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TOKENLESS BLOCK INSTRUMENTS FOR SINGLE LINE

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

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Issued in November 2009

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No. of Pages	124
Date of Issue	November, 2009
Version No	A2

CHAPTER – 1: INTRODUCTION

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

Due to various steps involved in Extracting Token & Handing over to Driver (Loco Pilot) at despatching station and Handing over of token at Receiving station and Normalisation causes delay (Token loss is another problem), this Token working is not suitable for high speed trains / where traffic is dense. In this context, Tokenless were Introduced in Indian Railways.

1.1 The Signal Standards Committee in the 29th Report recommended the introduction of Tokenless working on the Indian Railways to increase the single 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 were 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. These were examined by the Signal Standards Committee 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 the modifications approved by the Railway Board were incorporated. In this chapter, the modified design and circuits are described.

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

The codes used in the instrument are

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

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

(c) 1800 Hz or 2700 Hz modulated by 65 Hz - To set the other end instrument to "Train on Line"

(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 Description of the instrument

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

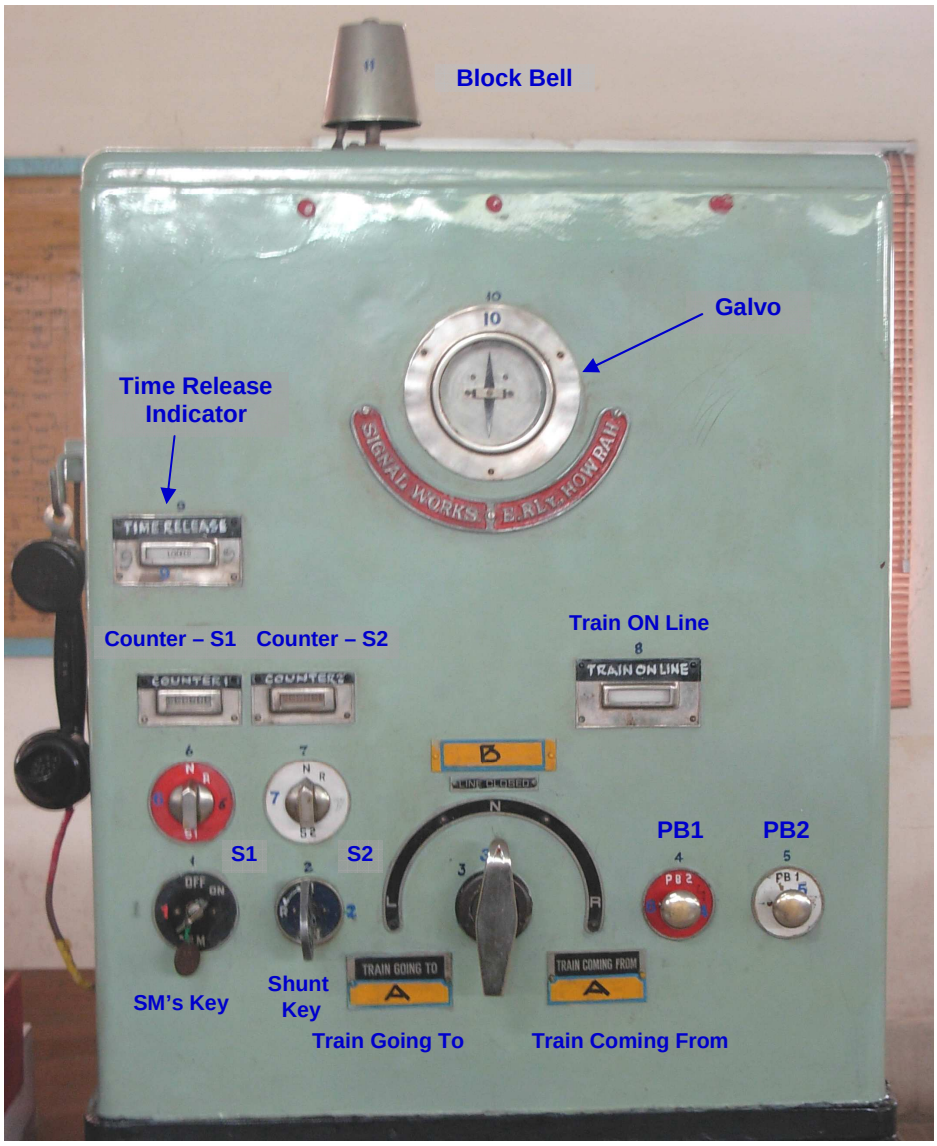


Fig: No.1.1

The instrument consists of the following parts

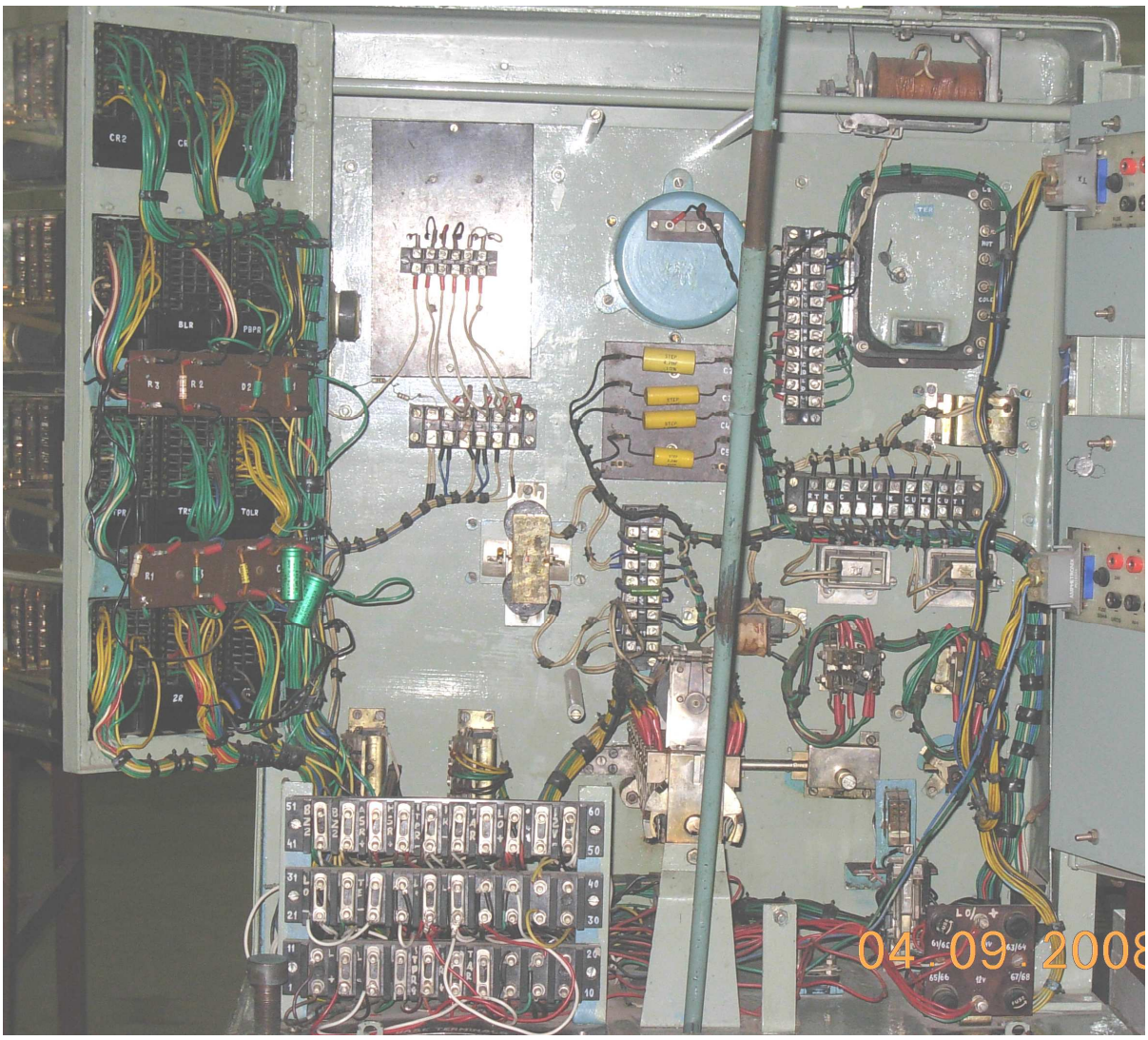
(a) Galvanoscope: This indicates incoming and outgoing dc currents. The resistance of the coil is 18.2 Ohms.

(b) Time Release Indicator: 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.

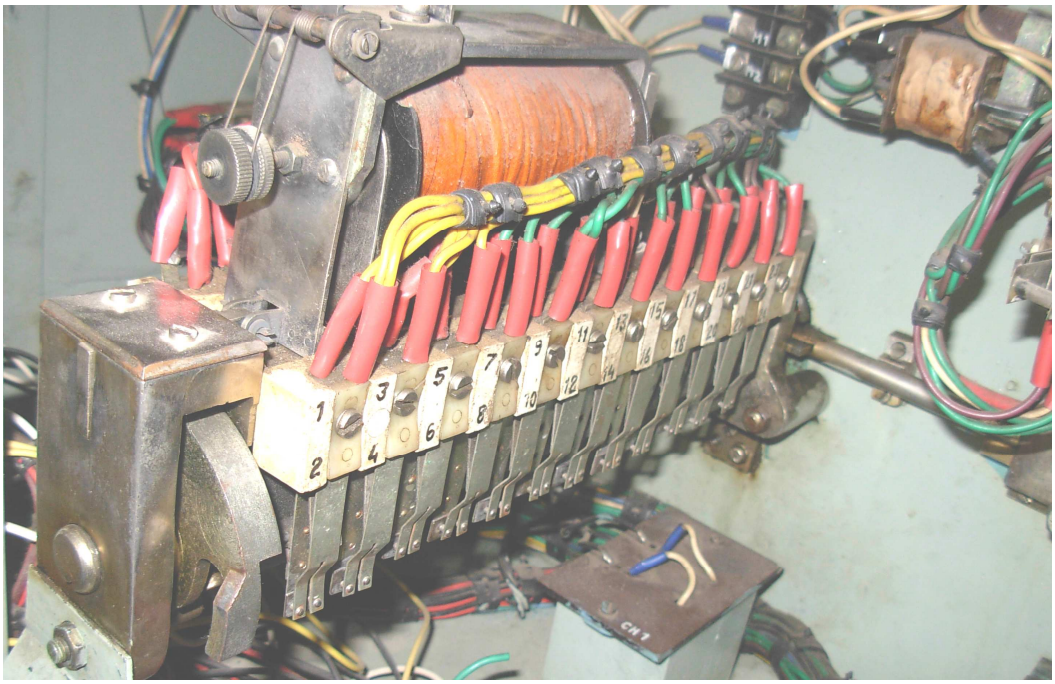
(c) Switch S1 with counter: It is used for cancellation of Line Clear. The counter registers the numbers of such operations.

(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 numbers of such operations.

(e) TOL Indicator: This indicator normally displays a white indication and displays red indication with caption "Train on Line" when a train enters the block section.



INTERNAL VIEW



Inside View of the Block Handle with spring contacts

(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 code.

(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 (L) "Train Going To" or (R), "Train Coming From" 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 and Y, R and D and also between L and 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 forced 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 concerned notch 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.

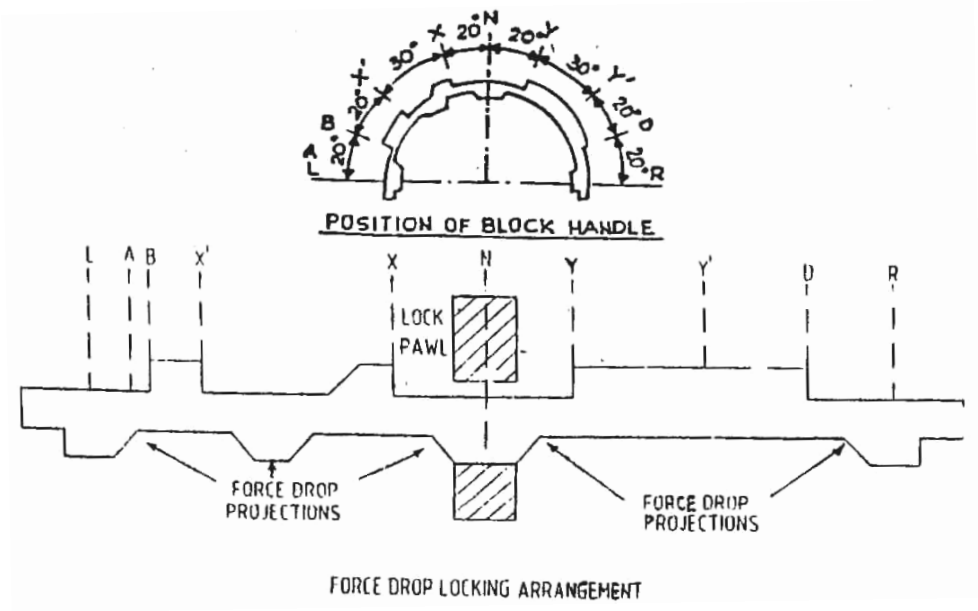


Fig: 1.2 CONTACT POSITIONS AND LOCKING POSITIONS OF BLOCK HANDLE

(i) Single Stroke bell: This is mounted on top of the instrument and is used for exchanging bell code signals. The bell coil is wound to a resistance of 310 ohms 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 is cleared. The output of both the buzzers are connected to a common speaker.

(k) SM's Key: When this key is removed, the instrument is in-operative for all functions except for the reception of bell code signal 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.

(m) Transmitter: This gives a frequency modulated output when the DC feed is connected to the transmitter by different selections. The modulating frequency is selected by the transmitter by an external loop completed through the relevant selection 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.

The level of the signal output of the transmitter can be adjusted by this.

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

(q) Impedance Switch: This is a switch having three positions one for 600 ohms, the second one for 1120 ohms and the other for 1300 ohms. When the instruments are connected with overhead lines, the switch is put on 600 ohms side and when connected with cables (normally in RE area) the switch is put on to the 1300 ohms side to obtain proper impedance match and to 1120 ohms when the instrument connected through RE cables.

For DCC (TX/RX) make the impedance switch is having only two positions i.e 600 & 1120ohms.

1.4 SEQUENCE OF OPERATION FOR SENDING A TRAIN FROM STATION A TO STATION B

Note : The instruments connected are assumed to be of 1800 Hz carrier frequency.

(a) ‘A’ presses PB1 button and transmits bell code signal to 'B'.

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

(c) ‘A’ now presses PB1 and PB2 buttons when a FM tone of 1800 Hz modulated by 85 Hz and D.C +ve are transmitted.

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

(e) ‘B’ now presses PB1 and PB2 push buttons when a FM tone of 2700 Hz. modulated by 65 Hz. along with DC +ve are transmitted.

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

(g) ‘A’, clears the last stop signal and train departs from Station 'A'. On passing the last stop signal, the F.V. track circuit is operated, and a FM tone of 1800z modulated by 65Hz is automatically transmitted. Last stop signal is also automatically restored to ON position. The last stop signal lever is then restored to normal. "Train on Line" indication appears at A station, and a buzzer sounds.

(h) Simultaneously at ‘B’, "Train on Line" indication appears and a buzzer sounds as soon as the train enters the block section. B acknowledges the train entering section signal by pressing PB1 and prolongs the last beat.

(i) At ‘A’, transmission of the FM tone of 1800 Hz modulated by 65 Hz ceases and buzzers at ‘A’ and ‘B’ stop sounding with TOL indications at both stations persist.

(j) ‘B' lowers reception signals. Train on passing (Home signals) the block clearance point, operates last vehicle track circuits and causes a buzzer to sound continuously. Home signal is automatically restored to ON position. After ensuring complete arrival of train ‘B’ puts back home signal lever and SMs control slide to normal. When SMs control slide is put to normal the train arrival buzzer stops sounding. ‘B’ then transmits Train out of section signal by pressing PB1 and PB2 when FM tone of 2700 Hz modulated by 85 Hz and D.C. +ve is sent to A.

(k) At 'A' the FM tone and DC +ve is received. ‘A’ turns block handle to Normal (Line Closed) position. "Train on Line" indication disappears at 'A'. ‘A’ now acknowledges the signal by pressing PB1 and PB2 buttons,, when a FM tone of 1800 Hz modulated by 85 along with DC +ve is transmitted to B.

(l) ‘B’ turns block handle to normal (Line closed position). "Train on line” indication also disappears at 'B’.

Both instruments are now brought to normal.

1.5 CANCELLATION OF LINE CLEAR BEFORE ALLOWING A TRAIN INTO THE BLOCK SECTIOIN.

(a) to (f) Same as in 1.4.

(g) ‘A’ informs ‘B’ that LC obtained is to be cancelled and operates switch S1, immediately LSS becomes ON, with LSS control in reverse. After normalizing LSS control S1 counter registers a higher number. After a delay of 120 seconds, time release indicator changes from white to green. A puts switch S1 to normal, and presses PB1 and PB2 buttons when a FM tone of 1800 Hz modulated by 85 Hz. is transmitted to ‘B’ along with DC +ve.

(h) ‘B’ on receipt of the code signals, turns block handle to normal position during the prolonged beat and in turn presses PB1 and PB2 buttons to send the acknowledgement . FM tone of 2700 Hz modulated by 85 Hz is transmitted to 'A' along with DC +ve.

(i) ‘A’ now turns block handle to normal position.

Both instruments are now brought to normal.

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) A operates switch S2 and lowers home signals. S2 registers one higher number. Train on passing home signal operates last vehicle track circuits. A buzzer sounds continuously at 'A' which stops when SM's slide on Home Signal is put back to normal. Home Signal is automatically restored to ON position. After ensuring complete arrival of the train, puts the home signal lever, SM’s control slide and switch S2 to normal. He then presses PB1 and PB2 buttons when a f.m. tone of 1800 Hz. modulated by 85 Hz. is transmitted to B station, along with d.c. +ve.

(h) 'B' turns blocks handle to normal (Line closed) and then presses PB1 and PB2 buttons when FM tone of 2700 Hz. modulated by 85 Hz. is transmitted to A along with DC.

(i) The above code helps to turn block handle to Normal position at 'A'.

Both instruments are now brought to normal.

1.7 CIRCUIT DESCRIPTION

The detailed circuit is given in Figures 1.4,1.5,1.6 and 1.7 at the end of this book. A pair of these block instruments of a block section have the two carrier frequencies. The two carrier frequencies chosen are 1800 Hz and 2700 Hz. This arrangement offers better protection to work against failures on wrong side.

1.8 The following relays are housed inside the block instrument

(a) PBPR Relay: This relay is energized when PB1 and PB2 are pressed together or PB1 is pressed when TOLR relay is energized with B.H. in 'R' position. This relay when energized connects the line battery to line in such a way that positive terminal of line battery is connected to L1 and negative to terminal L2 to pick up NR relay at the other end. PBPR relay, 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 Code signals.

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

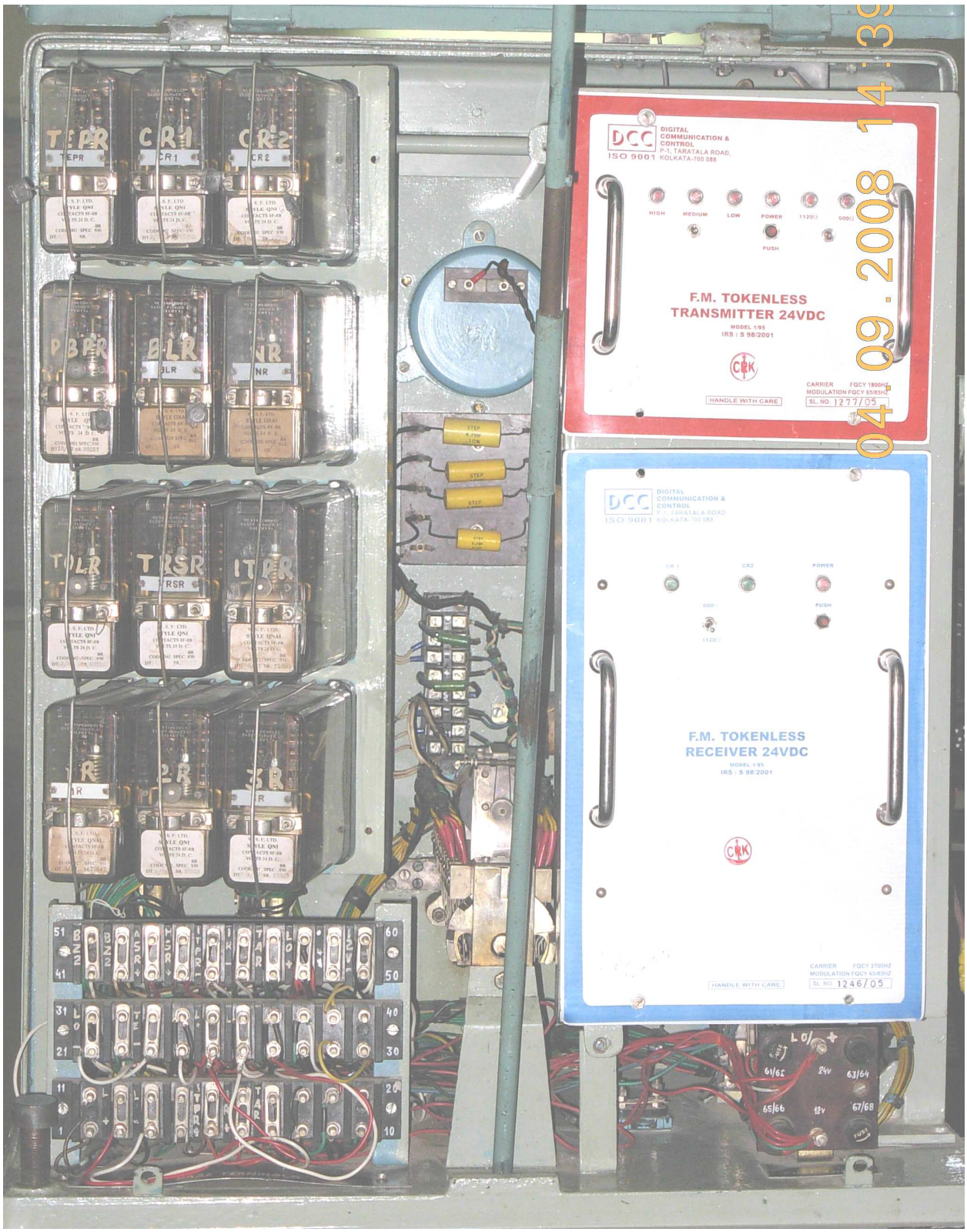
(e) TELR: This is a telephone type relay having a resistance of 70 ohms, which is energized when the pressel switch of hand micro telephone is pressed. This relay connects the telephone circuit to the line through its front contact and isolates the transmitter and receiver from lines as they are connected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

(f) 3R: This is line clear cancellation relay. It also operates the time release indicator. It operates after about 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 proves the normal conditions of the signals/controls pertaining to the block section. It remains normally energized to prove the LSS and Home Signal levers and SM slides are normal in addition to other selections if any.

(h) TRSR: Train sending relay: It picks up when operating handle is being turned to 'L' position, and sticks in the LX' position. It releases when the train passes the first vehicle track 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 "train on line relay", and is operated when the train occupies the last stop signal control track circuit when the operating handle is in 'L' position or on receipt of the TOL code when the handle is in 'R' position, when operated, gives TOL indication and sounds buzzer BZ1. This picks up only after CR2 picks up at train receiving station.



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

(k) CR1: Code Relay 1 It picks up when a code of 1800 Hz or 2700 Hz modulated by 85 Hz is received from the distant station. When energized releases electronic lock on the block handle (through other relevant selections) for the operation of the handle from (1) N to R 2) R to N and (3) L to N.

(l) CR2: Code Relay 2. It picks up when a code of 1800 Hz or 2700 Hz modulated by 65 Hz. is received from the distant station. When energized releases electric lock on the block handle (through other relevant selections) 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 used for proving the arrival of the train.

1.9 In addition to the relays housed in the instrument, two line relays HSR and ASR are also required for controlling the Home Signal and last stop signal respectively. HSR relay is normally energized via R or N position of block handle in conjunction with other selections and when energized extends the feed to Home Signal. 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

1.10 There are two indicators in the block instrument viz.

(a) TOLK: This is Train On Line indicator, and is of the magnetic stick type. It consists of two coils (normal and release) wound to a resistance of 500 and 200 ohms respectively. The normal coil is energized via front contact of TOLR. The release coil is energized via XX' and YY' contacts of block handle.

(b) TEK: Time release indicator: This time release indicator consists of single coil of 200 ohms. It is energized via front contact of relay 3R.

1.11 There are two track circuits, with associated relays, which operate in conjunction with the movement of the train. The track circuit associated with the last stop signal 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.

The track circuit associated with the home signal 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 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.1.3. When a train entering the station on proper reception signals T1R and T1PR are first de-energized and create a condition to pick 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 energies 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 two track 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

1.12 Power Supply

There are three sets of batteries required namely Line Battery, Local Battery and Location/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 24.0 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 instruments according to the requirements of the circuits.

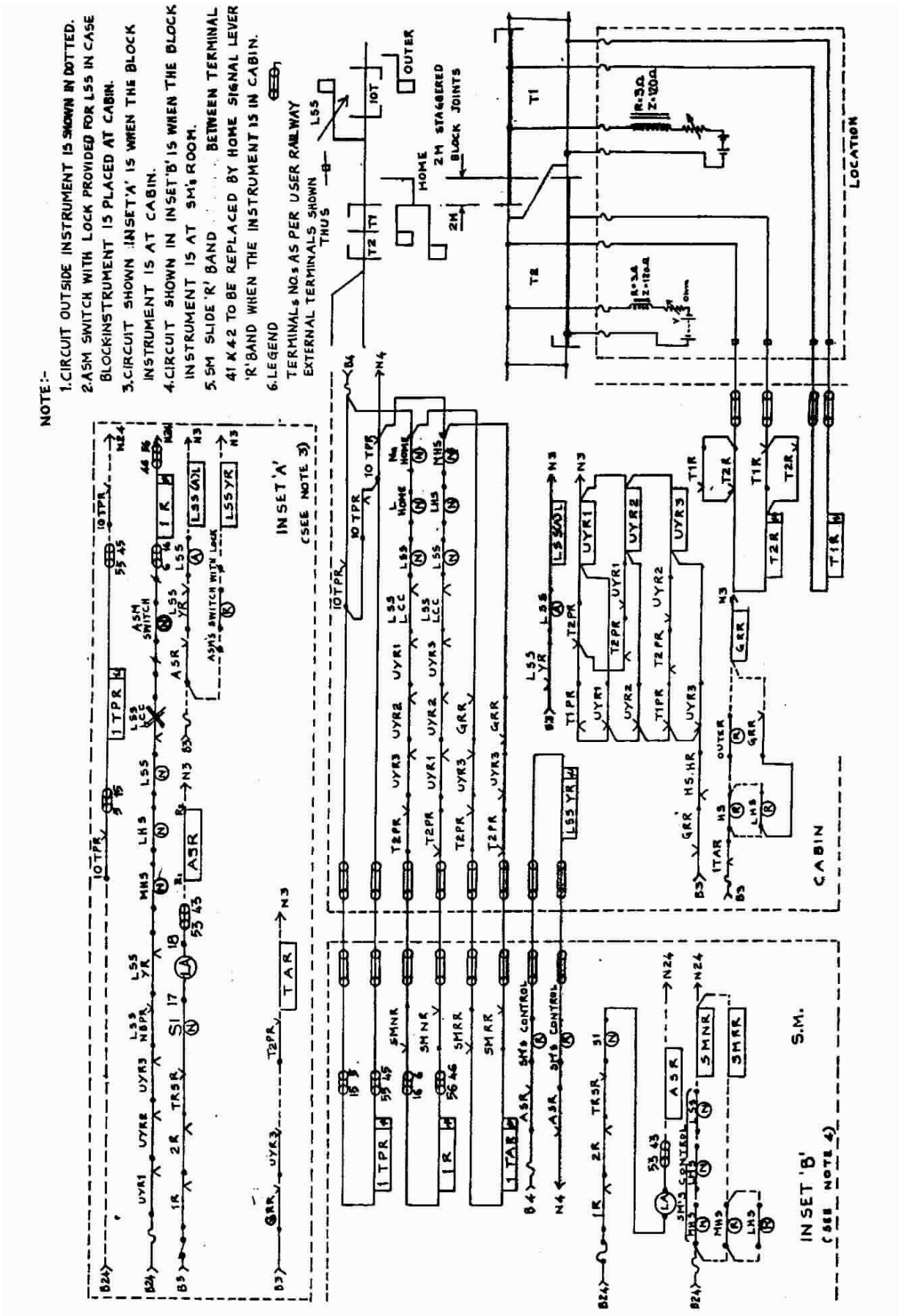


Fig: 1.3 TRAIN ARRIVAL PROVING CIRCUIT

* * *

CHAPTER – 2: DETAILED CIRCUIT DESCRIPTION

2.1 References

(a) Assembly diagram - AKGE/201/008

(b) Wiring diagram - AKGE/201/001 based on CSTE/E.Rly.

- Drg.No.SI/6553 dt.26.9.88.

(c) 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 ITPR and IR 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)

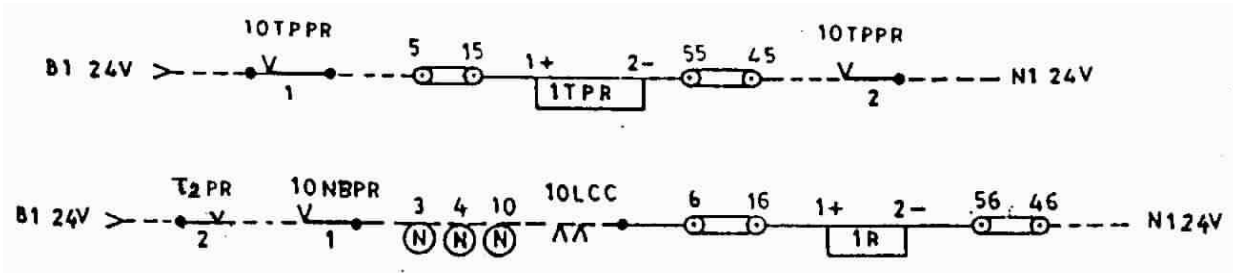


Fig : 2.1

2.3 When a Train is leaving 'A' station for 'B' station

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

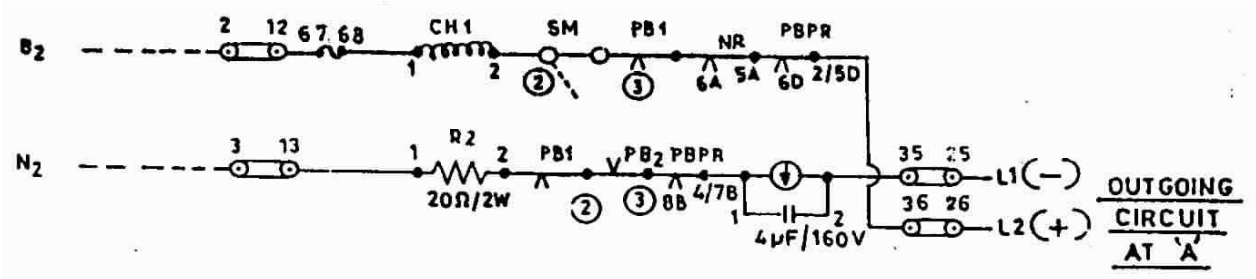


Fig : 2.2

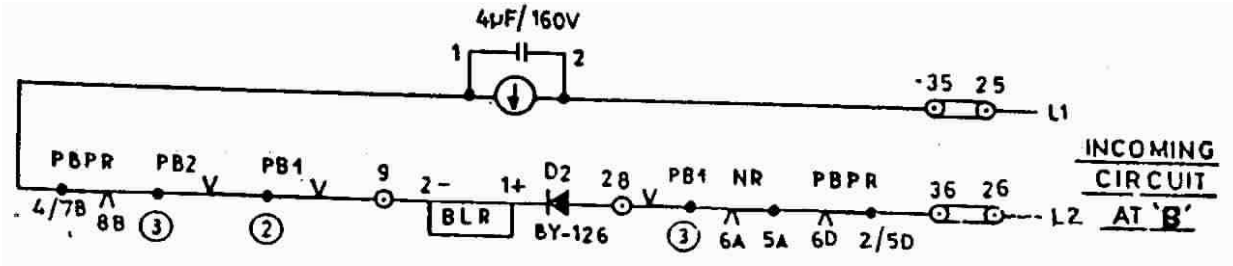


Fig : 2.3

B2-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)-N2. 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).

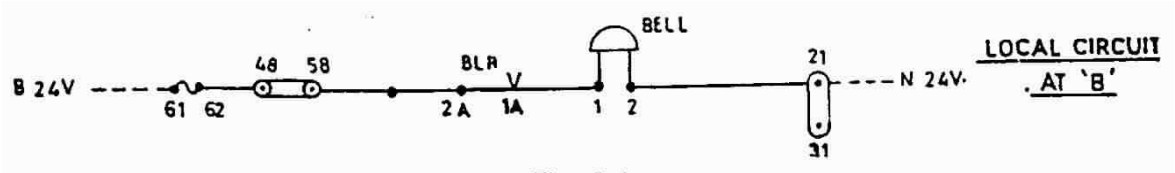


Fig: 2.4

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

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

(d) Push buttons PB1 and PB2 are pressed together at A station to send a code of signal, with both buttons being pressed. A current flows in the following circuit to pick up the PBPR (See Fig.2.5). B 24V- fuse (61-62)-SMK(ON)-CR1 (B)-PB1 (R)-PB2 (R)-CR2 (B)-IR (F)-PBPR-NR (B)-N 24V. with the PBPR picking up at A, NR at B station picks up through the line circuit. (See Fig.2.6 & 2.8). B2-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) N2. 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 A Station 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)-IR (F)-PBPR(F)-PB2(R)- TOLR (B) CR1(B)-CR2(B)-TX(3.4)-N 24V. With a circuit TX (5)-N-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 A Station is broken by PBPR(B)getting disconnected).

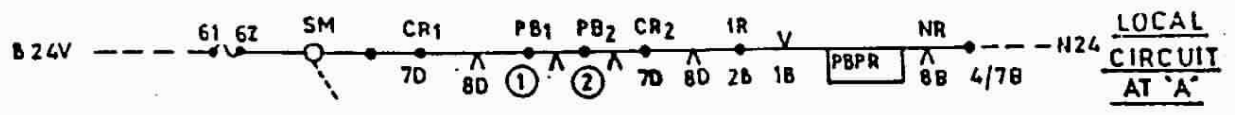


Fig: 2.5

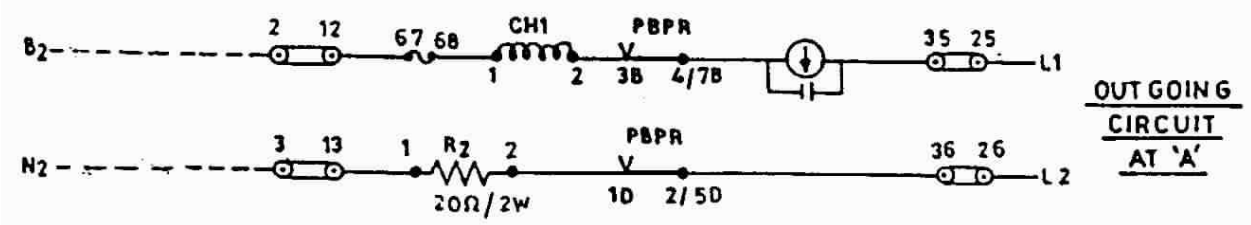


Fig: 2.6

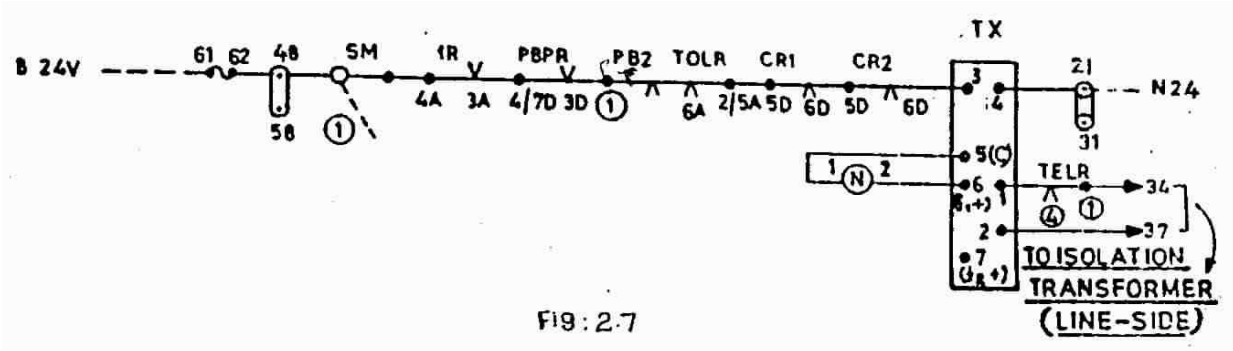


Fig : 2.7

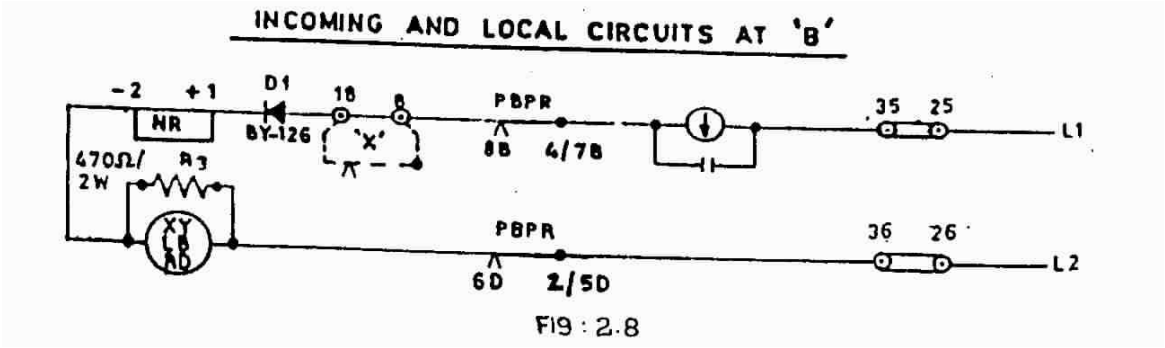


Fig : 2.8

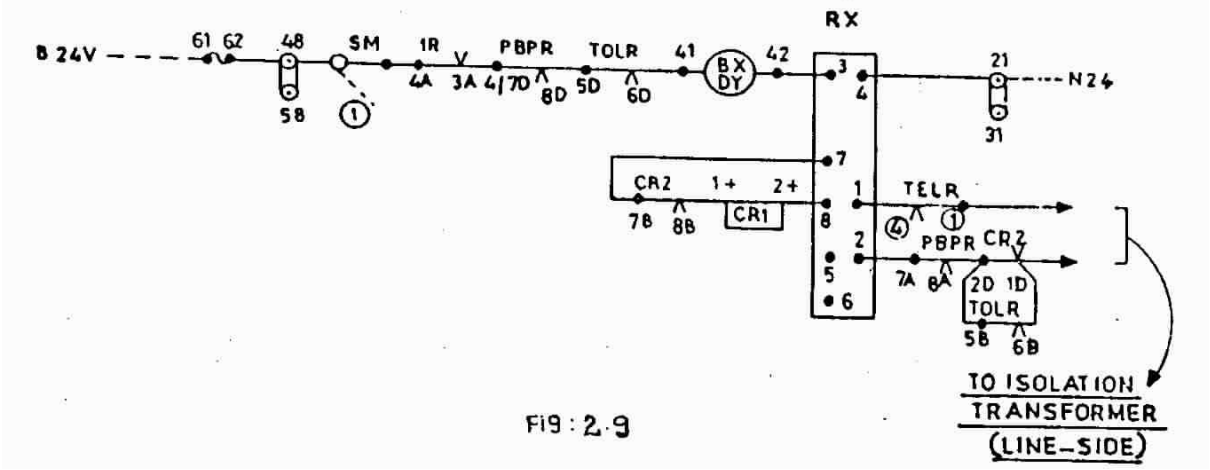


Fig : 2.9

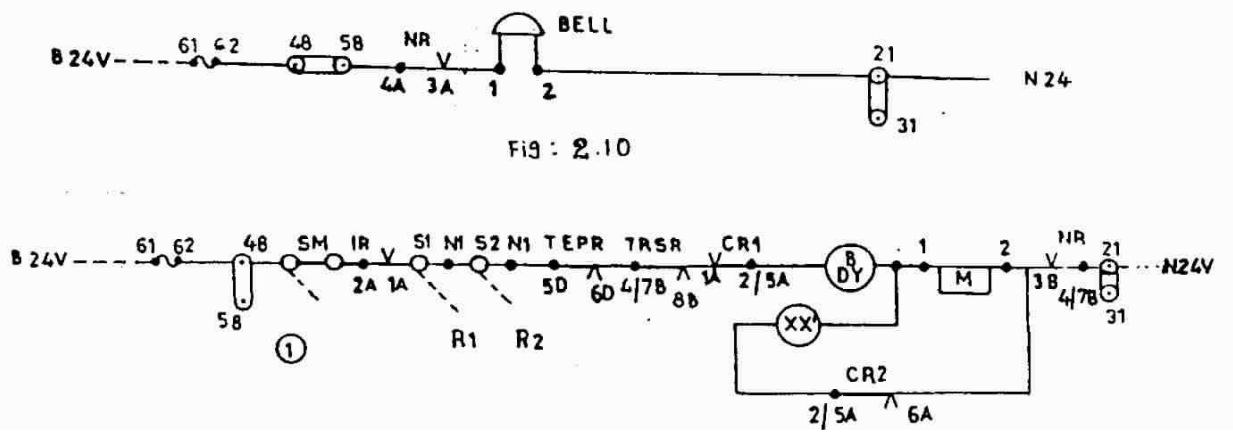
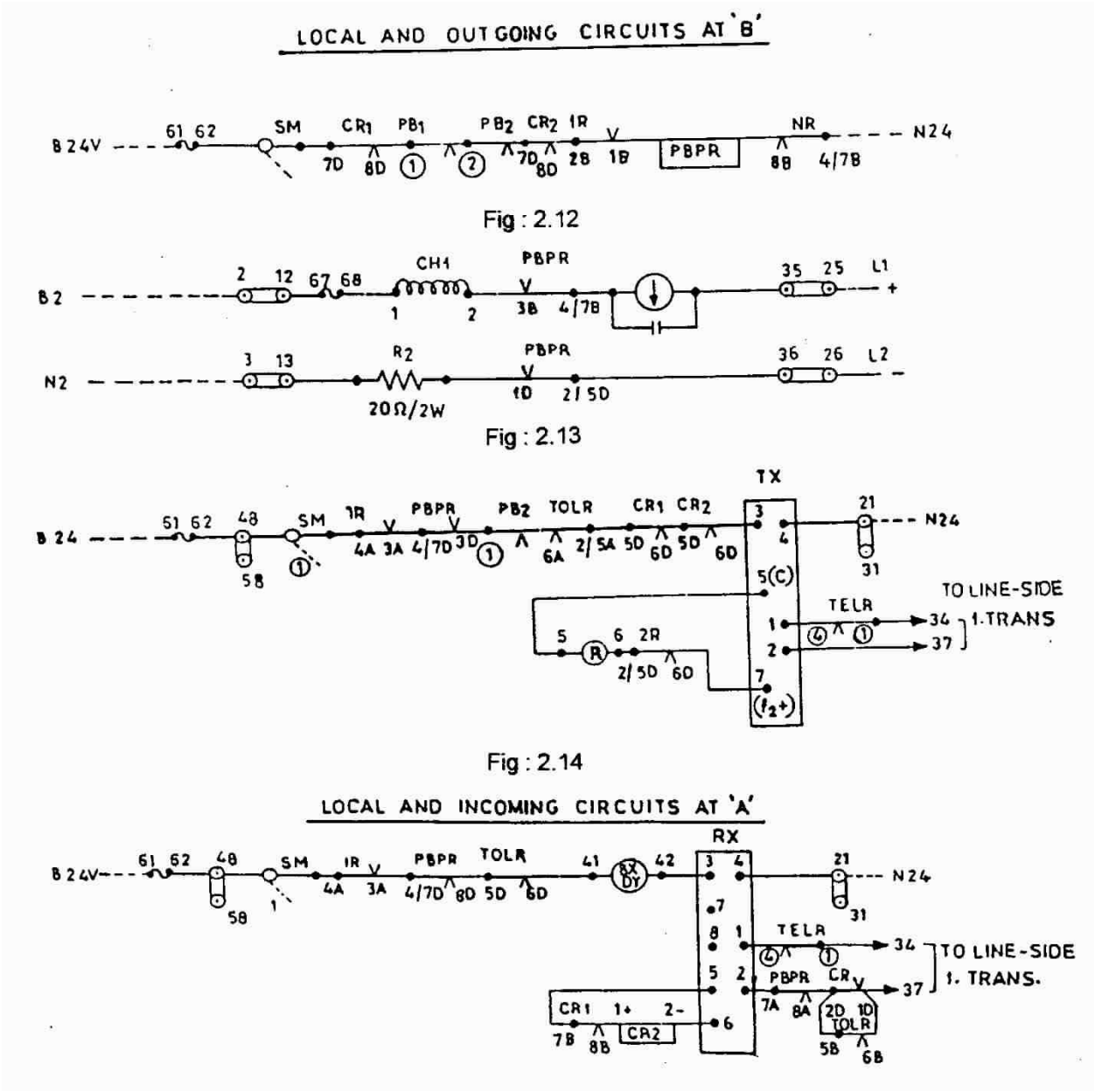


Fig : 2.10

Fig : 2.11

(e) Upon receipt of a modulated current F1, the receiving relay CR1 at Station B picks up (See Fig.2.9). As the bell rings one time at B station 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 (See Fig.2.11) B 24V Fuse (61-62)-terminals (48-58) SMK (ON)-IR (F)-S1 (N)-S2 (N) TEPR (B) - TRSR (B)-CR1 (F)-BDY-M-NR (F)-Terminal 21-N 24V. 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 (See 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 B station. Then PB1 and PB2 at A station may be released. (The same procedure is followed in operating the handle as described later)



(f) After confirming that the pointer of Galvanometer G has returned to zero position (indicating that A station has stopped sending a code of signal), PB1 and PB2 are now simultaneously pressed at B station to send a code of signal to A station. In this instance, the same circuit as described in Fig:2.4 operates. However 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 (See Fig. 2.12, 2.13, 2.14 & 2.16)

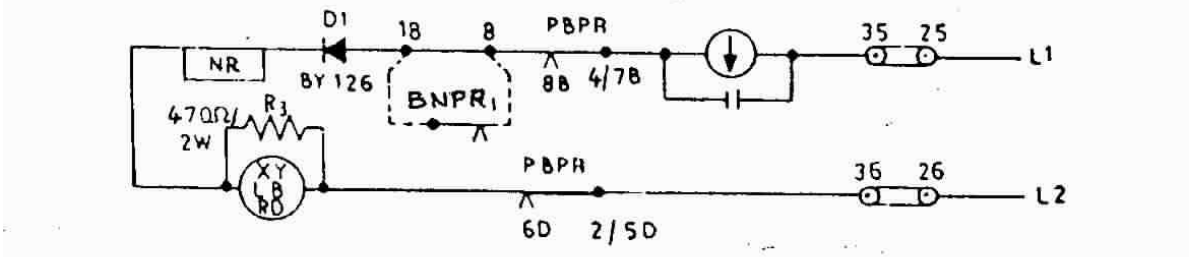


Fig : 2.16

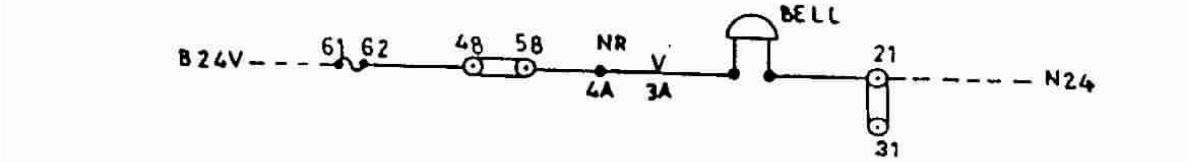


Fig : 2.17

(g) Upon receipt of a direct current (+) and a modulated current F2 the NR and CR2 at 'A' station pick up, with the bell ringing one time because of the NR picking up. Turning the block handle as far as to the X point at this time causes the TRSR to pick up through the following circuit (Fig.2.18) B 24V-fuse (61-62) terminals (48-58) 3R (B)-CR2(F)-NR (F)-1TPR(F)-XX'-TRSR-Terminals 21 -N 24V and further it sticks through its own front contact. With the TRSR picking up, the handle can be released and turned to left position (TGT position) through the following (fig.2.19) B-24V 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 B 24-fuse- terminals (48-58)-3R (B)-TRSR (F)-1TPR(F)-LX'-TRSR-Terminal 21-N 24V.

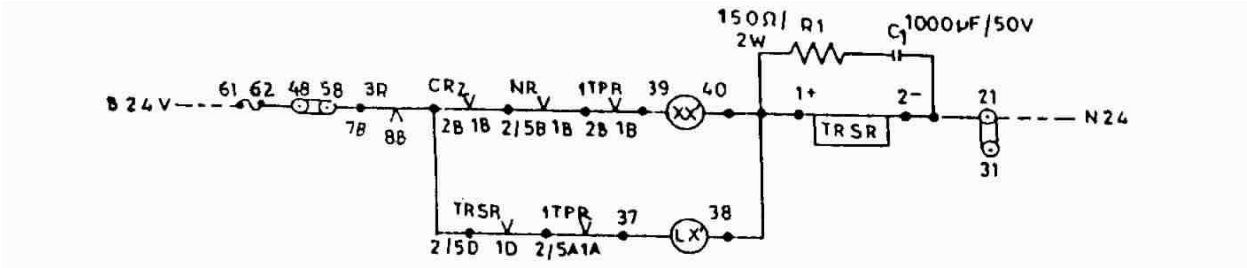


Fig : 2.18

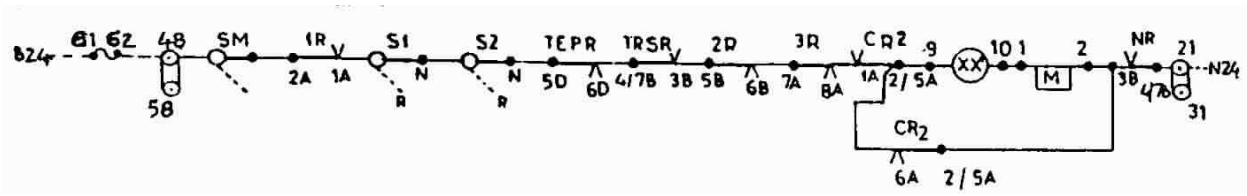


Fig : 2.19

(h) Putting the SM slide in reverse position after turning the block handle to left position causes a relay 1R to drop away. An advance starter control relay ASR picks up through the following circuit (Fig.2.20) B3 12V-fuse (65-66) 1R(B) - 2R(B) -TRSR(F) - S1N LA Terminals (53-43)-HSR(B)-ASR-N3-12. With the ASR picking up, a circuit outside the instrument is completed making it possible to take off the Last Stop Signal.

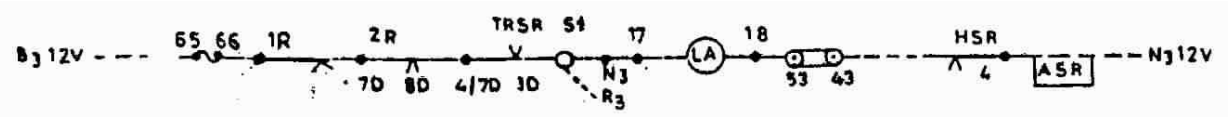


Fig : 2.20

(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 Last stop signal to normal (ON) position automatically.

(j) With the 1TPR dropping away, on the other hand, the TRSR also drops away (Fig.2.18). The TRSR having slow release characteristics, however, picks up TOLR through the following circuit (Fig.2.21) B 24-fuse (61-62)-Terminal (48-58) 3R (B)-TRSR (F)-1TPR(B)-LB-TOLR-Terminal 21 N 24. When TRSR drops after the time lag, TOLR sticks through the following circuit B 24-fuse (61-62) terminal (48-58)-3R (B)-TRSR (B)-NR(B)-TOLR(F)-S2 (N)-LB-TOLR-terminal 21-N 24. 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 Last stop signal lever is restored to normal position.

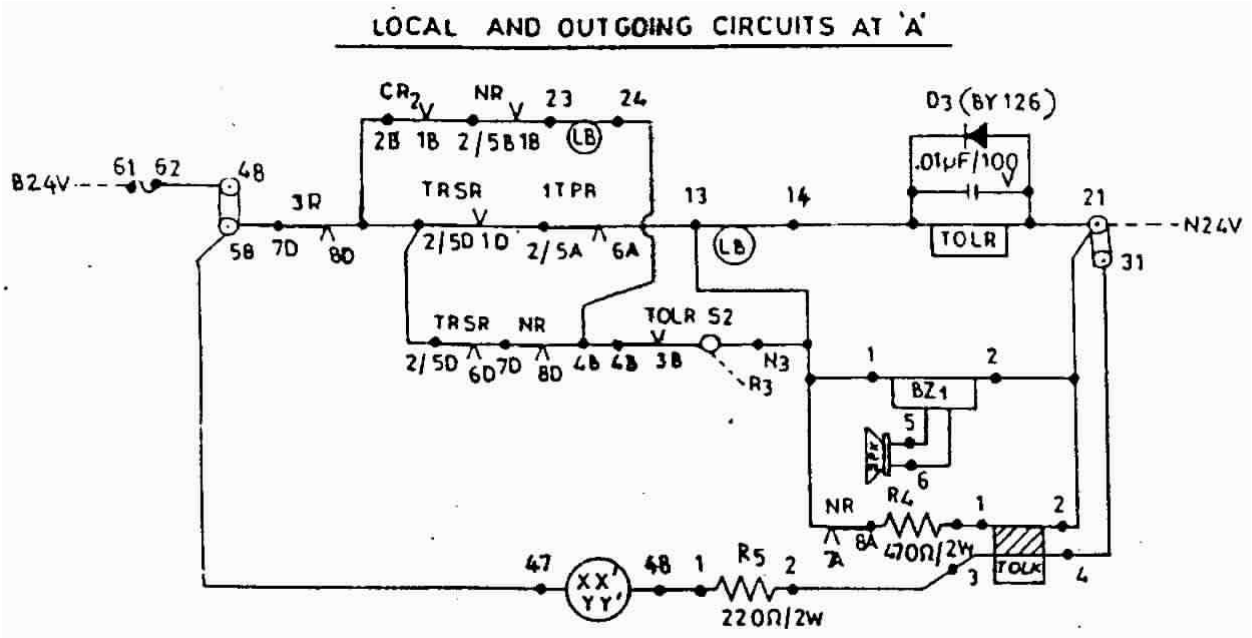


Fig : 2.21

(k) With the TOLR picking up, a source voltage is applied to the TX through the following circuit (Fig.2.22) B 24-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).

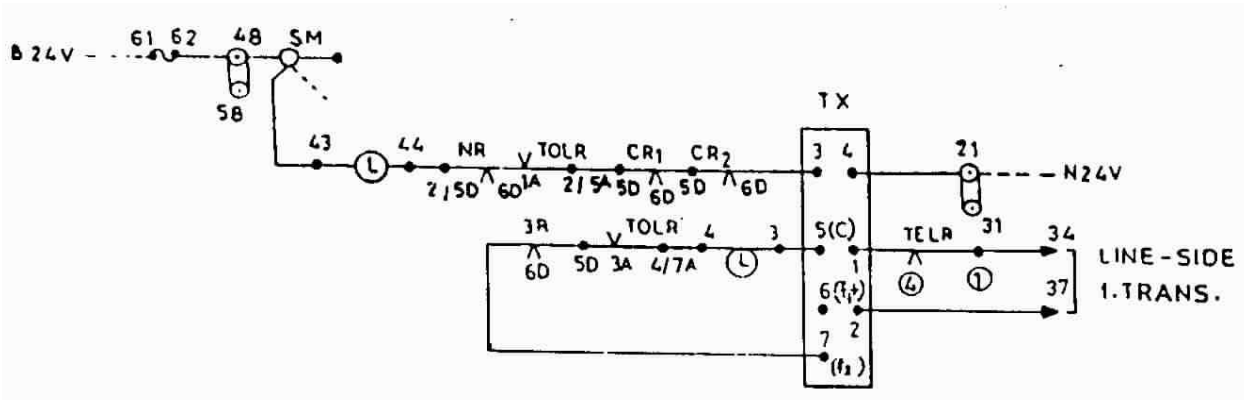


Fig : 2.22

(l) With a modulated current F2 being received at B station, the CR2 picks up (Fig.2.23) because the RX power source is connected through B 24-fuse (61-62). Terminals (48-58)-2R (B)-R, causing the TOLR to pick up (Fig.2.24)through a circuit B 24-fuse (61-62) - Terminals (48-58)-3R(B)-CR2(F)NR(B)-RD-TOLR-Terminal 21-N 24, with the TOLK and BZ1 operating through the same circuit as in A station to give an indication of train departure.

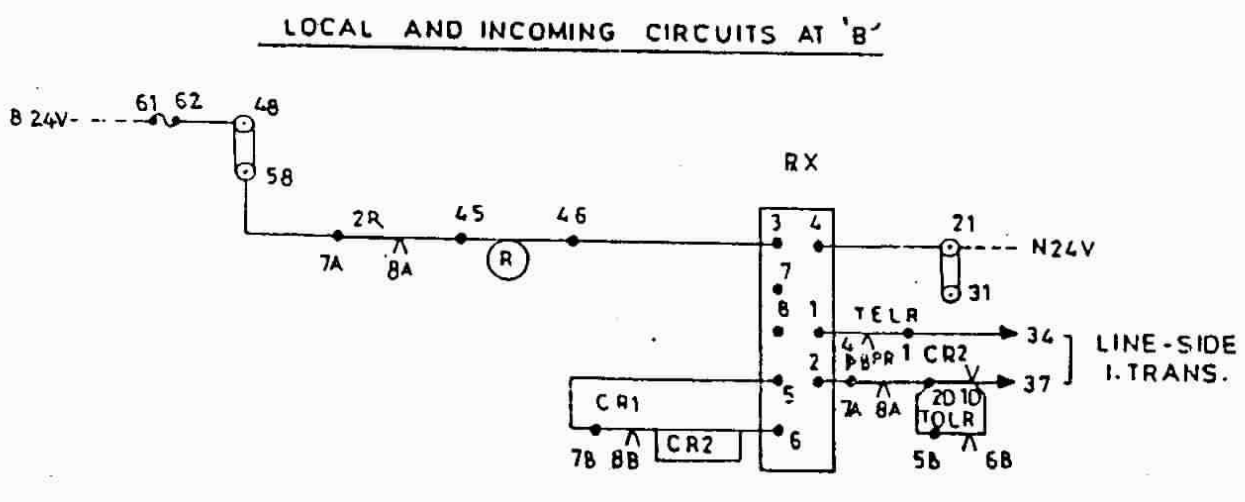


Fig : 2.23

(m) For acknowledging the TOL Buzzer push button PB1 is pressed at B station. The PBPR at B station 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 direct current (+) flows to A station through the same circuit as described in. (Fig.2.6) causing the NR at A station to pick up, (Fig.2.8) with the power circuit of TX being broken, no modulated current flows from A station to B station and CR1 and CR2 at B station will not pick up.

(n) With the NR at A station 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 stick type, however, 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 B station 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).

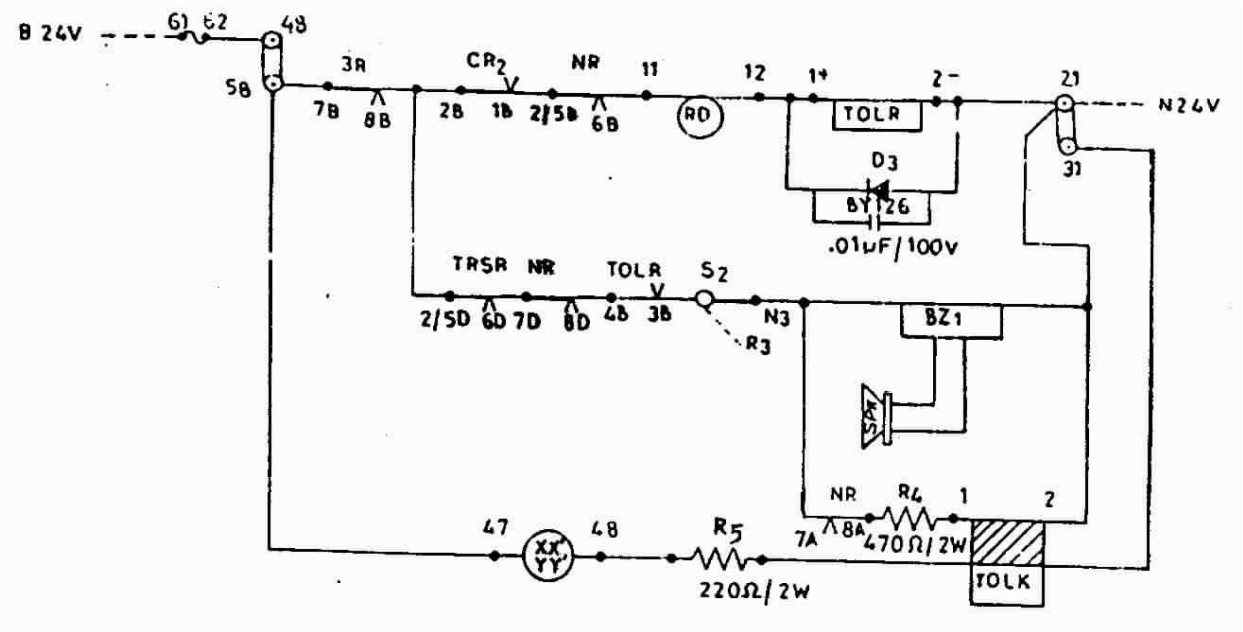


Fig : 2.24

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

(p) The home signal is taken off at B station. With the home SM slide being in reverse position and the 1R dropping away (1R back contact is looped in instrument in HSR and 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) B3 24V-fuse (65-66) 1R (B) or looped 2R (B)-TRSR (B)-S2 (N)-RD/XY terminal (54-44)-ASR (B)-HSR-N3 24V.

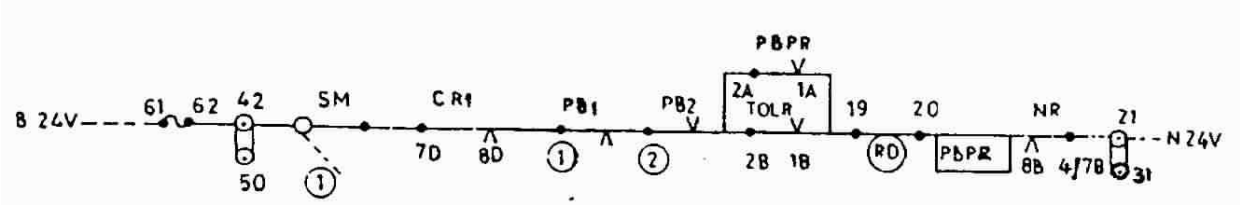


Fig : 2.25

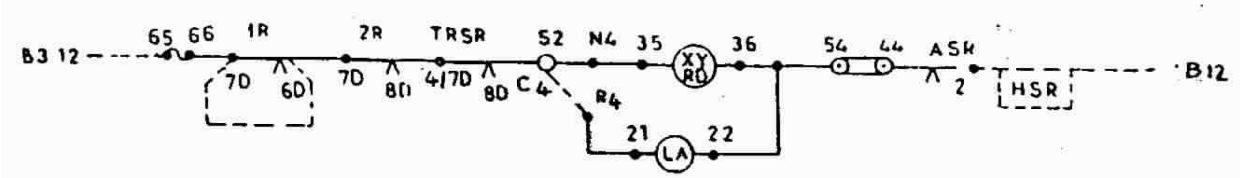


Fig : 2.26

(q) When a train reaches B station, the T_2R picks up and a relay 2R picks up through the following circuit (Fig.2.27) to stick through LX/RY B 24-fuse (61-62)- terminals (48-58) and (7,17)-TAR (F)-Terminals (57-47) LX'/RY' - 2R- Terminal 21-N 24. With the relay 2R picking up, the HSR drops away and the Home Signal is automatically restored to normal position. At the same time, a Buzzer BZ2 produces a buzzing sound to tell the train arrival. Restoring the HS, SM slide to normal position causes the BZ2 to stop buzzing.

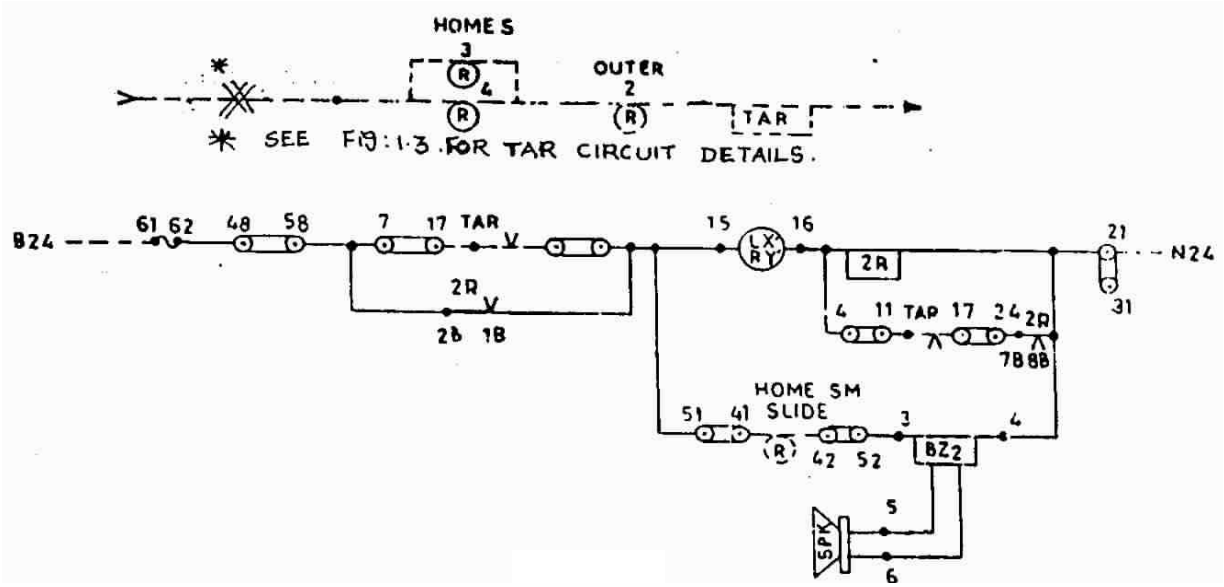


Fig: 2.27

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

(s) As the keying circuit for TX (Fig2.28) which is TX5-R-2R(F)-TX6 is for a modulated current F1, a direct current (+) and a modulated current F1 flow to A station. NR picks up through the same circuit as described in Fig2.16 earlier at A Station, 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; B 24 fuse-(61-62)- Terminal (48) - SMK (ON)-1R (F)-PBPR (B) -TOLR (B)-BX/DY RX3-RX4- Terminal (21)-N 24.

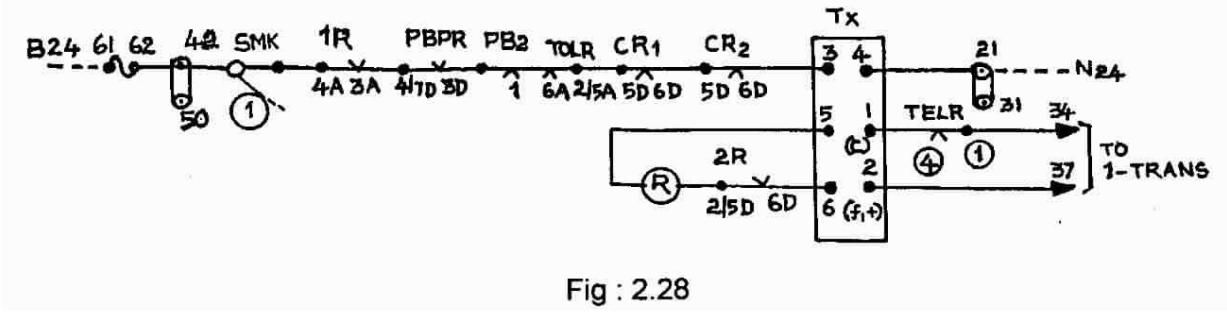


Fig : 2.28

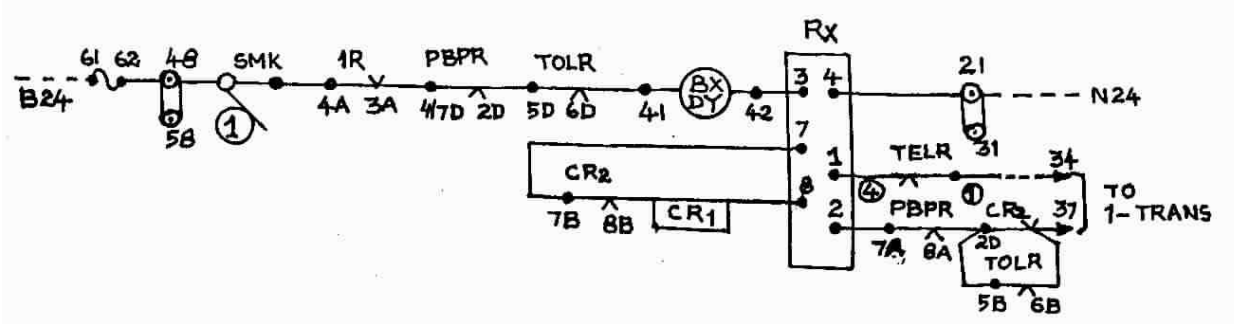


Fig : 2.29

(t) With the NR and CR1 picking up, Lock Magnet M is energized the handle lock magnet circuit … B 24V-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 N-24V (Fig2.30) making it possible to restore the handle to normal position. TOLK in turn is energized and restored to normal (Fig.2.31).

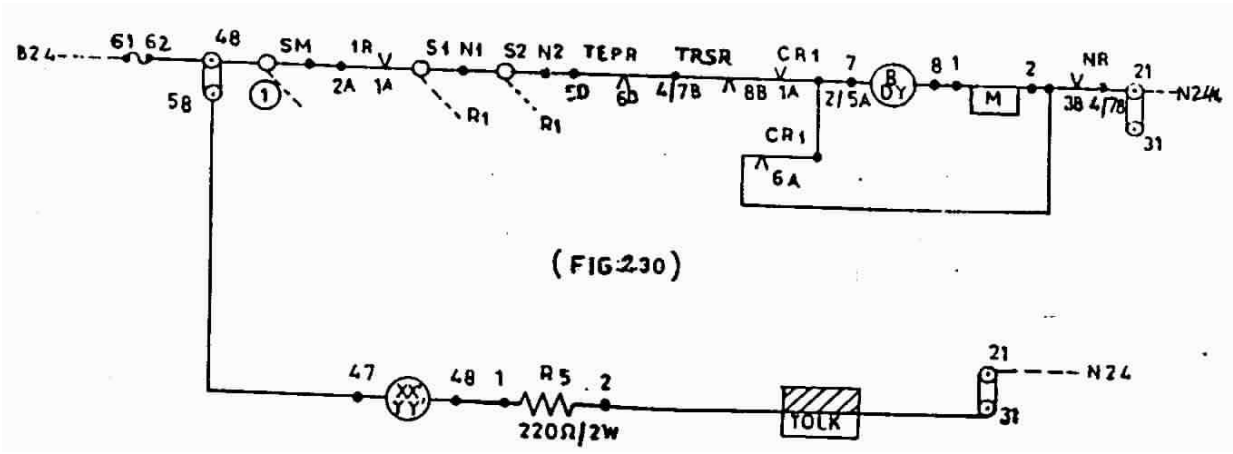


Fig : 2.31

(u) Pressing down PB1 and PB2 at A station causes a direct current (+) and modulated current F1 to flow to B Station. NR picks up at B station, causing a bell to ring (Fig.8 & 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 B station from A station.

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

(a) The block handle in A station in ‘L’ position (TGT) with all the signals and signal - levers concerned being in normal position. Block handle at B station is in ‘R’ position (TCF) with all the signals and signal lever concerned being in normal position.

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

(c) The cancellation switch S1 is put to reverse position at A station. 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 energisation 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.

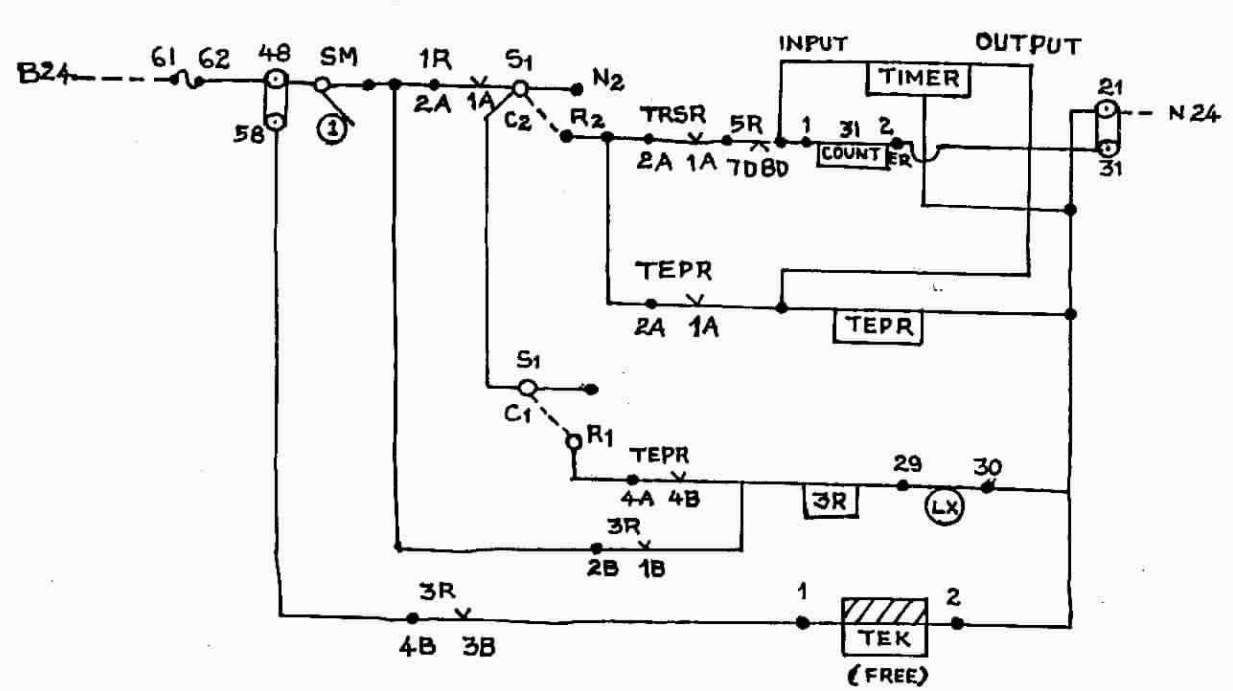


Fig : 2.32

(e) A cancellation signal is issued from A station to B station. Push button PB1 and PB2 are pushed at A station 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. Direct current (+) and a modulated current F1 flow to B station.

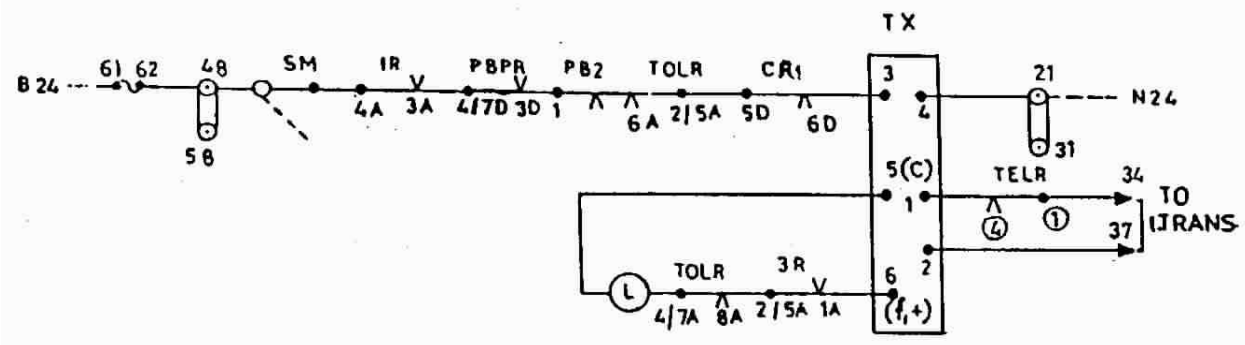


Fig : 2.33

(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 and PB2 are pushed down at B station to issue a code signal to A station. The signal sent in this case, which is the same as aforementioned, is direct current (+) and a modulated current F1. Upon receipt of the signal at A station after the cancellation switch S1 has been restored to normal position, the block handle is restored to normal position at A station.

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

In this instance, the block handle at 'A' station and 'B' station 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 'A' station actuates the counter S2 through a circuit of B 24 fuse-(61-62)-Terminal (48)-SMK(ON) - S2(R)counter-LX Terminal 21-N 24 (Fig.2.34).The home signal lever is put to reverse position at A station. In this instance the home signal is taken off position through the control circuit of HSR which is as follows: B3 24-fuse (65-66)-1R (B) or looped -2R(B)-TRSR(B)-S2(R)-LA-Terminal (54,44)-ASR (B)-HSR-N3 24 (Fig.2.26).

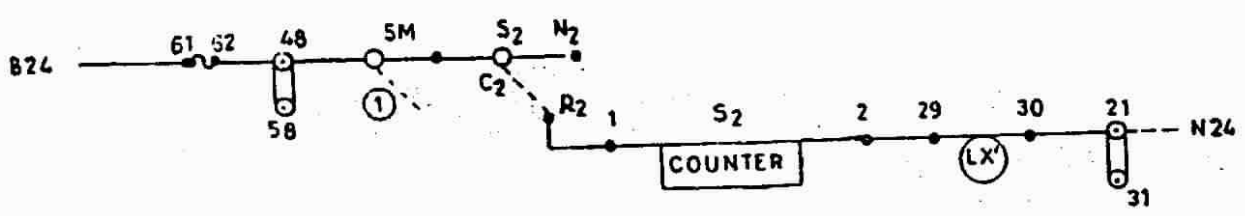


Fig: 2.34

(b) Upon arrival of the pushing back train to 'A' station, the Home Signal is restored to normal position automatically through the same circuit as described in Fig 2.26. With 2R picking up and the arrival buzzer BZ2 producing a buzzing sound, putting the home's SM slide to normal position causes the buzzer to stop buzzing.

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

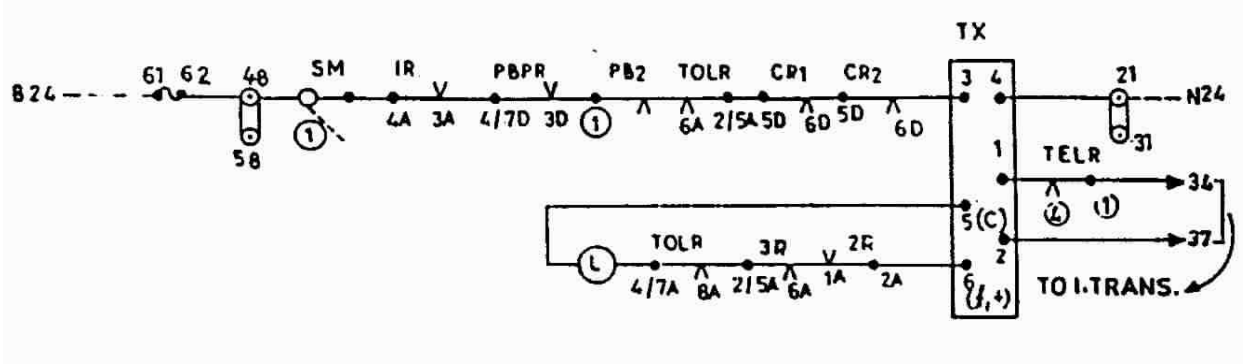


Fig: 2.35

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

2.6 When a train is shunting in advance of LSS (At 'A' Station)

(a) When the block handles are in normal position at both at 'A' station and 'B' station.

(i) 'A' station calls 'B' station to obtain authorization over the telephone.

(ii) After the SM key has been turned, the SH key is turned and pulled out to be handed over to the driver of a shunting train. The block handle is locked at this time. The SM key is pulled out. Upon finishing a shunting operation, the SH key is returned to the Station Master, who after inserting and turning the SM key inserts the SH key and turns it to normal position, notifying B station over the telephone to that effect.

(b) When the block handles at 'A' is in 'L' Position and at 'B' is in 'R' Position.

The facility of Shunting after the running Train for which line clear has been obtained enters the Block Section is available

(i) A station calls B station to obtain authorization over the Telephone.

(ii) After the SM key has been turned, the SH key is turned and pulled out to be handed over to the driver of a shunting train. The block handle is locked at this time. The SM key is pulled out. Upon finishing a shunting operation, the SH key is returned to the Station Master, who after inserting and turning the SM key inserts the SH key and turns it to normal position, notifying B station over the telephone to that effect.

2.7 Telephone Circuit

While modulated current 85Hz or 65Hz 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.

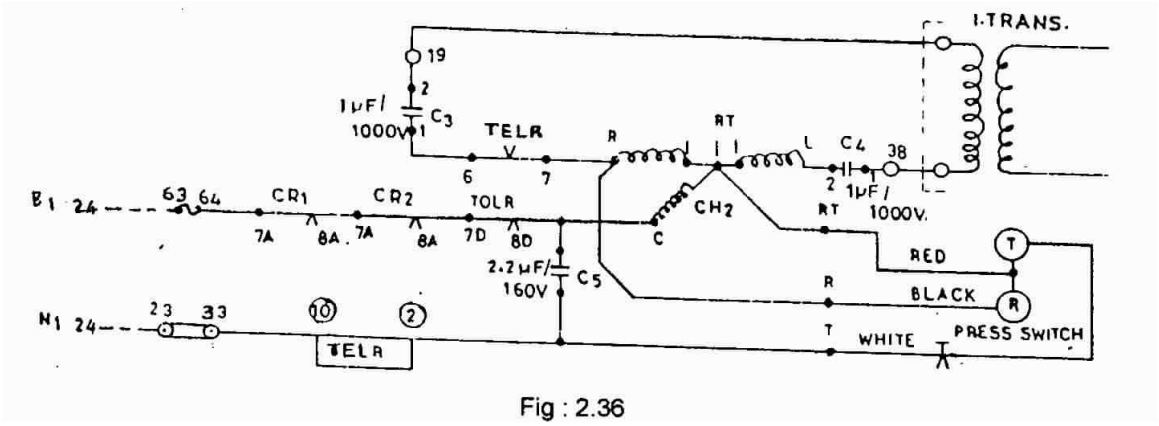


Fig : 2.36

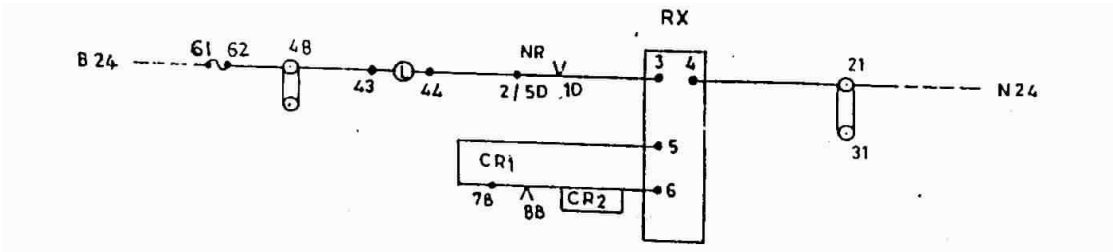


Fig : 2.37

2.8 SALIENT FEATURES OF THE CIRCUIT

(a) To ensure that relays 'NR' and '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, whereas back contact has been proved in the Receiver circuit to guard against receiving its own FM output modulated frequency transmitted by the same instrument. Similarly, back contacts of' CR1' and '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 energies '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 energies 'CR2' relay, and similarly back contact of CR2 relay is provided to energies CR1 relay.

(i) Cross protection to the lock magnet coil is given through 'CR1' and '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' and ' 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 energies TOLR again after the acknowledgement which is effected by breaking the stick circuit of TOLR.

(m) It may so happen that PB1 and PB2 buttons 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 energies 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 - vide Para 2.9.

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

(o) To ensure heater circuit of the "Time Element Relay" not to be kept no longer than what is necessary TER' relay is energized through the back contact of 'TEPR' relay on energisation through TER hot contact and held by its own contact. Thus as soon as 'TEPR' relay is energized TER relay de-energizes. Cold contact of 'TER' relay is proved in the 'LOCK' magnet 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.

2.9 Special Circuit Arrangement to establish TOL Indications

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

Vide item 13 under 2.8.Pressing of push-button PB1 and PB2 at ‘B’ station immediately before Train enters the FVT of ‘A’ station does not interfere with the display of TOL indications which is effected through the operations as described herein below:

(a) While the push button PB1 and PB2 are being pushed down at B station a direct current (+) and a modulated current F2 are transmitted as aforementioned to ‘A’ station. IN this state, the NR at A Station picks up.

(b) When a train enters the FVT of A station, the TOLR at A station 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 however, the NR has already picked up at A station, the power circuit of RX is completed as follows causing the CR2 at A station to pick up (Fig.2.37) B24-fuse-(61-62)-Terminal (48) - L-NR (F) RX (3)-RX4 terminal (21) N 24. 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, no sooner a train enters the FVT than the TOL indication is displayed at ‘A’ station.

(d) The TOL code signal is not transmitted, as the power circuit for Transmitter TX at 'A' station is broken because of the NR picking up and the TOL indication is not displayed at B station because of the TOLR dropping away while push buttons PB1 and PB2 are being pushed down.

(e) Releasing the PB1 and PB2 at 'B' station in this state results in the PBPR dropping away, causing the transmission of a direct current (+) to be stopped, so that the NR at 'A' station drops away. With the NR dropping away, the stick circuit for TOLR is completed with a concomitant completion of the power circuit for transmitter TX at A station so that a modulated current F2 is Transmitted to effect a display of TOL indication at B station.

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

* * *

CHAPTER – 3: FREQUENCY MODULATION - TRANSMITTER AND RECEIVER

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

(b) Frequency modulation

(c) Phase modulation

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 closely (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 signal (i.e. information or the intelligence 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 (intensity) of the modulating signal.

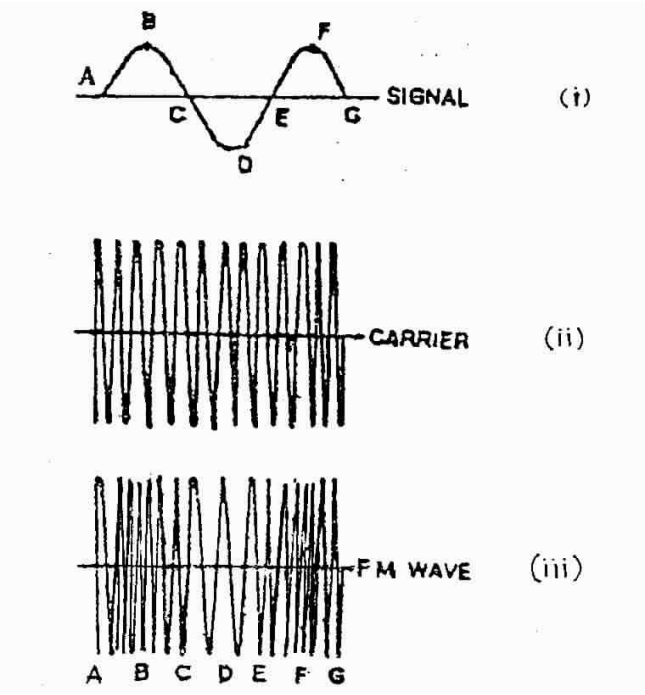


Fig: 3.1

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, FLT, 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 AKGEI - MODEL - M5

Transmitter and Receiver (Model M-5) for FM Token less Block Instrument as per Drawing Nos: 103/68A & 103/67A respectively of A.K.G .Electronics Industries are used.

INTRODUCTION:

AKGEI make frequency modulated transmitter and receiver model M5 is based on CSTE, Eastern Railway's Specification. The model has been approved and passed by CSTE, Eastern Railway to work with FM token less block instrument.

The transmitter and receiver unit is designed to work at 24 V.DC with input supply variation between 19.2 V and 28.8 V with the carrier frequency 2700\1800 cycles per sec. and modulated frequency 65/85 cycles/sec. The maximum power consumption of transmitter and receiver are 1.2 W and 8 W at 24 V.DC respectively. Test points are provided in the back of the equipment's 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 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 transmitters and receivers for 2700 Hz are provided with blue colored name plates spotting even Nos. and those for 1800 Hz are provided with Red colored name plates spotting odd numbers.

Besides, the transmitter/receiver of AKGEI make (Model-M5) has been type approved including the environmental severity tests conducted by RDSO, Lucknow, which makes the Model (M-5) trans. receiver sets, fit and safe for use in single line train operation system.

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

3.4 SPECIFICATION

3.4.1 TRANSMITTER

Supply voltage	24 V.DC, + 20%, - 20%
Carrier frequency	1800 C/S, 2700 C/S, + 2%
Modulated frequency	65 C/S + 1.5 C/S
Modulated frequency	85 C/S + 1.5 C/S
Shift frequency	+ 15%
Power consumption	1.2 W at 24 V.DC

3.4.2 RECEIVER

Supply voltage	24 V.DC, + 20%, - 20%
Carrier frequency	1800 C/S, 2700 C/S, + 2%
Modulated frequency	65 C/S + 1.5 C/S
Modulated frequency	85 C/S + 1.5 C/S
Shift frequency	+ 15%
Power consumption	8 W. Max. at 24 V.DC

3.4.3 General (Normal 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's 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 (65 C/s) No voltage minimum 21V. Modulation frequency 85 Hz Minimum 21V. No voltage.
Operating temperature range	O^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 Kgs.(Approx.) Receiver - 6.5 Kgs.(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 and 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 meg ohms at 500 V.DC.

3.5 DESCRIPTION

3.5.1 Input & Output terminals

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

Terminal No. of coupler	Transmitter	Receiver
1	Output	Input signal
2	-do-	-do-
3	+ VC DC	+ VC DC
4	- VC	- VC
5	Common	CR1 Voltage (+)
6	85 Cycles	-do- (-)
7	65 "	CR2 Voltage (+)
8	Spare	-do- (-)

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 and receiver as follows:

Transmitter:

+	+				
O	O	O	O	O	O
24V	11.5V	65 Hz	85 Hz		Output
O	O	O	O	O	O
U/Reg	Reg	Mod/	FQCY		Carrier

Receiver:

		+	+		
O	O	O	O	O	O
24V.		Input	Den	CR1	CR2
O	O	O	O	O	O
U/Reg	Reg.				

The above terminals are provided exclusively for measurement purpose and not for drawing any external connections. Test points are provided with cover and sealing facility.

3.5.3 FUSE, SWITCH, & INDICATION

TRANSMITTER

The transmitter is provided with two switches to select the output level and output impedance in three and two ranges respectively. Six Red LED indications are provided to display respective positions of both output level (1mW, 3mW, 5mW) and output impedance (600 ohms, 1120 ohms) corresponding to the position of level switch and impedance switch. These two switches and six LEDs are provided with facility of seeing. Another red LED is provided for the indication of power supply 'ON'. All these LEDs are connected through a 'Push to ON' switch. The input fuse is located at the rear side and it is easily accessible.

RECEIVER

The receiver is provided with two selector switches on the front panel to simulate 0-28 dB attenuation at 2 dB change per step. The two selector switches are coupled with a toggle switch which connects 0-16 dB on the left side and 18 dB-28 dB on the right hand side. If the toggle switch is placed on left side 0-16 dB scale is connected to the circuit. Similarly, when the toggle switch is switched to right hand side 18 to 28 dB is connected. Three LED indications have been provided viz. Red for input power supply, Green for relay pick up condition and Yellow for de-energised condition of the relay. All three indications are available when a press switch in the front plate is pressed. The input fuse is located at the rear side and it is easily accessible.

BLOCK & LEVEL DIAGRAMS

The functional block and level diagram of both transmitter and receiver is very straight forward and easy to understand. All the E core and pot core ferrite transformers which have been used in the circuit are indicated as E4, E5, E6, E7 & P1,P2,P3,P4,P5 & P6 etc. and they perform different functions in the respective circuits.

BLOCK & LEVEL DIAGRAM OF TRANSMITTER (TX)

Let us explain in brief, the block and level diagram of transmitter (TX). The oscillator generates the keying frequencies 65 Hz/85 Hz with the help of E4 in conjunction with (CT) the tuning capacitors, where as the carrier frequency 1800\2700 Hz is generated by P1. Now the keying frequency and the carrier goes to modulator where frequency modulation is performed. The total FM signal goes to the output stage through a coupling transformer P2. The output stage comprises of an isolation transformer P3, which is connected to two conductors, which in turn is connected to proper receiver, and the other part is connected to some indicator circuit to show the level of output power and the impedance levels for which 6 LEDS mounted on the front panel of TX have been used.

BLOCK & LEVEL DIAGRAM OF RECEIVER (RX)

The output of transmitter now becomes the input to receiver (RX). The received signal now passes through the automatic signal processing stage and isolation transformer P4 and goes to automatic level control circuit (ALC)\Band pass filter circuit via an attenuator pad (0 db to 28 dB) range.

The processed signal now goes to amplifier for initial and proper amplification before it is decoded/discriminated by a tuning circuit/decoding circuit.

The decoded received signal which is 65\85 Hz again goes to final amplification in stage and subsequent stage which is called the lower deck where 2 orgo transformers and two relays associated with rectifier circuits process the decoded signal to drive the respective relays as per received signal.

The beauty and the logic of the circuit is such that both 65 Hz and 85 Hz are never processed at a time and thereby it is definite that both CR1 & CR2 do not pick up at a time.

A part of the final output signal is sampled by a comparator circuit to indicate the level of the received signal which is sufficient to drive the relay or not. A green LED gain margin H will glow which is mounted on the front panel of the Rx if PTM switch is pressed.

If the signal is insufficient to drive the relay or no received signal is there another LED will glow instead of green LED.

3.6 TROUBLE SHOOTING - METHOD FOR TX/RX - M5

Apparatus

Analogue Multi meter, Frequency counter, O to 30V range power supply 2 Amp.CR1 & CR2 relay (QN1).

The system should be mounted in a test gauge or working instrument. If there is no output from receiver (RX), check if the supply is OK by pressing push to make switch both in your Tx & Rx which have power on indicator Red LED. If the LED does not glow, check the fuse. If the fuse is missing/block up, replace it.

If power OK, LED OK, Relay does not pick up, press the PTM switch which is on the front panel and see if the level indicator green LED glows or not. If GREEN LED glows, that means your relay driving signal is OK - problem is with the respective relay, so replace it and get the desired result.

If the level indicator Amber LED glows:-

The relay driving signal is missing, so you check the following:

(a) Input to the Rx between 5 & 6 + 10V to + 13V P.P. &
7 & 8, + 1.5V to 2.5V P.P. 9 & 10
or 11 & 12, + 21.6 to 26V DC.

Ref.Drg.No.103\58\1
(Rx test terminal wiring diagram)

If the above voltage signals are not regular/proper, you have to open the cabinet and follow the signal flow as per the drawing Ref.No.103\67A (Schematic Rx) and check the voltages as indicated. In all cases, try to follow the LEGENDS as given in the schematic Drg.No.103\67A & 103\65\A and follow the circuit description as given.

Similarly (b) follow the voltage/signal levels as indicated in the Drg.No.103\59\1 and 103\68\A for TX trouble shooting.

3.7 CIRCUIT DESCRIPTION FOR TX/RX

TRANSMITTER: (Ref.Drg.103\68A)

The transmitter circuit consists of a regulated power supply unit 85\65 cycles modulation frequency oscillator unit, switching unit, a carrier frequency oscillator unit and an output circuit for impedance matching.

The unregulated supply is fed to the regulated power supply circuit through R/P coupler (3 & 4) and fuse employing transistors Q1, Q2 and IC1 to give a regulated output of 12 V +0.5 V with short circuit and overload protection over the entire input voltage range.

The 85\65 cycle modulated frequency is generated by employing transistors Q3, Q4. Oscillating transformer E4 and tuning condensers. The output of E4 becomes a sine wave by tuning it to its primary by tuning capacitors for 85\65 cycles. The output of the oscillator unit drives the switching circuit employing transistor Q5 and transformer E5. The transformer E5 and primary of P1 along with the tuning capacitors select the modulation index and provide necessary filter.

The transistor Q6, transformer P1, and P2 gives the carrier oscillation superimposed with modulated frequency. The carrier oscillator is tuned to 2700\1800 cycles by tuning capacitors. The secondary of P2 gives the modulated frequency output.

The output circuit employing transistor Q7 and output transformer for impedance matching gives the ultimate transmitter output through R/P coupler (1 & 2).

The output power of the transmitter is controlled by adjusting the emitter bias.

RECEIVER: (Ref.Drg.No.103\67A).

The receiver unit incorporates a DC regulated power supply unit. Automatic signal processing (ASP) unit, attenuator unit, amplifier/limiter unit (PS\ALS) discriminator unit decoding unit and output circuit unit.

The unregulated power supply is fed to the regulated power supply circuit through R/P coupler (3 & 4) and fuse employing transistors Q1.Q2 for 17V. output and IC1 for giving 12V, output with short circuit and overload protection over the entire input voltage range.

The line input from the Transmitter output end is fed to receiver input through R/P coupler (1 & 2). The signal is passed through an automatic signal processing unit to restrict noise and spikes - the output of which is passed through an isolation transformer P4 followed by 0 - 28 dB attenuator unit.

The signal after attenuation passes through frequency selective automatic level control unit (FS\ALC) which maintain its output to a maximum and minimum level automatically with 0 - 28 dB attenuation so that stable operation of the subsequent stages is maintained.

The output of FS\ALC unit passes through the discriminating stages employing transistors Q3, Q4 and transformer PS, P6 to discriminate the carrier frequency and modulated frequency along with tuning capacitors.

The discriminator output processed through filter capacitors is fed to the decoder circuit employing transistors Q5 to Q11 and transformers E6, E7 for selecting 65\85 Hz. modulated output.

The output of the decoder circuit is fed to two CRGO transformers (8 & 9) to get the ultimate output. The secondary of the output transformers passes through some relay circuit, bridge rectifiers, filters etc. gives the DC output for the operation of CR1\CR2 relays. The relay logic is maintained by sensing the decoder output at the output transformer and passed through a sense logic circuit. The margin logic circuit is a comparator circuit to sense the operating level of the relays with visual indication.

* * *

CHAPTER – 4: MODIFICATIONS IN 25 KV RE AREA

4.1 Normally the transmitter/receiver circuit (FM Signals) is superimposed on the same pair of line wires of D.C. circuit. In RE area it is worked on a pair of conductors of pet quad of main telecom cable and the D.C. circuit works on two phantoms derived from the pet quad.

Since diodes are used in the BLR and NR circuits, induced EMF under earth fault conditions will get rectified and affect these relays. Hence, to protect the BLR and NR from AC induced voltages, a block filter unit is connected between the block instrument and the line. External relays XR and YR are also used, as in the case of Neal's type token block instrument, to prevent energisation of the line relays due to momentary discharge of condenser in the filter unit. The block telephone is connected to the other physical pair of the PET quad.

The external connections to suite RE are shown in Fig. 4.1.

4.2 RDSO Modifications to Line Circuit

RDSO has examined different ways of reducing the operating voltage for the handle type tokenless block instrument to be used in RE area and suggested the following: vide their letter.No.S.1 S/WS-6 dt.2-4-91.

(a) Removal of Choke CH-1

Choke CH 1 is provided (in non-RE area) to prevent FM Signal getting affected by the local battery since both DC and FM signals are superimposed on the same pair of line wires. However, in RE area, since a physical pair is used for FM signal and a derived phantom is used for DC the choke CH1 does not serve any purpose. 'Removal of the choke will result in a reduction of 4 volts in the power supply in view of 100 mA current flowing through the circuit.

(b) Removal of Resistance R2

Short circuit protection resistance R2 (20 Ohms) may be dispensed with, since this protection is not required and is not, in any case, provided in other Block Instruments. This will mean, consequently, a reduction of 2 volts in the power supply.

(c) Elimination of diodes and - Filter Unit

In the existing circuit, both NR and BLR are of QBA1 type, each requiring about 100m.A. current. They are connected in parallel and blocking diodes D1 and D2 have been used to limit the current to 100 m A by giving feed to only one relay at a time. The use of these diodes has, however, necessitated the need for use of filter units, which are otherwise not required. In absence of filter unit the induced AC. voltage might result in rectified DC voltage due to the presence of the blocking diodes. This problem is now sought to be eliminated by the use of AC immunised 1000 ohms neutral relay instead of QBA1 relay for BLR. This will, however, result in increase of line current from 100 mA to 112 mA. In such case, filter unit can be dispensed with, resulting in overall reduction in the power supply. The circuit with this arrangement is as given in Fig .1.7.

Filter units will not be required up to length of 28 Kms of block section, provided proper precautions are taken for human safety. Implementation of recommendation (i),(ii) and (iii) above will result in to the total reduction of the line resistance to 40 + (4x90) + 20 = 420 ohms. Keeping in view, 10 % extra current now flowing in the line on account of removal of blocking diodes, the overall reduction in the working voltage will be about 35 V.

Replacement of two numbers of QNA1 relays for BLR and NR with one no. of Polar Relay (See Annexure 1,2,3&4) and relaxation for use of earth return circuit are also being considered by RDSO.

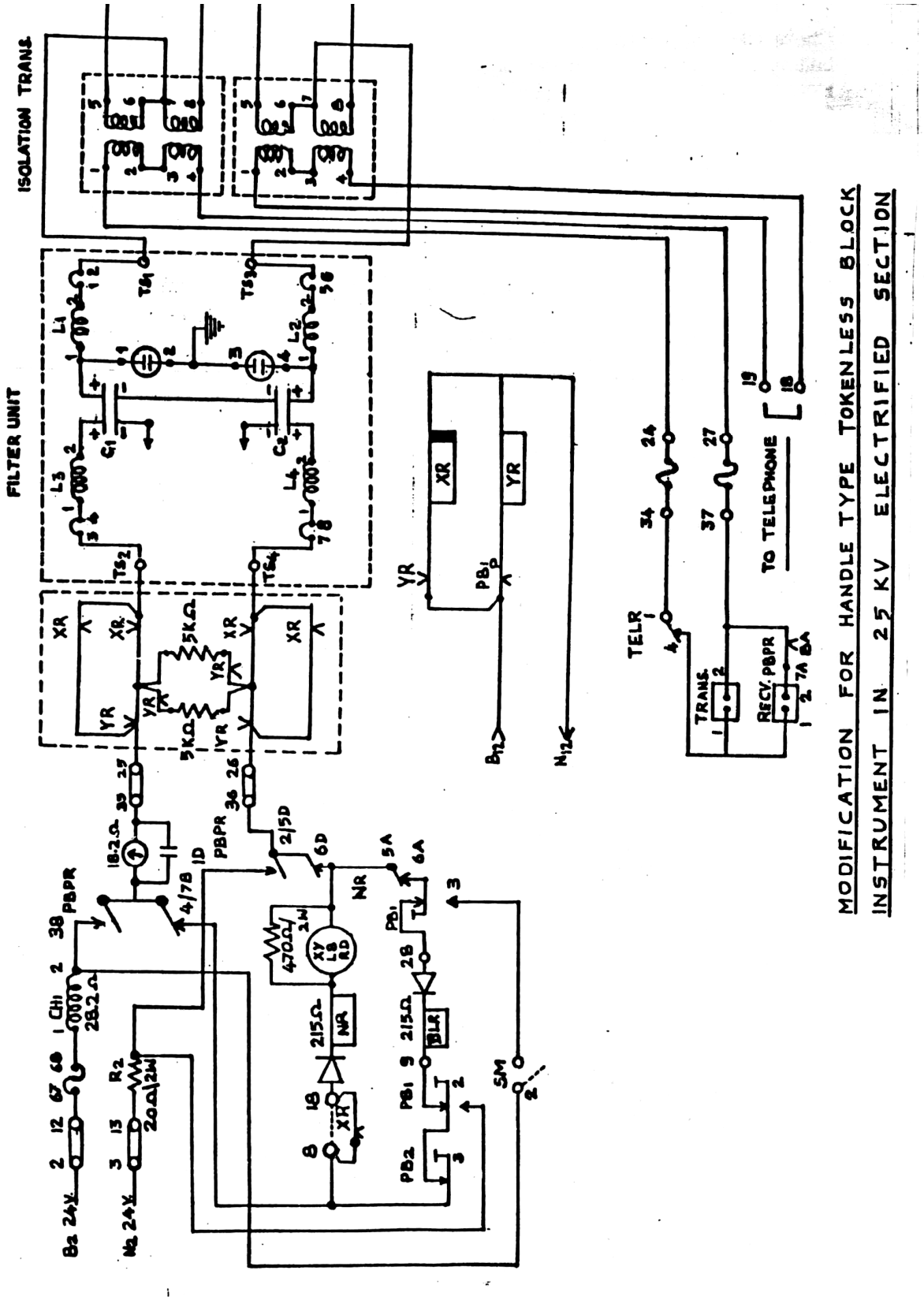

MODIFICATION FOR HANDLE TYPE TOKENLESS BLOCK
INSTRUMENT IN 25 KV ELECTRIFIED SECTION
ISOLATION TRANS.
FILTER UNIT
TO TELEPHONE
TRANS.
RECV. PBPR
TELR
PBPR
XR
YR
NR
BLR
SM

Fig.4:1

* * *

CHAPTER – 5: SPECIAL REQUIREMENTS AND GENERAL MAINTENANCE

Special requirements of Single Line 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, "Train Coming From" at the receiving station.

(c) When Line Clear for a train to leave a Block station has been received from the Block station ahead, "Train Going To" 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 Station Master at the other end of the section shall be necessary. Even with the cooperation of the Station Master at the other end, the Station Master has to go through one or more definite moving operations on the instrument in addition to working of bell plunger:

(a) before he can grant Line Clear to the Station Master at the other end of the section to release a token, or

(b) before he can obtain Line Clear and extract a token. (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 "Train Going To"/"Train Coming From" 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 Para 4.15.1. (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 "Train Going To" 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)

Additional requirements of Single Line Tokenless Block Instruments

5.6 Fixed Indications: In addition to the fixed indications specified in paragraph 4.13. the instrument shall be provided with means to indicate "Train On Line" 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 impulse/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 "Train Going To" and "Train Coming From": The instrument shall be such that even with the cooperation of the Station Master at the other end of the section, the Station Master 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 "Train Coming From"

(b) before he sets his instrument to "Train Going To".(SEM 7.151.1)

5.8.2 "Train On Line": Means shall be provided to ensure that the instruments are set to "Train On Line" 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 "Train Going To" or "Train Coming From" 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 "Train Going To"/"Train Coming From" 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 Para-4.23.1. (SEM 7.15)

General maintenance

(a) Each part shall be always 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. Number of counter operates 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 - 24 V.DC Output

(u) Receiver - Source voltage - 24 V.DC
Input voltage - 0.2 V to 1.0 V (with VTVM).

(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 volt min.

Tokenless working - DO's (For operating staff)

(a) Cabin man must always see that when putting back signals to 'ON' the Signal arms corresponds the levers otherwise the Block Instruments at both end may get locked.

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

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

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

(e) The Adv. Starter lever should always be pulled with slow start to release the lock in normal position. Where lever locks are provided.

(f) 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.

(g) In case of cancellation by switches it must be ensured that departure and approach signals at both ends are put back to 'ON' if already lowered to make the cancellation effective.

(h) Always see that the Telephone HMT is on the Hook at both ends are put back to 'ON' if every time before PB1 and PB2 are pressed simultaneously.

(i) The Home and outer signal levers must be kept pulled for reception of a train even in case of failure of Home signals slot or reverser. Non compliance will result in unnecessary failure.

Tokenless Working – DON'T s (for operating staff)

(a) Before starting any operation of the instrument do not fail to see that the S.M. key, S1and S2 switch are in proper normal position. All relevant signals are at "ON" & Levers normal.

(b) Do not pull any of the Home Signal or Advance Starter Signal lever 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 promptly the train entering section code or TOL, bell and indication.

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

(f) (i) Do not 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.

(ii) Simple rule:

Normal Operation (without S1or S2switch)	Sending station Normalizes first.	Receiving station Normalizes last.
Operation (with S1 or S2 switch).	Receiving Station Normalizes first	Sending Station Normalizes last

(g) In case of receiving back the same train by the sending station do not fall to operate S2 switch to make the slot effective for lowering of the reception signal and also do not forget to put back the switch to normal after the train arrival bell starts ringing.

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

Salient features of Transmitter and Receiver Units

1 Handle type Tokenless block Instruments using frequency modulated current system are suitable for use in 25 KV 50 cycles AC Traction area.

1.1 The frequency are :

Carrier frequencies - 1800 HZ and 2700 HZ

Modulating frequencies - 65HZ and 85 HZ

The carrier frequency of 1800 HZ and 2700 HZ have been adopted and the 65 HZ and 85 HZ modulating frequencies are utilized for coding purpose as given below

CONDITION	CODE
i) To turn Block Handle from Normal to " Train Going To"	65 Hz - DC 24 V
II) Normal to "Train Coming From "	85 Hz - DC 24 V
iii) Train Coming From " to Normal "	
iv) Train Going to "Normal "	
v) "Train On Line " Indication (Automatic)	65 Hz - only

ADDITIONAL CODE

"Train On Line " Acknowledgement	+ 24 V.DC
Bell Code ringing.	- 24 V.DC

1.2 The Electronic Equipment :Transmitter and Receiver Operates between 21.6 V to 28 V DC

1.3 The Coding Relays CR1/CR2 Operate from the rectified feed in the receiver unit.

1.4 The signalling relays CR1/CR2 being Q series plug in type worked from 24 V.DC supply, the electronic portion of the equipment in the receiver unit have been suitably designed. The stabled operation of the equipment has been achieved by working the receiver stages from 20 V regulated supply and 12 V regulated supply derived from 24 V.DC source.

1.5 To protect the Transmitter out put 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 received unit to limit the voltage to safe limits.

1.6 The Transistors used are of silicon type with higher ambient temperature (0 to 70 C)

1.7 Suitable indigenous ferrite cores have been used in all the transformers and tropicalised to suit weather conditions.

1.8 The condensers and resistors, diodes used are of superior grade and precision type for accuracy and printed circuits have been used.

1.9 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.

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 600 V.AC 50 Hz on the line circuit for 300 msec within the receiver energized will not break the back contact of signalling relays CR1 or CR2 connected to the receiver.

3. Induced Voltage of 600 V.AC 50 Hz on line circuit of 300 msec with transmitter and receiver energized from a source voltage of 24 V.DC will not affect CR1 or CR2 (Q series relays) and will not cause break in back contact.

4. A general application of 350 V.AC 50 Hz injected on the line will not have effect on the relays CR1 or 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 Mega ohms with a 500 V.DC Megger.

General:

1. The Transmitters and receivers are suitable for vertical mounting.

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

3. 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 ohms or 1120 ohms.

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

   Carrier frequency – input source voltage

   Keying frequency – regulated supply voltage.

5. Sensitivity of Receiver unit. With 1 MW transmitter output power, Receiver will operate with 28 db line attenuation. Receiver consists of an attenuator, a band pass filter and impedance switch.

6. Accuracy of frequencies:-

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

7. 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:

   P.U. – 19.2 V : D.A. – 13.6 V (min).

Relay	**Terminal voltage of Relay** CR1(85 Hz) CR2 (65 Hz)	
65Hz $\pm$ 5%	The terminal voltage should be under the drop away voltage	The Relay should pick up.
85 Hz $\pm$ 5%	The relay should pick up	The terminal voltage should be under the drop away voltage.

8. In the A.C 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 V.F Transformer.

9. The Token less Block Instrument manufactured as per IS – 98 – 2001 with modifications (1) Rated current value for normal operation up to 1 Amp. (2) Variation of the source supply voltage 21.6 V DC to 28.8 V.D.C (3) The time release 90 Sec to 120 Sec.

*** * ***

CHAPTER – 6: METHOD OF OPERATION AND FAILURE

6.1 Method of Operation

Method of Operation for Single line Token less Block Instrument is as follows. Both stations are assumed to be equipped with semaphore signals.

(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 the PB1 push button and sends 'call attention' code of bell signals.	
3		Bell sounds for 'call attention' code of bell signals.
4		Inserts 'SM's Key and turns.
5		Acknowledges the 'call attention' code by pressing the PB1 button.
6	Bell Sounds as acknowledgement of 'call attention' code of bell signals.	
7	Sends 'Attend Telephone' code of bell signals by pressing the PB1 button	
8		Acknowledges the 'Attend Telephone' code of bell signals by pressing the PB1 push button to Acknowledge the 'Attend Telephone' code and attends on Telephone.
9	Asks for 'Line Clear' on telephone (giving name of station on the telephone)	
10		Accepts the 'Line Clear' enquiry.
11	Sends 'Is Line Clear' enquiry code of signals by pressing PB1 button along With PB2 button until Galvo needle gives a kick	
12		On receiving 'Is Line Clear' code turns Block handle to 'Train Coming From' Position
13		Answers back the 'Is Line Clear' code of bell signals by pressing 'PB1' button along, with 'PB2' button until Galvo needle gives a kick.
14	On receiving answer back to its 'Is Line Clear' code. turns Block handle to 'Train Going To Position	

Sl. No	Station A	Station B
15	(a) Takes 'OFF' the Last Stop Signal. Train enters Block Section. (b) Last Stop Signal return to 'ON' position. (c) 'Train on Line' Indicator appears automatically and Buzzer starts operating (Where provided). (d) Instrument sends automatic 'Train on Line' code. Replaces Last Stop Signal Lever to N	
16		'Train on Line' indicator appears on receiving the 'Train On Line' Code and Buzzer sounds.
17		Sends 'Call attention' code of signals by pressing PB1 button.
18	The instrument stops automatic 'Train on Line' code.	
19	Where provided 'Train on line' buzzer stops.	
20		'Train on Line' buzzer Stops
21	Acknowledges 'Call attention' code of signals by pressing PB1 button	
22	Sends 'Train on Line' code of bell signals.	
23		Acknowledges 'Train on Line' code of bell signals.
24		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 home Signal lever at SM's control. f) 'Train arrival' buzzer stops
25		Sends 'Call attention' code of bell signals.
26	Acknowledges 'Call attention' code of signals.	
27		Sends 'Train arrived' code by pressing 'PB1' button along with 'PB2' button until 'Galvo' needle gives a kick.
28	On reception of 'Line Closed' code turns Block handle to Line Closed' indicator. 'Train on Line' indicator turns 'OFF'	
29	Answers back the 'Line Closed' code of bell signals by pressing'PB1'' button along with 'PB2' button until 'Galvo' needle gives a kick	
30		On reception of 'Line Closed' code turns Block handle to 'Line Closed'.

Note: Similar procedure is repeated when dispatching a train from Station 'B' to Station ' A'

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

Sl. No	Station A	Station B
	Normal Status: Block handle at 'Train Going To' position.	**Normal Status: -** Block handle at 'Train Coming From' position.
1.	Calls the attention of station 'B' and takes his consent on telephone	
2.		Gives consent on telephone and ensures all concerned signals & their controls at normal on 'SIGNAL NORMAL' indicator.
3.	a) Operates 'Cancel' switch S1 to reverse/ presses 'Cancel' button b)Puts back all controls of relevant signals to 'ON' and ensures all concerned signals and their controls are at normal c) Counter registers next higher number d) Waits for 2 minutes for 'TIME RELEASE' indicator. e) 'TIME RELEASE indicator operates. f) Turns 'Cancel' switch S1 (if a switch is provided) to normal	
4.	Sends 'Call attention' code of signals	
5.		Acknowledges 'Call attention' code of signals.
6.	Sends 'Cancellation' code of Bell signals as under: Presses 'PB1' button along with 'PB2' button until Galvo' needle gives a kick	
7.		On reception of 'Cancellation' code Turns Block handle to 'Line Closed' Position
8.		Answers back the 'Line Closed' code of bell signals by pressing 'PB1' button along with 'PB2' button until 'Galvo' needle gives a kick
9.	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
	Block handle at 'Train Going to' Position 'TRAIN ON LINE' Indicator 'ON'	Block handle at 'Train Coming From' Position 'TRAIN ON LINE' Indicator 'ON'
1	Calls the attention of Station 'B' on Telephones and takes his consent.	
2		Gives consent on telephone and ensures all concerned signals & controls at normal on its 'SIGNAL NORMAL' indicator.
3	a) Operate switch S2 to reverse. Takes 'OFF' the reception signals b) Train enters the station. c) Home Signal returns to 'ON' position d) 'Train arrival' Buzzer sounds. e) Replaces Home Signal lever at operator's control. f) 'Train arrival' buzzer stops. g) Cancellation counter registers next higher number. h) Turns 'Cancel' switch (if a switch is provided) to normal i) Ensures all concerned signals & controls at normal on its 'SIGNAL NORMAL' indicator.	
4	Sends 'Call attention' code of signals	
5		Acknowledges 'Call attention' code of signals.
6	Sends 'Cancellation' code of Bell Signals Presses PB1 button along with PB2 button until 'Galvo' needle, gives a kick.	
7		On reception of 'Cancellation' code turns Block handle to 'Line Closed' Position. 'Train on Line' indicator turns OFF
8		Answers back the 'Line Closed' code of bell signals by pressing 'PB1 ' button along with 'PB2 ' button until 'Galvo' needle gives a kick.
9	On reception of answer back 'Cancellation' code Turns Block handle to Line Closed' indicator 'TRAIN ON LINE' Indicator turns OFF.	

(D) Shunting between Last Stop Signal and Opposing First Stop Signal

S.No	Station A	Station B
	Instrument Block Handle Indicator in 'Line closed position. All concerned signals at normal on its 'SIGNAL NORMAL' indicator. Reception signal shall not be taken 'OFF' for shunting.	Instrument Block handle in 'Line closed' position.
1	Calls the attention of Station 'B' and obtains his consent on telephone.	
2		Gives consent on telephone.
3	(a) Applies 'SM's' key and takes out the shunting Key of the concerned section Block instrument. (b) Hands over Shunting Key to the Driver (c) Driver completes shunting and returns Key to SM. (d) Applies 'SM's' key , Shunting Key is replaced in the instrument.	
4	Informs the SM at 'B' on telephone	
5		Acknowledges on telephone.

(E) Shunting between Last Stop Signal and Opposing First Stop Signal behind a departing train with Block indicator in 'Train Going To' position with or without 'Train on Line' indicator:

S.No	Station A	Station B
	Instrument Block Handle in 'Train Going To' position. All reception signals at 'N0RMAL'. Reception signal shall not be taken 'OFF' for shunting	Instrument Block Handle in 'Train Coming From' 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 Shunting Key' of the concerned Section's Block Instrument. (b) Hands over Shunting Key to the Driver. (c) Driver completes shunting and returns key, to SM (d) Applies SM's key. Shunting key is restored to the Instrument.	
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 Last Stop signal fails to return to 'ON' position as a train passes it.

(d) If the Train arrival buzzer does not sound the alarm even after the complete passage of the train inside the Home signal over the Last Vehicle track Circuit (This may be due to failure of, the Last Vehicle Track Circuit.)

Note: Though Home Signal may go automatically to 'ON' by passage of the train, home signal lever shall not be put back to 'Normal' Position unless the whole of the train has arrived inside the Home signal. Failure to adhere to this will result in a Block Failure and the Train arrival buzzer will not sound alarm 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 'Train on Line' buzzer fails to give the alarm for any reason at the receiving station, even after display of 'Train on Line' 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 Station Master at other end should use S-2 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 General and Subsidiary Rules.

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 Station Masters themselves shall resume block working in a accordance with paragraph 8.7 below:

(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 Station Masters themselves shall resume block working in accordance with paragraph 8.7 below :

(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 'Train on Line' indication falls to appear on the Instrument after the train has entered the: Block Section.'

(c) If the Last Stop signal lever cannot be reversed when the Block Handle is turned to the 'Train Going To' position.

(d) If the Last Stop signal lever can be reversed when the Block Handle is not turned to the 'Train Going To' position.

(e) When the train arrives at a station with out 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 'Train On Line' 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.

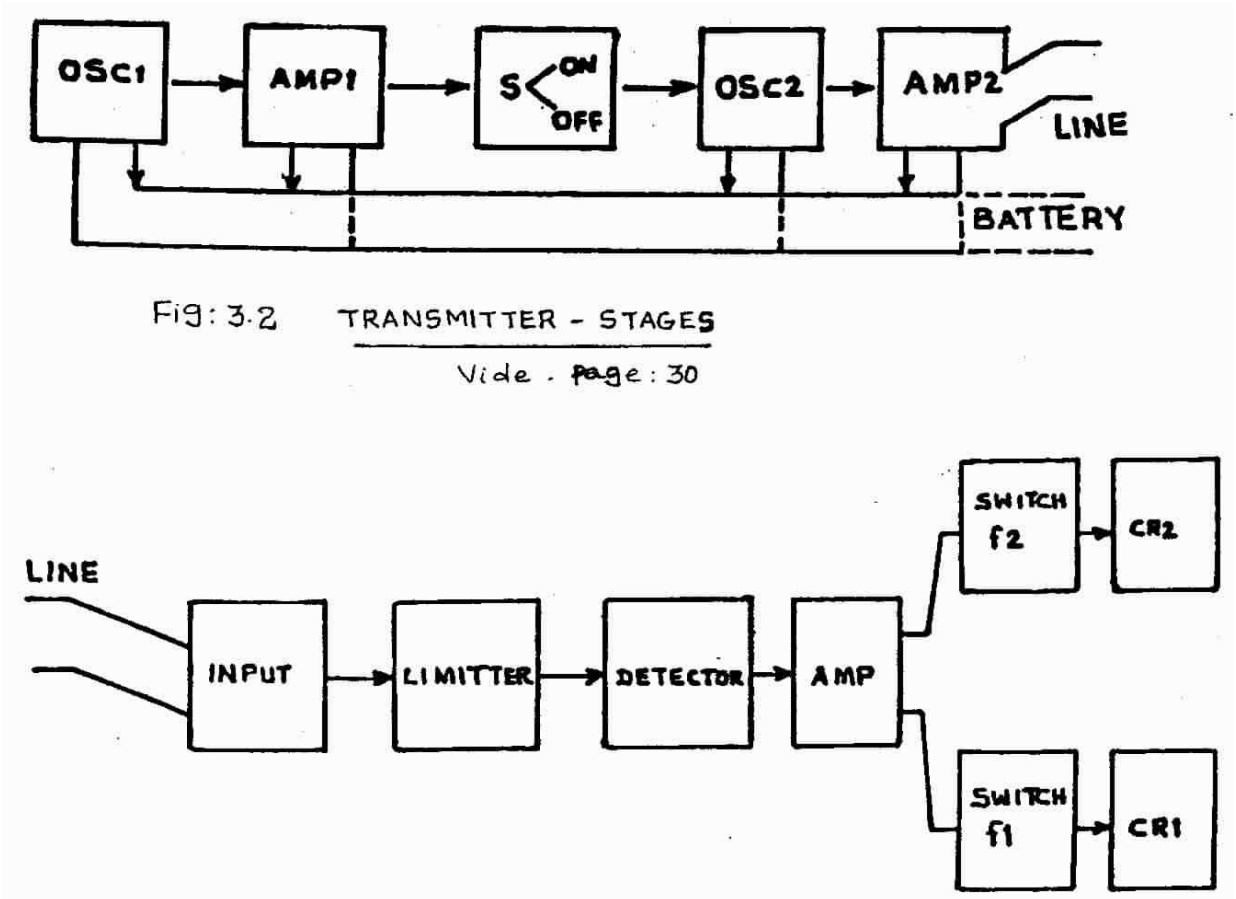


Fig : 3.3

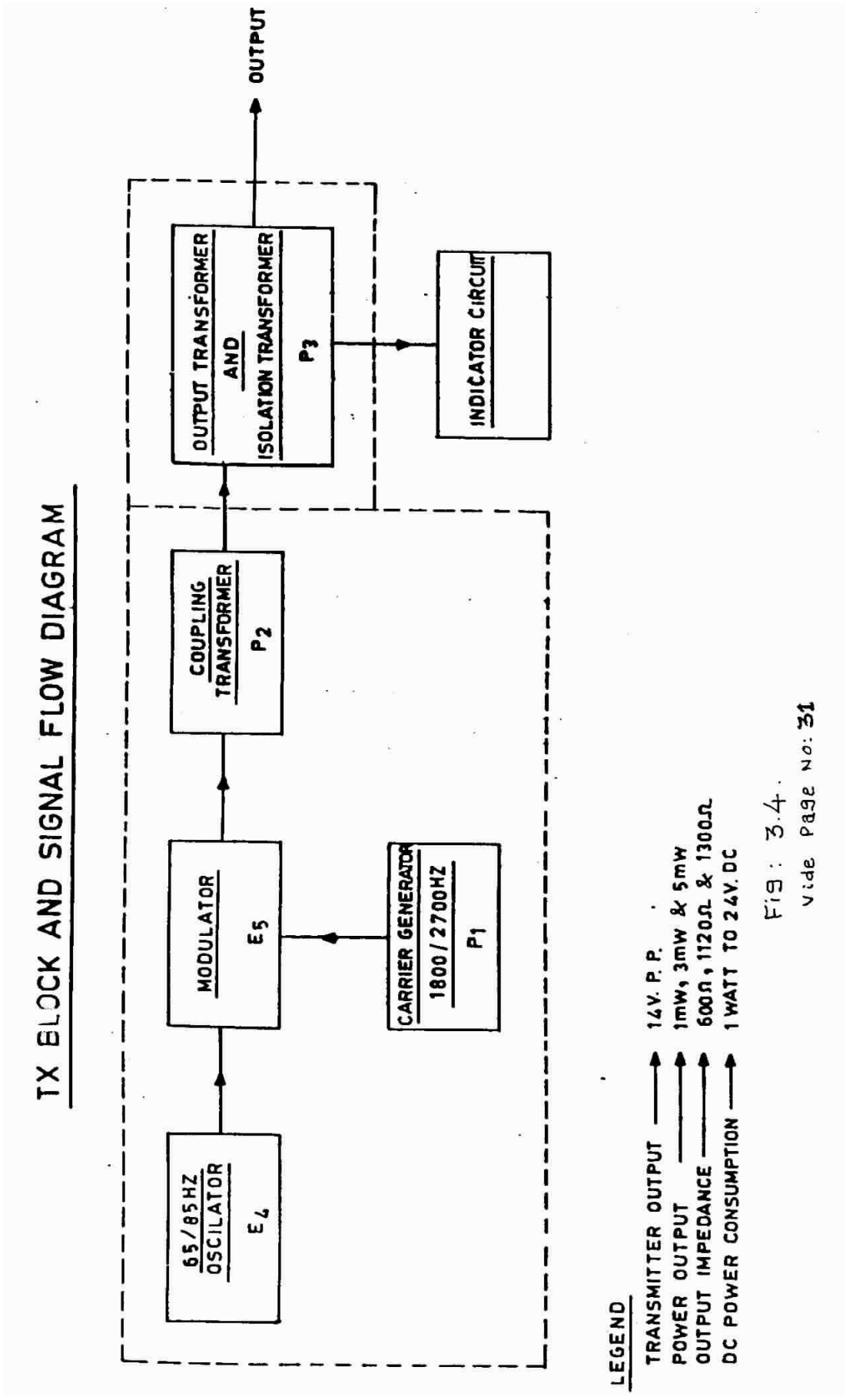

TX BLOCK AND SIGNAL FLOW DIAGRAM
OUTPUT
OUTPUT TRANSFORMER AND ISOLATION TRANSFORMER P3
INDICATOR CIRCUIT
COUPLING TRANSFORMER P2
MODULATOR E5
CARRIER GENERATOR 1800/2700HZ P1
65/85HZ OSCILATOR E4
LEGEND
TRANSMITTER OUTPUT 14V. P. P.
POWER OUTPUT 1mW, 3mW & 5mW
OUTPUT IMPEDANCE 600Ω, 1120Ω & 1300Ω
DC POWER CONSUMPTION 1 WATT TO 24V. DC
Fig : 3.4.
vide Page No: 31

Fig : 3.4

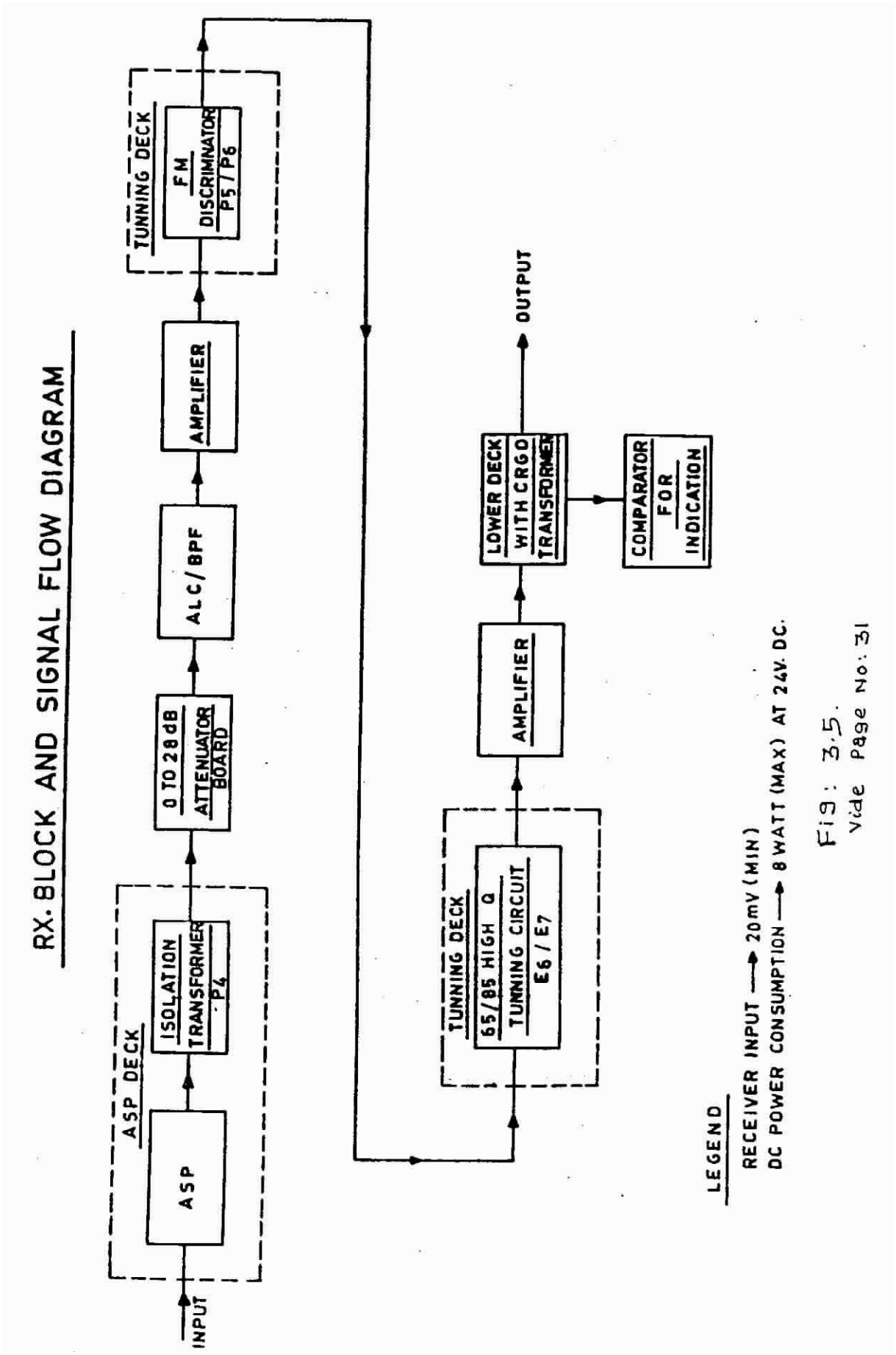


Fig : 3.5.
Vide Page No: 31

Fig : 3.5

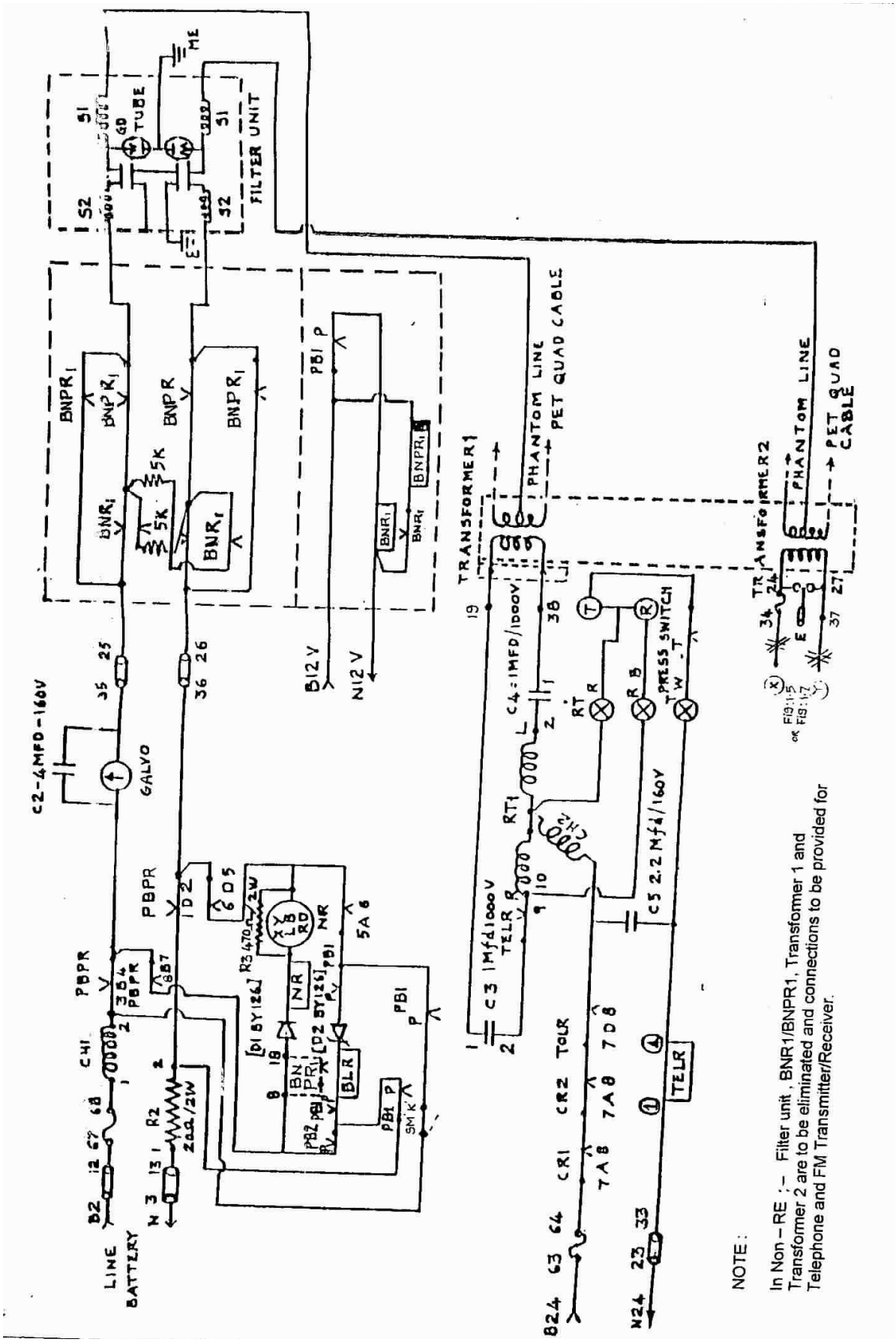

FILTER UNIT
TUBE
GD
ME
S2
51
32
BNPR1
BNR1
5K
BNPR
PBI P
B12 V
N12 V
TRANSFORMER1
PHANTOM LINE
PET QUAD CABLE
TRANSFORMER2
C2-4MFD-160V
GALVO
PBPR
D2
D5
R3 470Ω 2W
NR
5A6
BLR
SMK
C3 1Mfd1000V
TELR
RT1
C4:1MFD/1000V
RT
RB
PRESS SWITCH
C5 2.2 Mfd/160V
CR1
CR2
TOLR
7A8
7D8
LINE
BATTERY
B2
N3
R2
220Ω/2W
C41
B24
N24
NOTE :
In Non – RE :- Filter unit , BNR1/BNPR1, Transformer 1 and
Transformer 2 are to be eliminated and connections to be provided for
Telephone and FM Transmitter/Receiver.

Fig : 1.4

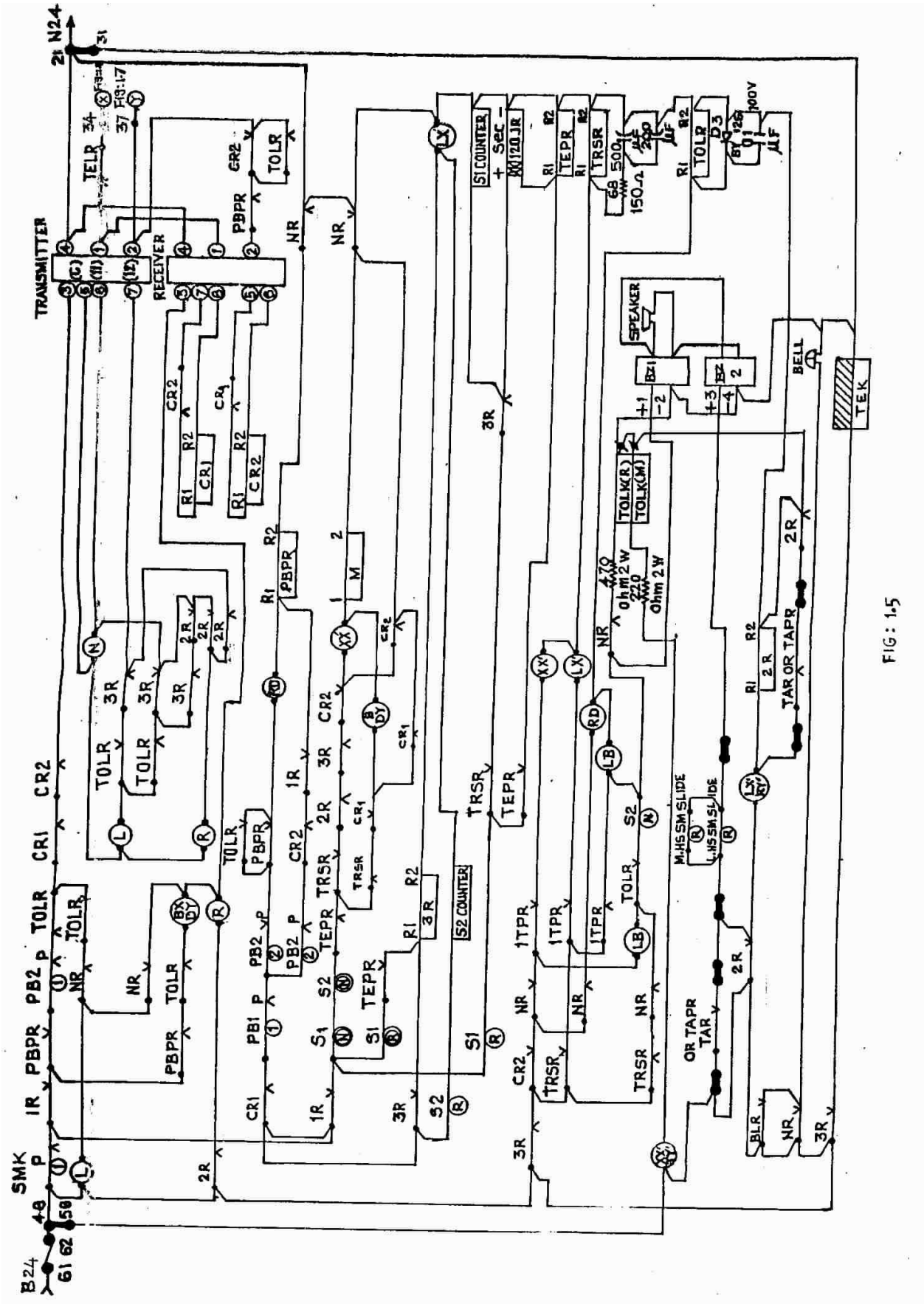

TRANSMITTER
RECEIVER
TELR
TOLR
PBPR
CR1
CR2
SMK
IR
PB1
PB2
TEPR
TRSR
S1
S2
1TPR
2R
3R
NR
BELL
TEK
SPEAKER
TOLK(R)
TOLK(M)
TAR OR TAPR
S1 COUNTER
S2 COUNTER
+ Sec -
470 ohm 2W
220 ohm 2W
FIG : 1.5

Fig : 1.5

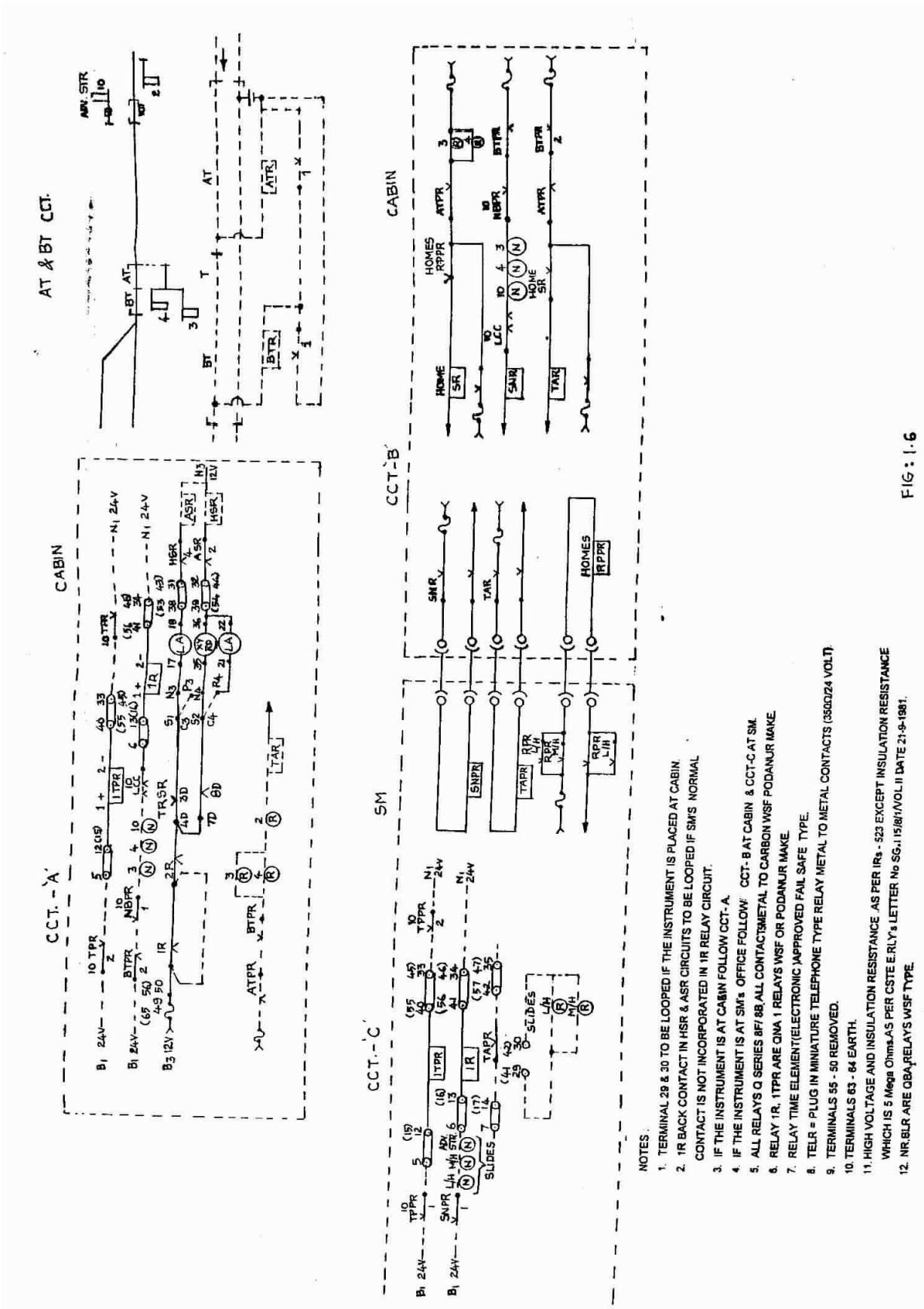

AT & BT CCT.
CCT. - 'A'
CABIN
CCT.-'C'
SM
CCT-'B'
CABIN
NOTES:
1. TERMINAL 29 & 30 TO BE LOOPED IF THE INSTRUMENT IS PLACED AT CABIN.
2. 1R BACK CONTACT IN HSR & ASR CIRCUITS TO BE LOOPED IF SM'S NORMAL CONTACT IS NOT INCORPORATED IN 1R RELAY CIRCUIT.
3. IF THE INSTRUMENT IS AT CABIN FOLLOW CCT-A.
4. IF THE INSTRUMENT IS AT SM's OFFICE FOLLOW CCT- B AT CABIN & CCT-C AT SM.
5. ALL RELAYS Q SERIES 8F/ 8B ALL CONTACTSMETAL TO CARBON WSF PODANUR MAKE.
6. RELAY 1R, 1TPR ARE QNA 1 RELAYS WSF OR PODANUR MAKE.
7. RELAY TIME ELEMENT(ELECTRONIC)APPROVED FAIL SAFE TYPE.
8. TELR = PLUG IN MINIATURE TELEPHONE TYPE RELAY METAL TO METAL CONTACTS (3500/24 VOLT).
9. TERMINALS 55 - 50 REMOVED.
10. TERMINALS 63 - 64 EARTH.
11. HIGH VOLTAGE AND INSULATION RESISTANCE AS PER IRs - 523 EXCEPT INSULATION RESISTANCE WHICH IS 5 Mega Ohms.AS PER CSTE E.RLY's LETTER No SG.115/81/VOL II DATE 21-9-1981.
12. NR.BLR ARE QBA,RELAYS WSF TYPE.
FIG : 1.6

Fig : 1.6

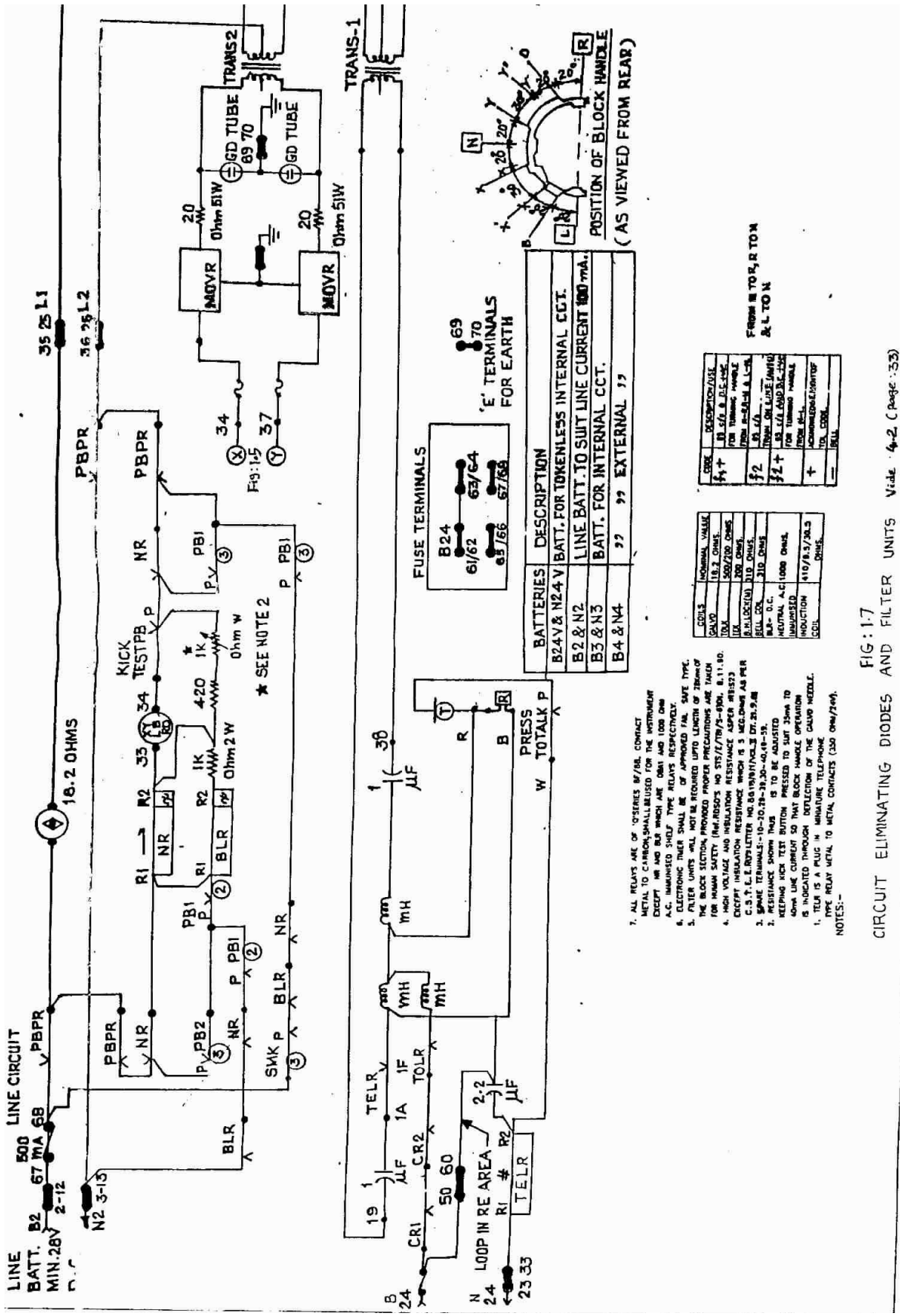


FIG:1.7
CIRCUIT ELIMINATING DIODES AND FILTER UNITS Vide 4-2 (Page :33)

Fig : 1.7

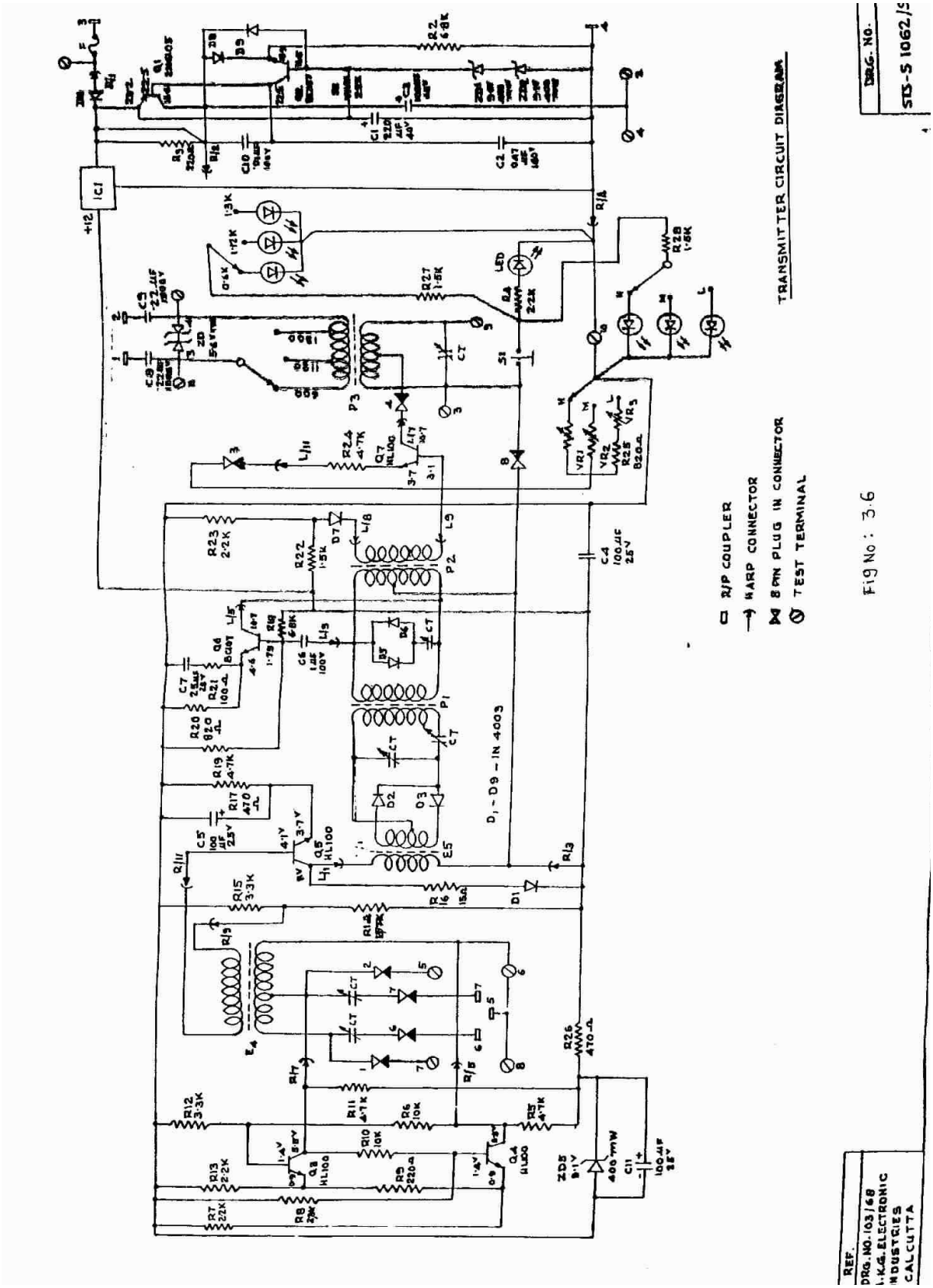

TRANSMITTER CIRCUIT DIAGRAM
DRG. NO.
STS-S 1062/S
R/P COUPLER
HARP CONNECTOR
8 PIN PLUG IN CONNECTOR
TEST TERMINAL
Fig No : 3.6
D1 - D9 - IN 4003
REF.
DRG. NO. 103/68
I.K.G. ELECTRONIC
INDUSTRIES
CALCUTTA

Fig : 3.6

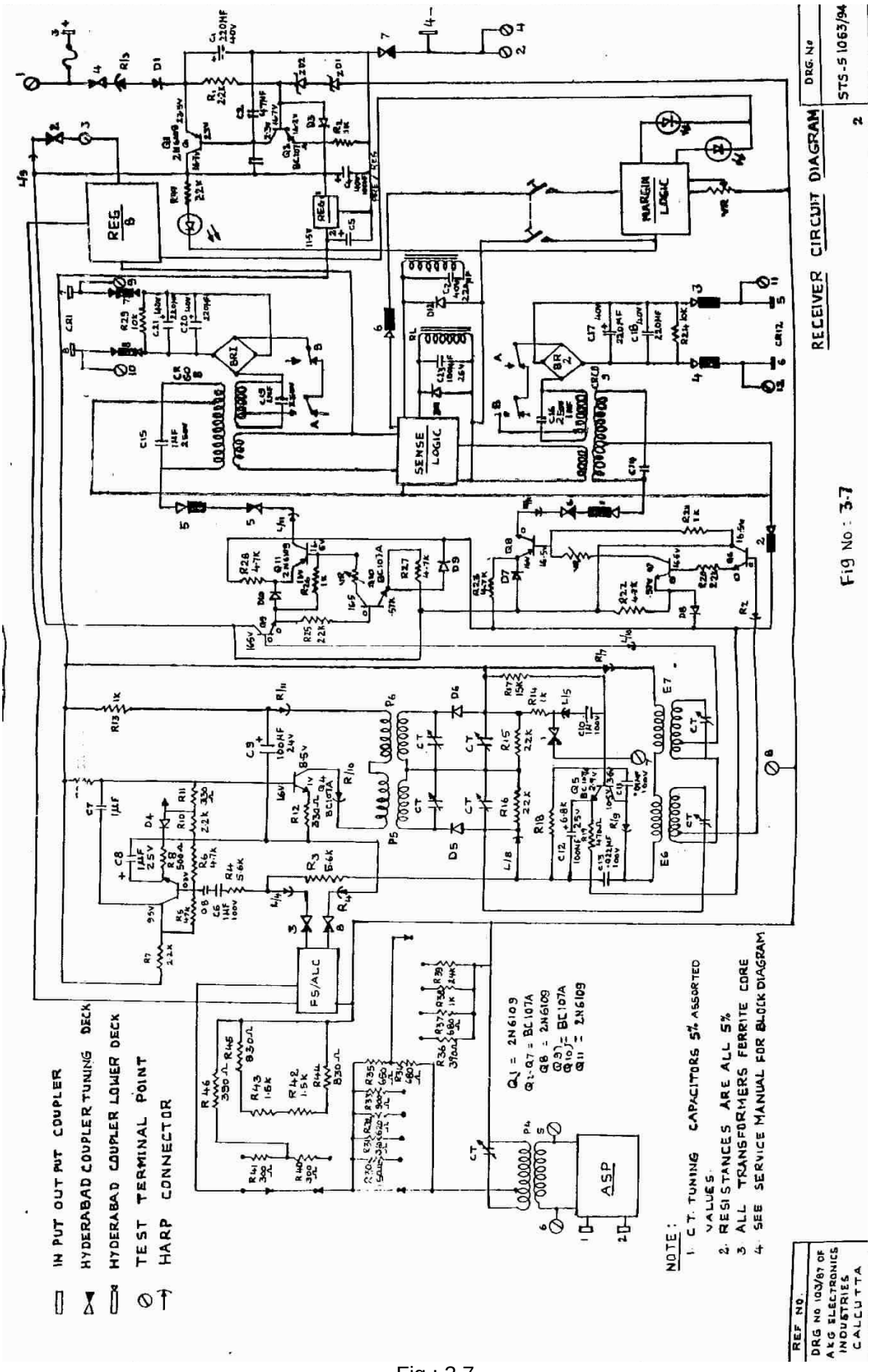

RECEIVER CIRCUIT DIAGRAM
DRG. Nº
STS-S 1063/94
2
Fig No : 3-7
REG
SENSE LOGIC
MARGIN LOGIC
FS/ALC
ASP
IN PUT OUT PUT COUPLER
HYDERABAD COUPLER TUNING DECK
HYDERABAD COUPLER LOWER DECK
TEST TERMINAL POINT
HARP CONNECTOR
NOTE :
1. C.T. TUNING CAPACITORS 5% ASSORTED VALUES
2. RESISTANCES ARE ALL 5%
3. ALL TRANSFORMERS FERRITE CORE
4. SEE SERVICE MANUAL FOR BLOCK DIAGRAM
Q1 = 2N6109
Q2-Q7 = BC107A
Q8 = 2N6109
Q9 = BC107A
Q10 = BC107A
Q11 = 2N6109
REF NO.
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Fig : 3.7

CHAPTER – 7: INTRODUCTION TO PUSH BUTTON TOKENLESS BLOCK INSTRUMENT

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

7.1.1 INTRODUCTION

The main purpose of introducing Tokenless Block working is to reduce the block operating time. 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.

7.2 System: Tokenless Block Instrument of the push button type consists basically of 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 instrument 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 "Train Going To" 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 "Train Coming From" code to the instrument at the other end and if the conditions for granting of "Line Clear" are satisfied, sets the instrument to "Train Coming From" 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 "Train Going To" 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	-do-	TGT	-	-	+
TOL Code	-do-	TOL	-	-	-
Line Closed Code either from TGT or from TCF position. or on cancellation of line clear both in normal or on push back operation.	-do-	to normal	-	+	+

For transmission of bell signal positive current is sent on line 1 (L1) and -ve on line 2(L2)

7.3.3 Construction: The instrument consists essentially of two parts

(a) A relay cabinet housing all relays, and

(b) A dash board called 'Control 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.

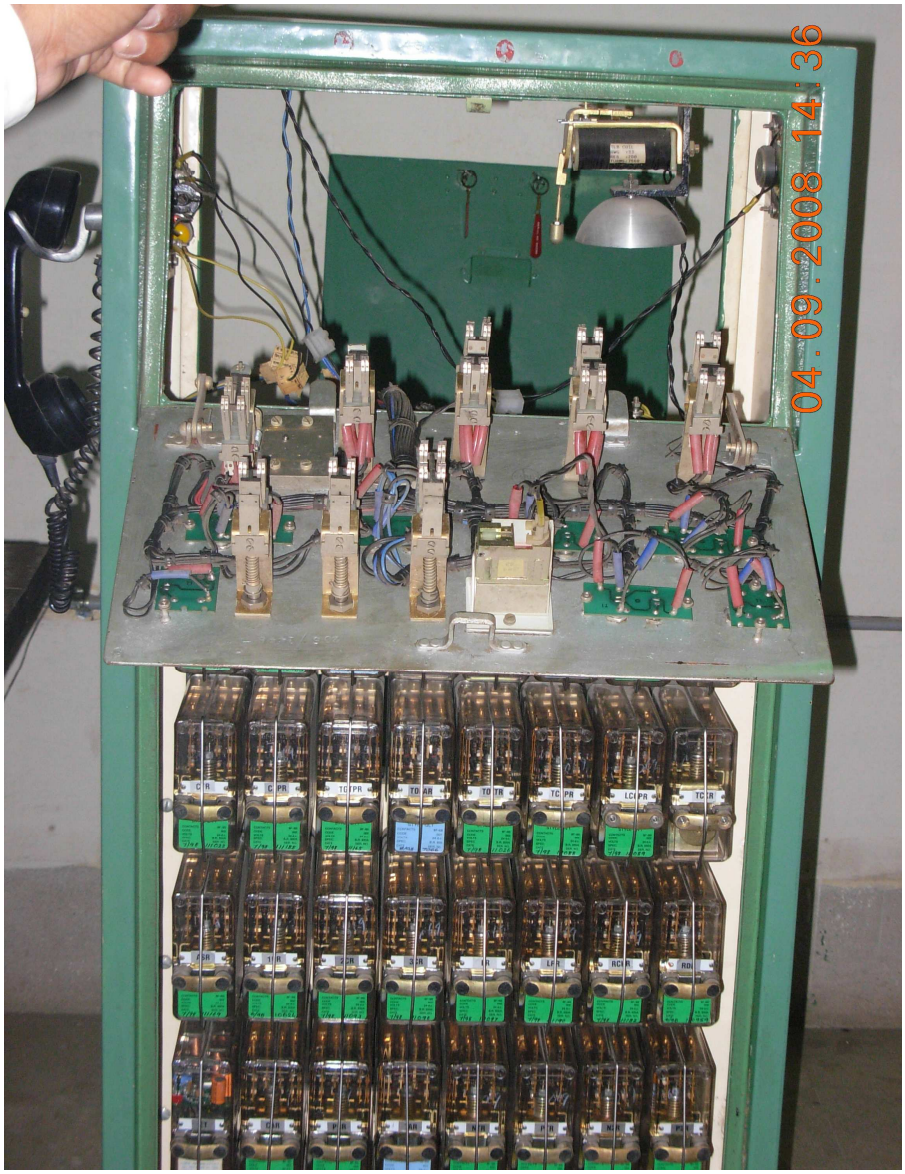
Relay Cabinet: Height is 141 cm. The base measures 56 cm x 31 cm. There are two doors one on each of the broader sides. These doors are removable type and do not swing out. This reduces the area required for maneuvering. The panel and the relays are on the front side, while the button contacts and jack 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 (QBA) terminals totaling 72/50 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 colour code for easy identification.

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

Control 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.

Description of Push Buttons, Indicators, etc.

Push Buttons

(a) Bell Push Button: Colour - Black. Code - BCB. This is the most often used button. This is used to call the other station master'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) "Train Going To" 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 are 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 - Panel Lamp.(PL)

The indicators except - TOL & FREE are lit when BCB or PL 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 Station Master. Lighting up of indicators, only when required, minimizes the drain on the power source.

(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. shunt key cannot be extracted from EKT in TCF condition.

(g) "Catch Slip Siding Control Key Button: Colour - Blue. Code SCK.

To be pressed to extract the key from EKT instrument. The key is used to operate. Slip Or catch siding points.

Panel Indicators

(a) "Train Coming From" (Green): Indicates when lit that the instrument is in 'TCF' condition i.e., it has granted 'Line Clear'.

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

(c) "Train Going To" (Green): Indicates when lit that the instrument is in 'TGT' condition i.e., it has obtained 'Line Clear'.

(d) "Last Stop Signal Indications": When lit, red indication means the last stop signal is at ON and GREEN means that the signal is at OFF.

(e) "SNR" Indicator: This is an indication to the Station Master to verify if all the relevant controls/levers etc. are normal.

All the above indications are lit only when the BCB or Panel Lamp Button is pressed. They are normally off. except SNRK.

(f) "Train On Line" (Red): Indicates that the train has entered 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. Both the above indicators are lit on establishment of their respective conditions without the requirement that the BCB or Panel Lamp Button should have been pressed.

(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) Station Master's Key: Code - SMK. This is used by the Station Master to lock up his instrument to prevent manipulation by any other person. When the instrument is locked by the Station Master, 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 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 Station Master 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 This instrument consists basically of a set of push buttons and relay circuits, and operates on DC impulse codes. By eliminating transistors and diodes from the line circuit, this instrument can withstand high surge voltage accidentally encountered in the line.

7.4.2 The code employed in this system consists of three step polar impulses 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.

7.4.3 To cancel "Train Going To" 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, buttons "Line Closed" and "Bell Code" must be operated at both stations concurrently.

7.4.4 Except "Train On Line" code, all codes are transmitted only when button "Line Closed" or "Train Going To" is pressed with button "BCB" at the transmitting station.

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

7.4.6 The "Train On Line" bell operates intermittently only at the receiving station until the acknowledgement operation is made by the train receiving station.

7.4.7 When "Train Going To" condition is cancelled before the train leaves the station, or when "Train Going To" is to be cancelled when the train is pushed back to the station, the same button "CANCEL" is used in conjunction with BCB Button.

7.4.8 The "Train On Line" code is suppressed by the sending station keeping the "TGB Button" pressed. Then, it is possible to transmit "Bell" signals by pressing the "BCB button".

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

7.4.10 Circuit is so designed as to minimize power consumption.

7.5 Sources of power

All the relays are housed inside the relay cabinet. Wiring is colour coded for easy identification. Space is provided inside the cabinet, to accommodate extra relays at a future date.

Removing the front and back doors respectively can conveniently make inspection of relays and wiring. It is worthwhile to look into the placement of sources of power.

The sources may be float charged secondary cells where electricity is available or primary cells elsewhere for local battery to power the internal circuits of the instrument and for location battery to energies external circuits. For line circuit, dry cells may suffice. There is also a battery for telephone.

Thus, there are 4 sources of power and so, the relays may be grouped according to the source that powers them.

7.5.1 Relays energized from location battery

EXTERNAL CIRCUIT RELAYS: This circuit is used to ensure and achieve the highest safety in train working. Hence, monitoring of the Field conditions such as i) Normal position of Reception and Dispatch Signals and their controls. ii) Entry/occupation of Block section by a train and iii) Clearing of Block section by a train through the Inst. Are incorporated in this circuit by using field/external battery source. In case of panel interlocked/RRI stations, field/external battery can be dispensed and Relay Room battery supply can be used for this circuit.

This relays used in this circuit are

(a) SNR

(b) ASTR and

(c) TAR

SNR-SIGNAL NORMAL RELAY: This relay proves the normal position of all the signals and their control levers/knobs pertaining to that block section. It picks up by pressing BCB along with TGB/LCB buttons 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 siding/catch siding keys are IN Position. Normal position of first vehicle and Last vehicle tracks 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/selection 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. (i.e. only on receipt of line closed code).

ASTR-ADVANCED STARTER TRACK RELAY

It is a repeater for the First Vehicle Track 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 EKD-B. or QB3 as CRR (N)/CRR (R)

(b) TCKR - Transmission of code checking relay. Type NV1 AB

The polarized relay CRR in the other instrument and TCKR in this instrument come 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 a 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 are ordered by the circuit at the receiving end.

The picking up and dropping of CRR and TCKR at their respective ends energize and de-energize 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 (e.g.) 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 Relay energized from local battery

RCKR - Code reception checking relay – This senses the progress of the coding circuit at the receiving end and terminates the pulse that is being received by opening the line circuit. (Please see under 'CRR' and 'TCKR'). 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-energisation 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 reception and dispatch signals and their control levers/slides/knobs pertaining to an instrument are normal.

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

(c) SM is keeping the required buttons i.e. BCB along with TGB or LCB in the pressed conditions with the SM switch is in normal.

(d) The conditions are favourable 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, resets 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 energisation 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 there relays 1 CR 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:

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 ASR2 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 Station Master 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 Station Master 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 pulse 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 'Reverse' contacts. This picks up on successful reception of TGT code and releases when 'Line Closed' code is received. Its reverse contacts are proved in the last stop signal 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 this 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 last stop signal, before the signal can be cleared. 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 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 21.0 V. While replacing this relay, the Rheostat shall be checked and readjusted, if necessary, and sealed to obtain the rated values.

7.5.4 The 3.0 V source is for the telephone

Units of condensers, resistors, etc.

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: The drawing attached shows the circuit diagram of the push button tokenless block instrument for single line (Southern Railway Type):
(Circuit: STS-S.1082/94).

7.6.1 Transmission and reception of bell signals

As "Bell Code" Button 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 is operated to Normal Side. Consequently, the single stroke bell is actuated in the local circuit by local battery. (See circuit diagram No.8.3 and 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 'TGB' & 'BCB' buttons. 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. (See circuit diagrams 8.1, 8.4, 8.5, 8.6, 8.7 and 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 impulse. 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. (See Circuit Diagrams 8.9, 8.10, 8.11 and 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 1CR relay CTPR picks up (see circuit diagram 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 impulse

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 impulses since TCKR and LR will remain pick up during 2nd and 3rd impulses. 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) to reverse side at Station B relay RDR is picked up and remains up over its stick circuit until the reception of 'Train Coming From' 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. [See the Circuit Diagram No.8.15.]

When relay RCKR is picked up the line circuit is opened by RCKR back contacts and the transmission of first negative impulse 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. (See circuit diagram No. 8.16.)

Consequently, relay PTR is energized at Station A (See Circuit Diagram No.8.20).

Picking up of 2CR at Station 'B' causes release of RCKR thus the receiving circuit is kept ready for receiving the next impulse. The line circuit of 2nd positive impulse is now closed and TCKR at Station 'A' and CRR (N) at Station 'B' are picked up. (See circuit diagram 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 (See circuit diagram No.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 impulse register relay, once picked up gets a stick feed through 1CR front contact when P2R is energized. In the meantime relays TOLAR, SHKR, SCKR, 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. (See circuit diagram No. 8.22).

On energisation of 3CR the circuit for RCKR is completed at station B and this causes opening of the line circuits and transmission of second impulse is terminated. (see circuit diagram No 8.15).

As soon as relay RCKR is picked up at Station 'B' relays TCKR at Station 'A' and CRR(R) 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 receiving circuit is again kept ready for receiving the 3rd impulse. At Station 'A' dropping of 2CR completes the circuit of NTR over the front contact of TGBR button relay for sending 3rd negative impulse.

Since the line circuit is closed at both Stations 'A' and 'B' 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 impulse.

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. (See circuit diagrams 8.18 and 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. (See circuit diagram 8.32)

When relay LR is picked up for the third impulse 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 impulse 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 3 CR front contacts, when the first impulse 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 buttons 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 impulse also does an additional function of causing the energisation of CTR relay, when 3CR drops. (See circuit diagram No 8.7).

Dropping of 3CR disconnects the feed to RCKR, but the relay still remains energized on account of its slow release characteristic. With RCKR and CTR up the answer back auxiliary relay ABCXR now picks up and maintained by a stick feed through its contact.

When RCKR drops after its release time lag, NTR picks up as CTR is already up, for sending the first negative impulse. It may be noted here that CTR does not drop with dropping of RCKR since (see circuit diagram No 8.8) the holding path of CTR will keep the relay CTR energized through out, for the transmission of code.

In the meantime, relay RCKR at Station 'A' which had picked up momentarily over 1 CR drop and 3CR up contact, is released, the receiving circuit for code is also completed and the first negative pulse of "Train Going To" code is transmitted from Station 'B' to Station 'A'. (see circuit diagram No 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 and 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 "Is Line Clear" (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. (See the circuit diagram No 8.8).

On the other hand, at Station 'A' by the release of relay CRR(R) Relay LR is released, Relay 2 CR is picked up and relay RCKR is released successively closing the line circuit at receiving end. (See the circuit diagram No 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 3 CR are picked up (See the circuit diagram No 8.22).

By the pick up 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 and RCKR are released successively. (See circuit diagram No 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 operated to Normal side. As relay TCKR is picked up, relay LR is picked up and relay 1CR is released at Station 'B'. At Station 'A' because relay CRR (N) is operated CRR (N) relays ASR1 and ASR2 are 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 "Train Going To" indication appears on panel (See the circuit diagram No 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 and 3CR are successively dropped. Consequently relays RCKR, CTPR, CTPPR and 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 slide is pulled.

Thus, a series of relay operation for setting the block instrument to "Train Coming From" and "Train Going To" conditions are completed. After "Train Going To" indication is turned ON, the push buttons BCB and TGB kept pressed so long at Station 'A' are released. After "Train Going To" indication has tuned on, concerned Station Master's slide is operated to reverse. Then relay SNR is dropped which will cause ASCR relay to pick up. With ASCR up the last stop signal can now be cleared. (See the circuit diagram No 8.25).

7.6.2.3 Transmission of "Train On Line" 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 relay contacts of advance starter signal are opened for a short period of time. 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 ASR1 and ASR2.

Dropping of ASCR causes - last stop signal to return automatically to ON position as the reverser feed is cut off.

Dropping of ASR causes - 1) TOL indication to appear (See circuit diagram No 8.34.)

2) TOLTR to pick up. (See circuit diagram No 8.33.)

TOL indication will remain lit till the instrument is normalized. Picking up of TOLTR relay now causes energisation of CTR relay for initiating the automatic TOL code transmission. All the three pulses in this case are of -ve polarity (see circuit diagram No 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 and NTR picked up, the first negative pulse current flows, the relay TCKR is picked up. By the pick up of relay TCKR, relays, LR, LPR and 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 and RCKR are successively picked up. (See circuit diagram No 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 and 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. "Train on Line" indicator is now lit. (See circuit diagram No 8.8, 8.9 and 8.34)

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 to the reverse side, 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. (See circuit diagram No 8.8, 8.9 and 8.28).

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

The bell rings intermittently as described below:-

In case of "Train On Line" code, no answer back code is transmitted when reception of "Train on Line" 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 "Train On Line" code is reinitiated and completed in the same manner mentioned above. Transmission of "Train On Line 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 button, "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 energisation 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 "Train On Line" code is terminated. As a result, at Station 'B' relay TOLTR remains released, and the TOL bell is stopped.
(See circuit diagrams No 8.9 and 8.22).

As mentioned above, when the transmission of "Train on Line" code has been completed, relays TOLAR and TOLTR get released. However, "Train On Line" indicators at both stations remain lit.

When the train approaches Station 'B' the Home Signal is taken off. The movement of the train, within the Home Signal 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 Station Master puts back his slide of Home Signal lever to Normal. (See Circuit Diagram No 8.29 and 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 Station Master's at 'B' now presses BCB and LCB buttons 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 Station '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 Station 'B' is restored to Normal. At this time, the answering code is also similar to the above-mentioned code. (See circuit diagram No 8.32, 8.7 and 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' and '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 impulses 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. (See circuit diagram 8.21).

Operation of CRR(N) relay on receipt of 3rd impulse, complete the circuit of the relay LCCPR, the final impulse register relay of Lined Closed Code. (See the circuit diagrams No 8.24 and 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. (See the circuit diagram No 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 and 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 impulse the circuit of which is same as given earlier for the first impulse of other codes.

The answering "Line Closed" code is the same as initial "Line Closed" code, and consists of negative, positive and positive pulses. Accordingly, the operations of relays during the first and the second pulses are similar to those initial "Line Closed" Code. Consequently relay P2R is picked up and remains up due to the ON period of the 3rd positive pulse at Station 'B'. The circuit for the relay PTR at Station 'A' for the 2nd positive impulse transmission is same as that of second impulse of TCF code. (See the circuit diagrams No.8.9 and 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. (See the circuit diagram No 8.18.).
By the restoration of relay TCFR, relay TCFPR is dropped, "TCF" indication is turned off, and "Line Closed" indication lights on (See the circuit diagram 8.32).

Furthermore, by the release of relay TCFR & TCFPR relays PCR and 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' and 'B' are now returned to the original "Line Closed" condition. At this condition both buttons "Line Closed" and "Bell Code" are released at Station 'B'.

7.6.2.6 To cancel "Train Going To" 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, buttons "Cancel" and "BCB" are pressed concurrently and released. Then relays TER, and CAR are energized, and remain stick fed as shown in the circuit diagram No 8.31 & 8.30

At this time, "Call Attention" code is transmitted to Station 'B'. Receiving this code, Station 'B' inserts Station Master's key, turns, and further acknowledges intention to cancel "Train Going To" condition on telephone. If the signals had been taken off, reception signals and levers 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 stick circuit of relay CAR is held through holding path of relay CAR, as shown in the circuit diagram No 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" and "BCB" are operated 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 and 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, buttons "LCB" and "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 Home Signal 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. Home Signal lever or Station Master's slide controlling Home Signal is returned to Normal, and the bell stops. After verifying the complete arrival of train, the buttons "Cancel" and "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 "Train Going To" condition before the train enters the Block Section, excepting that the relay PCR in this case picks up without a time delay. Then buttons "BCB" and "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 No. 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(NV1-AA) and LCBR(NV1-AA) 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.

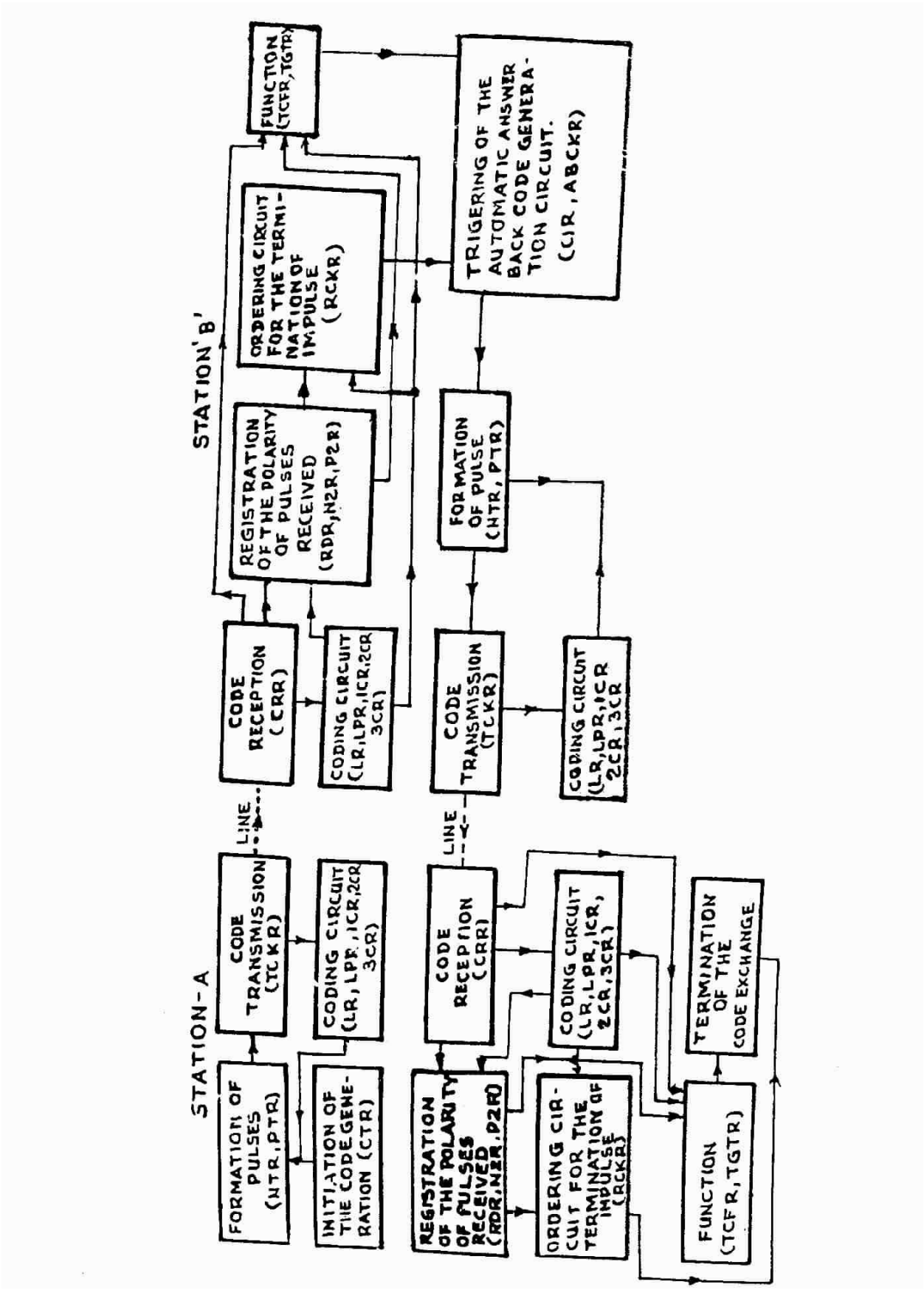


Fig : 7.1 BLOCK DIAGRAM SHOWING THE PRINCIPLE OF WORKING DURING A CODE EXCHANGE BETWEEN TWO CONNECTED INSTRUMENTS

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CHAPTER – 8: ALL 'Q' STYLE RELAY VERSION OF PUSH BUTTON INSTRUMENT

8.1 In this recently developed by Podanur workshop single line tokenless push button block instrument NV type relays are not used. Without changing the size and shape 'Q' series relays are used. Total 36 Nos. of relays provided with Button relays TGTBR, LCBR, BCBR 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. Depending upon the Block Section Condition and LSS aspect indication are available on the block operating panel.

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

The 'Q' 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			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 Advance starter and Home signal. The relays energised by external supply are SNR, ASTR, and TAR.

Reduction in relays compared to NV 40 relays and NV 36 relay instruments are:

4 relays eliminated in which P2 PR, ASR2 other relays CTPPR and ABCXR.

TOLAR and TAR in NV Type relay Block instrument Double coil relays are used. In the 'Q' relay type instrument Magnetic latch relays are used. Hence for releasing these relays circuit differs from earlier relay circuit.

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

ASR: Advanced starter Relay. (Earlier version ASR1 and ASR2)

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 the buttons BCB and TGB kept in pressed condition.

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

(b) BCBR and 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/selection 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. (i.e. only on receipt of line closed code).

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 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. The battery voltage depends on Length of block section and hence it varies from one section to other section.
4.	External circuit	24 V battery

This external circuit battery is generally provided at home or Adv. Starter 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 24 V & 29 V.

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 (QL1 Relays) should be in de-latched condition while commissioning the equipment.

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

8.4 COMPARISON OF 'Q' RELAY INSTRUMENT WITH CODING RELAY INSTRUMENT

Sl. No	Description	Instrument with coding Relay	Instrument with Q Relay	Reason/Adv. Of Q Relay Instrument
1	Total No. of relays used	Forty	Thirty six only	Saving of 4 relay
2	Types of relays used	Both coding and Q series relays are used	Q series relay only used	Uniformity and increase the scope of relay interchangability
3	Available of spare contacts	Mostly not available	Mostly available	No need to change a relay in case of contact failure
4	Availability of spare relays	Not readily available as these relays are used only in this instrument	Mostly available in all stations as Q relays are used in all most all circuits	Instrument failure duration can be reduced
5	Current drain	Approx. 1.8 A	It is 1.2 A maximum	Saving of power
6	Change of jack boards and wiring alterations at site	It is very much difficult and requires only efficient and experience staff	It is quite easy and can be done by all staff	Instrument failure duration is minimised
7	Reliability of relays worked	Wide variation	Mostly reliable	Instrument failure can be minimised
8	Fusing of contacts	More possibility except in external circuits because of metal to metal contacts	No possibility as the contacts are metal to carbon	Instrument failure can be minimised
9	Manufacturing cost of the instrument	More	Less	Economy and easy production

8.5 CIRCUITRY COMPARISON

Sl. No	INSTRUMENT WITH CODING RELAY	INSTRUMENT WITH 'Q' RELAYS	REMARKS
1	Both single and double winding non-vital relays are employed. Further the relays TCKR & CRR are of different types and requires special care in Manufacturing of TCKR in order to achieve identical electrical characteristics for trouble free working.	Only vital relays are employed. Regarding TCKR & CRR(QB3) same type relay is used and this reduces the risk in obtaining identical electrical characteristics	Increases the scope of relay interchangeability and minimise the failure.
2	Premature appearance of TCF-TOL and other relay failures due to low voltages is eliminated/ minimized by carrying out the suggested twelve alterations.	It is totally eliminated in the initial circuit design itself ref. Bell circuit and CRR circuit.	Trouble shooting is made easy.
3	Premature suppression of TOL code transmission is prevented by adding an additional relay CTPPR	It is achieved by CTPR relay itself	Saving of one relay
4	Change of codes (1) from TCF to line closed by release of TGB button & (2) line closed answer back code to TCF code by pressing TGB button during answer back are prevented by having additional relays ABCXR & LCCPR.	It is achieved by LCCPR itself by allowing it to drop only after the completion of line closed code transmission.	Saving of relay
5	Bimetallic thermal type relay is used for achieving cancellation time	Electronic timer is employed	Helps in maintaining constant time irrespective of temp & voltage variations
6	Possibility of setting both instrument to TGT immediately after setting the instruments to line closed condition (without setting the other instrument to TCF) by pressing BCB and TGB and feeding TGT code externally is prevented by picking up of CTPPR only in one coil and using its front contact in TGTR latch circuit.	It is not possible to set even one Instrument as TGBR circuit is modified and including CTPR down contact in CRR circuit.	More safe and reliable in its working.

8.6 CIRCUITRY CHANGES AND THEIR REASONS

Sl. No	Relay Circuit	Contacts included	Reasons
1	CTR Circuit	LCCPR back contact	To prevent transmission of TGT code for a line closed enquiry code during normal cancellation due to non co-operation at the other end.
		Addition front contact of CTR in its condenser circuit and SNR front contact in its negative limb	To prevent discharge of CTR condenser through TGTR/TCFR coils and setting the instrument to line closed condition without SNR.
2	CRR Circuit	TOLTR front contact in parallel with TGBR front contact	To close line circuit for receiving TOL acknowledgement from other station.
3	TOLAR Circuit	2CR front contact in latch coil circuit.	To prevent picking up of TOLAR at the end of the code-after the instrument changes to line closed condition.
		3CR front contact & 1CR back contact in detach coil circuit.	To set this relay to its normal condition in the event of TCFR/TGTR not picking up at the end of their respective codes.
4	SHK coil circuit	ASR back contact .	To allow shunting only in TGT TOL condition after setting the instrument to TGT
5	BCBR, TGBR and LCBR circuit	SM's key in contact.	To minimise number of SM's switch contact and to make its manufacturing process easier.
6	SHKR circuit	Front contacts of CTR TCFR and LCCPR in its stick circuit.	To facilitate transmission of answer back code with no drain circuit arrangement.
		Back contacts of CTPR and LCCPR in its initial pickup circuit.	To ensure that these (last dropping relays) relays are assumed their normal position prior to initiation of a line clear.
		Condenser across its coil.	To prevent momentary dropping and picking up of this relay during the process of answering back code (in changeover pause period) transmission.
		TAR back contact.	To prevent continuous buzzer during line closed operation in case its key in contact is offering High Circuit Resistance

Sl. No	Relay Circuit	Contacts included	Reasons
7	ASTR Circuit	ASCR back contact	To avoid proving of its back contact in SNR circuit as it prevents appearance of SNR (K) on putting back LSS and its controlling lever to normal (which has been cleared for a train) for normal cancellation or for other reasons.
8	TOLTR circuit	Front contacts of 1CR & RCKR in parallel	To prevent TOLTR condenser discharging through buzzer & causes only short TOL buzzer.
9	LCCPR circuit	Front contacts of LCCPR & SHKR	To retain LCCPR in up condition so as to complete the transmission of line closed answer back code.
10	PCR, CAR and timer circuit	PCR B1 & B2 front contact	To prevent timer feeding CAR in addition to PCR relay during normal cancellation.
		TAR B1 & B2 reverse contacts.	To prevent PCR picking up during push back cancellation.
		Additional ASR D1 & D2 front contact in CAR relay circuit.	To prevent PCR picking up during push back cancellation.
		TAR back contact C5 & C6 normal in timer circuit.	To prevent-ve connected to Timer output terminal A1 on arrival of a train at train receiving end.
		TOLAR 1 & 2 (R) contact in timer –ve limb	To allow timer circuit to work only for normal cancellation and to prevent short circuiting of local battery.
		Condenser across PCR relay & ASR relay.	To assist in PCR picking up during normal cancellation as picking up of PCR results in cutting of supply to timer.
11	Free indication circuit	PCR front contact	To prevent appearance of free indication immediately on carrying out normal cancellation.
		TGTR(R) contact in the –ve limb of the free indication.	To prevent momentary free indication along with line closed indication on normal cancellation due to PCR/CAR condenser.
12	1CR Circuit	Additional 3CR back contact	To prevent 2CR second time picking up during third pulse transmission.
13	Bell circuit (suggested but not introduced at present.)	Back contact of TGBR & TOLAR front contact in parallel.	To prevent possibility of line battery coming in series with the other instruments local battery due to one reason or other during answer back TGT code transmission/reception.

14	TGBR circuit	CTPR back contact.	To prevent setting of an instrument to TGT by pressing BCB & TGB buttons immediately after setting the instrument to line closed condition and at the same time feeding TGT code from externally.
15	CTPR circuit	3CR front contact in initial pickup circuit.	To allow CTPR to pick up only after transmission of 2nd pulse to save one relay CTPPR
16	ASR circuit	Addition TGTR(R) D3 & D4 contact Addition 1CR front contact. TGTPR & LCCPR back contacts.	To prevent ASR & TGTR picking up without SNR, BCBR and etc. To prevent back feeding of N2R relay at the end of 3rd TGT pulse. To have additional protection to ASR circuit.
17	ASCR circuit	PCR back contact	To have double break in ASCR circuit during cancellation.
18	TGTPR circuit	Additional TGTR(R) contact in –ve limb.	To prevent picking up of TGTPR without TGTR pickup.
19	TAR circuit	TGTPR & TCFPR back contacts and LCCPR front contact. TGTPR & TCFPR front contact PCR back contact.	To prevent TAR picking up when a train is received without line clear. To open the TAR pickup coil circuit after it picks up and to Prevent detaching of this relay due to any back EMF in its extended circuit.

8.7 SPLIT CIRCUITS

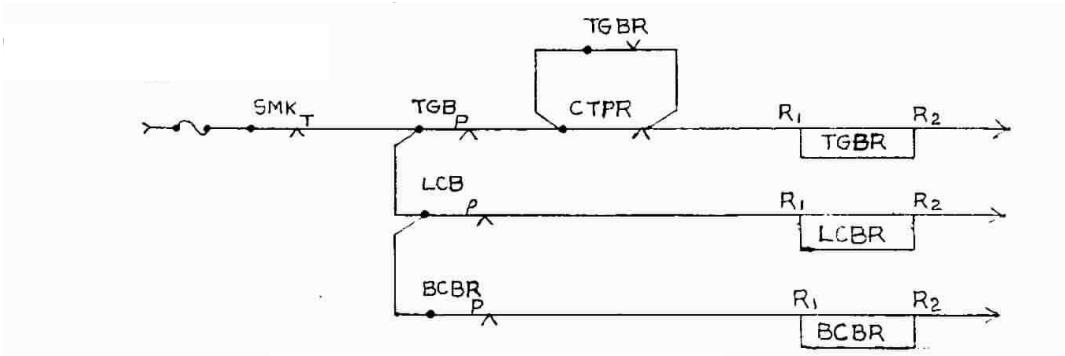


Fig : 8.1 PUSH BUTTON CIRCUITS

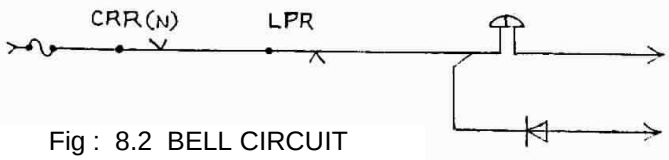


Fig : 8.2 BELL CIRCUIT

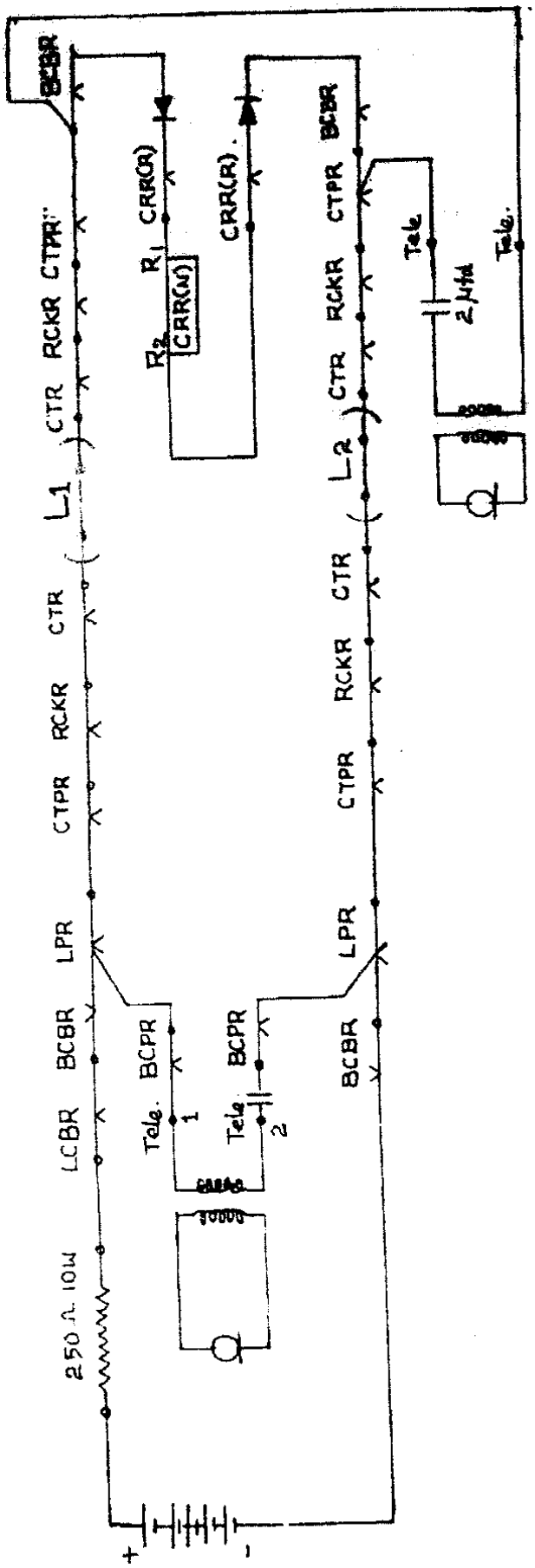


Fig : 8.3 LINE CIRCUIT FOR BELL AND TELEPHONE

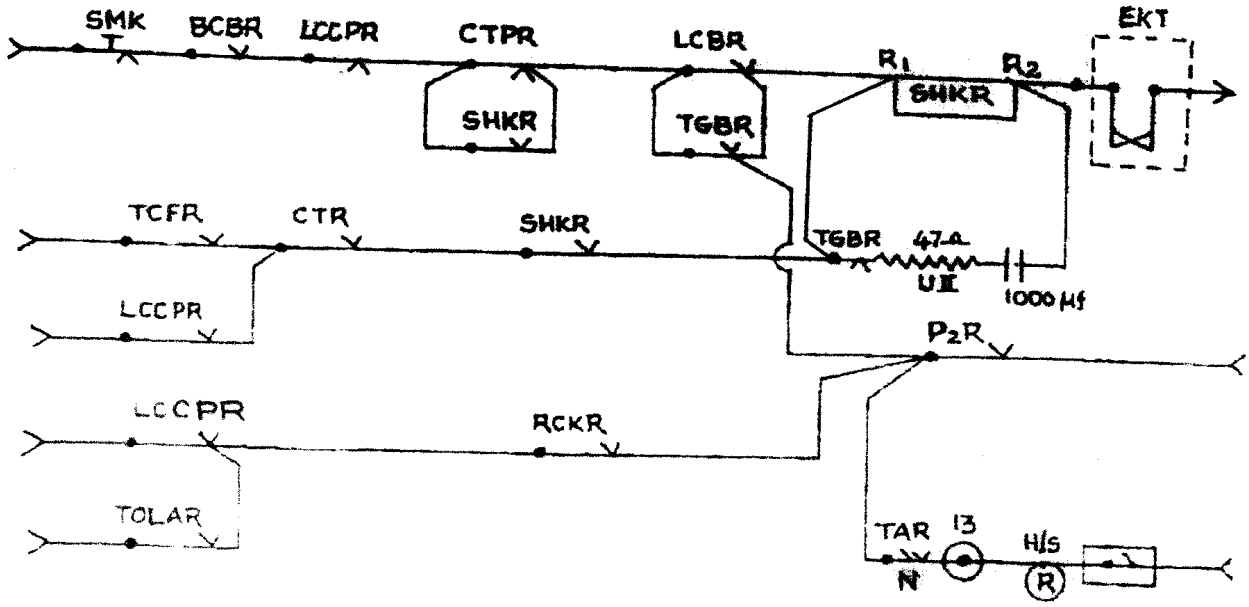


Fig : 8.4 SHKR CIRCUIT

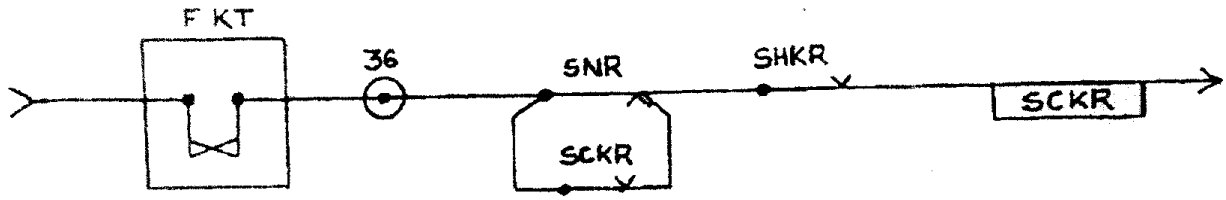


Fig : 8.5 SCKR CIRCUIT

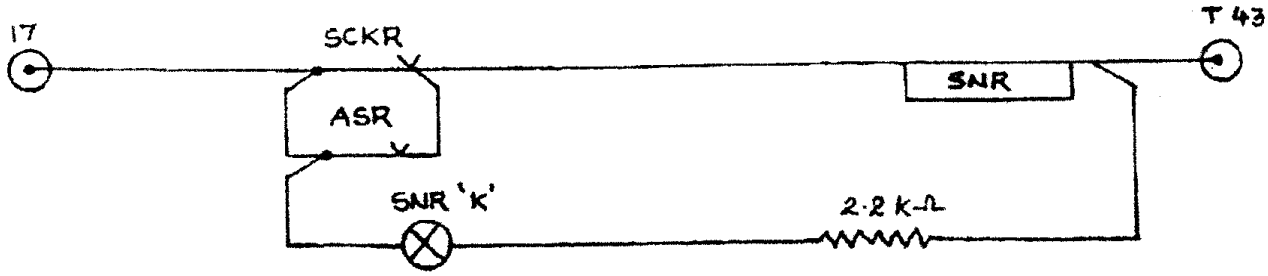


Fig : 8.6 SNR CIRCUIT

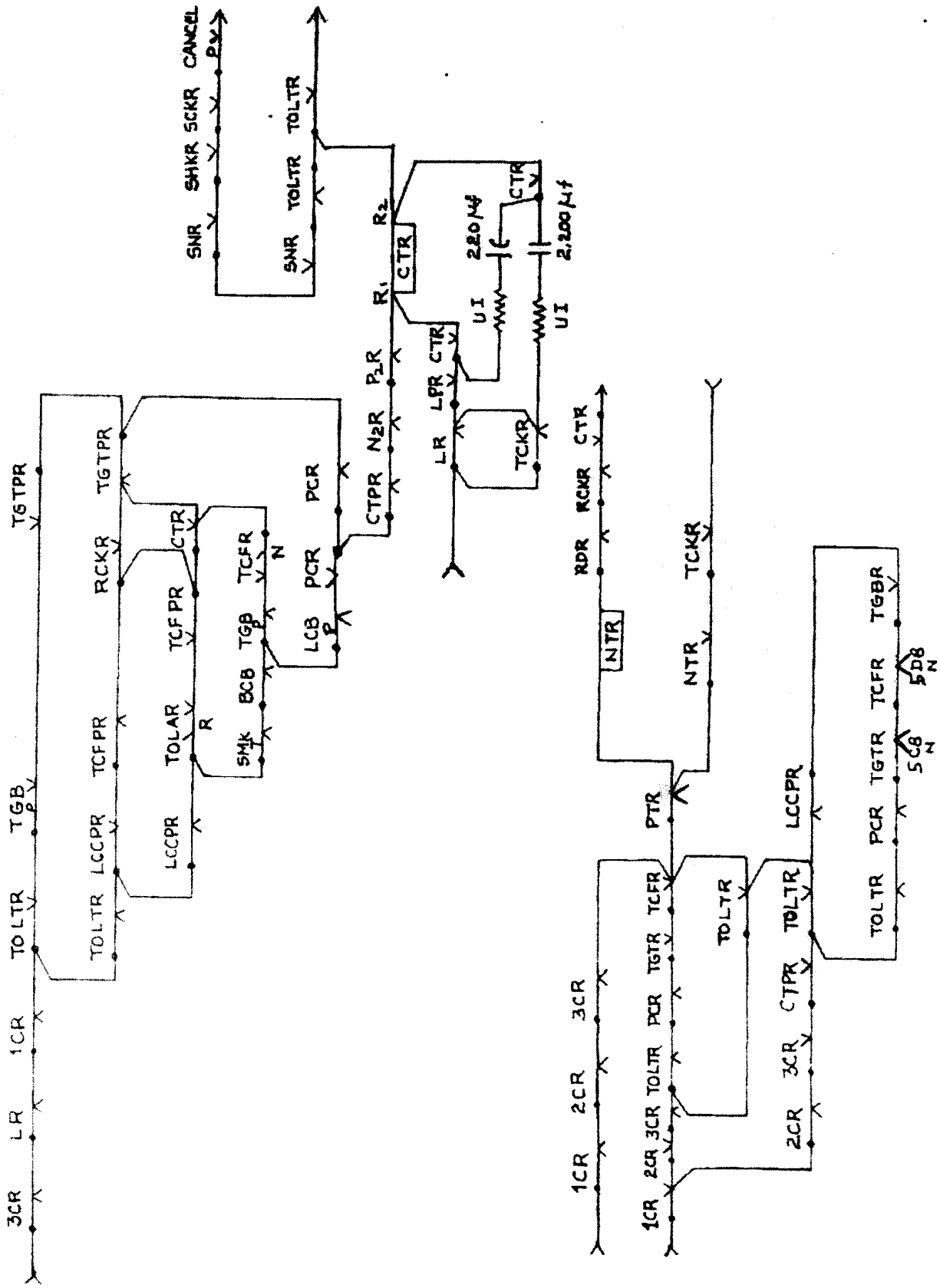


Fig : 8.7 CTR CIRCUIT & Fig : 8.8 NTR CIRCUIT

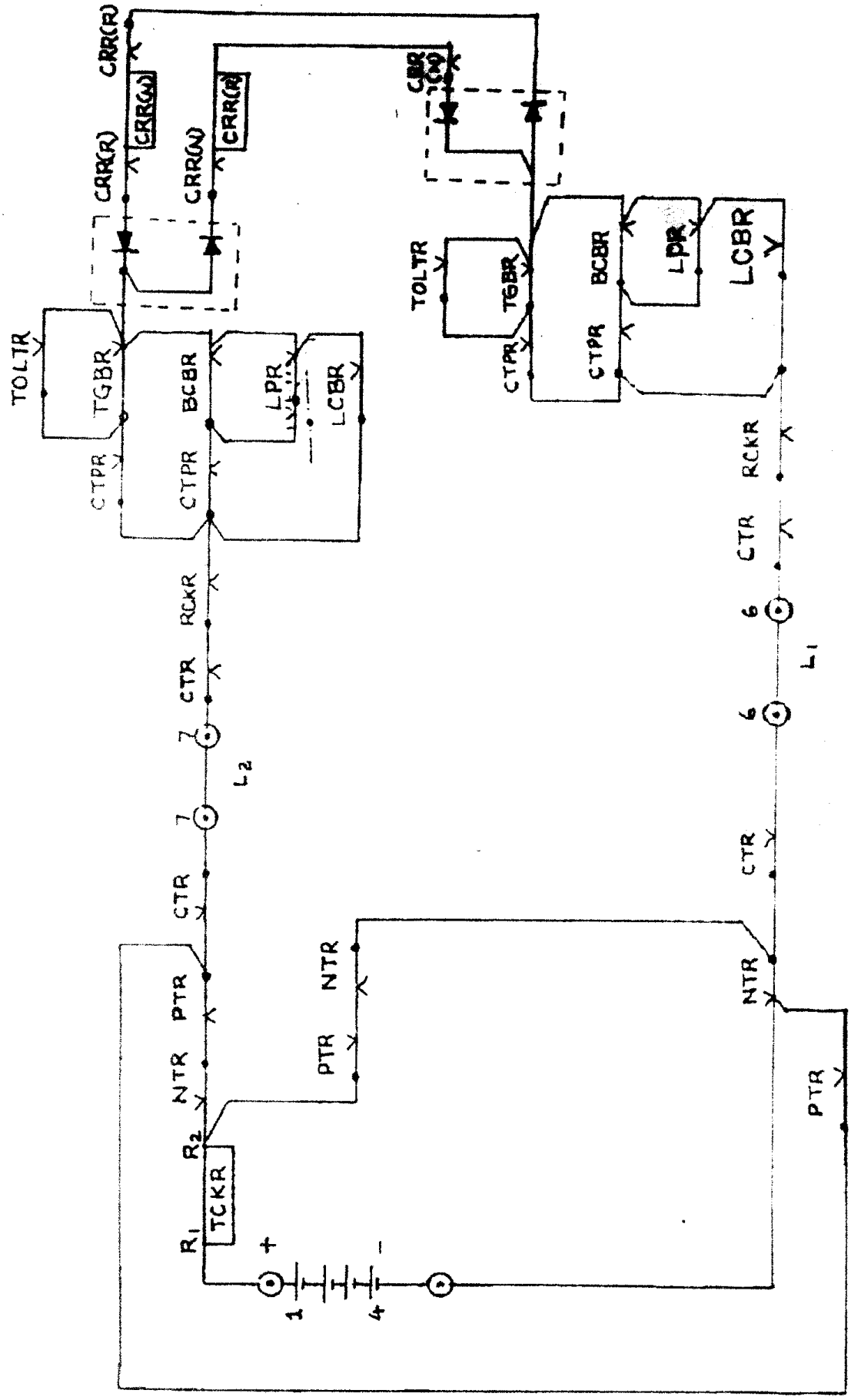


Fig : 8.9 TCKR & CRR LINE CIRCUIT

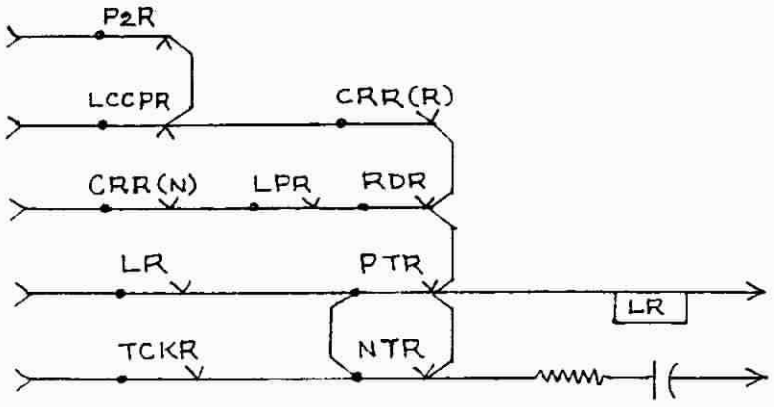


Fig : 8.10 LR CIRCUIT

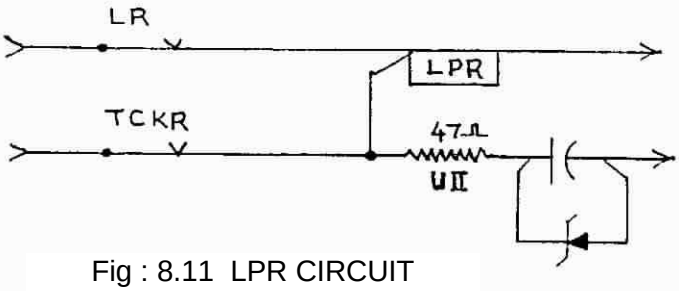


Fig : 8.11 LPR CIRCUIT

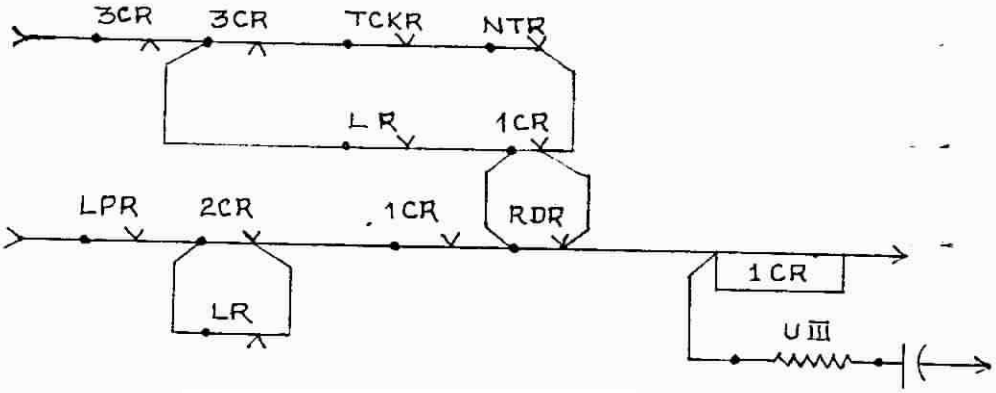


Fig : 8.12 1CR CIRCUIT

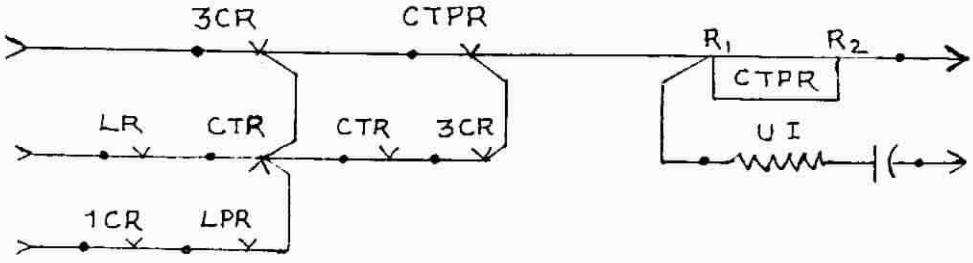


Fig : 8.13 CTPR CIRCUIT

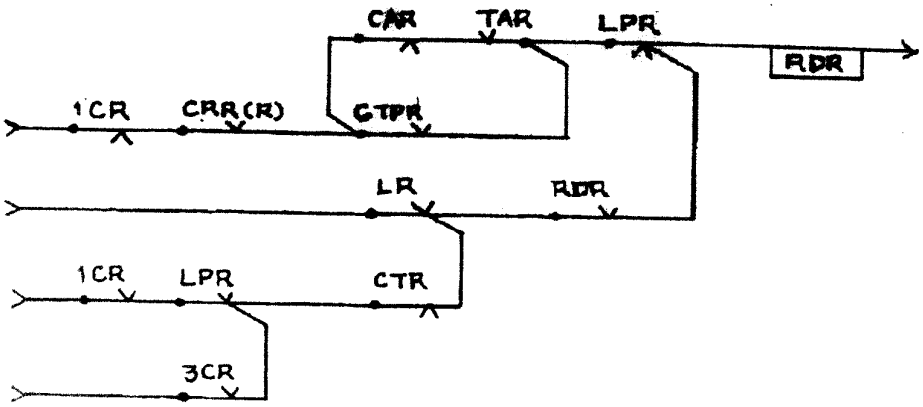


Fig : 8.14 RDR CIRCUIT

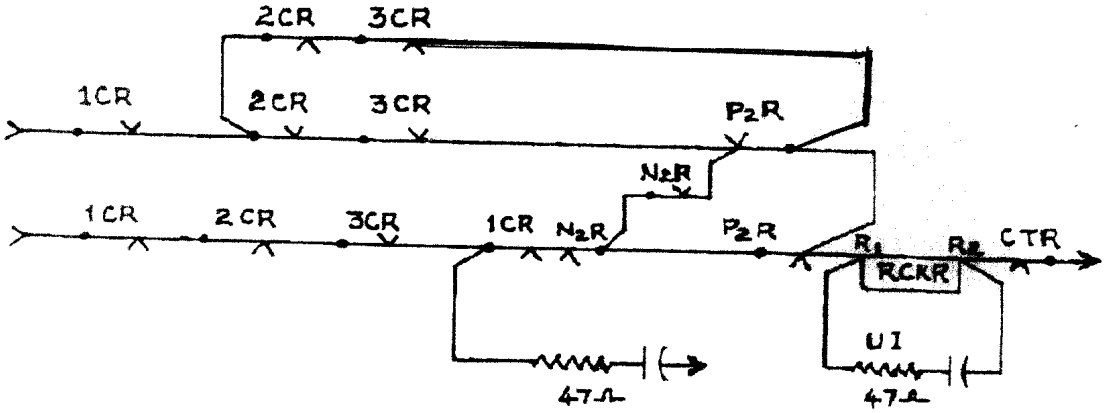


Fig : 8.15 RCKR CIRCUIT

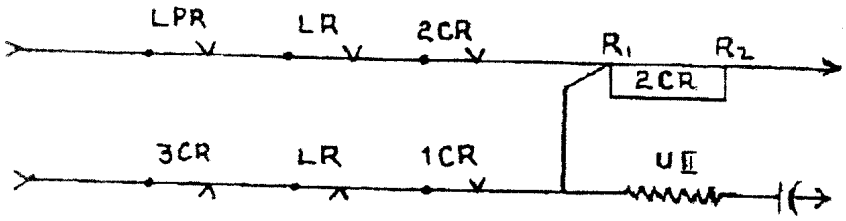


Fig : 8.16 2CR CIRCUIT

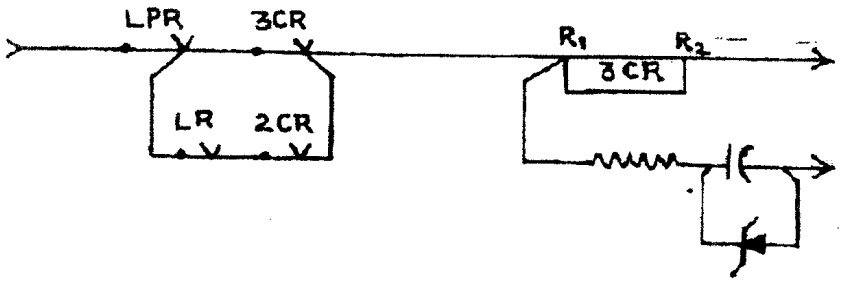


Fig : 8.17 3CR CIRCUIT

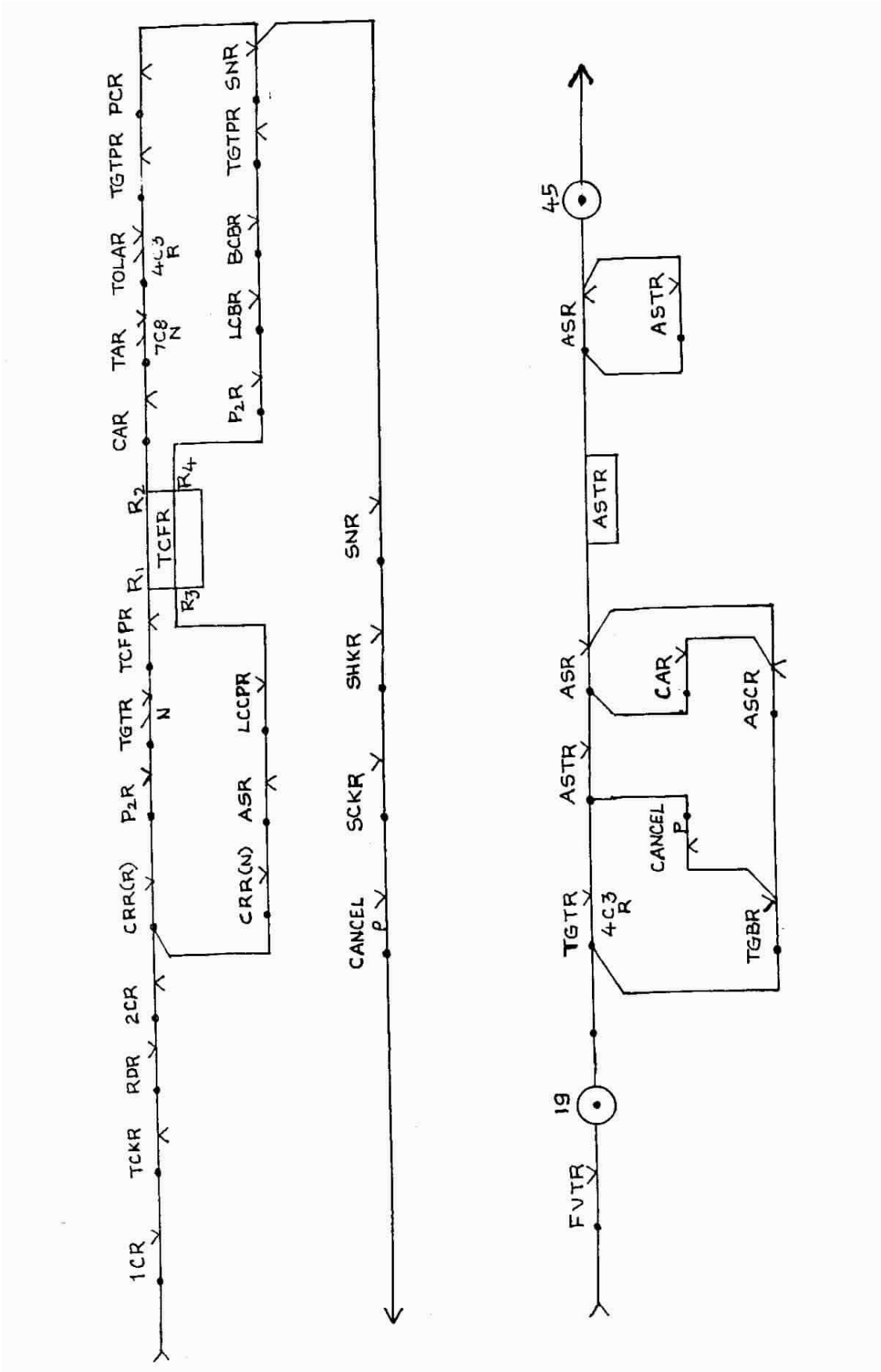


Fig : 8.18 TCFR CIRCUIT & 8.19 ASTR CIRCUIT

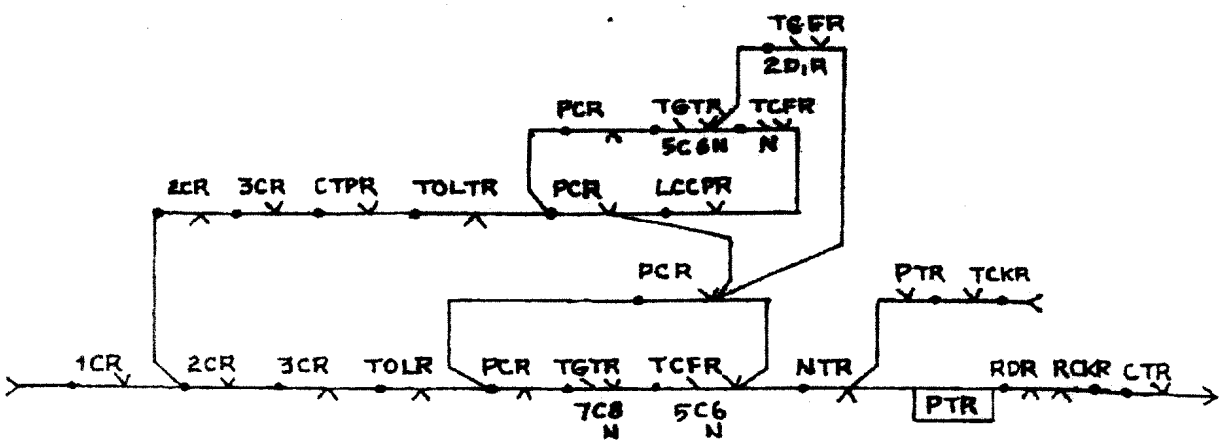


Fig : 8.20 PTR CIRCUIT

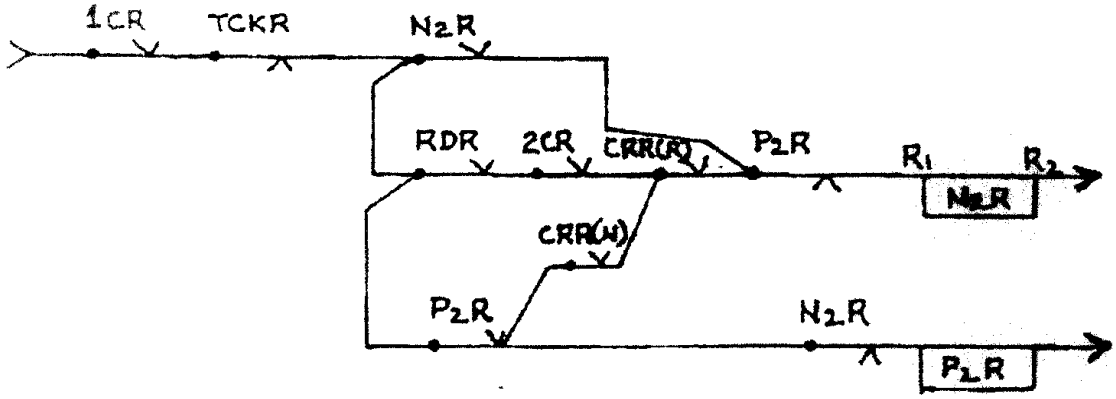


Fig : 8.21 P2R/N2R CIRCUIT

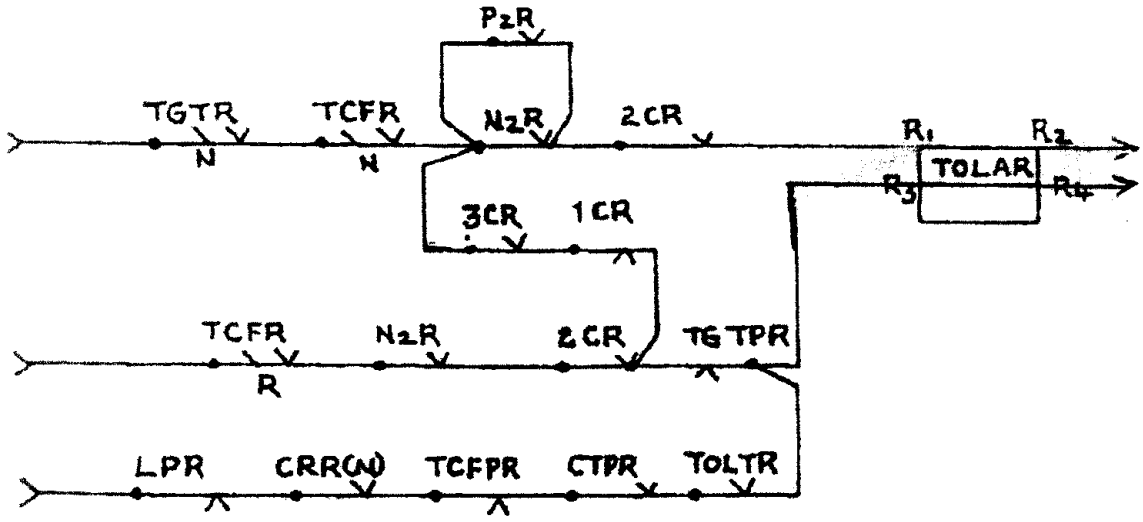


Fig : 8.22 TOLAR CIRCUIT

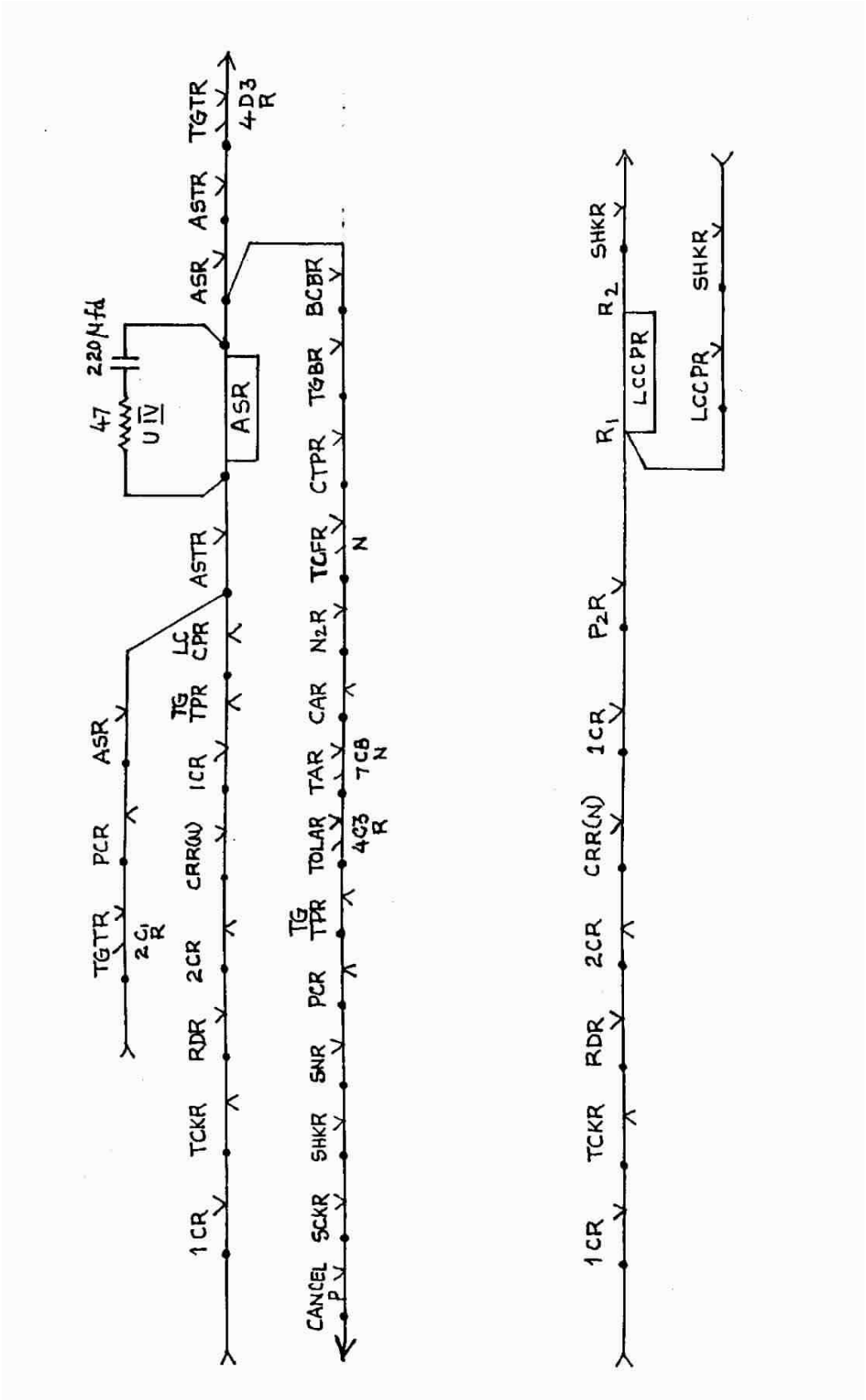


Fig : 8.23 ASR CIRCUIT & Fig : 8.24 LCCPR CIRCUIT

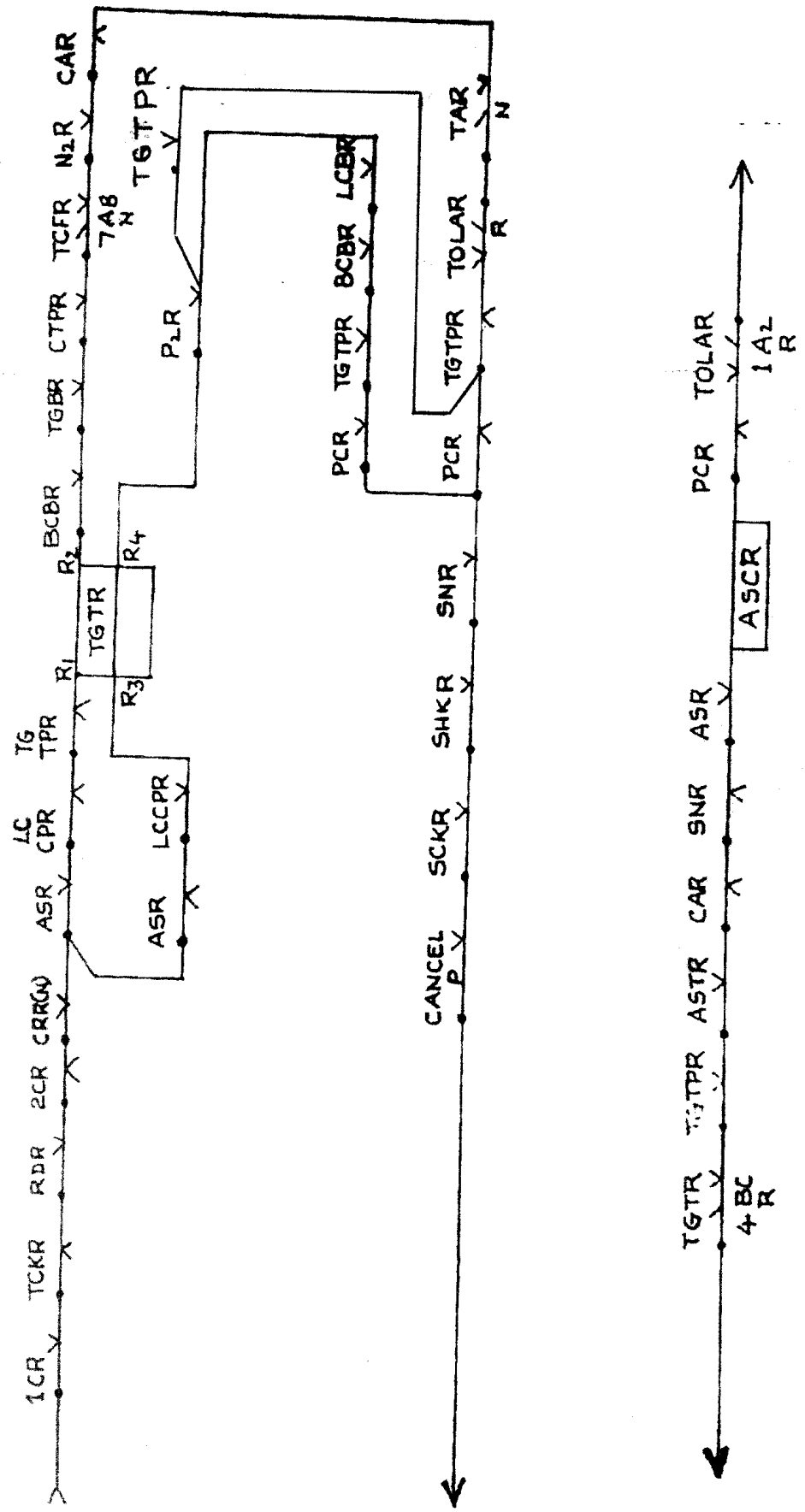


Fig : 8.25 TGTR CIRCUIT & Fig : 8.26 ASCR CIRCUIT

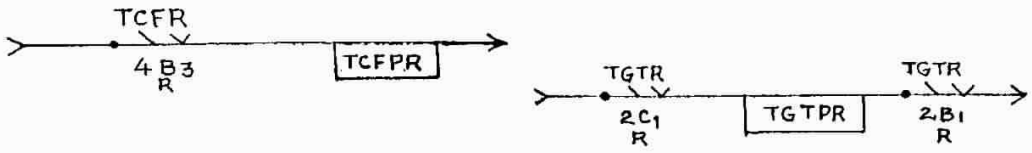


Fig : 8.27 TCFPR/TGTPR CIRCUIT

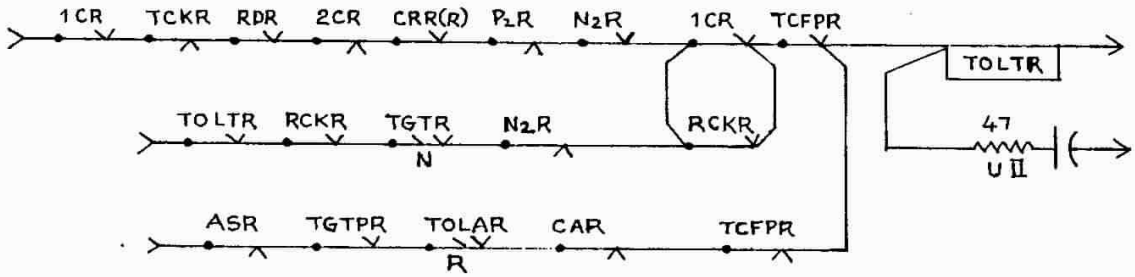


Fig : 8.28 TOLTR CIRCUIT

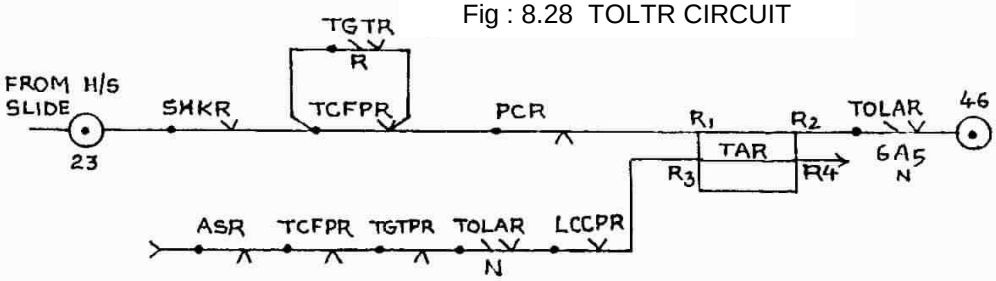


Fig : 8.29 TAR CIRCUIT

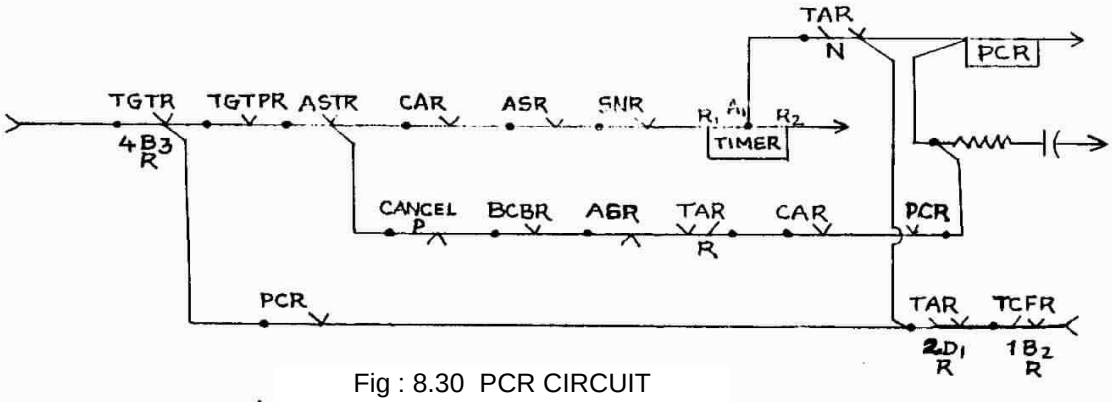


Fig : 8.30 PCR CIRCUIT

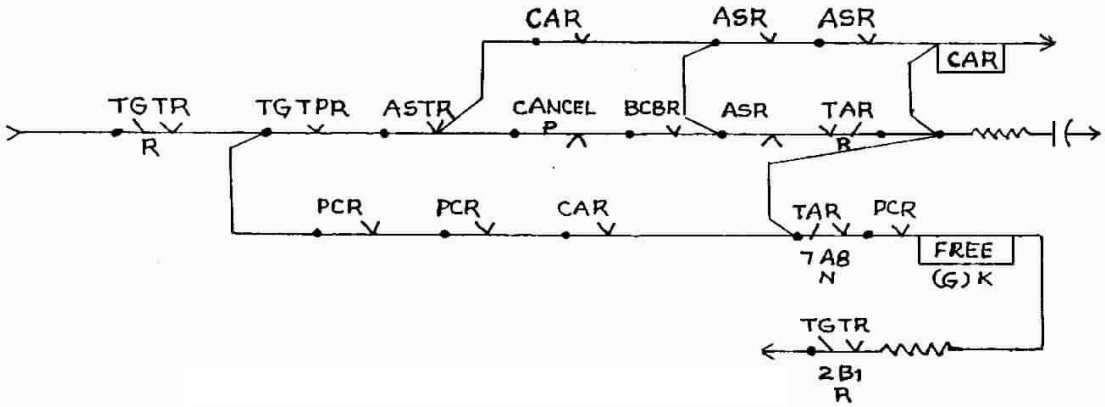
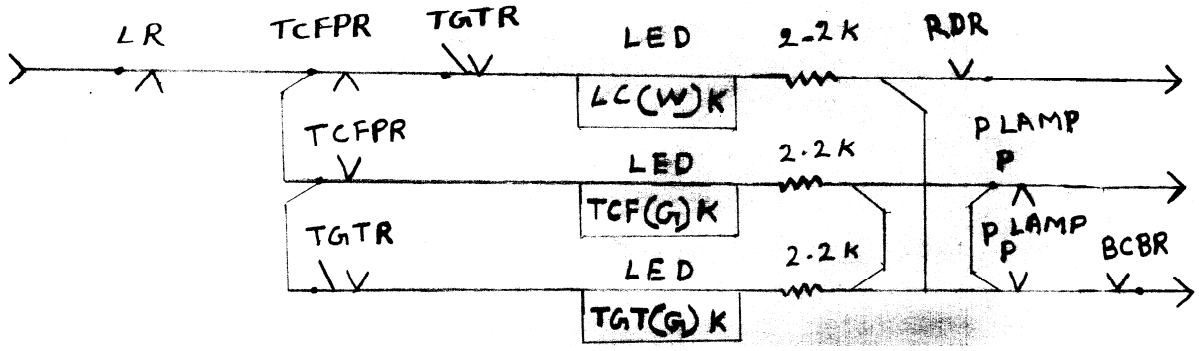
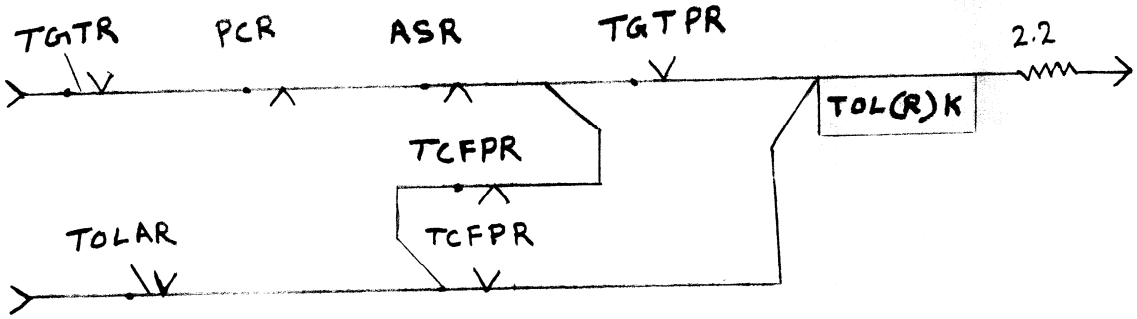


Fig : 8.31 CAR & FREE INDICATION CIRCUIT



8.32 INDICATION CIRCUIT



8.33 TOL INDICATION

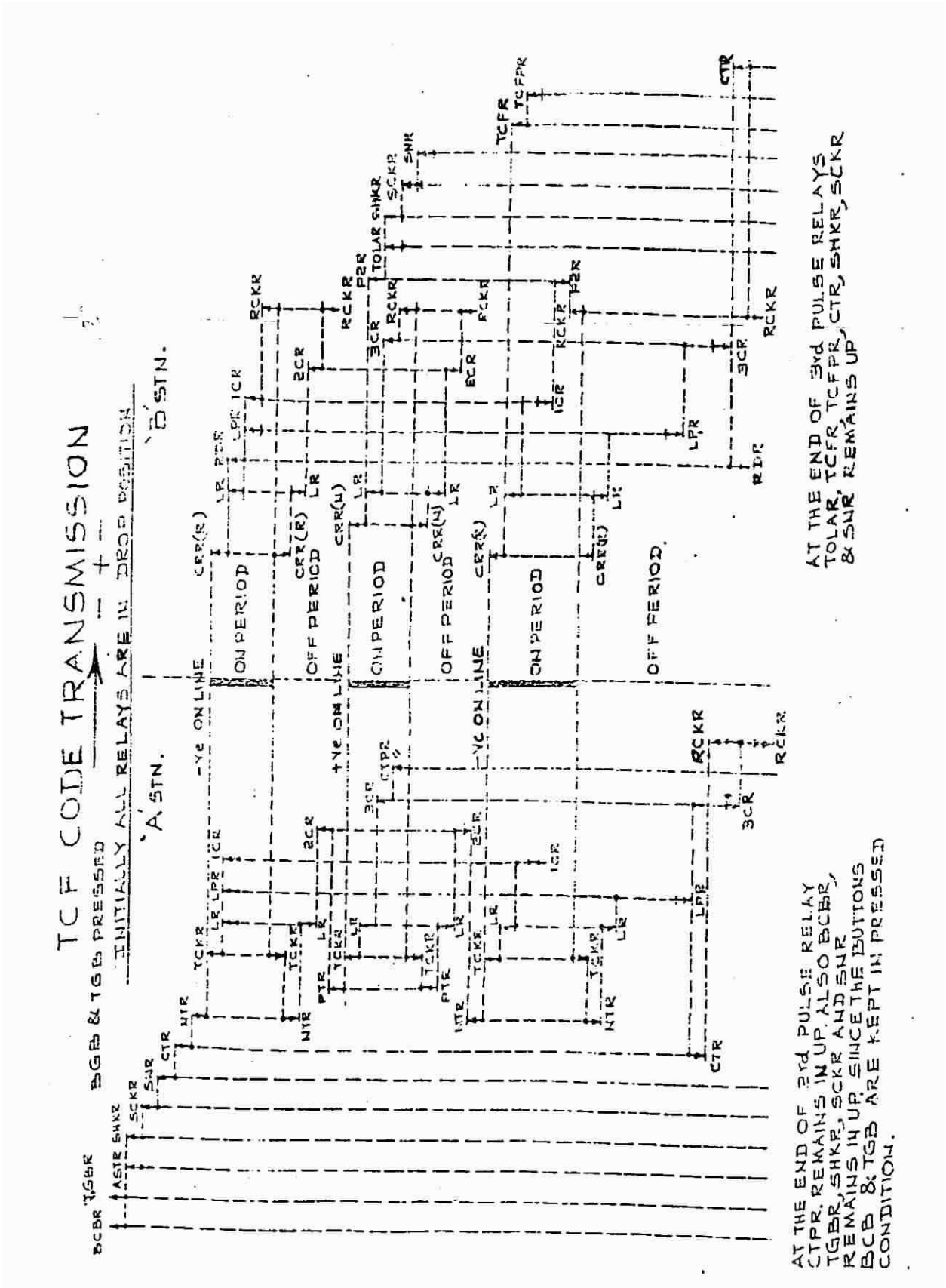


Fig : 8.32 TCF CODE TRANSMISSION FLOW CHART

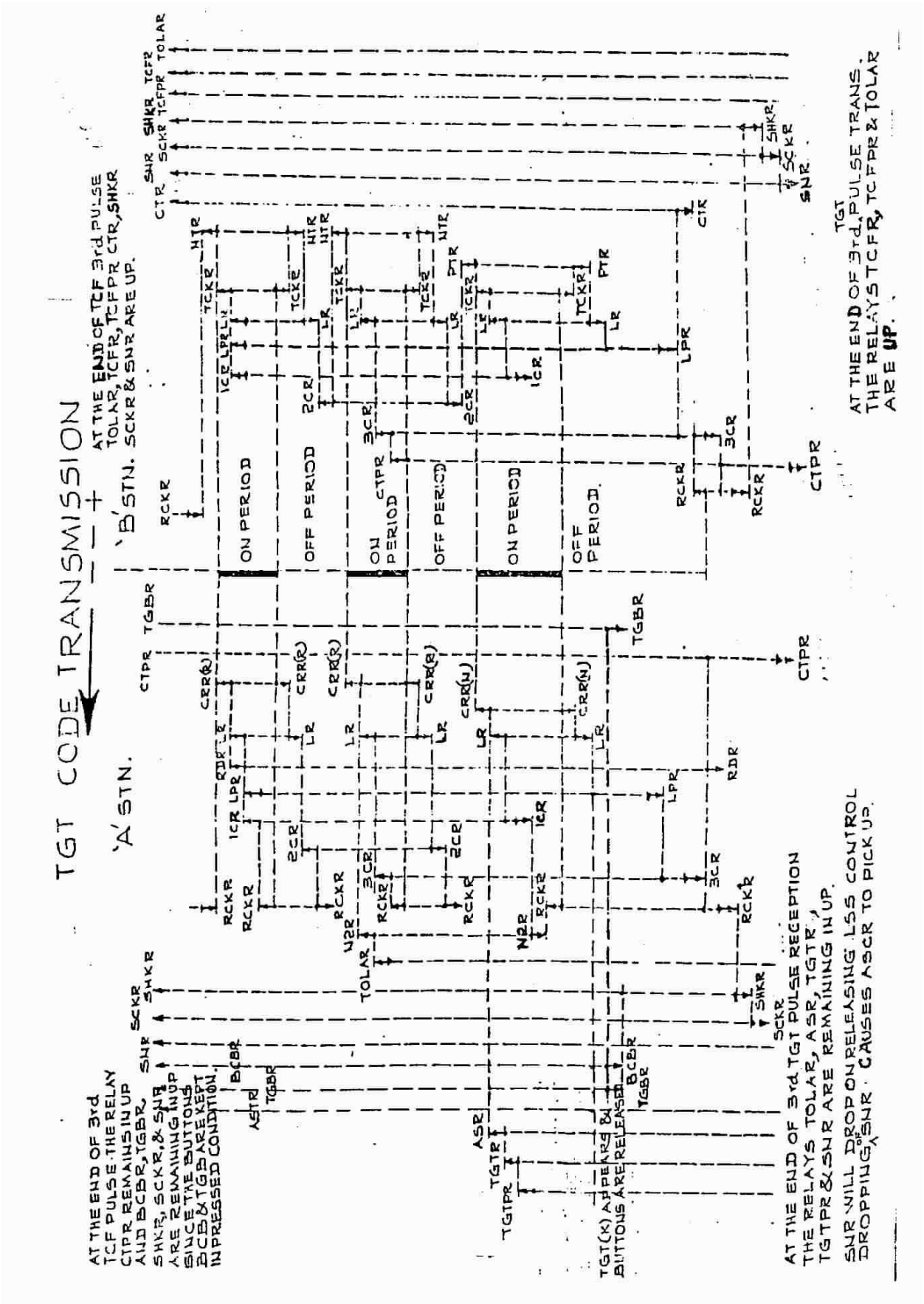


Fig : 8.33 TGT CODE TRANSMISSION FLOW CHART

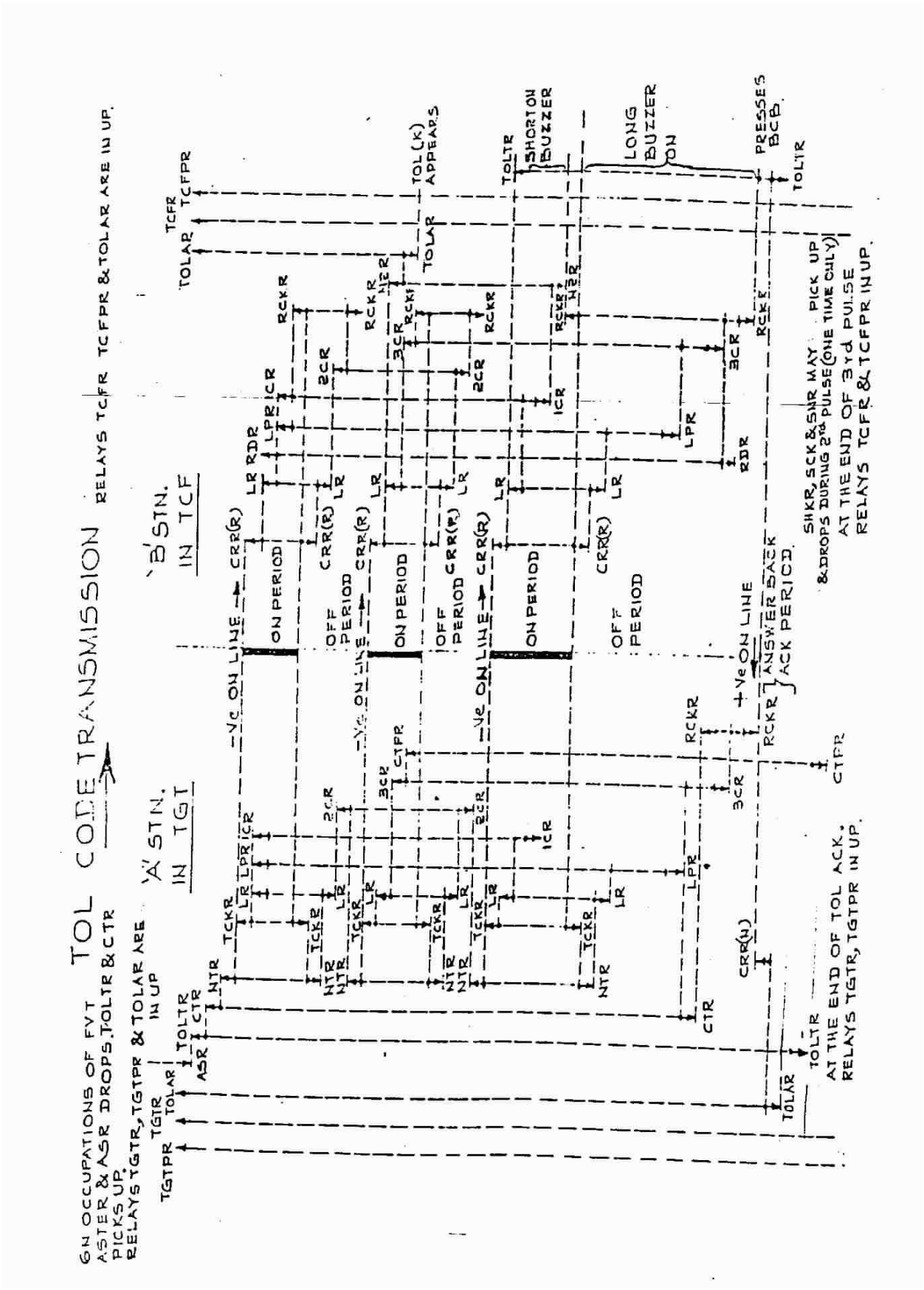


Fig : 8.34 TOL CODE TRANSMISSION FLOW CHART

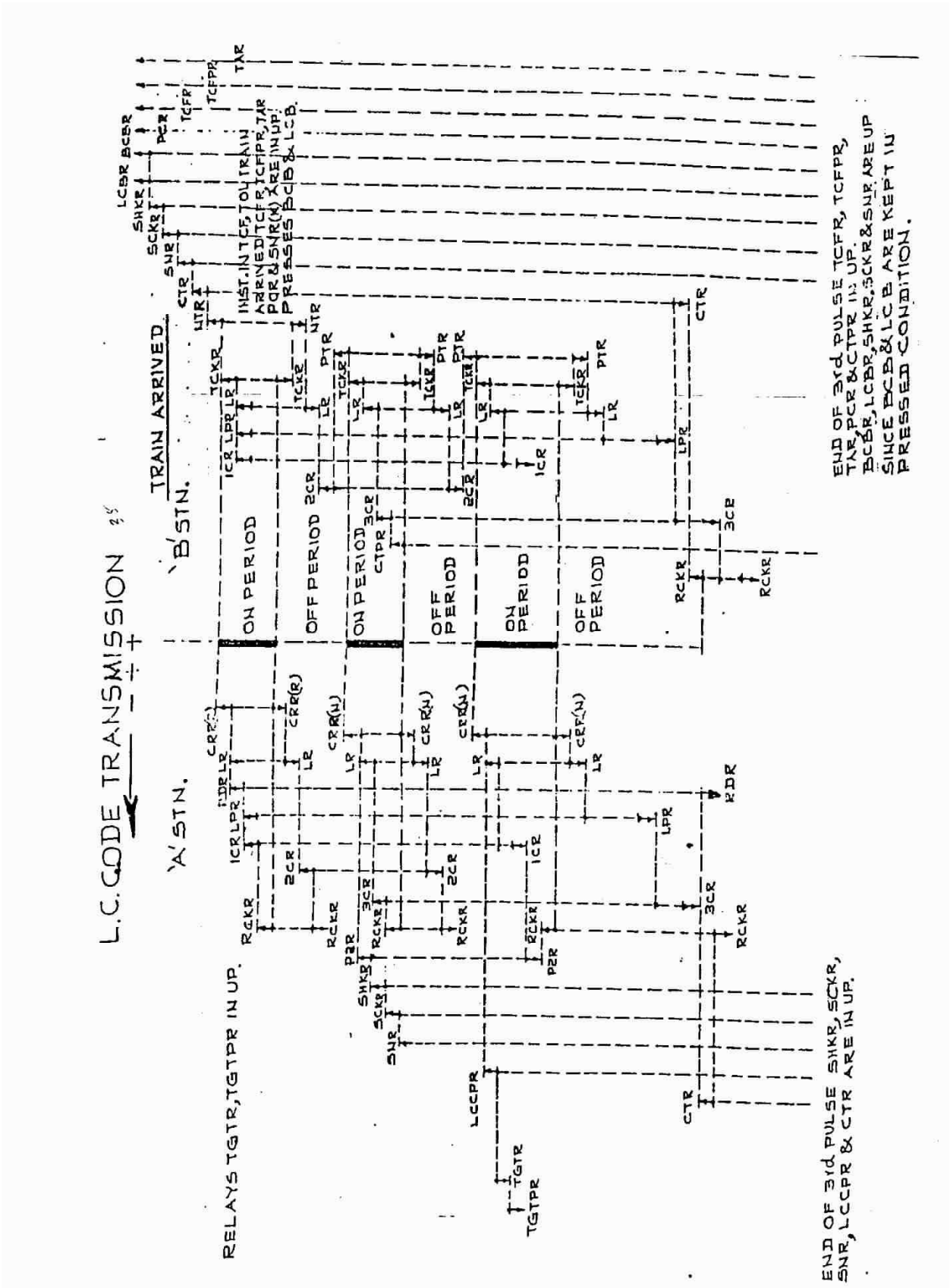


Fig : 8.35 LINE CLOSE CODE TRANSMISSION FLOW CHART

* * *

CHAPTER – 9: METHOD OF OPERATION

(Both Stations are assumed to be equipped with Semaphore Signals)

9.1 To send a train from Station 'A' to Station 'B'

Station 'A'	Station 'B'
Block Instrument in 'Line Closed' condition and Outer and Home or Distant and Home Signals, as the case may be, and Last Stop Signal at "ON"	Block Instrument in 'Line Closed' condition and Outer and Home or Distant and Home Signals, as the case may be, and Last Stop Signal at "ON".
(1) Inserts the Station Master's Key and turns	
(2) Presses the 'Train going To' button along with the "Bell code" button.	
	(3) Block Instrument displays 'Train Coming From' indication.
(4) Block Instrument displays 'Train Going To' indication. Releases buttons.	
(5) (a) Takes 'OFF' the Last Stop Signal.	
(b) Train enters Block Section.	
(c) Last Stop Signal return to "ON" automatically.	
(d) 'Train on Line' indication appears automatically.	
(e) Last Stop Signal Lever and Station Master's slide are replaced to normal.	
	(6) 'Train on Line' indication appears automatically and audible warning sounds.
	(7) (a) Inserts Station Master's Key and turns.
	(b) Acknowledges audible warning by pressing the 'Bell Push' button.
	(c) Audible warning stops.
	(8) Calls attention through 'Bells code' button and attends on telephone
(9) Acknowledges 'Call Attention' through 'Bell code' button 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 reception signals.
	(b) Train enters the station.

	(c) First Stop Signal replaced to 'ON' position automatically.
	(d) Audible warning sounds.
	(e) First Stop Signal lever (and Home Signal Lever or Station Master's slide controlling Home signal if required) replaced to Normal
	f) Audible warning stops.
	(14) Where automatic device is provided for proving complete arrival of a train, section is automatically closed. Where this is not, the 'Line Closed' button along with the "Bell code" button is operated, after visually checking that the complete train has arrived and that all signals are at 'ON'.
(15) Block Instrument set to 'Line Closed' condition.	
	(16) Block Instrument set to 'Line Closed'
Note: the procedure for sending a train from Station 'B' to 'A' is same.	

9.2 To cancel the "Train Going To" condition before a train enters the Block Section

Station 'A'	Station 'B'
Block Instrument displays 'Train Going To" indication and Last Stop Signal at "ON"	Block Instrument displays 'Train Coming From' indication and First Stop Signal at "ON"
(1) Replaces Last Stop Signal Lever and Station Master's slide to normal if the signal had been taken "OFF"	
(2) (a) Inserts Station Master's Key and turns	
(b) Operates the 'Cancellation' button/along with the "Bell code" button.	
(c) Counter registers next higher number	
(3) Calls attention through "Bell code" button, and attends on telephone.	
	(4) (a) Attends and inserts Station Master's Key and turns.
	(b) Acknowledges "Call Attention" and attends on telephone.
(5) Advises on telephone intention to cancel "Train Going To" condition.	
	(6) Acknowledge intention to cancel 'Train Going To' condition.

Station 'A'	Station 'B'
	(7) Replaces reception Signal Lever and Station Master's slide to normal, if the signals had been taken 'OFF'
(8) Time release "Free" indication appears . after 2 minutes after the 'Cancellation' button is operated.	
(9) Calls attention and presses the 'Line Closed' button along with the 'Bell code' button after checking that all relevant signals are at 'ON'.	
	(10) Acknowledges and co-operates for normalizing of the instruments by pressing the 'Line closed' button along with the 'Bell code' button.
	(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 'Train Going To' and "Train on Line" indication	Block Instrument displays 'Train Coming From' and 'Train on Line' indications and audible warning sounds.
	1(a) Inserts Station Master's Key and turns. (b) Acknowledges audible warning by pressing the 'Bell code' button. (c) Audible warning stops. (d) Calls attention through 'Bell code' button, and attends on telephone.
(2) (a) Inserts Station Master's Key and turns.	
b) Acknowledges 'Call Attention' through 'Bell Push' button and attends on telephone.	
3) Advises intention to push back the train.	
	(4) Acknowledges intention to push back the train, and replaces reception Signal levers and Station Master's slide to normal, if the signals had been taken 'OFF'.
(5) (a) Takes 'OFF' the reception signals.	
(b) Train returns to the station.	
(c) First Stop Signal replaced to 'ON' position.	

Station 'A'	Station 'B'
(d) Audible warning sounds.	
(e) First Stop Signal Lever (and Home Signal lever or Station Master's slide controlling Home Signal, if required) returned to normal.	
(f) Audible warning stops.	
(6) (a) Operates the 'Cancellation' button/ for pushing back along with the 'Bell code' button. (b) Counter registers next higher number.	
(7) (a) Verifies complete arrival of train usually or through automatic device where provided and that all relevant signals are at 'ON'.	
(b) Calls attention and operates the 'Line Closed' button along with the 'Bell code' button.	(7) (c) Acknowledges and co-operates for normalizing of the instruments by pressing the 'Line Closed' button along with the 'Bell code' button.
	(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 Last Stop Signal and opposing First Stop Signal

Station 'A'	Station 'B'
Block Instrument in 'Line Closed' condition and Outer and Home or Distant and Home Signals, as the case may be, and Last Stop Signal at 'ON'.	Block Instrument in 'Line Closed' condition and Outer and Home or Distant and Home Signals, as the case may be, and Last Stop Signal at "ON".
(1) Inserts Station Master'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 Shunting Key to Station Master.	
(b) Shunting Key is replaced in the instrument.	
Note: If Station 'B' fails to establish 'Train Going To' condition when Station 'A' has extracted the shunting key, Station 'B' should verify position from Station 'A', who should advise Station 'B' as soon as shunting is completed.	

9.5 To shunt between the Last Stop Signal and Opposing First Stop Signal behind a departing train with the instrument in "Train Going To" condition.

Station 'A'	Station 'B'
Block Instrument in 'Train Going To' condition and Outer and Home or Distant and Home Signals as the case may be and Last Stop Signal at 'ON'.	Block Instrument in 'Train Coming From' condition.
(1) Inserts Station Master's Key and turns.	
(2) (a) Takes out the shunting key.	
(b) Hands over the shunting 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 shunting key to Station Master.	
(b) Shunting 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 Station 'B' fails to establish 'Line Closed' condition as, Station 'A' has extracted the shunting key, Station 'B' should verify position from Station 'A'/	
(3) (a) After completion of shunting, driver returns the shunting key to Station Master.	
(b) Shunting 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 instruments to 'Line Closed' condition.

9.6 Operation of Slip and Catch Siding while sending a train from Station 'A' to Station 'B'.

Station 'A' is assumed to be provided with a Slip Siding protected by Last Stop Signal and Station 'B' with Catch Siding protected by First Stop Signal.	
Block Instrument displays 'Train Going To' indication.	Block Instrument displays 'Train Coming From' indication.
(1) Inserts Station Master's Key and turns.	
(2) (a) Takes out the Slip siding key.	
(b) Transmits the slip siding key to the siding point either electrically or manually.	
(c) Slip siding point is set.	

(3) (a) Takes off the Last Stop Signal.	
(b) Train enters Block Section.	
(c) Last Stop Signal returns to 'ON' automatically.	
(d) 'Train on Line' indication appears automatically.	
(e) Last Stop Signal Lever and Station Master's Control are returned to normal.	
	(4) 'Train on Line' indication appears automatically and audible warning sounds.
	(5) (a) Inserts Station Master's Key and turns.
	(b) Acknowledges audible warning by pressing the 'Bell Push' button.
	(c) Audible warning stops.
	(6) 'Calls Attention' through 'Bell code' buttons and attends on telephoned
(7) Acknowledges 'Call Attention' through "Bell code" button 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 Station Master either electrically or manually.	
(c) Inserts Station Master's Key and turns.	
(d) Siding key is replaced in the Instrument.	
	(12) (a) Takes out Catch Siding Key.
	(b) Transmits the Catch Siding Key to siding point either electrically or manually.
	(13) (a) Train comes to a stop at the First Stop Signal.
	(b) Catch Siding point is set.
	(14) (a) First Stop Signal is taken "OFF".
	(b) Train enters the Station.
	(c) First Stop Signal replaced to 'ON' position.
	(d) Audible warning sounds.
	(e) First Stop Signal Lever, (and Home Signal Lever, or Station Master's slide controlling Home Signal if required) returned to normal.
	(f) Audible warning stops.

	(g) Catch siding point set to normal.
	(15) (a) Siding Key is transmitted back to Station Master either manually or electrically.
	(b) Inserts Station Master's Key and turns.
	(c) Siding Key is replaced in the instrument.
	(16) Where automatic device is provided for proving complete arrival of a train, section is automatically closed. Where this is not provided, the 'Line Closed' button along with the "Bell Push" button is operated, 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 Last Stop signal fails to return to 'ON' position as a train passes it.

(d) If the Train arrival buzzer does not sound the alarm even after the complete passage of the train inside the Home signal over the Last Vehicle track Circuit (This may be due to failure of the Last Vehicle Track Circuit).

Note: Though Home Signal may go automatically to 'ON' by passage of the train, home signal lever shall not be put back to 'Normal' position unless the whole of the train has arrived inside the Home signal. Failure to adhere to this will result in a Block Failure and the Train arrival buzzer will not sound alarm 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 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 JE/SE/SSE(Sig) or any other authorized person.

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

(g) When 'Train on Line' buzzer fails to give the alarm for any reason at the receiving station, even after display of 'Train on Line' 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 Station Master 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 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 General and Subsidiary Rules.

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 Station Masters 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 Station Masters 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 'Train Going To' indication is not displayed on the instrument when operated or 'Train On Line' indication is not displayed on the Instrument after the train has entered the Block Section.

(b) If the Last Stop signal lever cannot be reversed when the instrument displays 'Train Going To' indication.

(c) If the Last Stop signal lever can be reversed without displaying 'Train Going To' indication on the Block Instrument.

Note: This test shall be made when Station Masters take charge of the Block Instrument and an entry made in the Train Signal Register.

(d) Since the 'OFF' aspect of the Last Stop signal is the authority to enter the block section in the Tokenless territory, even in case lever can be pulled but the signal does not assume 'OFF' aspect, the Block working should suspended.

(e) When a train arrives at a station when the Block Instrument is not displaying 'Train On Line' 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 'Train Going To' indication cannot be cancelled even though proper manipulation has been done.

(h) If the 'Train Going To' indication can be cancelled without the co-operation of the Station Master 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 Block instrument

(b) Control Telephone

(c) V.H.F.Sets

Shall be worked in accordance with the procedure laid down in Appendix- III to the General and Subsidiary Rules Book.

All failures shall be reported promptly to all concerned.

10.4 Block Instruments failure record

A record of Block Instrument failures shall be maintained in the Signal and Block Inspection and Failure Register at the station.

10.5 Reports to be sent

When block working is suspended the Station Masters at both ends of the Block section shall at once make entries in red ink, in the Train Signal Register, immediately below the entries for the last train, showing the date and time from which block working has been suspended and the cause of suspension if known. Both the Station Masters shall then advise each other by Telephone of the suspension of Block working and the cause thereof if known and also advise the ESM, Signal Inspector and Divisional Railway Manager.

The Electrical Signal maintainer and the mechanical signal Maintainer shall also be advised, when there is a failure of the Last Stop signal after Line clear has been obtained from the Station ahead.

10.6 Train Signalling during interruption or suspension of Block working

When Block working between X and Y is interrupted or suspended, trains shall be signalled through any one of the prescribed alternative means in the order of the precedence, as laid down in Para 10.3.

When Block working is suspended, X and Y shall advise each other and the ESM/MSM, Signal Inspectors of the suspension and the cause thereof, if known (the cause of the failure being given only by the Station Master who first suspends Block working). A copy of this message shall be sent to the Divisional Railway Manager by *cover* and the Controller on duty shall be advised on controlled sections, by X and Y.

Example: (BF stands for Block Failure; 8 stand for 8 hrs.)

(a) XR **-** Code Time

From SM/X to SM/Y Copy SI & ESM

BF— X-Y-— 8/ (The actual cause *as observed by the Station Master)*

(b) XR **-** Code Time

From SM/Y to SM/X Copy SI & ESM

BF— Y-X— 8/-

Whenever any failure is reported to the Government Telecommunication Department staff, owing to the line faults, ‘GTD advised’ shall be added at the end of the message by the Station Master who first suspends block working. X and Y shall at once make an entry in red ink, in the Train Signal Register that block working has been suspended showing the time and date ot suspension and the cause thereof, if known.

Before actually signalling a train through any one of the alternative means, X and Y shall at once exchange messages by telephone as laid down in clauses 10.7, 10.8 and 10.9 below and copy out the messages in the Train Signal Register.

(a) Whenever trains between X and Y are signalled through the telephones attached to the Block Instruments, or Control telephone or V. H, F. sets as the case may be, they shall be dealt with in all respect in accordance with the provisions of the General and Subsidiary rules and other rules given in the manual.

(b) The number and description and the arrival and departure time of each train dealt with between X and Y, with the Private Number shall be recorded in red ink, then and there, in the Train Signal Register.

(c) The Station Master shall record the means of communication through which Line Clear was asked for or given in the Enquiry Book or Reply Book, as the case may be.

(d) The progressive number of the Line Clear Ticket issued for each train shall be recorded in the remarks column of the Train Signal Register against the entry for the train.

Procedure to be adopted when the 'Train Entering Block Section' signal cannot be given or 'Train On Line' indication not displayed owing to the failure of the Block Instrument after the departure of the train or before clearing the section for the train.

(a) If after the departure of a train the 'Train Entering Block Sections signal cannot be given in case of Handle Type Tokenless Block Instruments or the 'Train On Line' indication is not displayed in case of Push Button Tokenless Block Instrument or owing to the Failure of the Instrument, X shall fill in the column 'Train Left at' in the Train Signal Register in red ink and send the following messages by Telephone to Y.

No -------

Block Instrument failed. Train (No. and description) ---------- left my station at ---------hrs ------mts.

Y shall record the departure time in his Train Signal Register, in red ink, and then acknowledge the message as under:

No --------
Your No ---------- understand Block Instrument failed and that Train (No. and description) ----------left your station at ---------- hrs ---------- mts

(b) When the Line Closed' indication is not displayed after complete arrival of the train in case of Push Button Tokenless Block Instrument owing to the failure of the instrument, Y shall on arrival of the train fill the column 'Train Arrived At' in the Train Signal Register in red ink and send the following message, by telephone to X .

No--------

Train (No. and description) ---------- arrived here complete at----------hrs **-------**mts.

X shall record the arrival time in his Train Signal Register book in red ink and then acknowledge the message as under:

No----------

Your No -------- Understand that train (No. and description ---------- arrived at Your station complete at ---------hrs -------mts,

10.7 Procedure for signalling trains between X and Y Through block Telephone

(a) If Block Instrument is suspended between the stations X and Y the Station Master at X shall send a message through the Block Telephone to Y as under:

NO ---------

Block Instrument working is suspended. Train signalling shall be done through Block Telephone.

Y shall acknowledge it as under:

Y our No -------- understand Block Instrument is suspended and Train Signalling shall be done through Block Telephone.

(b) The Station Masters at X and Y shall then signal all trains on the Block Telephone, when Line Clear' is obtained through the Block Telephone, the Station Master shall write the words 'Block Telephone' after the words 'Line Clear obtained through' on the top of the Line Clear ticket in the Blank space provided for this purpose.

(c) All trains shall be stopped at stations X and Y, run through trains being stopped out of Course. The signature of the Driver shall be obtained in the Line Clear Enquiry Book in token of his having checked the Line Clear Ticket and found it to be correct and complete.

10.8 Procedure for signalling trains between X and Y through control

(a) If Block Instrument, and Block Telephone working are suspended between the stations X and Y on sections of the line where control working is in operation, the Station Master at X shall send a message through the control to Y as under:—

(b) Block Instrument and Block Telephone working are suspended. Train Signalling shall be done through control.

In token of his having checked the Line Clear ticket and found it to be correct and complete.

10.8.1 Instructions for working Trains during total interruption of all means of communication for exchanging Line Clear

When all means of communications for exchanging Line Clear between Stations X and Y have failed, trains between Stations X and Y shall be worked in accordance with Appendix lll of the General and Subsidiary Rules. Both the Station Masters at X and Y shall record, then and there, in red ink, in the Train Signal Register the fact that the communication is totally interrupted. The number and description and the departure and arrival time of each train dealt with shall also be entered in red ink n the Train Signal Register by the Station Masters at stations X and Y.

10.9 Resumption of Block working after Interruption or suspension

(a) (i) When Block working has been suspended under items (h) and (i) of Para 10.1 (1) above, Block working shall be resumed in these cases by the Station Masters themselves on the conditions laid down in the note under each item being fulfilled and after exchanging messages in accordance with clause (b) below:

(ii) When Block working has been suspended under any of the other items (i.e. those not included in Clause (i) above) Block working shall not be resumed by the Station Masters themselves even if the Instrument or communication is restored until the Instrument have been tested and certified by the Electrical Signal Maintainer or JE/SE/SSE(Sig) and the messages have been exchanged in accordance with clause (b) below.

(b) Before resuming Block working, X and Y shall satisfy themselves that the Block Section is clear by exchanging messages by telephone (Classed XR) giving the time of arrival and departure of the last train at stations X and Y.

(c) When Block working is resumed, X and Y shall advise each other, the ESM and Signal Inspector by telephone of the resumption. A copy of this message shall be sent to the Controller on duty shall transmit the message to the Station Master at Y who shall acknowledge it as under:

No---------

Your No ------- understand Block Instrument, and Block Telephone working are suspended and Train signalling should be done through control.

(d) The Controller on duty shall transmit the message to the Station Master at X.

(e) The Station Master shall record this message in his Line Clear Enquiry or Reply Book, as the case may be, and then repeat it to the Controller on duty who shall record it immediately in the Register specially provided for the purpose and then transmit it to the Station Master concerned. The Station Master shall record the message received immediately in his Line Clear reply or Line Clear Enquiry Book, as the case may be. He shall also record the name of the Controller in the Train Signal Register.

(f) The Station Masters at X and Y shall, before asking and giving ‘Line Clear’, repeat the arrival and departure timings of the Last two preceding trains on the X—Y block section. The Controller shall also check the correctness of the particulars to ensure that the correct stations are contacted.

(g) The Station Masters at X arid Y shall then Signal all trains through control. When line clear is obtained through control, the Station -Master shall write the word ‘Control’ after the words Line Clear obtained through’ on the top of the Line Clear Ticket in the blank space provided *for* this purpose.

(h) All trains shall be stopped at stations X and Y, run through trains being stopped Out of course. The signature of the Driver shall be obtained in the Line Clear Enquiry Book in token of his having checked the Line Clear ticket and found it to be correct and complete.

10.10 Instructions for working trains during total interruption of all means of communication for exchanging Line Clear.

When all means of communications for exchanging Line Clear between Stations X and Y have failed, trains between Stations X and Y shall be worked in accordance with Appendix III of the General and Subsidiary Rules. Both the Station Masters at X and Y shall record, then and there, in red ink, in the Train Signal Register the fact that the communication is totally interrupted. The number and description and the departure and arrival time of each train dealt with shall also be entered in red ink in the Train Signal Register by the Station Masters at stations X and Y.

10.11 Resumption of Block working after Interruption or suspension

(a) (i) When Block working has been suspended under items (h) and (i) of Para 4.1 above, Block working shall be resumed in these cases by the Station Masters themselves on the conditions laid down in the note under each item being fulfilled and after exchanging messages in accordance with clause (b) below:

(ii) When Block working has been suspended under any of the other items (i.e. those not included in Clause (i) above) Block working shall not be resumed by the Station Masters themselves even if the instrument or communication is restored until the Instruments have been tested and certified by the Electrical Signal Maintainer or JE/SE/SSE (Sig) and the messages have been exchanged in accordance with clause (b) below.

(b) Before resuming Block working, X and Y shall satisfy themselves that the Block Section is clear by exchanging messages by telephone (Classed XR) giving the time of arrival and departure of the last train at stations X and Y.

(c) When Block working is resumed, X and Y shall advise each other, the ESM and JE/SE/SSE(Sig) by telephone of the resumption . A copy of this message shall be sent to the Divisional Railway Manager by cover and the Controller on duty advised on the controlled sections by the Station Masters of Stations X and Y.

(Example - (BRSD stands for Block Failure Restored. stands for 15 hours)

XR-Code Time.

From SM/X to SM/Y Copy JE/SE/SSE(Sig) & ESM
BRSD—X-Y—1 *5/*—

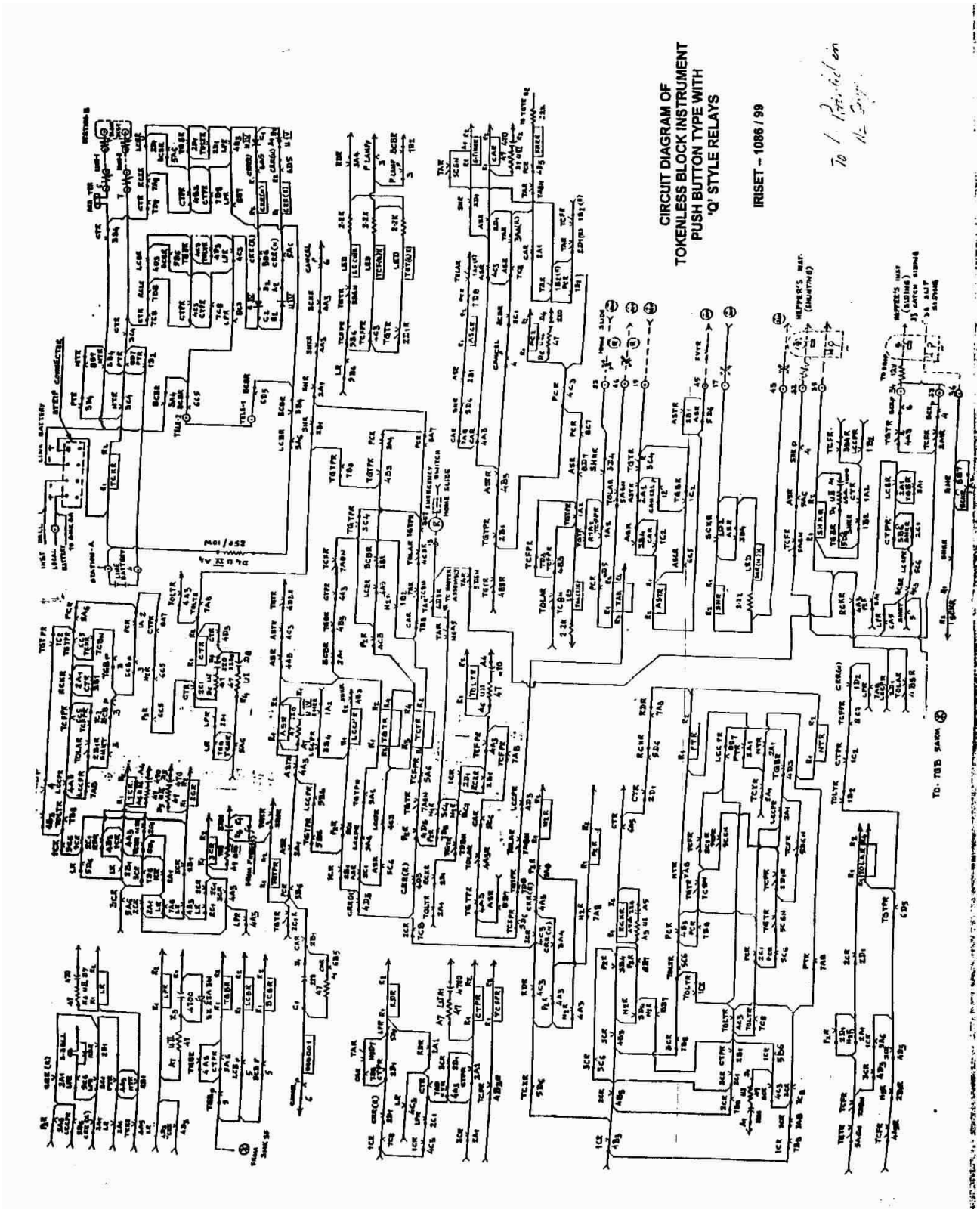
XR-Code Time

From SM/Y to SM/X Copy JE/SE/SSE(Sig) & ESM
BRSD—Y-X—l *5/*—

10.12 Resumption of normal working

(a) Then communication by the Train Wire has to be restored, block working by the Train Wire shall not be resumed until the Station Masters of X and Y have both satisfied themselves that the line between them is clear of trains by exchanging Messages classed XR, giving the time arrival and departure of the last train at stations X and Y.

(b) When the train wire working is restored, the Station Masters at X and Y shall advise each other and JE/SE/SSE (Sig) and the Controller by a message of the resumption of Train Wire Working. A copy of the message shall be sent by cover, to the Divisional Railway Manager by the Station Masters at X and Y.



CIRCUIT DIAGRAM OF TOKENLESS BLOCK INSTRUMENT PUSH BUTTON TYPE WITH ‘Q’ STYLE RELAYS

10.13 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, Home Signal 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 units. – 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
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.

S.No	Type of Failures	Observation	Causes
se 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 CONDENSOR FAULT in UI.
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 ohms resistance developed open cct. Fault 220 Mfd condenser punctured resulting in ASR not holding. 3. CTPR not holding due to 4700 mf 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 coil 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

S.No	Type of Failures	Observation	Causes
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 ohms 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.

Additional requirements of Single Line Tokenless Block Instruments

10.14 Fixed Indications - In addition to the fixed indications specified in paragraph 4.13. the instrument shall be provided with means to indicate "Train On Line" at both the sending and receiving stations when a train has entered the block section. (SEM 7.149)

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

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

10.16.1 'Train Going To' and 'Train Coming From' - The cooperation of the Station Master 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 "Train Going To" position. (SEM 7.152.1)

10.16.2 'Train On Line' - Means shall be provided to ensure that the instruments are set to 'Train On Line' 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 'Train Going To' or 'Train Coming From' indications. (SEM 7.152.2)

10.16.3 Line Closed - Both the instruments shall be restored to normal before a further operation of setting the instrument to 'Train Going To'/'Train Coming From' 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. This feature can be dispensed with where an automatic device of closing the Block section is provided. (SEM 7.152.3)

10.17 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)

10.18 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 Last Stop Signal and up to the opposing First Stop Signal. (SEM 7.154).

* * *

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 the modifications required in FM instrument when we use it in AC RE area

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
5. 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. SNR 'K' 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

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