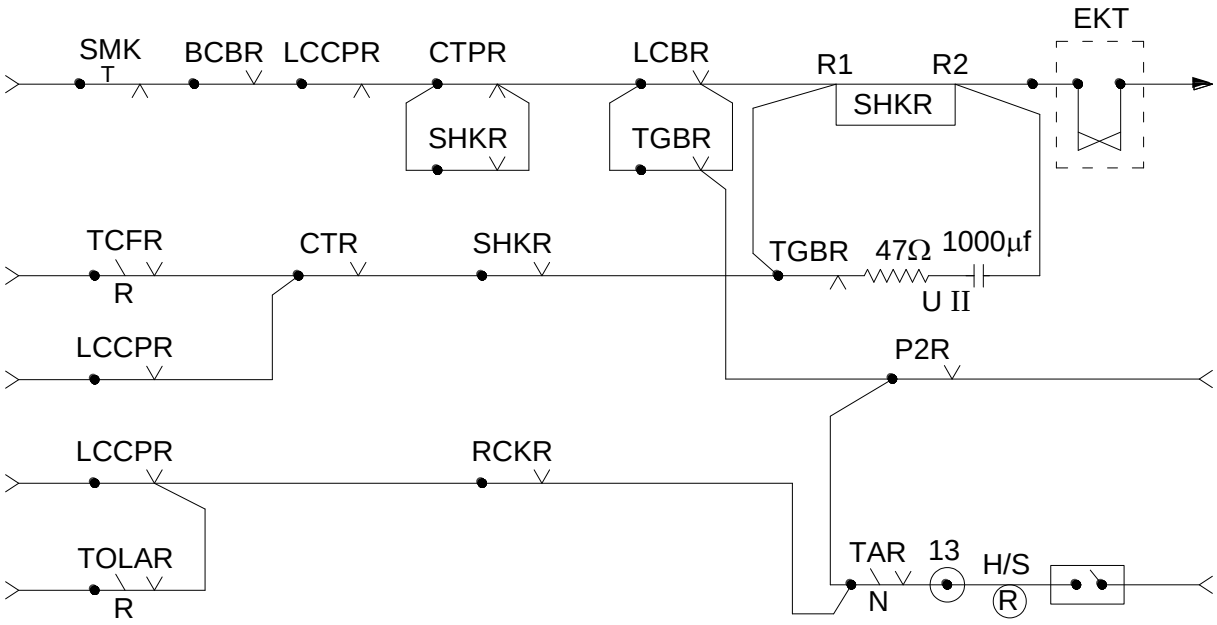


Fig: 8.4 SHKR CIRCUIT

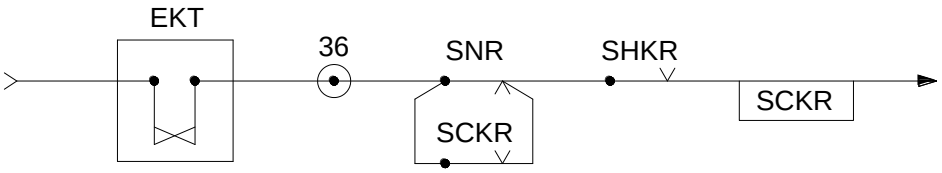


Fig: 8.5 SCKR CIRCUIT

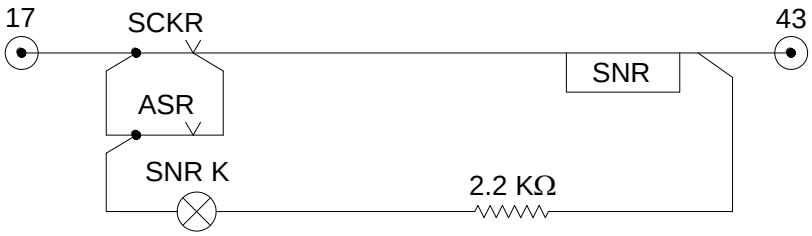


Fig: 8.6 SNR CIRCUIT

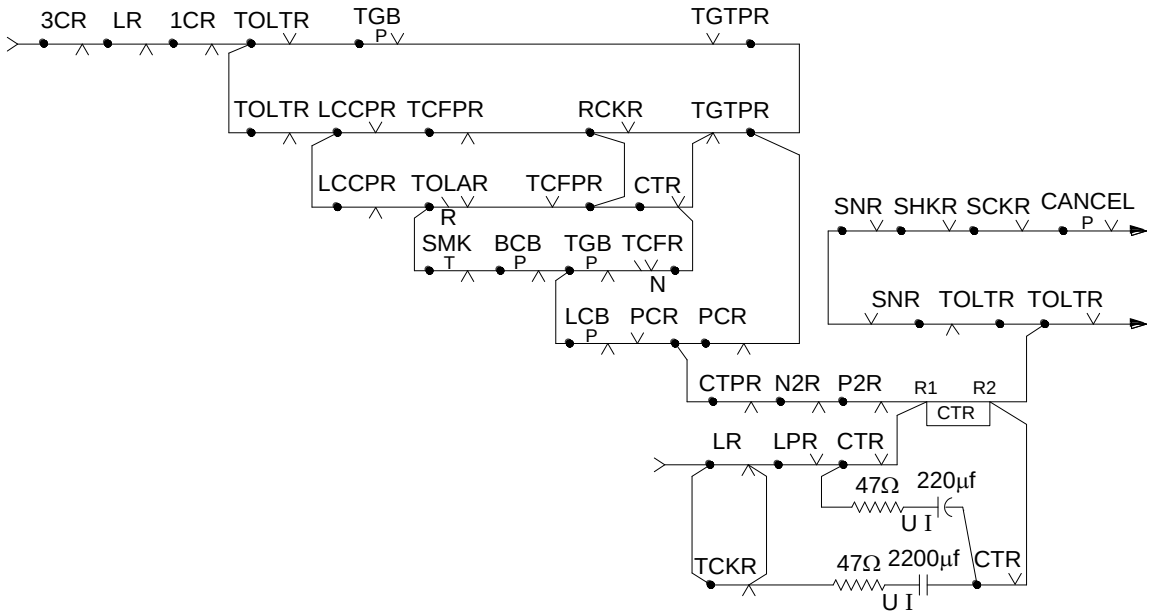


Fig: 8.7 CTR CIRCUIT

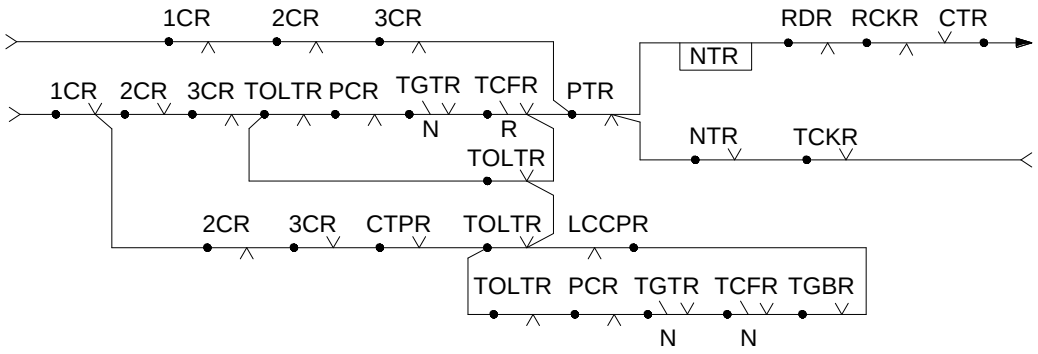


Fig: 8.8 NTR CIRCUIT

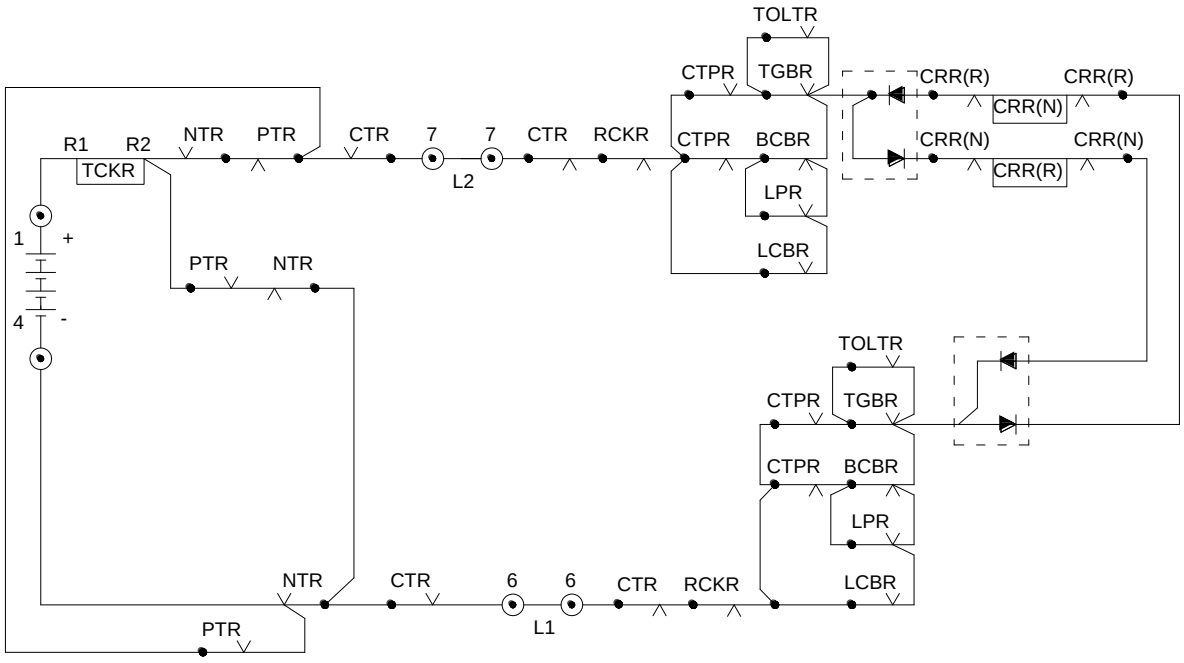


Fig: 8.9 TCKR & CRR LINE CIRCUIT

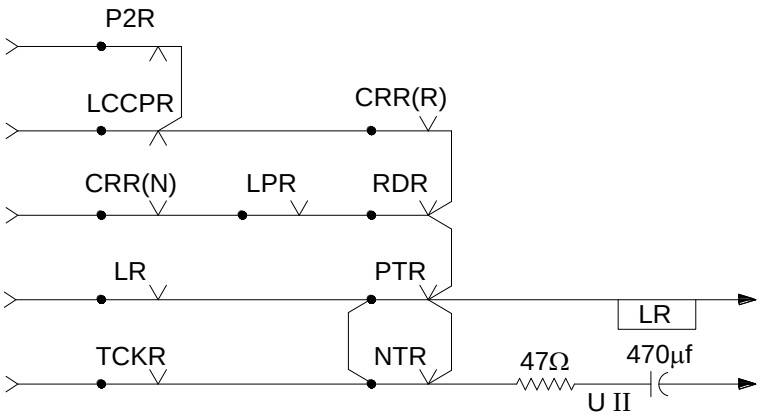


Fig: 8.10 LR CIRCUIT

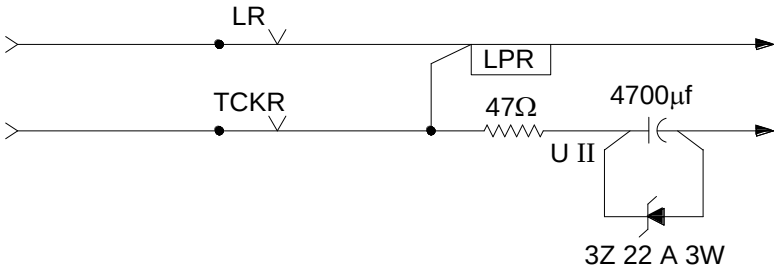


Fig: 8.11 LPR CIRCUIT

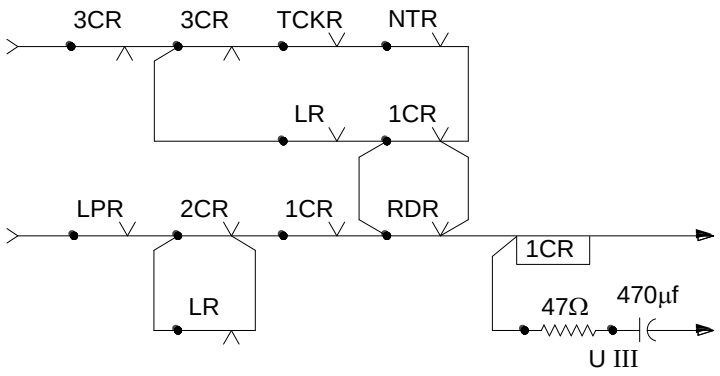


Fig: 8.12 1CR CIRCUIT

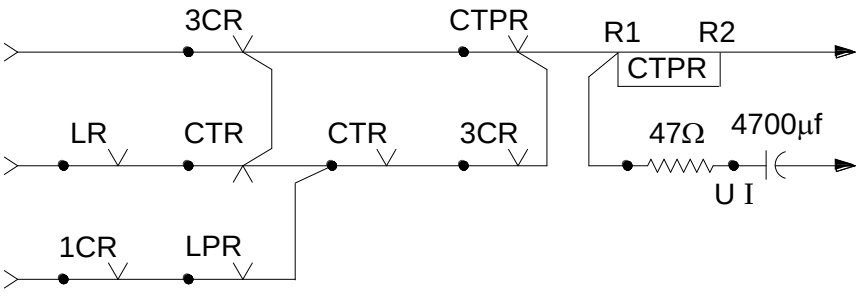


Fig: 8.13 CTPR CIRCUIT

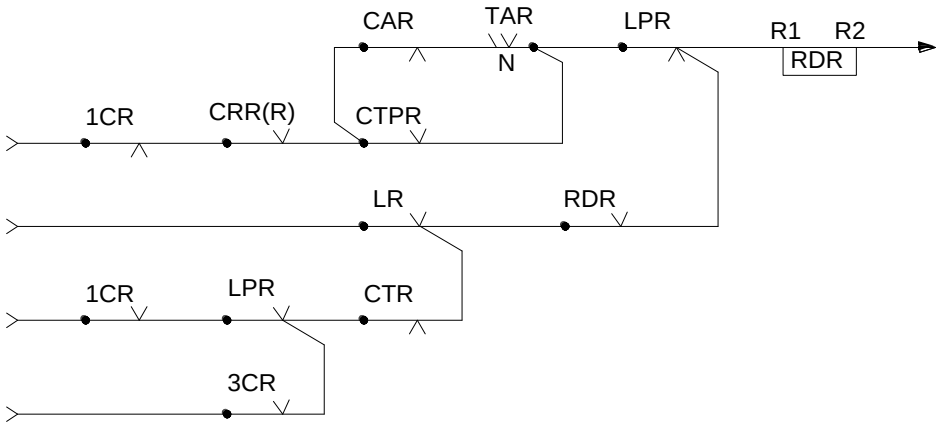


Fig: 8.14 RDR CIRCUIT

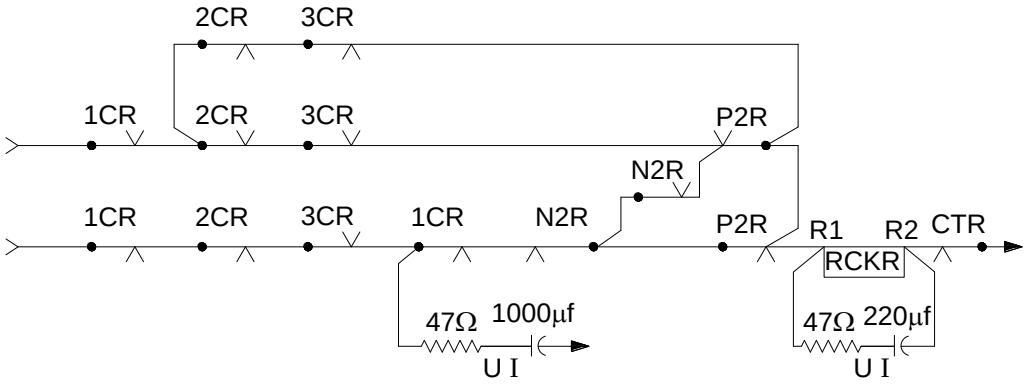


Fig: 8.15 RCKR CIRCUIT

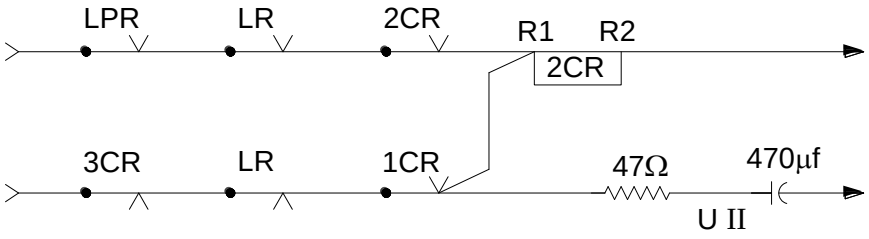


Fig: 8.16 2CR CIRCUIT

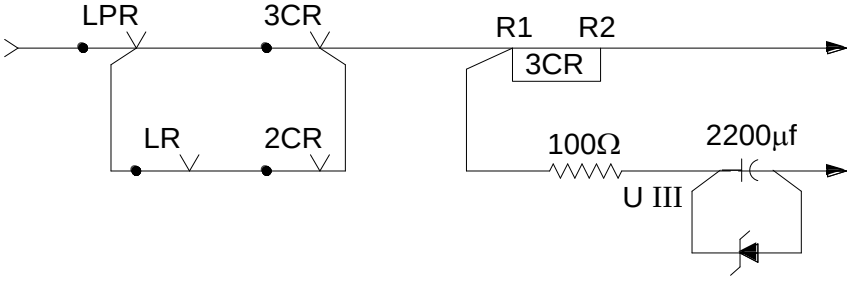


Fig: 8.17 3CR CIRCUIT

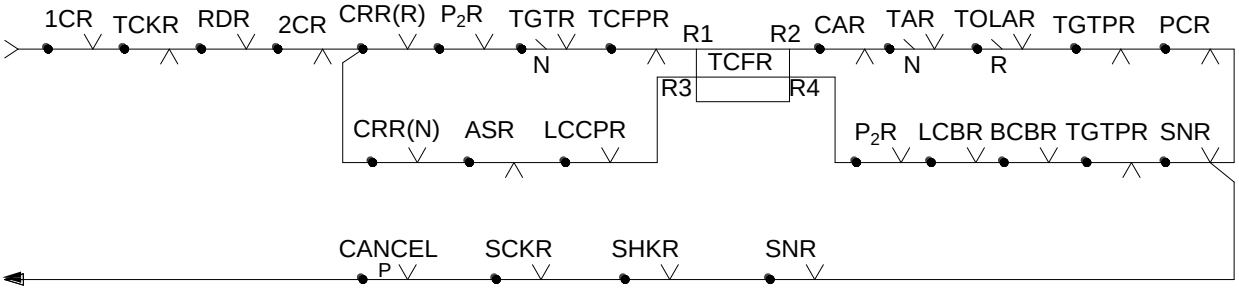


Fig: 8.18 TCFR CIRCUIT

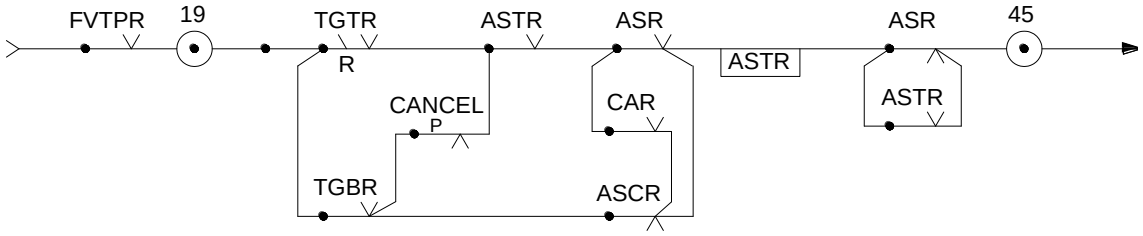


Fig: 8.19 ASTR CIRCUIT

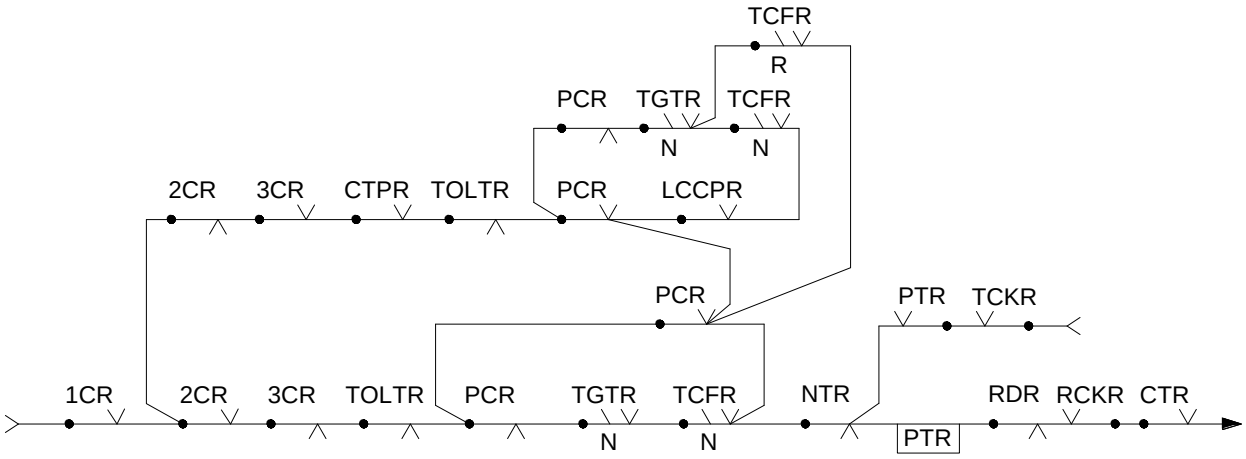


Fig: 8.20 PTR CIRCUIT

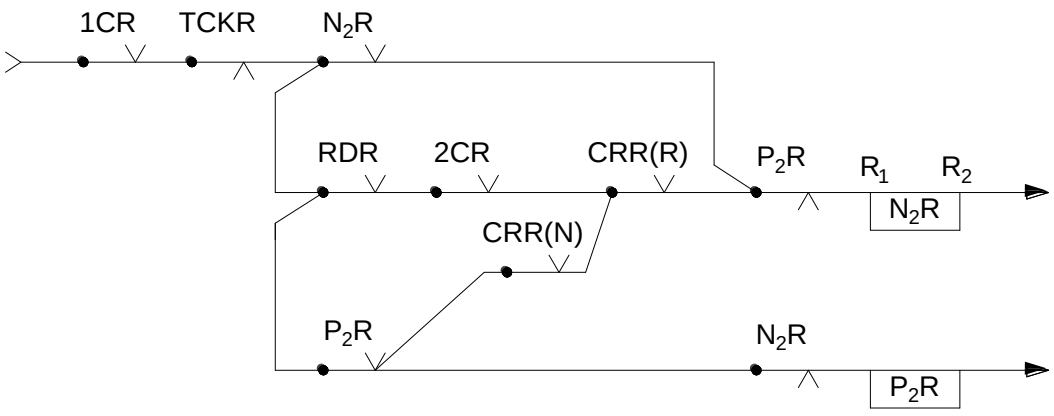


Fig: 8.21 P2R/N2R CIRCUIT

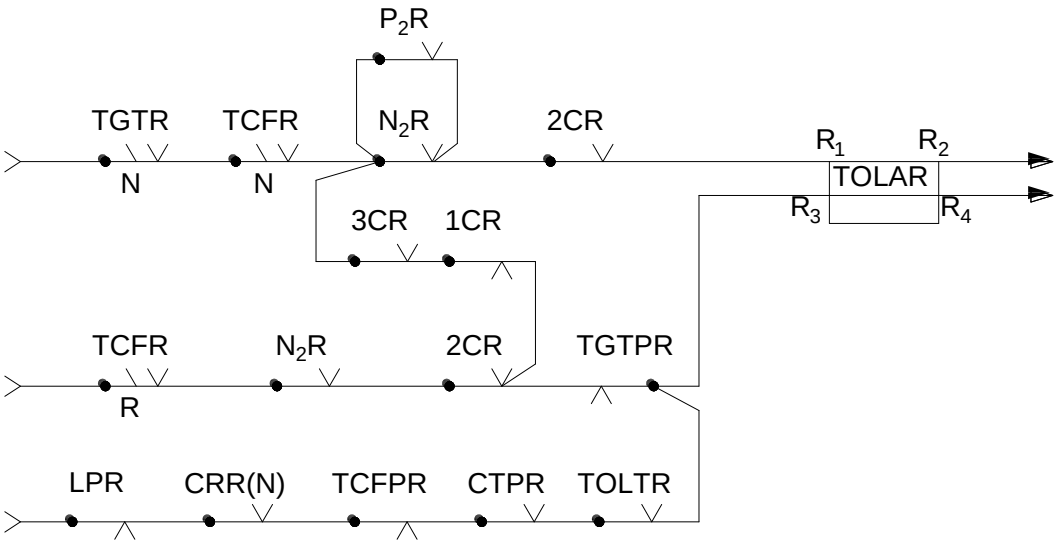


Fig: 8.22 TOLAR CIRCUIT

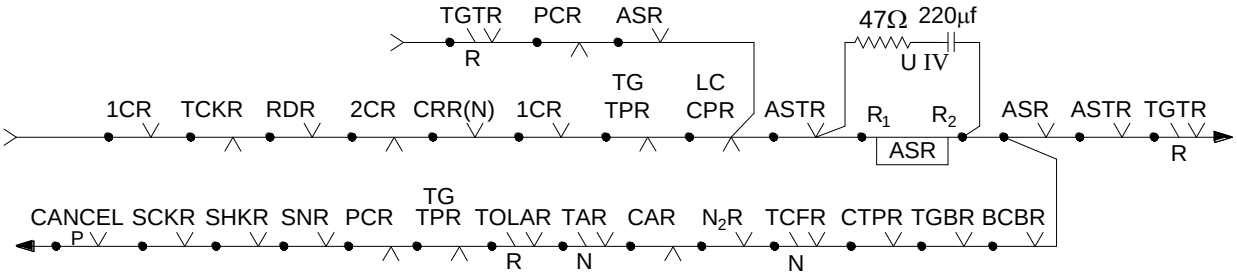


Fig: 8.23 ASR CIRCUIT

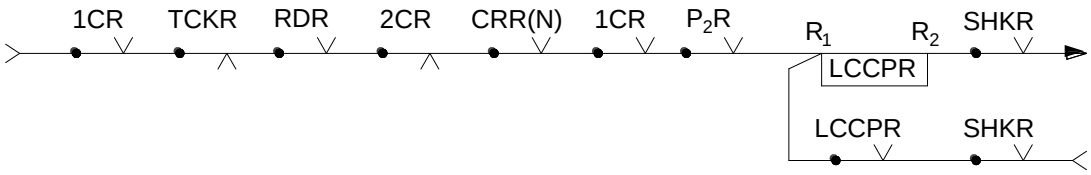


Fig: 8.24 LCCPR CIRCUIT

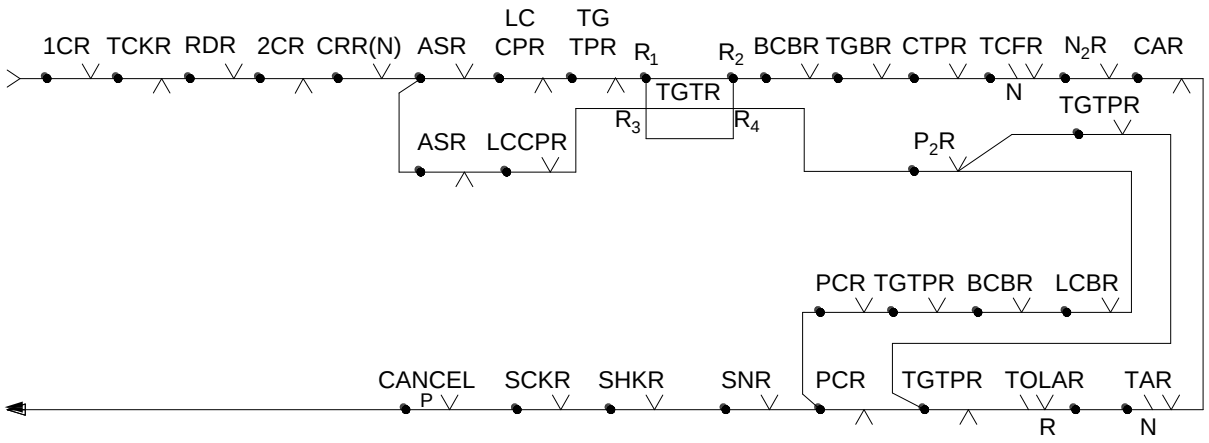


Fig: 8.25 TGTR CIRCUIT

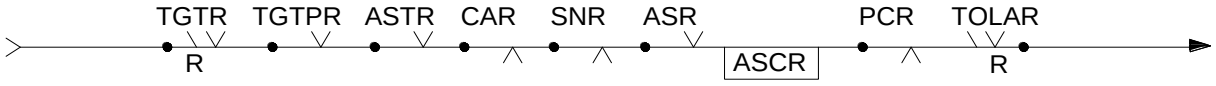


Fig: 8.26 ASCR CIRCUIT

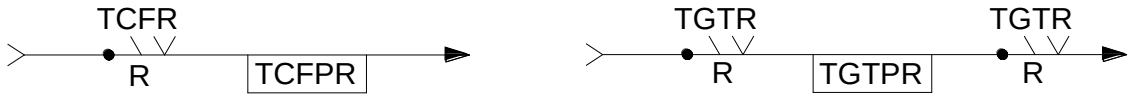


Fig: 8.27 TCFPR/TGTPR CIRCUIT

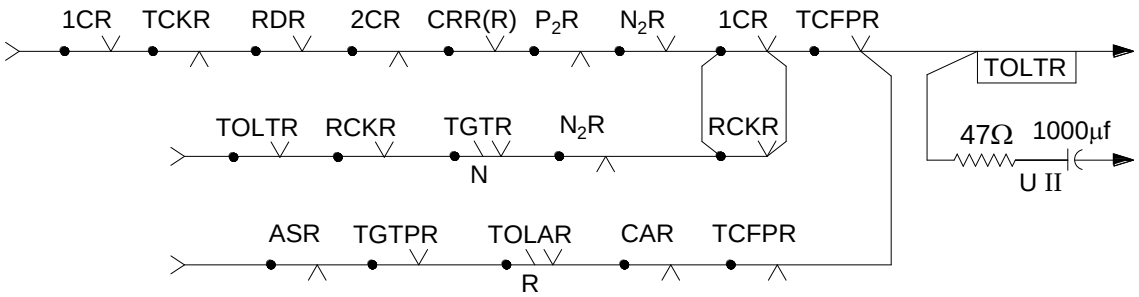


Fig: 8.28 TOLTR CIRCUIT

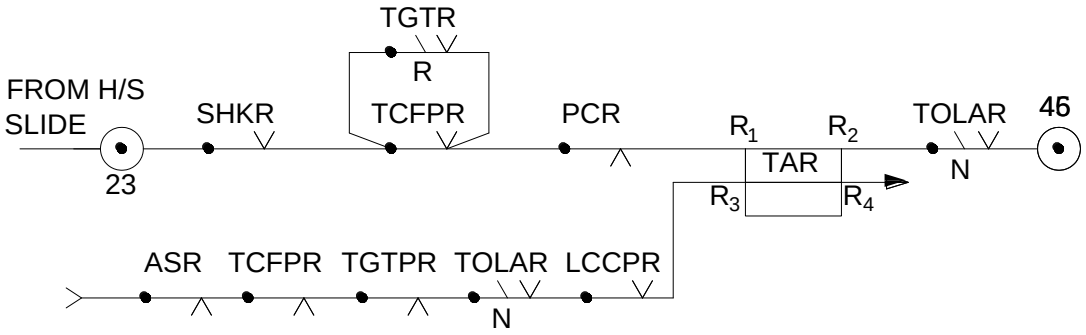


Fig: 8.29 TAR CIRCUIT

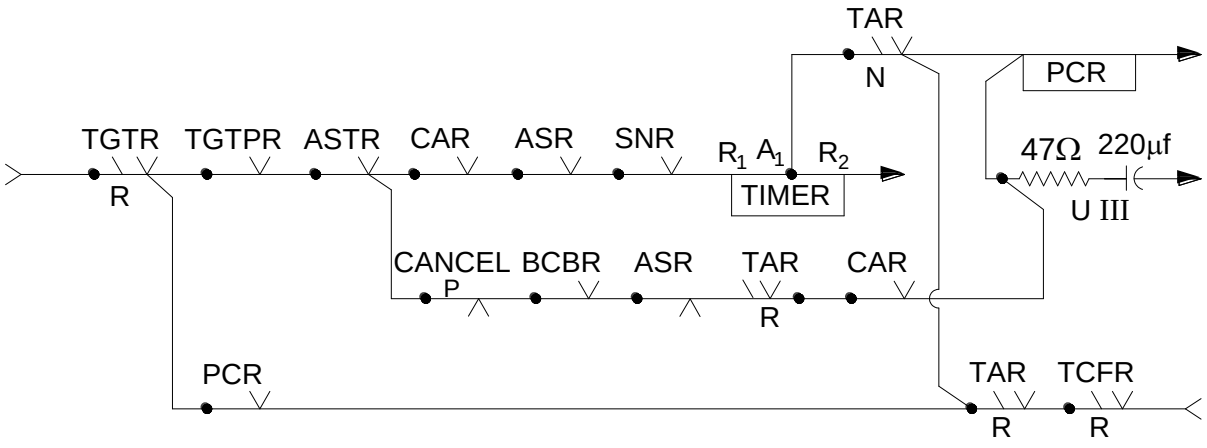


Fig: 8.30 PCR CIRCUIT

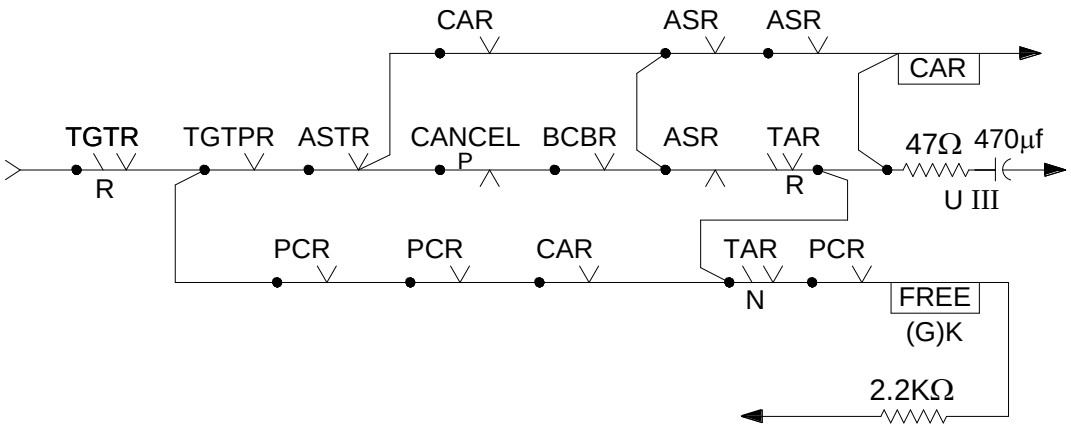


Fig: 8.31 CAR & FREE INDICATION CIRCUIT

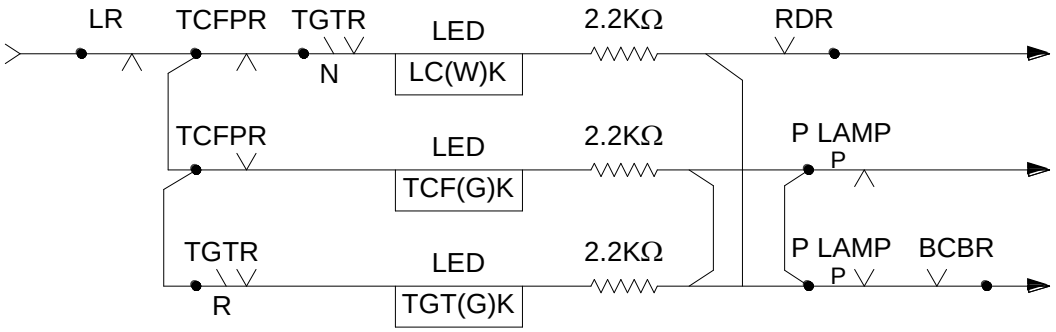


Fig: 8.32 INDICATION CIRCUIT

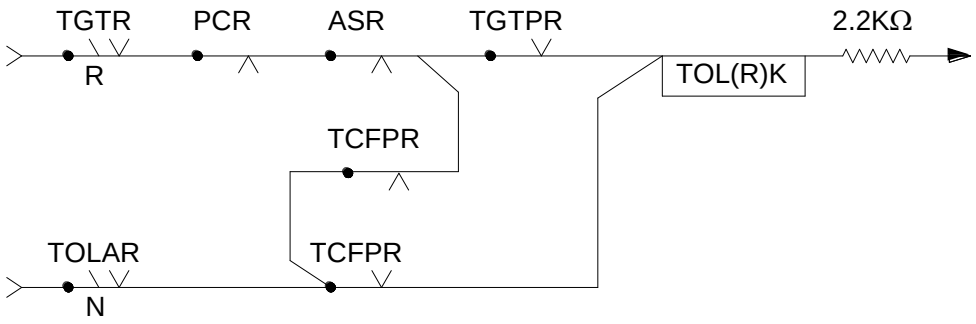


Fig: 8.33 TOL INDICATION

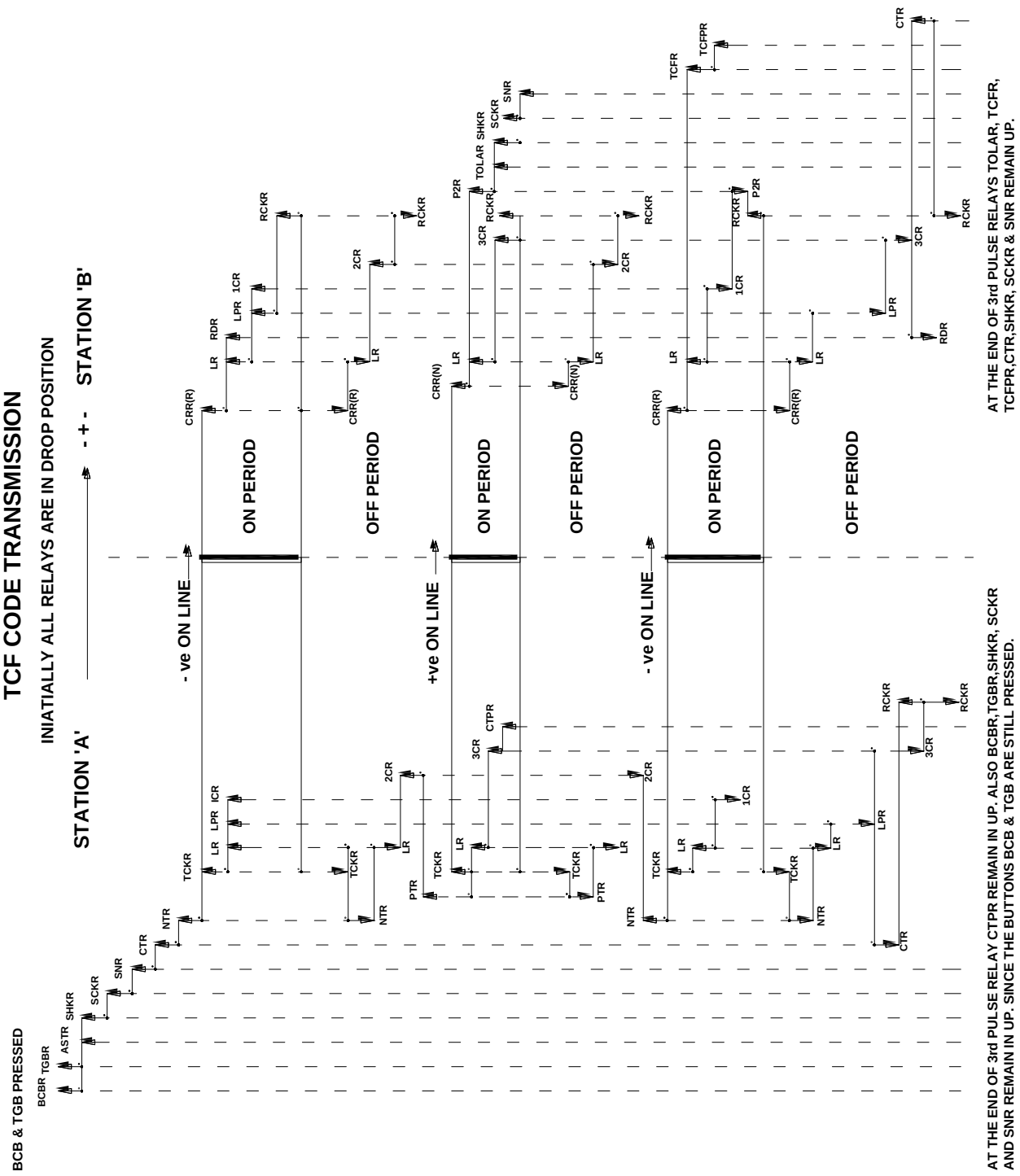


Fig: 8.34 TCF CODE TRANSMISSION FLOW CHART

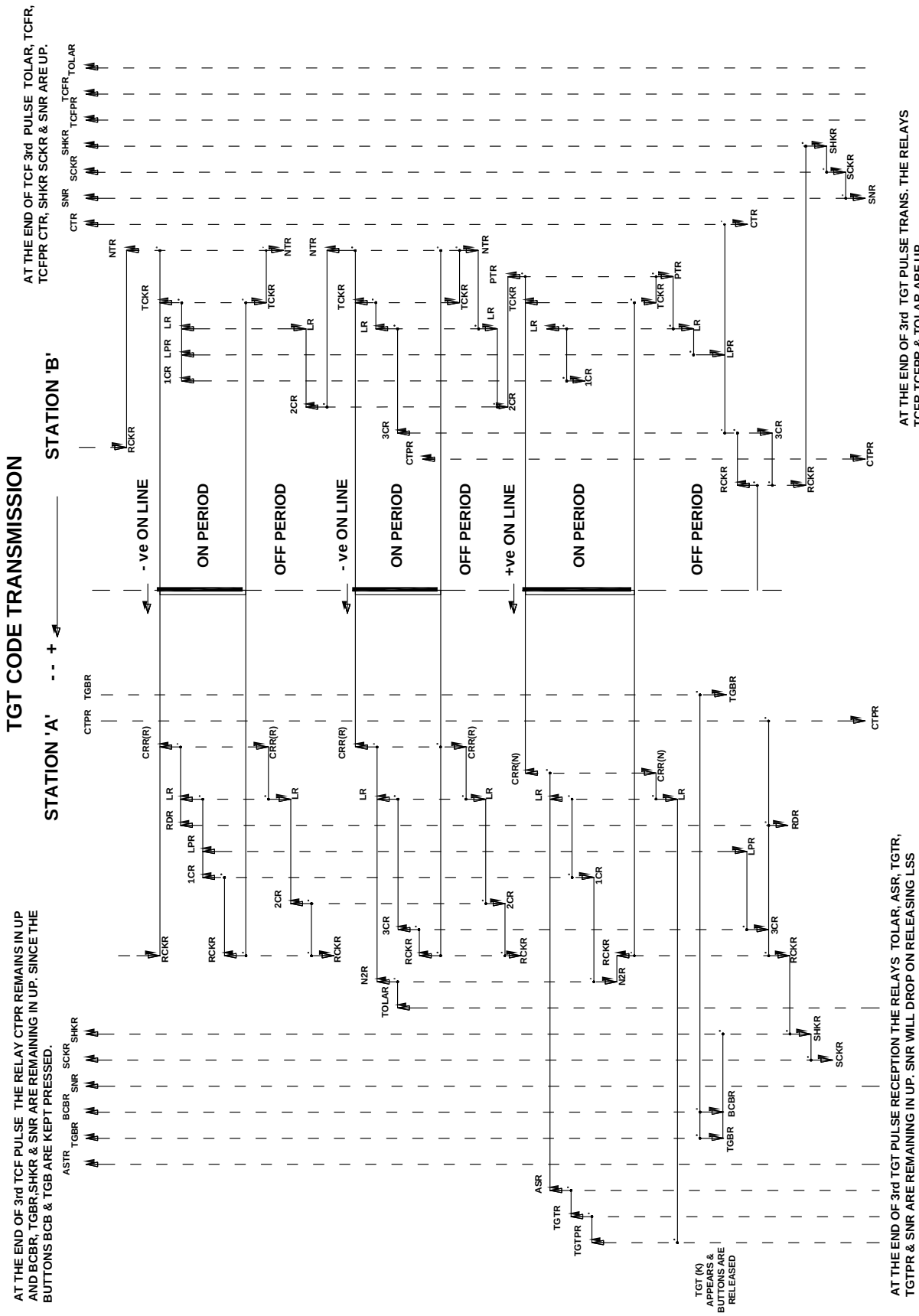


Fig: 8.35 TGT CODE TRANSMISSION FLOW CHART

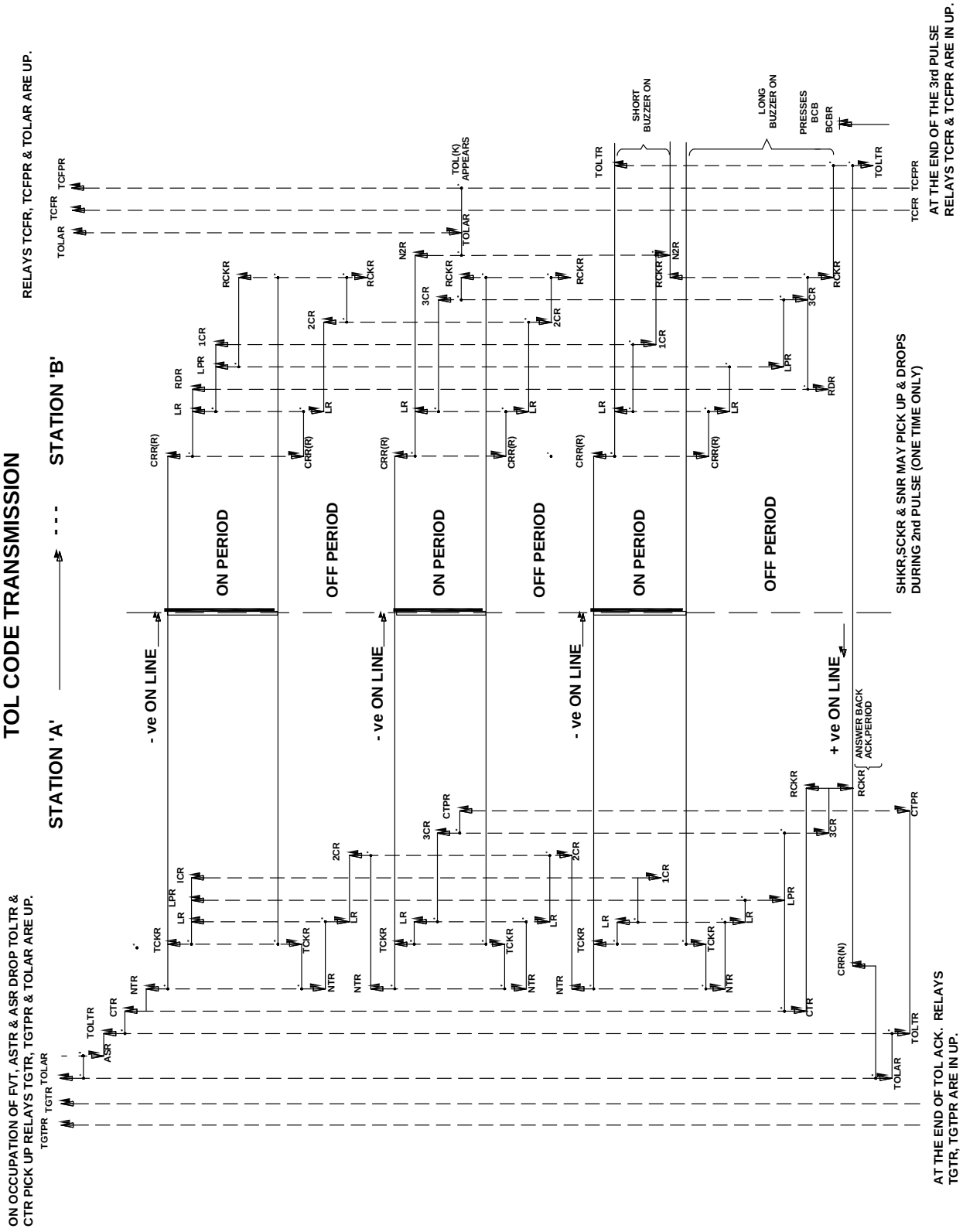


Fig: 8.36 TOL CODE TRANSMISSION FLOW CHART

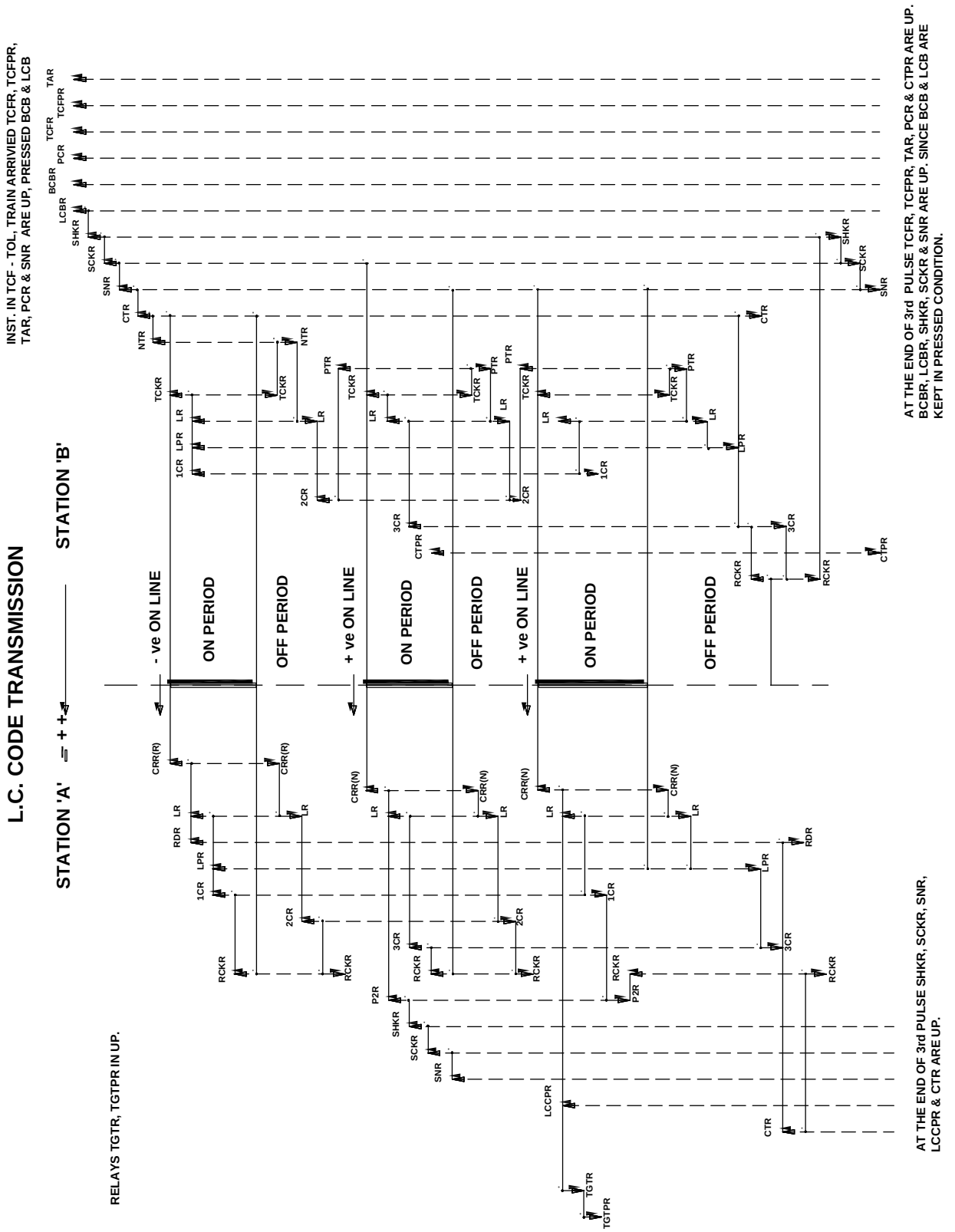


Fig: 8.37 LINE CLOSE CODE TRANSMISSION FLOW CHART

* * *

CHAPTER 9: METHOD OF OPERATION

Push button token less block instrument

9.1 To send a train from Station A to Station B

Station A	Station B
Block Instrument in Line Closed condition and LSS & FSS, at ON	Block Instrument in Line Closed condition and LSS & FSS, at ON
(1) Inserts the SM's Key and turns	
(2) Presses the TGB along with BCB	
	(3) Block Instrument displays TCF indication.
(4) Block Instrument displays TGT indication. Releases buttons.	
(5) (a) Takes OFF the LSS.	
(b) Train enters Block Section.	
(c) LSS return to ON automatically.	
(d) TOL indication appears automatically.	
(e) LSS knob replaced to normal.	
	(6) TOL indication appears automatically and audible warning sounds.
	(7) (a) Inserts SM's Key and turns.
	(b) Acknowledges audible warning by pressing the BCB.
	(c) Audible warning stops.
	(8) Calls attention through BCB and attends on telephone
(9) Acknowledges Call Attention through BCB and attends on telephone.	
	(10) Calls for description of train on telephone.
(11) Gives description of train on telephone.	
	(12) Acknowledges the description of the train
	(13) (a) Takes OFF the FSS.
	(b) Train enters the station.
	(c) FSS replaced to ON position automatically.
	(d) Audible warning sounds.
	(e) FSS knob replaced to Normal
	(f) Audible warning stops.
	(14) LCB along with BCB is operated, after visually checking the complete arrival of train and signals are normalized.
(15) Block Instrument set to Line Closed condition.	
	(16) Block Instrument set to Line Closed

9.2 To cancel the TGT condition before a train enters the Block Section

Station A	Station B
Block Instrument displays TGT indication and LSS at ON	Block Instrument displays TCF indication and FSS at ON
(1) Replaces LSS knob to normal if the signal had been taken OFF	
(2) (a) Inserts SM's Key and turns	
(b) Operates the Cancellation button along with the BCB	
(c) Counter registers next higher number	
(3) Calls attention through BCB, and attends on telephone.	
	(4) (a) Attends and inserts SM's Key and turns
	(b) Acknowledges Call Attention and attends on telephone.
(5) Advises on telephone intention to cancel TGT condition.	
	(6) Acknowledge intention to cancel TGT condition.
	(7) Replaces FSS knob to normal, if the signals had been taken OFF
(8) FREE indication appears after 120 Sec after the Cancellation button is operated.	
(9) Calls attention and presses the LCB along with the BCB after checking that all relevant signals are at ON.	
	(10) Acknowledges and co-operates for normalizing of the instruments by pressing the LCB along with the BCB.
	(11) Block Instrument set to Line Closed condition. Releases buttons.
(12) Block Instrument set to Line Closed condition. Releases buttons.	

9.3 To set the Block Instruments to Line Closed when a train pushes back to the dispatching station.

Station A	Station B
Block Instrument displays TGTK & TOLK	Block Instrument displays TCFK and TOLK audible warning sounds.
	(1) (a) Inserts SM's Key and turns. (b) Acknowledges audible warning by pressing the BCB. (c) Audible warning stops. (d) Calls attention through BCB, and attends on telephone.

(2) (a) Inserts SM's Key and turns.	
(b) Acknowledges Call Attention through BCB and attends on telephone.	
(3) Advises intention to push back the train.	
	(4) Acknowledges intention to push back the train, and replaces FSS knob to normal, if the signals had been taken OFF.
(5) (a) Takes OFF the reception signals.	
(b) Train returns to the station.	
(c) FSS replaced to ON position.	
(d) Audible warning sounds.	
(e) FSS knob turned to normal.	
(f) Audible warning stops.	
(6)(a) Operates the Cancellation button for Pushing back along with the BCB. (b) Counter registers next higher number.	
(7) (a) Verifies complete arrival of train visually or through automatic device where provided and that all relevant signals are at ON.	
(b) Calls attention and operates the LCB along with the BCB.	(7) (c) Acknowledges and co-operates for normalizing of the instruments by pressing the LCB along with the BCB
	(8) Block Instrument set to Line Closed condition. Releases buttons.
(9) Block Instrument set to Line Closed condition. Releases buttons.	

9.4 To shunt between the LSS and opposing FSS

Station A	Station B
Block Instrument in Line Closed condition and all the signals concerned at normal.	Block Instrument in Line Closed condition and all the signals concerned at normal.
(1) Inserts SM's Key and turns.	
(2) (a) Takes out the Shunting Key.	
(b) Hands over the Shunting Key to the Driver.	
(3) (a) After completion of shunting, driver returns the Shunt Key to SM.	
(b) Shunt Key is replaced in the instrument	
Note: If Stn B fails to establish TGT condition when Stn A has extracted the shunt key, Stn B should verify position from Stn A, who should advise Stn B as soon as shunting is completed.	

9.5 To shunt between the LSS and Opposing FSS behind a departing train with the instrument in TGT condition.

Station A	Station B
Block Instrument in TGT condition and all the signals concerned at normal	Block Instrument in TCF condition and all the signals concerned at normal.
(1) Inserts SM's Key and turns.	
(2) (a) Takes out the shunting key.	
(b) Hands over the shunt key to the driver.	
Case (1) If shunting is completed before the train clears Block Section.	
Station A	**Station B**
3(a) After completion of shunting, driver returns the shunt key to SM.	
(b) Shunt key is replaced in the instrument.	
	(4) After usual reception of the train, Block Instrument set to Line Closed condition.
Case (2) If train clears section before shunting is completed when Stn B fails to establish Line Closed condition as, Stn A has extracted the shunt key, Stn B should verify position from Stn A	
(3) (a) After completion of shunting, driver returns the shunt key to SM.	
(b) Shunt Key is replaced in the instrument.	
(4)(a) Advises on telephone about completion of shunting.	
	(5) (a) Acknowledges on telephone completion of shunting.
	(b) Sets instrument to Line Closed condition.

9.6 Operation of Slip & Catch siding while sending a train from Station A to B

Stn A is assumed to be provided with a Slip Siding protected by LSS and Stn B with Catch Siding protected by FSS.	
Block Instrument displays TGT indication.	Block Instrument displays TCF indication.
(1) Inserts SM's Key and turns.	
(2) (a) Takes out the Slip siding key.	
(b) Transmits the slip siding key to the siding point electrically or manually	
(c) Slip siding point is set.	
(3) (a) Takes OFF the LSS.	
(b) Train enters Block Section.	
(c) LSS returns to ON automatically.	
(d) TOL indication appears automatically.	

(e) LSS knob normalized	
	(4) TOL indication appears automatically and audible warning sounds.
	(5) (a) Inserts SM's Key and turns.
	(b) Acknowledges audible warning by pressing the BCB.
	(c) Audible warning stops.
	(6) Calls Attention through BCB and attends on telephone
(7) Acknowledges Call Attention through BCB and attends on telephone.	
	(8) Calls for description of train on telephone.
(9) Gives description of train on telephone.	
	(10) Acknowledges description of the train.
(11) (a) Slip Siding point is set to normal.	
(b) Siding key is transmitted back to SM Either electrically or manually.	
(c) Inserts SM's Key and turns.	
(d) Siding key replaced in the Instrument.	
	(12) (a) Takes out Catch Siding Key.
	(b) Transmits the Catch Siding Key to siding point electrically or manually.
	(13) (a) Train comes to a stop at the FSS
	(b) Catch Siding point is set.
	(14) (a) FSS is taken OFF.
	(b) Train enters the Station.
	(c) FSS replaced to ON position.
	(d) Audible warning sounds.
	(e) FSS knob turned to normal.
	(f) Audible warning stops.
	(g) Catch siding point set to normal.
	(15) (a) Siding Key is transmitted back to SM either electrically or manually
	(b) Inserts SM's Key and turns.
	(c) Siding Key replaced in the instrument.
	(16) LCB along with the BCB is pressed, after visually checking that the complete train has arrived and that all signals are at ON.
(17) Block Instrument set to Line Closed condition.	
	(18) Block Instrument set to Line Closed condition. Releases buttons.

* * *

CHAPTER 10: FAILURES OF INSTRUMENT

10.1 The Push Button Tokenless Block Instruments shall be considered to be interrupted and their working suspended in the following circumstances.

(a) When attention cannot be obtained direct on the Block Instrument.

(b) When signals on the Bell are received indistinctly or fail altogether.

(c) If the LSS fails to return to ON position as a train passes it.

(d) If the TAR(Train Arrival) buzzer fails even after the complete passage of the train inside the FSS over the LVT Circuit (May be due to failure of the LVT circuit)

Note: Though FSS may go to ON automatically by passage of the train, FSS shall not be put back to Normal position unless the whole of the train has arrived inside the FSS. Failure to adhere to this will result in a Block Failure and the TAR buzzer will not sound under such circumstances.

(e) When there is reason to believe that there is contact between the Block line wire and any other circuit:

Note :(i) If a contact exists between the Block wire and any other circuit, there is a possibility of irregular beats on the bell. A contact between two block wires would cause signals given on one instrument to be repeated on the neighboring instrument.

(ii) The Telephone connected with the instrument for train signalling, also shall be considered as having failed and working by means of the telephone would not be resumed until authorized by the Signal engineer or any other authorized person.

(f) If the Instrument or its battery counter is found unlocked or seal missing.

(g) When TOL buzzer fails at the receiving station, even after display of TOL indication on the Block Instrument.

Note: (i) If a following train in the same direction working on paper line clear ticket actuates the TAR buzzer, block working may be resumed.

(ii)If there is no following train but there is a train to proceed in the opposite direction the same will be dispatched on paper line clear ticket. The SM at other end should use cancel push button as in the case of a train pushing back and receive the train on proper signals after which block working may be resumed without waiting for S&T staff.

(h) When Material Train etc. is required to be taken into a Block Section after Line Block has been imposed in accordance with Appendix V to the G & SR.

Note: Block Working with Line Clear exchange by any means shall to suspended and the Material train etc. started on an 'Authority to proceed without Line Clear'. After the Line Block has been removed the SMs themselves shall resume block working.

(i) When a train is required to enter a block section which is obstructed by an accident or any other reason.

Note: Black Working with Line Clear Exchange by any means shall be suspended and trains started on an 'authority to proceed without Line Clear'. On the obstruction being removed, the SM themselves shall resume block working.

(j) If it is known that the Instrument is defective in any way not specified above.

10.2 Push Button Tokenless Block Instrument - Other failures

(a) If the TGT indication is not displayed on the instrument when operated or TOL indication is not displayed on the Instrument after the train has entered the Block Section.

(b) If the LSS cannot be cleared even when the instrument displays TGT indication.

(c) If the LSS can be cleared without displaying TGT indication on the Block Instrument.

Note: This test shall be made when SM take charge of the Block Instrument and an entry made in the Train Signal Register (TSR)

(d) Since the OFF aspect of the LSS is the authority to enter the block section in the Tokenless territory, in case LSS does not assume OFF aspect, the Block working should be suspended.

(e) When a train arrives at a station when the Block Instrument is not displaying TOL indication.

Note: In this case irregularities shall be reported as an accident.

(f) If the Line closed indication can be displayed on the Instrument before complete arrival of the train.

(g) If the TGT indication cannot be cancelled even though proper manipulation has been done.

(h) If the TGT indication can be cancelled without the co-operation of the SM at the other end of the Block Section

10.3 Alternative Means of Communication

In the event of failure or suspension of Block Instruments Line Clear shall be obtained by any one of the alternative means of communications in the order of priority indicated below:

a) Telephone attached to the Block Instrument,

b) Station to Station fixed telephones wherever available,

c) Fixed telephone such as Railway auto phones and BSNL telephones,

d) Control telephone and

e) VHF set.

Shall be worked in accordance with the procedure laid down in G&SR 14.01

All failures shall be reported promptly to all concerned.

10.4 Trouble Shooting Chart for Tokenless Block Instruments - Push Button Type

S.No	Type of Failures	Observation	Causes
1	Bell Code Failed	1. Bell Beats failed altogether both sides	Due to twist on line or break fault CRR is not picking up. CTR Back contact in CRR circuit not making
		2. Outgoing bell beats only failed	1. Disconnection of Line Battery at sending end. 2. Disconnection in 250 Ohms resistance in Unit No. IV at sending end. 3. Disconnection of Local Battery at the receiving end.
		3. Incoming Bell Beats only failed	CRR is not energizing due to BCB normal contact No. 15 not making.
2. a)	Generation of Code failed	1. SHKR not picking up	Shunt Key IN contact inside EKT is not making properly
		2. SCKR not picking up	Local Battery Weak
		3. SNR not picking up	1. Disconnection in Location Battery 2. Disconnection in SNR circuit. Due to Circuit Controller contact not making, FSS Lamp fused etc.
		4(a) CTR not picking up	1. Cancel Button developed High Resistance fault. 2. BCB/TGB contact spring not making while buttons are pressed. 3. SNR –2A1 contact developed high resistance fault. 4. SHKR – 4A3 -do- SCKR – 4A3 –do-
		4(b) CTR not holding	1. Condenser for the time lag arrangement unit. – I 2. CTR stick circuit contacts of TCKR 5A6, LR 7B8, LPR 2D1 relays.
		5. TAR not picking up on arrival of train.	1. Faulty circuit controller of Home Signal lever/disconnection in other contacts of TAR circuits (or) TOLAR- 5A6 offer high resistance 2. LVT track circuit failed.
b)	Code Transmission Failed	CTR actuating but code is not transmitted	Disconnection of Line or Disconnection in Line Battery

S.No	Type of Failures	Observation	Causes
c)	Code reception failed	CRR is not picking while code is being received from the other end.	CRR not energizing due to BCBR- 6A5/6B5 not making at receiving end.
d)	Code Transmission not progressing	CTPR picking up & dropping 1st pulse only being transmitted	Condenser across CTR in Unit No. 1 punctured.
e)	Failure to generate TGT automatic reply code or answer back code in response to incoming TCF code	RCKR not holding hence CTR not picking up.	RCKR picked up at receiving station but not holding due to condenser fault in Unit I.
3.a)	Answer back code is recd., but TGTR is not picking up	Instrument is not set to TGT even though TGT code is received	1. ASR- 2CI front contact in TGTR circuit is not making. 2. In Unit IV 50 ohm resistance developed open circuit. Fault 220 mfd condenser punctured resulting in ASR not holding. 3. CTPR not holding due to 4700 mfd condenser defective, in Unit No.1 4. ASTR not picking up due to failure of FVT.
b)	While taking line clear no TGT or TCF indication set up at sending station/ receiving station	TCFR not picking up at receiving end on receipt of the 3rd pulse of TCF code.	Disconnection in TCFR coils resulting in failure of replay code or answer back TGT code.
4. a)	Both TCF & TOL indications appeared at receiving end simultaneously while the other station is trying to take line clear	TOLAR not holding at receiving end	Local Battery at the receiving end is defective or momentarily interrupted (some time due to development of reverse polarity in one of the cells).
5.	When TGB & BCB are pressed, TOL code is transmitted instead of TCF Code.	TCKR contact No. 4 A3 offered high resistance. Hence, LR and LPR did not pick up. Hence, 3 CR did not pickup	TCKR Defective

6.	In reply to the incoming TCF code, TOL code is transmitted as 'Answer Back' instead of TGT code.	During the code progress TCKR contact No. 4A3 is not making. Hence, LR is not picking up. 3CR is not picking up. Consequently NTR is not dropping while the instrument is 'Answering Back'	TCKR defective.
7.	Transmission of reply code is incomplete	CTR is not holding CTR 2CI is not available as the solder is given up	Solder given up
8.	Failure of transmission of code.	CTR was not picking up and holding. LPR was not holding since the wire of condenser is given up. In U-II (R3 &R1)	Wire given up
9.	No Answerback for Line Closed Code	This was due to LCCPR not holding in the Line closed code receiving instrument due to the IA2 contact of SHKR was offering high resistance.	Relay contact not making.
10.	While taking line clear TOL indication appeared immediately after getting TGT indication at the train sending end	TOLAR not holding at sending end	TOLAR latch is not effective
11.	TOL indication appeared before the entry of train into the Block Section	TOL indication appeared prematurely	Failure of FVT after the instrument is set to TGT before the train passed over FVT
12.	TOL indication failed	No TOLK	Check the LED of 2.2 K ohm resistance
13.	TOL Buzzer failure	Buzzer is not sounding	TOLTR not picking up at receiving station.
14.	Train arrival buzzer failure	-do-	TAR not picked up (or) not holding.

10.5 Special requirements of Single Line Tokenless Block Instruments

10.5.1 Fixed Indications - The instrument shall be provided with means to indicate TOL at both the sending and receiving stations when a train has entered the block section. (SEM 7.149)

10.5.2 Immunity from extraneous currents - Single Line Tokenless Block Instruments shall work on coded pulse/frequency modulated current system so as to be immune from the effects of extraneous currents. (SEM 7.150)

10.5.3 Operation - Push Button Tokenless Block Instruments: **(SEM 7.152)**

10.5.4 TGT and TCF - The cooperation of the SM at the other end of the section may be dispensed with. The instrument shall be such that a button in addition to the bell button shall be operated for TGT position. (SEM 7.152.1)

10.5.5 TOL - Means shall be provided to ensure that the instruments are set to TOL automatically by the entry of the train into the block section and maintained in that position until the train has cleared the block section. This indication shall be in addition to the TGT or TCF indications. (SEM 7.152.2)

10.5.6 Line Closed - Both the instruments shall be restored to normal before a further operation of setting the instrument to TGT/TCF can be carried out. The instrument shall be such that the receiving station for setting both the instruments to the Line Closed condition shall operate a button in addition to the bell button. (SEM 7.152.3)

10.5.7 Operation of Line Clear receiving and granting mechanism - It shall not be possible for the mechanism which permits a Line Clear to be received and that which permits a Line Clear to be granted to be in operation at the same time. (SEM 7.153)

10.5.8 Tokenless Block Instruments shall be provided with

(a) Audible indicators to warn the receiving station

(i) When the train enters the block section at the sending station; and

(ii) When the train has passed the Home Signal at the receiving station.

(b) Shunting key suitably interlocked with the Block Instrument for use as an authority for shunting beyond the LSS and up to the opposing FSS. (SEM 7.154).

Do's:-

Operating department:

(1) Ensure SM's key/ SHK /SCK "IN" for taking Line Clear.

(2) Block competency Authorised person only shall operate Block Instrument.

Signal and Telecom department:

(1) Megger Block line wires jointly with SSE/JE (Telecom) once in a year.

(2) Maintain the Line, Local and Location Batteries in good condition.

(3) Ensure Incoming/Outgoing Line current 60 – 70 mA.

(4) All Relays shall be plugged correctly according to code pins.

(5) Retaining clips shall be properly fixed.

(6) Ensure Double Locking of Block Instruments.

(7) Ensure proper sealing of Block Instruments.

Don'ts:-

Operating department:

(1) Do not allow unauthorized person to operate the Block Instrument.

(2) Do not allow to interfere with the Block Instrument without proper disconnection.

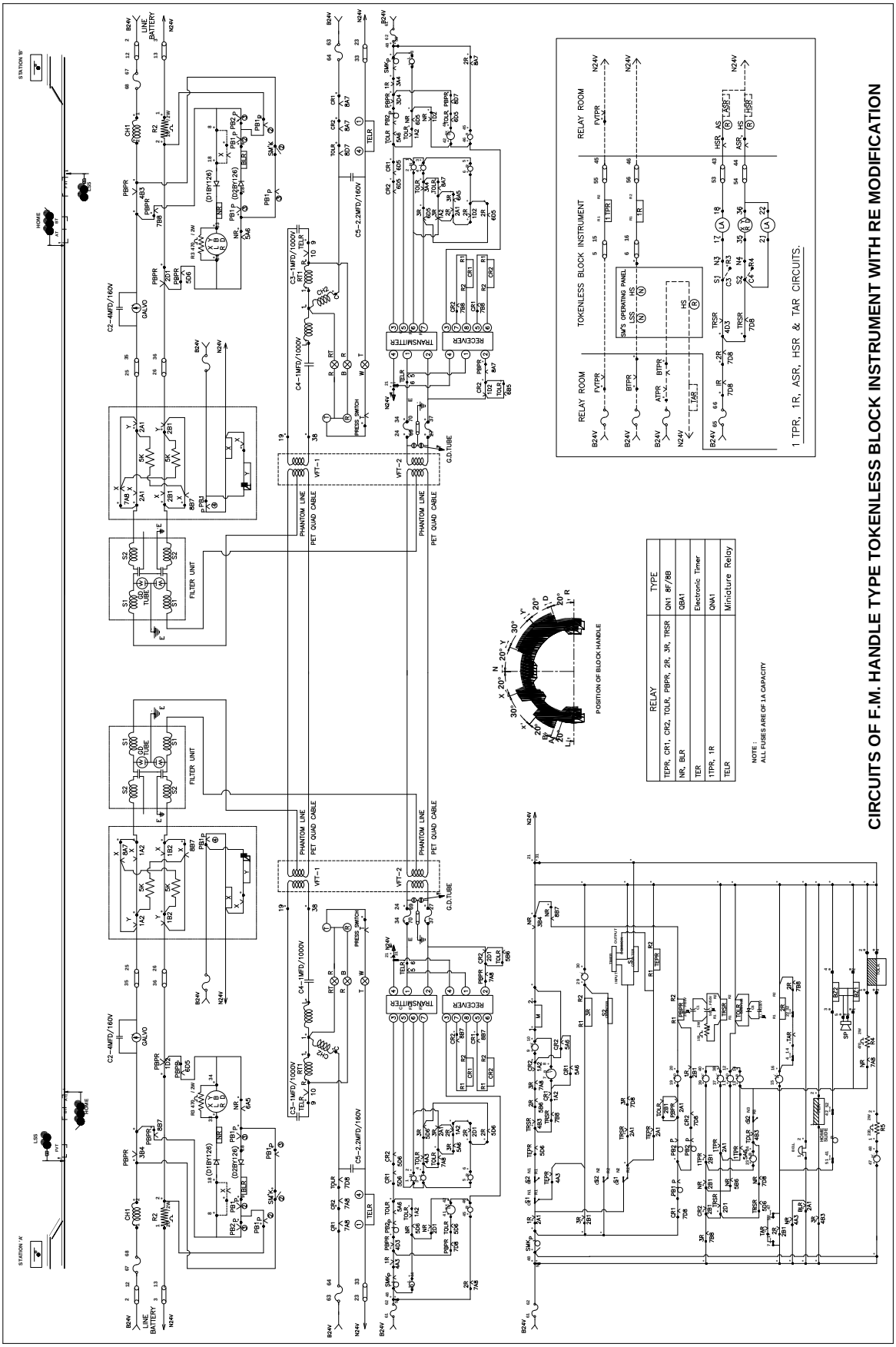
(3) Never allow testing of the Block Instrument by S & T staff with train in the Block section.

Signal and Telecom department:

(1) Local Voltage shall not be more than 28.8 V D.C.

(2) Do not certify the Block Instrument after attending Block failure without testing and issuing of Reconnection notice.

11. Annexure - I



CIRCUITS OF F.M. HANDLE TYPE TOKENLESS BLOCK INSTRUMENT WITH RE MODIFICATION

12. REVIEW QUESTIONS

CHAPTER 1

Subjective

1. What are the codes used in FM block instrument
2. Write short notes on
   (a) TOL indicator
   (b) Buzzer
   (c) Shunting key
   (d) Level adjust switch
   (e) Impedance switch
   (f) Attenuator
   (g) Coding relays

Objective

Fill in the blanks

1. Carrier frequencies used in FM instruments are _____ or _____
2. The modulating frequencies are _____ and _____
3. Resistance of the galvanoscope coil is _____ ohm
4. The resistance of the time release indicator coil is _____ ohm
5. The block handle assembly consists of _____ sets of spring contacts
6. Resistance of the single stroke bell coil is _____ ohm

True or false

1. Shunting key can be removed only in TGT or line closed position
2. The time delay for push back cancellation is 120 sec
3. CR1 picks up when a code of 1800 Hz and 2700 Hz modulated by 85 Hz is received from the other station
4. Local battery is of 24v, supplies TX, RX, Indicators, lock magnet coil and operating relays etc. of the instrument.

CHAPTER 2

Subjective

1. Explain PBPR circuit
2. Explain Bell circuit
3. Explain TRSR Circuit
4. Explain cancellation Circuit
5. Explain sending end TOLR circuit

Objective

Fill in the blanks

1. Bell circuit is having two parallel paths with _____ and _____ up contacts
2. In the DC supply path of Transmitter PBPR _____ [up/down] contact is proved
3. TRSR is a slow to _____ relay
4. NR is a _____ [local/line] relay
5. In M lock coil circuit NR _____ [up/down] contact is proved in –ve limb

True or false

1. Resistance R3 in NR circuit of FM instrument is an electrical equivalent of jerking contact of Token block instrument
2. TOLR is a slow to pick up relay
3. BLR is a line relay
4. PBPR pick up contact is proved in DC supply path of the receiver
5. CR1 pick up is required to turn the block handle to TGT position

CHAPTER 3

Subjective

1. Write short notes on
   (a) Transmitter
   (b) Receiver

Objective

Fill in the blanks

1. Level adjust switch is associated with the _____ [transmitter/Receiver]
2. Attenuator associated with the receiver _____ [T/F]

CHAPTER 4

Subjective

1. What are different types of tests required in FM instrument

Objective

True or false

1. VF Transformers are required when we use FM Instruments in AC RE Area
2. Block bell equipment is not required for FM instruments when used in AC RE area

CHAPTER 5

Objective

True or false

1. FM Block instrument is non-cooperative for cancelling the line clear
2. First the sending end block instrument becomes TGT before the receiving end becomes TCF

CHAPTER 6

Objective

True or false

1. After 120 sec of initiating the cancellation block instruments can be normalised
2. Switch S1 is required to be reversed and LSS control to be normalised for initiating the line Clear cancellation
3. If the LSS fails to return to ON position as a train passes it, block working is to be suspended
4. When signals on the bell are received indistinctly or fail together, block working need not be suspended

* * *

CHAPTER 7

Subjective

1. Short notes on SNR relay
2. Explain relays energised by line battery
3. Name relays energised by local battery

Objective

Fill in the blanks

1. External relays in Push Button Block Instrument are _____ , _____ and _____
2. SNR picks up by pressing BCB along with _____ or _____ button
3. _____ relay senses the progress of the coding circuit at the receiving end and terminates the pulses that is being received by opening the line circuit

True or false

1. N2R and P2R are conflicting relays
2. SM'S key is not required to be in the instrument at receiving end when sending end SM is taking line clear
3. Train arrival buzzer stops sounding when home signal lever is normalised
4. Train on line buzzer sounds only at train sending station
5. Cancellation counter is of resetting type

CHAPTER 8

Objective

Fill in the blanks

1. No of relays in Push Button block instrument With Q Series relay are _____ no
2. No of condenser and resistance units in Push Button Block Instrument with Q relay base are _____ no
3. _____ picks up while receiving a train on signals with Block Instrument in TCF –TOL/ TGT –TOL Condition

True or false

1. TOLAR relay is a magnetic latch relay
2. TAR relay is not a magnetic latch relay
3. ASTR relay is proving relay for FVTPR
4. LPR drop contact is proved in bell circuits
5. SNRK will not prove SNR relay pick up condition

CHAPTER 9

Objective

True or false

1. Push Button block instrument is co-operative type
2. Train on line buzzer sounds only at receiving station in PB block instrument
3. For cancellation in Push Button block instruments cooperation is not required
4. Removal of shunt key prevents the block instrument to become TGT

CHAPTER 10

Subjective

1. Write short notes on the following Relays

1. TCKR	2. RDR	3. CTR	4. CTPR
5. TCFR	6. TGTR	7. LCCPR	8. TOLAR

Objective

Fill in the blanks

1. - + - Code in TCFR relay is proved by _____ _____ _____ relay contacts
2. - + + Code LCCPR relay is proved by _____ _____ _____ relay contacts
3. - - + Code in TGTR relay is proved by _____ _____ _____ relay contacts

* * *