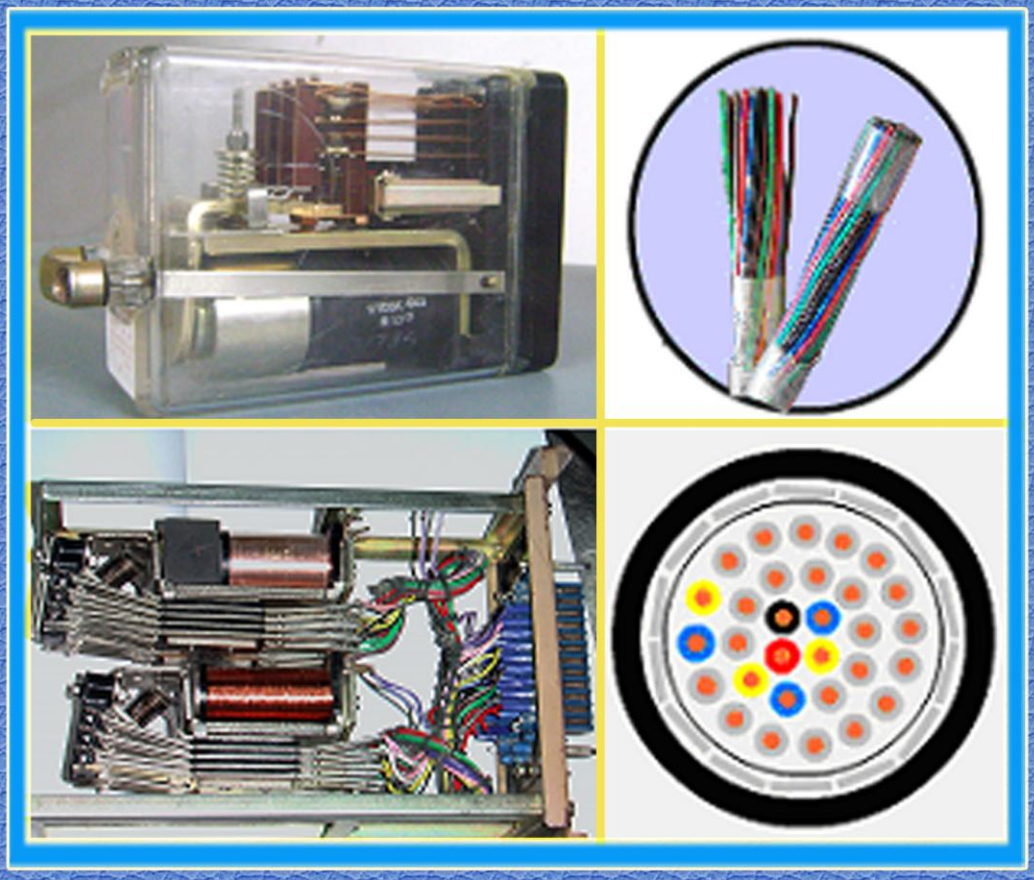
इरिसेट IRISET

S 19

SIGNALLING RELAYS AND CABLES



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

S 19

SIGNALLING RELAYS & CABLES

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

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INDIAN RAILWAYS INSTITUTE OF

SIGNAL ENGINEERING & TELECOMMUNICATIONS

SECUNDERABAD - 500 017

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S-19
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CHAPTER 1: INTRODUCTION

1.1 INTRODUCTION

In earlier days Signalling systems were having more mechanical signalling components. Gradually they were reduced with the usage of electromagnetic, electrical components and electrical lever.

The two essential components used in this Electrical signalling are "Relays" & Cables ". These find their application in modern control systems also.

Relays can be classified based on type of contacts material used as-

(a) Metal to Metal contact
(b) Metal to Carbon contact (Silver impregnated graphite)

Based on the usage, the relays can be classified as-

(a) Line relays
(b) Track Relays
(c) Lamp Proving Relays
(d) Time Element Relays
(e) Flasher Relays
(f) Contactor Relays

Based on polarity requirement relays can be classified as –

(a) Polar Relay
(b) Neutral Relay

Cables for signalling use are mainly of three types

(a) Signalling Cables
(b) Power Cables
(c) Quad cables

Let us study certain symbols, abbreviated nomenclatures.

1.2 SYMBOLS AND NOMENCLATURE:

Symbols are brief sketches which represent the character and main function of the equipment.

These are usually determined by numerical or alphabetical terms to specify and identify them with a particular device or its component.

Nomenclature is a collection of simple and brief designations of apparatuses to describe their nature and location.

In an electrical circuit diagram straight lines represent the wire connections between the specified devices or their components with their symbols and nomenclatures. These also include the wire terminals, the separation between locations as well as the interconnections between power sources, controls and the operated loads.

The power signalling systems on Indian railways conform to two practices: (1) The British Railway practice and (2) the continental or German practice(Siemens). Therefore we adopt two different practices. There are some few common elements between them but broadly they differ very sharply.

INTRODUCTION

To study the various symbols and nomenclatures, the signalling gears may be broadly classified as: -

(1) Signals (2) Points (3) Level crossing gates (4) Locks and (5) Controls.

The standard symbols adopted in the British practice are covered in the British standard specification No.376 part (11) for wiring symbols and written circuits and IRS Specification S-101/90.

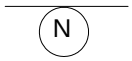
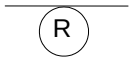
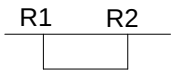
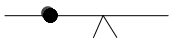
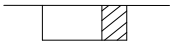
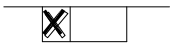
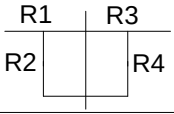
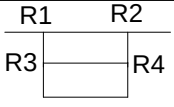
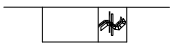
As far as possible, the first letter of the description of apparatus is chosen for the nomenclature. But where the descriptions of more than one apparatus start with the same letter, all but one equipment is represented by arbitrarily chosen letters.

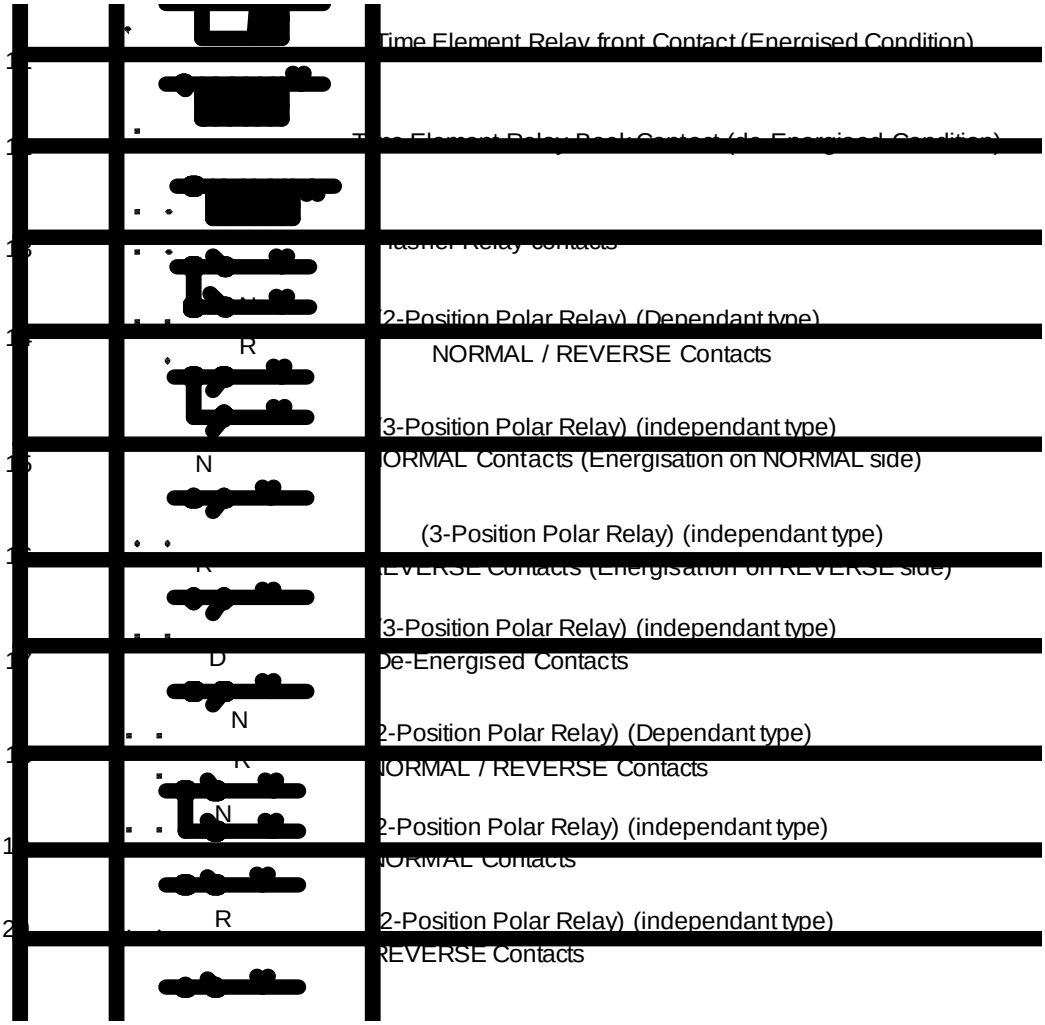
1.2.1 MEANING OF LETTERS - DESCRIPTIVE AND DESIGNATIVE AS USED

Alphabet	Descriptive term (prefix)	Apparatus (Last letter)	Descriptive & designative
A	Approach, automatic	--	Approach
B	Block, Bolt	Block instruments	Block, Button, Positive energy, Bridge, Back
C	Checking or proving	Contact	Common, changer, counter, Correspondence, changer Circuit controller, code,
D	Clear (green) Decoding	--	Proceed indication of a signal, detector, decoding,
E	Light: heat (externally applied)	(Electric lamp illuminating), earth	Earth, eastward, electric light, element, equipment,
F	Fog	Fogging apparatus, (example: Detonator placer)	Traffic, front, frequency, fuse
G	--	Lightning arrestor	Ground, gate, signal aspect
H	Caution (yellow)	Capacitor	Home, approach indication of a signal
I	--	Indicator	--
J	Time (delayed action)	Rectifier	Skate, dual control
K	Indicating or detecting	Indicator (visual)	Indicator
L	Locking, left,	Lock	Left, locking, lever, light, lock valve, lock
M	Magnet	Motor	Magnetic, marker, manual
N	Normal (push button or key)	Release (switch, P B & key)	Normal, north, northbound Negative,
O	Retarder	Resistor	Order, operating, off, overload, out
P	Repeater	Lever latch or trigger contact	Pole, power, purple, push, repeating, primary
Q	Treadle or bar	Local coil of a Double coil relay	Local or secondary coil,
R	Reverse, right, red	Relay or contactor	Right, red, reverse, relay, rail, stop indication of sig.
S	Stick	--	South, stick, storage, south word

Alphabet	Descriptive term (prefix)	Apparatus (Last letter)	Descriptive & designative
T	Track circuit	Transformer, transmitter	Track, time, train, telephone, transformer, transmitter,
U	Route	Route indicating	Retarder unit.
V	Train stop	Train stop apparatus	Train stop (track element E. P. stop)
W	Point	Point operating apparatus	Switch, west, white, westward
X	Audible indicator	Audible indicator (buzzer)	Cross, interlocking, bell, buzzer.
Y	Slotting	Disengaging apparatus	Slot, yellow, hold, clear.
Z		Special unit (to be explained on plan)	Zone, use for any special term.

1.2.2 BRITISH SYMBOLS

S.No.	Symbol	Description
1		Switch / Knob Contact in Normal Position
2		Switch / Knob Contact in Reverse Position
3		Relay Coil (Name of Relay is written inside the rectangle)
4		Closed Contact when Relay is in Energised condition (Front Contact)
5		Closed Contact when Relay is in de-energised condition (Back Contact)
6		Slow to release Relay
7		Slow to pickup Relay
8		Double Coil Relay (QNN1)
9		Latch Relay (QL1)
10		A C Immunised Relay



British relays and nomenclatures

Sl. No	Name	Description
1	TSR	Track stick relay
2	UCR	Route checking relay
3	ASR	Approach stick relay
4	WLR	Point lock relay
5	WNR	Point normal (operation) control relay
6	WRR	Point reverse (operation) control relay
7	NWKR	Normal point (position) indication relay
8	RWKR	Reverse point (position) indication relay
9	TRSR	Track right stick relay
10	TLSR	Track left stick relay
11	SMCR	Station master's control relay
12	UYR1,UYR2	Sequential route release relays

Note **:** For details refer to Annexure 'B'

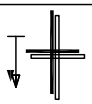
1.3 SIEMENS PRACTICE:

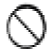
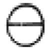
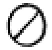
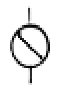
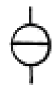
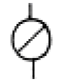
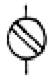
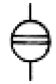
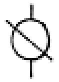
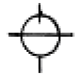
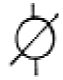
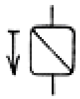
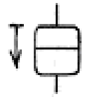
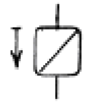
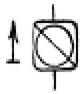
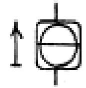
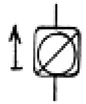
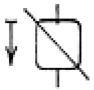
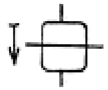
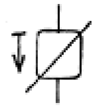
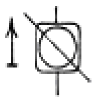
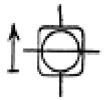
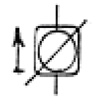
On our Railways, in Siemens installations, circuits are made using Siemens (German) symbols but nomenclature according to British practice is used.

1.3.1 SYMBOLS AND NOMENCLATURES

In Siemens relay interlocking, circuitry is drawn in German symbols with British nomenclature.

S.No.	Symbol	Description
1		Neutral Relay
2		Interlocked Relay Reverse Coil (Top Relay)
3		Interlocked Relay Normal Coil (Bottom Relay)
4		Track Relay
5		Track Repeater Relay
6		Block Relay in Automatic Territory
7		Time Element Relay
8		Normal Position of Neutral Relay is picked up
9		Normal Position of Neutral Relay is Dropped
10		Normal Position of Interlocked Relay is picked up (Normal Coil)

11		Normal Position of Interlocked Relay is Dropped (Reverse Coil)
12		Make Contact
13		Break Contact
14		Neutral Relay , Normally pick up Make Contact (Front Contact)
15		Neutral Relay , Normally pick up Break Contact (Back Contact)
16		Neutral Relay , Normally drop make contact (Back Contact)
17		Neutral Relay , Normally drop, Break Contact (Front Contact)
18		Interlocked Relay , Normally pick up, make Contact (Front Contact)
19		Interlocked Relay , Normally pick up Break Contact (Back Contact)
20		Interlocked Relay , Normally drop make Contact (Back Contact)
21		Interlocked Relay , Normally drop, Break Contact (Front Contact)

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

***Note**: The arrow on the left with a base line indicates the normal condition of the relay.*

1.3.2 Relay Contacts: -

In the Siemen's Relay interlocking systems, the control of signalling gears is exercised generally in three and more stages. This is unlike the British practice. Also at each stage more relay contacts are used for control as the relay integrity needs to be proved at each stage. The relays used in the three stages of control, viz. (i) initiation (ii) control and (iii) locking have their nomenclature including the stage of control, the gear controlled and the sequential order of the relay used at that stage.

Some of the relays nomenclature and abbreviation used in the siemen's practice of controls are as follows: -

Relays nomenclatures

RELAY	NOMENLATURES
GNR	Signal button relay
GNCR	Signal button checking relay
SH-GNR	Shunt signal button relay.
CO-GGNR	Common button relay for calling-on signals
EGGNR/ERNR	Common button relay to replace any signal at 'ON"
UNR	Route Button relay.
UNCR	Route button checking relay
EUYNR	Emergency sub-route release button relay.
EUYZ	Emergency sub-route release operation counter.
EUUYNR	Emergency (full) route release button relay.
EUUYZ	Emergency (full) route release operation counter
EUUYNCR	Emergency (full) route release button checking Relay
EUYR	Emergency route release relay (common for sub route and full route cancellation)
WNR	Point button relay.
WNCR	Point button checking relay
WWNR	Common point button relay. (when point zone track circuits are up)
EWNR	Emergency Common point button relay (when point zone track circuit is down)
EWZ	Emergency points operation-counter
WLR	Point locking relay
WJR	Point time delay relay
WR	Point contractor relay (heavy duty contractor relay)
CHYNR	Crank handle slot release button relay.
CHYRNR	Crank handle slot return button relay.

RELAY	NOMENLATURES
CHKLR	Crank handle key lock relay.
XYNR	Gate control slot release Button relay
XYRNR	Gate control slot Return Button Relay
XCKR	Gate closed indicating relay.
XOKR	Gate opened indicating relay.
NNCR/NCR	All buttons Normal checking relay (common for all buttons)

Review Questions

Subjective

1) What is the meaning of letter A, B, C, G ?
2) What is the meaning of letter X, F, W, O?
3) What is the symbol of point controlling relay in Siemens?
4) What is the symbolic difference between neutral relay and interlocked relay In Siemens?
5) What is the full form of TRSR, TSR, TR, TPR, and TLSR?

Objective

1) WJR stands for ----------
2) WR relay stands for ----------
3) XOKR stands for ----------
4) Show a symbol of front contact of normally drop neutral relay ----------
5) Show a symbol of flasher relay contact ----------

CHAPTER 2: SIGNALLING RELAYS

2.1 INTRODUCTION

A relay is an electromagnetic device, which is used to convey information from one circuit to another circuit through a set of contacts i.e. front or back contact.

Constructionally and electrically, relays may be divided into two types DC and AC relays, because the means by which the electrical energy in the coil is converted in to mechanical Energy in order to move the contacts are fundamentally different. In DC type, the contacts are carried on an armature, forming part of a magnetic circuit in which a field is set up by the current flowing in the coils. In AC types, the contacts are attached by a link mechanism to a metal sector, disc or cylinder in which currents are induced by the alternating magnetic field produced by the current in the coils.

Every endeavor has been made to explain the action of each type of relay in the simplest possible manner.

Relays are sophisticated switch gears used for remote control and succession control of various electrical equipment. In present days they are widely used because they are capable of protecting the controlled equipment from cross feeding and overloading even as they cater for speedy operations.

Most of the relays in present day signaling are electromagnetic devices, although some of the relays control circuits through electronic components like diode/transistors/ Integrated Chips etc

Railway signaling relays are unique in that:

(a) They operate on low voltage and current
(b) They are more articulate as, according to their special features, they can work under restrictive conditions and in any specified manner. Virtually they can cater for all situations while contributing to speed and accuracy in operations.

2.2 CLASSIFICATION OF SIGNALLING RELAYS:

(a) According to the method of their mounting or fixture, they are classified as:

(i) **Shelf type:** Relays, which are loosely kept on shelves.
(ii) **Plug in type**: Relays, which are plugged in to a pre- wired plug boards.

(b) According to their connection and usage, they are classified as:

(i) **Track relays**: Relay, which is directly connected to the track, to detect the presence of vehicle.
(ii) **Line Relays**: Other than track relay, all are line relays. Relays connected to the selection circuit.

(c) According to their vitality or importance in ensuring train working safety, they are classified as:

(i) **Vital Relays:** All relays, directly used for train control such as signal, point, controls, track detection etc.
(ii) **Non-vital Relays**: Relays, which operate control aids and accessories like warnings, buzzers, Indications etc.

(d) According to their special provisions to ensure reliability of their contacts, they are classified as:

(i) **Proved type**: are those whose normalization after each operation shall be proved in circuit controlled by their contacts. Contacts in which both the springs have metal surfaces on their tips. They may get fused due to high sparking current across them during operation. These may prevent relay normalization and causes unsafe condition in traffic control. To avoid this, proving of relay normalization after each operation is necessary.

(ii) **Non - proved type**: Need not to be proved to have been normalized after each operation as their contacts have at least one non-fusible contact (carbon contact)

(e) According to their feed source, relays are broadly classified as:

(i) **DC relays:** The relay, which requires DC power supply for its operations are, called DC relays. Among the DC relays.

- **DC neutral relays**: This relay closes the same set of contacts on energization, with Normal polarity or Reverse polarity supply.
- **Polar Relays**: This relay closes different set of contacts when energized with Reverse polarity supply. They may or may not have contact to close when de-energized.

(ii) **AC Relay**: AC Induction motor track relays. Time element relays, flashing indication control etc.

(iii) **Electronic Relays**: DC relays with electronic components in them are called electronic relays. e.g Electronic Timer

2.3 DC Neutral Relay

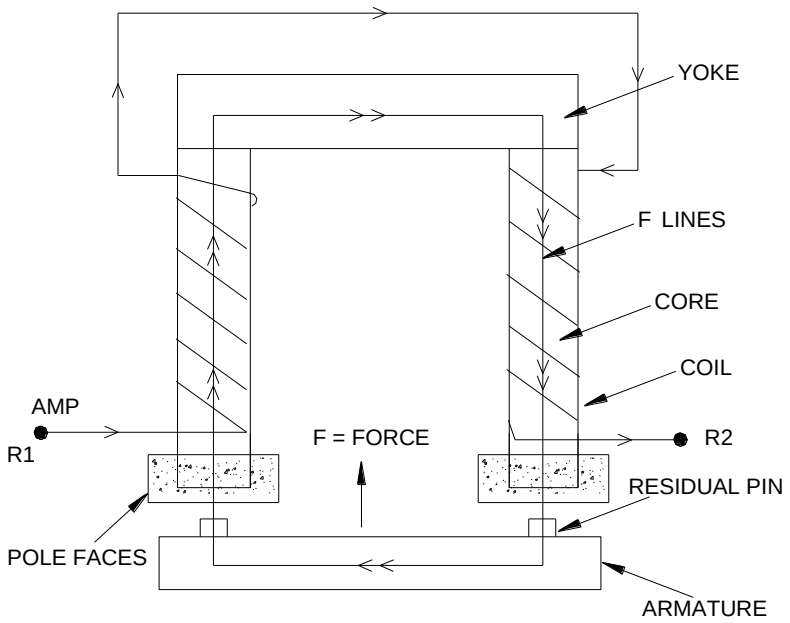


Fig: 2.1 DC NEUTRAL RELAY

Each Relay has usually one or two coils with a hollow center to accommodate a core. The coils are made up of a large numbers of turns of small gauge soft drawn copper wire. The two coils can be connected in series or parallel according to the requirement of relay resistance. The ends of the coils are terminated on binding post to which the control wires are connected. Each coil is placed around a core of specially selected Iron or steel having high permeability and low retentivity. The core should be susceptible to magnetism and at the same time should have little residual magnetism. The cores are connected at the top by a yoke to complete the magnetism coupling between two ends of coils. The bottom of each core is equipped with a large steel or Iron block known as pole piece or face.

A flat piece of Iron or steel called armature is supported by brackets, which are securely fastened to the pole piece. The armature, yoke, and the pole pieces are also made of specially selected iron or steel of the same quality as the core. The armature carries the metallic spring contacts, which are insulated from it.

The circuit through the coils of the relay is closed. It sets up a magnetic flux through the core, yoke and the armature. The flux passing between the armature and pole faces causes the armatures get attracted to the pole faces and armature picks up and closes front contacts. When the circuit is opened the magnetic flux collapses and the armature drops away by gravity from the pole faces, the front contacts break and back contacts close. The front and back contacts of the relay can be utilised to make or break other circuits. Two stop pins of non-magnetic material are fixed either on the armature or pole faces so that the armature cannot come in contact with the pole faces. It is essential to maintain a small air-gap between the armature and pole faces so that low value of residual magnetism may not retain the armature in picked up position and causes the relay to fail to drop away with a break in its control circuit.

2.3.1 GENERAL USAGE

DC Neutral line relays are most commonly used for Railway Signalling controls and detection. Among them, plug-in type relays are preferred in larger installations for space considerations. Shelf type relays are also in use, mostly in wayside stations.

There are many DC Neutral line relays in use with special features such as

(a) Delayed operation (Slow to pick up & slow to release)
(b) Biased DC control
(c) DC control unaffected by AC interference currents
(d) Getting latched in last operated condition till further feeding, and others.

Usage of DC polar relays is mostly in conjunction with block instruments that control traffic between stations.

AC line relays are almost extinct in installations of British Signalling practice. They are, however, used for time control operations, flashing indication control and such other special purposes in installations with Siemens signalling practice widely.

Track relays are used according to the type of track detection circuits chosen for a given location and context. While most of the track circuits are still of the DC working type requiring DC neutral track relays with them, the prospects of their being replaced with Electronic track circuits directly feeding DC line relays, in future, are great.

AC Track Circuits are used in DC Traction area, as conventional DC Track Circuits are not suitable there. AC Track relays are used with them, almost all, of the induction motor type.

In the British practice of signalling which was first introduced on Indian Railways, non-proved type relays with carbon to metal switching contacts are generally used for vital controls.

They facilitate simple circuit designs. But with the advent of German Practice, introduced by M/s Siemens later, proved type relays with all 'metal to metal' contacts are widely accepted in spite of complications in circuit design caused by them. A recent introduction is that of the same type relays made by M/s Integra (ABB) control. However, for some time now, the appreciable features of both the practices are getting incorporated together in the indigenous designs of signalling by railwaymen. With this, the usage of all types of relays anywhere can be found without straight-jacketed segration of relay types.

2.4 CHARACTERISTICS OF ELECTRO-MAGNETIC RELAY:

The following are the characteristic of electro-magnetic relays. A brief study of them helps in understanding the choice of their components and designs features.

(a) Force of attraction
(b) Effect of air gap.
(c) Effect of Hysterisis
(d) Transient condition.

2.4.1 Force of attraction:

In any electro-magnetic system, the force of attraction is given by.

$$F \propto B^2 a$$

Where: B - is the flux density
a - is the cross sectional area of the particular part of the magnetic circuit.

In the case of a DC neutral Relay, B is proportional to the current, that is flowing in the coil surrounding the electro-magnet and thus the force of the attraction is directly proportional to the square of the current. This square relationship has its own advantage especially in the case of DC track relay, in that a small reduction in the current will have a great effect on the working of the relay. Also for a given change of current, the make and the break will be quicker with lesser possibility of arcing.

2.4.2 Effect of air gap:

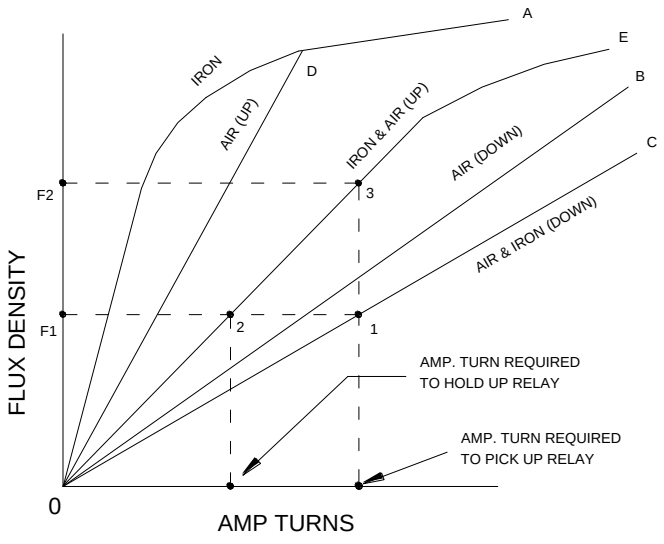


Fig: 2.2

Curve 'A' is magnetisation curve for the iron and is all practical purpose a straight line up to the saturation point. Curve 'B' is the magnetisation curve for the open-air gap, which is a straight line through out because permeability μ for air is 1. Curve 'C' is the resultant magnetisation curve of the whole magnetic circuit of the relay and for a given force is the sum of the amp-turns for the iron part and the amp-turns for the air gap.

When the front contacts are open, the force required to pick up the armature is shown on curve 'C' to be F1 but after the armature has operated, it will be separated from the core by stop pins. In this position the amp-turns required to maintain the armature is less, as indicated by the dotted line from 1 on curve C to 2 on curve E. But actually the current in the coil is unaltered, the force on the armature is greater than required, as indicated at 3 on curve E. Part of this extra force is used to flex the front contacts sufficiently to give good contact pressure, when it is in energised position.

The difference between the pick-up and the drop-away current should be as small as practicable in track relay to ensure good shunting characteristics. This is achieved firstly by the choice of good quality relay iron and secondly by having a small air gap between armature and core. If the air gap is not available, then the residual magnetism fluxes might cause the armature to be retained when the supply is disconnected. For this reason, residual pins are provided to ensure a definite minimum air gap in the energised position.

2.4.3 Effect of Hysteresis:

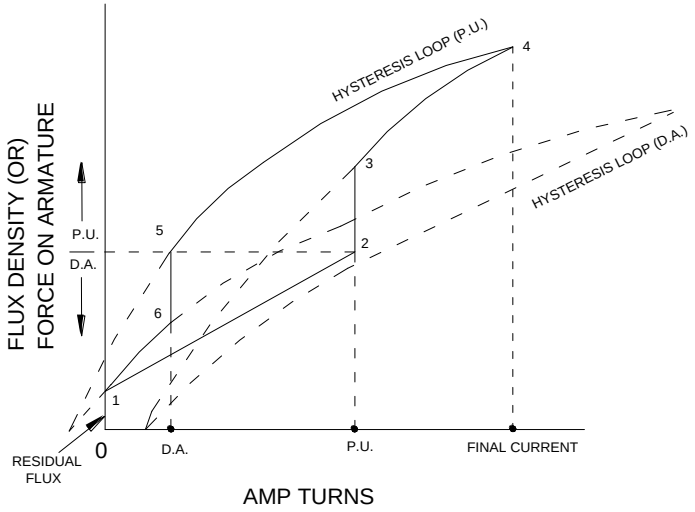


Fig : 2.3

Hysteresis is the property by which the flux produced lags behind the current. In the de-energized condition there will be small residual flux in the core. When the voltage is applied to the coils, the current in rising to its steady value first causes the flux to rise from 1 to 2 along the curve. At this point the flux density will be sufficient to attract the armature and reduce the air gap, the flux then raise to 3 and continue to 4 which corresponds to the steady current in the coils. When the voltage is disconnected, the current in falling caused the flux to fall from 4 to 5 along the curve. At this point the flux density will fall below the value required to maintain the armature, which will release, thus increasing the air gap and reducing the flux to 6. Finally the flux will decrease from 6 to 1 where the current will again be zero.

The relay core is made of material having high permeability and low retentivity. As mentioned in the IRS specification, Electromagnet iron may be in the form of a

(a) Bar of silicon steel

(b) Best Yorkshire wrought iron

(c) Swedish charcoal iron

(d) Electrical steel sheets.

This reduces the difference between pick up value and Drop away value. By selecting good quality core material, Percentage release and sensitivity of the relay will be improved.

2.4.4 Transient Condition:

When the voltage is applied or disconnected from the coils, it takes some little time before the current become steady. These are known as transient conditions" and are important so far as track relays are concerned.

When the voltage is first applied to the coils, the magnetic flux in rising, cuts the turns on the coils and in so doing produces a back EMF that opposes the applied voltage and retards the growth of current.

The growth and decay of flux are decided by the relationship between the inductance and resistance in the circuit is known as time constant. It is not fixed quantity in the case of DC neutral relay. This value of 'L' is less when the relay is in de-energised condition (L1) than when the relay is in energised condition (L2). The magnitude of flux that is established for a given change of current is different in two cases.

When the current reaches the pick up value, the armature closes and the inductance is increased to L2, due to reduced air gap, the flux per amp is increased. The increase in flux increased the back EMF, during the movement of the armature after which the current continuous to raise along a new curve corresponding to the increased inductance, until it reaches the final value (E/R). This process is indicated below in fig.2.4

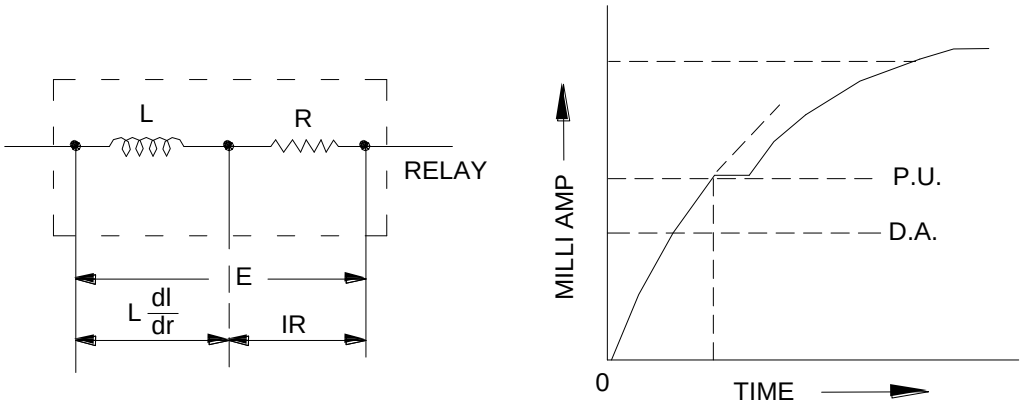


Fig : 2.4

When the supply is disconnected the current is obliviously reduced to zero immediately but the flux decay comparatively slowly owing to the eddy currents, produced in the core by the rapid flux change, which tend to maintain the flux. The drop away time on a disconnection is, however, generally negligible. See fig 2.5 below.

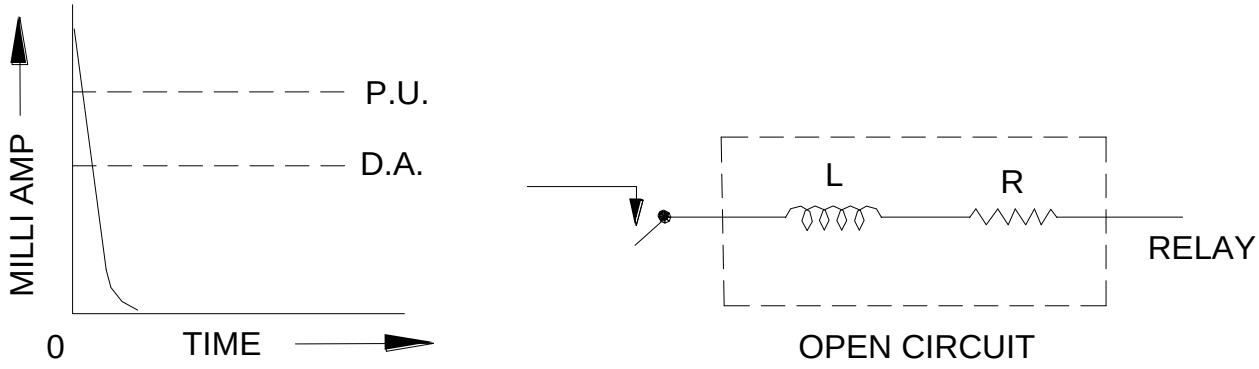


Fig : 2.5

If the relay releases due to the reduction in current, caused by the application of shunt resistance (as in the case of track relay), the time taken is much longer than the relay is simply disconnected.

The rate of rise or fall of current during the transient conditions is also depends on exterior circuit values because L and R apply to the whole circuit.

The production of eddy current in the core, the flux will decay at a slower rate than the current. So that the actual release time will be a little longer than it takes the current to fall to the release.

$T \propto L / R$, where T= time constant
L= Inductance
R= Resistance

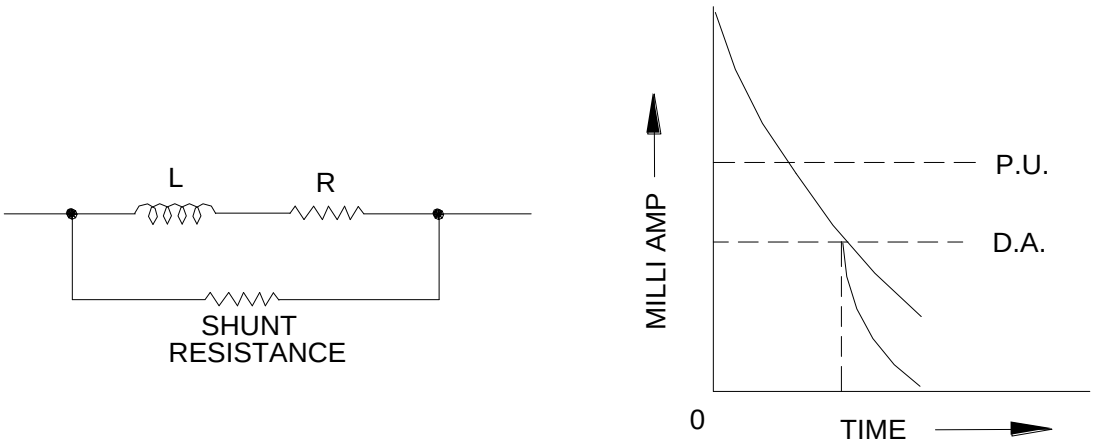


Fig : 2.6

It is now clear that to reduce releasing time to a minimum it is necessary that

- The relay iron should have low Hysterisis loss and low retentivity.
- The degree of over energization of the relay should be restricted
- Connecting a suitable external resistance in series with the relay to keep L/R ratio low. In non RE area for track circuit length less than 100M 9 ohm track relay only to be used.

Using relay with minimum contacts, as they require lesser current which keeps inductance value low

Train working safety is ensured only if the track relay of shortest length track circuit is released before a light engine running at a highest permitted speed clears it. Otherwise, the track circuit occupation may go undetected. To avoid this, a special provision has to be made in signal control circuits, wherever necessary.

The following methods may be adopted for reducing the time lag of track relay.

(a) Restrict the over energisation of relay since the release time depends on the initial working current.
(b) Connecting a suitable external resistance in series with the relay to keep the L/R ratio low.
(c) Using relays with minimum contacts, as they require lesser operating current, keeping the inductance value low.

Review Questions

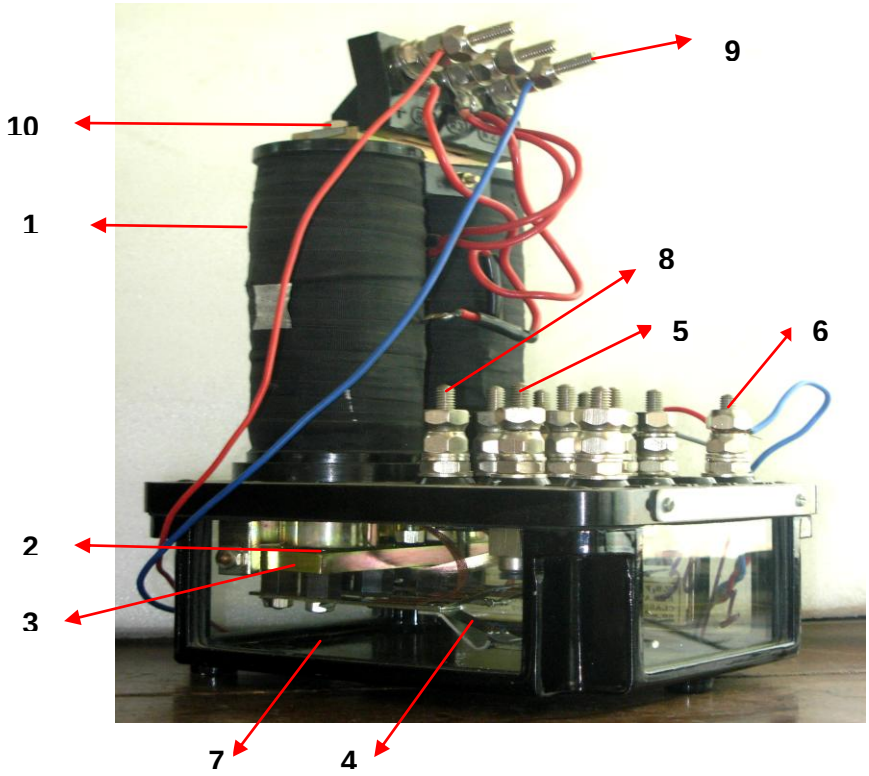
Subjective

1) What is the classification of relays on the basis of mounting or fixer?
2) Explain briefly difference between proved type and non proved type relays
3) What are the main characteristics of electromagnet relays?
4) Explain the working of DC neutral relay.

Objective

1) In any electro-magnetic system, the force of attraction is given by. ----------
2) Relays, which are loosely kept on shelves are called ----------
3) **Track relays**: Relay, which is directly connected to the ----------
4) The relay iron should have high ---------- and low ----------
5) $T \propto L / R$, where
   T = ---------
   L = ----------
   R = ----------

CHAPTER 3: SHELF TYPE DC LINE & TRACK RELAYS.



1.	ELECTRO-MAGNET	2.	RESIDUAL PIN
3.	ARMATURE	4.	ARM SPRING
5.	FRONT CONTACT	6.	BACK CONTACT
7.	CONTACT CHAMBER	8.	CONTACT TERMINALS
9.	COIL TERMINALS	10.	YOKE

Fig No: 3.1

3.1 COMPONENTS

1) Electro-magnet: It has a pair of coils and cores each. Cores are joined at the top by a yoke or back strap. Coil terminals can be connected externally to make their series or parallel combination on an insulated block at the top.

The pole faces of the cores are fixed below inside the contact chamber while the contact terminals called "binding posts" extend above on top of the chamber.

2) Armature: A flat piece of iron called "armature" is hinged at the rear on its bracket on two bush type bearings that allow an upward movement for it at the front when the magnet is energized.

3) Residual Pins: The armature has on it two copper or brass pins facing the magnet poles to maintain a small air-gap in its attracted position.

4) Arm Springs: The armature caries on an insulated block a maximum of six arm contact springs made of phosphor bronze with a fork - shaped front. These springs close with front contacts when the armature is picked up and they close with back contacts when it is dropped. They have silver elements at their tips.

5) Front Contacts: These have Silver Impregnated Graphite (SIG) element. A contact, which is made when the relay is in energized condition.

6) Back Contacts: These have silver elements. A contact, which is made when the relay is in de-energized condition.

7) Contact chamber: This is a glass-walled enclosure for all the contacts and armature.

When the electro magnet coil is energized, a tractive torque acts on the armature below to raise it. The arm springs fixed on the armature are lifted thus, to open back contacts and close front contacts.

When the feed on the coils is removed or reduced, the armature drops due to the gravitational pull downwards, thus opening the front contacts and closing the back contacts.

The line relays have to be according to the IRS Specification No.S53-1988 (Draft). The track relays have to be according to the IRS specification No. S54-1988 (Draft). Most of the requirements in these two specification documents are similar to those in British standard specification No.1659-1950. The important requirements of these specifications are given below.

Before studying these, it will be useful to understand certain definitions of terms connected with these relays, given in the specifications.

1. Non-fusible contacts: A pair of contacts in which one contact element comprises of non-fusible material, which presents practically no risk of welding of contacts.

2. Carbon contacts: 'carbon' in the expression ''metal - to- carbon contacts' is used as a general term covering graphite compounds and mixture of carbon and metals.
3. Metal contacts: 'Metal' in the expression 'metal to metal contacts' is used as a general term covering the use of silver, silver cadmium oxide, tungsten, platinum or any other suitable material to an approved specification.

4. Front contact: That contact which is made with 'arm contact' when the relay is energized.

5. Back contact: That contact which is made with 'arm contact' when the relay is de-energized.

6. Arm contact (or armature contact): That contact which is movable part of the pair of contacts and is made with front contacts when the relay is energized and with back contact when the relay is de-energized.

7. Arm: The movable part of the pair of contacts.

8. Dependent contact: The condition in which a movable arm contact connects to a front contact when the relay is energized and the same arm contact connects to a back contact when the relay is de-energized.

9. Independent contact: The condition in which the movable arm contact connects to either a front or a back contact but not to both.

10. Contact element: Contact piece, which is secured to a contact spring.

11. Wiping (self-cleaning) contacts: Contacts designed to have certain relative motion, during the interval from the instant of touching until completion of the crossing motion.

12. Contact follow: That distance which the movable arm contact travels after touching the front or back contact.

13. Contact bounce: means the uncontrolled making and breaking of the contact after it has closed first.

14. Operate: That condition of the relay when all front contacts are just made.

15. Full operate: That condition of the relay when the armature has completed its maximum travel, i.e. up to the stop.

16. Release: That condition of the relay when all front contacts have just opened.

17. Full release: That condition of the relay when the armature comes back up to the back stop.

18. Pick up value: The value of the current or ampere turns which is just sufficient to close all the front contacts of a relay under specified conditions.

19.Drop away (release) value: The value of current or ampere turns at which all the front contacts of a relay just open under specified conditions.

20. Full operate value: The minimum value of current or ampere turns sufficient to energize the relay to the 'full operate' position.

21. Reverse pick up value: The value of current or ampere turns fed in the non-working direction at which all the front contacts are made under specified conditions.

22. Operate Time (of):

(a) Back Contact: Means the time interval from the instant of application of the current to the coil until breaking of the back contact, which is the last to break.

(b) Front contact: Means time interval from the instant of application of the current to the coil until closing of the front contact which is the last to close and the contact bounce has ceased.

23. Release Time (of).

(a) Front Contact: Means the time interval from the instant of removal of energy to the coil until breaking of the front contact, which is the last to break.

(b) Back contact: Means the time interval from the instant of removal of the energy to the coil until closing of the back contact which is the last to close and the contact bounce has ceased.

24. Transfer Time:

(a) Transfer time of operate is the interval of time from the instant first back contact breaks until the last front contacts is closed and the contact bounce has ceased.

(b) Transfer time of release is the interval of time from the instant first front contact breaks until the last back contact is closed and the contact bounce has ceased.

3.2 Common requirements specified in IRS specifications (S53 & 54) for shelf type DC line and Track Relays & B.S. Spec. 1659.

1. To avoid damage to contacts during transportation, storage and installation, the relay shall be provided with a transport screw. This shall be designed to keep the armature locked in the 'full release' position. The user shall remove the transport screw and fit a plug-screw in its place. He shall seal it before the relay is used in a circuit.

	(As per BS spec. 1659-50).
The maximum overall dimensions of the relay shall be	250mm (Height) X 200mm (width) X 200mm (depth).
Minimum insulation resistance of the coil shall be	50 M ohms in dry condition and
	10 M ohms in humid condition.
Contact elements shall be	'Carbon' - for fixed front contacts
	Metal' - for fixed back contacts, & Movable arm contact.
Maximum permitted resistance of	Front Contacts:
	0.2ohms (When carrying 100mA DC)
	(0.18 ohms as per BS.Spec. 1659-50).
	Back Contacts:
	0.05 ohms initially and
	0.10 ohms through out the relay
	(0.03 ohms as per BRS spec.1659-1950)
Minimum front contact pressure	14 grams at 125% of PU current in coils.
	28 grams at 150% of PU current in coils.
Minimum Back contact pressure	15 grams when the relay is in full release position.

3.3 Comparative Statement of other requirements as in IRS specifications for Line Relays and Track Relays of shelf type.

S.No	**Feature**	**Line Relay**	**Track Relay**
1	Working Voltage	Normal 12V D.C	Minimum: 125% of Relay P.U.V. Maximum: 250% of Relay P.U.V.
2	Coil Resistance	Two coils of 500 Ω ±10% Two coils of each (to be connected in series or parallel as required.)	4.5 Ω ± 5% two coils of each (to be connected in series or parallel as required.)
3	Standard contact arrangements	2F/B, 4F/B and 6F/B (all dependent)	2F/B and 2F, 2F/B for Non-ACI relay. 2F.2F/B and 4F/B for ACI Relays.

<table>
<tr><th>S.No</th><th>Feature</th><th>Line Relay</th><th>Track Relay</th></tr>
<tr><td>4</td><td>Contact current ratings:
(a)Continuous for front contacts
(b)For 30 sec. Through front contact
(c)Continuous for back contacts
(d)Non-inductive DC current breaking capacity of contacts
(e)Inductive load breaking capacity of contacts</td><td>3A

5A

3A

<table><tr><th>Max Circuit Current</th><th>Voltage</th><th>No. of operations/ minute</th></tr><tr><td>0.6 A
1.5A
5.0A.</td><td>12.5V
125V
50V</td><td>10 to 20
1 to 2
1 to 2</td></tr></table>
Current drawn by 3 parallel connected relays of this type.</td><td>3A

5A

3A

<table><tr><th>Max Circuit Current</th><th>Voltage</th><th>No. of operatio / minute</th></tr><tr><td>0.6 A

5.0A.</td><td>125V

50V</td><td>10 to 20

1 to 2</td></tr></table>
Current drawn by one line relay of shelf type</td></tr>
<tr><td>5</td><td>Initial pick up current for new relay in mA</td><td><table><tr><th rowspan="2">Coil Res.</th><th colspan="2">2 or 4Arms</th><th colspan="2">6 Arms</th></tr><tr><th>Min.</th><th>Max</th><th>Min.</th><th>Max.</th></tr><tr><td>250 Ω
1000 Ω</td><td>12ma
6ma</td><td>15ma
7.5ma</td><td>15 ma
7.5 ma</td><td>18ma
9ma</td></tr></table>
(6 to 7.5 mA for 4F/B relays)</td><td>(n) For Non-ACI relays
<table><tr><th rowspan="2">Coil Res.</th><th colspan="2">2F/B</th><th colspan="2">2F.2F/B</th></tr><tr><th>Min.</th><th>Max</th><th>Min.</th><th>Max.</th></tr><tr><td>2.25 Ω
1000 Ω</td><td>74 ma
37 ma</td><td>78 ma
39 ma</td><td>78 ma
3ma9</td><td>83ma
41ma</td></tr></table>
(37 to 39 mA for 9Ω relay & 74 to 78 mA for 2.25Ω relay)
(b) <u>For ACI Relays, Only 9 Ω Relay is allowed.</u>
<table><tr><th colspan="2">2F.2F/B or 4F/B contacts</th></tr><tr><th>Min.</th><th>Max.</th></tr><tr><td>68</td><td>72</td></tr></table></td></tr>
<tr><td>6</td><td>Initial pick up voltage for new relay in Volts.</td><td><table><tr><th rowspan="2">Coil Res.</th><th colspan="2">2 or 4Arms</th><th colspan="2">6 Arms</th></tr><tr><th>Min.</th><th>Max</th><th>Min.</th><th>Max.</th></tr><tr><td>250Ω
1000Ω</td><td>2.70 v
5.40 v</td><td>4.13 v
8.25 v</td><td>3.38 v
6.75 v</td><td>4.95 v
9.90 v</td></tr></table></td><td>(a) For Non-ACI relays
<table><tr><th rowspan="2">Coil Res.</th><th colspan="2">2F/B</th><th>2F.2F/</th></tr><tr><th>Min.</th><th>Max</th><th>Min.</th></tr><tr><td>2.25Ω
9.0Ω</td><td>0.158
0.316</td><td>0.184
0.368</td><td>0.167
0.333</td></tr></table>
<u>(b) For ACI Relays, Only 9 Ω Relay is allowed</u>
<table><tr><th colspan="2">2F.2F/B or 4F/B contacts</th></tr><tr><th>Min.</th><th>Max.</th></tr><tr><td>0.58</td><td>0.68</td></tr></table></td></tr>
</table>

S.No	Feature	Line Relay	Track Relay
7.	Minimum percentage release.	50% (as per B.S. Spec1659-50 it is 50% for class 'B' relays & 60% for class'A' relays).	68%
8.	Maximum operate time for front contacts.	450 ms. for non ACI relays 500 ms for ACI relays.	500 ms for non-ACI 550 ms for ACI relays.
9.	Max. release time for front contacts	100ms for non ACI relays. 125ms for ACI Relays	60ms for ACI relays. 120ms for ACI relays.
10.	Max.operate transfer time for front contacts.	400ms	200ms for non-ACI relays 300ms for ACI relays.
11.	Permissible max. rise in P.U current from initial value.	10%	10%
12.	Permissible maximum decrease in DA current from initial value.	15%	15%
13	Permissible max. change in percentage release.	20%	10% (% Rel. not to fall below 68%).
14.	Maximum reverse pick up current	110% of PU current (in the working direction)	110% of PU current (in the working direction.).
15.	AC Immunity of relay.	300V750v as per SEM para 22.6.2.5 (achieved intrinsically without using any external means).	50V(achieved by the provision of copper sleeves and magnetic shunt

3.4 Comparison of Line Relay & Track Relay

S. No	Track Relay	Line Relay
1.	These are connected to the rails directly to detect track occupation	These are connected in different circuits through necessary controls (not connected to rails directly)
2.	These works on the principle of reduction in control current changing their position.	These works on the Principle of current or no current controlling their change of position
3.	These are necessarily more sensitive.	These are not highly sensitive
4.	These carry less number of contacts due to low power operation	These can have more contacts due to sufficient power application
5.	POH is 10-12 years for shelf type. In plug in type no overhauling period but relay can be replaced after 10-12 years	POH is 15 years for shelf type relay
6.	It works on low voltage i.e. less than 1.00 volts DC	It works on high voltage minimum 12 volts DC

3.5 SHELF TYPE A.C. IMMUNISED D.C. NEUTRAL RELAYS:-

A.C.Immunity of a DC Line Relay is indicated by the value of AC voltage when applied abruptly to a de-energized relay that breaks any of its back contacts.

AC Immunity of a DC Track Relay is indicated by the value of AC voltage which when superimposed on normal DC working voltage causes a change of more than a prescribed limit in the relay pickup current.

3.6 Operating and other characteristics of AC immunised DC line Relays of shelf type. (Ref. IRS. spec. S60-1978)

(a) The relay shall not make any of its front contacts as a result of 1000V AC (R.M.S) 50Hz sinusoidal voltage when applied gradually at any instant to the terminals of the coil(s) of the de-energized relay.

(b) The relay shall not make any of its front contacts as a result of 750V AC (R.M.S.) 1-phase 50Hz sinusoidal AC voltage when applied abruptly at any instant to the terminals of the coil(s) of the de-energized relay.

(c) The relay shall not break any of its back contacts as a result of 300V AC (R.M.S.) 1-phase 50Hz sinusoidal AC voltage when applied to the terminals of the coil(s) of the de-energized relay. (I) gradually, (ii) abruptly at any instant.

(d) When 100V 50Hz AC voltage is applied continuously to relay coil(s) for 30 minutes, the heat generated in the coils shall not damage the insulation of the coils.

3.7 Operating and other characteristics of AC immunised DC Track Relays of Shelf type.

(a) Determination of DC characteristics under AC influence:-

(i) Maximum 50Hz AC voltage superimposed on normal DC working voltage, without causing a change of more than ± 7% in the pickup current ,shall not be less than 50V.

(ii) Maximum 50Hz AC voltage superimposed on normal DC working without causing a decrease in the minimum specified percentage release, shall not be less than 50V.

(iii) Maximum 50Hz AC voltage superimposed on maximum DC pickup current + 10% causing the armature contacts to move from compressed position shall not be less than 85V.

(b) Non-energisation of the relay under AC influence:-

(i) The relay shall not get energized with abrupt application of up to 350V 50Hz AC to its coil.

(ii) The relay shall not get energized with gradual application of up to 500V 50Hz AC to its coil.

(iii) Permanent application of up to 100 Volt AC to the relay coil shall not cause injurious heating to it.

3.8 Timing Characteristics:

(a) Minimum total pick up time when the relay is fed with 10% above the max. Specified pickup current shall not be more than 1 second.

(b) Maximum picks up transfer time, when the relay is fed with 10% above the max. Specified pick up current, shall not be more than 300 milli seconds.

(c) Minimum total pick up time, when the relay is fed with 250% of the maximum specified pick up current, shall not be less than 250 milli seconds

(d) Maximum drop away transfer time when the relay is fed with 250% of the max. Specified pick up current shall not be more than 200 milli seconds.

3.9 INTERNAL PROVISIONS OF SHELF TYPE AC. IMMUNISED DC NEUTRAL RELAY

In this relay (I) two copper slugs on the core near pole faces and (ii) a magnetic shunt above them are provided for immunization purpose.

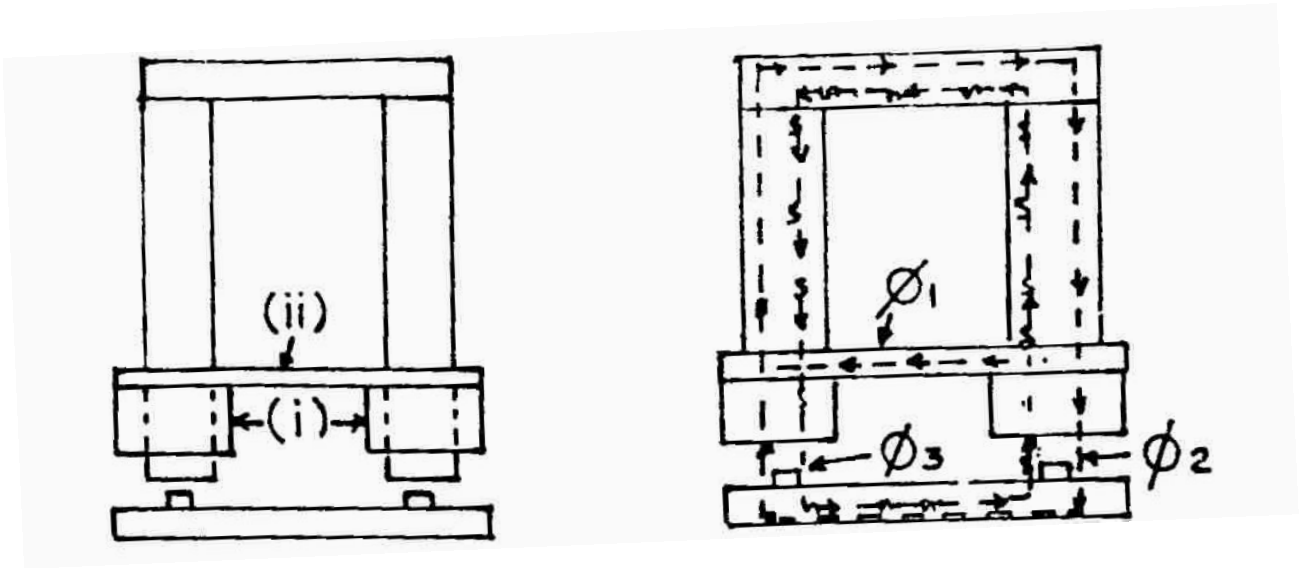


Fig: 3.2

When A/C current passes through the relay coil,(Fig3.2) a part of the flux set up in the core say (Ø1), passes through the magnetic shunt. The remaining flux, say (Ø2), is set up through the air gap and armature which links with the copper slugs causing, induced currents in them. The directions of Ø1, Ø2 & Ø3 shown are instantaneous.

The induced currents set up their own flux in opposite direction to (Ø2) through the armature, say (Ø3). This almost neutralizes the operating flux (Ø2). Thus the copper slugs and the magnetic shunt make the relay inoperative for AC. supply.

When DC current passes through the coil, the opposition to the build up of flux through the armature is momentary (transient), which is during the rise of current to its full value. Once the coil current and flux are established, the current in the copper slugs cease to flow and the armature remains in the attracted position. This arrangement, however, requires more operating power and delays operation.

Similarly, when the coil current is falling, the slug current oppose the decay of flux through the core. This results in a delayed release of the armature.

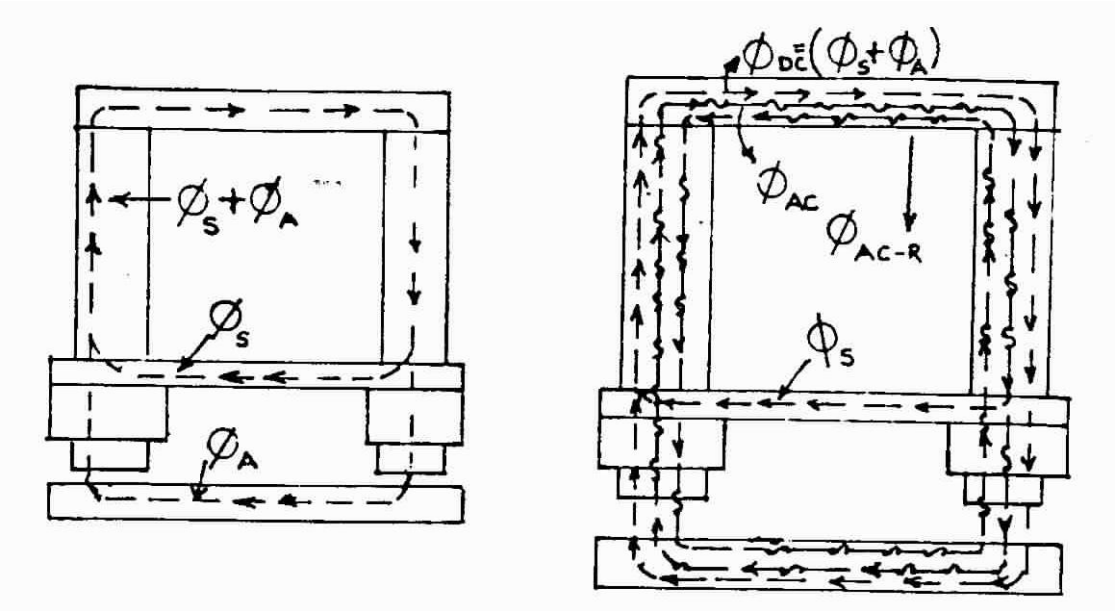


Fig: 3. 3

ØS=Flux in shunt ØAC=flux in AC
ØA= Flux in Armature ØAC-R=flux due to induced voltage

When a certain AC current is superimposed on the DC working current, the alternating flux shows a tendency to destabilize the DC flux, which lifts or holds the armature. Hence the DC pickup value of the relay increases. This increase may cross the limits beyond a permitted minimum value for AC interference, i.e., 50V for this relay.

The fluxes set up in the core by the DC and AC currents before the relay operation are shown in the fig 3.3. In this case also, the pick up and release of the relay gets delayed till the reactive current flux is setup by the slugs in the core.

Review Questions

Subjective

(1) What are the parts of shelf type relays?

(2) Draw the figure of shelf type relay.

(3) Explain how the AC immunity is achieved in AC immunized DC neutral shelf type relay?

(4) What is the purpose of residual pin?

(5) Compare the line relay and track relay

Objective

(1) The armature has on it copper or brass pin facing the magnet poles to maintain a small air-gap in its attracted position is called ----------

(2) Working voltage of line relay is ----------

(3) Working voltage of track relay is ----------

(4) Coil resistance of line relays is ----------

(5) Coil resistance of track relays is ----------

CHAPTER 4: PLUG IN TYPE DC NEUTRAL LINE RELAYS (NON-PROVED TYPE)

4.1 Two styles made in this type to BR specifications 930 series are introduced on Indian railways, P-series / Q-series relays. They are called because their name code starts with these letters. However, P-series relays are going out of use gradually. Q series relays are now universally used with the British signalling practice. Even as no separate IRS specifications are issued for these relays, they confirm to IRS specification No S23 and S34 (for testing procedures) broadly.

4.2 Plug in DC Neutral Relays of Non-Proved Type (Q-series relays)

RDSO/SPN/198/2009(draft)

The basic constructional features of these relays are as follows:

(a) Standard plug board common to all relays.
(b) Plug-sockets kind of interconnection between plug board and relay.
(c) A retaining clip provided to hold the relay firmly in the plug board, so that there is no possibility of loose electrical connections.
(d) Connectors, which are positively locked in to the plug board and can be with drawn by a special tool to permit easy disconnection.
(e) Means for terminating permanent wiring to plug board on the connectors both by crimping & soldering.
(f) Registration device with specified coding combination in order to prevent a wrong relay being plugged.
(g) No electrical connection possible between plug board and the relay base until code pins have correctly engaged.
(h) Fixed contact positioned by adjustment cards and moving contact positioned by operating arm driven by the armature.
(i) Provision of helical spring to provide definite back contact pressure and aid in return torque.
(j) Provided with Non-proved (metal to carbon contacts) and all are independent contacts only.

4.3 DC Neutral line Relay -- Style QN1

The fundamental relay of the Q-series is the DC neutral line relay style QN1. All other relays of the Q series have been developed around the QN1 in an effect to standardize the components.

The iron circuits and the contact stacks are mounted on a molded base of extremely stable thermosetting material. Up to four contact stacks are fixed to the base, each with four independent contacts.

The iron circuit is mounted below the contact stacks. It consists of an ‘L’ shaped heel piece, core with bobbin and an armature. The armature pivots on a phosphor bronze pivot plate, which is riveted to the heel piece.

The contact springs are made of phosphor bronze. The fixed contacts are positioned by adjustment cards located on the brackets riveted to the heel piece, while the moving contacts are positioned by operating arms driven from the armature. All movable arm contacts are silver (Ag)and fixed front and back contacts are silver impregnated graphite (SIG)

The relay is provided with a handle attached to molding base of the relay. A transparent cover covers all the components.

The rated life of relay shall be taken as 1000000 cycles under specified conditions of operation where one cycle consists of an operation followed by a release.

RELAY CONSTRUCTION:

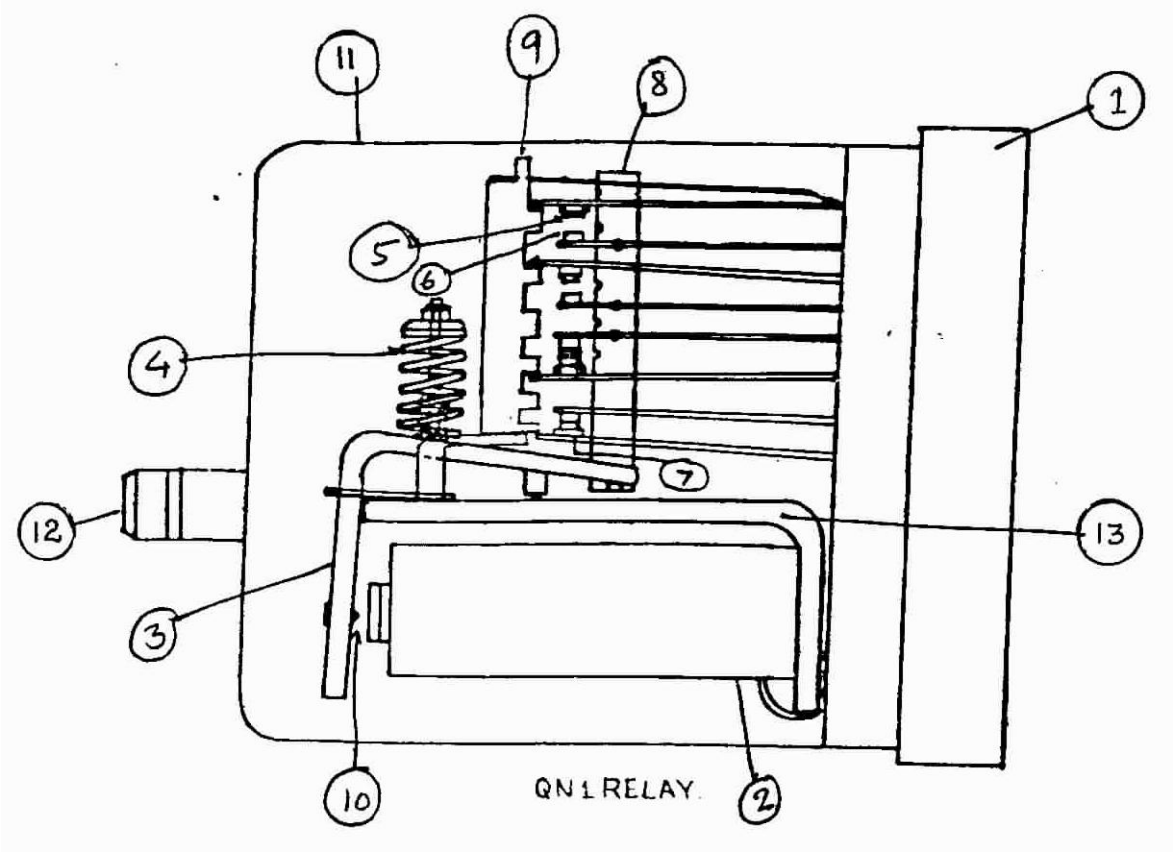


Fig : 4.1

1) Relay base	2) Electro-magnet	3) Armature
4) Pusher spring	5) Fixed front contacts	6) movable arm contact
7) Fixed back contact	8) Operating arm	9) Adjustment card
10) Residual pin	11) Transparent cover	12) handle
13) Heel piece		

4.4 Details of Parts:

1. Base: It is a one piece moulding of non-hygroscope thermosetting material. Contact springs extend behind on it and below them are coil connection springs. Coding pins are fitted below these springs on the base in nominated positions.

2. Electro-magnet: It is mounted on the base below the contact stacks. It consists of a bar magnet core and an L-shaped heel piece that extends above to the front. A coil is wound on a bobbin over the core.

3. Armature: It is mounted on a phosphor bronze pivot plate riveted to the heel piece. A non-magnetic residual pin is fixed on the inner face of armature facing the core in all the relays except the magnetic latch relay.

4. Pusher spring: It is fixed above the armature and helps in restoring it to its full released position when the relay is de-energized.

5. Contacts: The fixed front and back contact springs are held in position by adjustment cards located on a bracket riveted to the heel piece. These springs are preset against their stops on the *adjustment cards* so that equal pressure is obtained on all the contacts during their making. Contact wear during the life of relay has little affect on the contact pressure.

Operating arms each held between the armature and a holding spring on top of the contact stacks drives the moving arm springs.

All the front and back contacts of these relays are independent 'metal-to-carbon' contacts except the heat-operated contacts of Time element relays. This ensures their non-fusibility.

6. A transparent cover: A transparent cover covers all the components.

7. A handle: a handle attached to moulding base of the relay.

8. A retaining clip: It is hooked onto the plug board over the relay and holds them tight together.

While an exhaustive data sheet is given at the end of this chapter with details of all the relays in common use, a brief account of the salient features of each relay is given below:

4.5. Plug Board (Back view)

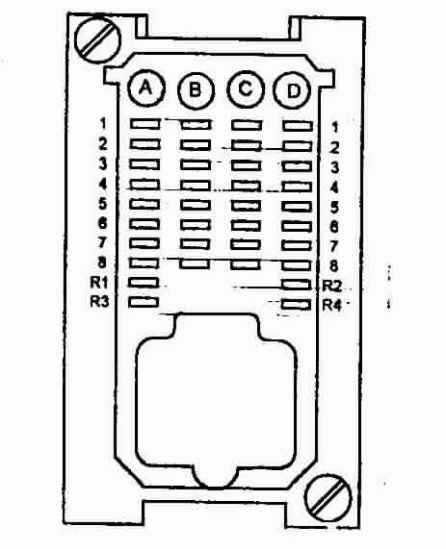


Fig: 4.2

It is a one piece moulding of the same material as the relay base. It is provided with slots (sockets) for accommodating wire connectors and a relay. It is provided with 4 columns and each column is provided with 8 No of slots, i.e. for 4 numbers of contacts. Maximum 16 numbers of independent contacts are available in 'Q -series relay and for relay coil connections 4 slots are provided, there by two numbers of coils can be terminated.

Removable connectors are provided with soldering or crimping. Connectors can be removed only with a special tool.

Q- Series neutral line relays are provided with 16 numbers of independent contacts.
In this some of the contacts are fixed front / back contacts, which cannot be changed, and some are the interchangeable contacts. These contacts can be interchanged. The changing of contacts can be done by the manufacturers at their manufacturing unit.

The manufacturer seal the relay, users are not allowed to open the relay.

(a) Fixed Front contacts (08 No.s)

A1	B1	C1	D1
A2	B2	C2	D2
A3	B3	C3	D3
A4	B4	C4	D4

(b) Fixed back contacts (04 No.s)

A5	D5
A6	D6
A7	D7
A8	D8

(c) Interchangeable contacts (04 No.s) (Front/Back)

B5	C5
B6	C6
B7	C7
B8	C8

4.6 Registration Device (Coding pins / Sockets)

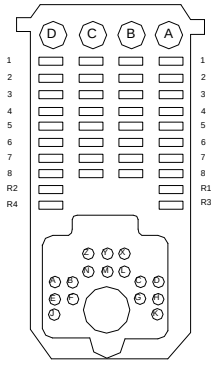


Fig: 4.3 FRONT VIEW OF PLUG BOARD

Each relay is provided with code pins, which prevent a relay being plugged in to wrong plug board. Pin position coding is provided for plug-in type relays. This ensures that a front contact does not get connected to the circuit wiring of a back contact or a back contact does not get connected to the wiring of a front contact in the base, which may cause unsafe conditions. There are 10 (ten) positions for code pins in the relay base with corresponding socket positions in the plug board as shown in the figure 4.3 above.

The base of a Q- series relay is plugged in to a vertically mounted plug board on the rack, with a matching “code pins and sockets” arrangement between them. Any five of the ten positions are drilled in the plug board and five pins are fitted to the relay base in the corresponding positions. This gives 252 unique arrangements. All these arrangements are numbered serially as 001, 002 …….252.These are known as code numbers. Relay of the same type having different contact arrangements will have different code numbers. Six (6) more code pin positions are used for special relays.

It may be seen that relays of different contact arrangements having identical positions for front and back contacts, have the same code numbers.

4.7 Contact Arrangements:

'Q'- Series relays are provided with a maximum of 16 independent contacts, and the standard contact configurations are:

(a) Line relays: -- 12F / 4B, 8F / 8B, 8F / 4B, 6F / 6B, 6F/ 2B, 4F / 4B etc

(b) Track relay: -- 2 F /1B, 2F / 2B, 4F/2B

(c) ECRs : -- 3F / 3B , 4F /4B etc.

Rear view of a plug board of line relay

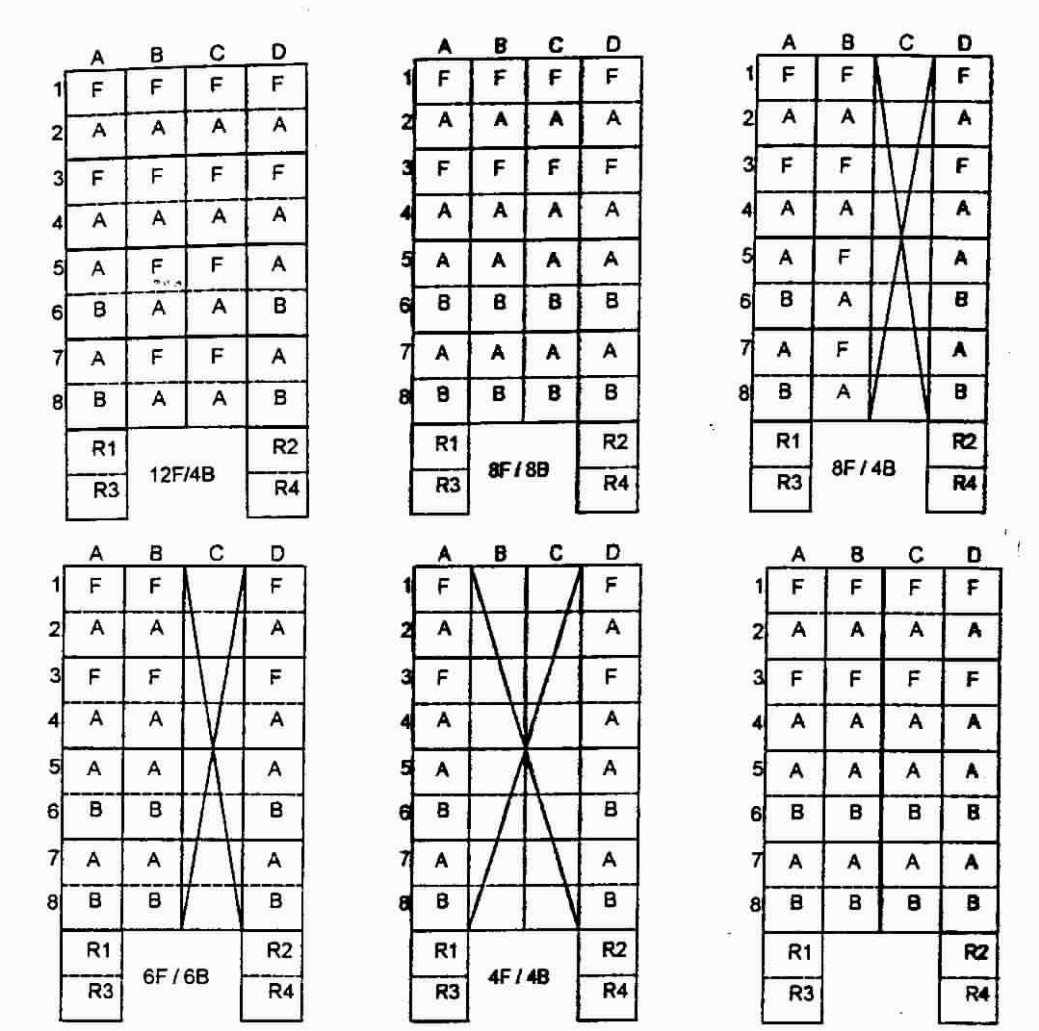


Fig : 4.4 4F/4B & 4F/4B QNN1 RELAY

4.8 Deference between shelf type and plug in type relays:

Shelf Type	Plug in Type
Heavy and large	Light and Compact.
Takes more space.	Less space.
Replacement takes time	Replacement is quicker.
As wiring gets disturbed during replacement, circuit has to be tested again.	Not Necessary as no wiring is disturbed
No coding arrangement required.	Coding arrangement is provided for safety.
More sensitive as they have large magnets.	Less sensitive.
Lesser voltage of operation.	Comparatively more voltage of operation.
Periodical overhauling to be done. a) Line relay- 15 years b) Track relay-10-12 years	No periodic over hauling for a line relay. Track relay to be replaced after 10-12 years.
Both independent and dependent contacts are available	Only independent contacts are available
Maximum 6 dependant contacts are available	More number of contacts are available i.e. 16 No.s

4.9 Types of Q Series Relays

4.9.1 QN1: DC Neutral Line relay: (Spec: BRS 930A)

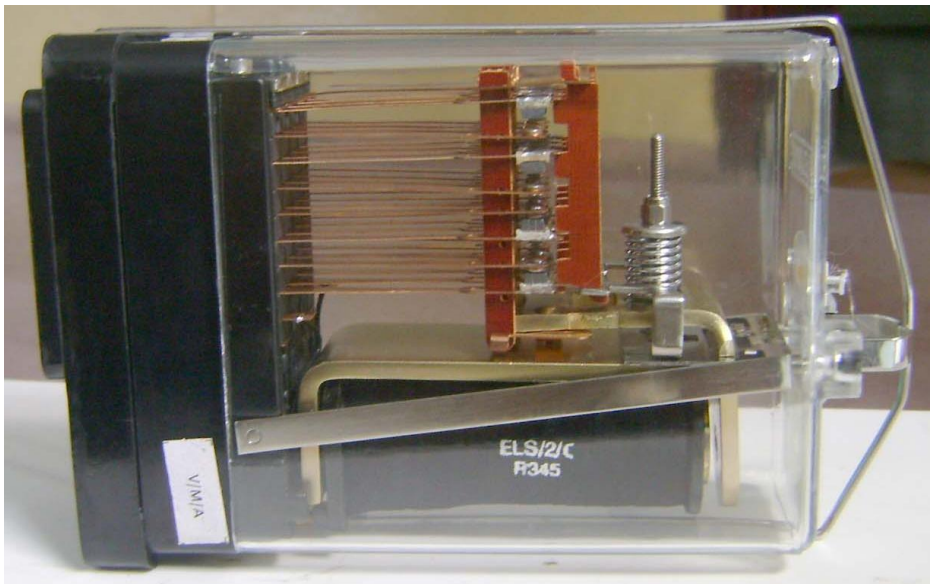


Fig: 4.5 QN1 RELAY

All combinations:	12F/4B, 8F/8B, 8F/4B, 6F/6B, and 4F/4B).
Working voltage:	24V, (50V ,1006Ω as track relay for ABB AFTC).
Coil resistance:	400 Ohms for 24V relays.
Operating current:	60mA.
Max P.U is	19.2 V,
Min. DA is:	3.6V.
P.U time:	150milli seconds,
DA time:	20milli seconds.
Application:	All control and detection circuits of Non RE area and Internal Circuits in RE area.

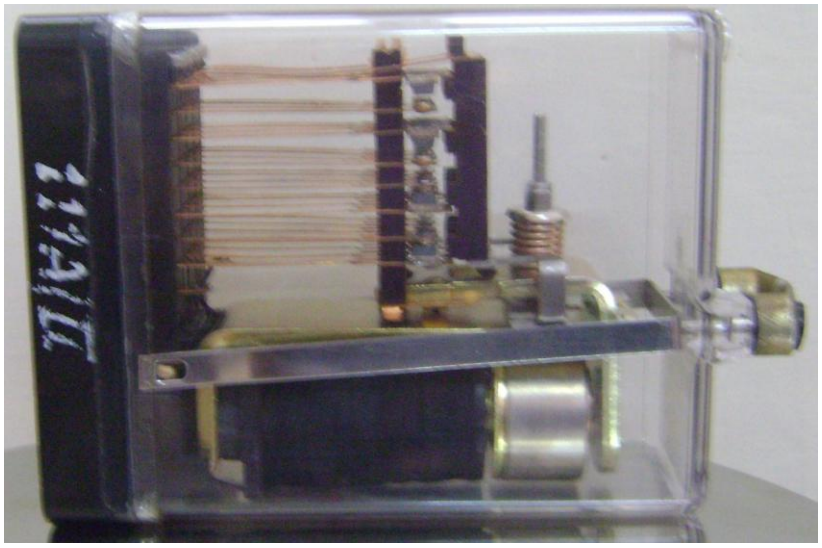
4.9.2 QNN1: DC Twin Neutral Line Relay. (Spec: BRS 960)

Two neutral relays with common heel piece, common base. Both relays are independent of each other and can be used for two different circuits. (Unrelated)

Contact combination: 6F/2B, 4F/4B each.(Both relays will have same contact combination).
LH - 4F/4B, RH - 4F/4B , R2,R4 - LH side Relay
C,D - Column for LH Relay R1, R3 - RH side Relay
A,B – Column for RH Relay(viewing the relay from the front side)
Coil Resistance: 470 ohms
Normal working voltage: 24v
Max PU: 19.2V,
Min DA: 3.6V.
Application: All circuits of Non RE area and Internal circuits of RE area.

Saving of space and used in circuits needing less number of contacts. They have equal number of contacts on both the relays.

QNA1: AC immunized DC Neutral Line Relay. (Spec: BR 931A)



QNA1 RELAY
Fig : 4.6

AC immunity requirements of (IRS S 60-78), the relevant provision of which are given below:

(a) No front contact to make by sudden application of 1000 V 50Hz AC.

(b) Relay not to break its back contact when 300V R.M.S is applied gradually or abruptly.

(c) Maximum P.U transfer and release transfer time not more than 200 milli Seconds when relays energized with 80% rated voltage.

A/C Immunisation is achieved by the provision of copper slug at the armature end of the core. No magnetic shunt is used. A/C immunisation principle is same as in the case of shelf type relay.
In all other aspects it is same as QN1.

AC immunity level: 1000V (R.M.S) 1-phase 50 Hz

Voltage: 24VDC. PU time: 220milli seconds, DA time: 70milli seconds.

Application: All external control and detection circuits in RE area.

4.9.4 QS3: Q Series Sensitive Neutral Relay (Spec BRS 930A)

This is a sensitive line relay designed to work on low voltage and current in a manner similar to shelf type neutral line relay. It is intended to replace shelf type line relay. This is made to work on 12V DC

Working voltage	:	12V DC
Coil resistance	:	1000 ohms
Contact configuration	:	4F/4B contacts
Operating current	:	12 mA.
Max PU voltage	:	9.35V,
Min PU voltage	:	7.5V,
Min DA voltage	:	3.75V

This relay is classified as 'A' class relay and % release is more than 60 %. Designed originally to replace shelf type 1000 ohms line relays in axle counters, i.e. evaluator relay and supervisory relay (EVR, SUPR)

QSA3: Q Series sensitive AC immunized DC neutral relay. (12V,1000 ohms, 4F/4B).

4.9.5 QB3: DC Biased Neutral Line Relay (Non AC Immunized)

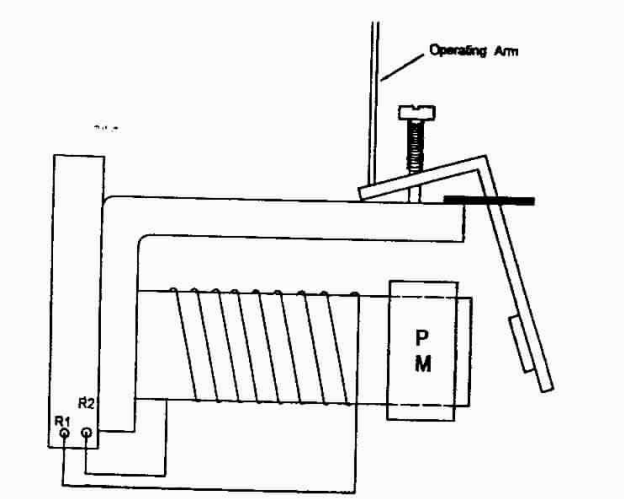


Fig: 4.7

This is a DC biased neutral line relay. It operates only when rated DC supply of correct polarity is connected. The armature does not get attracted for reverse polarity supply of 20 times the rated 12V DC (i.e. 240 V DC)

Biasing of the relay is achieved by the provision of a permanent magnet, which aids the Electromagnet flux. Permanent magnet need not be powerful, as 'armature' need not to be held in attracted position by its flux alone. Neither the electro-magnetic coil flux nor the Permanent Magnetic flux can hold the armature in attracted position on their own. Armature gets attracted only when both fluxes are acting in the same direction. Advantage of biasing is that two relays can be connected on the same line. Hence a pair of conductors can be saved. It is used in Podanur make single line token less push button type block instruments as code receiving relays CRR(R) and CRR(N).

Rated voltage	:	12 VDC and current: 60 mA
Standard contact	:	4F/2B.
PU current	:	45 mA.
PU Time	:	380 milli seconds
DA Time	:	20milli seconds

QBA1: Biased AC Immunized DC Neutral Line Relay. (Spec: BRS 932A)

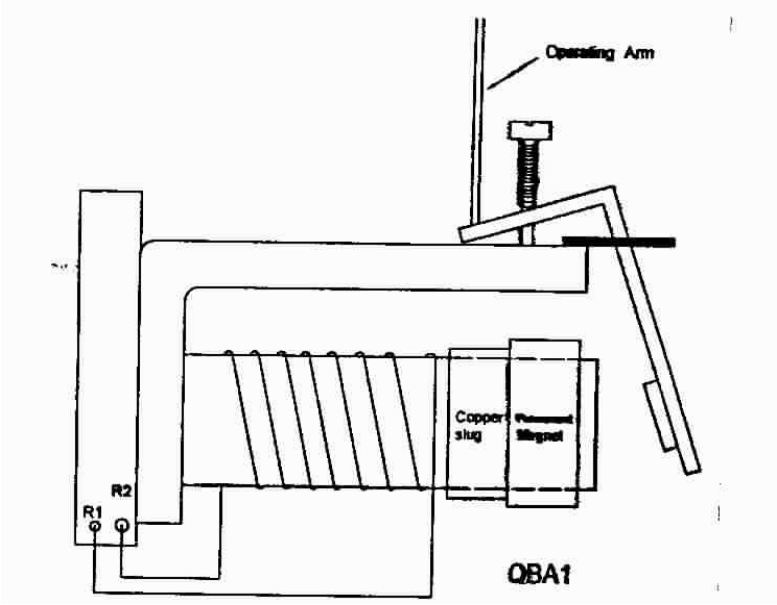


Fig: 4.8

This is a DC biased AC Immunized neutral line relay. It operates when rated DC voltage of correct polarity is connected. It does not get attracted for 20 times the rated 24 VDC in reverse polarity. To make the relay AC Immunized Copper slug is provided at its armature end and biasing feature is achieved by providing a permanent magnet adjacent to copper slug.
This relay is used in "DAIDO" Single line Block Instrument, used in RE area.

Coil resistance	:	200 Ohms coil.
Working voltage	:	24V DC.
Contact combinations	:	12F/4B, 8F/4B, and 8F/8B.
AC immunity level	:	120 VAC as per BRS931.
Contact current rating	:	3A (continuous) and 2A (Switching).

4.9.7 QBCA1 Relay made to BR specn.No.943

(Q series biased A/C immunized relay with heavy duty front contact)

This is a relay similar in construction to QBA1 relay. But it has two heavy duty front contacts and four back contacts of standard current rating. The front contacts can carry and switch up to 30A inductive current at 110 VDC.

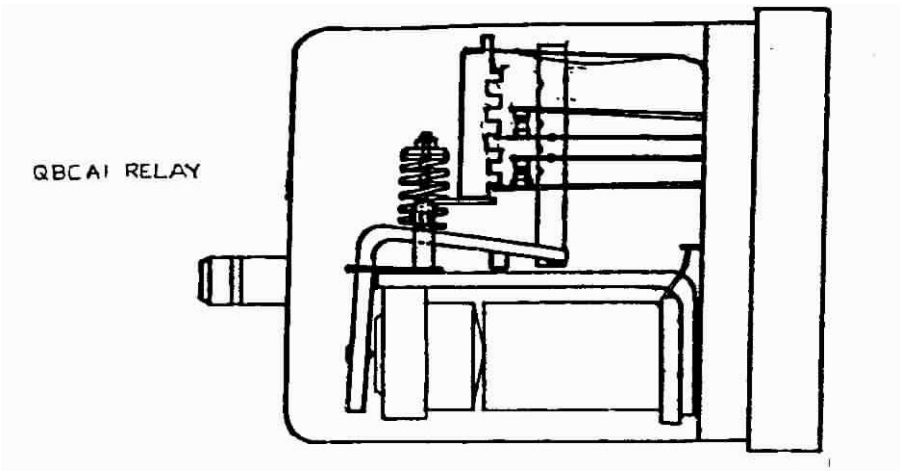
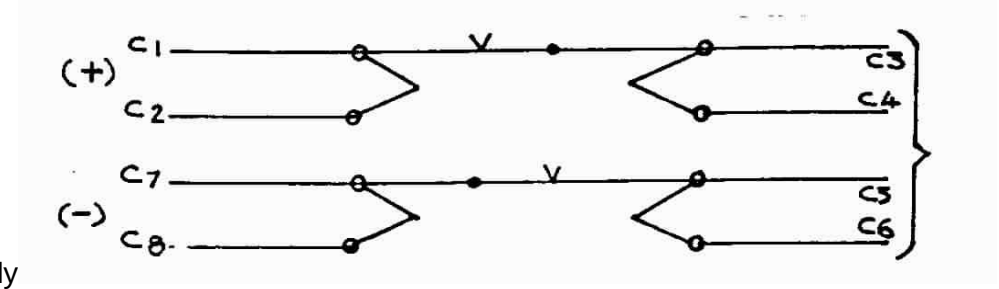


Fig: 4.9 A

PLUG IN TYPE DC NEUTRAL LINE RELAYS (NON-PROVED TYPE)

These relays are used for point machine control of both high voltage type (110 VDC) and low voltage type (24 VDC). In this relay, two natural magnet pieces called "Blow Out" magnets are fixed on a bracket by the side of front contact elements. Spark quenching by these magnets during operation makes it possible for them to switch heavy currents.

Two extension springs each behind the base are joined with front contacts and their arm springs so that two wires can be connected for sharing the heavy current through these contacts. Point motor feeding through these contacts shall be as given below:-



Input supply

Fig : 4.9 B

Output to load

Note: *For correct operation of heavy-duty contacts, polarities shown above must be observed correctly.*

The wires recommended for use with these contacts are 9/0.012" copper conductors. Current to the back contacts can be carried by 16/0.2mm dia. wires like in the case of any other Q-series relay contacts. The relay is immune to the affects of 1000V AC 50Hz in the de-energised condition. However, it is usually tested with 120V 50Hz abrupt application for AC immunity. The minimum pressure specified for the front contacts of this relay is 56 gms, whereas it is only 28 gms for the m-to-c contacts of other relays of this series.

QSPA1: Q series Slow to pick up AC Immunized DC Neutral Relay (Spec. BRS 933A)

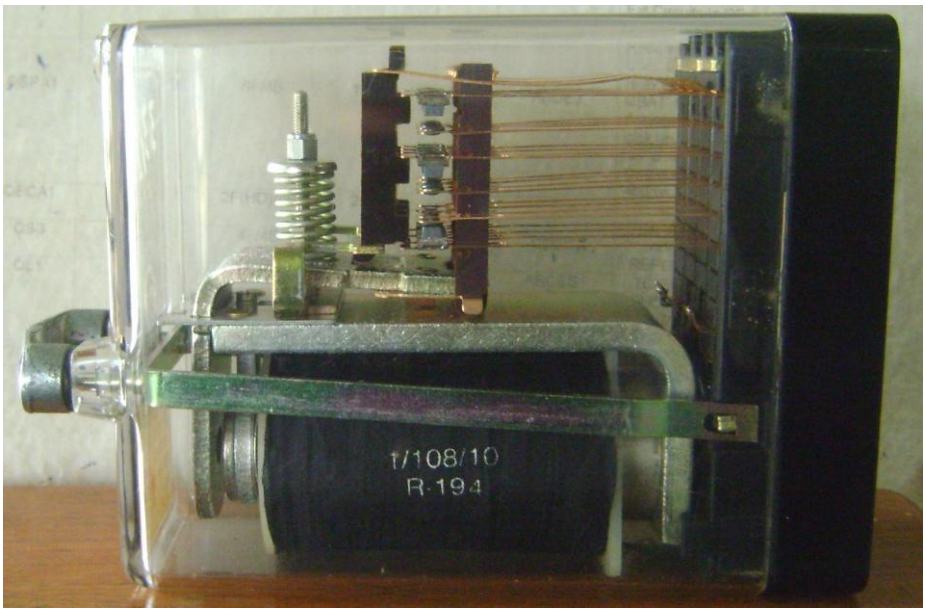


Fig: 4.10

A Magnetic shunt is provided at the armature end to make the relay slow to pick up. Magnetic shunt is of a magnetic material, when the current flows through the coil it set up a flux which passes through the magnetic shunt, after a time delay the magnetic shunt saturates, further flux will not flow through the magnetic shunt. Then magnetic circuit completes through core, air gap, armature and heel piece there by armature get attracted after a time delay of 540-600 milli seconds. Hence this relay becomes suitable to used as TPR for Q series TRs.

To make the relay AC Immunized, Copper slug is provided at the heel piece end.

Used as TPR where Q-series AC immunized track relays are provided. OHE Circuit Breaker tripping may take around 300 milli seconds after catenary's snapping/short circuiting of OHE supply. This causes high voltage drop across the track, which may operate the Track relay. But it is essential that the repeater should not pick up. Hence slow to pick repeater relay is used. Pick up time for relays used as repeating relays with plug in type AC immunized track relays shall have a pick up time of at least 400 milliseconds.

Pick up time	: 540-600 milli seconds.
Release time	: 140-200 milli seconds.
Working voltage	: 24 V DC
Coil resistance	: 208 ohms
Contact configuration	: 8F / 4B
A/C Immunity level	: 300 V AC

4.9.9 QSRA1: Slow to release AC immunized DC Neutral Relay (BRS Spec. No. 934A)

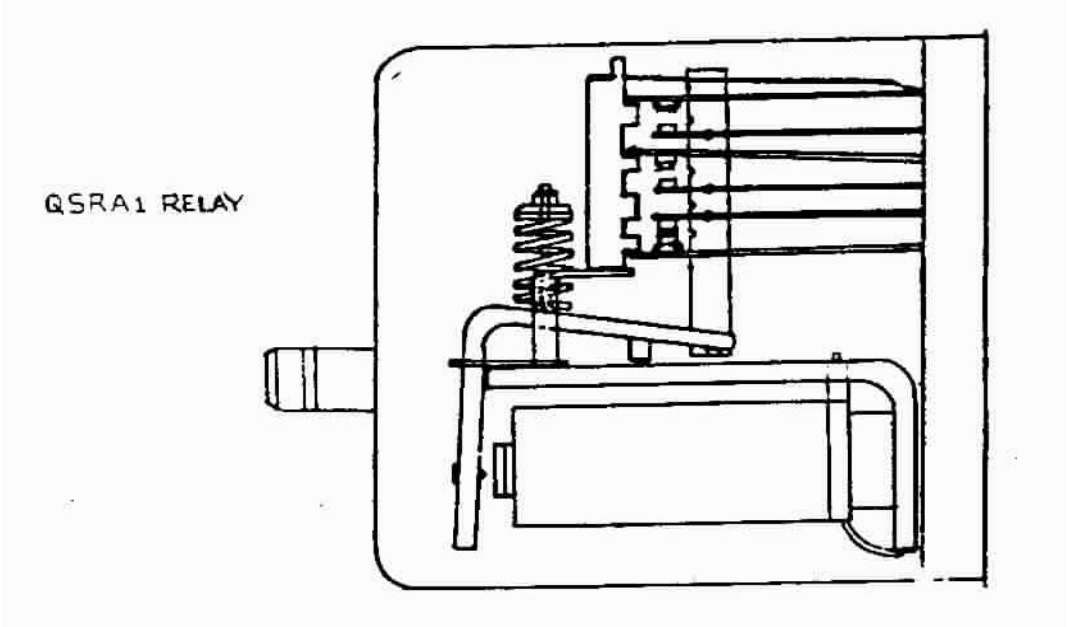


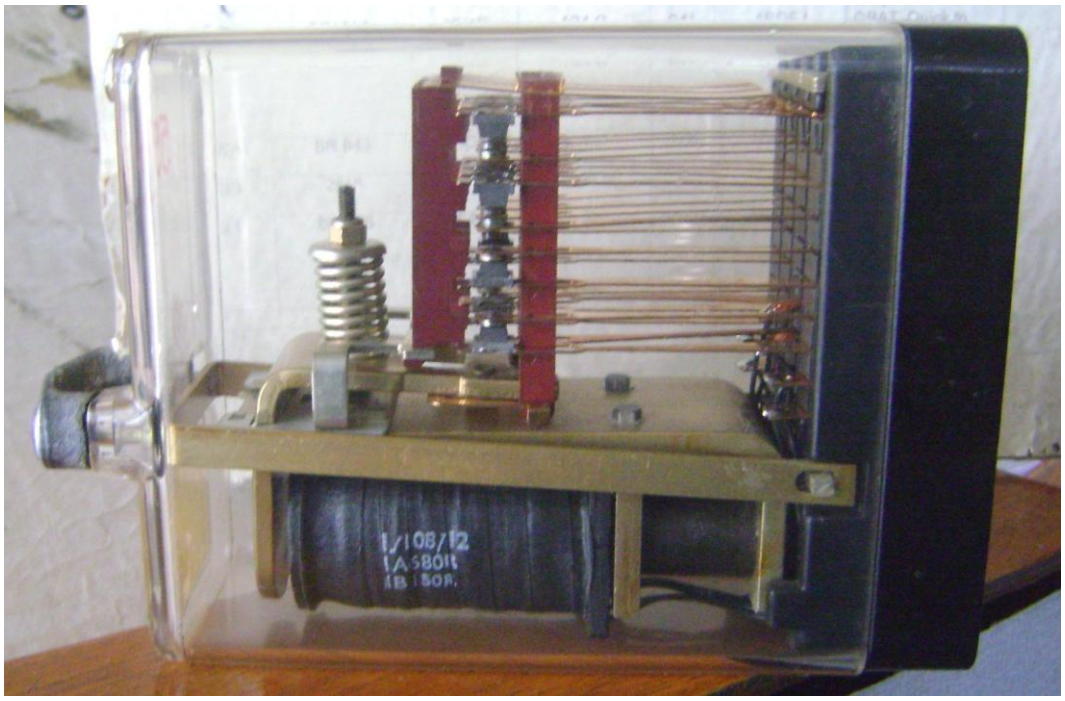
Fig: 4.11

Magnetic shunt is provided at the heel piece end to make the relay slow to release.
Copper slug is provided for AC immunization.

DA time	: 260milli seconds.
Working voltage	: 24 V DC
Coil resistance	: 208 ohms
Contact configuration	: 8F/4B
A/C Immunity level	: 300V AC

Used as HPR, DPR in RE area**.** Insensitive to momentary track circuit bobbing and power supply fluctuations.

4.9.10 QL1: Q – Series Magnetic Latch Relay (BRS Spec. No. 935A)



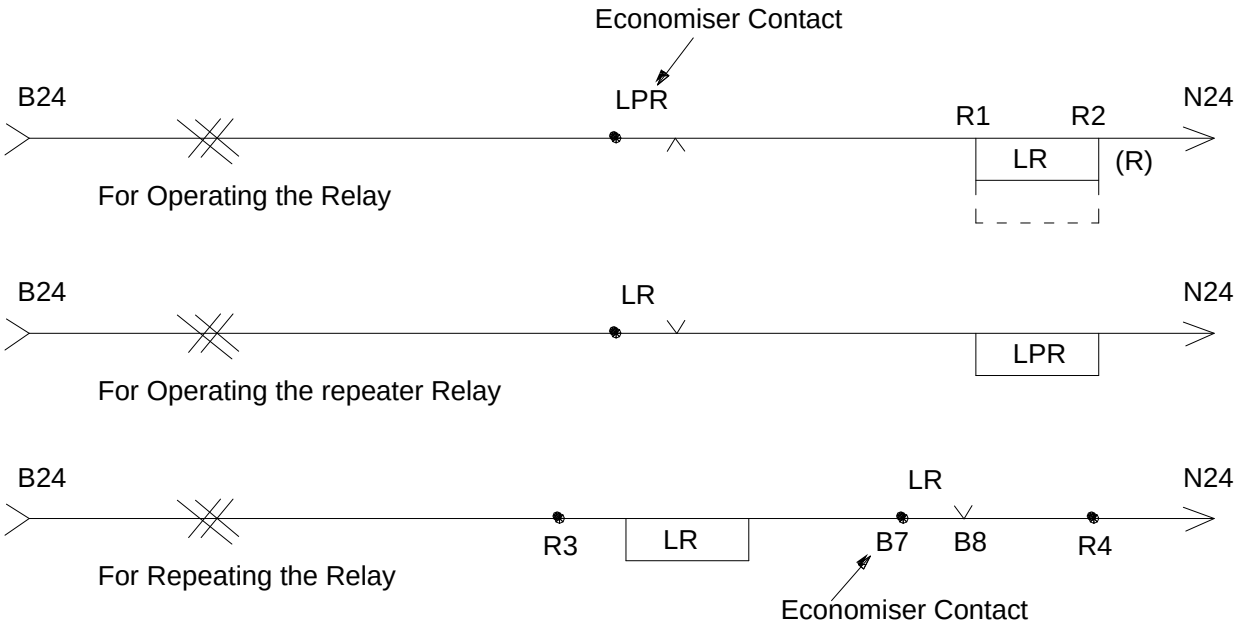


Fig: 4.12

Relay latches magnetically in the operated position. This is achieved by the use of a permanent magnet, provided at the heel piece end.

Note: *The difference in the position of the Permanent magnet i.e. in biased relays the Permanent Magnet is at armature end and for latch relays it is placed at the heel piece end.*

There is no residual pin as it is a latched relay and requires power supply for releasing the relay.

This relay contains two coils namely Reverse Coil (Operating coil) (150 ohms as more flux is required for operating) and Normal Coil (Release Coil) (680 Ohms release coil as less flux is required to oppose the flux of permanent magnet causing the armature to release). They wound on the same core in opposite direction to each other.

When pick up coil is energized, flux produced assists Permanent magnetic flux and the armature is attracted to pick up position. The armature is held in this position by the Permanent magnet flux even after P.U coil supply is disconnected. The latched relay feed is cut off as soon as it is latched. The Permanent magnet is a strong magnet, as it is required to hold the armature in the pick up position. Feed to operating coil is cut off externally by using back contact of repeater relay.

When the release coil is energized it produces a flux, which opposes the permanent magnet flux there by force on the armature reduces, the pusher spring pushes the armature to release position. Feed to the release coil is cut off internally (internally wired in series with a front contact and is automatically open circuited during the release cycle). This arrangement is done to avoid prolonged feed to Normal coil whose flux opposes the PM flux, may demagnetize the Permanent magnet.

Working Voltage	: 24V.
Coil resistance (reverse)	:145 ohms
(Release)	: 680 ohms
Contact combinations	: 11F/4B, 8F/6B.
Application	: TCFR, TGTR, TAR and TOLAR in PTJ push button block instruments.

***Note**: In the latch Relay only when correct polarity given to the reverse coil the Relay latches i.e +ve toR1 , –ve to R2 In the Same way when correct polarity given to the Normal coil the Relay releases i.e +ve to R3,-ve to R4*

Review Questions

Subjective

1) Draw the contact arrangement for 8F/8B Q series relays.
2) What is the difference between shelf type and plug in type relays
3) Explain the features of QN1 relays
4) Explain the coding arrangement provided in Q series relays
5) Explain the latch relay working in Q series type

Objective

QL1: Latch relay is used in ---------- block instruments

1) Q series Latch relay contains two coils namely Reverse Coil (Operating coil) --------- Ohm and Normal Coil (Release Coil) ---------- Ohms
2) QSRA1: Slow to release AC immunized DC Neutral Relays are used for ----------
3) Coil resistance of QSPA1 relay is ----------
4) QBCA1 relay heavy duty front contact can carry current of ----------.

CHAPTER 5: PLUG IN TYPE DC NEUTRAL LINE RELAYS (PROVED TYPE) FOR RAILWAY SIGNALLING IRS Specification No: S46-76.

5.1 This specification relates to design and performance requirements for DC Neutral Line Relay (proved type) with metal to metal contacts for use in Railway Signalling Circuits. Some of the important points are as under.

GENERAL REQUIREMENTS

5.1. 3.0 Design and Drawings

5.1.3.1.1 The relay shall meet the requirements of this specification for material, design assembly and finish, etc, in entirely and also relevant requirements in other specifications.

5.1.3.1.2 Necessary technical particulars including drawings forming an essential part of an offer for relay to this specification may be asked to be furnished for examination by the purchaser.

5.1.3.2 Mounting and cover

5.1.3.2.1 The relay shall be so designed that it can be mounted with in a relay group housing such that the relay are protected against dust and moisture under service conditions when enclosed in such relay group housing . Alternatively, the relay shall be provided with an individual transparent cover which protects the relay from dust and moisture under service conditions. In either case the relay and its moving parts including contacts shall be clearly visible for inspection from out side.

5.1.3.2.2 Sealing arrangement shall be provided for the relay group housing in which the relays are enclosed for individual cover for the relay where provided, so that there is no possibility of unauthorized interference with the contact arrangement and other moving parts. Locking arrangements may also be provided when required by the purchaser.

5.1.3.2.3 The relay housing or cover shall all be free from detrimental warping which may reduce clearance between the housing or cover and any moving parts of the relay, either from temperature or moisture changes or long term ageing or from release of locked up stresses.

5.1.3.2.4 The clearance between the cover of relay or group of relays and the moving parts of the relays shall not be less than 3mm.

5.1.3.2.5 The cover and base of the relay group housing or individual cover and base—plate of the relay shall be gasketted in such a manner as to protect the whole against dust, moisture and Vermin.

5.1.3.3 Air Clearance Distance

5.1.3.3.1 An Air Clearance distance of minimum 1.8 mm. shall be provided between any exposed current carrying part and any other metallic part insulated from there. However, it is desirable that a clearance of not less than 3 mm wherever possible, is provided.

5.1.3.4 Surface Leakage Distance

5.1.3.4.1 A surface leakage distance of minimum 1.8 mm. shall be provided between any exposed metallic part carrying current and any other metallic part insulated from there. However. it is desirable that a surface leakage distance of not less than 3 mm wherever possible is provided.

5.1.3.5 Other Requirements

5.1.3.5.1 These shall be as in Clause 4 of IRS Specification No. S 23(except sub-clauses 4.4, 4.5 and 4.6).

5.1.3.5.2 All nuts and screws shall be securely locked and shall not loosen while in service due to vibration or other causes as normally met with in Railway usage.

5.1.3.5.3 Screw threads in parts fabricated of materials which do not lend themselves to successful tapping shall be formed in bushes made from suitable material, and these bushes shall be properly moulded, embedded or otherwise securely fixed.

5.1.4.0 DIMENSIONS

5.1.4.1 The overall dimensions of the Relay (with maximum contact equipment) shall not exceed the following, unless otherwise approved by the purchaser

	WITH OUT COVER	WITH COVER
HEIGHT	55 mm	75mm
	115mm	135mm (Interlocked relays when mounted height wise)
WIDTH	42mm	62mm
	85mm	105mm (Interlocked relays when mounted width wise)
DEPTH	120mm	140mm

5.1.4.2 Limits and fits shall be in general as per sub-clauses 6.1 and 6.2 of IRS Specification:No.S23, except where specified or required otherwise for proper functioning of the equipment.

5.1.4.3 Dimensions on which tolerances are not indicated shall be with in the following limits depending also on related dimensions for correct functioning, unless otherwise agreed up on by the purchaser.

5.1.4.4

Casting and sheet metal parts	± 0.50 mm
Insulating moulding parts	As per BS : 2026
Spacing of Machined holes	±0.05mm
Angular Dimensions	± ½ *degrees*
Linear dimensions	±0.5mm.
Diameter of Drilled holes (Clearance holes)	As per IS :1821 (Fine).

5.1.5.0 WORKMANSHIP

5.1.5.1 The standard of workmanship shall be as per clause 5 of IRS Specification No.S 23.

5.1.6.0 MATERIALS

6.1 Transparent material for relay cover or for use in front of relay group housing shall be permanently transparent though self extinguishing and non-hygroscopic and shall be unaffected by changes in- temperature between - 25^{o}C and 85^{o} C

6.2 Magnetic materials for Armature and Core etc., shall comply with clauses 10.1 and 10.3 of IRS Specification No S 23.

6.3 All insulating materials shall be tough and non hygroscopic and shall be unaffected by changes in temperature between -25^{o}*C* and +85^{0}C. Insulating materials used as insulation for contacts and coil bobbin must be self-extinguishing and preferably so for other purposes also as far as possible.

All insulating materials in contact with current carrying parts of the relay shall comply with the following test.

"Two 6 mm diameter electrodes shall be placed 3 mm. a part on a sample of the material, which is at a temperature of not more than 20^{0}C. The sample then shall be transferred to a test chamber having a temperature of *55^{0}C* and a humidity of *9*5%. The insulation resistance measured at a voltage of 500 V D. C. between the electrodes shall not fall below 1 meg ohm while the samples remain in the test chamber for a period of not less than 15 seconds".

6.4 Material used for impregnation or insulating the coils shall be chemically neutral and physically stable between temperature limits of - 25^{0} and 85$^{0.}$

6.5 Insulating material used for filters in winding coils shall be chemically neutral.

6 6 Insulating sealing compound shall not melt, flake or crack between temperature limits of - 25^{0}C and +85^{0}C.

6 7 Contact springs shall be made either from phosphor bronze material to specification BS 407, Grade PB 102 (Extra hard or hard) or from Nickel Silver with minimum 18% Nickel to Specification BS 790). The contacts shall be made either from fine silver of minimum 99.9 per cent purity to specification IS 211*2* or from silver cadmium oxide material (having minimum 10 percent cadmium oxide conforming to an approved specification acceptable to the purchaser. Material for electrical contact springs and contacts shall comply with clause 9 of IRS Specification No. S 23.

6.8 Contact keeper, where provided, shall be of the same material as of contact spring, as far as possible. –

6.9 Other materials employed in the construction of the relays shall allow them to function perfectly with in a temperature range from - 25^{0}C to +85^{0}C and shall be in accordance with Specification for 'Materials' in the IRS Specification No. S 10 or, other appropriate approved standard specifications, as far as applicable.

6.10 No materials shall be used in the construction of the relay which are capable of supporting growth of mould or which are subject to deterioration by exposure to sun light or which would cause alteration in performance during storage life or which are not capable of maintaining all their essential electrical and mechanical properties during service life of the relay.

5.1.7.0 PROTECTION AGAINST CORROSION.

7.1 Protection against corrosion shall be provided as per clause 13 of IRS Specification No S 23.

7.2 Material used for protection against corrosion shall neither melt nor flake under ordinary conditions between temperature limits of - 25^{0} and +85$^{0.}$

7.3 All parts, both separately and in combination shall either be resistant to corrosion. Dis-similar metals used in contact with each other shall be so chosen or protected as to minimize the effect of electro - chemical action.

5.1.8.0 MAGNETIC SYSTEM

8.1 The core and armature supports shall be so designed as to ensure a reliable operation of the core with respect to the armature and to the fixed parts at the contacts shall be maintained constant through out the service life of the relay.

8.2 The armature supports shall be so designed as to ensure a reliable operation of the armature. The movement of the contacts shall be controlled rigidly by the movement of the armature indirect control by other contacts springs or by any other means being dis-allowed. The functioning of the contacts shall be controlled by gravity or combination of gravity and spring action provided that gravity alone must cause the front contacts to open, if the spring action fails, when the relay is de-energized in the normal mounting position of the relay.

8.3 The armature shall positively be located so as to prevent any displacement other than that required for a proper operation of the contacts. End play of the armature when pushed or slide from one end to the other end shall be not less than 0.1 mm and not more than 0.4 mm

8.4 The travel of the armature must be limited by means of stops which shall last for the 'whole service life of the relay, and which shall not cause any rebounding, with-holding or sticking of the armature. These stops must be made of an anti-residual, anti-corrosive material, and the gap between armature and core must not be affected either by distortion or by wear. With the armature in the picked up position, a minimum physical air gap of 0.3 mm. (0.1 mm. for special relays) shall be provided (at the center of the portions of core and armature coming opposite each other) by a non-adjustable stop suitable dimensions.

8.5 In relays fitted with knife-edge bearings, the armature shall be held in its place in such a manner as to permit free movement throughout the normal stroke, but shall prevent its being displaced as a result of Type Tests carried out under Clause 15.2.

8.6 In relays fitted with pivot bearings, the armature pivots and bearings shall be cylindrical and the bearings shall be neither less than 0.05 mm. nor more than 0.1 mm. larger in diameter than the pivots. The armature pivots and bearings shall be of dissimilar materials possessing high resistance to corrosion under service conditions, shall fit rigidly in their supports, and be suitably secured and so constructed that they cannot restrict the desired motion of the armature. The design shall be such that the breaking of a pivot shall not allow any front contact to close irregularly.

5.1.9.0 ELECTRO-MAGNET COILS

9.1 Electro-magnet coils shall comply with the requirements as per Clause 8 of IRS Specification No. S23* (except sub clause 8.2, 8.6, 8.11 and 8.12).

9.2 When electrically separate windings are, provided, each shall be capable of fully, operating the relay and the design shall be such that both windings could remain continuously' energized simultaneously.

9.3 No conductor of diameter smaller than 0.08 mm. (0.05 mm. For special relays) shall be used for coil windings, unless otherwise approved by the purchaser.

9.4 Coils shall be such that they shall be able to carry 125% of the rated current continuously and 150% of the rated current for four hours without injurious heating, at an ambient temperature of 20^0C+2^0C.

9.5 The coils shall have leads (preferably flexible) of suitable size, length and strength for connection to solder lugs / tags of the coil. The insulation of the leads shall remain flexible under all service conditions. The solder lugs/tags of the coil shall be made out of brass sheet silver plated or of same material (Un plated), as of contact spring

9.6 Coil resistance shall not vary from the nominal value by more than $\pm$15 % for wires below 0.08 mm. diameter and $\pm$10% for wires of 0.08 mm. dia and above, when measured at 20^0C. This permissible variation in resistance shall have no adverse effect on the performance of the relay as per the specified operating requirements.

9.7 The purchaser may specify the nominal resistance of the coil. Where it is not so specified, coil resistance shall be such that the coils comply with specified operating requirements, within a variation up to ±20% from the rated voltage.

9.8 Four contact prongs (solder Lugs/coil tags) must always be provided, being marked R1, R2, R3 and R4. Coil of a single wound relay shall be connected to contact prongs marked R1 and R2 and the coil of the second winding, when provided, would be connected to contact prongs marked R3 and R4; the connection- to be so made that the coils must assist with the like polarities:- on contact prongs marked R1and R3.

9.9 The particulars of the coil respect of Manufacturers Trade Mark, nominal resistance at 20 deg C, number of turns, size of wire and kind of wire insulation shall be exhibited on a label, tag of non conducting material plainly and indelibly marked which shall be located at a conspicuous position and securely fixed, preferably the first layer of the coil sheathing.

5.1.10.0 CONTACTS

10.1 Contact equipment -

10.1.1 The relay shall be provided with one of the standard contact arrangement as shown below, except where specified differently by the Purchaser.

Number of Independent Contacts.

Front ... 2 3 4 6 5 *4.*
Back ... 2 3 *2* 2 3 4.

10.1.2 Contacts shall be ‘metal to metal’.

10.2 Contact Assemblies:

10.2.1 Contact springs shall be formed in such a way that their main axes lie at not more than 45° from the direction of rolling of the strip and so that abrupt changes of dimensions, giving rise to high-localized stresses do not occur.

10.2.2 The design shall be such that contact springs shall not be subjected to any twist about their longitudinal axis.

10.2.3 Contact elements shall not be out of center with respect to each other by more than *0.5* mm. (0.02”).

10.2.4 Contact elements shall be firmly secured so that they will not shift or become loose during transport or service.

10.2.5 The materials used in affixing contact elements shall be such as not to cause corrosion

10.2 6. All similar contacts, i.e. either front or back, shall function approximately simultaneously when the relay is operated or released. The difference in the voltage- between that at which the first and the last front or, back contacts break shall as far as -possible be within *5%* of the maximum full operate voltage. In the alternative the difference in the stroke between that at which the first and the last front or back contacts break shall be within about 10% of the full stroke of the moving contacts/the Contact pins.

10.2.7 If twin contact elements are employed, these shall be co-planar and shall make or break contact approximately simultaneously.

10.2.8 Contacts when enclosed inside the relay cover shall be readily visible from the front of the relay. Similarly, the relay contacts shall be visible from the front of the relay group housing.

10.2.9 Contact spring fingers shall be made of such material and so Proportioned that they shall not stress beyond half of their elasticity limit. Movements of contact springs shall ensure self-aligning, self-cleaning and wiping action between the Contacts.

10.2. 10 Contact springs must be in positive contact with their backing springs, when provided.

10.2.11 As far as possible, the opening and closing contacts must not be accompanied by any rebound exceeding duration of 10 milli-seconds and the contact elements shall establish steady contact conditions after this period when the relay is energized at rated voltage or is released.

10.2.12 When in the normal mounting position a relay must still function perfectly, i.e., a closed contact must not open and an open contact must not close on their own, whether the relays are energized at 20% in excess of rated voltage or they are not energized, when subjected to sinusoidal vibrations, in which the oscillations have an amplitude of 1 mm. at a frequency between 5 and 50 Hz.

10.3 Contact Clearances -

10.3.1 Minimum clearance between the back contact elements:

(a) When the relay is in operate position **-** (at the instant at which closure of front **-** Contacts occur.

0.5 mm for contacts in series (1.1 mm desirable).
1.0 mm for single contacts . (1.3 mm desirable)

(b) When the relay is in full operate position: -
1.2 mm for contacts in series . (1.8 mm desirable).
2.0 mm for single contacts . (2.5 mm desirable)

10.3.2 Minimum clearance between the front contact elements shall be as under.

(a) While dropping of the moving armature of the relay is taking place (at the instant at which closure of the back contacts occurs)

0.5 mm for contacts in series (1.1 mm desirable)
1.0 mm for single contacts (1.3 mm desirable)

(b) When the relay is in full release position

1.2 mm. for contacts in series (1. 8 mm desirable).
2.0 mm. for single contacts (2 .5 mm desirable).

10.3.3 The values for contact clearances specified in clauses 10.3.1 and 10.3.2 must not vary during the endurance test on the relay to clause 15.2.2(d)

10.4 Contact Pressure

10.4.1 When the armature is in the full operate position, initial contact pressure for front contacts shall not be less than 15 gms per contact element in the case of single contacts, and 10 grams per contact element in the case of double contacts.

10.4.2 When the armature is in the full release position initial contact pressure for back contacts shall not be less than 15 gms per contact element in the case of single Contacts, and 10 grms per contact element in the case of double contacts.

10.4.3 The loss in contact pressure through out the endurance test on the relay to clause 15.2.2(d) (both for loaded and un-loaded contacts) shall not exceed 40% of the initial contact pressure.

10.5 Contact Resistance

10.5.1 For "metal to metal' contacts, initial clean contact resistance shall not exceed 0.05 ohms.

10.5.2 Increase in contact resistance through out the endurance test on the relay to clause 15.2.2(d) shall not exceed 100% of the initial contact resistance; maximum value of - contact resistance shall not, however, exceed 0.1 ohm.

10.5.3 Contact resistance shall be measured when the contact unit is-carrying 100 mA. DC and then by measuring the voltage drop across the solder Lugs/contact tags. Contact resistance shall be determined by taking at least 10 readings on each contact at approximately equal intervals through out the endurance test on the relay to clause I*5.2•2*(d) ; the average of all readings shall be considered as the contact resistance. Contact resistance shall be measured for front contact with the armature in the full operate position and for back contact with the armature in full release position. Contact resistance shall be measured in both conditions for unloaded contacts as well as for contacts loaded as per contact loads specified in clause 10.6.

10.5.4 For contact element with two contacts in series the permissible values of contact resistance may be considered to be twice of the values given in sub-clauses 10.5.1 and 10.5.2.

10.6 Contact Rating -

10.6.1 Each front contact shall be capable of carrying a current of 3 amps. Continuously and *5* amp for 30 seconds with the relay in the full operate position. Each back contact shall be capable of carrying a current of 3 amps. Continuously with the relay in the full release position. The contact shall not become over heated and there shall be no injurious effect to the contacts.

10.6.2 During the endurance test on the relay to clause 15.2.2 (d), each contact shall be capable of making and breaking a 12 Volt circuit having the resistive load with a Switch-on surge of 5 amps, dropping to a maximum steady value of 2 amps after a further 100 milli seconds. (equivalent to normal circuit for a SL 17 Lamp).

10.6.3 During the endurance test on the relay to clause 15.2.2(d), each contact shall be capable of making and breaking the current in an unquenched circuit consisting of three parallel connected relays of a type covered by this specification.

10.6.4 Over a few operations, as shown below, each contact shall be capable of making and breaking the following resistive load at a rate of 20 cycles per minute, with out any spark-quenching arrangement:

Contact loads. Volts.	**Contact loads Max. Amp.**	**No. of cycles (Make & Break).**
60 volts	0.5 amps	1000
24 volts	1.25 amps	1000
12 V AC/DC	2.5 amps (for front contact).	1000
	1.25 amps (for back contact).	1000

10.7 Contact Failure

10.7.1 If a back contact remains accidentally closed (due to a failure/welding), none of the front contacts shall close even if, the supply voltage is equal to 1.5 times the rated voltage.

10.7.2 Where a front contact remains closed due to faulty functioning, when the relay is de energized, all the other front contacts must open, and none of the back contacts should close. However, in case of series contacts when both the contacts remain closed due to faulty conditions, the requirement that the other front contacts should open may or may not be fulfilled. The entire returns torque of the relay must be available to attempt the opening of the defective contact.

5.1.11. PLUGGING-IN ARRANGEMENT AND WIRING.

11.1 The Plugging-in devices for relays of the plug-in type and for relay groups must be constructed and identified in such a way that it is practically impossible for any mistake in assembly or connection to take place.

11.2 Removable connectors, where provided, shall be suitable for both soldered and/or crimped connection.

11.3 The terminations may be provided in the form of contact prongs/solder Lugs either forming part of the contact spring concerned or separate and suitable for termination of wiring by both soldered and crimped connection.

5.1.12. STORAGE LIFE.

12.1 The relay shall be considered as having a possible period of up to 2 years in reasonable storage conditions prior to being brought into use without verification or examination and without any adverse effect on its operating characteristics.

5.1.13. OPERATING CHARACTERISTICS.

13.1 The relays shall be rated for operation on nominal supply voltages of either 24V DC or 60V DC or as specified by the purchaser.

13.2: Relay coil shall be able to withstand a maximum thermal load of *4.5* watts when the coil space is fully used.

13.3 The maximum rated power consumption for each relays coil shall be 2.5 watts. Full operate power consumption shall, however, not exceed 1.25 watts.

13.4 The operating values shall be as follows (through out the service life of the relay) when tested with the coil at temperature of 20^0C:

	24 Volt Relay	***60 Volt Relay***	***Remarks.***
Maximum voltage/current across windings for full operate.	19.2v/80.0 mA	48.0 v/32.0 mA	80% of nominal rated voltage / current
Minimum voltage/current across windings for release.	4.8 v/20.0 mA	12.0 v/8.0 mA	20% of nominal rated voltage / current
Maximum ampere-turns (AW) full operate.	-----	-----	335 (for single relay). 600(Interlocked relay)
Minimum ampere-turns release.			15% of measured value of amp – turns (AW) for full operate.

.

13.5 During and on completion of the contact rating test (mechanical) on the relay (1X 107 cycles), the increase in pick up current must not exceed 10% of its initial value ; the decrease in drop away current must not exceed 15% of its initial value ; and the ratio between drop away current and pick up current must vary by not more than minus 20% in relation to its initial ratio.

13.6 The pick up value of the current when measured in the reverse direction must not exceed 110% of the pick up value of the current in the normal direction.

13.7 Operating times for the relay when energized at rated voltage, shall not exceed the following:

(a) Operating time (interval between energisation and close of last front contact) — 100 milli seconds

(b) Release time (interval between de-energisation and opening of the first front contact). — 20 milli seconds

5.1.14.0 DETERMINATION OF OPERATING VALUES.

14.1 <u>Measurement of drop- away, pick up and full operate current:</u>

14.1.1 After the relay has been normalized, the relay shall be energized to four times the normal pick up current applied in the normal working direction. The current shall then be gradually reduced and the value at which all-front contacts open shall be recorded as drop away value for this direction. The current shall then be reduced to zero and then increased until the relay picks up and all front contacts are closed, and the value at which this occurs shall be recorded as the pick up value. The current shall then be further increased until the armature is in the full operating position. This value shall be termed as full operate value of current.

14.2 Measurement of reverse pick up current:

14.2.1 The relay shall first be saturated to four times the normal picks up current in the normal working direction and then current reduced to zero. The current again be increased gradually in the opposite direction, i.e. with polarity reversed and the value at which all the front contacts are closed shall be regarded as reverse pick up current.

14.3 Measurement of operate time, release time and contact bounce time:

14.3.1 Timing tests for the front contacts shall be make at the rated current value. Using a suitable electronic counter or an oscilloscope may make these measurements.

5.2 INTRODUCTION

With the introduction of German Railway Signalling practices by M/s Siemens on Indian Railways, metal to metal contact relays are accepted for control of vital signalling circuits. However, it is ensured that the release of these relays after each previous operation is proved before any function is controlled through their operated contacts. Hence, these relays are called as 'proved type' relays. Presently two makes of these relays are in use on our railways.
i.e Siemens and ABB

Although various designs of Siemens relays are tried in the earlier installations, the present usage is limited to only K50 neutral line relays of non-interlocked and interlocked units. For common usage, two relays are fixed in one unit called a mini group, except for lamp proving relay units in which only one relay is provided at the top with a transformer and rectifier together at the bottom. Larger modular units with 8 to 30 relays in them for individual function control are also used in relay interlocking systems.

Relays of this type are also introduced by M/s Integra Hindustan controls. There are single relay units as well as two relay units of non-interlocked or interlocked versions being supplied by them.

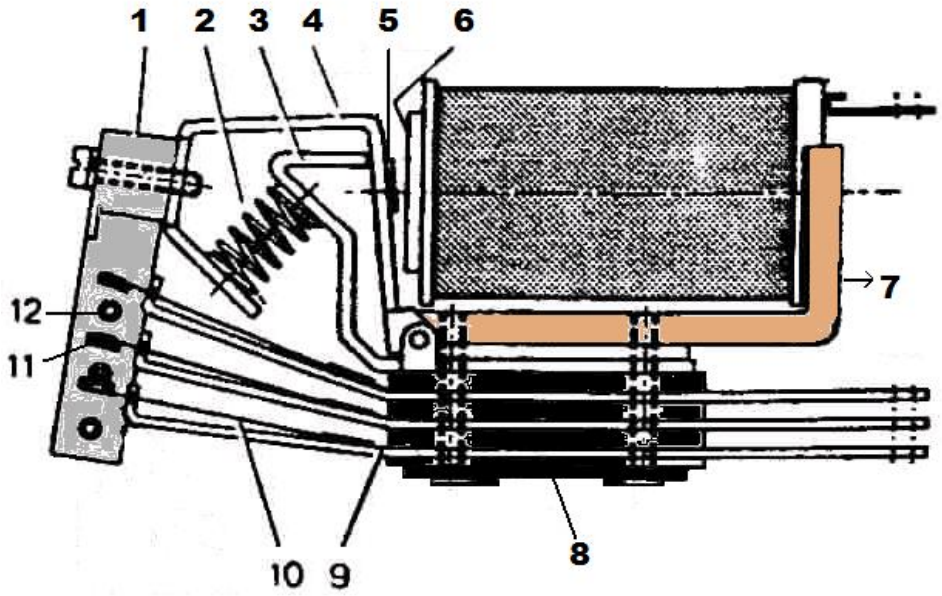
These relays are patterned after telephone exchange relays retaining their advantages of lighter construction, speeder operation and lesser contact resistance. However, their designs are improved to include features of reliable contact working and enhance safety. Those designed for 60V DC operation are chosen for our use due to their lesser operating currents so as to limit their power supply unit capacities.

The contacts of these relays are of a special design, known as 'series double break' type contacts. In this type two non-moving contact springs are placed at the same level. A bridge pin each mounted on a common contact bar fixed on the armature moves to close them or open them. While moving towards or away from the springs, the contact pin makes or disconnects them simultaneously on two element surfaces coming in series. Also due to the wiping action of the pin on contact elements after closing, the element surfaces get cleaned during every operation. Hence, the contacts are also described as 'self cleaning or wiping contacts.

The chances of these contacts getting welded are greatly reduced due to (1) fast operation of their relays (2) the contacts being of 'series double break' type and (3) narrow contact design in which triangular cross section rivets (elements or tips) get connected by a cylindrical pin across their axes.

Siemens K50 Relays:

These relays made to satisfy German standard specification. No. DIN 57831/VDE 0831 codex 736, 3rd issue on 1-7-1974 type C Signal Relay also conform to IRS specification. No. S46-74 for metal to metal contact relays.



1	CONTACT BAR	8.	PLACE FOR RELAY TYPE MARKING
2	PRESSING AWAY SPRING	9.	SPRING SUPPORT
3	STOP STIRRUP	10.	CONTACT SPRING
4	ARMATURE	11.	CONTACT RIVET
5	RESIDUAL PIN	12.	CONTACT PIN
6	MAGNETIC CORE		
7	HEEL PIECE		

Fig : 5.1a

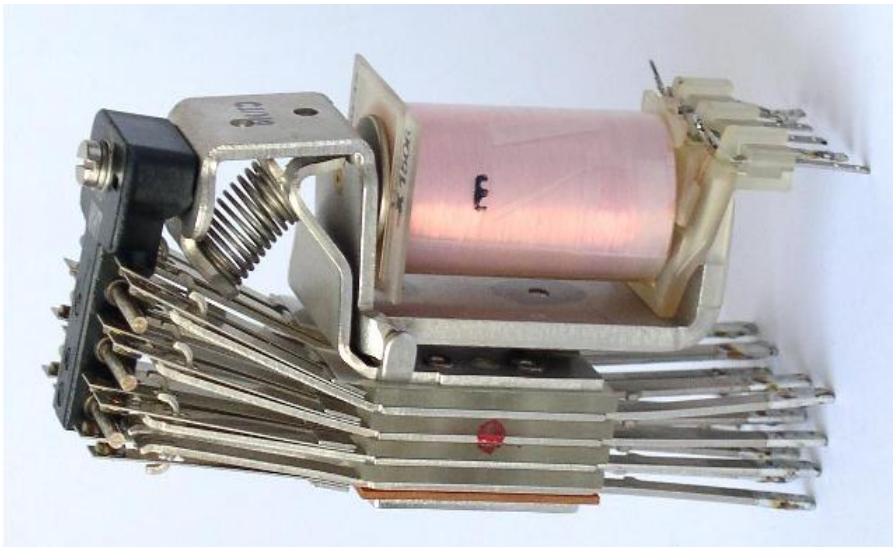
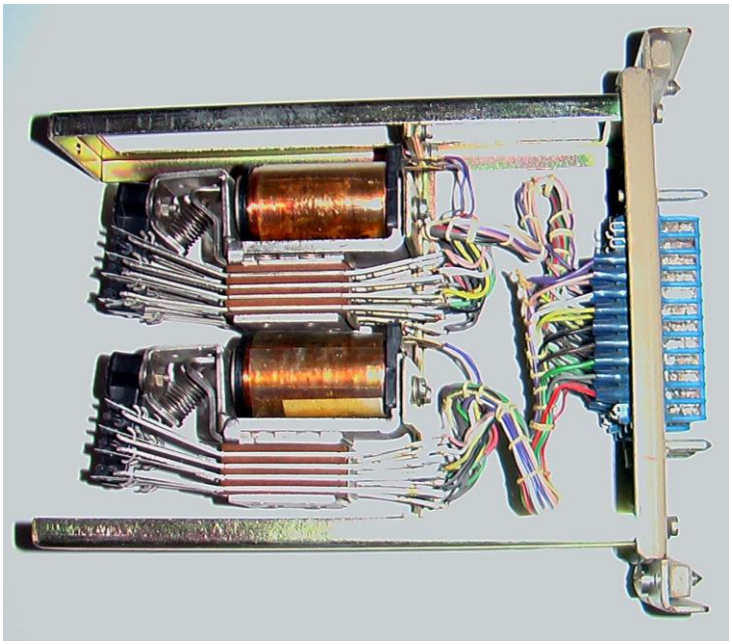


Fig : 5.1b

5.3 Relay construction:

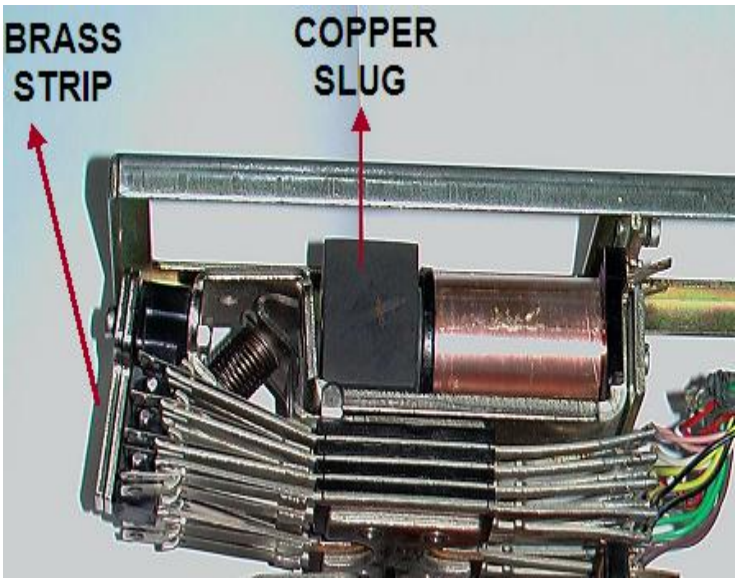
As seen in the diagram, the contact springs are stacked below the yoke which extends beneath the core. The armature when de-energized rests against stop stirrup. A contact bar with pins on it is rigidly screwed to an extension of the armature. A pusher spring provided between the armature extension and the stop stirrup is compressed when the armature is attracted and helps during its release when the relay is de-energized.



Non A.C IMMUNISED RELAY K-50 Fig.5.2 (a)

According to the contact material used, K50 relays of our installations are differently classified whose details are as below:-

In addition to the above, one more type viz. K.50 B type relay is available with special provisions for A/C Immunization. Its greater immunity is achieved by provision of a square short circuited ring / copper slug on the core and by fixing two brass strips for additional weight on the contact bar.



A.C IMMUNISED RELAY K-50 Fig.5.2 (b)

Additional Components.

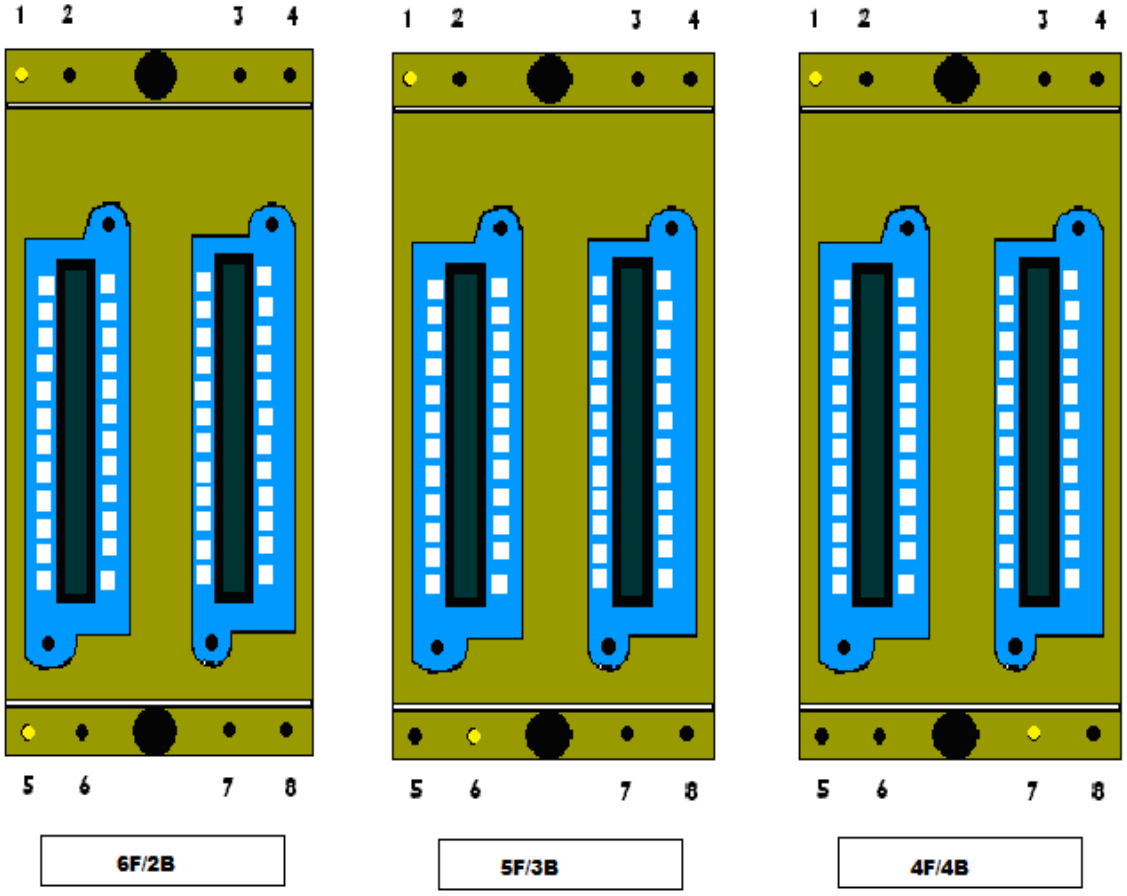
1. Copper slug on the core.
2. Brass strips

5.4 K-50 Relays

(a) K 50 NEUTRAL RELAY MINI-GROUPS (to Drg. RSSK 30/0011

Two K50A relays with eight contacts each are fixed one below the other on a frame fitted into a back plate. Contact springs and coil ends of relays are connected separately by wiring to two spring blocks with springs extending behind. These springs get joined with corresponding smug fitting spring terminals on two amphenol blocks fixed on a base plate when plugged. External wiring is soldered on the terminals behind the base plate. Two thick pins each on the blocks of group back plate enter into corresponding holes on base blocks and ensure correct alignment. They also prevent relay group being plugged upside down.

Group Coding: Two code pins are provided, one at the top and one at the bottom screwed onto the base enter into corresponding holes in one of the four position each when a proper group is plugged in to the base. These code pins ensure that no group can be plugged in a base with relay contact positions interchanged. Three different codes can be found for the three contact arrangements of these groups.



NEUTRAL RELAYS WITH CODING PIN COMBINATIONS
RELAY BASE PLATE FRONT VIEW

Fig: 5.3

(b) K.50 RELAY MINI GROUPS (to Drg. Rs Sk 30/0078)

The top relay of this group is provided with extra provisions for greater immunization. Both the relays of this group have 5F.3B contacts each. In all other respects, this group is similar to any other neutral relay mini - group except that it has a different pin code.

(c) K50 INTERLOCKED RELAY MINI-GROUP (to Drg. Rs Sk 30/0012):

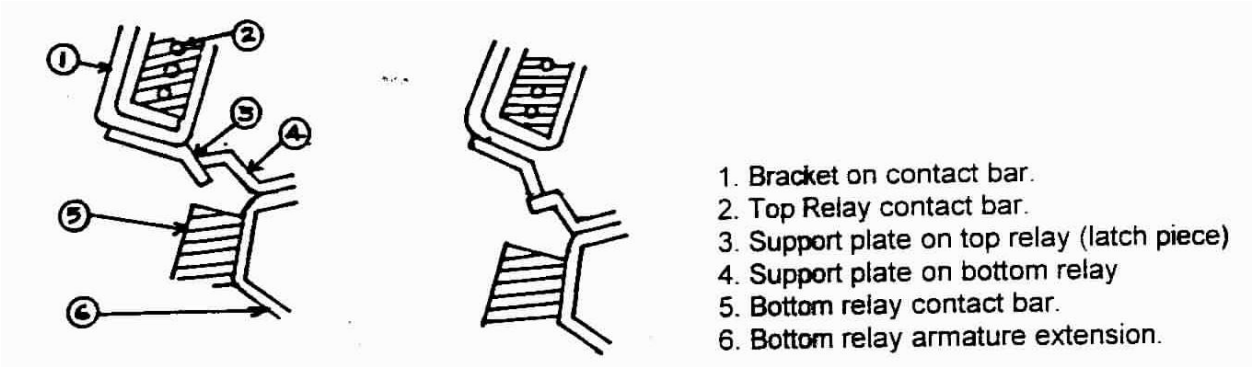
In this, two 'tiered' K50 relays are mounted on a channel plate fitted to a frame with a common back plate. These relays are mechanically so interlocked by two support plates that at a time only one relay can remain in the released position. Of the two support plates, one is fixed on a bracket screwed to the top relay contact bar. The other one is on the armature extension of the bottom relay.

In the normal condition of this unit, the bottom relay armature is latched in its operated position as its support plate is held up by that of the top relay which is dropped.

To reverse the unit, the top relay coil is momentarily energized. When its armature is attracted, its support plate clears the way for the bottom relay support plate to move down. With this, its armature drops. Now the bottom relay support plate latches the top relay in its operated position.

For normalizing the relay again, the bottom relay coil has to be energized momentarily so that its support plate moves up and lets the top relay armature to drop.

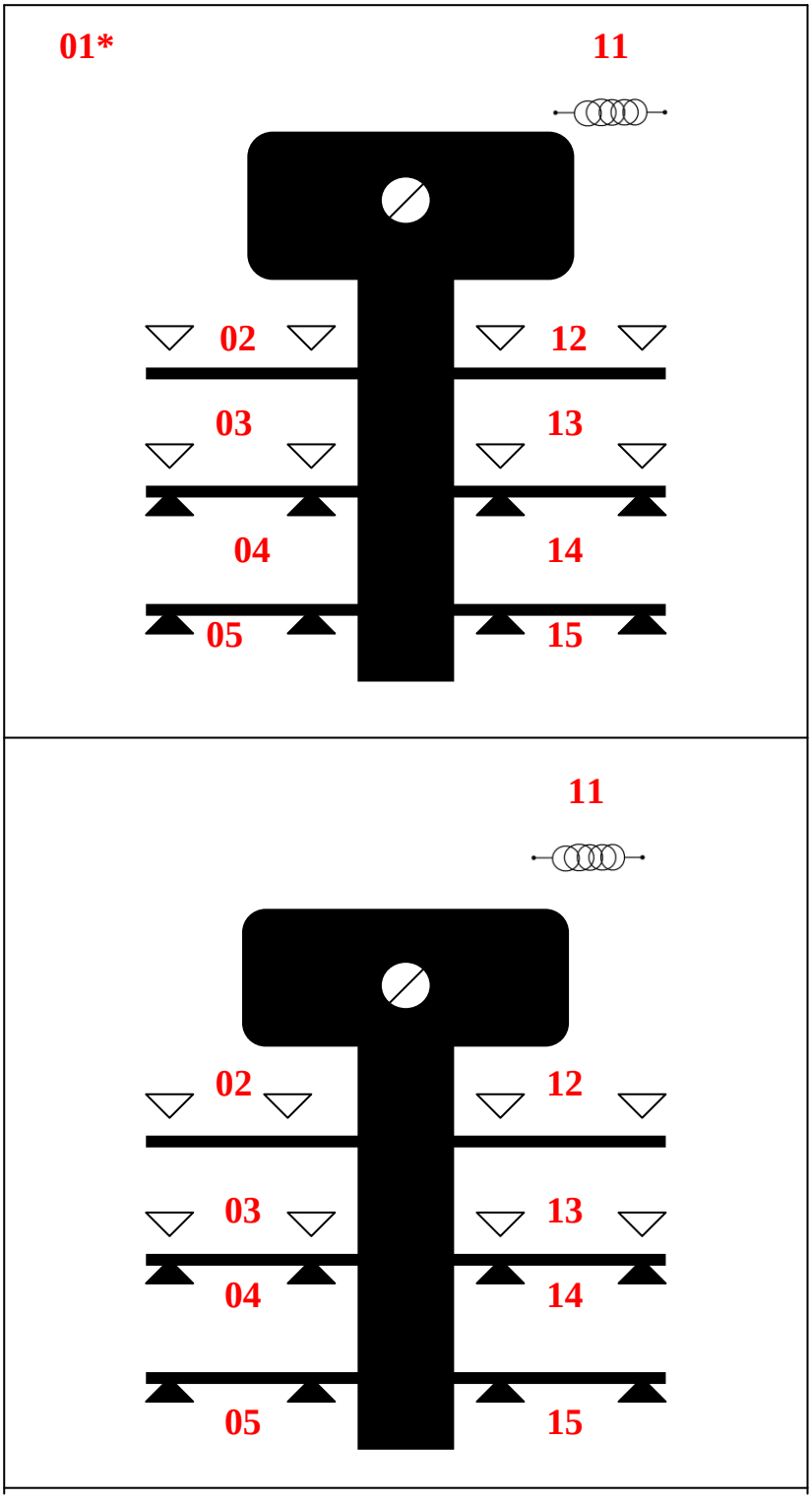
When the unit is normalized, its bottom relay front contacts and top relay back contacts are closed. These contacts are called the 'Normal Contacts' of the unit. When the unit is reversed, its top relay front contacts and bottom relay back contacts are closed. These contacts are called the 'Reverse Contacts'. In all, a latch relay has eight normal and eight reverse contacts, even as individual relays have similarly different contact arrangements.



NORMAL REVERSE

Fig : 5.4

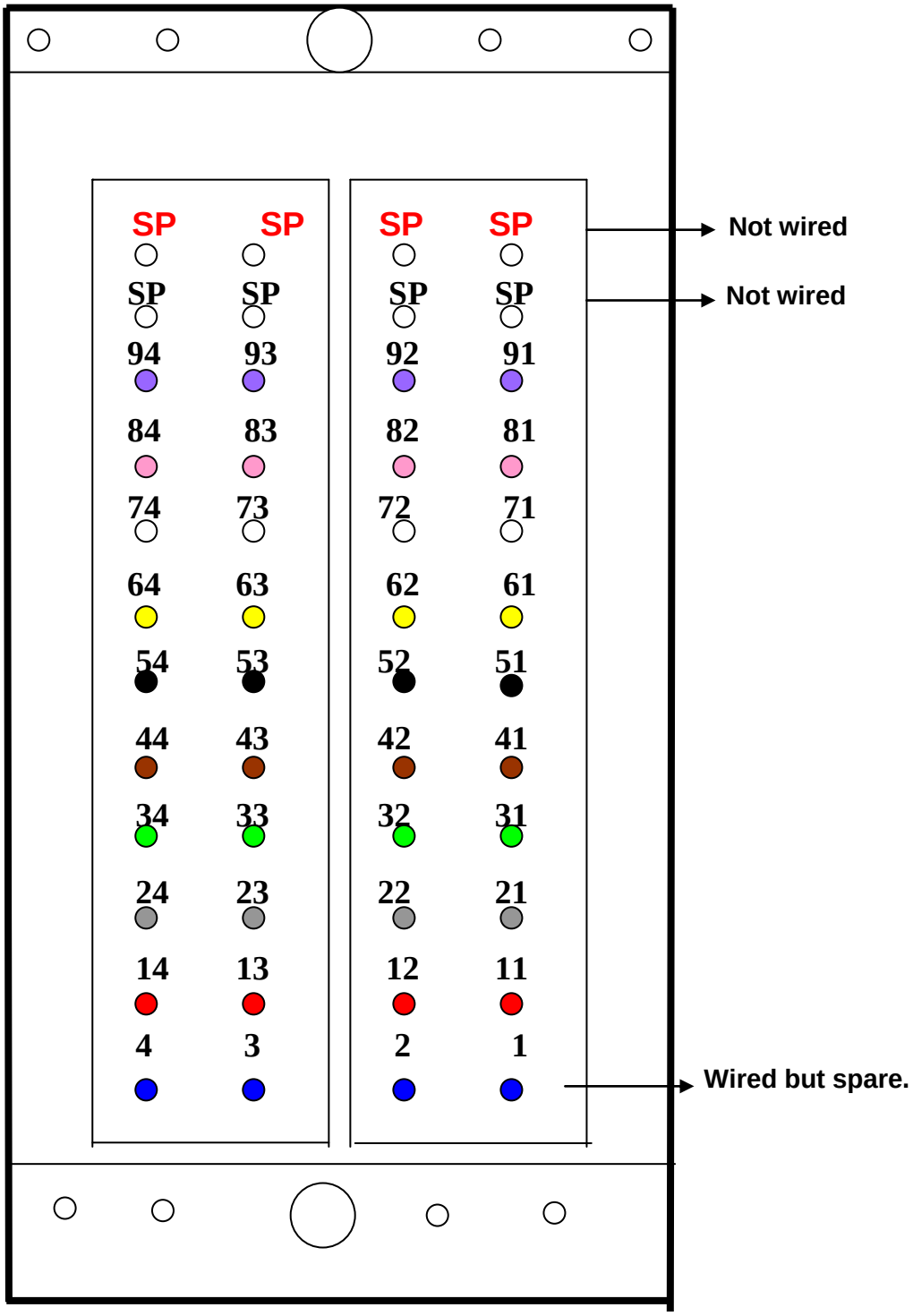
5.5 Contact & Coil Terminal Numbering



CONTACT NUMBERING OF MINI GROUP(4F.4B)
FRONT VIEW

Fig : 5.5a

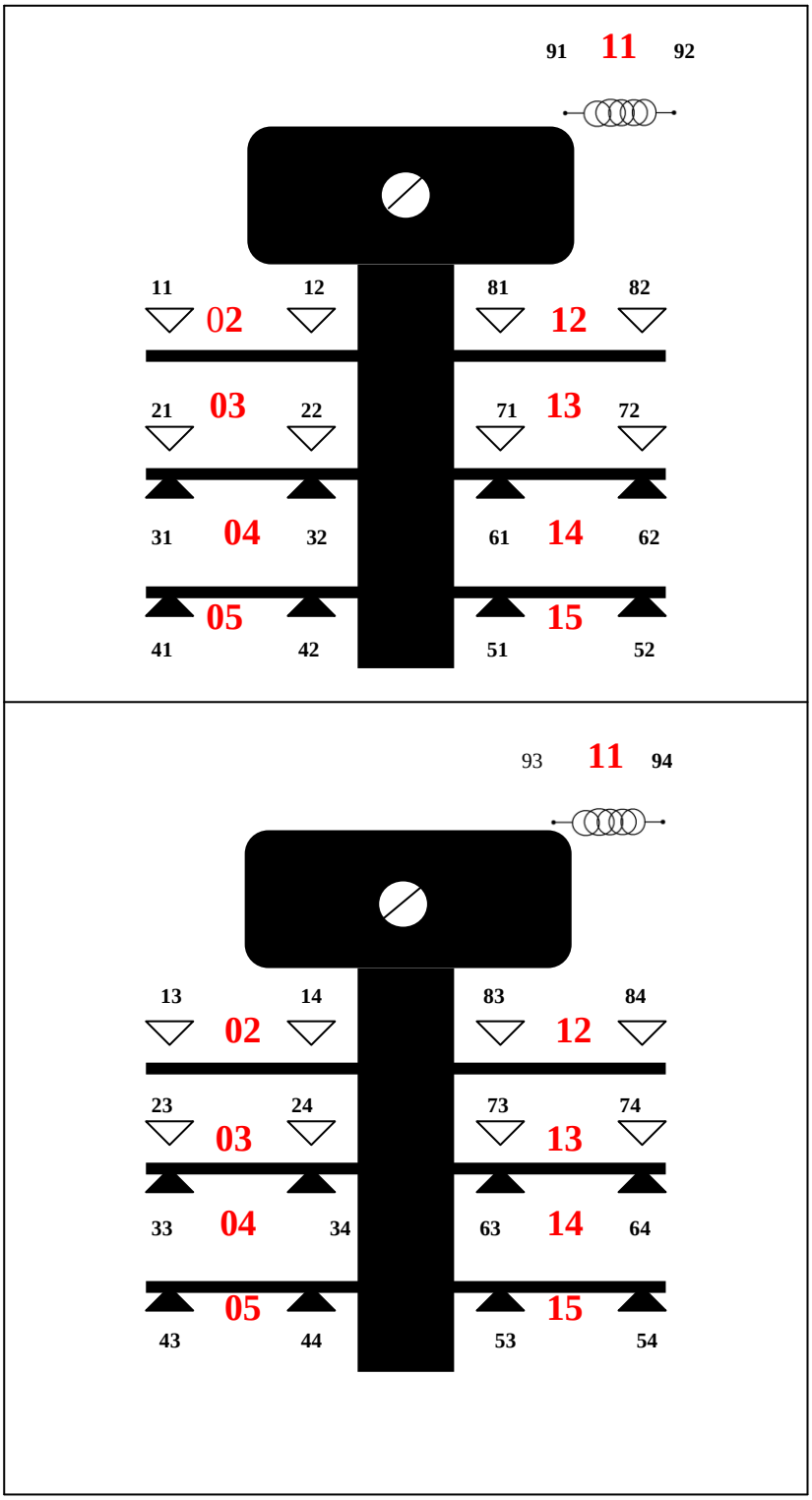
Note:- 01 Contact used for Double coil relay connection



AMPHENOL NUMBERING

K-50 RELAY BASE PLATE REAR VIEW

Fig: 5.5b



Amphenol numbering placed in contact numbers
K 50 Mini Group (4F.4B)
Front View

Fig: 5.5c

5.6 K-50 Relays

(a) Plug in proved type DC miniature relays.

(b) Independent type of contacts.

(c) Relays are available in form of mini groups (two relays).

(d) Manufactured by M/S. Siemens.

(e) IRS S-46 for metal to metal contact relays.

(f) Operate times are very fast: PU time is 25 to 60 milli seconds and release time is 7 to 15 milli seconds. This reduces chance of welding. AC immunized timings are 200 mill seconds.

(g) 60V operation limits the current levels and hence less power drain.

(h) Metal to metal contact resistance is much less than that of the metal to carbon and hence more number of contacts can be used in one circuit.

(i) To reduce arcing Series double break- double make contacts is used, and the elliptical shape of the contact element provides less contact area.

(j) Wiping action of contacts also called as self cleaning.

5.6.1 Welding of Contacts is greatly reduced due to

(a) A contact bar moves along with the armature and makes or breaks the contact. This makes contact at two places simultaneously. This is called “series double make and break”. Breaking and Making takes place at two places simultaneously there by dissipating spark fast.

(b) Elliptical contact elements are used. This will provide lesser area of contact.

(c) Faster operation of relays.

5.6.2 Neutral, Interlocked, Lamp proving relays.
Operating voltage: 60VDC

5.6.3 Classification:

Relays are classified as: A type, B type and E type on the basis of thickness of residual pin/separating pin.

(a) K50-A type: (0.35 mm residual pin thickness).
Non ACI Neutral, Interlocking Relays.

(b) K50-B type: (0.15 mm residual pin thickness).
ACI Neutral, double coil, special type relays (Z1RWR, Z1NWR, Z1WR1, Z1WR, WLR etc in points group), and UECR

(c) K50-E type: (0.45 mm thickness).
ON ECR and OFF ECR
Increase in residual pin thickness increases the sensitivity of the relay.

5.6.4 Parts: coil, core, armature, residual pin, Contact bar is connected to armature, Contact rivet, contact pins, contact springs, spring support stop stirrup (limits the movement of armature and armature rests on the stop stirrup in the release position, pusher spring, Base plate, code pins.

5.6.5 There is no arm contact. The contact pin moves and makes the contact between the two fixed contact springs.

Contact numbering.
Coils numbered as: 01 and 11
Contacts: 02 12
03 13
04 14
05 15
Numbering is identical for both the Top & Bottom relays.

5.6.6 AC immunized Relays:

Uses copper slug for AC immunization
A Brass strip is provided on contact bar to reduce the release time. This acts as counter weight on the armature.

Immunized to 450 V AC
Coil resistance 1840 ohms. (All contact combinations)
PU time: 200 milliseconds. DA time: 50 miiliseconds.

5.6.7 Code pins:

8 positions prevents the plugging of wrong combination relays
Positions for various relays are;

(a) Neutral:

5F/3B	(1260 ohms)	1 & 6
4F/4B	(1260 ohms)	1 & 7
6F/2B	(1840 ohms)	1 & 5

One ACI and one Non AC (5F/3B)
Group of two ACI (5F/3B)

(b) Inter Locked:

4F/4B	(615 ohms)	3 & 7
5F/3B	(615 ohms)	3 & 6
6F/2B	(615 ohms)	3 & 5
		2 & 5
		2 & 6

5.6.8 Guide pins: will not allow plugging of relay in inverted position and will enable plugging of the relay in proper alignment.

5.6.9 Coil resistance:

Neutral relays: 5F/3B and 4F/4B: 1260 ohms,
6F/2B: 1840 ohms,
Interlocked relays: All contact configurations: 615 Ohms. (More current is required for the operation of interlocked relay to overcome friction of latch pieces).

Lamp checking relays: 64.1 ohms. (UECR, ON / OFF ECR).

5.7 Contacts

Max no. of contacts is 8 in Neutral and Interlocked relays and
In ECR there are 6 contacts only.

Total terminations: 8 X 2 Contact + 2 X 2 Coil terminations=20 for one k50 relay.
For a mini group 40 terminations are required.

For 4 mini group relays will mean 160 terminations, hence a 160 way tag block is used for terminations and.

For 5 numbers of mini groups can be accommodated in one 200 way tag block.

5.7.1 Standard Contact configuration:

Neutral and Inter Locked	6F/2B, 5F/3B, 4F/4B
ECRs (ON/OFF)	3F/3B.
UECR	5F/1B.
Contact current rating is :	3A continuous and 5A switching.

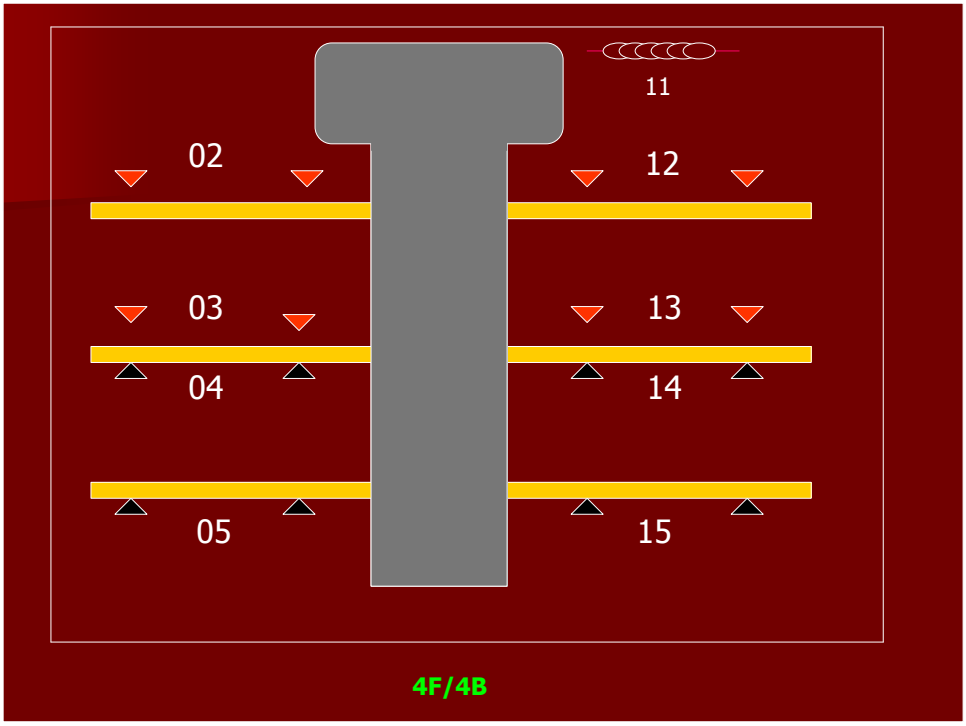


Fig : 5.6a

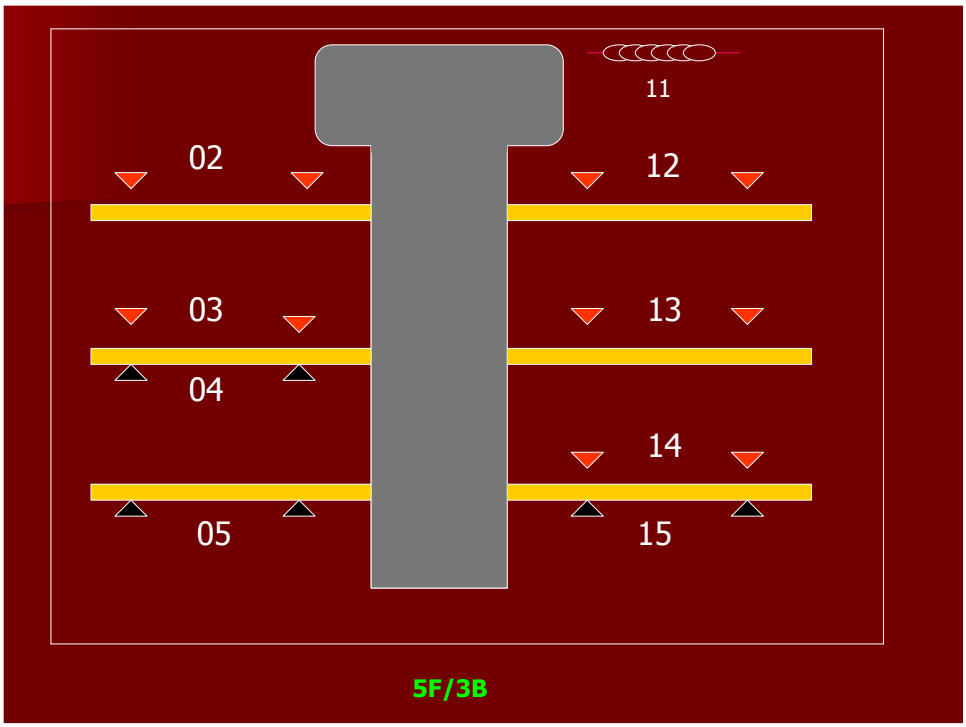


Fig : 5.6b

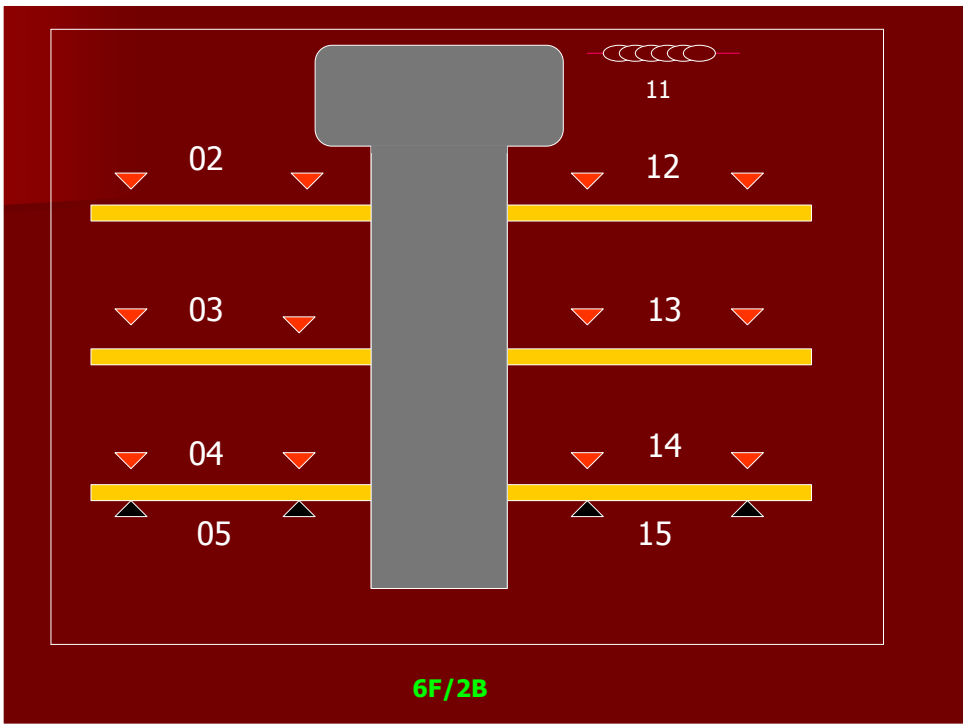
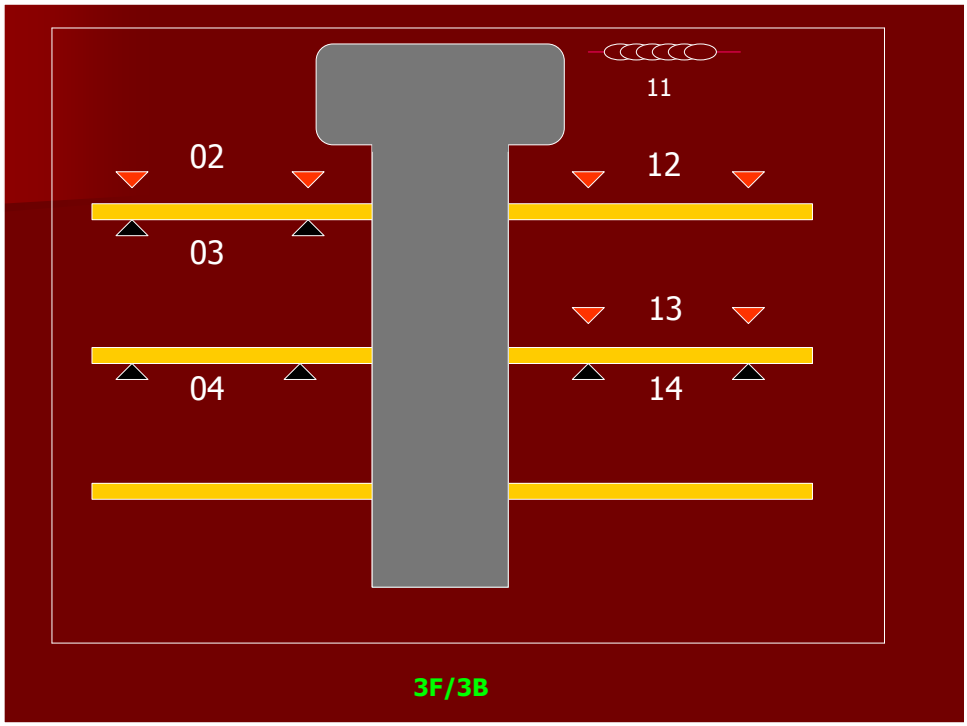
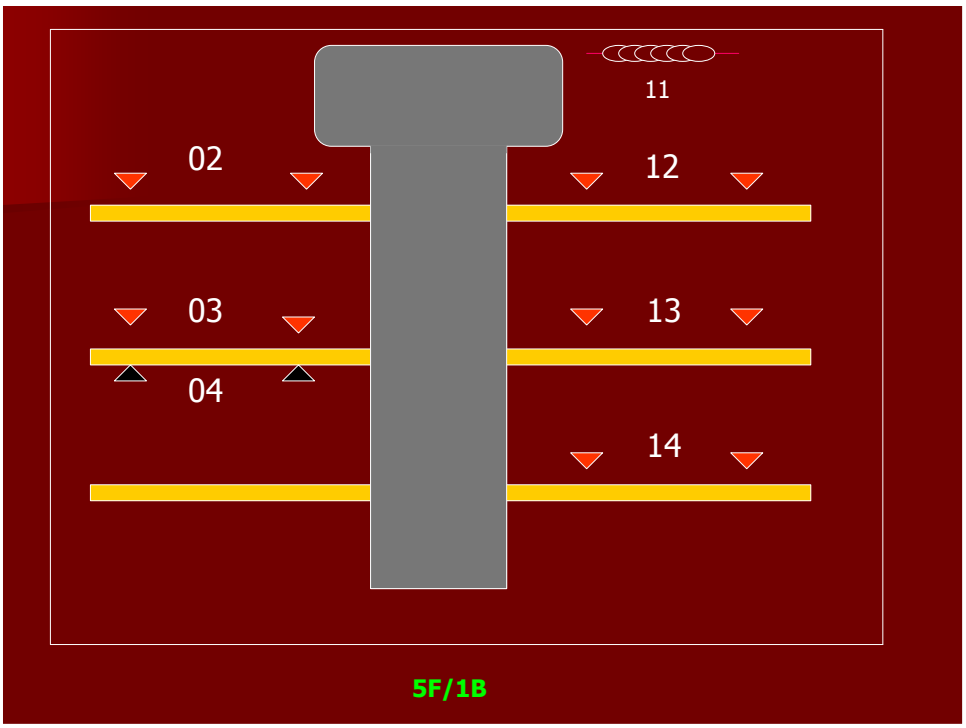


Fig : 5.6c



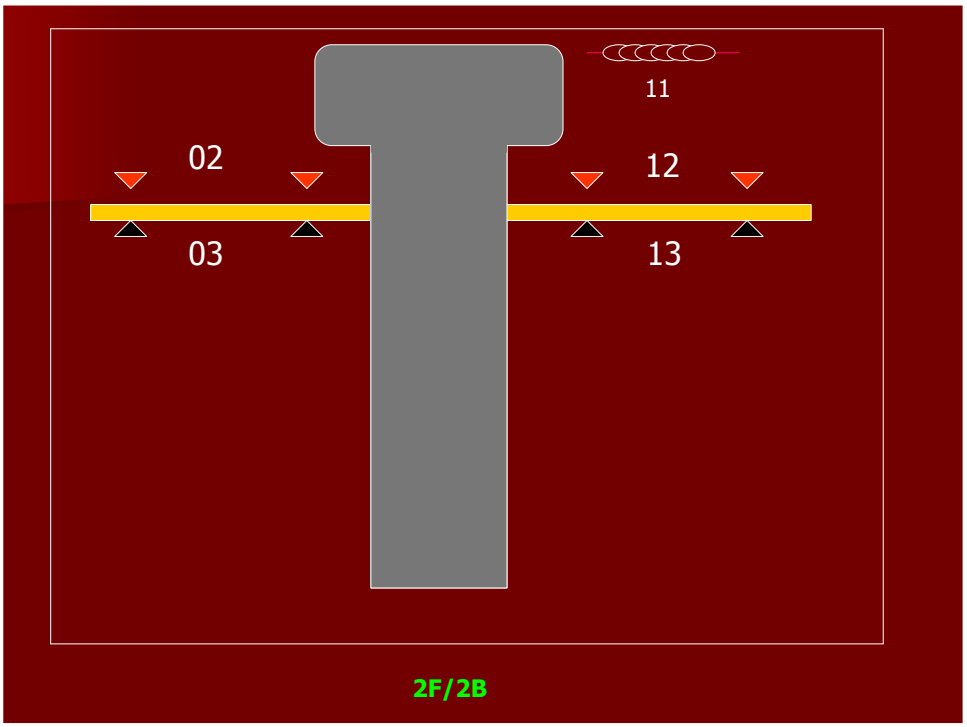
ON /OFF ECR

Fig : 5.6d



UECR

Fig : 5.6e

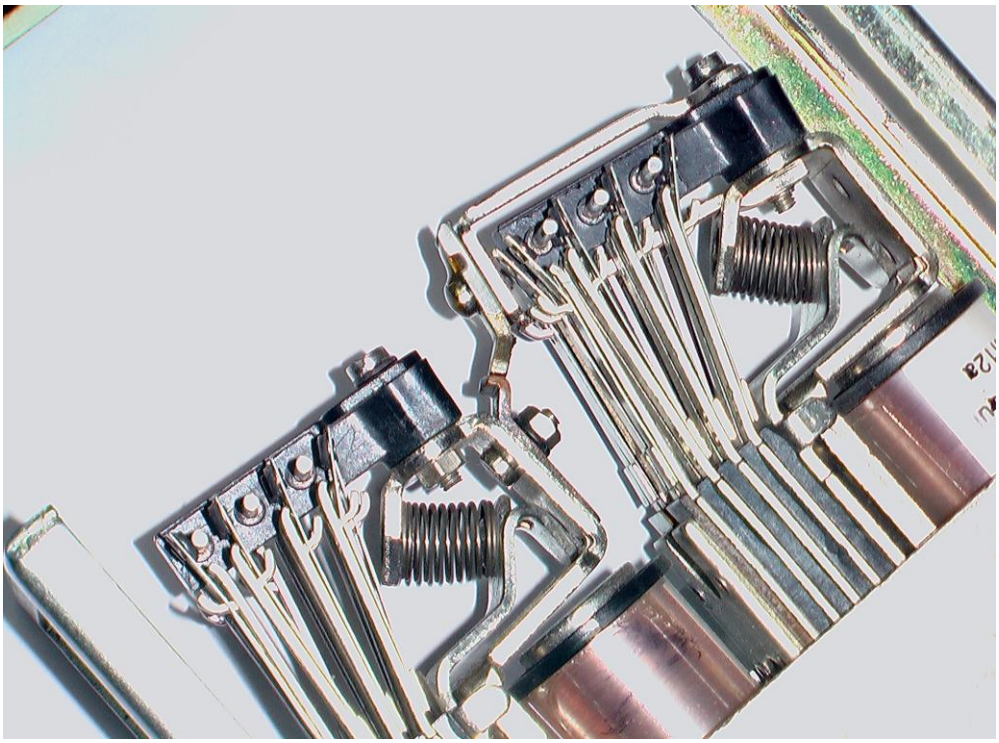


WJR (IN POINT MINOR / MAJOR GROUP)

Fig : 5.7

*** IN ANY MINI GROUP, CONTACT CONFIGURATION OF TOP AND BOTTOM RELAY IS SAME.**

5.8 INTERLOCKED RELAY:



INTERLOCKED RELAY K 50

Fig: 5.8

5.8.1 Features of Interlocked Relay:

(a) Two neutral K-50 relays are latched mechanically to form an interlocked relay. Top coil is called Reverse coil and bottom coil is called as Normal coil.
(b) Latch pieces are provided on the contact bar of a top relay and on the armature extension of a bottom relay.
(c) A guide bracket is provided to keep the relay in alignment. Front contact of the Reverse coil is placed in the pick up circuit of the Normal coil externally so that the supply is automatically cut off.
(d) This helps to save power. Hence this is called as Economizer contact.
(e) This will result in chattering of the relay if the feed is cut off before the relay settles down. Hence both the contact assemblies of top and bottom coils are in picked up condition momentarily.
(f) Front contact of top relay is equivalent to a back contact of bottom relay and vice versa
(g) All three combinations are available.
(h) The contacts are terminated on one side of a 'Tag block'.
(i) The other side of the tag block is used for inter contact wiring.
(j) Contact combinations are identical for both Neutral and Interlocked.

5.8.2 Applications:

(i) It works as a memory device to detect the last operation . W (R/N)R
(ii) It is used to achieve an interlocking between directly opposite conflicting functions. ZU(R/N)R

Review Questions

Subjective

1) Explain the construction of Siemens neutral relay and interlocked relay.
2) Explain the characteristics of Siemens relays.
3) Brief explanation of coding arrangement in Siemens relays.

Objective

1) Pick time of Siemens relay is-------- and drop away time of Siemens relay is----------
2) Metal to metal relays are also called ----------
3) ---------- relay(coil)of Siemens interlocked relay is normally dropped
4) Coil resistance of interlocked relay is ----------
5) In Siemens 5F/3B configuration 03 contact is ---------- contact

CHAPTER 6: LAMP PROVING RELAYS

6.1 Lamp proving Relays are current sensing D.C. line relays operated by derivative power drawn from A.C. signal lamp circuits to check the lighting condition of these lamps.

To derive input for these relays, some of the units have a current transformer to be connected in series with the signal lamp circuit. The output of this current transformer is fed into a bridge rectifier, which in turn feeds the relay. This is the arrangement in Siemens, CD-TVS and Hytronics make ECR units.

The basic circuit of this arrangement is given below: -

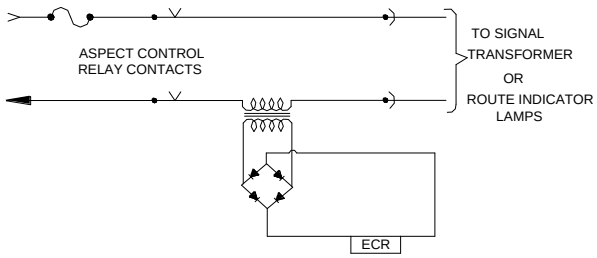


Fig: 6.1

6.2 Purpose of ECRs

(a) To provide a cascading arrangement.
(b) To provide a Red lamp protection arrangement
(c) Controlling the signal in accordance with the aspect displayed on signal in advance.
(d) To provide a signal aspects indication at the operating place.
(e) To prove the Integrity of the function.

6.3 Methods adopted for repeating the signal aspects

(a) Using a series resistance usually known as potential drop method
(b) Using a current transformer(C.T) method.

(a) Potential drop method:

The draw back of this method is greater drop in voltage for indication purpose.

As shown in the circuit diagram Fig: 6.2 (a) when the signal lamp is lit a potential about 10 V is obtained and this is used for light up the indication lamp connected across the resistor. When the signal lamp fuses, The signal transformer will work as a choke and draw only no load current: this current will not produce enough voltage to lit up the indication lamp.

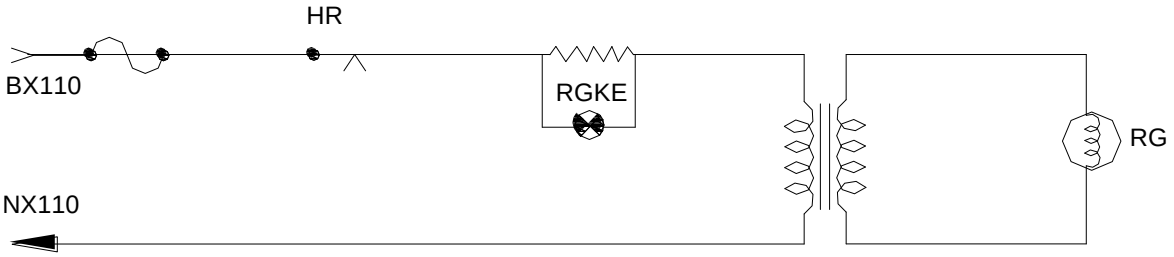


Fig: 6.2 (a)

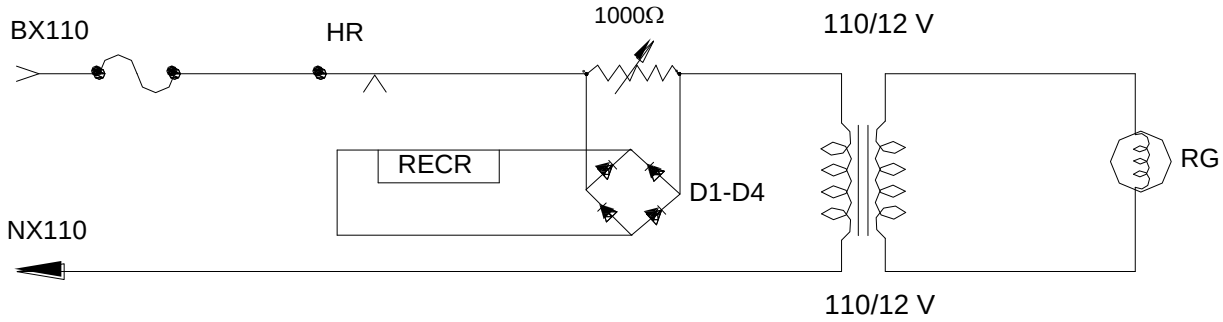


Fig: 6.2 (b)

The second method is provided with ECR (Lamp checking Relay)as shown in the Fig6.2 (b), in which the voltage drop across the resistor is rectified and the out put voltage is utilised to operate the relay. The voltage required for the energisation of relay can be adjusted by varying the resistance. When the lamp fuses, the current through the resistance decreases and therefore the relay drops, the dropping of ECR disconnect the indication lamp.

(b) Current transformer method: -

i) 'I' type current transformer.
ii) 'L' type current transformer.
iii) 'H' type current transformer.

(i) 'I' type of current transformer :- It is connected in series with the primary of the signal transformer and a 12V; 4W indication lamp is connected to the secondary of a current transformer. When both the filaments of signal lamp are litting, current transformer develops a voltage in its primary side and its secondary voltage lits up the indication lamp. If one filament of signal lamp is fused, the same will be indicated by the reduction in brightness of indication lamp when both filament of signal lamp fused, the signal transformer draw no load current (i.e. less than 15mA) hence no voltage is developing in primary side of a current transformer, there by indication lamp extinguishes and that indicates signal lamp is fused.

This type of current transformer is provided where only signal aspect indication is to be given.

(ii) "L" type current transformer: - (Low current rating) it is connected in series with the primary of a signal transformer, where the signals lamps are directly fed from the cabin. The secondary voltage of the current transformer (C.T). is rectified and utilised to energistic neutral relay, this relay will be called as a ECR, and its contact control the indication lamp in the cabin and also for aspect provision.

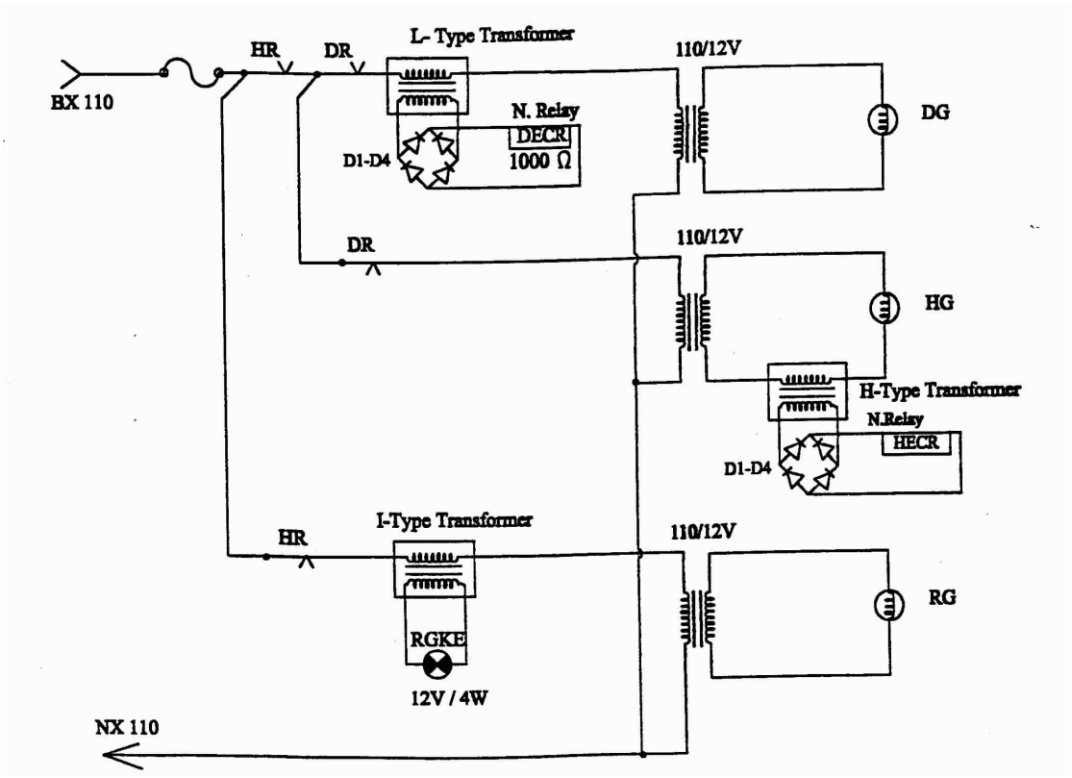


Fig: 6.3

(iii) "H" type current transformer:- It is high current rating type of current transformer and is connected in series with the secondary of a signal transformer, and lamp checking relay will be viewed in location box nearer to signal and repeater relays are aspect proving.

This type of current transformer is also used in triple pole lamp circuit to check the litting of main filament.

Salient features are: -

- 'I' type: - suitable for low current rating in the range of 0.3A on the primary, the secondary develops 7 volts across 2.5 VA load. The voltage ratio of primary/secondary = 10V/7V ± 5%
- 'L' type:- Suitable for low current in the range of 0.3 Amp on the primary, the secondary develops 9V across 0.09VA of the voltage ratio is 0.5V/9V ± 5%
- 'H' type:- Suitable for high current in the range of 2.5 Amp on the primary side, the secondary side develops 9V across 0.09VA of the voltage ratio is 0.3V/9V ±5%

6.4 MECR

In triple pole lamp MECR circuit, ‘H’ type current transformer is used: ‘H’ type current transformer is connected in series with the secondary of signal transformer. The secondary voltage of current transformer is rectified and utilized to energize the relay.

6.5 Siemens Lamp Proving Relays:

The relays metal to metal contacts are also utilised in large numbers for lamp proving purpose. These relays are manufactured by M/s siemen's India Ltd. The ECR relays are supplied as mini groups. The mini group comprises of a current transformer, bridge rectifier and a neutral relay of K. 50 'E' type. They are supplied separately for proving ON aspect ECR, OFF aspect ECR and UECR. The detailed particular regarding these relays are furnished below.

The ON aspect ECR is designed to de-energised when the main filament of a signal lamp is fused and the auxiliary filament is intact, so that the cabin man can get information about the failure of the ON aspect at the signal even when the auxiliary filament is intact at site, there by avoiding the possible blank signal. This consideration is not necessary for the OFF aspect.

6.5.1 RECR Unit as per Drg.No.Rs Sk.30/0013: -

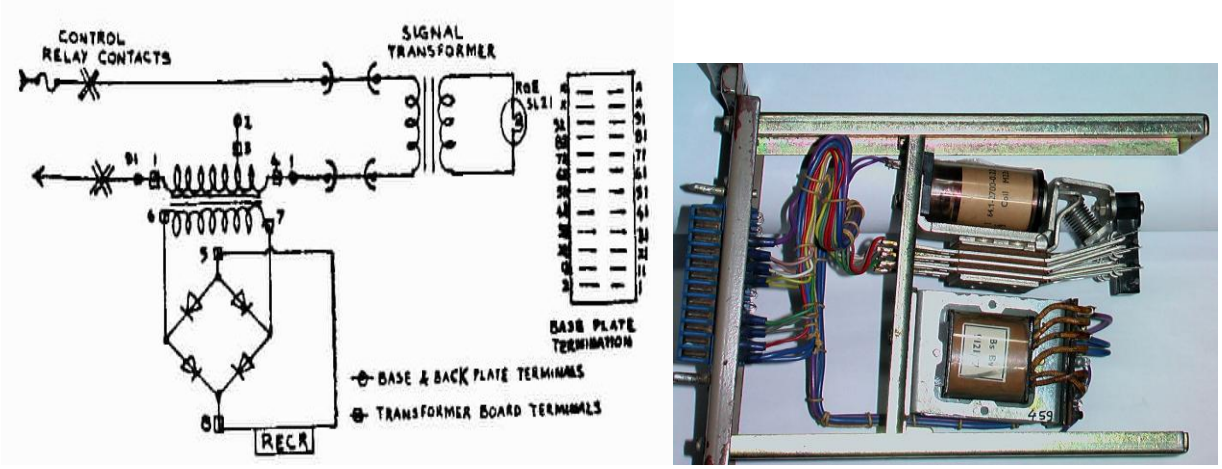


Fig: 6.4

K50E type relay is provided in this unit. The voltage ratio of its current transformer is about 1:3.

When both filaments of the signal lamp are lit, the primary voltage of the current transformer is about 3.4V at 300 mA current. The relay gets a D.C. voltage of over 7V and picks up. When the main filament of signal lamp is fused, the primary circuit current falls to about 100 mA. The relay voltage drops to less than 2V, well below its drop away value. The relay drops.

Since the drop away value of this relay is above 4.5V, it drops even when the auxiliary filament of signal lamp is fused and main filament above is lit.

6.5.2 DECR Unit as per Drg.No.Rs.Sk.30/0014:-

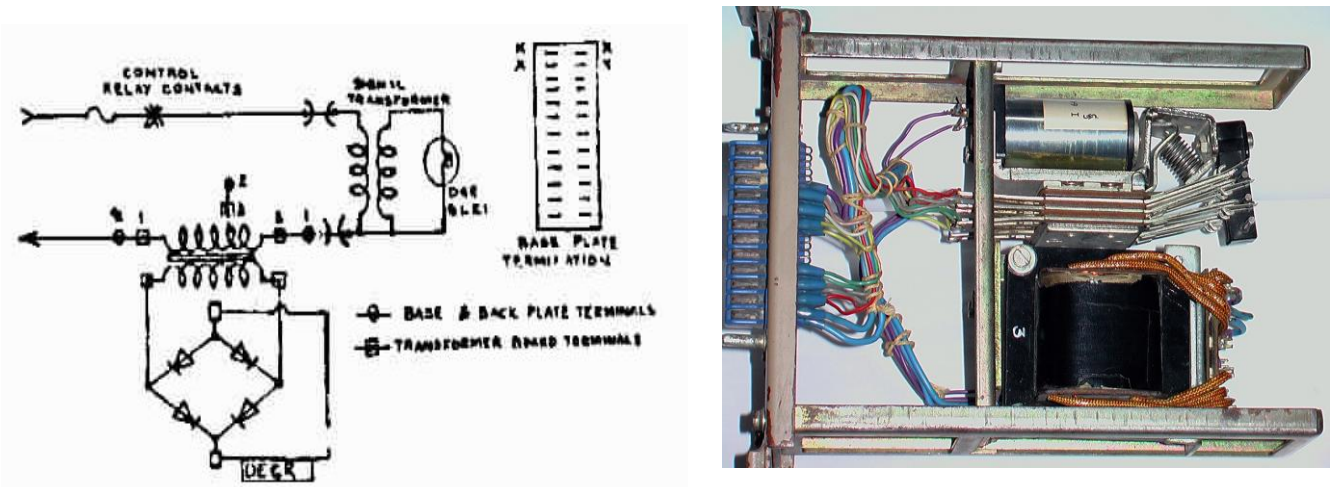
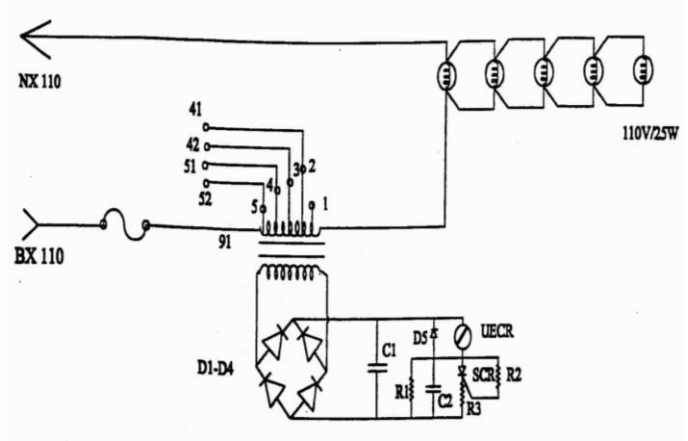


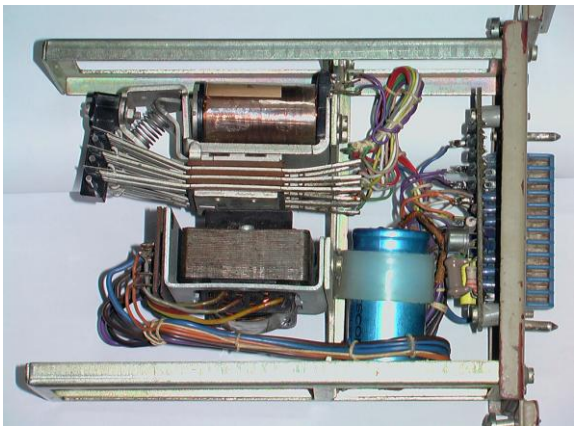
Fig: 6.5

K50E type relay is provided in this unit also. The voltage ratio of its current transformer is about 1:1. When both filaments of the signal lamp are lit, the primary voltage of this unit transformer is about 12.5V at 300 mA current. The relay gets a DC voltage of about 9.6V. When main filament is fused, the primary circuit current falls to about 50 mA. The relay gets a voltage of over 5V which is more than its D.A. value. The relay does not drop. When both the filaments fuse, the no load current of signal transformer, which is less than 15 mA makes the relay to drop.

Sl.no.	Description	ON ECR	OFF ECR
1	Drawing No.	RSSK.30/0013	RSSK-30/0014
2	Current transformer ratio	1 : 3	1:1
3	Amphenol terminal no's of relay coil	1-91	1-92
4	Relay coil Resistance	64.1	64.1
5	Std contact configuration/current	3F/3B	3F/3B
6	PU voltage/current	App.5 V/<340 m A	App 5v/<340 m A
7	DA voltage/current	App.4V/125 m A	App 4V/125 m A

6.5.3 UECR Unit as per Drg No.Rs SK 30/0015:





CT- Current Transformer
D1- D4- Bridge Rectifier
D5- To make relay slow to release
C1- Condenser -100 Mfd. Filtration of rectified PC
C2- Condenser - 0.1 Mfd
R1- Resistance = 33 K Ohms
R2- Resistance = 3.9 K Ohms to limit gate current
R3- Resistance = 10 Ohms to limit circuit current
UECR = K-50. 'B' Type relay
SCR- Silicon controlled rectifier

Fig: 6.6

The current transformer primary of the unit is connected in series with the signal lamp circuit. Its secondary voltage is rectified by D1-D4 and smoothened by condenser C1. This voltage is applied to the relay in series with an SCR. The SCR can get switched on when its gate current is not less than 5 mA. Also, SCR has a constant voltage drop across it irrespective of current through it.

When at least 3 lamps are lit on the route indicator SCR is switched on by its gate current through R2. The relay gets energized. If, after this, one more lamp is fused on the route indicator, the current through SCR is reduced to a value less than its hold current of 20 mA SCR stops conducting and so the relay drops. Resistance R3 limits the SCR current.

D5, R1 and C2 are necessary to protect the SCR from any spurious currents in the circuit.

Review Questions

Subjective

1) Draw the H type current transformer method of HECR and explain briefly.
2) Write a note on Siemens ON ECR
3) Write a note on Siemens OFF ECR
4) Write a note on Siemens UECR

Objective

1) ------ Type of current transformer is connected in series with the primary of the signal transformer and a 12V; 4W indication lamp is connected to the secondary of a --------.
2) ---------- Suitable for low current in the range of 0.3 Amp on the primary, the secondary develops ---------- of the voltage ratio is 0.5V/9V + or - 5%
3) ----------:- Suitable for high current in the range of 2.5 Amp on the primary side, the secondary side develops ---------- of the voltage ratio is 0.3V/9V + or - 5%]
4) In Siemens UECR relay ---------, ---------- and ---------- are necessary to protect the SCR from any spurious currents in the circuit.

CHAPTER 7: TIME ELEMENT RELAYS

7.1 SIEMENS MOTORISED CLOCKWORK TIMER RELAY AS PER DRG.No. RS SK (Railway Standard Specification for K-50 relays) 30/0052A:

This relay works on 110V A.C. ± 10%. It has a time range of 1 to 5 minutes. The time of operation can be adjusted on the relay. Its resetting is automatic.

Operation: A synchronous motor drives and switches over contacts after the lapse of a preset time. If the energizing circuit is prematurely interrupted, the mechanism returns to its normal position before actuating the contacts.

The relay has one change over contact. The back contact is between terminals 3 & 4 and the front contact is between 3 and 5. The contact is rated for 100 mA at 60V DC.

Two or three helper relays of K50 type (called AJTR1, AJTR2 and AJTR3) are used along with this relay for time control of circuits, so that the same time delay can be obtained for each following operation.

A set of four pinions and four gear wheels couple the motor shaft with the contact operating mechanism in this relay. The gear ratio is about 48:2:1 (approx).

Diagrams of
(1) Contact actuating Mechanism
(2) Reduction gear arrangement and
(3) Relay Front.

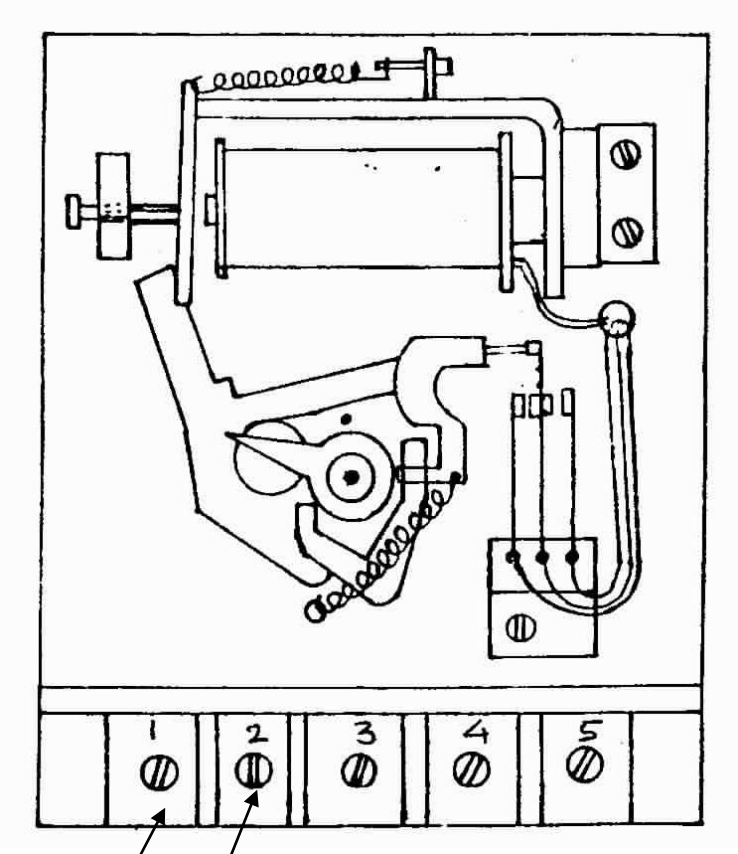


Fig: 7.1

7.2 ELECTRONIC TIME DELAY DEVICE (Spec. IRS S61-1987).

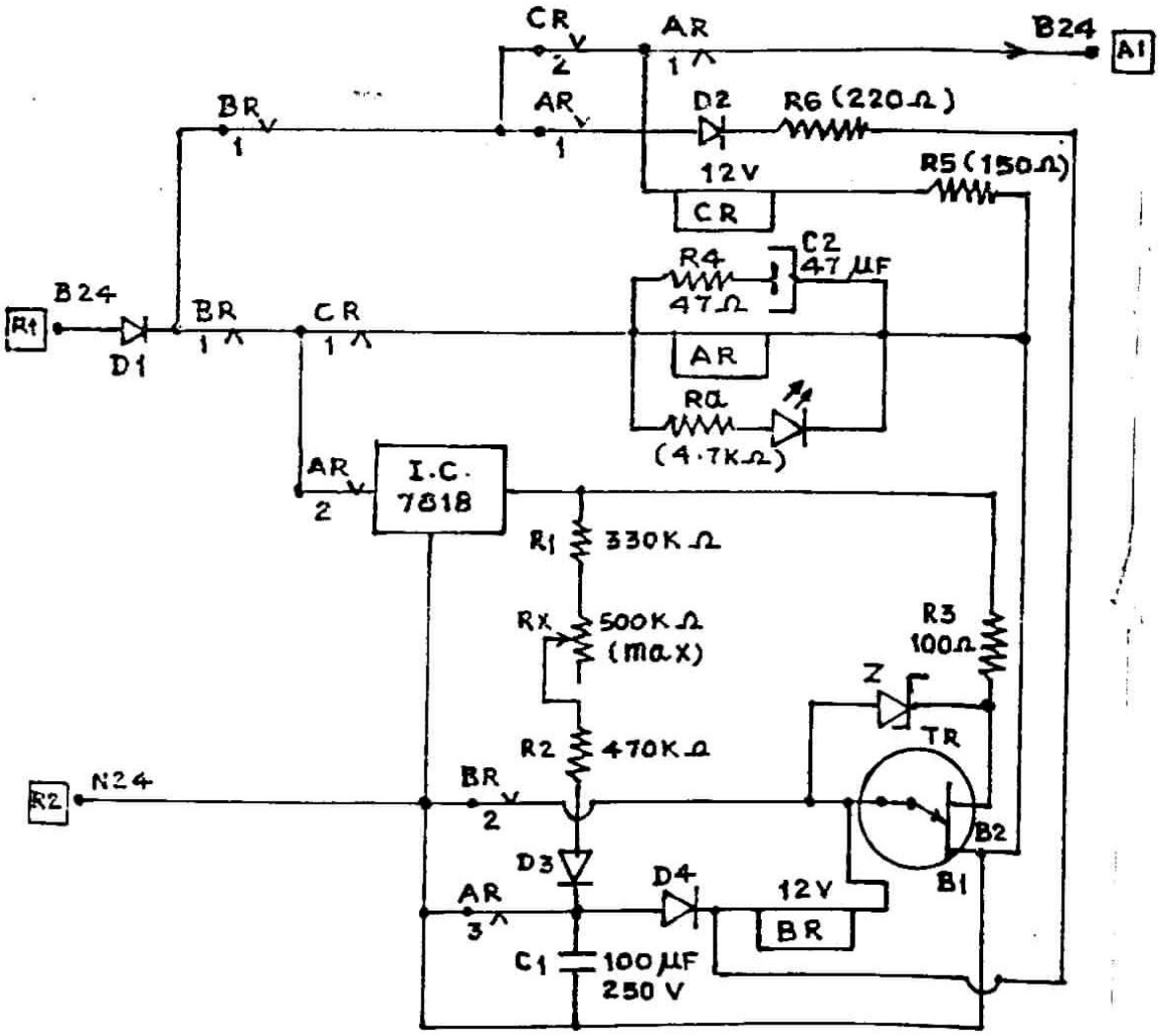


Fig: 7.2

Initially relays AR, BR, and CR are in the de-energized condition. 24V.DC input to the unit is fed between terminals R1 and R2, AR picks up directly through BR and CR back contacts with diode D1 in series.

Now, through diode D1, BR back contact and AR front contact, the regulator IC gets its input of 24V DC. Its 18V output is fed through resistors R1, Rx, R2 and diode D3 to charge the condenser C1. The charging time is decided by a suitable adjustment on Rx.

The regulator output is simultaneously available across base terminals B1 and B2 of the UJT in series with resistance R3. In case this voltage is excessive due to any fault of IC, it is brought down to its steady value by conduction through a zener 'Z' across the UJT.

When the condenser gets fully charged, its voltage reaches a value sufficient for the UJT to start conduction through its emitter and base B1. Then the condenser gets discharged through BR coil for a specific time and BR pick up. Once picked up, BR sticks through feed from R1, D1, BR's own front contact, AR front contact, D2 and R6.

The UJT stops conducting only when its current reaches a sufficiently low value.

Now through BR front contact and AR front contact CR picks up and sticks through its own front contact when AR drops after picking up of CR. AR is made slow to release by the provision of R4 and C2 across its coil so that CR feed is not prematurely cut off while it is picking up.

AR's front contact in BR stick circuit also is cut over by CR front contact to keep BR energized till UJT stops conducting. With CR and BR in picked up condition and AR finally dropping, feed on R1 is extended to the output terminal A1 of the unit. This is achieved after the required pre-determined time delay.

An LED is lit through resistance Ra across AR coil when AR is picked up.

This relay works on 24V DC -10%, +20%
The time of operation can vary by +10%.

Whenever electronic timers are to be used for locking release purposes, two times are energized simultaneously in parallel and their contacts are used in series in locking release circuits. These types of Relays are used in approach locking emergency release and overlap release circuits of railway signalling.

7.3 THERMAL TIMER RELAY:

QJ1 relay made to BR Spec. No.937: This is a thermal time element relay. It has a heating element (TH) and a neutral relay (JSR), which together energizes an external line relay after a pre-set time delay.

The thermal element consists of a bimetallic strip having ' invar' (iron) at the top and brass at the bottom(fig 7.4). A heating coil (TH) is wound over it. For a given heat, 'invar' expands less and 'brass' more. Since their ends are sealed together, the free end of the strip moves above gradually as being heated. This pushes up an arm contact to close with a 'hot contact' spring after a pre-determined time. Closing of hot contact energizes the 'JSR' relay coil, which sticks through its own front contact across the hot contact. When the 'JSR' is energized, its back contact in the thermal coil circuits opens. There by supply to TH coil is stopped. After some time, the heating element cools off and its arm closes with the cold contact. This cold contact in series with a 'JSR' front contact extends feed to an external relay (JR). The complete cycle of making a hot contact and then a cold contact ensures that the thermal contacts are normalized before each operation. This in turn results in the time delay being equal for all operations. In this relay, the time lapse during the 'cool off' of the heating element is thrice the time lapse during its heating.

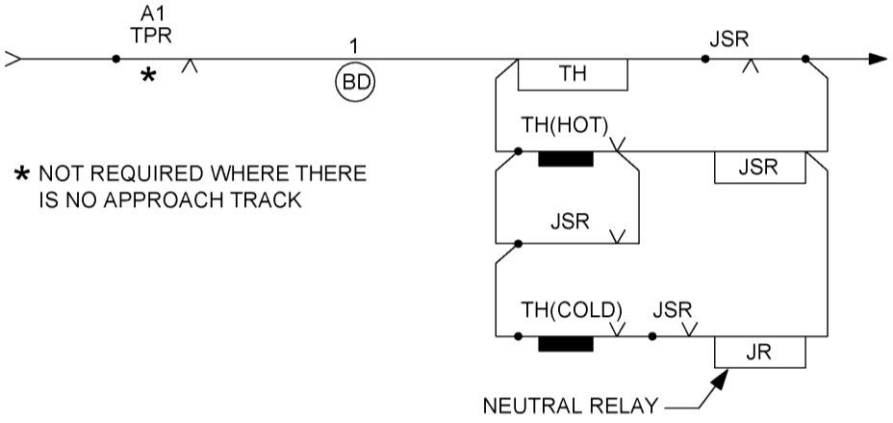
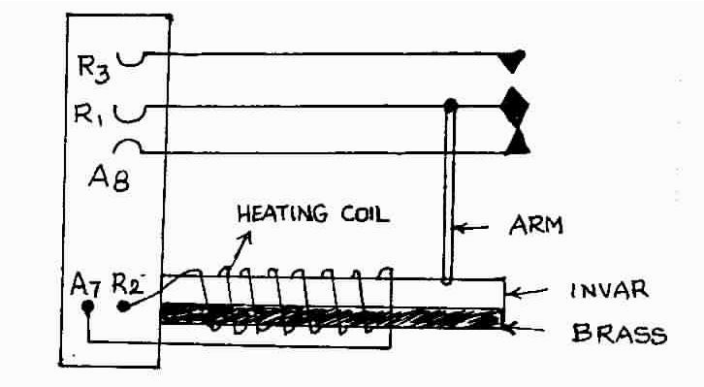


Fig: 7.3

In this diagram(Fig7.3), the relay internal wiring is shown in thick lines and the external wiring to be done in thin lines. The maximum rate of operations permitted on this relay is 100 operations per day. The rated life of the relay is 10^5 cycles of operations.

An increase of 10% in the applied Voltage may result in a time decrease of up to 10%.

A decrease of 10% in the voltage may result in a time increase of up to 20%.



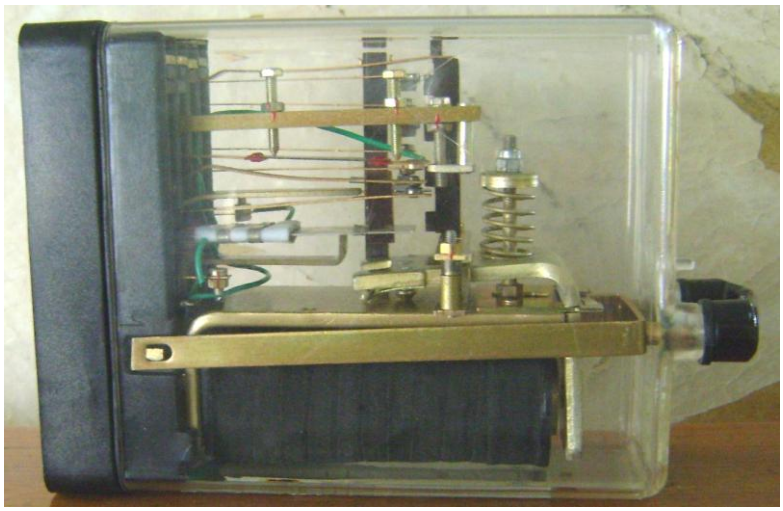


Fig: 7.4

Review Questions

Subjective

1) Explain the working of Siemens timer relay
2) How thermal time relay works, write in details
3) Draw a ckt of thermal time relay
4) Give the details of ckt where we required timer relays and why?

Objective

1) Specification of SIEMENS MOTORISED CLOCKWORK TIMER RELAY is ----------
2) Specification of electronic TIMER RELAY is ----------
3) In thermal time relay it has a heating element --------- and a neutral relay --------- which together energizes an external line relay after a pre-set time delay.
4) In thermal time relay bimetallic strip consists metal ---------- & ----------

CHAPTER 8: PLUG IN TYPE TRACK RELAYS

8.1 D.C. Track Relays with metal to carbon contacts

8.1.1 QT2 Style Track Relay made to Relay Spec. 26/6:-

This is according to B.S. Spec. 938 A.

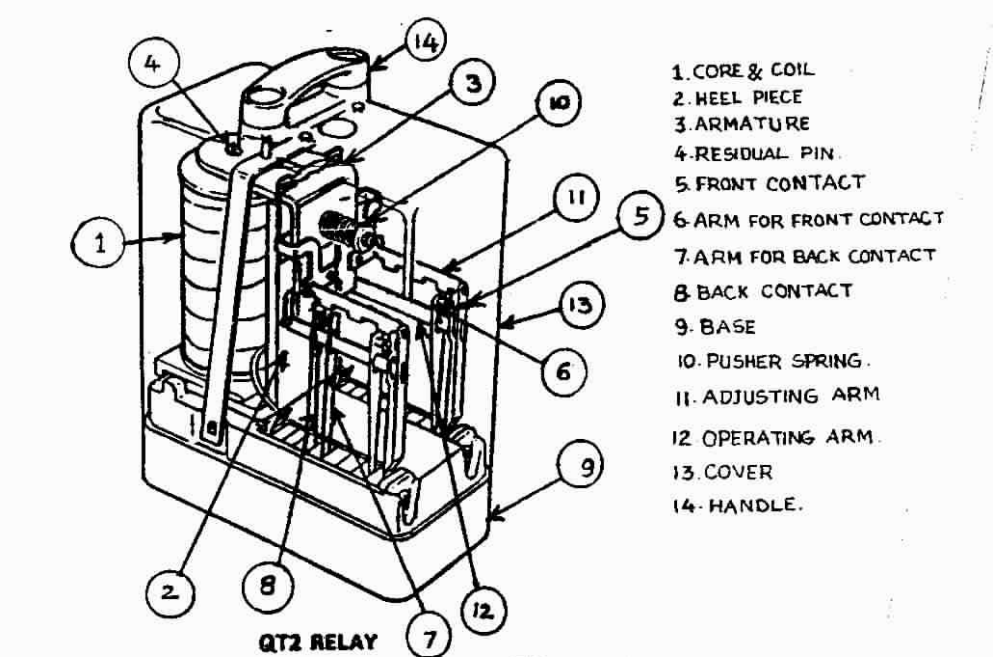


Fig: 8.1

The construction of this relay is similar to that of a Q-Series line relay except that its contact load is reduced drastically. Also, the relay is made more sensitive and workable on a low voltage.

While an earlier version of this type, i.e., QT1 relay has a double core magnet with only 2F contacts, in the QT2 relay only one core is provided. Also, it has one or two back contacts, in a deviation from B.R.Spec for QT2 relay, facilitating cross protection in remotely located TPR circuits. This has a single coil of 4 ohm or 9 ohm resistance unlike the shelf type relay which has two coils with open ends.

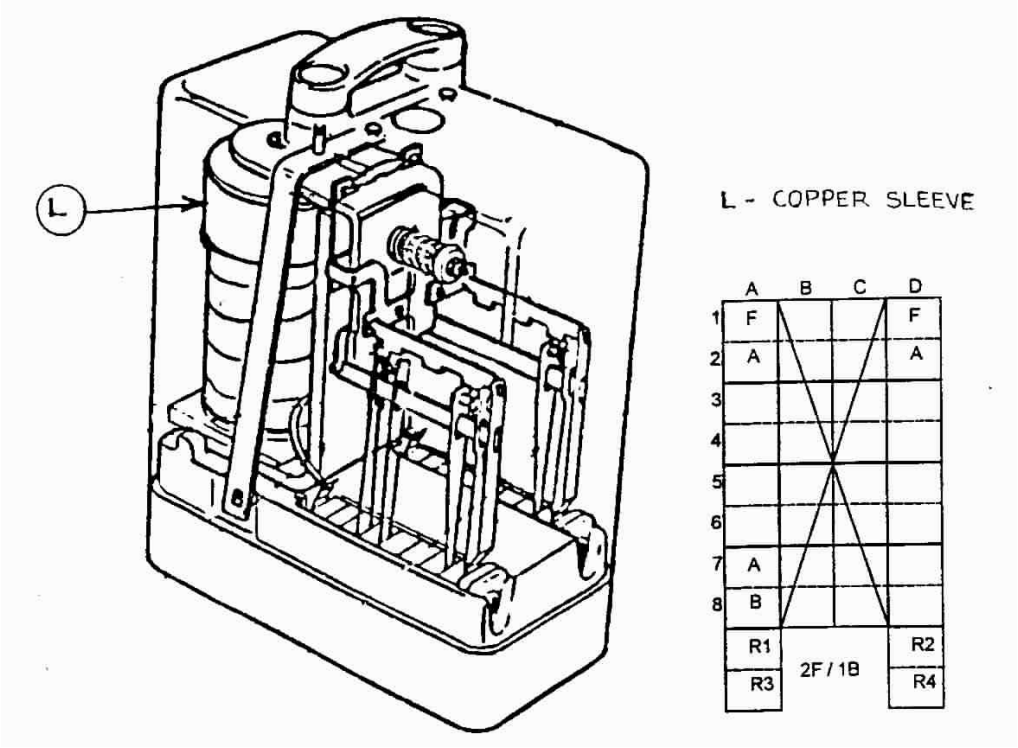
Similar in construction to line relay.
Coil resistance: 4 Ohms and 9 ohms.
4 ohms relay is used for longer length track circuits and 9 ohms relay for shorter length track circuits.

2F/1B is provided to reduce load on armature, hence sensitive and can operate at low voltages. Back contact is used for cross protection to prevent the repeater relay from picking up in case of false feed.

Maximum permissible excitation is 300% of the rated PU value. (Pusher spring allows higher excitation than shelf type). Minimum excitation is 125% of p.u.v

Percentage Release: must not be less than 68%.
Use: As Track relay in Non RE areas.
9 ohms relay: PU current: 103mA- 117mA, PU voltage: 1.5V.
4 ohm relay : P U voltage: 0.3V to 0.5V.

8.1.2 QTA2: AC immunized DC neutral track relay. Spec: BRS 939A.



QTA2 RELAY
Fig: 8.2

This accords with B.R. specifications 939A and 966 F to an extent.

In this relay, a copper slug is provided on the core at its armature end to make it immune to A.C. In all other respects, it is similar to QT2 relay in construction. Its coil resistance is 9 ohms, which can ensure A.C. immunity of not less than 50V. 20 ohms coil QTA2 relays are also available.

Due to the provision of copper slug, the relay requires more DC operating power and it takes more time for its pick up and release.

Only QSPA1 relay is permitted to be used as TPR (Track Repeating Relay) with this track relay. This is because an unsafe condition shall not be created during the catanery short circuit conditions, when A.C. voltage drop in a track circuit rail increases manifold, the TR (Track relay)may pick up under train and remain so for over 250 milliseconds . The circuit breaker in the traction power substation takes about 300 milliseconds to trip. In this context, QSPA1 relay's use as TPR is safer as it takes a longer time to pick up.

A/C Immunity level 50V AC R.M.S.

Contacts 2F/1B.

9 ohm relay is standard and 20 ohms relays is also available.

Being sensitive relay its DC PU value should not change by a larger extent hence the limitation on the AC immunity, same as in shelf type.

Max length of Track circuit is 450mtrs. (Rail voltage drop is 10V /90mtrs of track circuit).

QSPA1 only is to be used as repeater relay with QTA2.

20 ohm relay: PU volts: 1.4 to 2.0V, PU current: 80mA to 90mA.

9 ohm relay: PU volts: 1.0 to 1.4V, PU current: 120mA to 140 mA.

8.1.3 QBAT: Biased AC immunized Track Relay. MADE TO RDSO Spec. 84/88:

This also accords with B.R.Specn. 939 A and 966F .

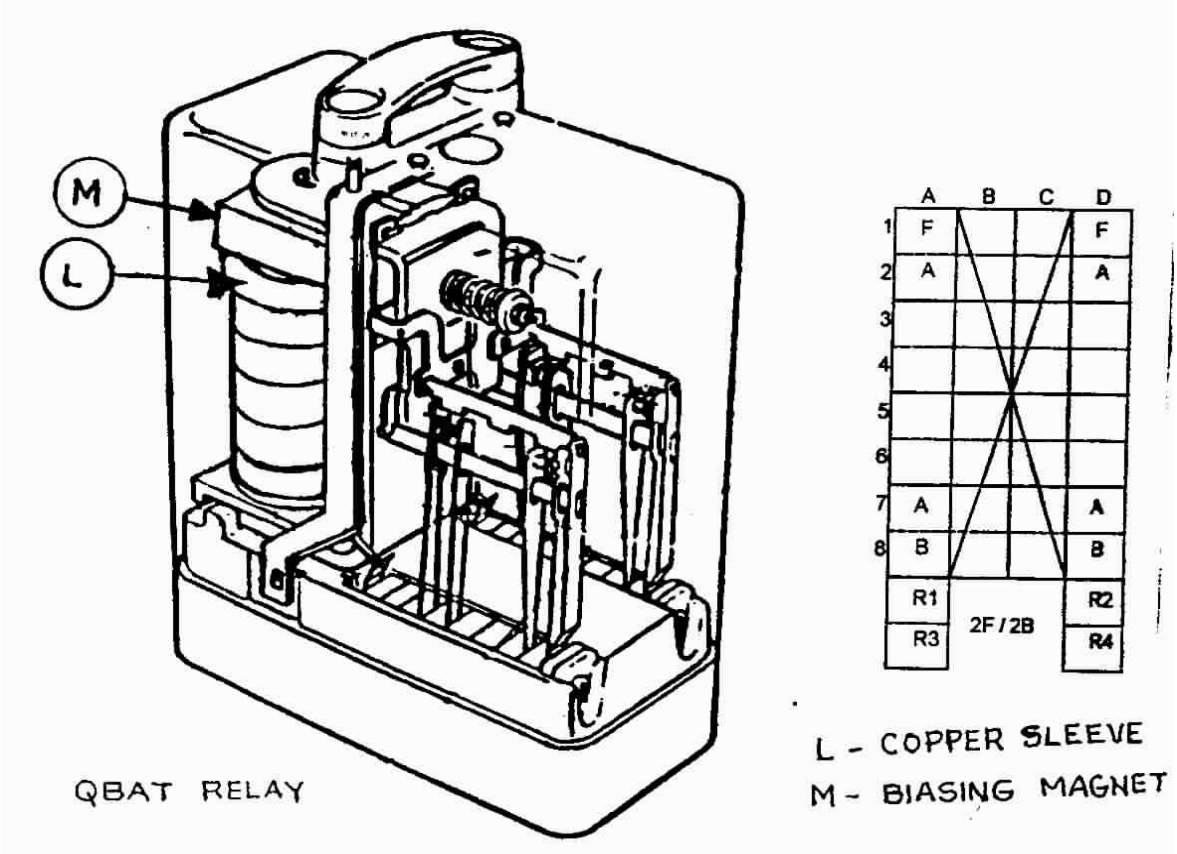


Fig: 8.3

This is a track relay with an improved immunity level of 80V A.C. by the provision of a biasing permanent magnet on its core along with its copper slug. This biasing by initially polarizing the core strengthens its electro-magnetic flux created in the correct direction by coil current. This takes more AC voltage to disturb the DC working flux.

This relay also requires QSPA1 relay as its TPR for the same reasons specified in the case of QTA2 relay.

Construction same as QBCA1 excepting for contacts.

PM is for biasing and also contributes to raising AC immunity level.

Copper slug for AC Immunity.

Contact configuration: 2F/2B.

PU volts: 1.1 to 1.75V, PU current: 140mA to 175 mA.

ACI: 80V,

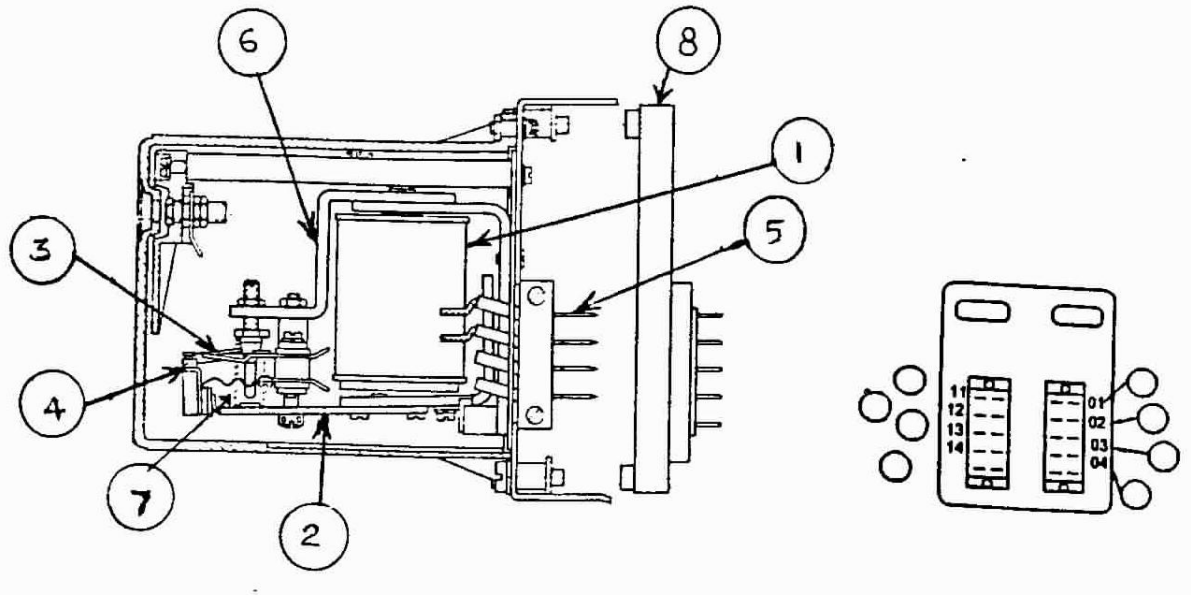
Coil resistance: 9 ohms.

Max length of track circuit: 720mtrs and can be extended to 750mtrs by using a choke at relay end also.
Maximum excitation: 235% of P.U.V only because of the flux of P.M.

In case of block joint defective, a normal neutral track relay may pick up by the polarity from the adjoining track but a biased track relay will not pick up.

8.2 DC TRACK RELAY WITH METAL TO METAL CONTACTS

Drs 50 Track Relay of Siemens Make:-



1.	COIL & CORE	2.	ARMATURE
3.	FRONT CONTACT	4.	BACK CONTACT
5.	TERMINATIONS	6.	EXTENSION BRACKET
7.	PUSHER SPRING	8.	BASE

Fig: 8.4

Three styles of this relay are available:-

(a) Style 1: Plug in type relay with cover for rack mounting.

(b) Style 2: Screw type terminal track relay with cover for permanent rack mounting.

(c) Style 3: Track relay with solder tag terminals, without cover for permanent installation in relay unit housings.

The style 1 relay is available in two designs: One with a U-section base plate and fully transparent cover (design No. V25427A). The other one is in a mini-group casing with a see-through front on cover (Drg. Rs sk. 30/0071)(Rs sk- Railway standard specification for K-50 relays). Except for their terminations on back plate, the insides of both relays look similar.

These relays are supplied with single break metal to metal back and metal to metal or metal to carbon front contacts as per user's choice. Contacts can switch a maximum load of 12W, with maximum current limited to 0.5A and maximum switching voltage to 60V D.C.

Relays are available with 1B.1F contacts or 1B.2F contacts or 2F/B (changeover) contacts. 2F.1B relays are used on our Railways.

The same relay is used in R.E. areas also with chokes in series, one at the feed end and one at the relay end of track circuit. Its A.C. immunity level is considered as 50V A.C.

Review Questions

Subjective

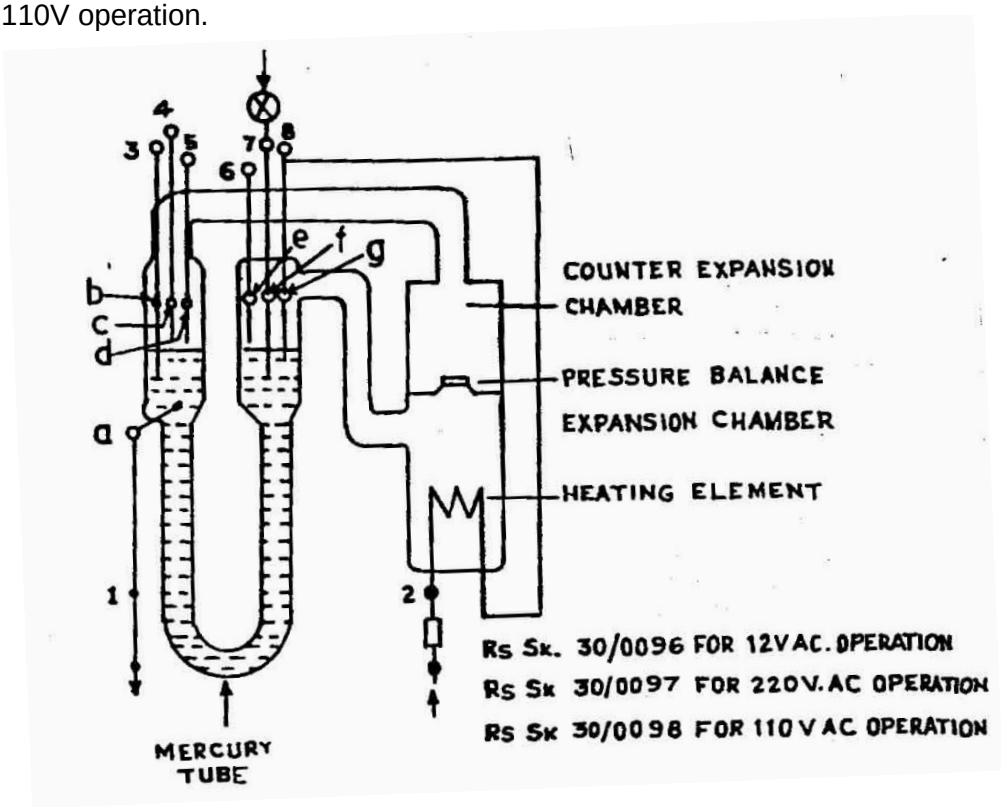
1) Write a note on QT2 relay in details
2) Write a note on QTA2 relay in details
3) Write a note on QBAT relay in details
4) Write a note on metal to metal track relay

Objective

1) Specification QT2 relay ----------
2) Specification of QTA2 ----------
3) Specification of QBAT ----------
4) Coil resistance of QBAT relay is ----------
5) By providing QBAT relay track length can be increased up to ----------

CHAPTER 9: SIEMENS THERMO FLASHER UNIT

9.1 Drg. No.RS SK 30/0096 for 12V operation, 30/0097 for 220V operation & 30/0098 for 110V operation.



RS SK : Railway Standard Specification for K-50 relays

Fig: 9.1

The thermo flasher serves the purpose of periodically interrupting light circuits there by bringing about flashing operation of light signals and indicating lamps. The Siemens thermo flasher unit works agelessly.

An oscillating mercury column enclosed in a U-shaped glass tube obtains the periodical flashing of about 60 impulses per minute. The movement of mercury column is caused by hydrogen gas in an interconnected glass chamber. In the lower portion of the gas chamber, a heating element is placed.

When current is passed through the filament of heater, gas expands and exerts pressure on the mercury column in one limb. With depression of the column in one limb, the contact of the heating element 'g/a' breaks. The mercury column then returns to its original position by force of gravity. Now, the heating circuit is closed again. This procedure gets repeated and swings the mercury column continuously till the external feeding circuit is opened. This opens and closes the contacts b/a, c/a, d/a, e/a & f/a, alternatively, which can be used for the required indication controls.

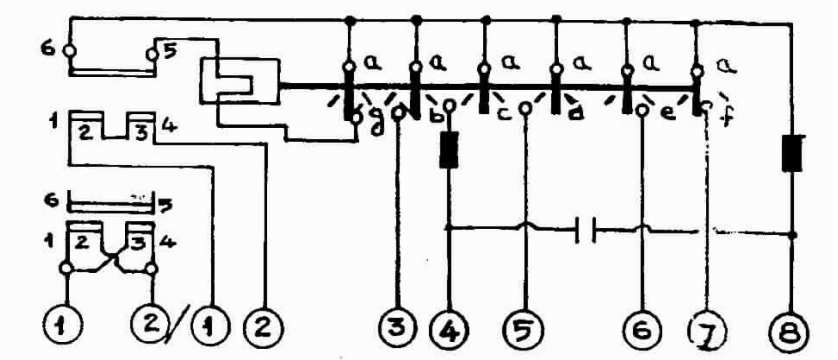


Fig: 9.2

9.2 RELAY DATA:

1. Coil (heating circuit input)	12V D.C/A.C or 110V/220V AC (With built in transformer).
2. Approx. power input during heating impulse	9W @ 12V and 20W @ 110/220V.
3. Approx. mean rate of power input	4.5W @ 12V and 10W @ 110/220V.
4. Flashing frequency	60/ minute.
5. Flashing ratio	for contacts d/a, e/a, f/a - Bright/Dark=1:1 for contacts c/a & g/a -Bright/Dark = 1:0.5
6. Contact Load Capacity:	
Current on contact	- 6A @ 12V, 2A @ 110V & 1A @ 220V.
Incan descant lamp load	- 72W @ 12V, 220W @ 110V & 220V.
7. Terminals	Sleeve terminal for a conductor cross section of 2.5mm^2.
8. Placing into operation	before installation of the flasher unit, check if the Mercury level in the pendulum tube coincides with 'full' mark. If not, tilt housing carefully to bring Mercury into the pendulum tube.

This type of Relays are used in Siemens RRI Installations

Review Questions

Subjective

1) Draw a diagram of Siemens flasher relay
2) Explain working of Siemens flasher relay
3) Give the features of Siemens flasher relay
4) In which ckt we are using Siemens flasher relay and why?

Objective

1) Metal used in Siemens flasher relay is ----------
2) Specification of Siemens flasher relay is ----------
3) Flashing frequency is ----------
4) Contact load capacity is ----------
5) Point indication flashing means ----------

CHAPTER 10: SLOW ACTING RELAYS

10.1 Slow acting relays are so called because their operation is delayed for a period of a few seconds or mili-seconds to keep circuits controlled by them live even after their own feed is cut off. This is necessary to maintain certain operational sequences.

DC Relays of this type only are popular in our installations, as the delay in operation is obtained in them by electrical means. In AC relays the delay is obtained by means like clock work timer mechanisms.
These relays may be classified as: -

(a) Slow to pickup and release relays;

(b) Slow to pick up relays, and

(c) Slow to release relays.

10.2 Slow to pick up and release relays: Provision of copper sleeves on their cores makes them slow to operate.

The following graphs indicate the build up and collapse of fluxes in these relay during their pick up and release respectively.

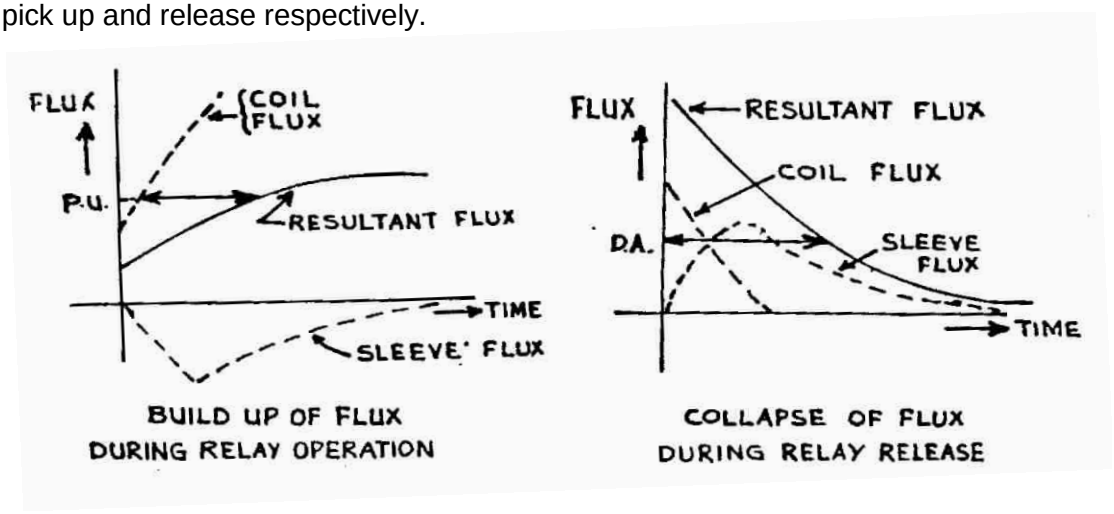


Fig: 10.1

The ratio between the inductance and resistance of the relay is its time constant (t = L/R).

10.3 SLOW TO RELEASE RELAYS:

(a) Sometimes, a rectifier is connected across the relay coil as shown to make it slow to release, with its cathode on the positive side and anode on the negative side.

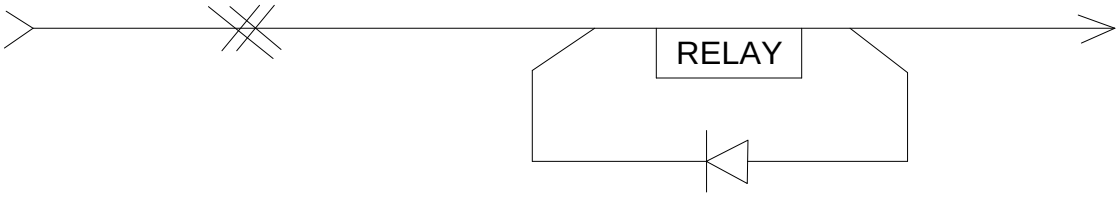
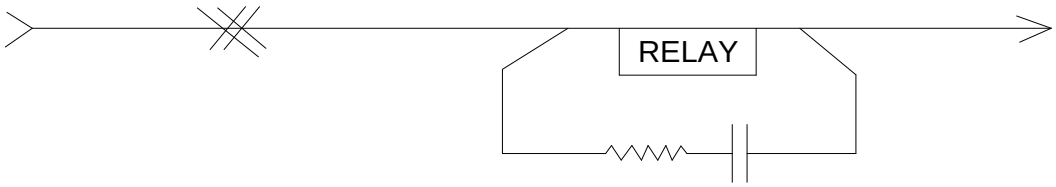


Fig: 10.2

During the relay coil energisation, the rectifier does not conduct. But when the coil feed is cut off, the collapsing core flux generates a back emf in the coil. This voltage is discharged through the rectifier during which time the relay drop is delayed. The release time lag so obtained is about 250 to 500 milliseconds.

(b) The use of a condensor across a relay also makes it slow to release. A resistance may be connected in series with the condensor to limit the initial charging current. The value of resistance also regulates the release time lag. This is the most common arrangement we find in our circuit designs.



These are used in Circuits for relays such as TSR, JSLR, RJPR, UYR, Etc

Fig: 10.3

10.4 Release time lags Effected by Condensers of different values Connected across Relays:

S.NO	Type of Relay	Value of capacitance	Release Time lag	Actual Time lag
1	DC Shelf type	100 micro farad	122.8 milli seconds	300 milli seconds
2.	Line relay	250 micro farad	307 milli seconds	440 milli seconds
3	1000ohms ITI maker	375 micro farad	481 milli seconds	560milli seconds
4	Siemens K-50Relay	100micro farad	955milli seconds	1second

10.5 Slow to Pick Up Relays:

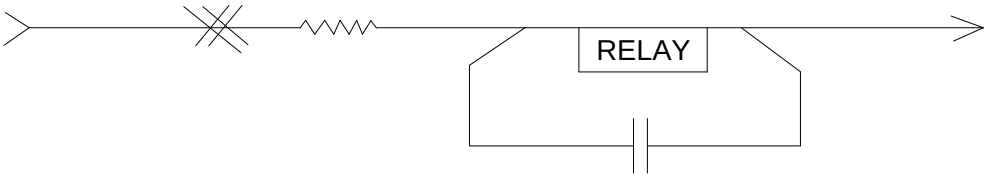


Fig: 10.4

With a resistance in series and suitable value of capacitance across the relay coil direct, the relay becomes slow to pick up due to the simultaneous charging of condensor in parallel. During release, the condensor discharges quickly through the relay coil, neutralising the effect of its inductance.

10.6 Fast to pick up and slow to release relay

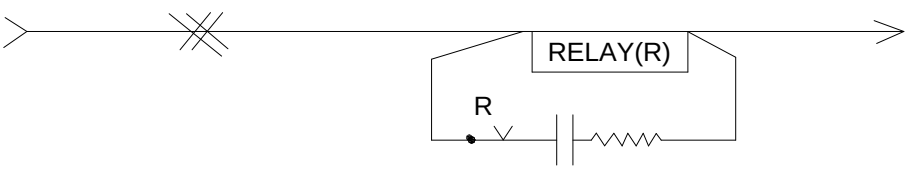


Fig: 10.5

Review Questions

Subjective

1) Where we are using slow to release relays and why?
2) Explain slow to release concept.
3) Explain slow to pick up relay concept.
4) What is the Basic concept of time delay circuit in relays.
5) Give the list of relays made slow to release in Siemens concept.

Objective

1) QSPA1 is ---------- to --------- relay used in ----------concept
2) Diode connected across the coil of relay is connected in ---------- condition
3) Diode across the coil in the Siemens point group relay is ----------
4) Symbol of slow to release relay in British practice is ----------

CHAPTER 11: DC POLAR RELAY
(Spec. No. S31-80)

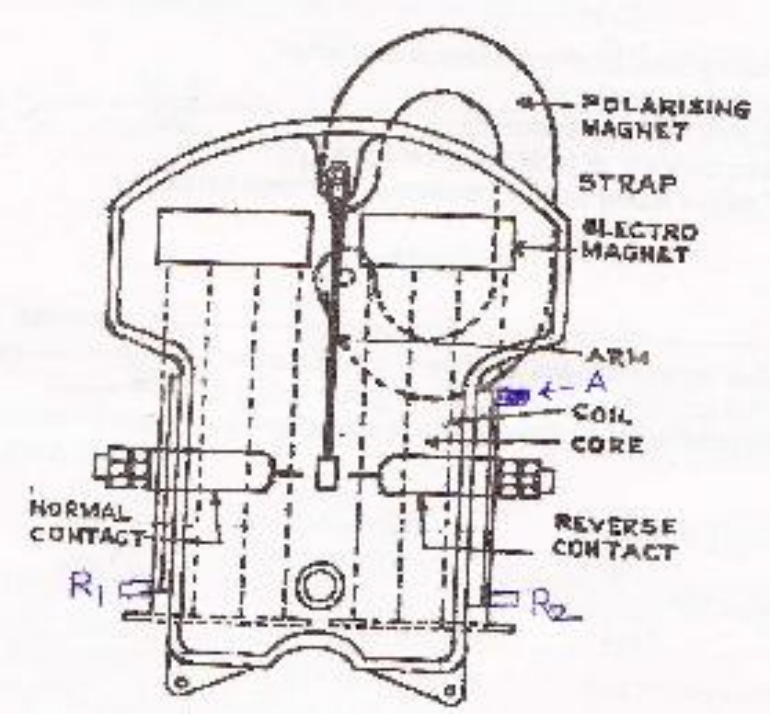


Fig: 11.1

11.1 A DC polar relay is one, which makes different contacts for different polarities of DC supply connected to it.

In this relay, a steel strap is polarized by a permanent magnet placed behind and is hinged between the poles of an electromagnet. A movable contact spring called 'arm' is attached to the strap in the front. This spring makes with one of the two fixed contacts on either side when the relay is energized with alternate supply polarities.

When the electromagnet coil is energized with normal polarity, say +ve on R1 and -ve on R2, the south pole at the free end of the strap is attracted towards the north pole of electromagnet to move to the left. Then the arm spring closes with the normal contact of relay on the left.

Similarly, when -ve polarity supply is connected to the coil, +ve on R2 and -ve on R1, the south pole of the strap is attracted towards the right. At this time, the north pole of electromagnet on the right is attracting the free end of the strap, connecting the arm with reverse contact of the relay.

A Polar relay is sensitive to the direction of current and makes different set of contacts for different direction of current flow through the coils.

The working may be explained in easier way by assuming that a permanent magnet is placed in between the pole faces of the electromagnet. In the centre position the permanent magnet flux divides equally on both sides, and there is no force of attraction towards any side but when the coil is energized, the electromagnetic flux causes a variation in the amount of flux on either side of the armature i.e. (QC+QP) on one side, and (QC-QP) on the other. This causes the fluxing of the armature towards the right hand pole face.

In this relay, it is important that, not less than 1.5 mm gap is maintained between the de-energized position of arm and the contact pins on either side. This ensures that the accidental making of contacts due to ground vibration does not take place.

11.2 Application: This relay is generally used to detect the block line polarity when block handle is turned at the other end of the block section so as to control movement of trains in to the block sections.

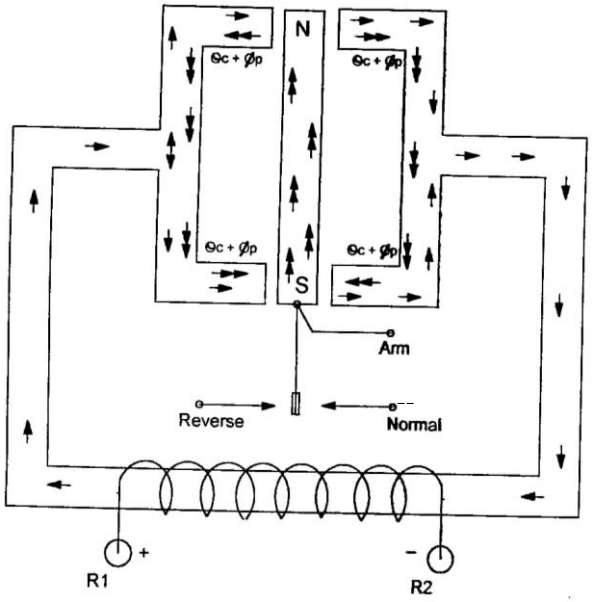


Fig: 11.2

Operating characteristics:

(a) Pick up value = 17 milli amperes.

(b) Rated pick up value = 21 milli amperes.

(c) Permitted over energisation = 25milli amperes.
as per SEM para 22.9.10.2

(d) Resistance = 77 ohms (38.5+38.5ohms)

(e) Drop away value = Not less than 50% of pick up value.

(f) AC Immunization = 10 V AC

(g) Current carrying capacity Of a contact = a. continuous = 1 Amp
b. for 30 sec = 2 Amp

(h) Contact resistance when Energized with 10% Excess of the P U Value = 0.25 ohms

Review Questions

Subjective

1) Draw a diagram of polar relay
2) Write a note on working of polar relay
3) What are the Operating characteristics polar relays?
4) What is the specification of polar relay?

Objective

1) Total resistance of polar relay is ----------
2) Pick up value of polar relay --------
3) Drop away value of polar relay is ---------
4) Polar relay is used in ----------block instrument
5) Contact resistance is ----------

CHAPTER 12: SIGNALLING CABLES

12.1. Type of Cables:

PVC insulated PVC sheathed and armoured signalling cables to specification IRS S. 63 shall be used for carrying signalling circuits. The conductors used shall be of copper and of approved size. Cross Section view of signalling cable as show in the figure 12.1. The cables used in signalling installations are broadly classified as:

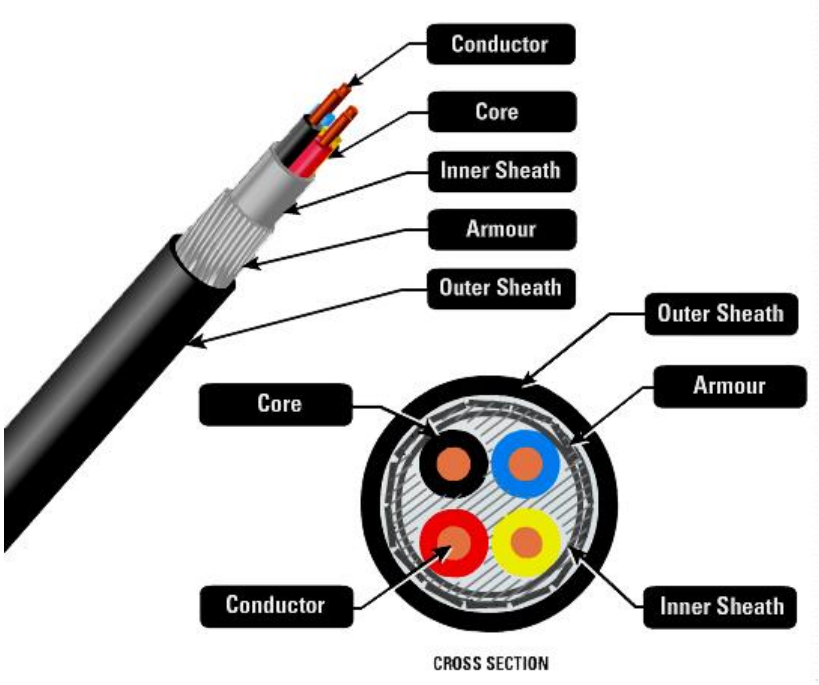


Fig 12.1 SIGNAL CABLE

(a) Indoor cables.

(b) Outdoor cables.

(c) Power cables.

12.1.1 Indoor Cables: Indoors cables are without Armour wire. In this, all the PVC insulated conductors are bunched and kept in thin PVC insulation tube. In addition to indoor cables, wires are also used for internal wiring. Indoor Cables normally used are 60 core(C), 40C, 24C, 20C and 16C cables. In any cable, all the conductors have equal cross section/diameter(Ø). In these cables, all the conductors used are copper conductors.

Each conductor having 0.6mm dia((Ø) available in the core of 60C, 40C, 24C and 20C. Each conductor having 1mm dia (Ø) available in the core of 60C, 40C, 24C and 16C. , 0.4 mm and 16 strand 0.2 mm diameter loose flexible wires.

Indoor cable conductors can be numbered according to colour code as shown below

1	2	3	4	5	6	7	8	9	10
Blue	Red	Grey	Green	Brown	Black	Yellow with Red dots	White	Pink	Violet

Fig 12.2 INDOOR CABLE

- 1mm. dia (Ø) copper-single strand wire is used for high current circuits such as signal lamp circuit, point operation circuit, gate circuit, etc.
- 0.6mm.dia(Ø) copper-single strand wire is used for relay wiring.
- 0.4mmdia(Ø) copper-single strand wire is used for indication lamps and panel wiring.
- 16 strand 0.2mm.dia(Ø) flexible loose wire is used for Q-Series relay wiring.

12.1.2 Outdoor Cables:

In these cables, all conductors used are copper conductors having equal diameter with PVC insulation. All the PVC insulated conductors are bunched and kept in PVC insulation tube. On the circumference of this tube, galvanised iron rectangular or circular cross section wires called Armour is provided to give the mechanical strength and to protect the cable from damages. On this Armour PVC insulated thick tube is provided to give the more mechanical strength and good insulation resistance in addition to (water proof arrangement) preventing the water entering inside the cable.

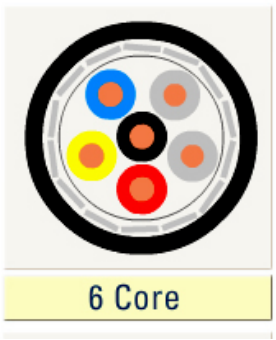
Generally, used conductor core sizes are 1.5 sq.mm., 2.5sq.mm.. Each size is available in the core of all the cables as mentioned below. Most commonly used cores are 2C, 6C, 12C, 19C, 24C and 30C.

Numbering of conductors in an Outdoor Cable: In these cables, conductors bunched in the form of layers. Numbering is generally started from outer most layers of conductors. Each layer starts from **blue** conductor and ends with **yellow** conductor.

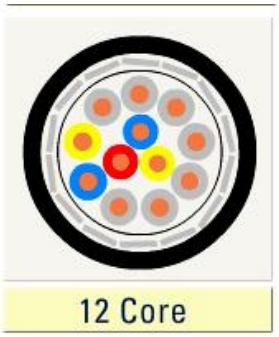
12C Cable:

Outer Layer	1	2	3	4	5	6	7	8	9	10
	Blue	Grey	Grey	Grey	Grey	Grey	Grey	Grey	Grey	Yellow
Inner Layer	10	11	12							
	Blue	Red	Yellow							

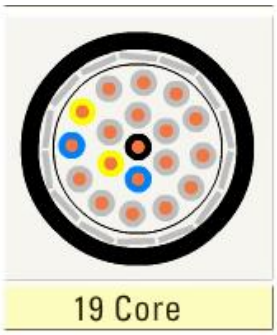
2.5 Sq.mm



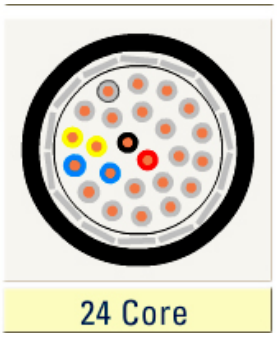
1.5 Sq.mm



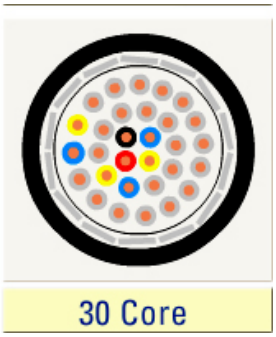
1.5 Sq.mm



1.5 Sq.mm



1.5 Sq.mm



1.5 Sq.mm

For example:

Fig 12.3 OUTDOOR CABLE

30C Cable:

1st Layer (Outer most Layer)	1	2 - 15	16	
	Blue	Grey	Yellow	
Outer Layer	17	18 - 25	26	
	Blue	Grey	Yellow	
3rd Layer (Inner Layer)	27	28	29	30
	Blue	Black	Red	Yellow

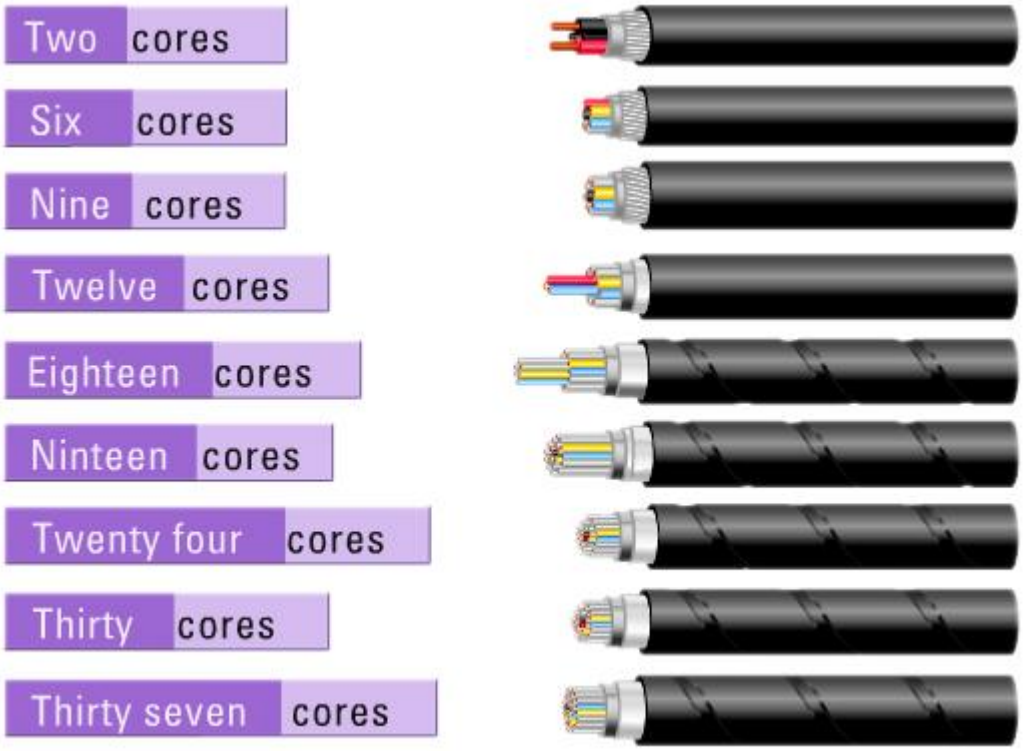


Fig 12.4

(a) In A.C. Electrified Sections:

(i) The main cables shall ordinarily be PVC insulated screened and armoured cable to I.R.S. specification No. S.35/1970 or, Paper Insulated lead sheathed and armoured to I.R. specification No.E.17/1959. However, any metallic sheathed armoured cable having a cable reduction factor of not more than 0.4 at a field strength of 87.5 to 450 volts per km may be used in lieu of the paper insulated lead *sheathed* and armoured (P.I.L.C) cable.

(ii) The tall cables shall be P.V.C. cables to Specification No. IRS S.63.

(b) Power cables laid by Signal & Telecommunication Department for carrying power supply up to 440 volts shall be PVC insulated PVC sheathed and armoured cables to specification IS:1554-PART I- 1964 with alluminium conductors. The conductor shall suit the electrical load.

12.1.3 Power Cables: Generally used power cables are -

- 70 Sq.mm. aluminum core single strands - 3 & 3 1/2 core cable.
- 50 Sq.mm. aluminum core single strands - 3 & 3 1/2 core cable.
- 25 Sq.mm. aluminum core single strands - 3 & 3 1/2 core cable.
- 25 Sq.mm. (Multi-strand-7) aluminum conductor core, also available in 2C, 3C, 3½C, 4C.
- 10 Sq.mm. alluminium single strand - 2C.
- 08 Sq.mm. copper conductor single strand - 2C.
- 06 Sq.mm. copper conductor single strand - 2C.

Difference between Screened cable and unscreened cable

Sl. No	Screened cable	Unscreened cable
1	IRS specification S-35/93	IRS specification S-63/07
2	It is PVC insulated metal sheathed armoured cable	It is a PVC insulated armoured cable
3	Cable screening factor 0.4	No screeining factor
4	Manufacturing cost more	Manufacturing cost less
5	No more use in future Installation	In future installation only to be used Unscreened cable

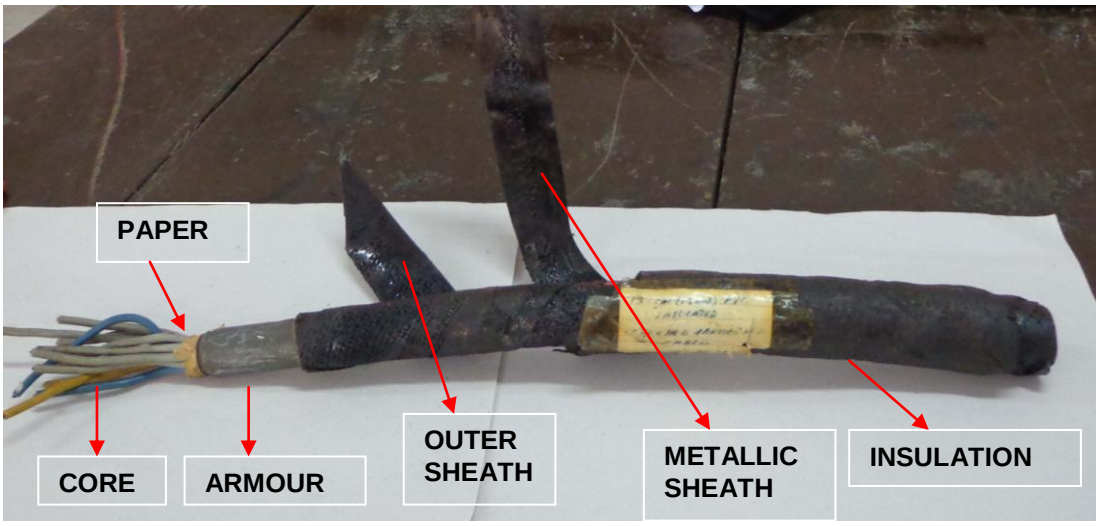


Fig 12.5 (a) SCREENED CABLE

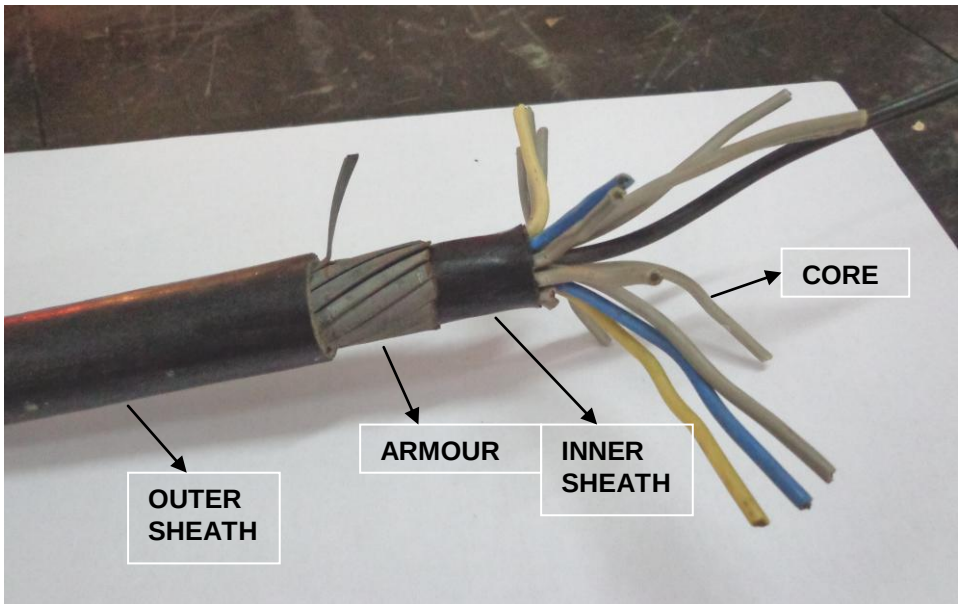


Fig 12.5 (b) UN SCREENED CABLE

Review Questions

Subjective

1) Write a note on indoor cable
2) Write a note on outdoor cable
3) What are different sizes in power cable?

Objective

1) PVC insulated screened and armoured cable to I.R.S. specification----------

DATA SHEET FOR "Q" SERIES NEUTRAL LINE RELAYS

Sl. No.	Relay Style	Description	B.R.B. Spec. No.	Relay Spec. No.	Contact Arrangements.	Code No.	Code Pin Positions	Coil Res. (Ohms)	Wkg. Volt. (Volts) D.C.	Max. PUV (volts)	Min. PUV (volts)	Min. DAV (volts)	A.C. Immunity (volts)	P.U. Time (m. sec)	D.A. Time (m. sec)	Contact Rating Continuous	Current (Amps) Switching	Usage & Other Remarks.
1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.	17.	18.	19.
1	QN1	D.C.Neutral Line Relay	930A	01/16 01/18	12F.4B 8F.4B	001	ABC DE	340 to 470	24	19.2	-	3.6	300	150	20	8	2	All ccts.of Non-RE & Internal ccts. of RE. In emergency external ccts. of RE area.
2	"	"	"	01/17 01/19 01/20	8F.8B 6F.6B 4F.4B	002	ABC DF	"	"	"	-	"	"	"	"	"	"	——u——
3	"	"	"	01/21 01/23	12F.4B 8F.4B	003	ABC EF	1000/ 1500	50	40.0	-	7.5	-	"	"	"	"	Used as Track Relays with AFTC
4	"	"	"	01/22 01/24 01/25	8F.8B 6F.6B 4F.4B	004	ABD EF	"	50	"	-	"	-	"	"	"	"	——x——
5	QS3	" (Sensitive)	"		4F.4B		CDEK X	1000	12	9.35	7.5	3.75	-	-	-	"	"	In place of shelf type relays:Ex: EVR & SUPR of AXC's
6	QNN1	" (2-relay unit)	960	19/1	6F.2B	092	ACD EK	470	24	19.2	-	3.6	-	-	-	"	"	All ccts.of non-RE & Internal ccts of RE Area.
7	"	"		19/2 19/3	4F.4B 2F.2B	057	ACE HJ	"	24	19.2	-	3.6	-	-	-	"	"	
8	QB3	D.C.Biassed Line Relay (N/I)	-	PTJ/ QB3	4F.2B	-	ABF GX	200	12	9.6 @ (45 mA)	8.0	-	-	380	20	"	"	CRRS of PTJ make T/less Block Instt.
9	QNA1	A.C.Immune DC/NL Relay.	931A	05/11 05/13	12F.4B 8F.4B	021	ABD FH	208	24	19.2	-	3.6	300	220	70	"	"	External circuits of R.E.Area.
10	"	"	"	05/12 05/14 05/15	8F.8B 6F.6B 4F.4B	022	ABD GH	208	24	"	-	"	"	"	"	"	"	
11	QBA1	D.C.Biassed ACI N/L Relay	932A		12F.4B 8F.4B			"	24	"	-	"	"			"	"	-do-
12	"	-do-	"		8F.8B			"	"	"	-	"	"			"	"	

Page No.2.

DATA SHEET FOR "Q" SERIES NEUTRAL LINE RELAYS (continued)

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
13	QBCA1	DC biassed ACI contactor Relay.	943		2F(HD). 4B	170	BCE JK	208	24	19.2	-	3.6	300			30A-F 3A-B	30A-F 2A-B	Point Machine Control in R.E.area.
14	QSPA1	Slow Pick Up ACI N/L Relay	933A	11/1	8F.4B	041	ABDEJ	"	"	"	-	"	"	540/600	140/200	3A	2A	For TPRs with QTA2& QBAT Track Relays
15	QSRA1	Slow Release ACI N/L Relay	934A	08/13	8F.4B	061	ADEFJ	"	"	"	-	"	"	-	260 ● 19.2 V	"	"	For use in AC Areas
16	QL1	DC Magnetic latch relay	935	09/05	8F.6B	007	ABCEG	R-150 N-680	"	"	9.6V	-	-	-	-	"	"	TCPR and TGTR of
17	"	-do-	"	09/03	11F.4B	009	ABDEG	"	"	"	"	-	-	-	-	"	"	PTJ make T/less Block.
18	QJ1	DC Neutral Time Element Relay.	937		1F		AFGH K	H-40 JS-400	"	-	-	-	-	30/60/90/ 120 Sec	-	"	"	

DATA SHEET FOR TM - TYPE INTEGRA RELAYS (PROVED TYPE)

S.No.	Description of Relay	IRS Spec. No.	Relay Type Number	Contact Arrange ment	Code Pin Positions	Coil Res. (Ohms)	Normal Wkg. Volts.	P.U. Current (Min.)	D.A. Current (Min.)	P.U. Time	D.A. Time	Contact Res. (Max) (Ohms)	Contact Current Rating	
													Continu-ous	Switch-ing
1	D.C. Neutral Relay (Non - Imm)	S 46	TMA 1144/ 111 - GUM	4 F . 4 B	10.11.12.14.28 30.31.32.41.43 (& also for mini Group)	1550 ± 10%	60 V DC	16 mA	5 mA	50 - 70 m sec	10 - 30 m sec	0.04	6 A	2 A
2	"	"	TMA 1153 111 - GUM	5 F . 3 B	10.11.12.15. 18.30.31.32. 41.43.(& also for Mini group)	"	"	"	"	"	"	"	"	"
3	"	"	TMA 1162 111 - GUM	6 F . 2 B	10.11.12.30. 31.32.41.43	"	"	"	"	"	"	"	"	"
4	D.C. Neutral Relay (A. C. Imm)	"	TMA 1144/ 112	4 F . 4 B	10.11.12.14.21. 30.31.32.46.48	1512 ± 10 %	"				"	"	"	"
5	D.C.Mechanically Interlocked Relay	"	TMA 1144/ 112 & TMA 1144/112	4 F . 4 B	10.11.12.14.21 30.31.32.41.43 & B	1070 ± 10 %	"	20 mA	.	50 - 80 m sec	.	0.05	"	"
6	"	"	TMA 1153/ 112 & TMA 1153/112	5 F . 3 B	10.11.12.15. 18.30.31.32. 41.43 & B	"	"	"	.	"	.		"	"
7	"	"	TMA 1162/ 112 & TMA 1162/112	6 F . 2 B	10.11.12.30. 31.32.41.43 & B	"	"	"	.	"	.	"	"	"

DATA SHEET FOR D.C. SHELF TYPE NEUTRAL RELAYS & D.C. POLAR RELAY

(REF : RDSO's Lr. No. STE/E/Rlys/Genl/SIG Tender dt. nil/1991)

S.No.	Description of Relay	B.S.S. Specn. No.	I.R.S. Specn. No.	Coil Res. (Ohms)	Contact Arrange-ment	Working Volts D.C.	A.C. Immu nity	P.U. Voltage (Volts)	P.U. Current (in mAmps.)	Min. % Rel.	P.U. Time (m sec)	P.U. Transfer Time (m sec)	D.A. Time (m sec)	Usage
1	D.C.Neutral Line Relay (Non - ACI)	1659-50	S 53	1000	6 F / B	12 V	-	6.75 to 9,9	5.75 to 9	50	450	400	100	All Circuits of non - RE & internal circuits of RE area
2	"	"	"	"	4 F / B	"	-	5.4 to 8.25	6 to 7.5	"	450	400	100	"
3	D.C. Neutral Line Relay (AC immunised) Cl. 'A'.	"	"	"	6 F / B	"	300 V	-	-	60	500	"	125	External Circuits of RE area
4	"	"	"	"	4 F / B	"	"	-	-	"	"	"	"	"
5	D.C. Track Relay (Non - ACI)	"	S 54	9	4 F / B	125% to 250% of P.U.V.	-	0.33 to 0.44	39 to 45	68	500	200	60	Non - RE area (TC upto 100 m)
6	"	"	"	"	2F.2F/B	"	-	"	"	"	"	"	"	Non - RE area (TC upto 100 m)
7	"	"	"	2.25	4 F / B	"	-	0.165 to 0.215	78 to 90	"	"	"	"	Non - RE area (TC upto & > 100m)
8	"	"	"	"	2F.2F/B	-	"	"	"	"	"	"	"	"
9	D.C. Track Relay (AC Immunised)	"	-	9	4 F / B	"	50 V	0.56 to 0.68	66 to 72	"	550	300	120	in A.C. RE area
10	"	"	-	"	2F.2F/B	"	"	"	"	"	"	"	"	"
11	D.C. Polarised Relay	-	S 31 - 80	77	1 N / R	2 V	10 V		16 - 18 mA (min.) & max. Wkg. 25 mA)	-	-	-	-	PTJ & HWH makes with B / Insits.
12	"	-	"	260	"	-	-	-	"	-	-	-	-	'WSF' make with B / Insits.

DATA SHEET FOR TM - TYPE INTEGRA - MAKE ECRs

S.No.	Description of Relay	IRS Spec. No.	Relay Type No.	Contact Arrange-ment.	Code Pin Positions	Coil Res. (Ohms)	P.U. Current	D.A. Current	Voltage Drop at 250 mA	Rated Current	Contact Res.(Ohms)	Usage
1.	'ON' Aspect Lamp Proving Relay w/o CKT.	S 46	TMB - 1133/ 401 - AK	3 F . 3 B		20.8 ± 10 %	< 185 mA A.C.	> 90 mA A.C.	07 V A.C. to 10V A.C.	320 mA A.C.	0.05	With SL 17/SL 21 Signal Lamps
2	'OFF' Aspect Lamp Proving Relay w/o CKT.	"	"	"	14.16.17. 40.42.44. 45.48	"	"	> 55 & < 70 mA A.C.	"	"	"	With SL 17/SL 21/SL 18 Signal Lamps
3	Route Indicator Lamp Proving Relay w/o CKT.	"	TMB - 1133/ 610 - GUM	"		1.7 ± 10 %	< 900 mA A.C.	> 500 & < 600 mA A.C.	06 V A.C.	1200 mA A.C.	"	With SL 33 Signal Lamps Direction Type R/I

DATA SHEET FOR SIEMENS K50 CONTROL RELAYS

S.No.	Description of mini - Group	Design. Drg. No.	Guide Pin Positions for Coding	Contact Arrange-ment of each relay	Coil Resistance (Ohms)	Normal Optg. Volts	Permitted Range of Voltage appln.	A.C.Imm-unity.	P.U. Time	D.A. Time	Usage
1	Neutral Relays	RS SK 30/0011	1 & 5	2 B . 6 F	1840 ± 10 %	60 V DC	50 - 110V	120 V	25 - 60 m sec	7 - 15 m sec	In all controls and detections of non - RE area and Internal circuits of RE area.
2	"	"	1 & 6	3 B . 5 F	1260 ± 10 %	"	"	150 V	"	"	"
3	"	"	1 & 7	4 B . 4 F	"	"	"	130 V	"	"	"
4	Interlocked Relay Unit	RS SK 30/0012	3 & 5	2 B . 6 F	615 ± 10 %	"	"	-	"	"	"
5	"	"	3 & 6	3 B . 5 F	"	"	"	-	"	"	"
6	"	"	3 & 7	4 B . 4 F	"	"	"	-	"	"	"
7	Group of one AC Imm. relay & one N/I Relay	RS SK 30/0078-I	2 & 5	3 B . 5 F	1840 ± 10% (ACI) & 1260 ± 10% (N / I)	"	"	450 V & 150 V	200 ms & 25 - 60 ms	50 ms & 7 - 15 ms	For External circuits of RE area use ACI relay
8	Group of two A.C. Imm. Relay	RS SK 30/0011-A	2 & 6	3 B . 5 F	1840 ± 10% each	"	"	450 V each	200 ms each	50 ms each	"

DATA SHEET FOR SIEMENS LAMP PROVING RELAYS

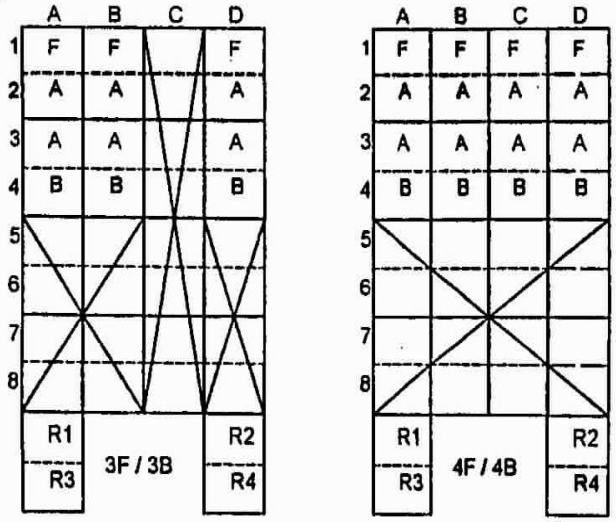
S.No.	Description of mini - Group	Design Drawing No.	Guide Pin Positions for Coding	Contact Arrange-ments	Coil Resis-tance (Ohms)	Boundary Pick Up Current (A.C.	Boundary Initial Pick Up Current (A.C.)	Boundary Drop Away Currents (A.C.)	Usage
1	Red Lamp Checking Relay (RECR)	30/0013	4 & 5	3 B . 3 F	64.1	Not more than 340 mA	-	Not less than 125 mA	With SL 21 Signal Lamps.
2	Off Aspect Lamp Checking Relay (DECR)	30/0014	4 & 5	3 B . 3 F	64.1	Not more than 145 mA	-	Not less than 62 mA	With SL 21 or SL 16 Signal Lamps.
3	Route Lamp Checking Relay (UECR)	30/0015	4 & 6	1 B . 5 F	64.1	Not more than 875 mA	Not more than 600 mA	Not less than 400 mA	With Direction Type Route Indicator having 5SL 33 Lamps in parallel.
4	Route Lamp Checking Relay (UECR)	30/0016	4 & 6	1 B . 5 F	64.1	Not more than 900 mA	Not more than 625 mA	Not less than 425 mA	With multi-lamp Route Indicator having SL 5 lamps in parallel
5	Route Lamp Checking Relay (UECR)	30/0017	4 & 6	1 B . 5 F	64.1	Not more than 1140 mA		Not less than 133 mA	With Direction type R/I having five lamps in Series (Without rectifier)
6	Route Lamp Checking Relay with Rectifier in - Built (UECR)	30/0018	4 & 8	1 B . 5 F	64.1	Not more than 1140 mA		Not less than 133 mA	With Direction type R/I having five lamps in Series (With inbuilt rectifier)
7	Shunt Signal ON Asp. Lamp Checking relay (SH - RECR)	30/0033	-	3 B . 3 F	64.1	Not more than 350 MA		Not less than 140 mA	With SL 33 lamps in parallel
8	Shunt Signal OFF Asp. Lamp Checking relay (SH - HECR)	30/0034	-	3 B . 3 F	64.1	Not more than 365 mA	-	Not lessthan 120 mA	"

Relay Type	Residual Pin size	Contact Rivet material	Nature of contacts	Maximum Continuous current through Closed contacts	Maximum Switching voltage through contacts	SWITCHING CURRENT RATING OF CONTACTS AT 60 V DC			AT 110V AC	USAGE
						Highly Inductive (L/R=50ms)	Less inductive (L/R=15ms)	Resistive	Resistive & Inductive	
K50A	0.35mm	Silver (Ag)	sensitive to sulphur in the air	5A	250 V AC & DC	0.1 A	0.4A	1.5 A	2.1 A	common controls and detections for indoor installations.
K50B	0.15mm	Silver/ Palladium (Ag/Pd30)	insensitive to polluted air	5 A	250 V AC & DC	0.1 A	0.4 A	1.2 A	2.1 A	for sequential operations and parallel connected route lamp proving
K50E	0.45mm	Silver/ Nickel (Ag/Ni20)	can withstand thermal stress of lamp loads	5 A	250 V	-	-	-	2.5 A	Main signal and series connected Route lamp proving

DATA SHEET FOR Q - SERIES LAMP PROVING RELAYS

S.No.	Relay Style	IRS Spec. No.	Relay Type Number	Contact Arrangement	Pin Code No.	Code Pin Positions	Coil Res. (Ohms)	Rated Current	Voltage drop @ 250 mA Current	Max. Full Operate Current	Max. Release current	Min. Release Current	Typical Interruption Time	Usage With
1	QECX1 (off/on)	941 A	13/1 (WSF)	4 F	071	ABCDK	35	400 mA	9 ± 0.6 V A.C.	180 mA	-	110 mA	100 ms @ 180 mA 200 ms @ 250 mA	SL 35 Lamp
2	QECX12 (off)	"	13/11 (WSF)	4 F	-	-	4.7	"	-	120 mA	-	60 mA	100 ms @ 110 mA	SL 17/SL 21 (DECR)
3	QECX13 (on)	"	13/12 (WSF)	4 F	-	CFKMX	"	"	-	225 mA	-	120 mA	100 ms @ 220 mA	SL 17/SL 21 (RECR)
4	QECX14 (off)	"	13/13 (WSF)	4 F . 4 B	-	CFJKM	"	650 mA	-	220 mA	-	70 mA	"	SL 17/SL 21 (DECR)
5	QUCX1	942 A	13/9 (WSF & Crompton)	2 F . 2 B	-	CFKLX	0.76	1400mA (@3 1·4A)	3.3 VA.C	780 mA	590 mA	520 mA	-	SL 33 Direction Type R/I (4F.4B)
6	QECX-51	941A	Crompton make	4 F . 4 B	-	-	-	400 mA	9 V A.C.	180 m	-	110 mA	-	SL 17/SL 21 (RECR)
7	QECX-52	"	"	4 F . 4 B	-	-	-	"	"	75 mA	-	35 mA	-	SL 17/SL 21 (DECR)

CONTACT ARRANGEMENT OF 'Q' SERIES LAMP CHECKING RELAYS



DATA SHEET FOR SIEMENS D.C. TRACK RELAYS

S.No.	Drg. No.	Contacts	Coil Res. (Ohms)	Safe P.U. Volts.	Boundary P . U . Volts	Boundary P.U. Curr ent (mA)	Boundary D.A. Volts	Boundary D . A . Current (mA)	Maximum Permitted Excitation	Minimum D . A . Factor	P.U.Time (msec)	D . A . Time	Usage
1	RS SK 30/0071	2 F . 1 B	50	1.77	1.46	29.2	0.77	19		0.65	100 - 200 with 120 % PU for excitation		D.C. Track circuits in Non - RE & RE areas.
2	V . 25438	"	50	1.59	-	-	-	-		0.65			

DATA SHEET FOR SIEMENS A.C. MOTOR TRACK RELAYS

S.No.	Description	Drg. No.	Contacts	Safe P. U. Volts	Boundary P.U. Volts	Boundary P.U. Curr ent (mA)	Boundary D.A. Volts	Boundary D.A.Curr ent (mA)	Maximum Permitted Excitation	Minimum D . A . Factor	Usage
1	A.C. 2 Pos. Track Relay	RS SK 30/0001	2 F . 2 B	18.2 @ 50 Hz 22.2 @ 83 1/3 Hz	14 - 17	6 - 15	9 - 13	5 - 12		0.70	50 Hz Freq. AC Tr. cets. in DC RE areas upto 2.3 Km length (non - directional) & 83⅓ Hz FREQ. AC TCs IN AC RE UPTO 1Km LENGTH.
2	A.C. 3 Pos. Tr. Relay	V - 25437	2 N . 2 R	19.1 @ 50 Hz 23.3 @ 83 1/3 Hz						0.70	Directional Type A.C. Tr. Ckts. in D.C. RE and A.C. RE areas

DATA SHEET FOR SHELF TYPE D.C. TRACK RELAYS

S.No.	Description	B.S. Spec. No.	I.R.S. Spec. No.	Contacts	Coil Res. (Ohms)	Max. P.U. Volts	Max. P.U. Current (mA)	Min. P.U. Volts	Min. P.U. current (mA)	Max. Permiss-ible Volts	Min. reqd. olts.	Min % Rel.	P.U. Time (mS)	D.A. Time (ms)	A.C. Immu-nity (volts)	Usage
1	Shelf Type Non - Imm. DC Track Relay	1659	S 54	4F/B. 2F.2F/B	9	0.388	39	0.333	37	250 % PUV	125 % PUV	68	500	60	-	Upto 100 m track cct. lengths in non - RE areas.
2	"	"	"	2F.2F/B	2.25	0.194	82	0.167	78	"	"	"	"	"	-	More than 100 m track circuit lengths in Non - RE areas
3	Shelf Type ACI DC Track Relay	"	"	4F/B	9	0.68	72	0.56	68	"	"	"	550	120	50	Upto 450 m track Circuit lengths in RE areas

DATA SHEET FOR Q - SERIES TRACK RELAYS (PLUG - IN TYPE)

S.No.	Relay Style	Description	B.R.B. Spec. No.	Relay Spec. No.	Contacts	Coil Res. (Ohms)	Code Pin Positions	Nominal PU Volts	Max. PU Volts	Max. P.U. Current (mA)	Min. P.U. Volts.	Min. P.U. Current (mA)	Max. Permiss-ible Volts	Min. Reqd. Volts	Min % Rel.	P.U. Time (mS)	D.A. Time (mS)	A.C. Imm. (Volts)	Usage
1	QT2	Plug-in Type Non-imm. DC Tr. Realy	938 A	26/6	2F.1B	9	–	1.4	1.158	117	0.834	103	300 % PUV	125 % PUV	68			-	In non-RE areas.
2	"	"	"	"	"	4	EHJKX	0.5	0.515	"	0.370	"	"	"	"			-	In non-RE areas
3	QTA2	Plug-in type AC Imm. DC TR. Relay	939 A & 966 F2	27/7	"	20	–	2.0	2.020	92	1.460	81	"	"	"			50	Upto 450m track ccts. lengths in RE areas
4	"	"	"		-	9	FGHKX	1.4	1.380	140	0.970	120	"	"	"			50	"
5	QBAT	"	"	84/88	2F.2B	9	ABEJX	1.75	1.733	175	1.134	140	235 % PUV	122 % PUV	"	100	200	80	Upto 750m track ccts. lengths in RE areas

ANNEXURE 'B'

Relay Nomenclatures (British)

Symbol	Description
SMR/SMCR/SMPR	Station Master's(Control) Relay
TSR	Track Stick Relay
RR	Knob reverse relay
NR	Knob normal relay
GNR	Signal Button Relay
UNR	Route Button Relay
WNR	Point Button Relay
GNCR	All Signal Button Normal Relay
UNCR	All Route Button Normal Relay
WNCR	All Point Button Normal Relay
NNCR	All Panel Button Normal Checking Relay
NWWNR	Point common button relay(Normal)
RWWNR	Point common button relay(Reverse)
EGGNR	Emergency common signal cancellation button relay
UCR	Route checking relay
ASR/ALSR	Approach(Lock) stick relay
OVSR	Overlap stick relay
UHR/UGR	Signal control relays for route
HR/HHR/DR	Signal control relays for Y/YY/G aspects
HPR/HHPR/DPR	Repeaters for signal control relays
RECR/HECR/DECR/UECR	Signal lamp proving relays for Red/Yellow/Green/route respectively
UYR 1,2,3	Sequential route release relays
TLSR/TRSR	Track left stick relays/Track right stick relays
CHNR	Crank handle button relay
KLNR	Siding control button relay
GXJR	Signal lamp not failed proving relay
WXJR	Point indication not failed proving relay
NWR/RWR	Normal/reverse point operating relay(At location)
WCR	Point contactor relay(At location)
PCR	Power control relay
NCR/RCR	Point normal/reverse control relay
WJR	Point time control relay(At location)
WXR	Point special relay(At location)
WLR	Point locking relay
WNKR	Point normal indication relay(At location)
WRKR	Point reverse indication relay(At location)
NWKR	Normal point indication relay
RWKR	Reverse point indication relay
NWLR	Point normal lock relay
RWLR	Point reverse lock relay
NWSR	Point normal indication stick relay
RWSR	Point reverse indication stick relay
LVR	Low voltage relay
JSLR	Timer cancellation initiation relay
RJPR	Timer cancellation not in progress proving relay
NJPR	Timer cancellation completion proving relay
CHLR	Crank handle lock relay
LXPR	LC Gate closed proving relay
AS1WR	Auto set point relay no. one
AS2WR	Auto set point relay no. two

WWR	Auto chain point control relay
WWFR	Auto point operation final normal relay
GS RBNR	Slot receive relay
GS BNR	Slot transmit relay
EWWNR	Emergency common point group button relay
EW(N/R)CR	Emergency point key IN checking relay
EWNR	Emergency point operation final relay
CHFR	Crank handle free relay
CHRR	Crank handle control reverse relay
CHCR	Crank handle IN checking relay
NNR	Route normal relay / Button Normal Relay
NRR	Route reverse relay / Button Reverse Relay
TR	Track relay
TPR	Track Repeating relay
ASWR	Auto switching of point chain operation/Auto switch point relay
NLR	Point initiation relay for normal
RLR	Point initiation relay for reverse
COCAR	Calling-on cancellation relay
CO-AR	Calling-on arrival relay
COGGNR	Calling-on initiation common button relay
LR	Route selection/initiation relay
ULSR	Route Lock stick relay