ALSTOM

Type B Vital Relays

B1

B2

Operation and Maintenance Manual
P1457

Type B Vital Relays

B1

B2

Operation and Maintenance Manual
Alstom Signaling Inc.

P1457, Rev. January 2009 Printed in U.S.A.

LIST OF EFFECTIVE PAGES

P1457, Type B Vital Relays Operation and Maintenance Manual

ORIGINAL ISSUE DATE: May/95

CURRENT REVISION AND DATE: January 2009, Removed Microchron II Timer Relays, now supported in P2519; updated AC Vane Relay parts list

PAGE	CHANGE OR REVISION LEVEL
Cover	Jan/09
Title page	Jan/09
Preface	Jan/09
i thru viii	Jan/09
1–1 thru 1–16	Jan/09
2–1 thru 2–42	Jan/09
3–1 thru 3–6	Jan/09
4–1 thru 4–20	Jan/09
5–1 thru 5–8	Jan/09
6–1 thru 6–22	Jan/09
7–1 thru 7–60	Jan/09
A–1 thru A–16	Jan/09
B–1 thru B–4	Jan/09
C–1 thru C–8	Jan/09

THIS PAGE INTENTIONALLY LEFT BLANK.

PREFACE

NOTICE OF CONFIDENTIAL INFORMATION

Information contained herein is confidential and is the property of Alstom Signaling Incorporated. Where furnished with a proposal, the recipient shall use it solely to evaluate the proposal. Where furnished to customer, it shall be used solely for the purposes of inspection, installation or maintenance. Where furnished to a supplier, it shall be used solely in the performance of the contract. The information shall not be used or disclosed by the recipient for any other purposes whatsoever.

FOR QUESTIONS AND INQUIRIES, CONTACT CUSTOMER SERVICE AT
1–800–717–4477
OR
WWW.ALSTOMSIGNALINGSOLUTIONS.COM

ALSTOM SIGNALING INC.
1025 JOHN STREET
WEST HENRIETTA, NY 14586

REVISION LOG

Rev.	Date	Description	By	Checked	Approved
0	May 1995	Original Issue			
1	March 1996	Update illustrations	JF	RD	NI
2	October 2001	Update illustrations	JF	RD	NI
3	September 2003	Update parts	TS	RD	NI
4	April 2004	Update style	MAS	RD	NI
5	September 2006	Update Installation Procedure, Appendix A, Parts Catalog and style; add AC Microchron II Timer Relay and Appendix C	MAS	RD JP	NI
6	November 2007	Updated Biased-Neutral Relay Test Procedure	MAS	MR	NI
7	January 2009	Removed Microchron II Timer Relays, now supported in P2519; updated AC Vane Relay parts list	MAS	MR	NI

THIS PAGE INTENTIONALLY LEFT BLANK.

ABOUT THE MANUAL

This manual is intended to provide the necessary information to maintain and ensure proper operation of Alstom Type B Vital Relays.

The information in this manual is arranged into sections. The title and a brief description of each section follow:

Section 1 – GENERAL DESCRIPTION: This section gives general information on the components of Alstom Type B Vital Relays.

Section 2 – THEORY OF OPERATION: This section gives general information on the operation of Alstom Type B Vital Relays.

Section 3 – INSTALLATION: This section describes the field installation and setup of Alstom Type B Vital Relays.

Section 4 – PREVENTIVE MAINTENANCE: This section describes the preventive maintenance procedures performed on Alstom Type B Vital Relays.

Section 5 – TROUBLESHOOTING: This section describes possible failures/symptoms along with the corrective action for Alstom Type B Vital Relays.

Section 6 – PREVENTIVE MAINTENANCE: This section describes the testing and adjustment procedures associated with corrective maintenance of Alstom Type B Vital Relays.

Section 7 – PARTS CATALOG: This section identifies and lists the spare parts associated with Alstom Type B Vital Relays.

Appendix A – RELAY ENGINEERING DATA (ED) SHEET LIST: This section identifies the engineering data sheets for Alstom Type B Vital Relays.

Appendix B – GLOSSARY: This section contains a glossary of terms used in this manual.

Appendix C – TOOLS AND KITS: This section summarizes the tools and tool kit used for B relay installation, maintenance, and troubleshooting.

THIS PAGE INTENTIONALLY LEFT BLANK.

MANUAL SPECIAL NOTATIONS

In the Alstom manuals, there are three methods used to convey special informational notations to the reader. These notations are warnings, cautions, and notes. Both warnings and cautions are readily noticeable by boldface type two lines beneath the caption.

Warning

A warning is the most important notation to heed. A warning is used to tell the reader that special attention needs to be paid to the message because if the instructions or advice is not followed when working on the equipment then the result could be either serious harm or death. The sudden, unexpected operation of a switch machine, for example, or the technician contacting the third rail could lead to personal injury or death. An example of a typical warning notice follows:

WARNING

DISCONNECT MOTOR ENERGY WHENEVER WORKING ON SWITCH LAYOUT OR SWITCH MACHINE. UNEXPECTED OPERATION OF MACHINE COULD CAUSE INJURY FROM OPEN GEARS, ELECTRICAL SHOCK, OR MOVING SWITCH POINTS.

Caution

A caution statement is used when an operating or maintenance procedure, practice, condition, or statement, which if not strictly adhered to, could result in damage to or destruction of equipment. A typical caution found in a manual is as follows:

CAUTION

Turn power off before attempting to remove or insert circuit boards into a module. Boards can be damaged if power is not turned off.

Note

A note is normally used to provide minor additional information to the reader to explain the reason for a given step in a test procedure or to provide a background detail. An example of the use of a note follows:

NOTE

A capacitor may be mounted on the circuit board with a RTV adhesive. Use the same color RTV.

THIS PAGE INTENTIONALLY LEFT BLANK.

TABLE OF CONTENTS

Topic Page

TABLE OF CONTENTS (CONT.)

Topic Page

TABLE OF CONTENTS (CONT.)

Topic Page

LIST OF FIGURES

Description Page

LIST OF FIGURES (CONT.)

Description Page

LIST OF FIGURES (CONT.)

Description Page

LIST OF TABLES

Description Page

LIST OF TABLES (CONT.)

Description Page

1. SECTION 1 – GENERAL DESCRIPTION

1.1. INTRODUCTION TO VITAL RELAYS

For over 70 years, Alstom Signaling Inc. has continually perfected the Type B relays. They are the standard relay of the signaling industry. Types B and VTB plug-in relays meet applicable manual parts of American Railway Engineering and Maintenance of Way Association (AREMA).

Alstom Type B plug-in relays are used in vital circuits, and are rack-installed in equipment rooms and in wayside cases and housings. These relays are divided into two sizes, B1 and B2, as shown in Figure 1–1. Some B relays are energized by DC voltage, others by AC voltage. A vital relay is designed so that the probability of its failing to return to a prescribed state when it is de-energized is so low that for all practical purposes it is considered to be nonexistent.

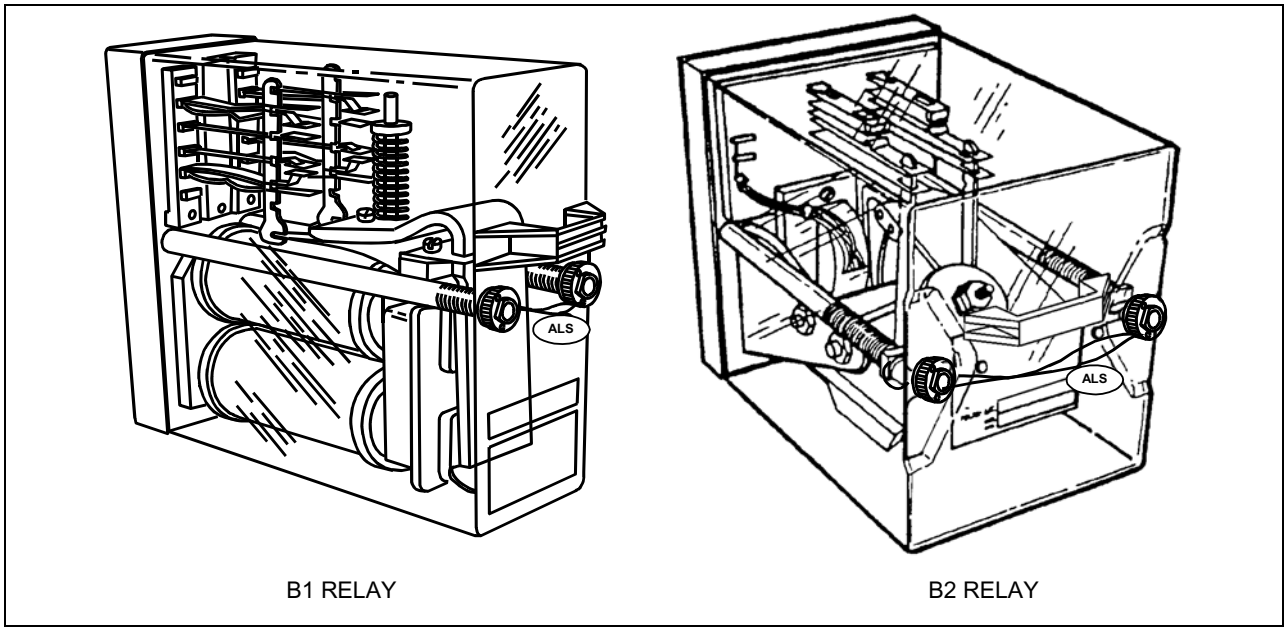


Figure 1–1. Alstom Type B1 and Type B2 Type Vital Relays

There are more than a dozen types of Type B relays, available in about 200 configurations. They are designed to meet the important requirements of safety, reliability, low maintenance and long operating life. Replacement parts for relays decades old may still be available should it become necessary to extend their operating life. Alstom furnishes its customers relay application and adjustment instructions, either as part of a contract or upon request.

1.2. RELAY CHARACTERISTICS AND COMPONENTS

1.2.1. Size

Type B relays are made in two sizes, Size 1 and 2, and are referred to as B1 and B2 relays. Two Size 1 relays occupy the same space as one Size 2 relay. Additionally, there is a special size relay, Type VTB code-responsive, which occupies the plugboard space for a B2 relay, but is not the same depth. Table 1–1 provides exact sizes and weights.

Table 1–1. Relay Sizes and Weights

Dimensions and Weights	Size 1	Size 2	VTB
Height of relay	6-5/16 in.	6-5/16 in.	7-11/16 in.
Width of relay	2-7/16 in.	4-15/16 in.	4-15/16 in.
Depth without plugboard	8-9/16 in.	8-9/16 in.	6-7/16 in.
Depth including plugboard fully wired (approx.)	15-1/2 in.	15-1/2 in.	13-3/8 in.
Weight of relay with plugboard (weight of wiring not included)	7 to 10 lbs.	10 to 15 lbs.	6 to 7 lbs.
Weight of plugboard alone without wiring	1 lb.	2 lbs.	2 lbs.

1.2.2. Identification

All Type B relays carry nameplates that contain the drawing number (part number) and catalog number of the relay. Relay drawing number is also shown on the registration plates of the relay. When inquiring about a particular relay, always provide the catalog or drawing number.

The drawing and catalog numbers can be used with the tables in Appendix A to look up the relay's Engineering Data (ED) Sheet number. The ED sheet contains technical specifications referenced during some maintenance procedures.

Each B2 Relay has a Test Data Form on the cover and a name plate located inside the relay, visible through the front of the cover.

Each B1 Relay cover contains two recesses to allow attachment of two metalized polyester film or mylar tags with permanent adhesive:

- a tag for relay operating and testing data
- a tag for circuit nomenclature

B1 Relays manufactured prior to 1991 have a different cover than those relays manufactured after 1991. The most obvious difference is the handle on the front of the relay. B1 Relay nameplate, nametag and test data form locations for relays manufactured pre and post 1991 are shown in Figure 1–2.

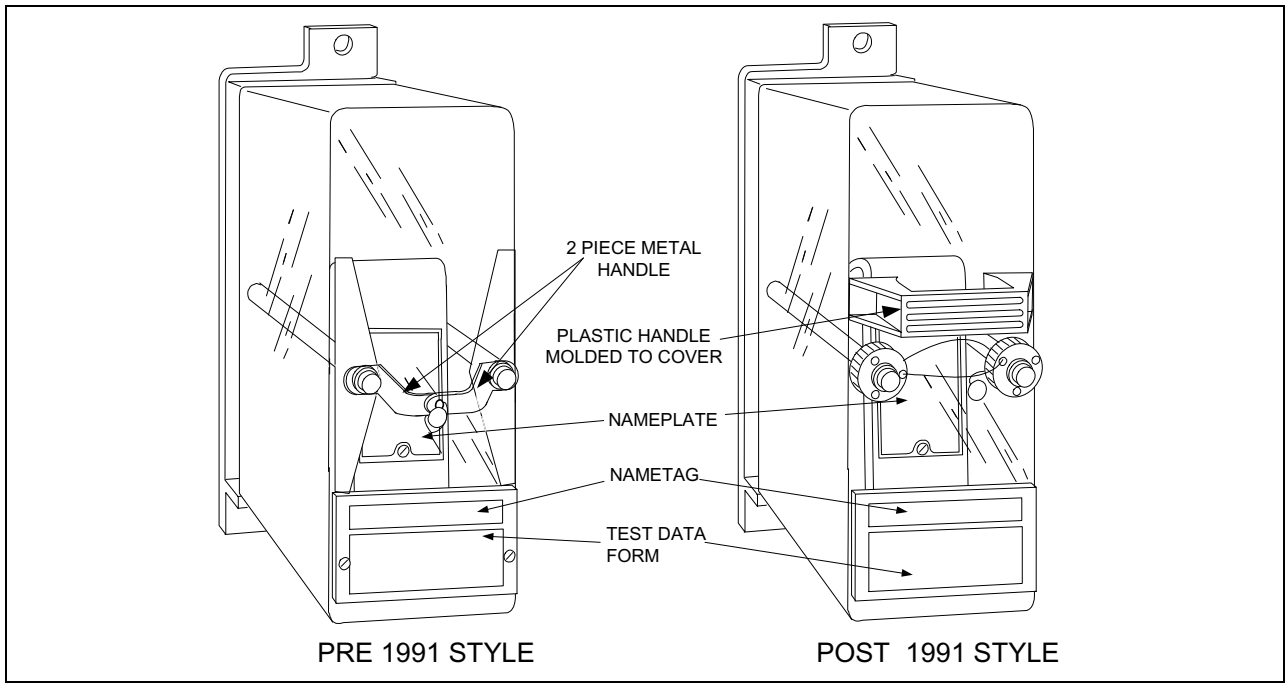


Figure 1–2. B1 Relay Nameplate, Nametag and Test Data Form

The information provided on the test data form includes the relay serial number, data from the specification sheet for the relay, the initials of the Alstom employee who tested the relay, and the date the form was completed.

An example B1 Relay test data form is shown in Figure 1–3. This example form includes the following:

- Space 1 - The serial number as shown on relay nameplate.
- Space 2 - The minimum DROP AWAY (D.A.) value from specification sheet in Amps for a DC relay or Volts for an AC relay. For example, on a 921-09 relay the space contains 0.077A for the minimum DROP AWAY. An "A" for Amps should be added or "VAC" for AC relays.
- Space 3 - The maximum PICKUP (P.U.) value from specification sheet in the same style as in Space 2.
- Space 4 - The maximum WORKING Current (W.C.) value from specification sheet in the same style as in Space 2.
- Space 5 - The initials of the Alstom employee who tested the relay.
- Space 6 - The date the form was completed in Month/Day/Year format (for example 7/26/94).

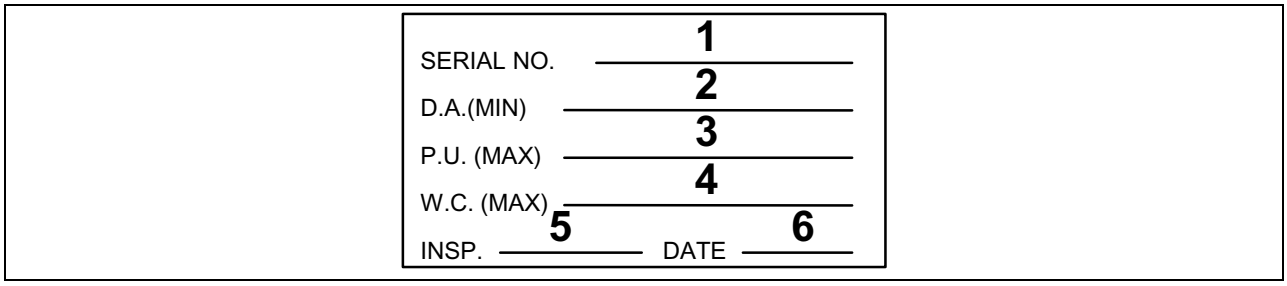


Figure 1–3. Example B1 Relay Test Data Form

1.2.3. Relay Prongs and Plugboard

All Type B relays plug onto plugboards. Relay contacts and coil(s) are brought out through the base of the relay as prongs. The plugboard has wedge shaped plug insulators. There are two terminals per insulator, one on each side. The terminals are installed from behind the plugboard. See Figure 1–4 for a simplified mating diagram. For exact dimensions, see Table 1–2.

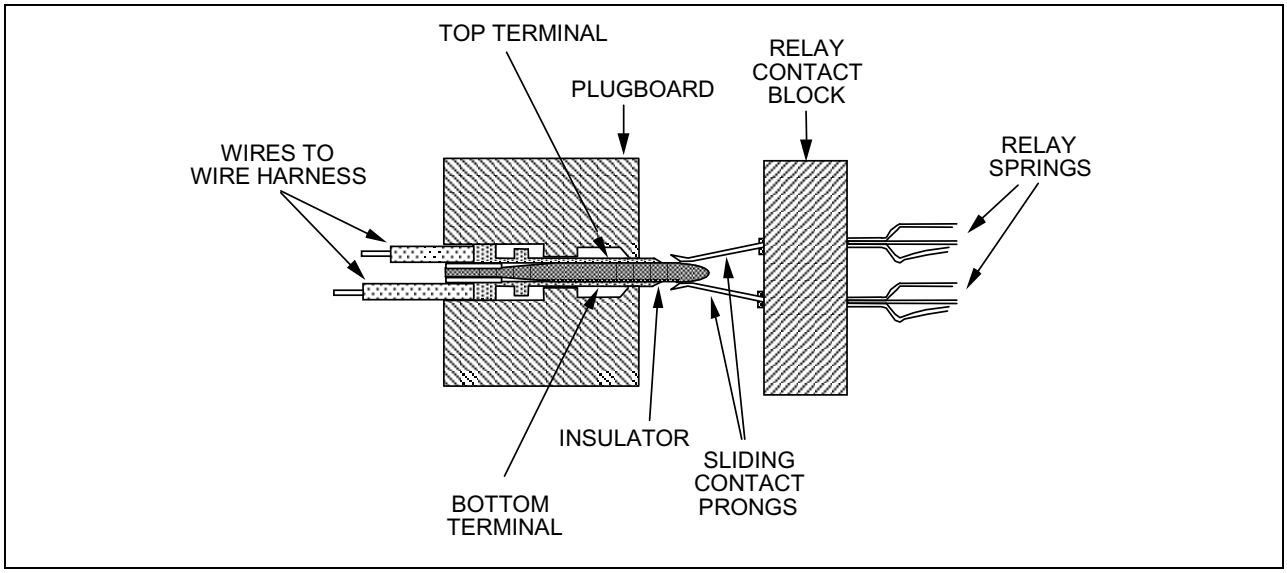


Figure 1–4. Plug Connection

Table 1–2. Plugboard Dimensions

Dimension	B1	B2
Overall Height	9-7/16 in.	9-7/16 in.
Overall Width	2-1/2 in.	5 in.
Overall Depth	10-1/2 in.	10-1/2 in.
Diameter of mounting holes (clearance for 1/4 in. bolt)	9/32 in.	9/32 in.
Vertical distance between centerlines of mounting holes	8-13/16 in.	8-13/16 in.

There should be about a 5-inch clearance behind a plugboard to give room for wire distribution in a relay rack.

When a relay is plugged in, two relay guide rods align the relay so that all prongs properly align with their corresponding insulators. The prongs slide onto their respective plugboard terminals, thus making contact. Figure 1–5 shows a B1 plugboard; including the location of the relay guide rods.

Because plugboard terminals are connected to the wires in cables behind the plugboard, no wiring changes are necessary when replacing a Type B relay.

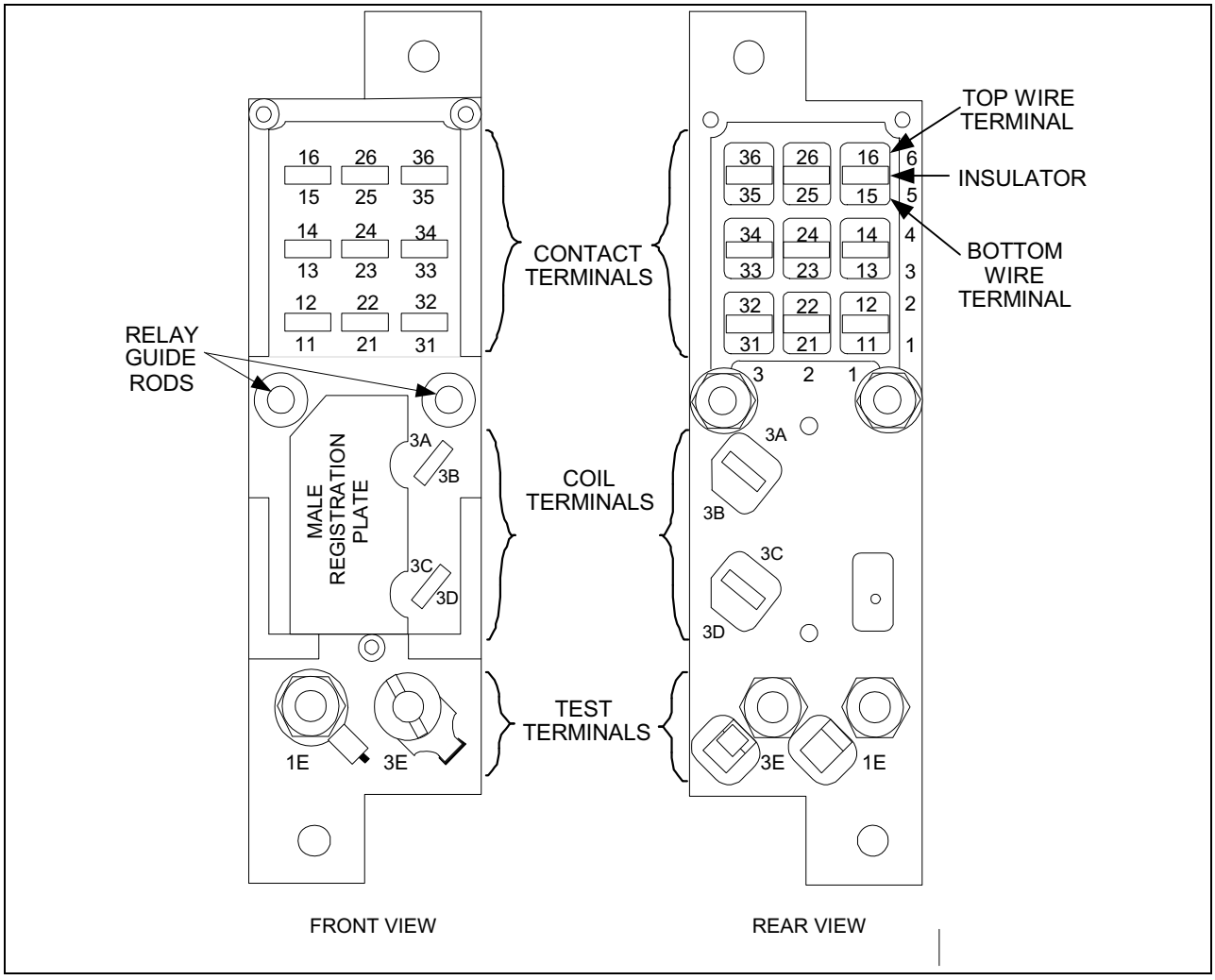


Figure 1–5. B1 Plugboard

1.2.4. Mounting

The B relays plug on to plugboards. The contacts and the coil terminals of the relay protrude through the base of the relay as prongs. The plugboard has wedge-shaped plug insulators with flat metal terminals on the two faces of the wedge. Two rods guide a relay being plugged in, allowing the pairs of relay prongs to meet with corresponding wedges, spreading the prongs apart. The prongs slide onto the respective plugboard terminals making contact as shown in Figure 1–6.

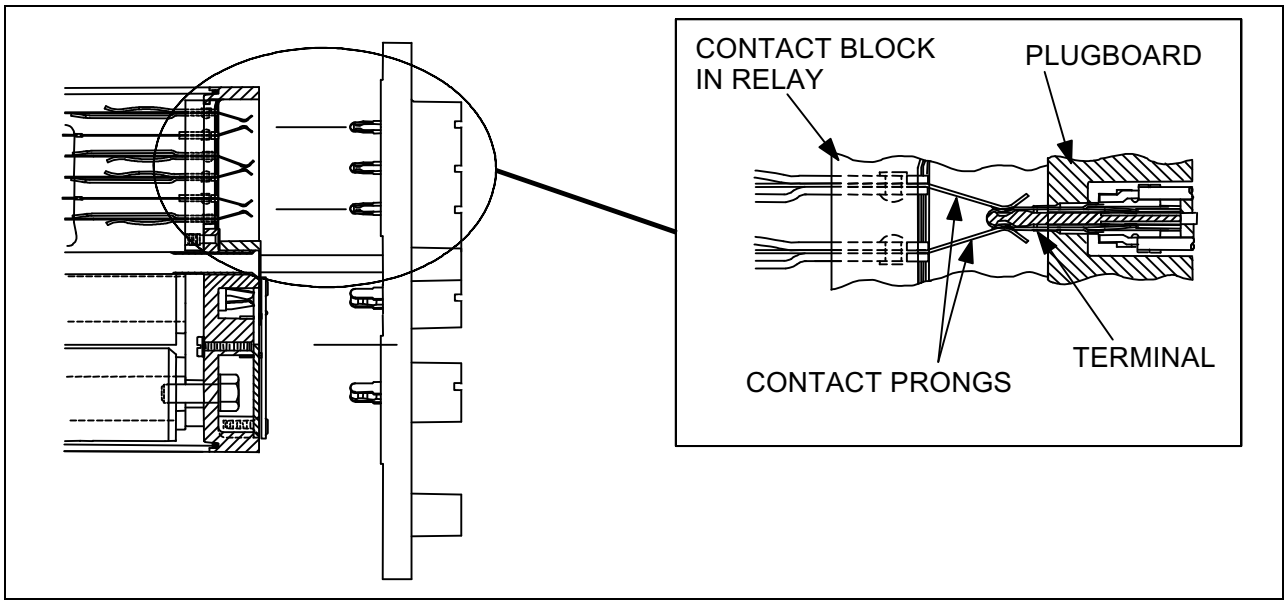


Figure 1–6. Type B Plug Connections

1.2.5. Registration

Registration plates prevent plugging a relay into the wrong place in a rack or module. Figure 1–7 shows two registration plates, one with holes, the other with pins. The plate with holes is attached to the base of the relay. The plate with pins is attached to the plugboard. If a relay that does not belong on the plugboard should be slipped on the guide rods, it is prevented from making contact with the terminals in the plugboard because the registration pins and holes do not correspond with one another.

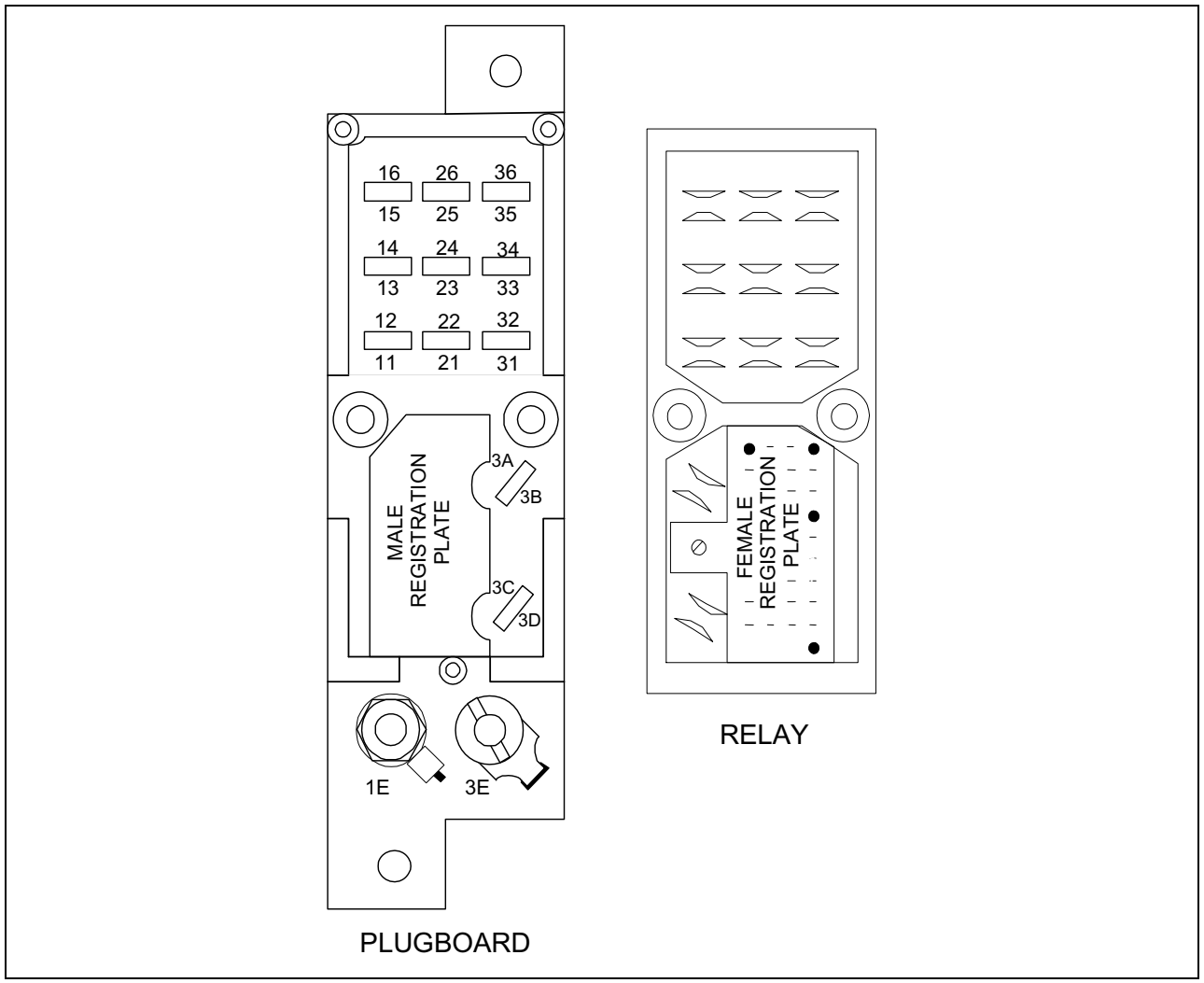


Figure 1–7. Registration Plates

The registration feature takes care of six important differences in relays:

- Differences in timing
- Differences in contact arrangement
- Differences in contact opening
- Differences between track and line relays
- Differences in coil resistance
- Differences in coil arrangement

1.2.6. Insulators

Insulators are made of molded plastic and fit into slots in the plugboard. Each insulator is held in place by a locking latch molded into a spring beam on one side of the insulator as shown in Figure 1–8. An extractor tool must be used to remove the terminals prior to removing the insulators. To release the insulator so that it can be pulled out of the plugboard, squeeze the spring beam and push the insulator towards the front of the plugboard.

There are 11 insulators in a B1 plugboard and up to 20 in a B2 plugboard.

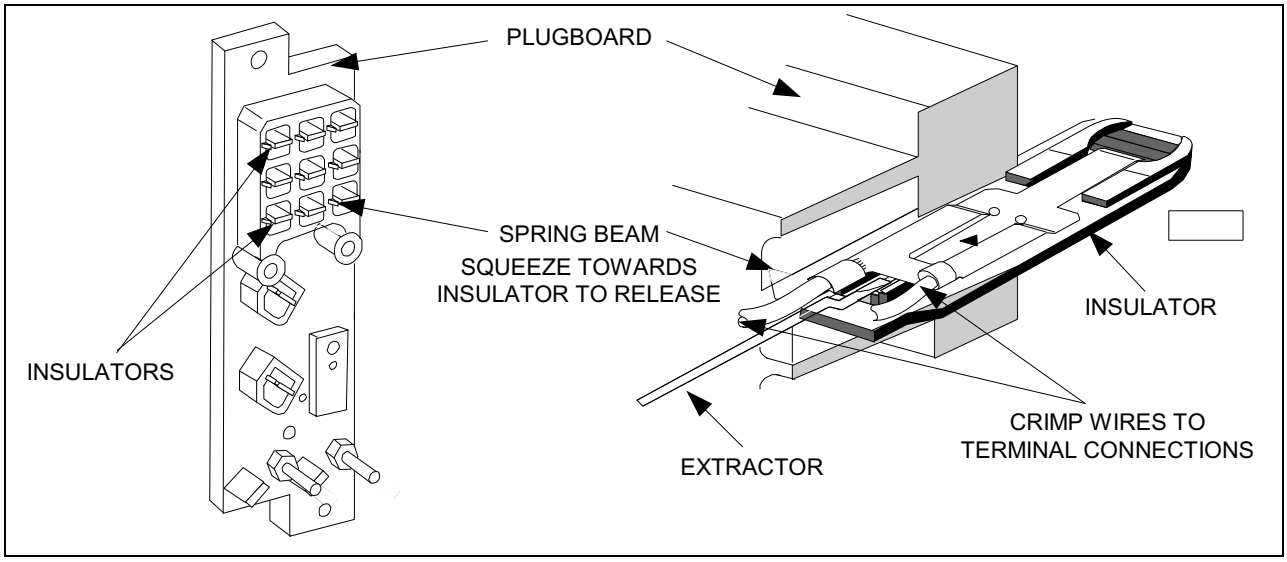


Figure 1–8. Latching Insulator

NOTE

An integral beam latch secures the insulator to the plugboard.

1.2.7. Terminals

B relay plugboards contain contact terminals, coil terminals and test terminals as shown in Figure 1–5. There are two types of terminals, solder terminals and crimp terminals. Refer to Section 3, Installation, for installation supplies.

1.2.7.1. Contact Terminals

There are two contact terminals per insulator, one on the top and one on the bottom as shown in Figure 1–9. Each terminal is completely insulated from the adjacent one, by either the insulator or the wall of plastic material that surrounds each insulator and terminal assembly.

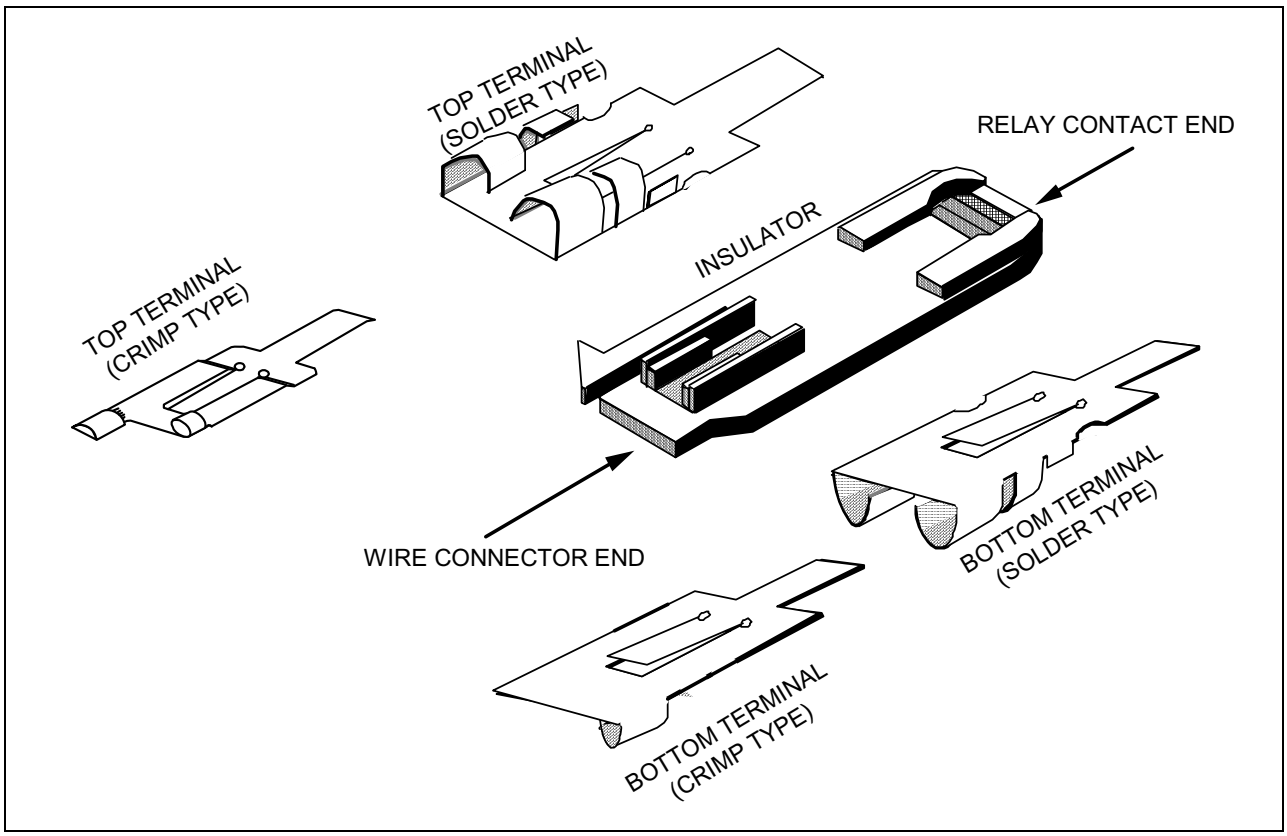


Figure 1–9. Insulator Separates One Contact Terminal From the Other

The terminal slips into place from behind the plugboard. First, the wire is connected to the terminal; then the terminal is pushed into the proper slot in the plugboard.

On B1 plugboards, there are slots for 18 contact terminals for circuits through relay contacts and 4 for circuits through the coils. On B2 plugboards, there are slots for 36 contact terminals and 4 coil terminals.

1.2.7.2. Test Terminals

A current test terminal is provided on the plugboard directly under the relay, as shown in Figure 1–10, to allow the checking of current flow through the relay coils.

NOTE

Not all relay plugboards are equipped with a current and voltage test terminal.

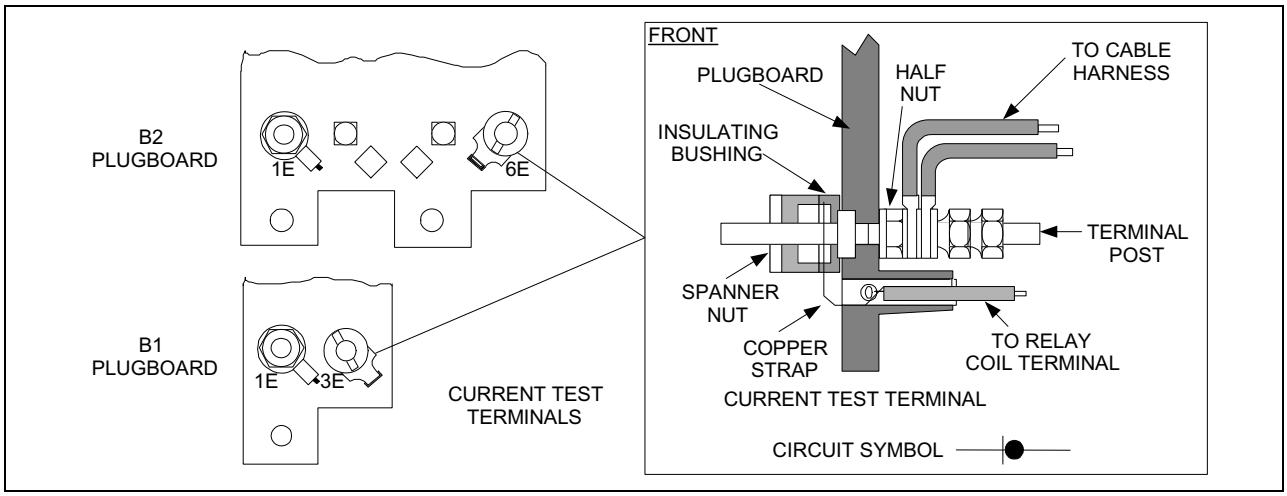


Figure 1–10. Current Test Terminal

A voltage test terminal is provided on the plugboard next to the current test terminal, as shown in Figure 1–11, to allow the checking of voltage across the relay coils.

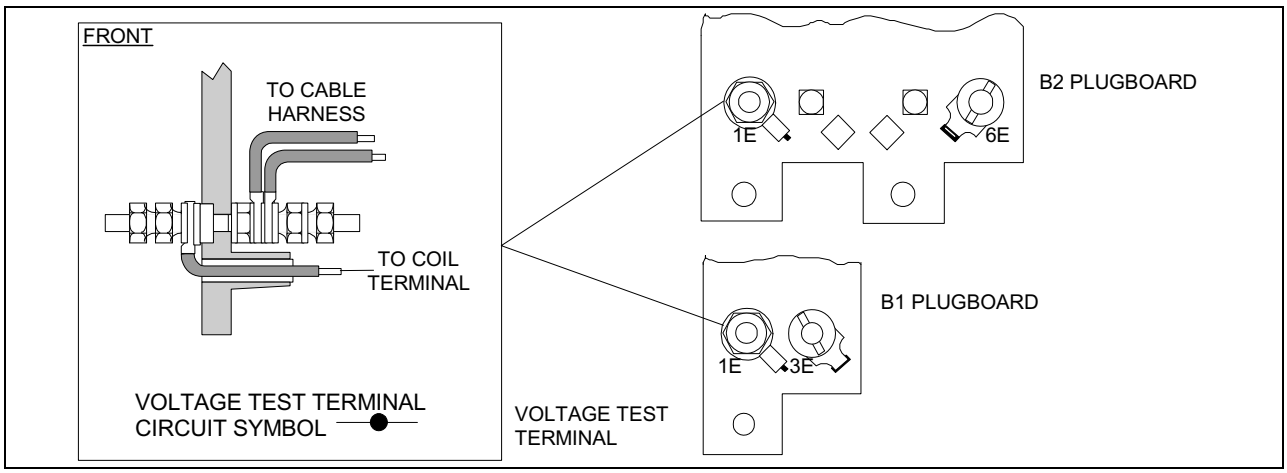


Figure 1–11. Voltage Test Terminal

1.2.7.3. Numbering of Contacts and Plugboard Terminals

From the front of the relay, the vertical columns of contacts and their plugboard terminals are numbered 1, 2, 3, etc. from left to right. The contact springs in each row are numbered from bottom to top 1, 2, 3, etc. These numbers are molded into the plugboard adjacent to the slots. Thus, all contact terminal numbers contain two digits, as shown in Figures 1–12 and 1–13. The first digit indicates the column; the second indicates the row. For example, terminal 36 is the third column from the left, sixth row from the bottom. The terminal 23 is the second column from the left, third row from the bottom.

Only the springs with contacts are numbered. The stops and pressure plate springs are not numbered.

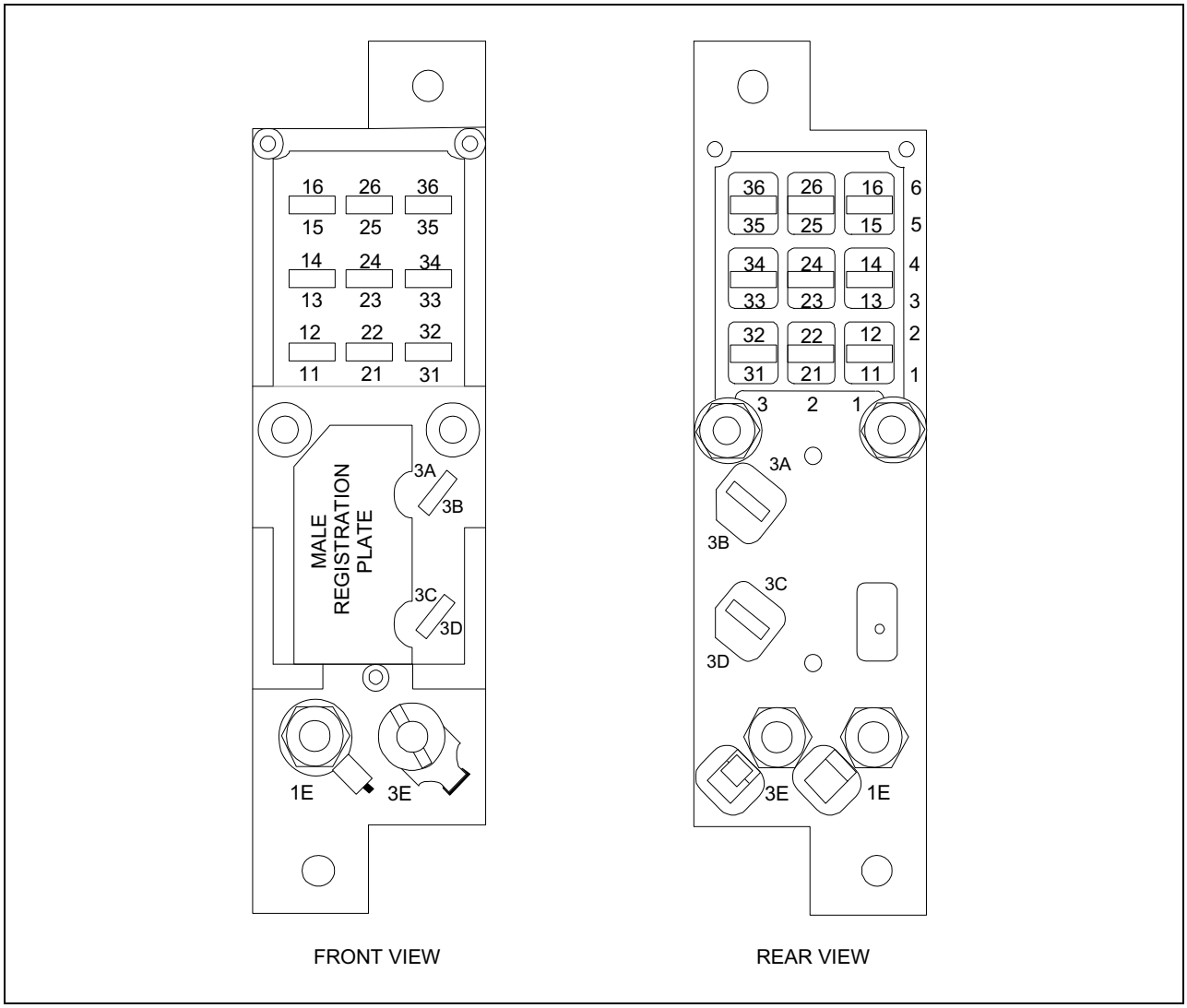


Figure 1–12. Terminal Numbering of Type B, Size 1 (B1) DC Relays

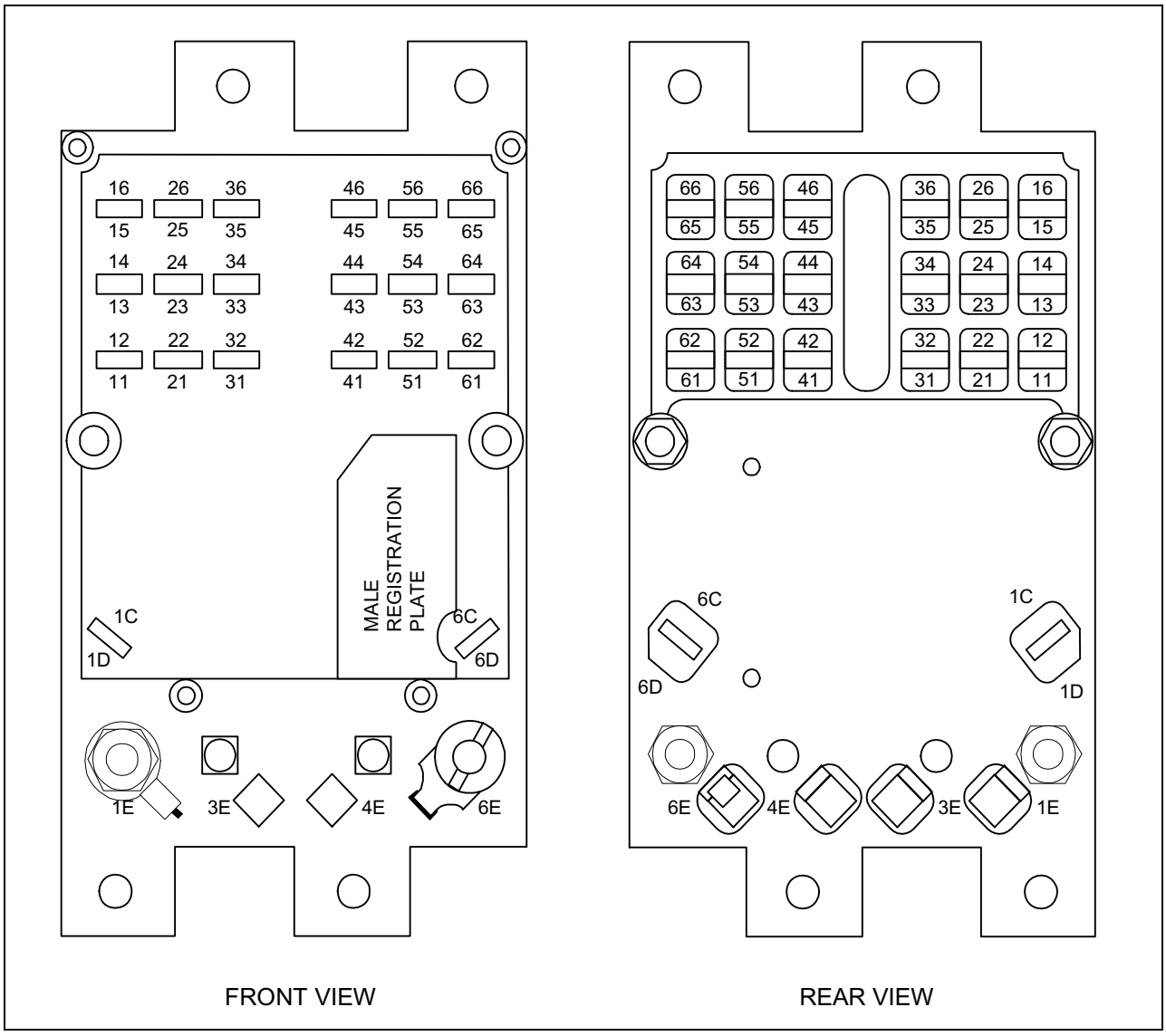


Figure 1–13. Terminal Numbering of Type B, Size 2 (B2) DC Relays

1.2.8. Guide Rods

Two guide rods, which extend from the face of the plugboard 8-1/2 inches, help guide the relay into alignment with the insulators on the plugboard.

Each rod has a knurled nut and a lock nut to secure the relay on its plugboard, as shown in Figure 1–14.

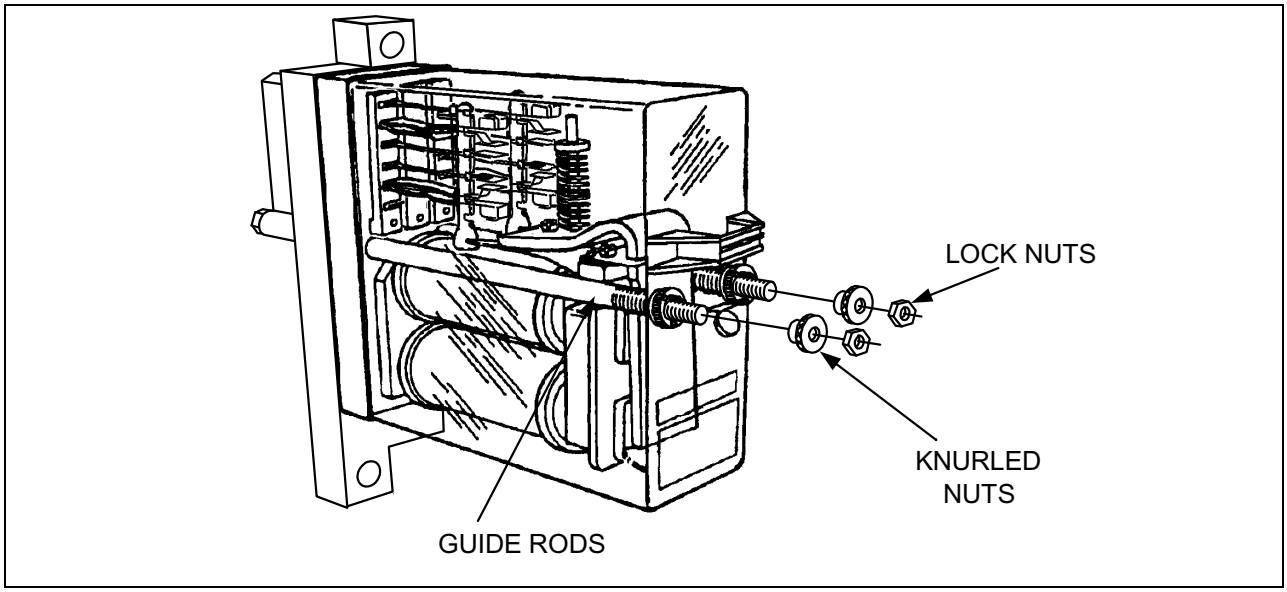


Figure 1–14. B1 Relay showing Guide Rods and Nuts

1.2.9. Wiring

Wires strapped together in cable form are supported behind the plugboard. Each wire is identified with a tag and then connected to its terminal. The terminal is pushed into its slot in the plugboard and locked in place.

The plugboard back can accommodate the mounting of a two-post terminal block as shown in Figure 1–16. This can be used to terminate coil leads where coils in a relay are circuited independent of one another.

1.2.10. Relay Contacts

Relays are furnished with specific contact arrangements. In all relays, the contacts are leaf springs molded in blocks. Each block is called a contact group. One end of the spring is formed into a prong, which makes contact with the plugboard terminal. The other end has a contact. Figure 1–15 shows a typical configuration of the relay contact components.

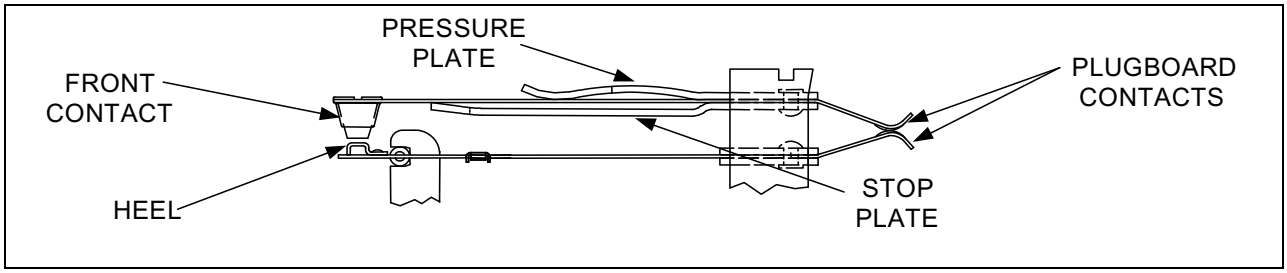


Figure 1–15. Relay Contact Components

1.2.11. Coils

On B1 and B2 DC relays, there is space enough on each of the two cores for one full-length coil, approximately 4 inches long. Coils shorter than this are used when the cores are partly filled with copper or aluminum washers or slugs for use in slow-acting relays.

1.2.11.1. Identifying Coil Leads

The two leads of a coil are designated as "in" and "out" leads. From the prong end of a coil, the IN lead is attached to the prong that is closer to the center of the coil. The OUT lead is attached to the prong furthest from the center.

If a coil has two windings, the winding nearer the prongs is connected to the prongs. Leads of the second winding are tagged and have terminals applied.

1.2.11.2. Numbering of Coil Terminals

Two digit coil terminal identifiers consisting of a number and a letter are molded in the phenolic plugboard. The number is taken from the vertical row in which the terminal is located. The letter shows its position in that row. Letter A is given to the highest terminal, letter D to the lowest terminal for B relays. Letter E is use to designate test terminals. See Figure 1–16.

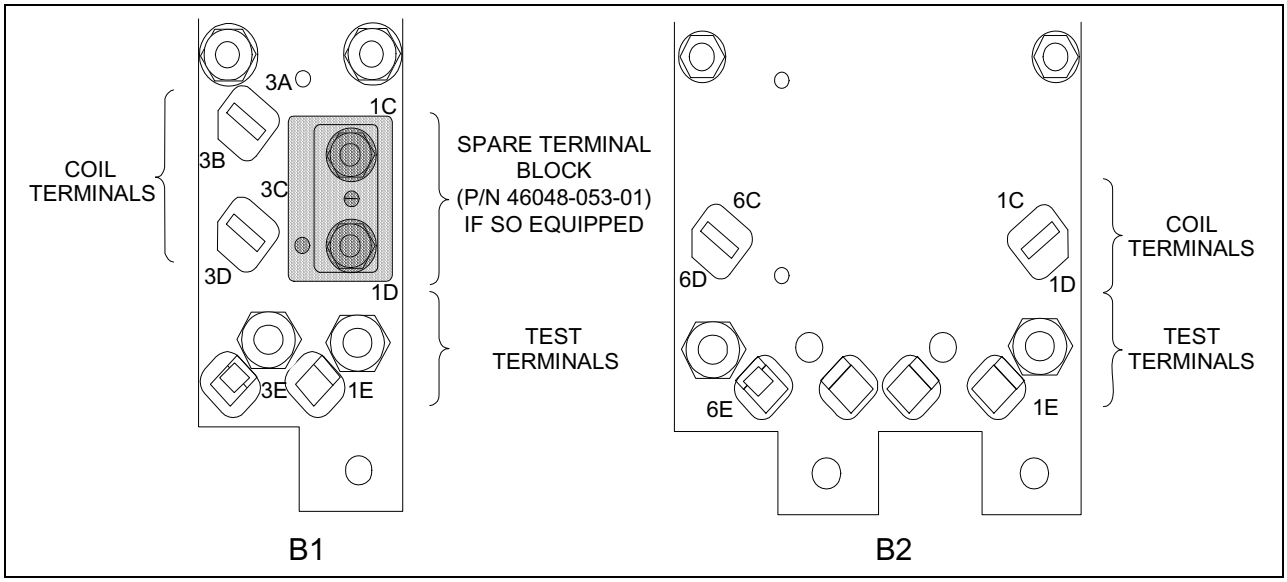


Figure 1–16. Coil Terminal Numbers, B1 and B2 Relay (Rear View)

2. SECTION 2 – THEORY OF OPERATION

2.1. GENERAL

This section covers the functions of Alstom Type B relays.

B relays contain various arrangements of contacts and coils. Information is presented as follows:

- Relay Contacts and Coils
- B1 Relays
- B2 Relays

Figure 2–1 identifies typical B1 Relay components. Some type B2 Relays look very similar to the typical B1 Relay shown, others do not. See the B2 Relay discussions for relay descriptions.

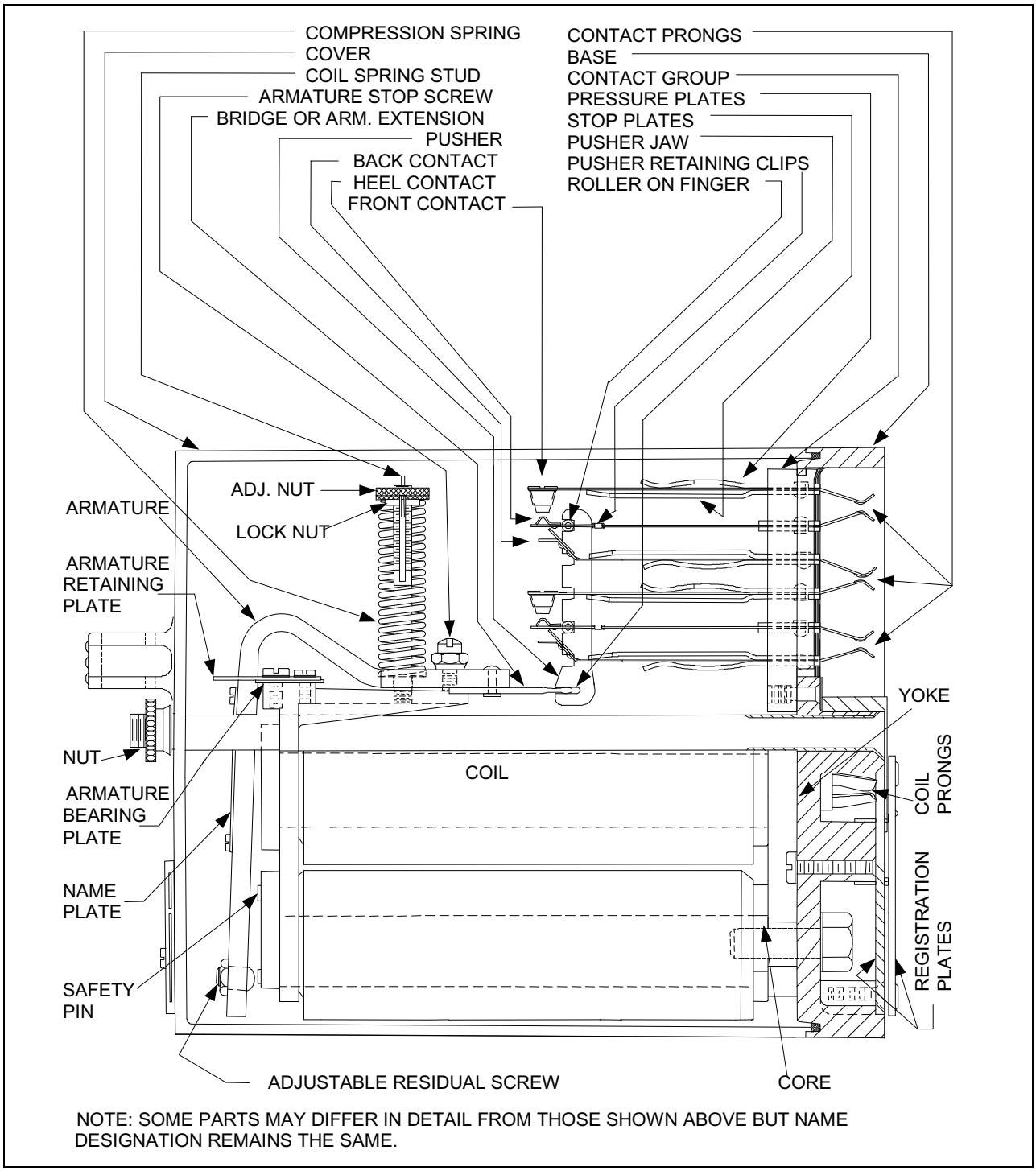


Figure 2–1. Typical B1 Relay Components

2.2. RELAY CONTACTS AND COILS

2.2.1. Definitions

The following terms are used in the descriptions of how relay contacts operate:

- Front -Relay contact that is open when relay is de-energized.
- Heel - Contact that is driven by pusher.
- Back - Relay contact that is made when relay is de-energized (normally closed).
- Make - Specified dimension that will cause all front or back contacts to be just made (closed) when a gauge of the specific dimension is inserted between the armature residual screw and core face with the relay energized.
- Break - All front or back contacts are just open when a gauge of a specific dimension is inserted between the armature residual screw and the core face with the relay de-energized.
- Break-before-make - In a dependent front-heel-back contact, the back contact will break before the front contact makes as the relay is energized.
- Makes-before-break - In a dependent front-heel-back contact, the front contact will make before the back contact breaks.

A complete glossary of terms used in this manual is available in Appendix B.

2.2.2. Contact Groups

There are typically six springs per contact group, furnished in various combinations of contacts. The AC Vane Relay contact groups contain four springs.

Springs are furnished for each group in various combinations of contacts. For example, a contact group can have two dependent front-back (FB) contacts or three independent contacts (front or back).

- A dependent FB contact uses three springs, one for the stationary front (F), one for the stationary back (B), and one for the movable heel.
- An independent contact uses two springs, one for the stationary contact (front or back), and one for the movable heel.

The relay armature, as shown in Figure 2–2, has a bridge attached to it, which engages a pusher. The pusher engages a roller on the heel contact to move the heel contact up or down in response to the movement of the relay armature.

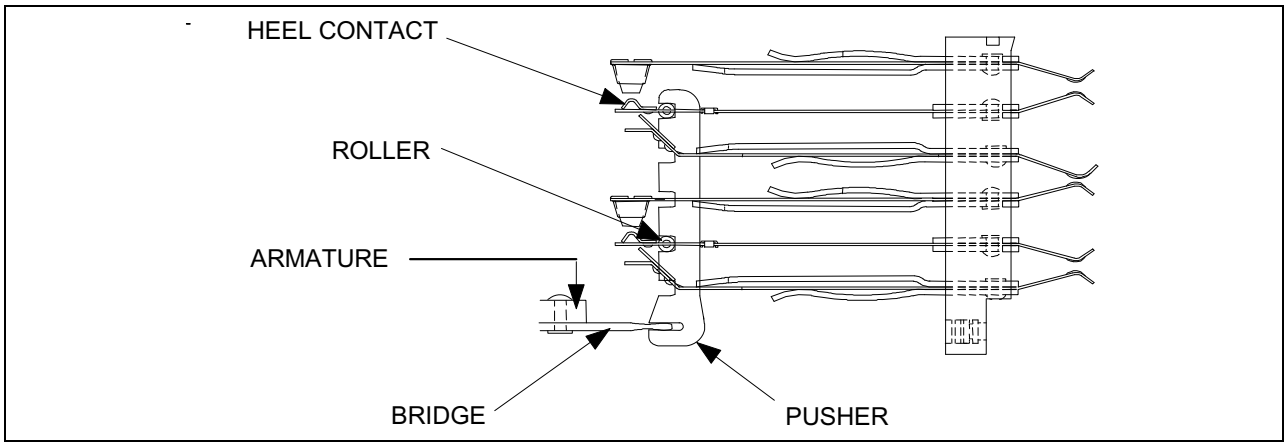


Figure 2–2. Heel Contact Engaging Pusher

Typical contact groups are shown in Figure 2–3.

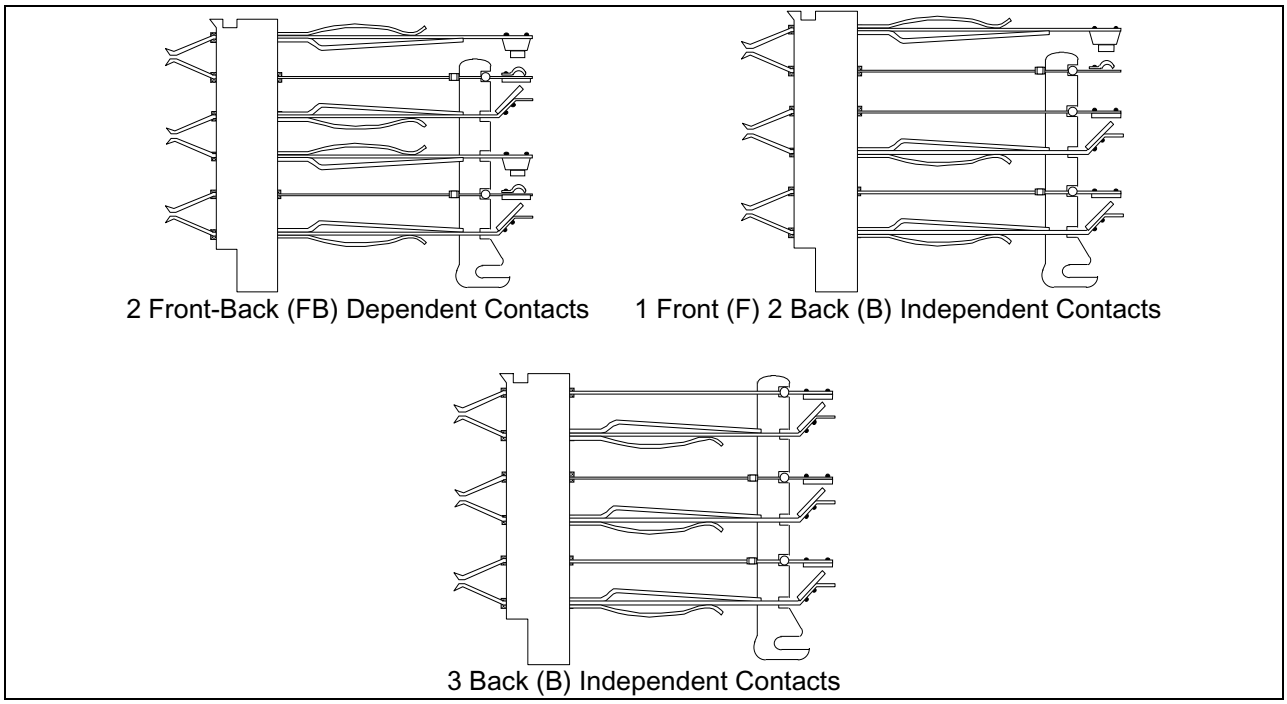


Figure 2–3. Three Different Contact Combinations

2.2.2.1. Contact Combinations

A B1 Relay has space for three contact groups. For example, a relay with 6 front-back dependent contacts has three groups, each with 2 front-back contacts. A relay with 4 front-back dependent contacts and 2 front and 1 back independent contacts also has three groups, two with 2 front-back dependent contacts, and one with 2 front and 1 back independent contacts.

A typical B2 Relay has space for six contact groups. For example, a relay with 12 front-back contacts has six groups, each with 2 front-back contacts. The B2 AC Vane Relay has a different configuration with space for four contact groups.

Table 2–1 shows the contact combinations normally furnished with B relays. For the configuration of specific arrangements, see Section 7.

Table 2–1. Typical Relay Contact Combinations

Type	B1 Relays (3 Contact Groups)	B2 Relays (6 Contact Groups)	B2 Vane Relays (4 Contact Groups)
Neutral	2FB, 4FB, 4F-2B,	12FB	
	4FB-2F-1B, 6FB		
Biased-Neutral	4FB-2F-1B, 6FB	8FB-4F-2B, 12FB	
Magnetic-Stick	4 NR		
Power-Transfer	2FB, 6FB		
Light-Out	4FB, 4F-2B, 6FB		
AC Vane			2FB, 4FB
FB	Front-Back Dependent Contact		
F	Front Independent Contact		
B	Back Independent Contact		
NR	Normal-Reverse Dependent Contact		

2.2.2.2. Regular Contacts

Contacts for regular service are rated for a resistance load of 4 amperes continuously. Front contacts are silver-impregnated-carbon to silver; back contacts are silver to silver. See Figures 2–4 and 2–5.

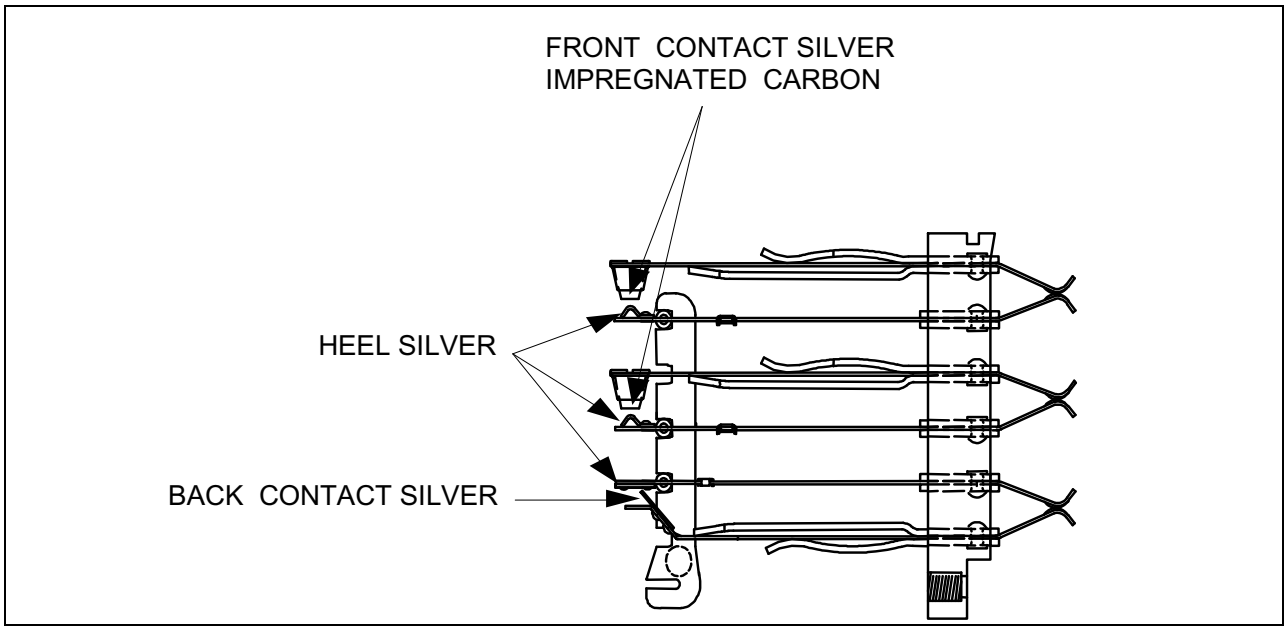


Figure 2–4. 2 Front (F) and 1 Back (B) Independent Regular Contacts

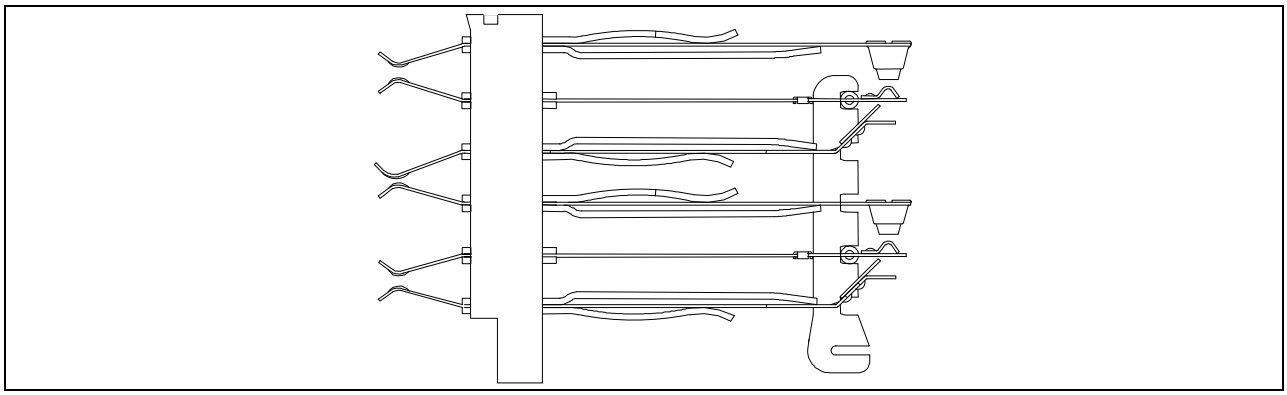


Figure 2–5. 2 Front-Back (FB) Dependent Regular Contacts

2.2.2.3. Heavy-Duty Contacts

Heavy-duty contacts, shown in Figure 2–6, are commonly used in circuits of the first and second voltage ranges where the continuous resistive load current is more than four amperes. The first voltage range is 30 volts or less; the second voltage range is over 30 volts to 175 volts inclusive. Front contacts are usually Silver-Impregnated-Carbon to Silver; back contacts are Silver to Silver.

For the rating of contacts on relays containing heavy-duty (HD) contacts consult the specific relay's Engineering Data (ED) sheet.

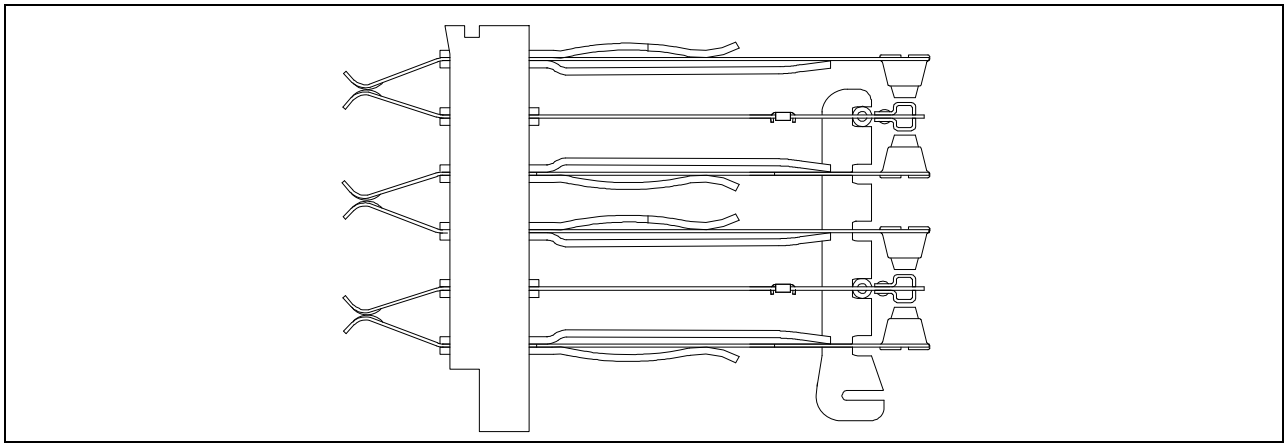


Figure 2–6. 2 Front-Back (FB) Dependent Heavy-Duty Contacts

2.2.2.4. Contacts with Magnetic Blowouts

Heavy-duty contacts equipped with magnetic blowouts, shown in Figure 2–7, are generally used in d-c circuits carrying inductive loads where the continuous current is more than four amperes and where operation is in the second or third voltage ranges. The third voltage range is over 175 volts to 250 volts inclusive.

For the rating of contacts on relays containing heavy-duty contacts with blowout magnets (XHD) consult the specific relay's Engineering Data (ED) sheet.

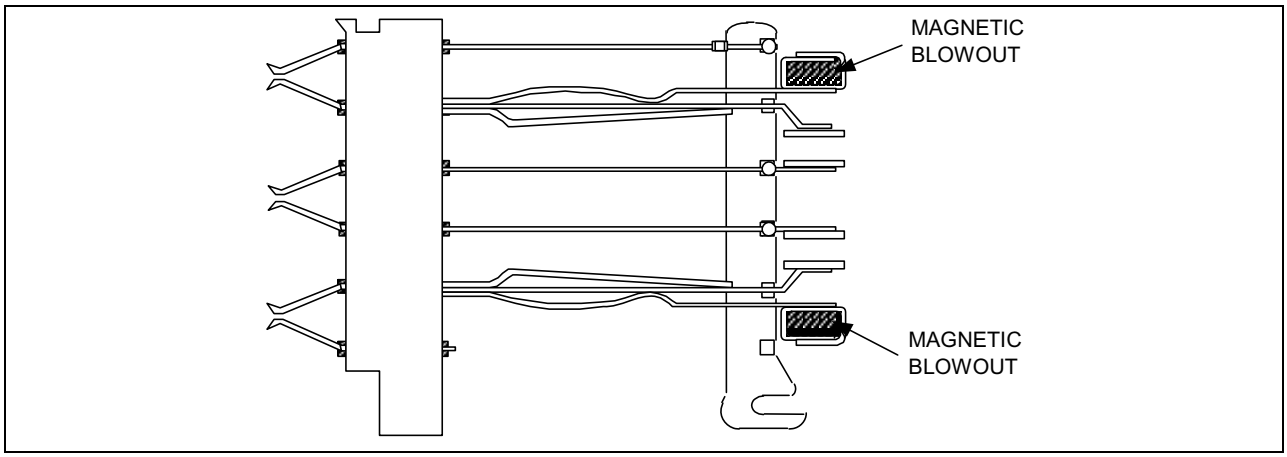


Figure 2–7. One Front and One Back Independent Heavy-Duty Contacts with Magnetic Blowouts

Both front and back contacts are the heavy-duty type just described. Magnets are held in clips close to the contacts. The effect is to "blow" or disperse the electric arc before it has a chance to grow and burn. The front contact opening is usually 0.125” minimum for this type of contact.

Using magnetic blowout contacts sacrifices the space of one contact group in the relay.

2.2.3. Coils

A coil may be made up of one or more separate windings, leads from these windings being fastened to prongs that engage with the plugboard terminals or to terminals that go on a binding post within the relay. See Figures 2–8 and 2–9.

A typical coil is wound on a phenolic spool that slips over one core of the relay. Every coil is identified with its drawing number and nominal resistance.

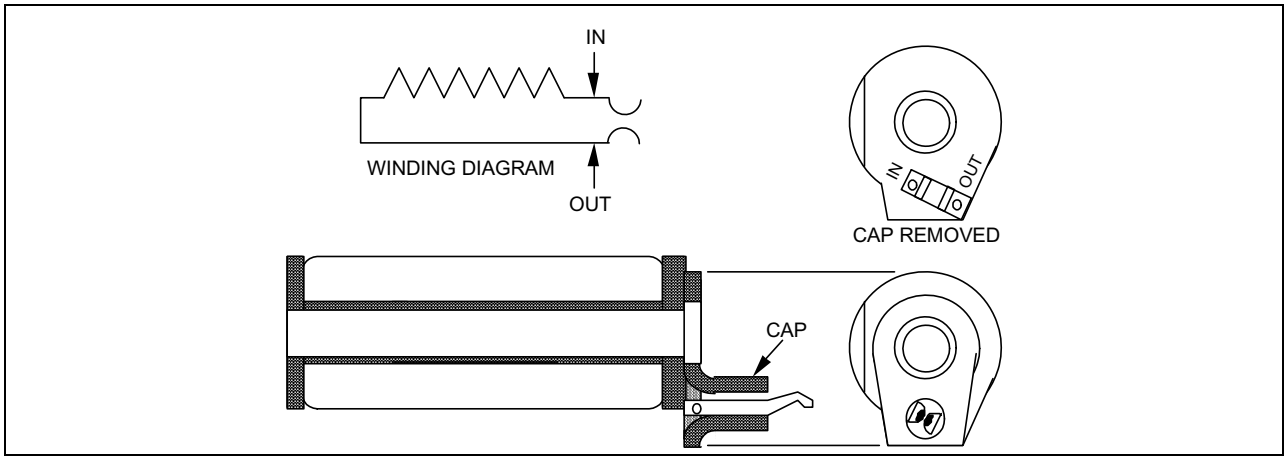


Figure 2–8. Coil Construction, One Winding

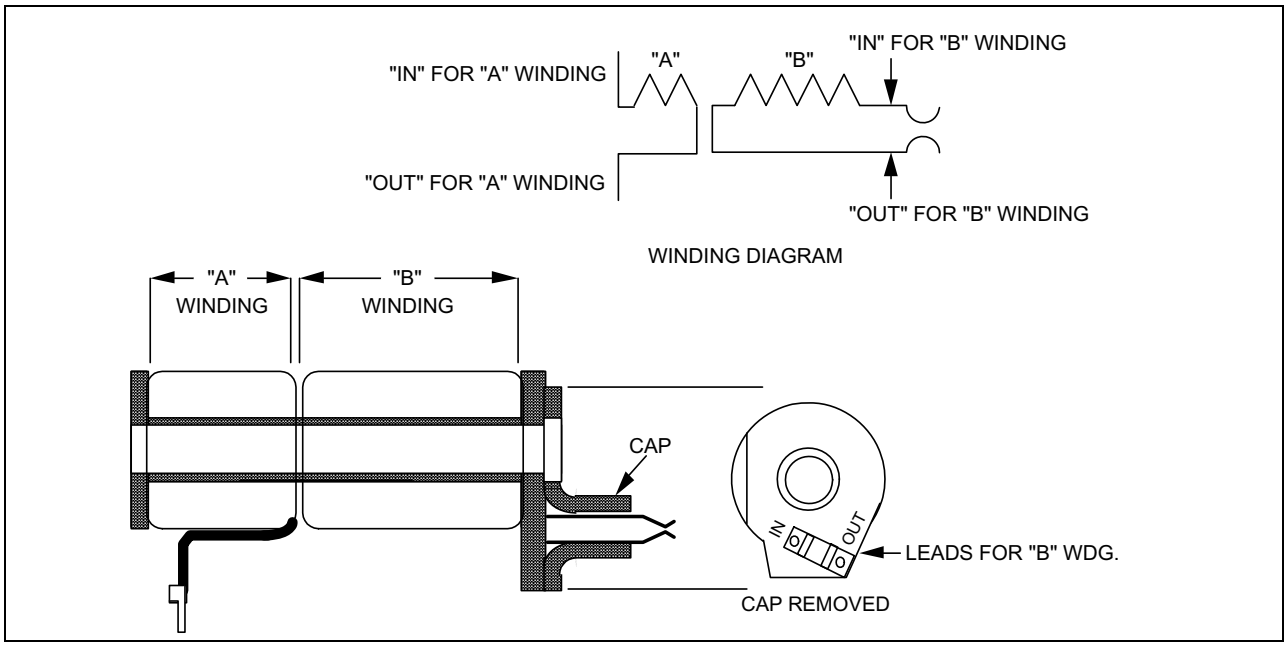


Figure 2–9. Coil Construction, Two Windings

2.2.3.1. One-Coil Relays (Slow Acting Relays)

One core of a relay can be completely filled with copper washers or a slug of aluminum or copper to make the relay slow acting. In this case, only one coil is used to operate the relay. The more washers used, or the longer the slug, the slower the relay operates.

If the relay is to be slightly slow acting, short coils on the cores usually provide enough room for the required number of washers or a short slug. If the relay is to be slower acting, one coil is put on the lower core and a slug is put on the upper core.

The circuit of a one-coil B1 Relay is shown in Table 2–2 (3A and 3B). The IN lead of the coil is connected to the 3C terminal on the plugboard; the OUT lead is connected to the 3D terminal. Positive energy is applied through the current test terminal 3E to terminal 3C.

The circuit for a one-coil B2 Relay is shown in Table 2–2 (3A and 3B). The IN lead of the coil is in contact with the 6C terminal on the plugboard; the OUT lead contacts the 6D terminal. Positive energy is applied through the current test terminal 6E to terminal 6C.

B2 Neutral Relays with slugs are rarely used, as there is seldom the need for B2 Slow-Release Relays with such large contact capacity.

2.2.3.2. Two-Coil Relays

In two-coil B1 Relays, the upper coil plugs onto terminals 3A and 3B of the plugboard, the lower coil onto terminals 3C and 3D. Connections between the coils are made on the back of the plugboard for series, parallel, or single coil operation. The circuits in Table 2–2 show these possibilities.

In two-coil B2 Relays, from the front of the relay, the left-hand coil plugs onto terminals 1C and 1D, the right-hand coil onto terminals 6C and 6D. See Table 2–2 for a brief explanation of circuit description, timing characteristics and application notes.

Table 2–2. Coil Connections and Timing Characteristics

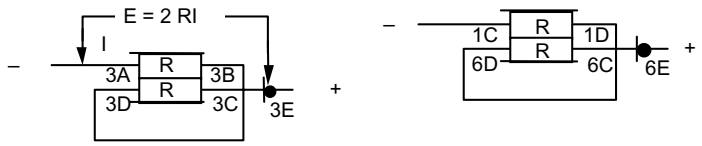
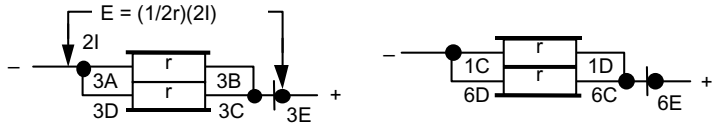
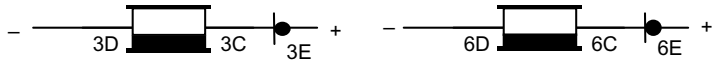
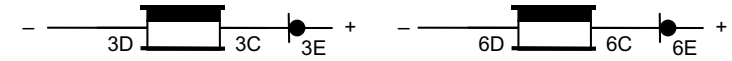
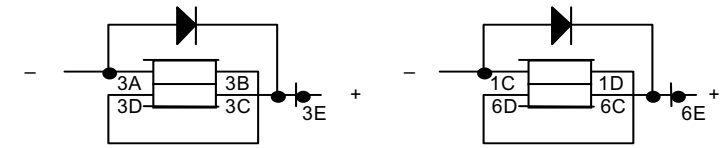
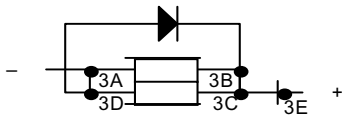
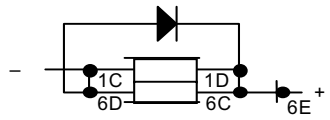
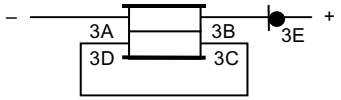
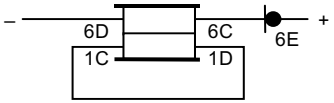
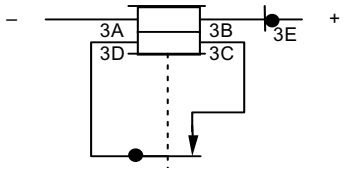
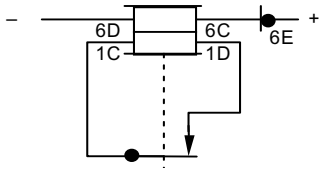
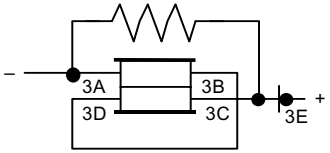
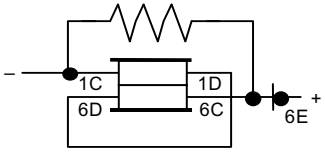
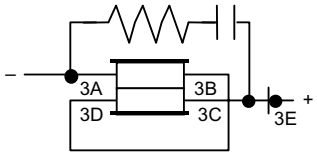
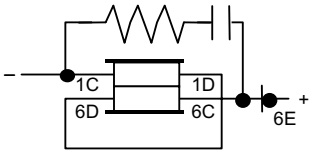
Circuit B1 Relay / B2 Relay	Circuit Description	Timing Characteristics	Notes
1 	Series	Pickup normal Release normal	I = WORKING current R = resistance of one coil E = voltage required to get full pressure on the front contact
2 	Multiple	Pickup fast Release normal	Voltage across coils is one half (1/2) the voltage across the coils of item 1 above
3A 	One coil separating slugs on other core	Release slow: up to as high as three (3) seconds	Timing is affected when controlled over line because of line drop
3B 	One coil separating slugs on other core	Pickup slow: up to as high as three (3) seconds	Timing is affected when controlled over line because of line drop
4 	Series with rectifier shunted across coils	Pickup normal Release slow, but less slow than 3A or 3B	Do not use in circuits subject to lightning Do not energize from a battery whose other circuits are subject to lightning

Table 2–2. Coil Connections and Timing Characteristics (Cont.)

Circuit B1 Relay	Circuit B2 Relay	Circuit Description	Timing Characteristics	Notes
5 		Multiple with rectifier shunted across coils	Pickup fast Release slow, but less slow than 4	Do not use in circuits subject to lightning
6 		One coil operating, one coil shunted	Pickup slow Release slow, but less slow than 4	Shunt should be applied to the lower coil of B1 Relays to get the maximum slow release effect
7 		One coil operating, one coil shunted when armature is picked up	Pickup normal Release slow, but less slow than 3A, 3B, or 4	
8 		Series with resistor shunted across coils	Pickup normal Release slow, but less slow than 3A, 3B, or 4	The lower the resistor, the slower the relay; takes more current, will therefore affect operation of any relays in series
9 		Series with resistor and capacitor shunted across coils	Pickup normal Release slow, slower than 3A or 3B, up to ten (10) seconds	The greater the capacity of the capacitor, the slower the relay; a resistor should always be used in series in case the capacitor shorts

2.3. BIASED-NEUTRAL TRACK RELAYS

All Biased-Neutral Track Relays (B1 and B2) have normal pickup and release timing characteristics. Figures 2–10 and 2–11 illustrate typical B1 Biased-Neutral Relays.

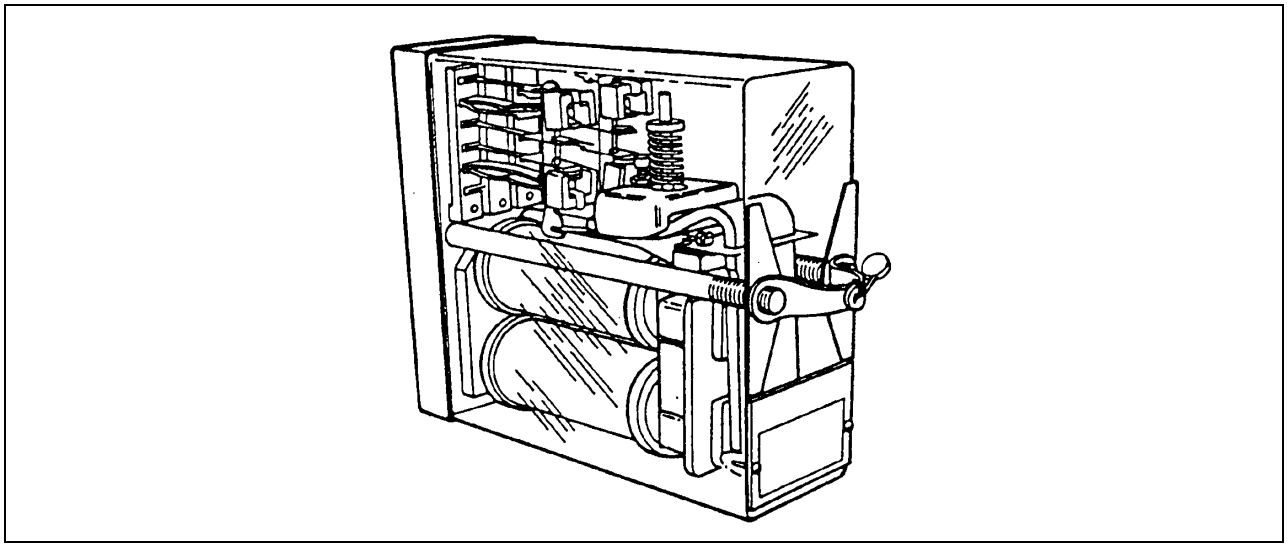


Figure 2–10. Type B1 Biased-Neutral Relay, Pre-1991 Cover

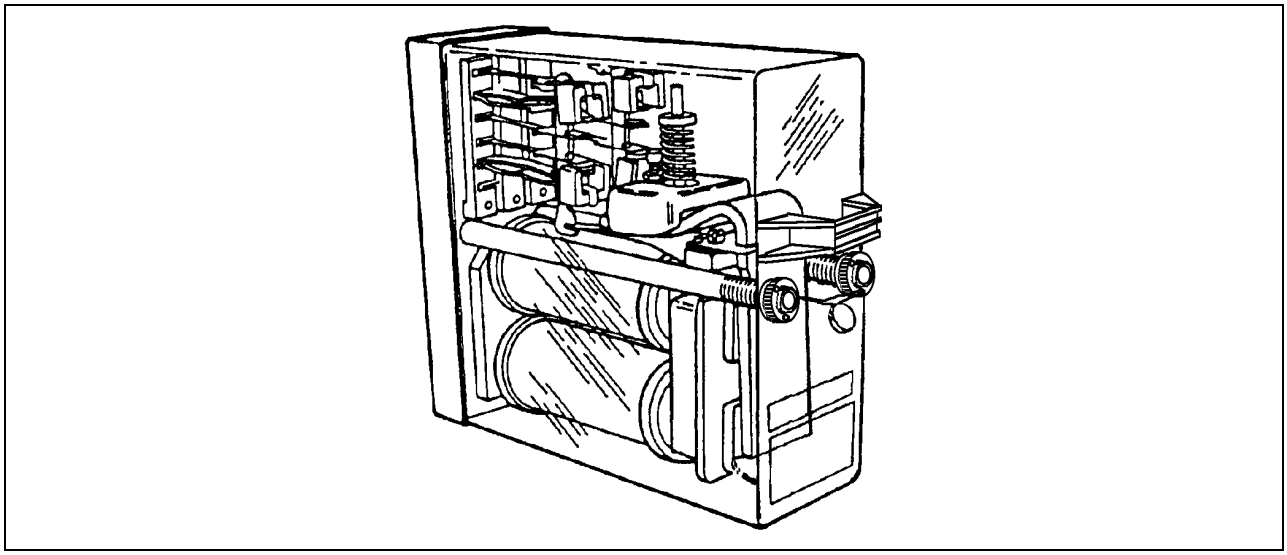


Figure 2–11. Type B1 Biased-Neutral Relay, Post-1991 Cover

Figure 2–12 shows typical B1 Relay wiring.

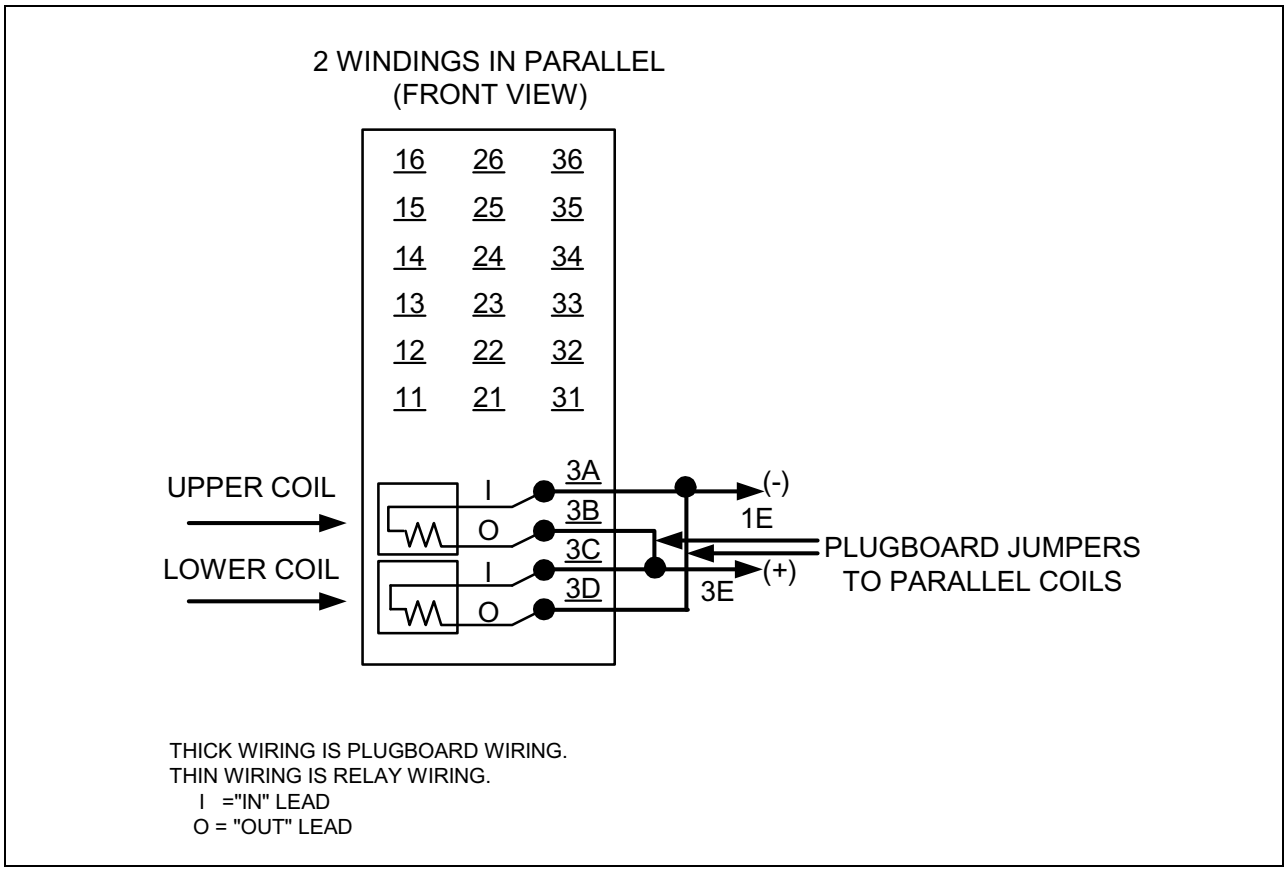


Figure 2–12. Typical B1 Track Relay Wiring

Another application of the biased-neutral function is in the DC high percentage release track relay that can be used in track circuits up to 20,000 feet long. With its low nominal resistance of 0.5 ohm (with coils connected in parallel), this B1 Relay provides fast, high shunting sensitivity under poor ballast conditions while giving excellent protection against foreign current. In addition, this relay will not pick up when 50 times reverse polarity WORKING current is applied.

The operation of a biased neutral line relay is discussed under Heading 2.4.2.

2.4. DC LINE RELAYS

2.4.1. Neutral Line Relay

Type B Neutral Line Relays are made in both Size 1 and Size 2. They have normal pickup and release, are available as slow-release, slow pickup, and slow pickup and release.

In the normal pickup and release relays, the coils are full length. In slow-release and slow pickup relays, coils of shorter lengths are used to make room for slugs on the cores. In relays where one coil only is used (a full-length slug being on the other core), the coil is usually placed on the lower core. Figure 2–13 shows coil connections.

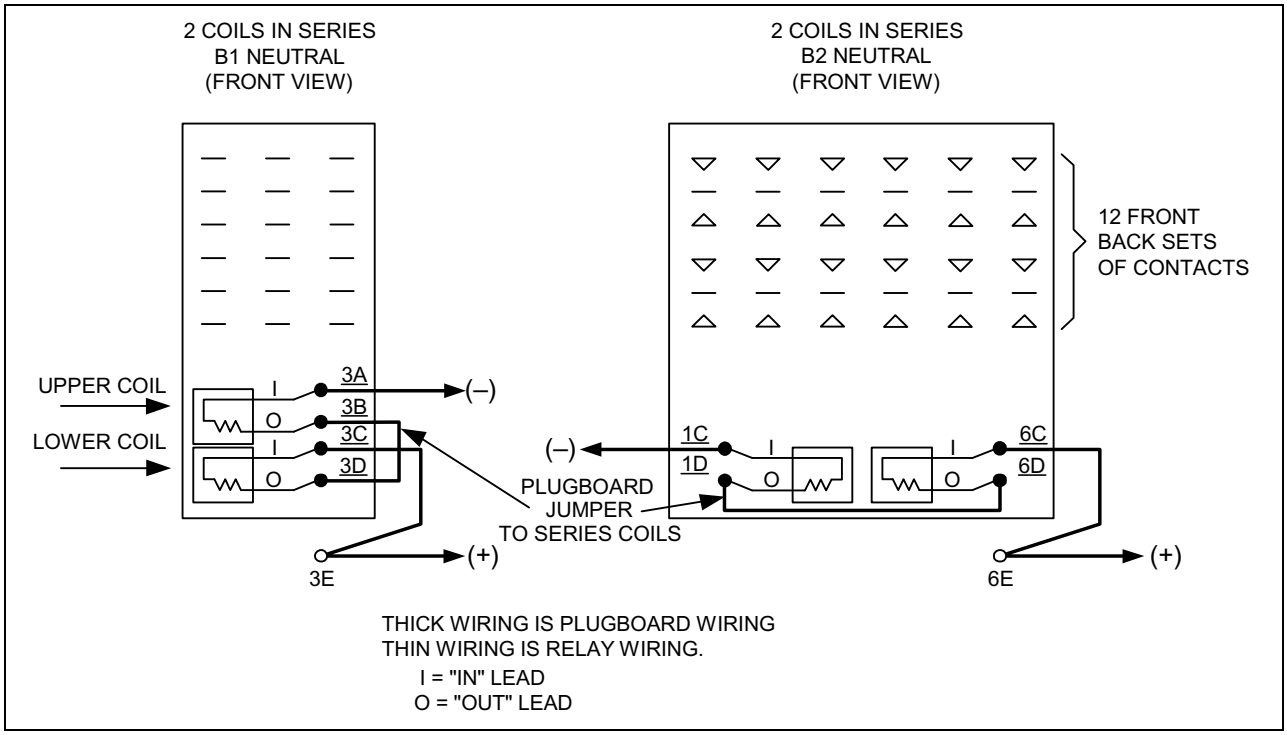


Figure 2–13. B1 and B2 Neutral Line Relays Wiring

Various resistances are available, but the nominal 500-ohm relay is recommended for most purposes.

2.4.2. Biased-Neutral Line Relay

The Biased-Neutral Line Relay is basically a relay with a neutral structure. It is, however, equipped with a permanent magnet and a leakage strip bridging the cores and placed between the coils and the armature. The effect on the operation is to allow the relay to pick up only if voltage of the proper polarity is applied.

In other respects, the relay is essentially like a regular neutral relay. It is built in Sizes 1 and 2.

Figures 2–14 through 2–16 how the relay works.

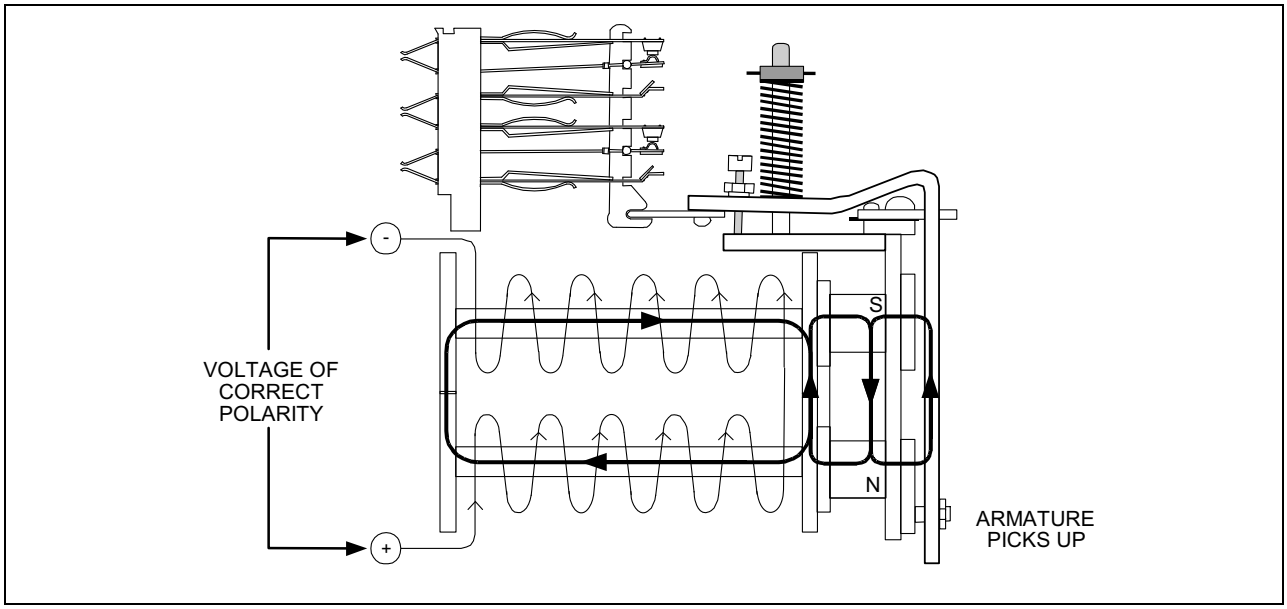


Figure 2–14. Voltage of Right Polarity Applied

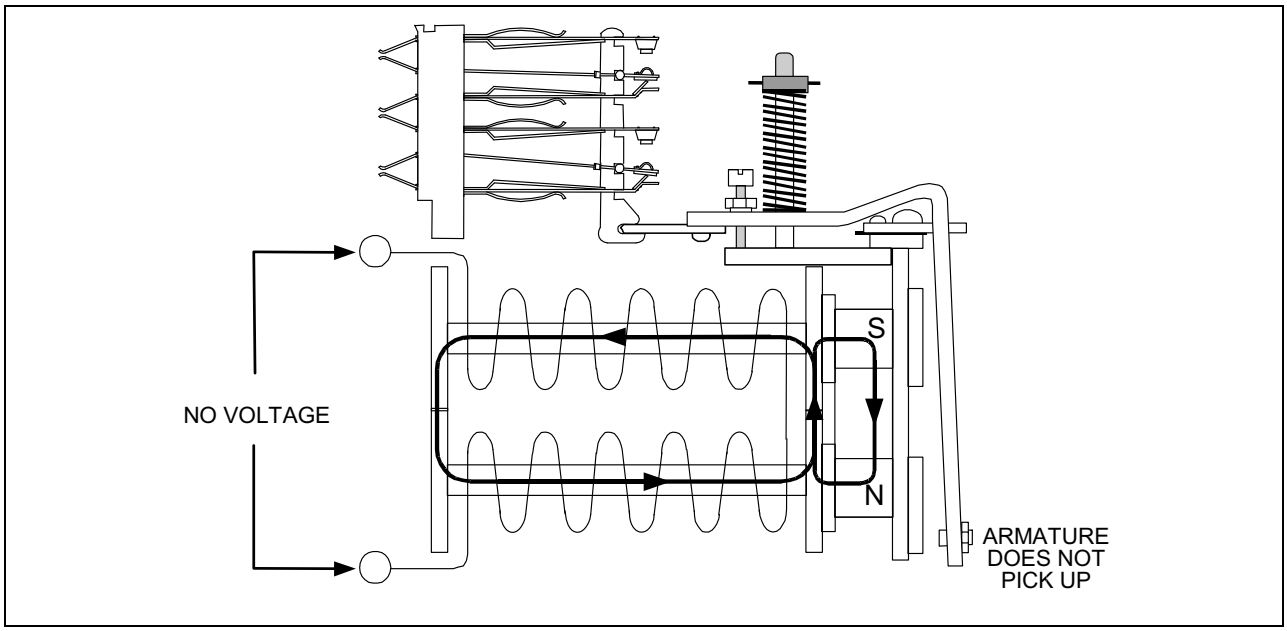


Figure 2–15. No Voltage Applied

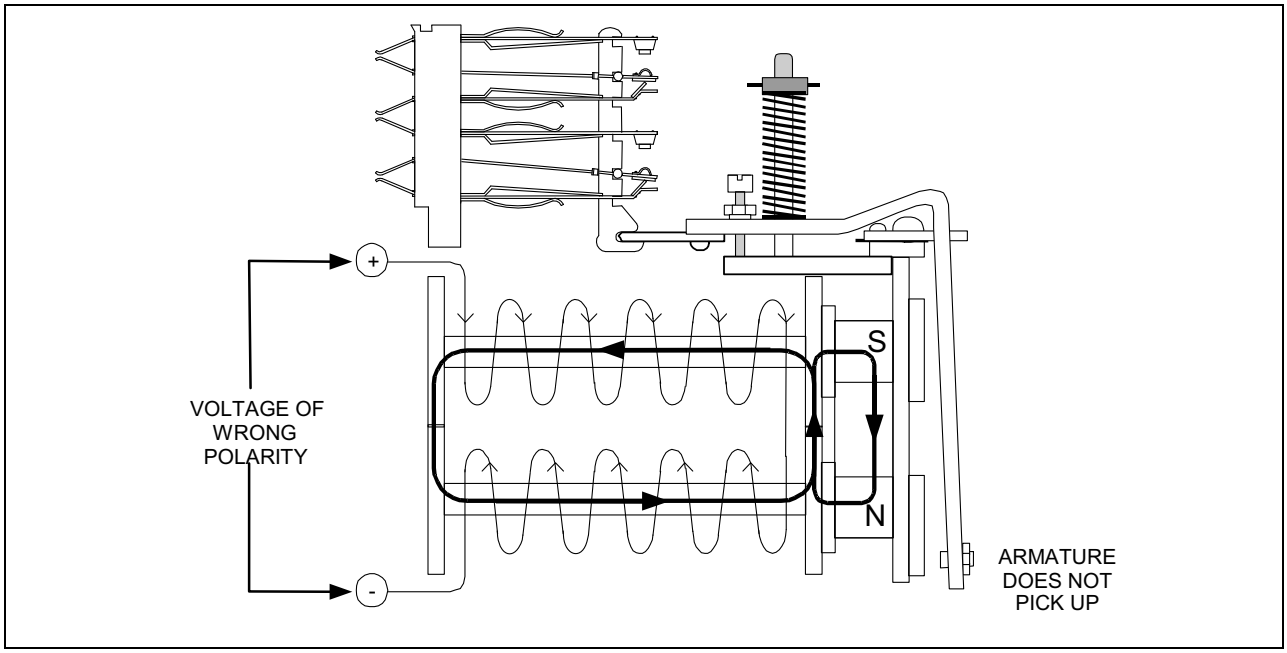


Figure 2–16. Voltage of Wrong Polarity Applied

2.4.3. Magnetic-Stick Line Relay

Magnetic-Stick Relays are commonly used in switch control and indication circuits. Magnetic-Stick or "Polar Stick" Relays operate by responding to a change in the direction of the current flow through their coils. The armature stays in its last operated position when energy is cut off.

The armature is polarized by two permanent magnets. Internal nominal 150-ohm resistors can be connected by plugboard jumpers for operation on 2, 10 or 20 volts.

Figures 2–17 through 2–20 show relay operation and different contact closures resulting from armature movement. Figure 2–21 depicts the normal wiring connections.

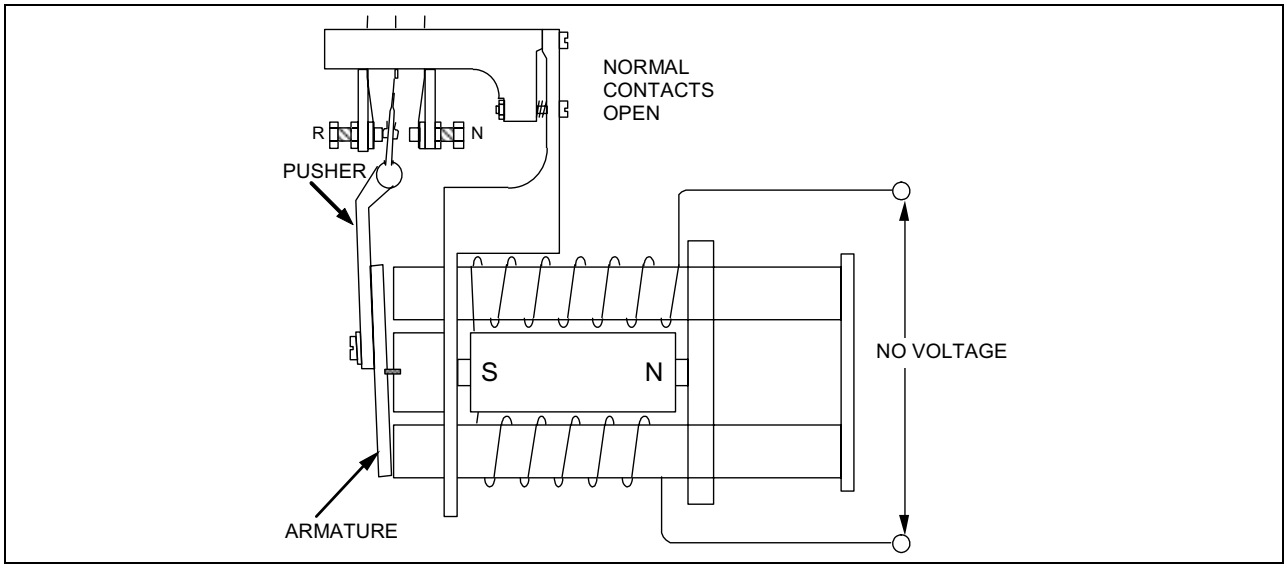


Figure 2–17. Magnetic-Stick Relay, Reverse Position

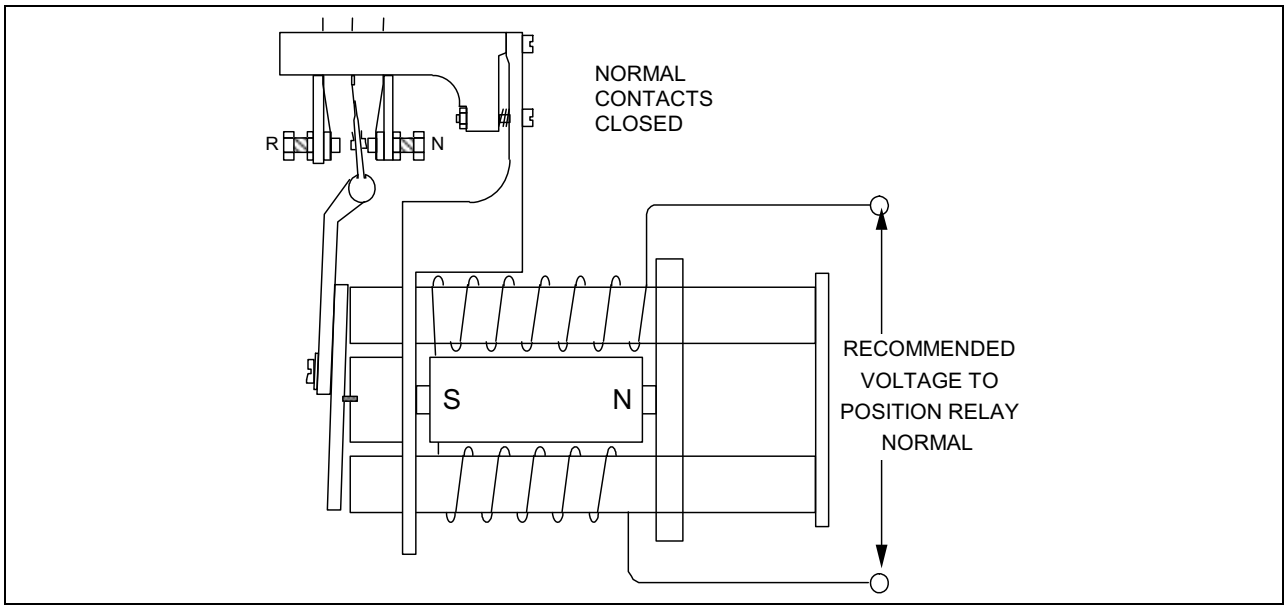


Figure 2–18. Armature Picked Up with Normal Polarity

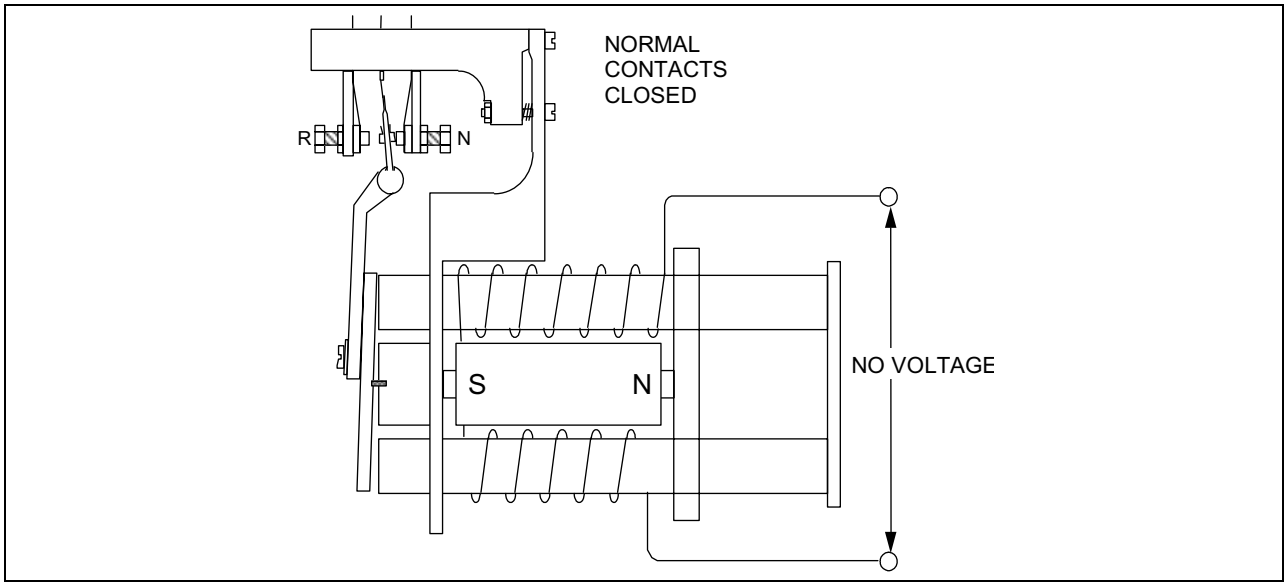


Figure 2–19. Armature Held Up By Permanent Magnet's Attraction

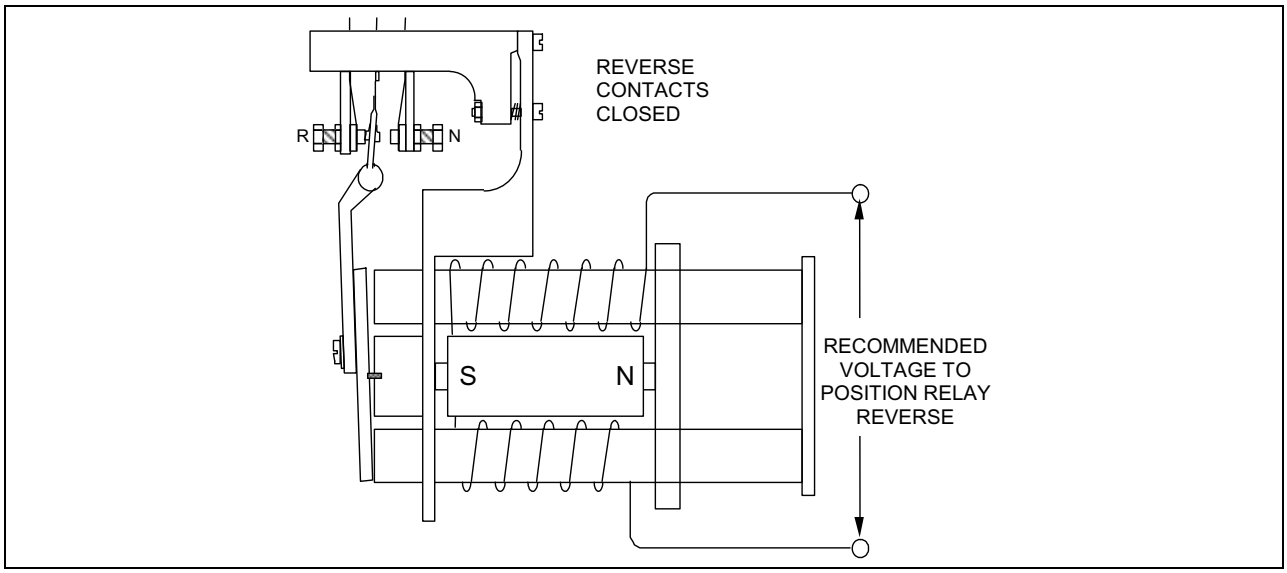


Figure 2–20. Armature Knocked Down with Reverse Polarity

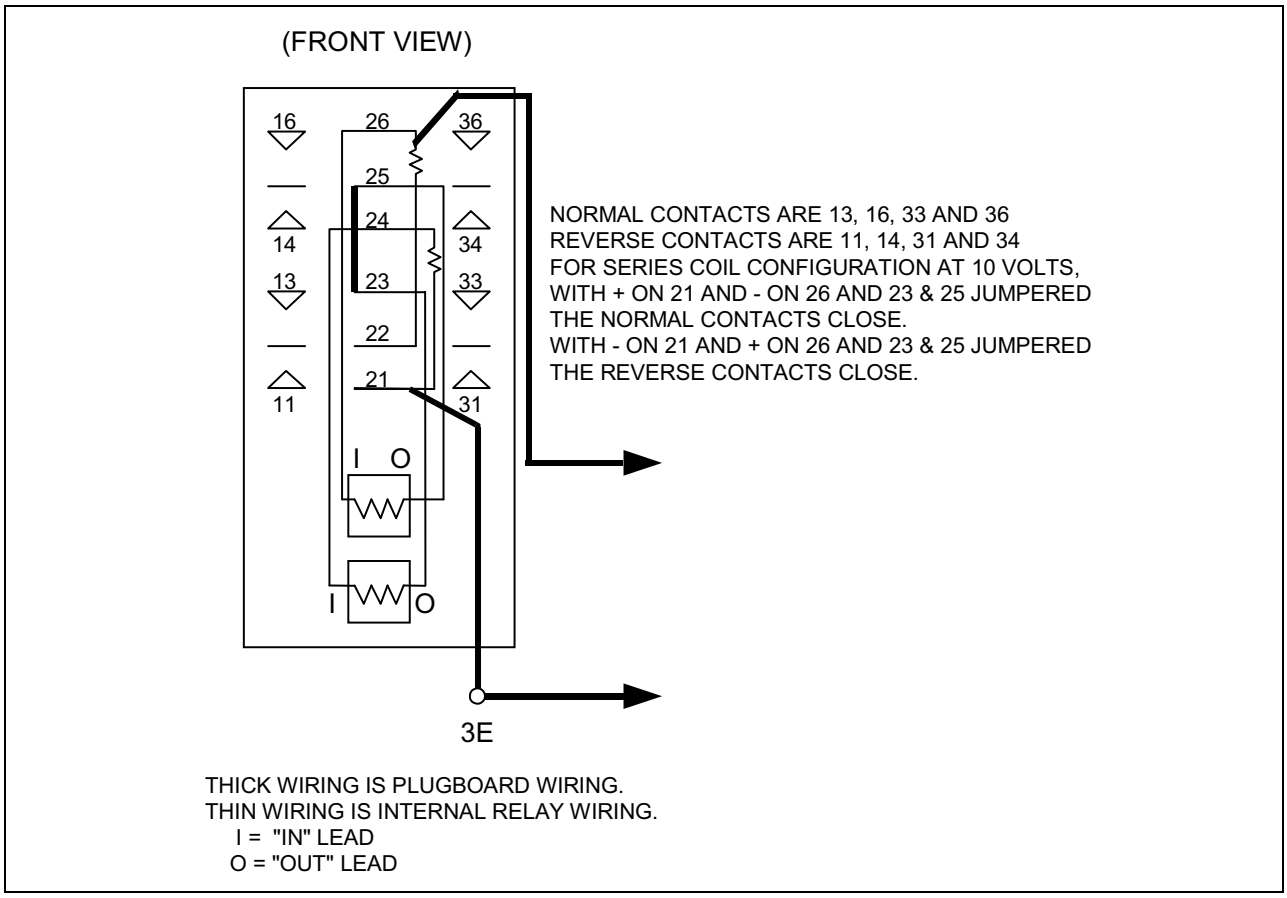


Figure 2–21. B1 Magnetic-Stick Relay Wiring

2.5. DC SPECIAL PURPOSE RELAYS

2.5.1. Highway Crossing Signal Flasher Relay

The electronically driven highway crossing flasher consists of a Type B1 Neutral Relay and a solid-state flasher module. The flasher module, attached to energy terminals on the back of the relays plugboard, establishes and maintains a flashing rate of 48 to 54 flashes per minute (fpm) for highway crossing signals or 56 to 64 fpm for flashing wayside signal aspects. The drawing number of the flasher module determines the flash rate. Wiring is shown by Figure 2–22.

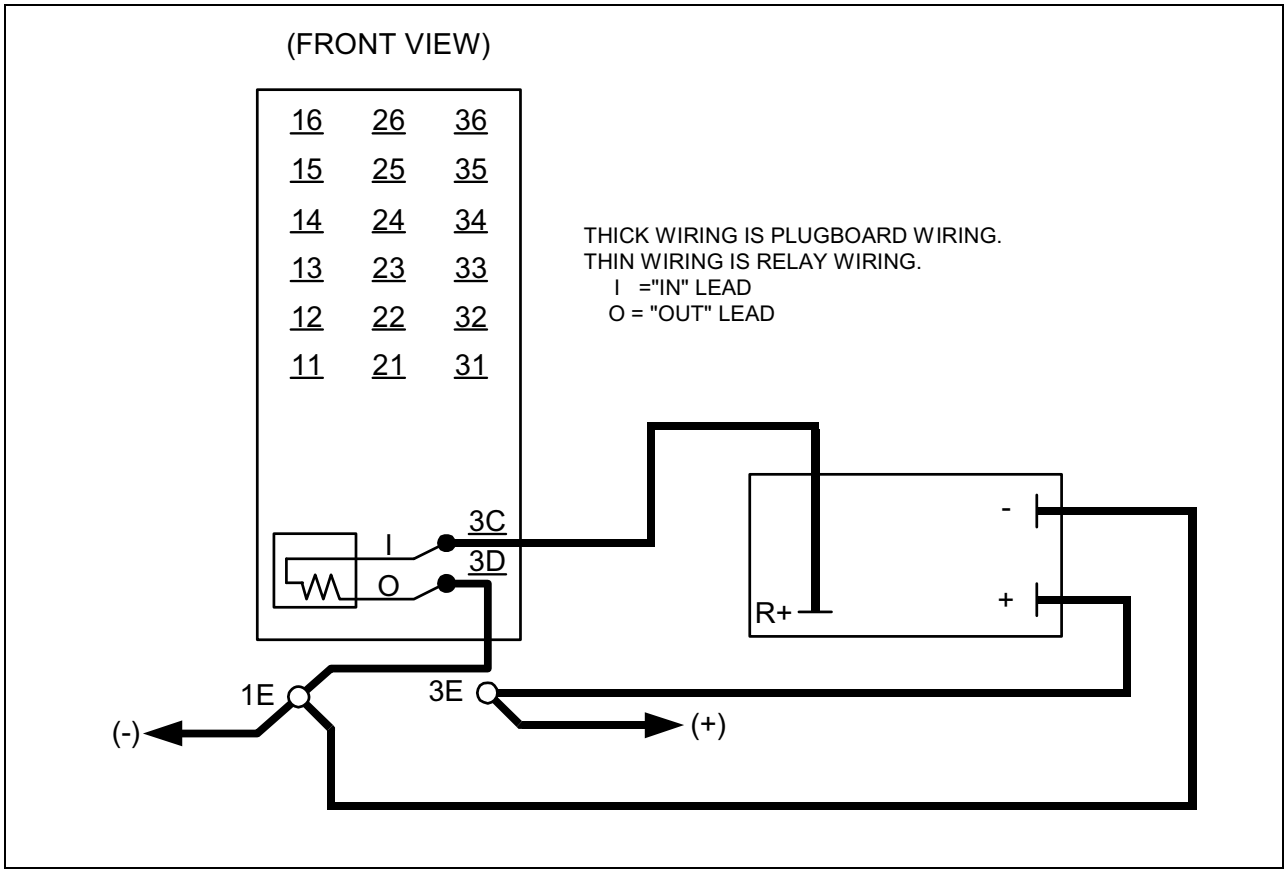


Figure 2–22. Electronically Driven Flasher Relay Wiring

The flasher module drives the Type B1 Neutral Relay that has four dependent front-back, heavy-duty, lamp-control contacts. Full back contact pressure is maintained while the relay is not operating.

2.5.2. Power-Transfer Relay

A Type B Power-Transfer Relay, built in Size 1 only, is essentially a DC Neutral Line Relay operating on rectified alternating current. The rectifier (P/N 59899-005-03) is shown in Figure 2–23.

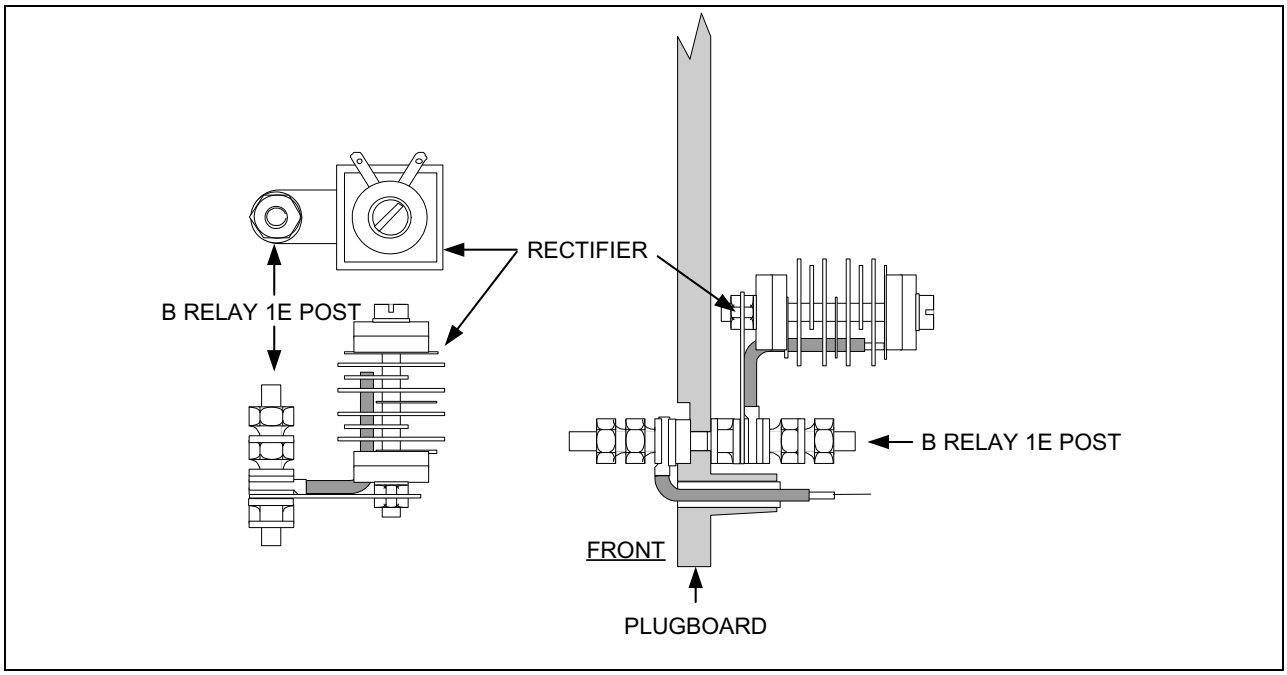


Figure 2–23. Type S1/4 Half-Wave Rectifier for Power-Transfer Relay

While AC energy is on, the relay stays energized. If AC energy fails the relay armature drops and automatically transfers the circuits to local battery. The percent of release voltage, found by dividing the DROP AWAY voltage by the PICKUP voltage, is about 75 percent at 70 degrees F. Power-Transfer Relay coil wiring is shown in Figure 2–24.

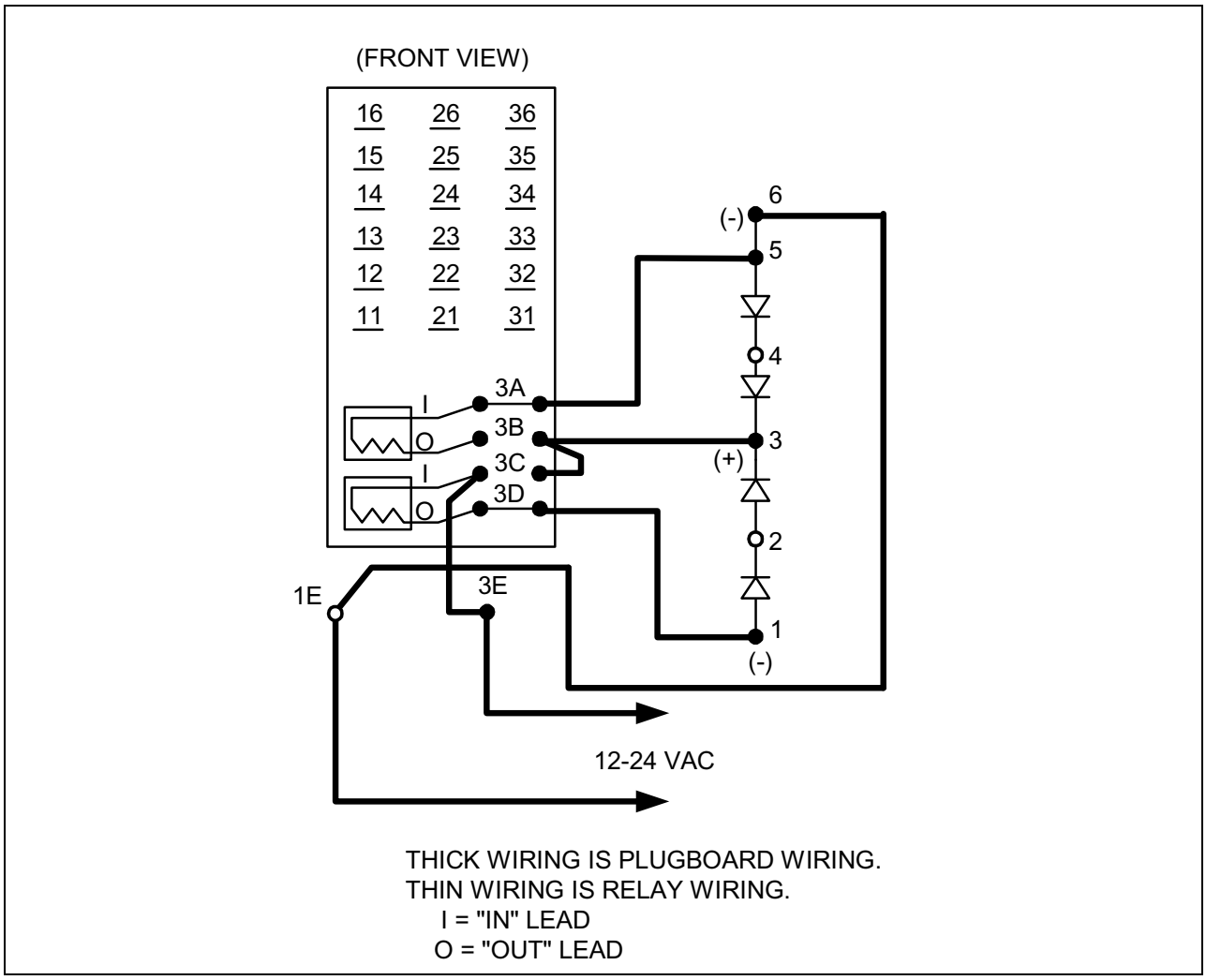


Figure 2–24. Power-Transfer Relay Wiring

2.5.3. Lamp-Control Relay

Type B Lamp-Control Relays, made in Size 1 only, regulate lamp circuits at highway grade crossings protected by flashing lights. The lamp-control contacts in space 1 handle up to 15 amperes at 12 volts. The regular duty contacts in space 3 are for other circuits.

When the relay is deenergized, the contact pusher in space 1 drops away from the lamp-control contact fingers. With this design, oscillations of the armature due to its striking the stop are not transmitted to the contacts when the relay is de-energized. The armature is completely disconnected from the contact fingers.

Coil resistance is lower than the resistance of regular line relays to obtain fast pickup, opening the back contacts as rapidly as possible. Figure 2–25 shows standard wiring connections.

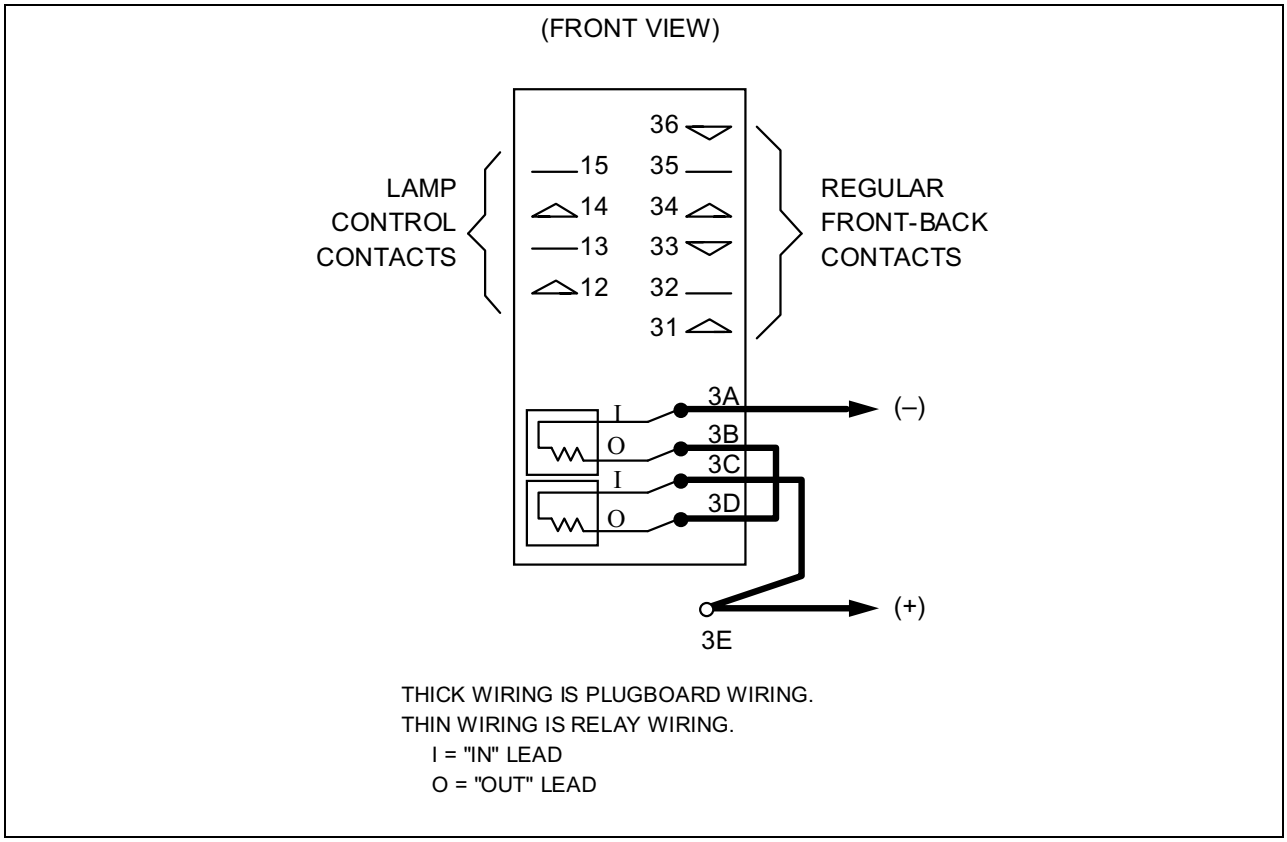


Figure 2–25. Lamp-Control Relay Wiring

2.5.4. Switch-Overload Relay

The Type B1 Switch-Overload Relay picks up on motor overload current through its low-resistance coil, and sticks up on control circuit energy through its high-resistance coil. See Figure 2–26 for an example of relay wiring.

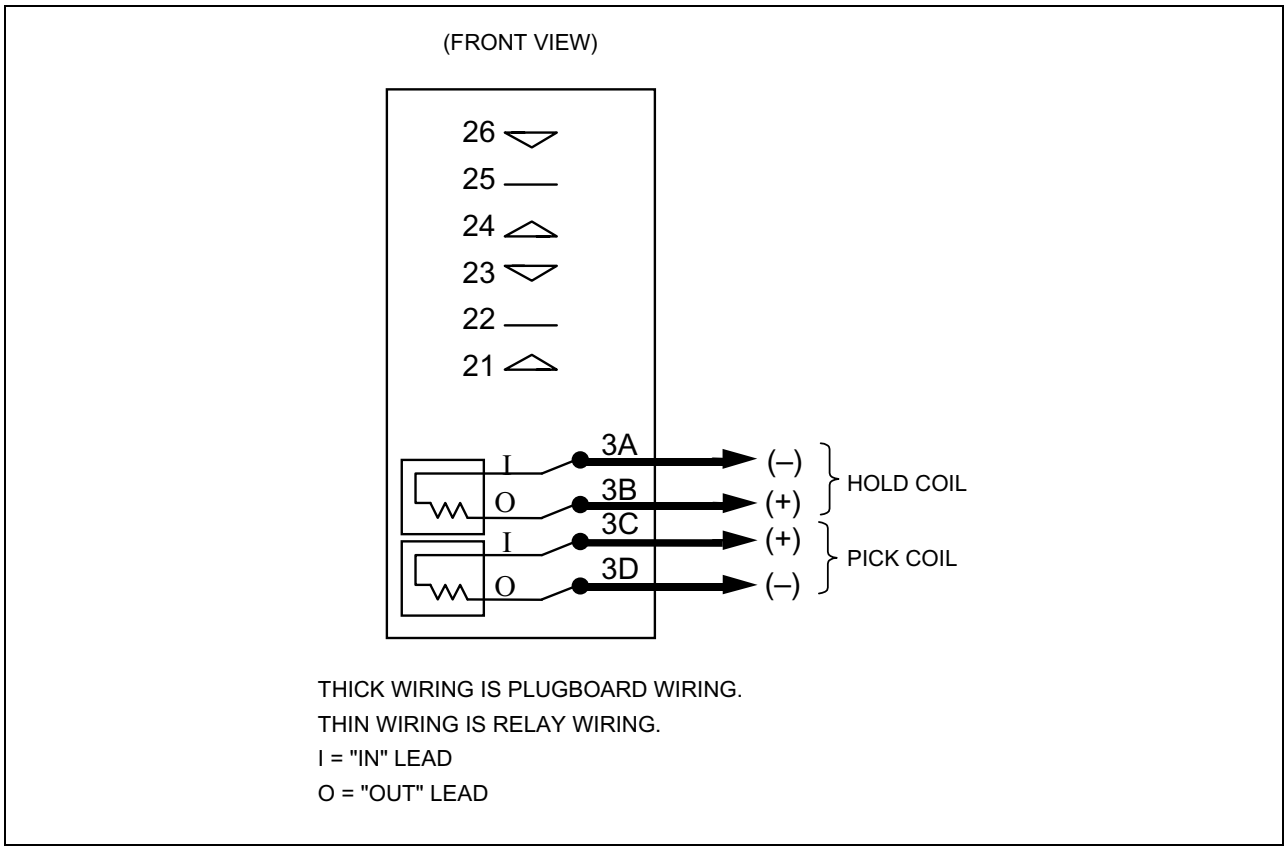


Figure 2–26. Switch-Overload Relay Wiring

Pickup of the relay releases the switch control relays, thus removing energy from the switch machine motor. When the polarity is reversed, the stick circuit opens and the overload relay releases, permitting reversal of the switch movement.

Built-in thermal slow pickup characteristics prevent the relay from operating on normal starting surges of the switch motor. This feature also permits repeated switch operation that may dislodge the switch obstruction that is causing the overload.

Switch-Overload Relays are available for low- or high-voltage switch machines.

2.5.5. Code-Responsive Relay

Type B Code-Responsive Relays are built in Size 1 only. They are made with a light armature and contact structure so that they respond quickly to pulses of coded energy, even when the pulse frequency is as high as four pulses per second.

Two types of structures are available. One structure has a maximum of two dependent front-back contacts and the other has a maximum of four dependent front-back contacts. The four-contact structure is usually supplied for heavy service, as the contact design provides more effective non-bounce characteristics.

The relay armature is polarized by two permanent magnets so arranged as to allow the front contacts to close only if the proper polarity is applied. When the relay is de-energized, a bias spring, together with magnetic bias, returns the armature to the de-energized position to close the back contacts. Figures 2–27 and 2–28 show how the relay works.

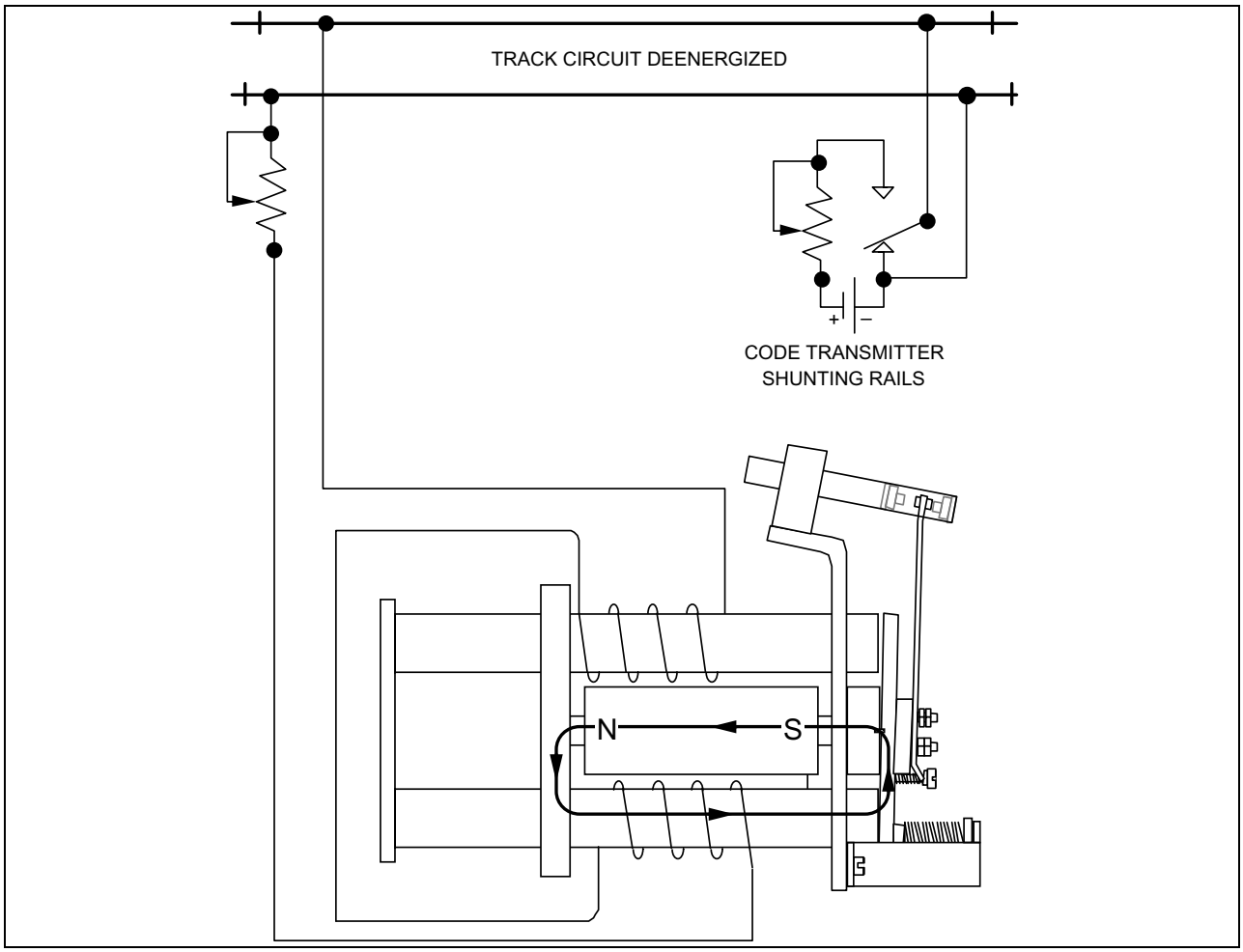


Figure 2–27. Code-Responsive Relay De-energized

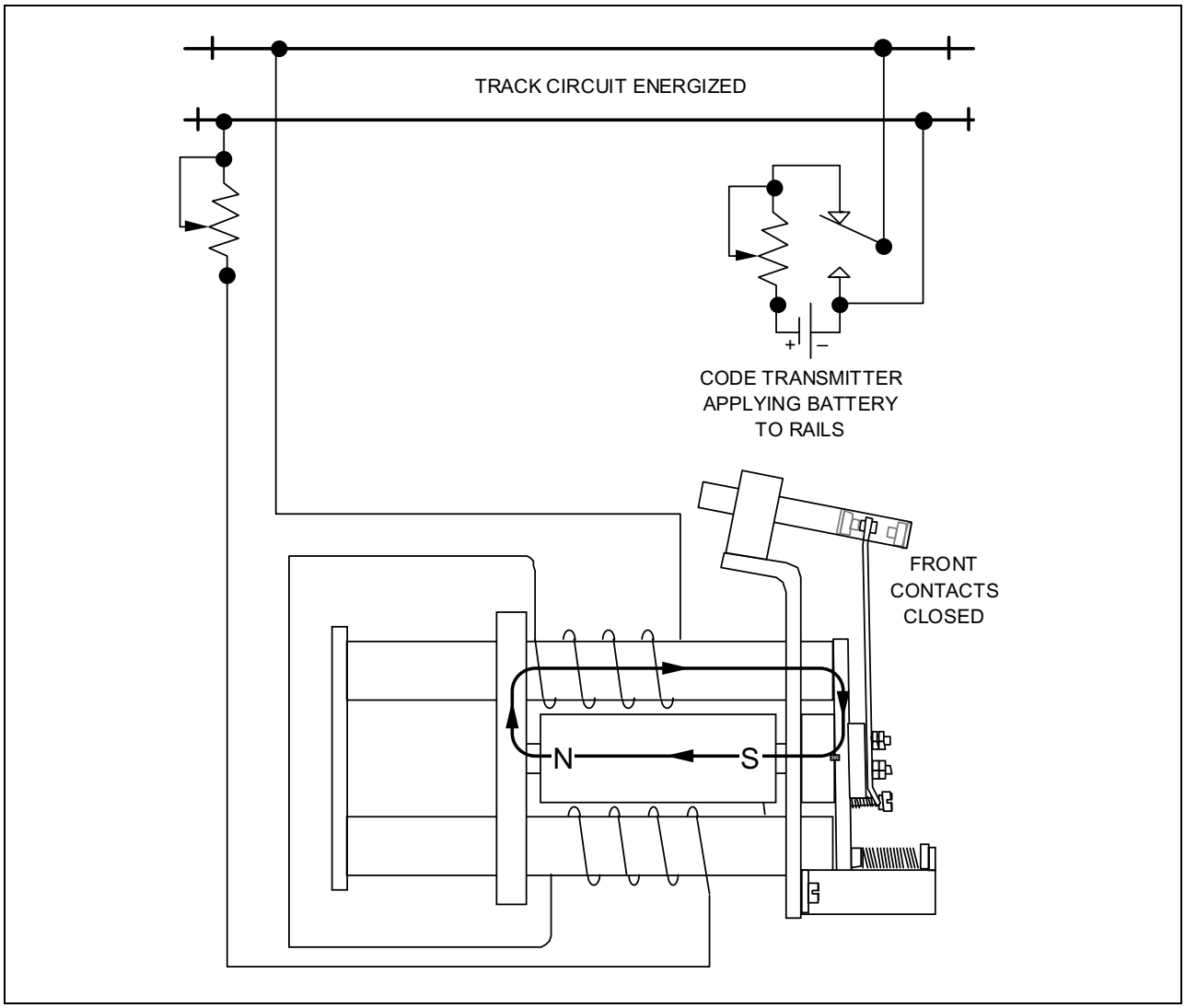


Figure 2–28. Code-Responsive Relay Energized

Figure 2–29 shows positive energy is connected to 3A and negative to 3C. All other B1 Relays have positive on 3C and negative on 3A. Each contact is connected internally to the terminal in the base for plug-in connection. Plugboard connections may be on 1 or 2 terminals, depending on current values.

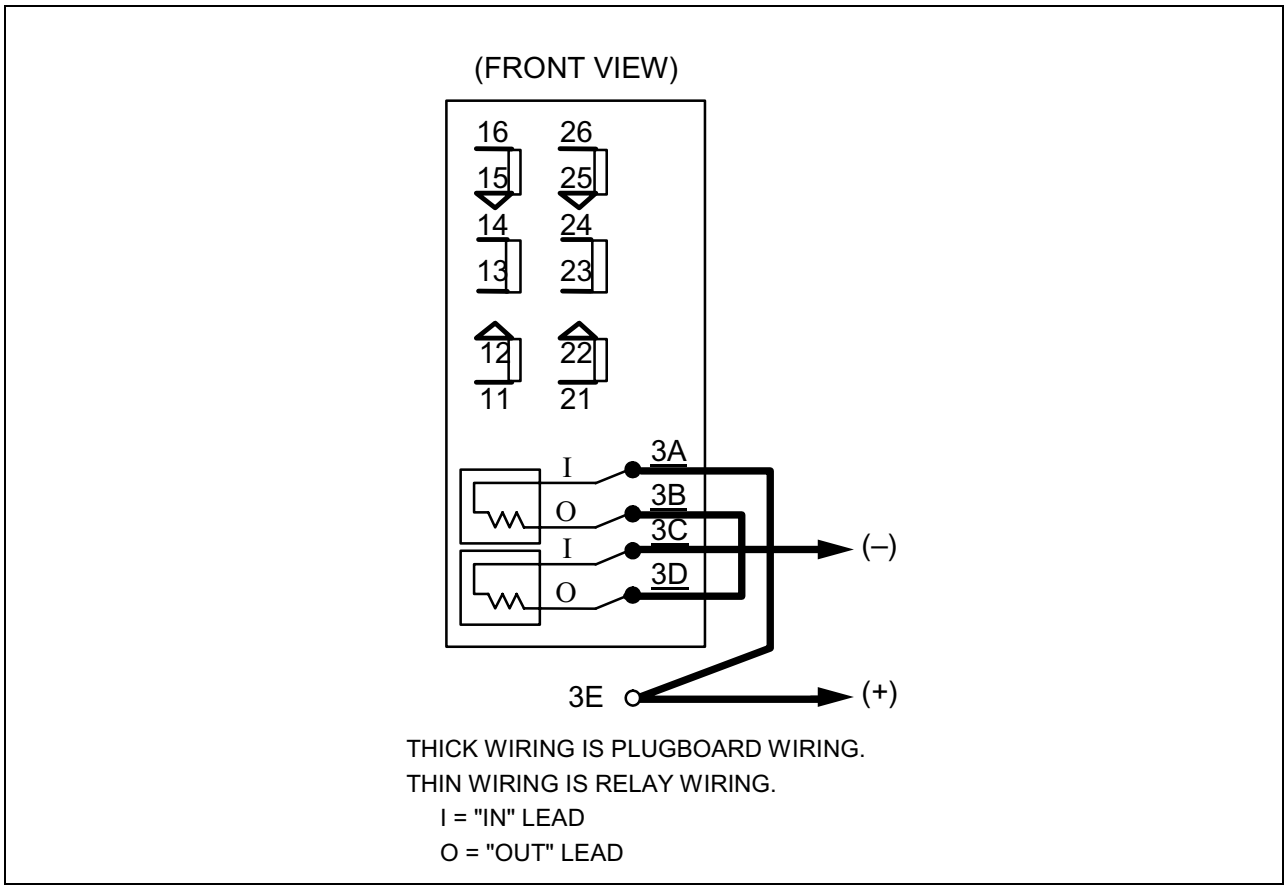


Figure 2–29. Code-Responsive Relay Wiring

2.5.6. Code Rate Transmitter Relay

Type B Code Rate Transmitter Relays are built only in Size 2. This relay has an oscillating armature secured to a vertical shaft that is supported at both ends by bearings. Affixed to the upper part of the shaft is one cam. The cam opens and closes sets of contacts. Below the cam is an armature positioned between two pole pieces. Below the armature is a spiral spring. These parts form the rotor for the relay.

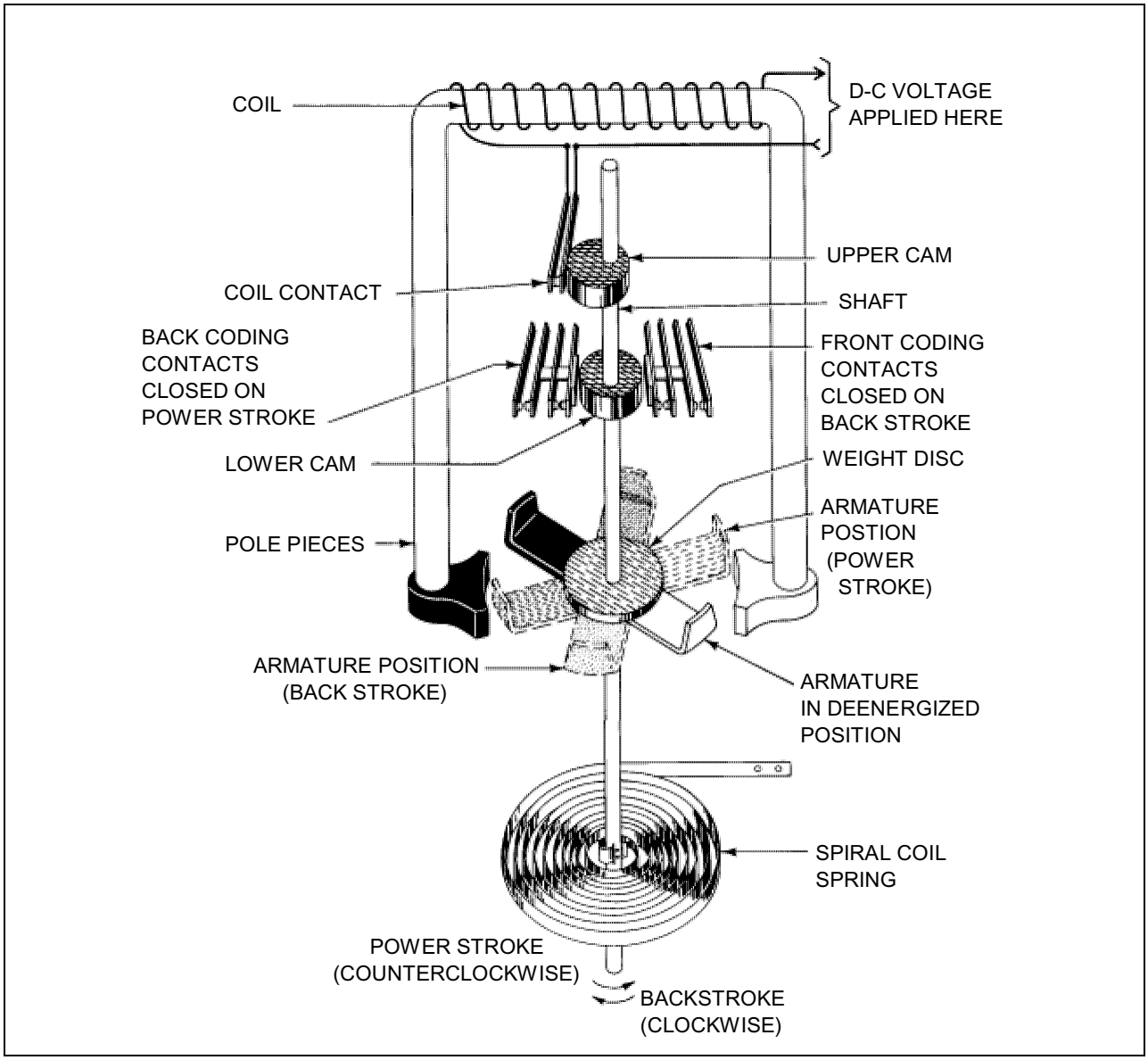


Figure 2–30. Code Rate Transmitter Relay Operation

The lower cam actuates contacts on either side of the cam to alternately open and close once for each rotor oscillation. Rate of armature oscillation depends on the mass of the armature and the length of the spiral spring. Relays with nominal rates of 50, 75, 120, 180, 220 and 270 cycles per minute are available.

CAUTION

Code Rate Transmitter Relays are shipped with a locked rotor. This lock must be released before the relay is placed in service. For more information, see "INSPECTION AND INSTALLATION," Section 3.

Code Rate Transmitter Relays have a single nominal 150-ohm resistance coil that operates in a 10-volt circuit. A nominal 1000-ohm resistance is shunted across the coil to absorb the inductive voltage surge, which occurs each time the contact opens the coil circuit.

In addition, a 0.25 mfd capacitor and a 150-ohm resistor form an RC network that is shunted across the coil contact to suppress arcing and eliminate electro-magnetic interference. See Figure 2–31.

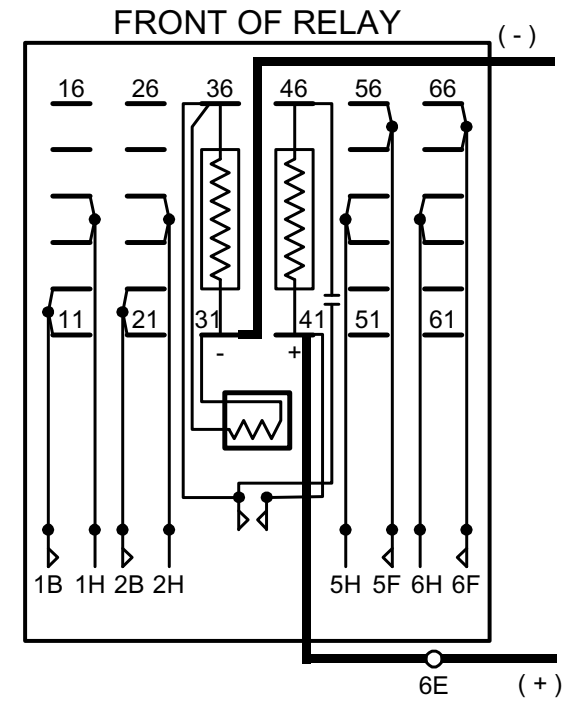


Figure 2–31. Code Rate Transmitter Relay Wiring

2.5.7. Code-Following, VTB Relay

Type VTB Code-Following Relays are used in coded track circuits and coded line circuits for signal control. It is used as a two position Polar-Biased Relay.

The relay occupies the plugboard space of a B2 Relay and has one or two armatures, depending upon circuit application. The VTB Relay plugboard, Figure 2–32, bolts on a B Relay rack. Both plugboard and current test terminals are standard design. Optional voltage test terminals are designed for a clip-on meter lead.

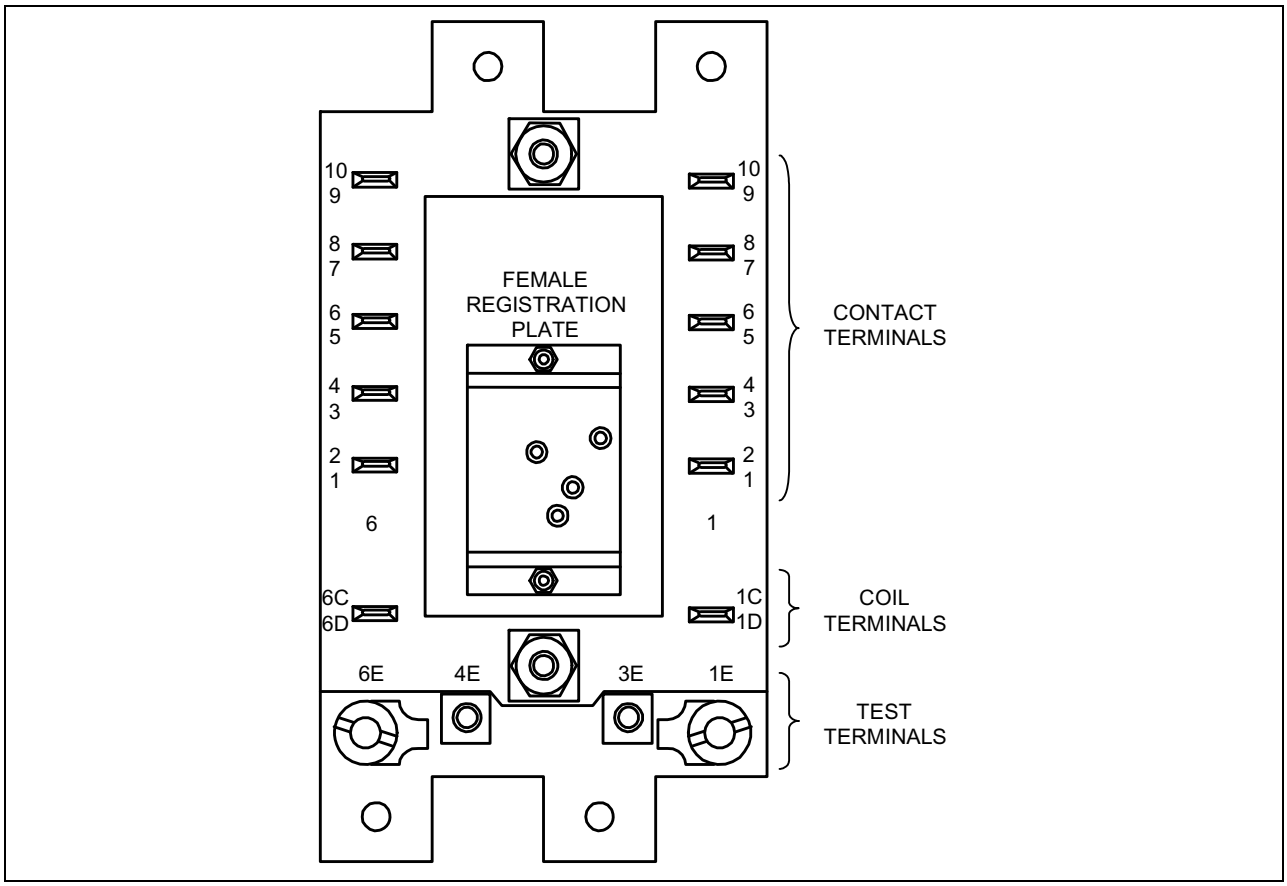


Figure 2–32. VTB Plugboard

A simplified operating diagram of the Polar-Biased Single Armature Relay is shown in Figure 2–33. The armature support spring is bent to provide a mechanical bias, thus, together with the permanent magnet, holding the armature against the left pole face when the relay is de-energized.

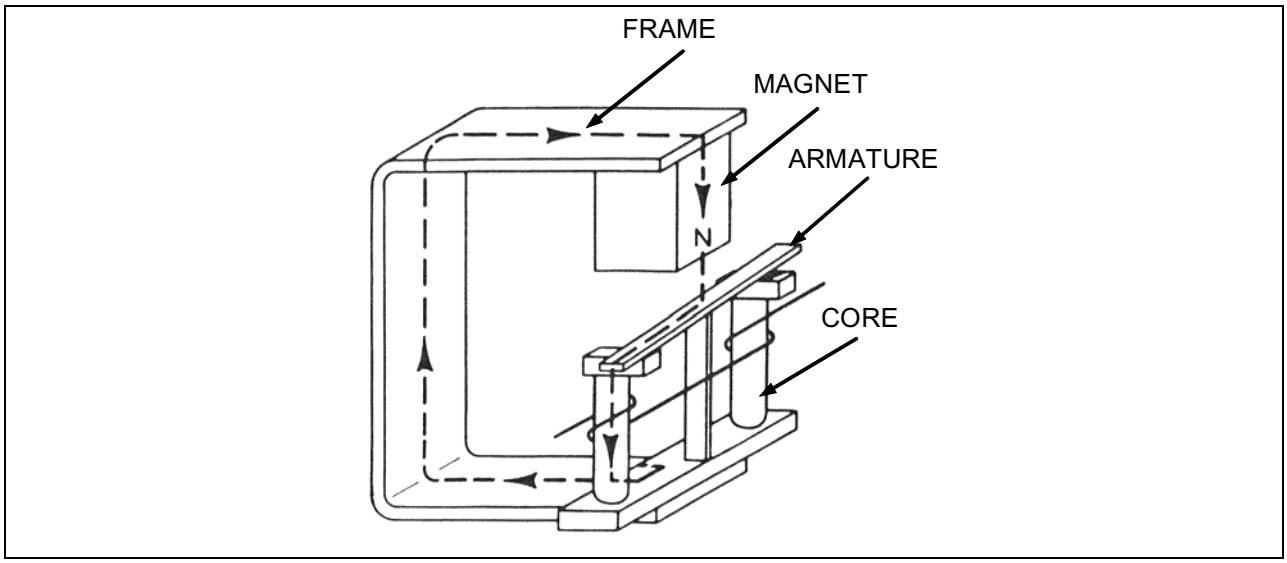


Figure 2–33. Polar-Biased Single Armature Relay

The following describes the two position polar-biased assembly. Both cores are connected by a yoke strap and bolted to the relay frame, forming a U-shaped structure. The armature is polarized by an alnico permanent magnet, which is mounted directly above the armature on the relay frame. The frame completes the magnetic circuit to the cores.

The armature is supported at the center by two springs, which act as a trunnionless bearing. Vertical armature support springs are fastened at the bottom to the yoke. Horizontal guide springs are fastened at one end beyond either the right or left pole faces. In the Double Armature Relay, each armature can be operated independently but not simultaneously. Contact actuation arms are riveted to the armature at the junction of the vertical and horizontal support springs. The vertical armature spring supports the armature and provides a torque bias to return the armature to the de-energized position.

With energy applied to the coils in the direction indicated in Figure 2–34, the armature is attracted to the right pole piece, overcoming the bias of the armature support spring. Magnetic flux is now concentrated in the right core. When energy is removed from the relay, the armature, because of biasing, returns to the left pole piece, Figure 2–35.

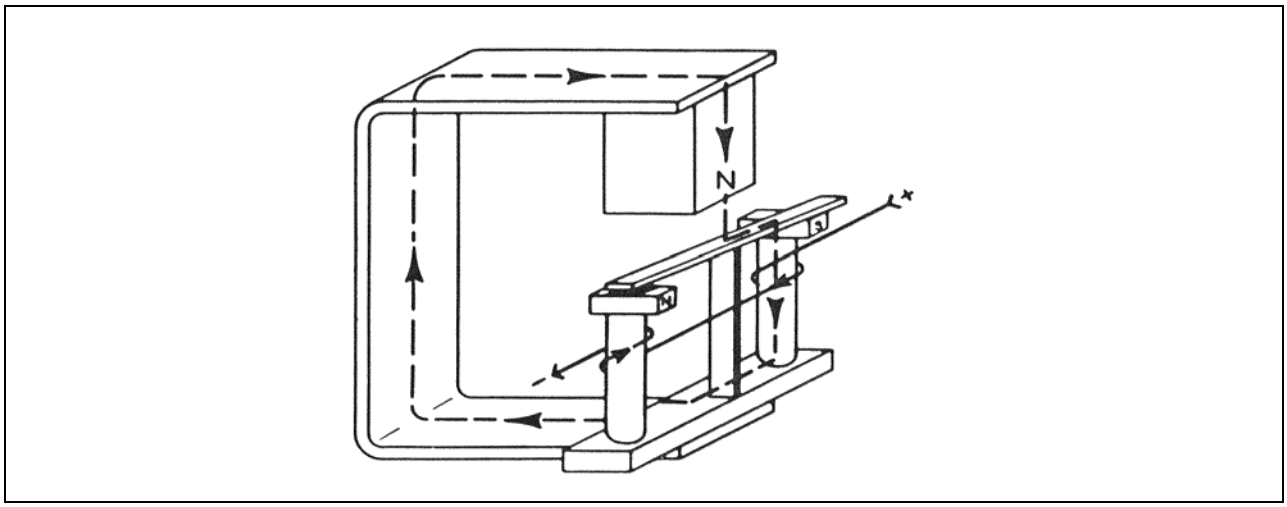


Figure 2–34. VTB Relay Energized

A simplified operating diagram of a VTB Polar-Biased Relay with two armatures is shown in Figure 2–35.

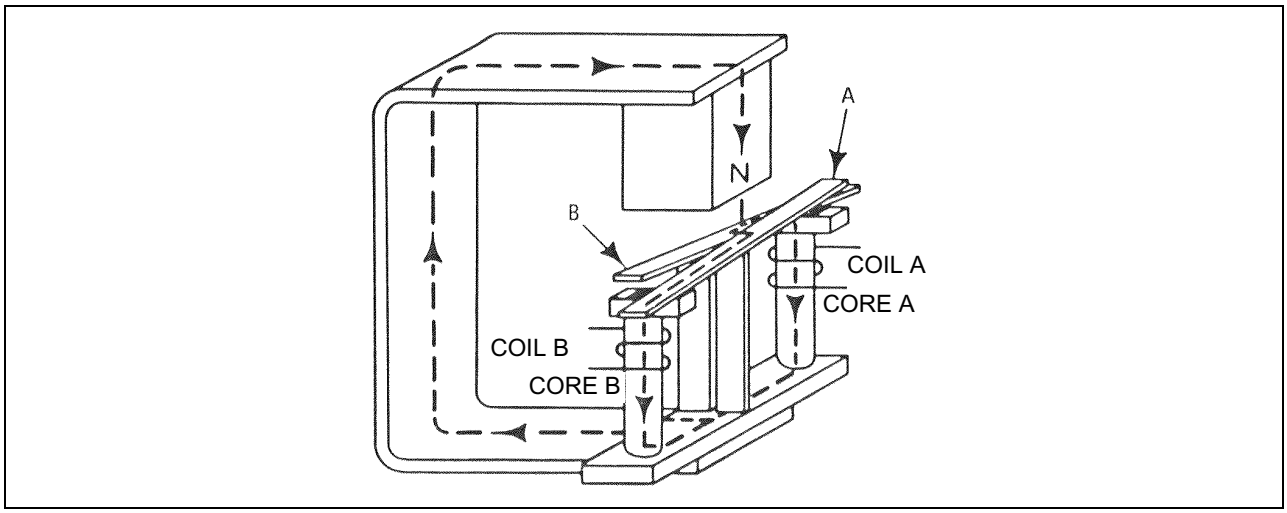


Figure 2–35. VTB Relay, Two Armatures De-energized

These armatures are biased in opposite directions, armature A against the left-handed pole piece, and armature B against the right-hand pole piece. This provides a symmetrical magnetic path. The permanent magnet flux divides equally between the two armatures and cores and reinforces the effect of the biasing springs on both armatures.

If coil B is energized in the direction shown in Figures 2–36, the flux through core B increases greatly.

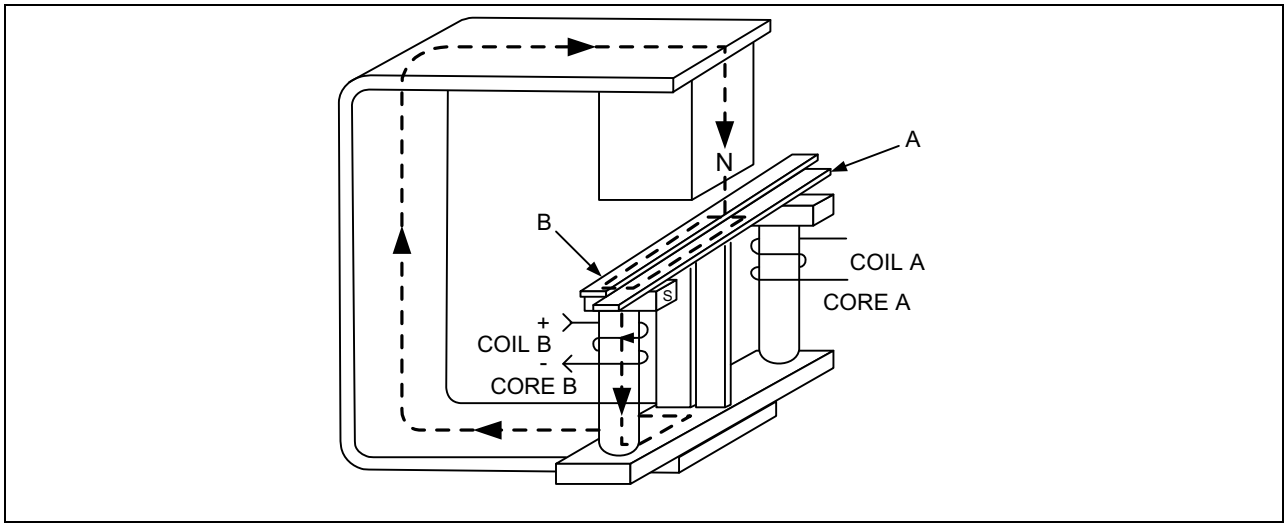


Figure 2–36. VTB Relay, Two Armatures Energized

As a result, the spring bias and permanent magnet flux acting on armature B are overcome and the armature is attracted to the left-hand pole piece. If, instead, coil A is energized to produce the proper direction of magnetic flux, armature B remains in its biased position and armature A is attracted to the right pole piece.

Figure 2–37 shows typical VTB Relay wiring.

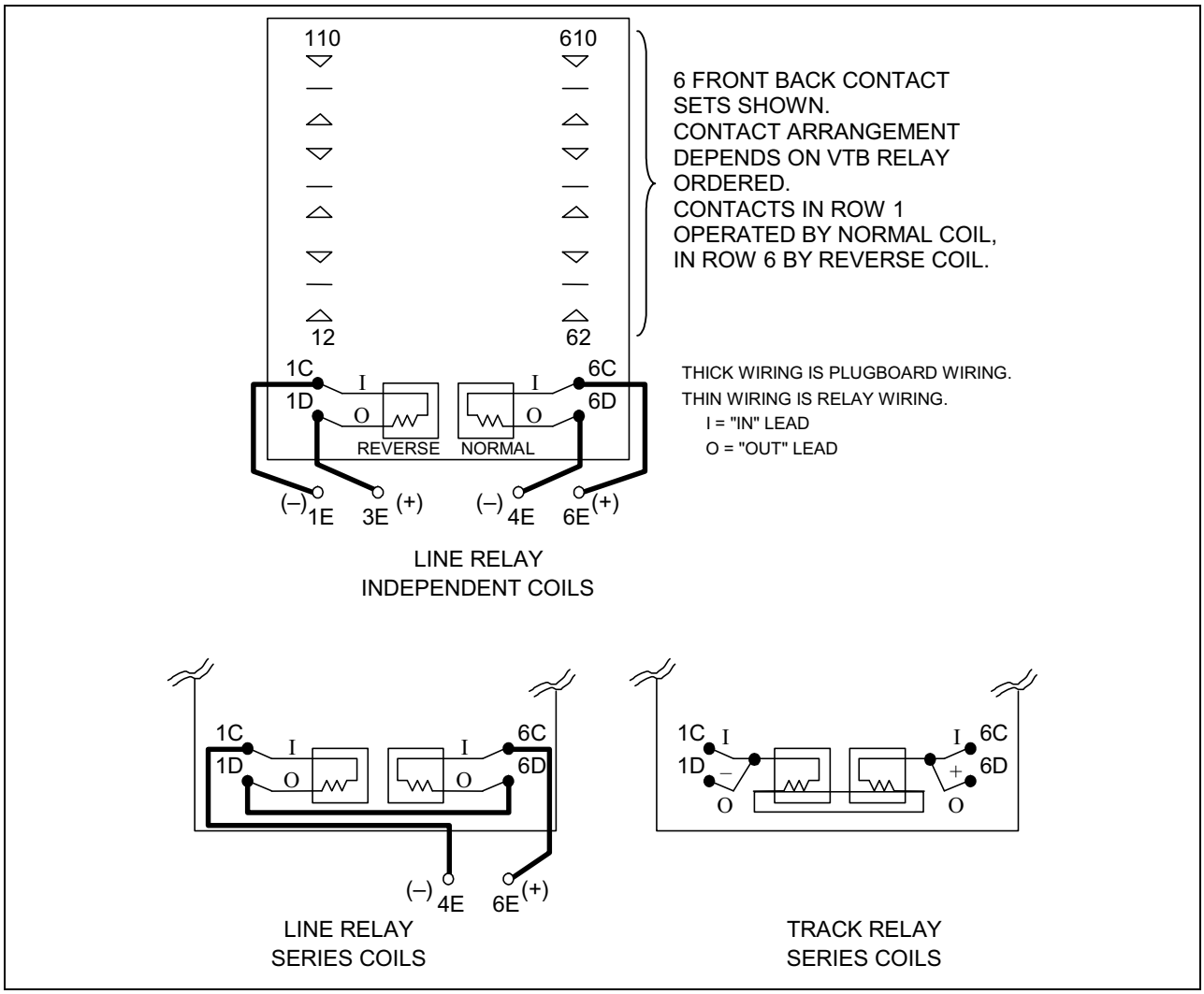


Figure 2–37. VTB Relay Wiring

2.6. AC TRACK RELAYS

2.6.1. Vane Relay

Type B2 Vane Relays are used in AC track circuits. They are high efficiency two position relays requiring low wattage in the track element for operation.

A vane of an aluminum alloy is secured to a horizontal shaft, with a trunnion at each end, which is supported by jewel bearings. They accurately position the vane in the air-gap between the two magnetic field structures with ample working clearance as shown in Figure 2–38.

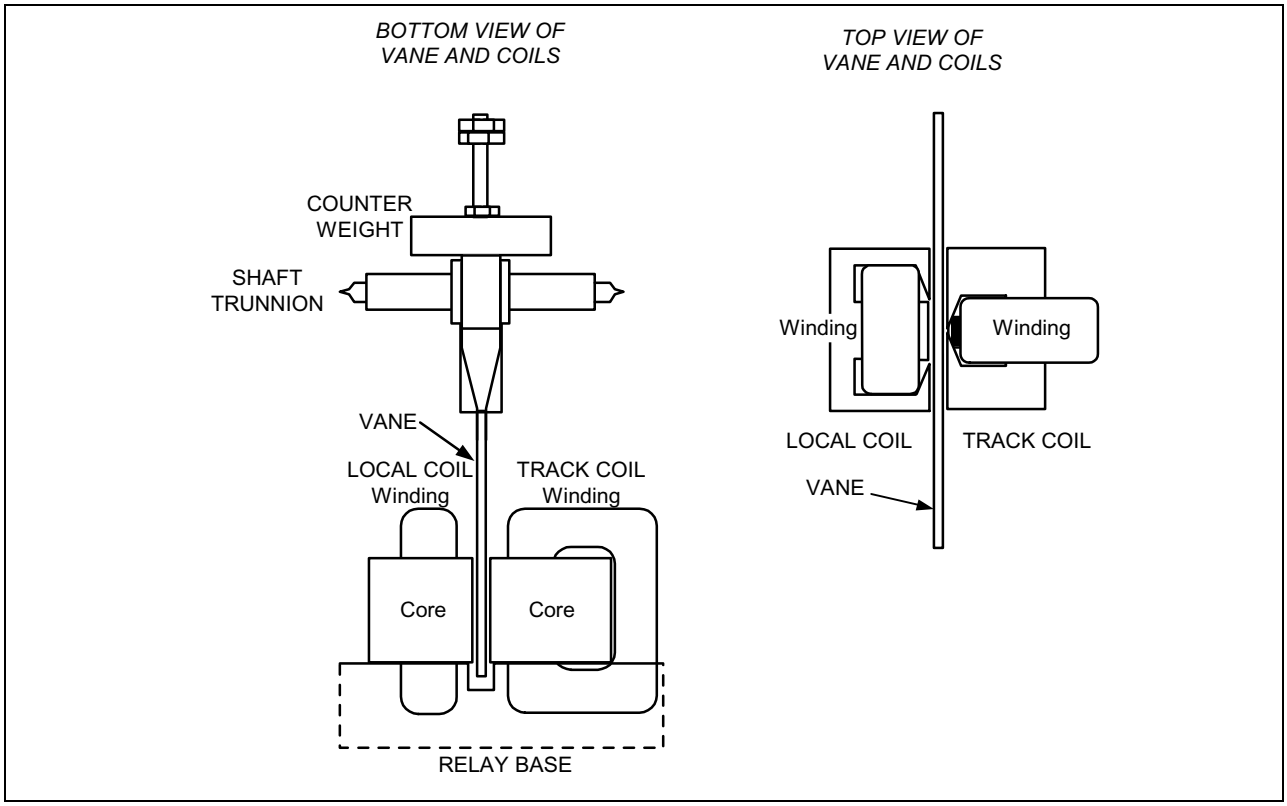


Figure 2–38. Vane Relay Structure

The local and track windings are fastened to the base of the relay, thus providing conduction of heat from the coils and laminations to the outside air. Both the vane and magnetic structure are compact, yet are designed for correct distribution of mass and magnetic flux. See Figure 2–39 for an illustration of relay components with the relay energized.

Pushers of insulated material transmit the movement of the vane shaft to the contacts. These contacts are similar to the ones used in DC relays, being flat springs molded in a phenolic block.

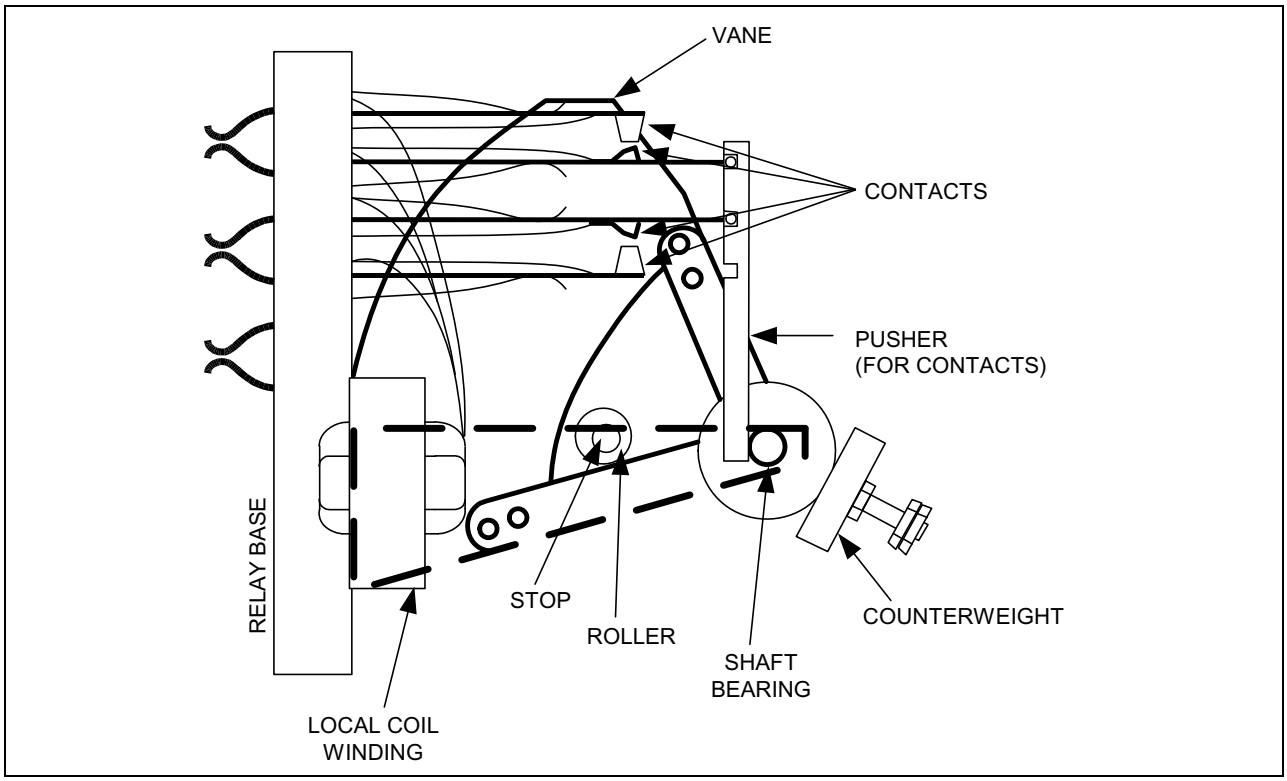


Figure 2–39. Vane Relay Components

The local coil may be double-wound so that the two windings can be hooked up in series or in parallel. When connected in parallel, each winding operates at half-voltage, and it becomes possible to connect a phase-shifting device, should track operating conditions make it necessary. Track windings are furnished the same way.

Examples of phase shifting devices are:

- track filter (P/N 58496-117-01)
- local filter (P/N 58496-118-01)

The local filter is a combined two-section series tuned and parallel tuned filter. The track filter contains a fuse, a capacitor, and a variable inductor.

The local and track filters are used to prevent line induced noise and traction energy from interfering with track circuit performance. The filter acts as a partial phase shifter to help establish a 90 degree phase shift between the track and local windings of the track relay. This is especially important at minimum ballast conditions.

Figure 2–40 shows the operation of the Vane Relay. An aluminum disc with a shaft through the center is supported so that it is free to rotate. If a permanent magnet is rotated about the disc shaft in such a way that the magnetic lines of force cut through and across the disc, the disc will start to rotate in the same direction as the permanent magnet, and at a slightly slower speed.

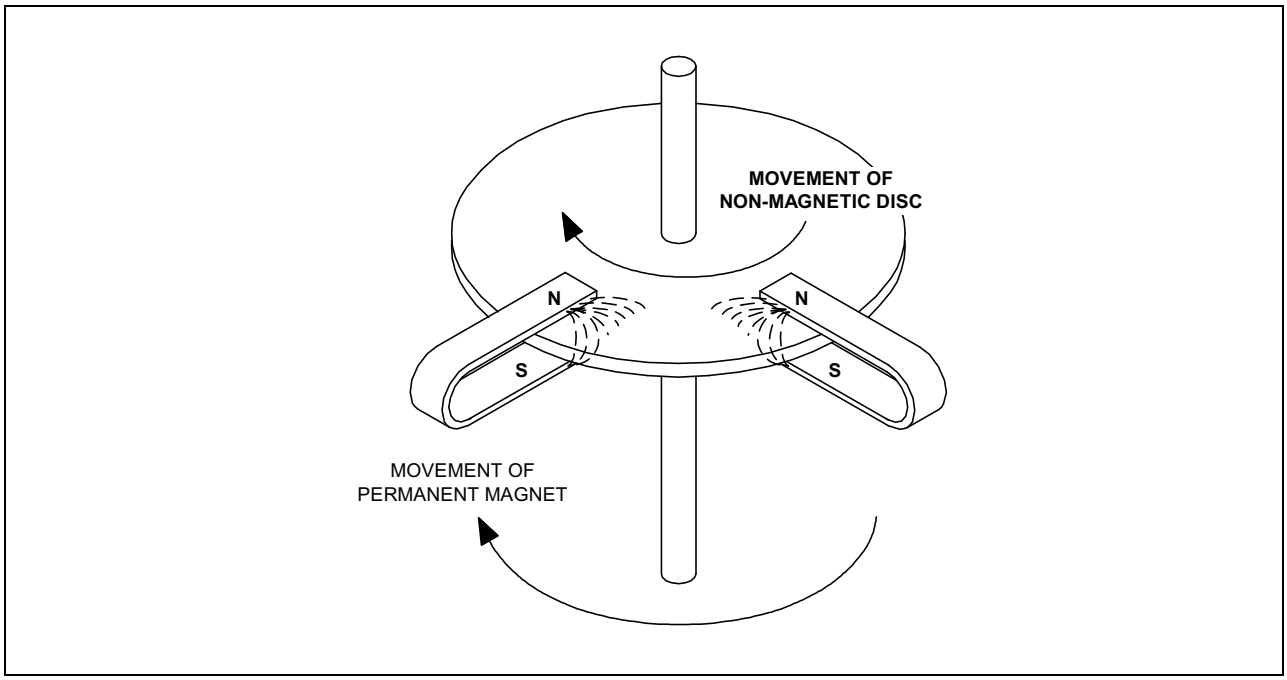


Figure 2–40. Magnet Movement Drags the Metal Disc

Figure 2–41 is an enlarged view of a section of the disc showing what occurs. When the permanent magnet is rotated, the magnetic lines of force cut the disc and produce a voltage between two points on the disc. A current, commonly known as an "eddy" current, flows between these points and back to its origin by the shortest path. These eddy currents produce small magnetic forces that react with the magnetic force of the permanent magnet, producing rotation.

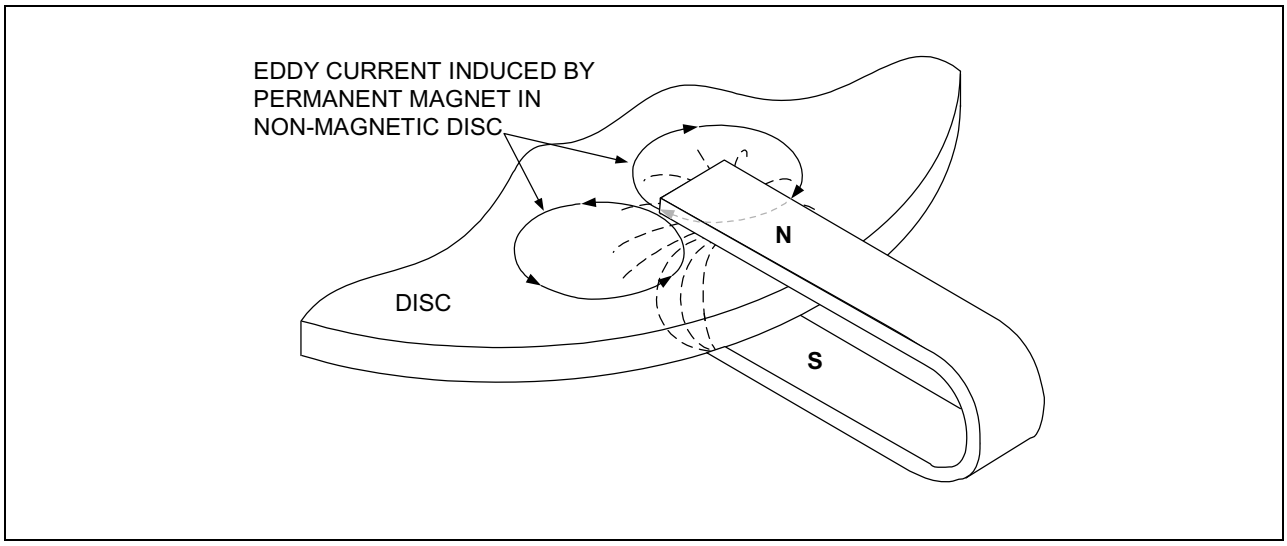


Figure 2–41. Eddy Current Induction by Permanent Magnet

In the Vane Relay, two electromagnets are constantly energized while the relay is picked up, but the magnetism produced by one of the electro-magnets lags in time with respect to the other. The reaction on the Vane Relay of the two independent magnetisms, which are out of phase, produces rotation, the same as that produced by the moving permanent magnet in Figure 2–41.

Figure 2–42 shows a complete cycle of local track currents plotted with the track current lagging the local current. The alternating current produces a lateral movement of flux in the air gap, as shown. Reference lines A, B, C, D, etc., divide the complete alternating current cycle into eighths, and the small figures represent instantaneous pictures or "snapshots" of what occurs in the relay magnetic circuit.

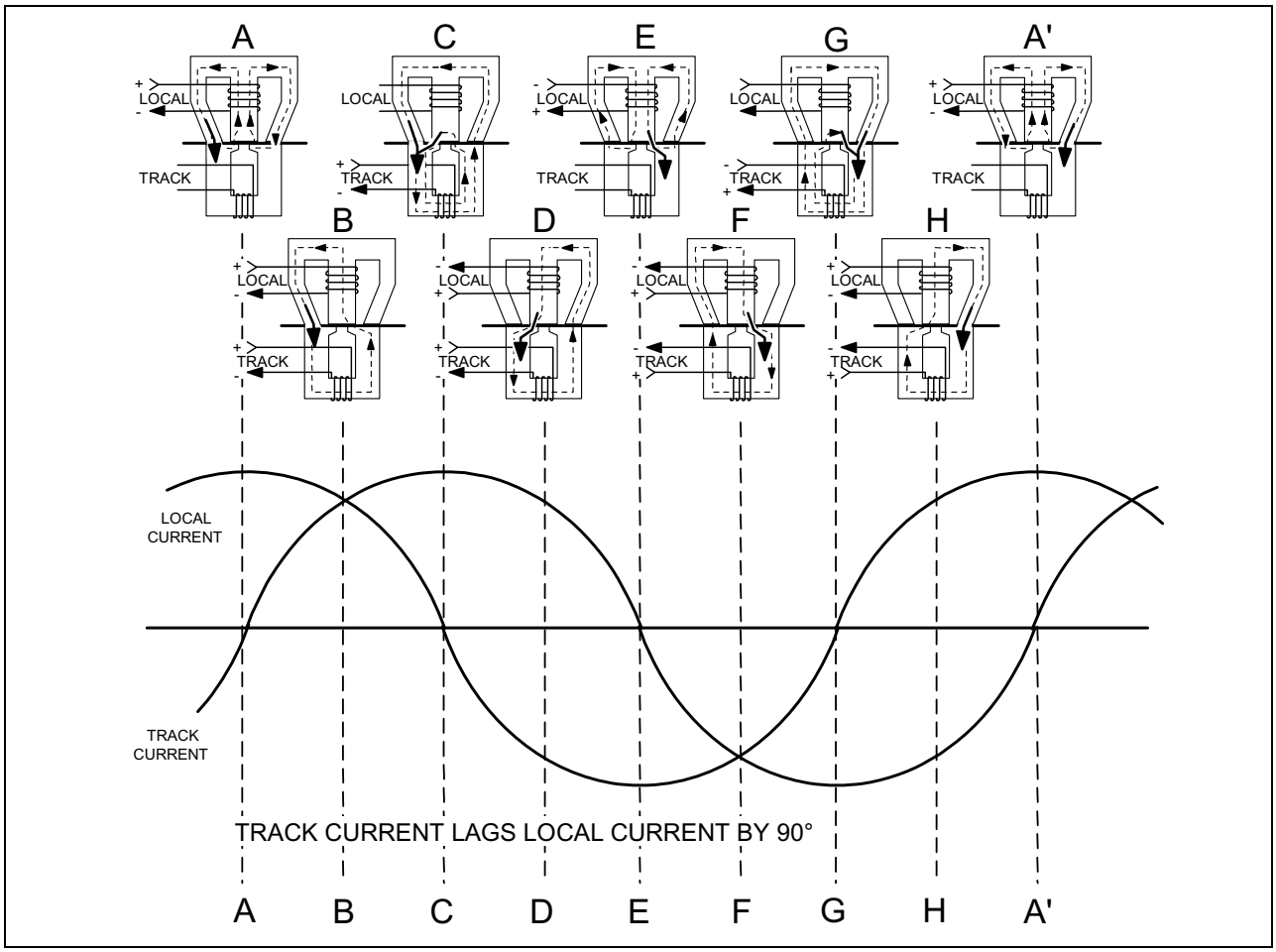


Figure 2–42. Local and Track Current Cycles

At A and A', the local current is at a positive maximum value and the track current is zero. The local winding is producing all the magnetic lines of force and their paths are shown by the dotted lines.

In each snapshot, notice the solid arrow, which is accentuated merely for reference and not because the lines of force are concentrated in that particular path. Compare the position of this arrow in snapshots B, C, D, and E. See how the arrow moves across the whole length of the air gap, cutting through and across the vane, much the same as the magnetic lines of force of the permanent magnet in Figure 2–41. All the other arrows do the same. Here, then, is the counterpart of the moving permanent magnet, except that, in this case, the magnetic structures are stationary, and the alternating current produces the magnetic flux motion.

For the relay to produce maximum torque with the minimum power input, the local and track current must be out of step by a quarter of a cycle or 90 degrees. Track relays, under adverse track conditions, may require a phase-shifting device inserted in the local phase to approximate the ideal current relationship.

Figures 2–43 and 2–44 show the parallel and series hookup of local and track windings, while Figure 2–45 shows relay and plugboard wiring along with some Vane Relay supporting components.

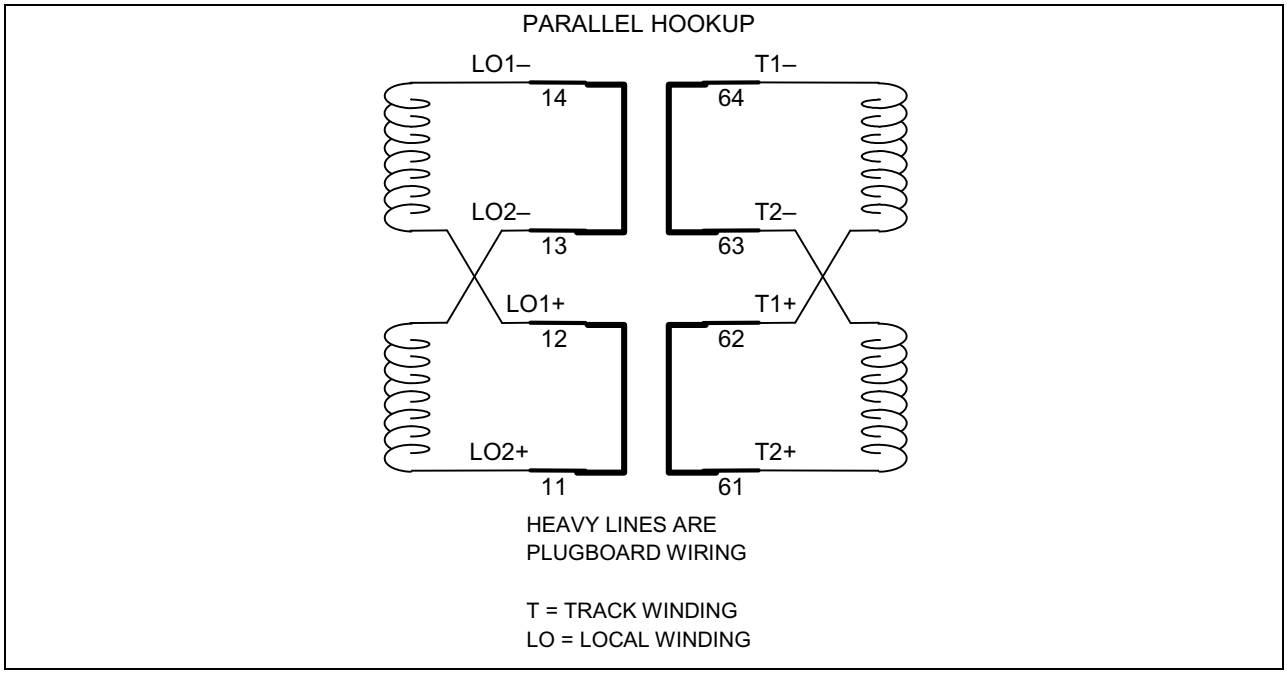


Figure 2–43. Parallel Hookup of Windings

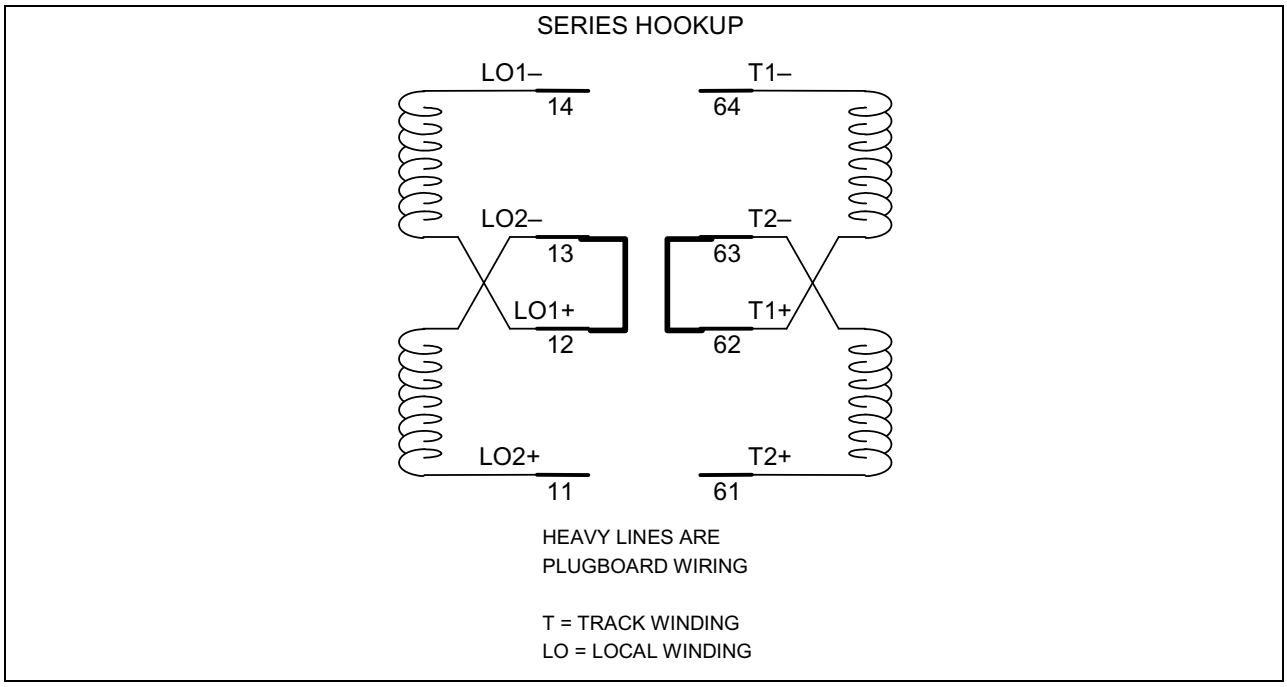


Figure 2–44. Series Hookup of Windings

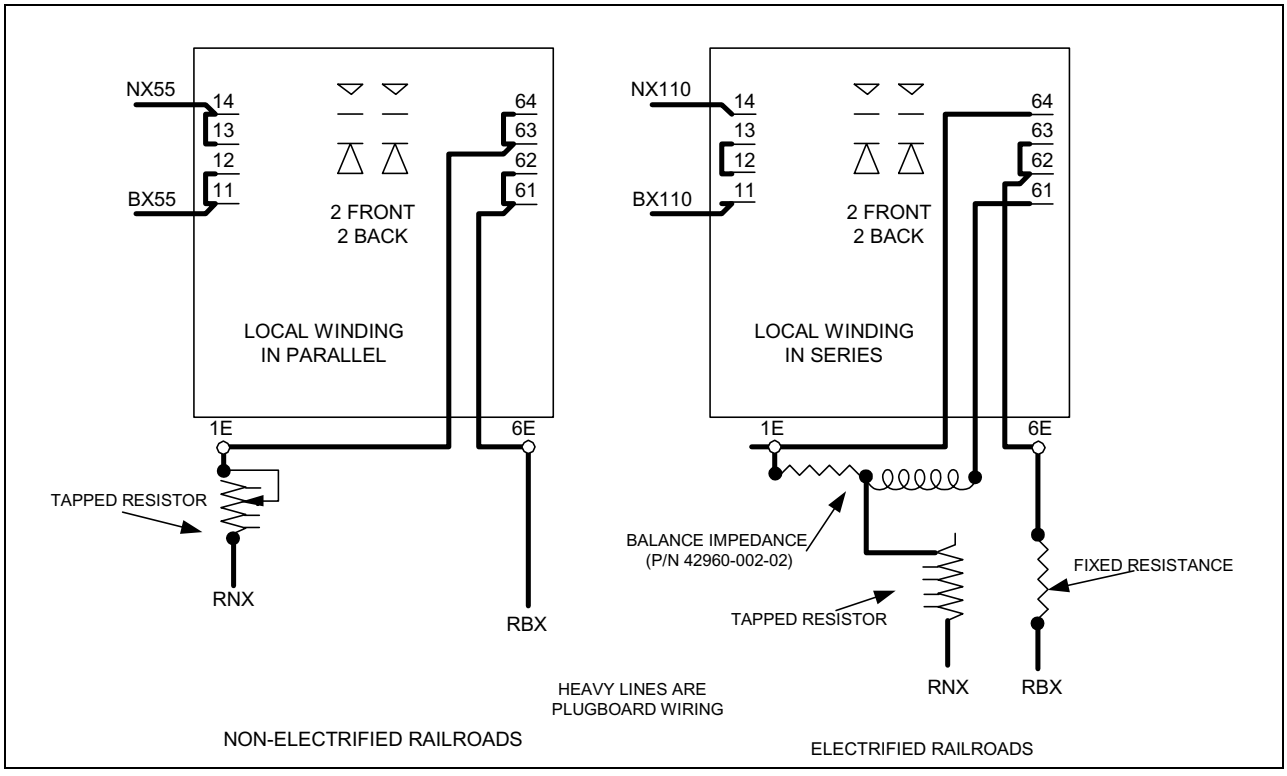


Figure 2–45. AC Vane Relay

3. SECTION 3 – INSTALLATION

3.1. GENERAL

This section contains general installation procedures for Type B Relays. Included is a procedure for inspecting each relay prior to installation, followed by the installation and adjustment procedure.

3.2. RELAY INSTALLATION TOOLS AND SUPPLIES

See Appendix C for a summary of B relay tools. See Section 7 for a listing of installation plugboards and supplies.

3.3. INSPECTION

Upon receipt of a shipment of Type B Relays, inspect them for cleanliness and overall condition. Also, always verify the operating characteristics of the relay before installing it in a particular circuit.

Prior to installing a Type B Relay, follow the inspection procedure provided in Table 3–1. Refer to Section 2, Figure 2–1 for an illustration identifying the basic B relay components.

Table 3–1. B Relay Pre-Installation Inspection Procedure

Step	Procedure
1	Check that the relay cover and seal are not damaged. **WARNING** BREAKING THE RELAY COVER SEAL VOIDS THE WARRANTY ON THE RELAY.
2	Verify that the relay prong surfaces are clean and not bent. While the prongs of the relay that engage with the terminals in the plugboard are clean and adjusted when they leave the factory, there is always the chance that they may become dirty or bent in handling. If prongs are dirty, clean by burnishing.
3	When relay racks complete with plugboards are received, verify they are clean and not broken or cracked. The terminals should lie close to the insulators. The guide rods should be straight and at right angles to the plugboard.

3.4. INSTALLATION

The B relay plugs into a plugboard assembly mounted on rack support bars. Plugboard assemblies:

- are available in either B1 or B2 sizes
- use insulators for separating the solder or crimp type terminals
- hold the guide rods for alignment and securing the relay
- hold the registration plates
- can be provided with current or voltage test posts

For a listing of plugboards, specialty parts, and mounting hardware refer to Section 7.15 B Relay Plugboards and Installation Supplies.

Most B relays are installed using the procedure provided in Table 3–2.

Table 3–2. B Relay Installation Procedure

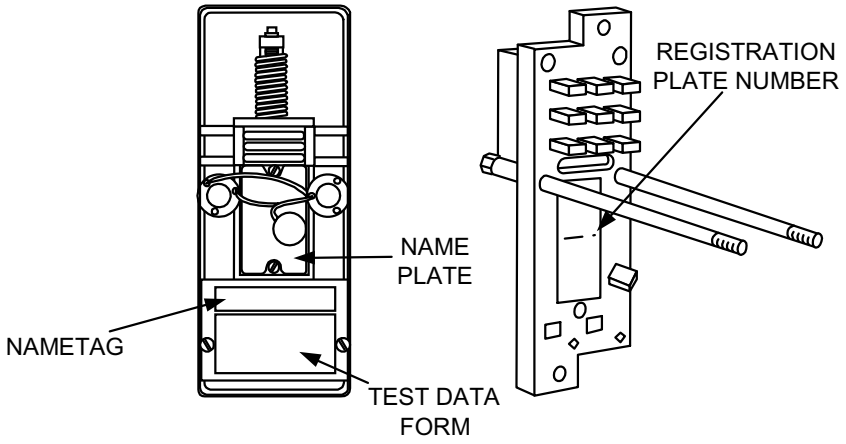
Step	Procedure
1	Verify the relay cover and seal are not damaged.
2	Verify the surfaces of the relay prongs that engage with the terminals in the plugboards are clean and not bent. While the relay prongs are clean and adjusted when they leave the factory, they may become dirty or bent during storage and handling. • If prongs are dirty, clean by burnishing. • If prongs are bent, bend them back into position so the make contact when the relay is installed.
3	Select the proper relay by checking the order reference number provided on the nameplate on the front of the relay. This number also appears on the detailed plans furnished with the installation and on the plugboard registration plate. 
4	Slide the relay Nametag into slot.

Table 3–2. B Relay Installation Procedure (Cont.)

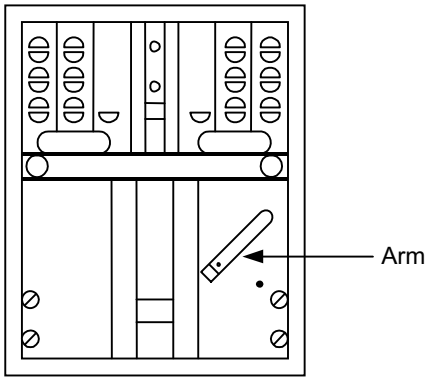
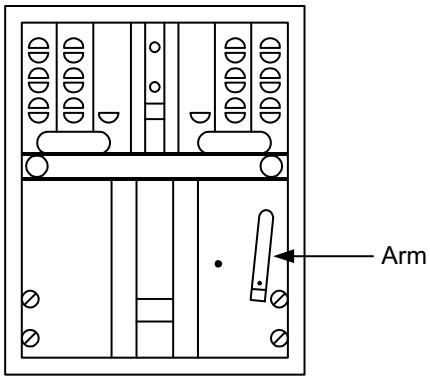
Step	Procedure
5	Code rate transmitter relays are shipped with the rotor locked to prevent damage to the relay. Before placing the relay into service the rotor must be unlocked by moving the arm on the back of the relay as shown below. ***ROTOR LOCKED FOR SHIPMENT*** Arm is located at back of transmitter.  Back of Transmitter ***TO UNLOCK ROTOR FOR SERVICE*** Slide arm at back of transmitter to the position shown below  Back of Transmitter A visual examination of the relay should also be performed to verify that with the arm in the unlocked position the rotor lock does not contact the rotor in any position of the rotor. After the relay is installed to its plugboard, the code rate of the relay should be verified to ensure it is correct.

Table 3–2. B Relay Installation Procedure (Cont.)

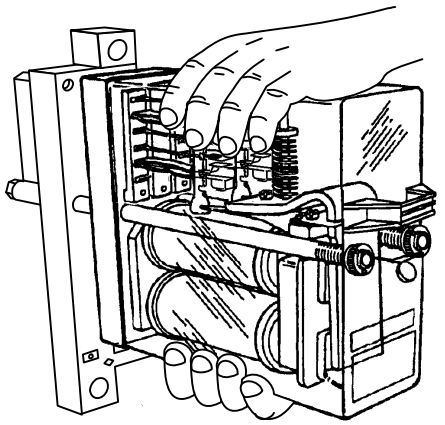
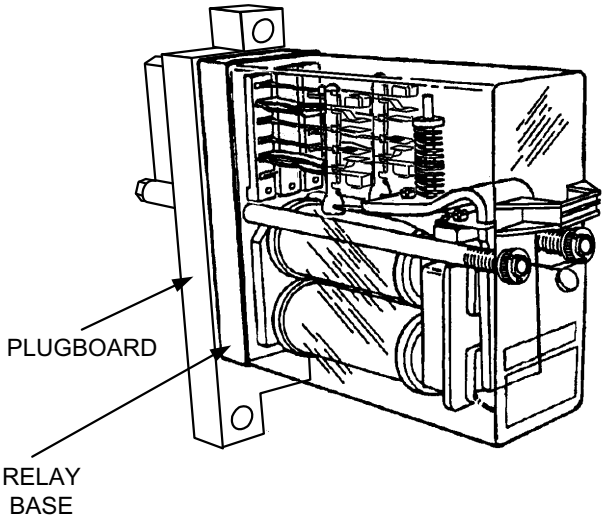
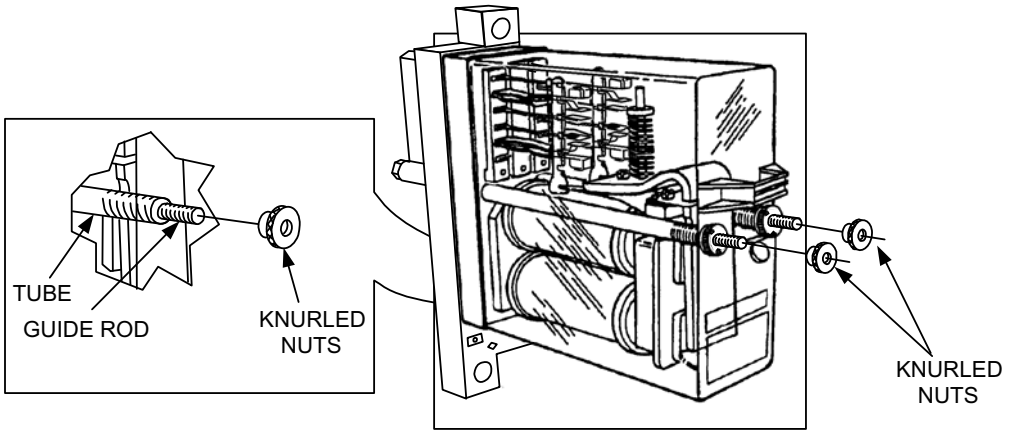
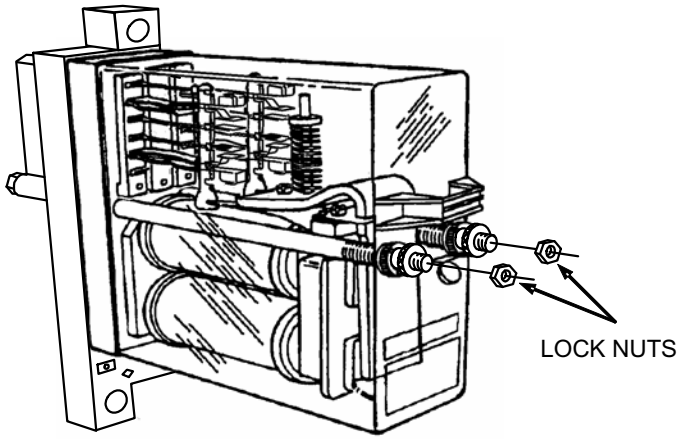
Step	Procedure
6	Grasp the relay on the top and bottom of the cover; slide it onto the guide rods.  If adjacent relay prohibits grasping of relay on top and bottom, use the handle on the front to push the relay along the guides.
7	Press the relay firmly into place so that the back of the relay is snug against its plugboard.  **CAUTION** Do not exert excessive pressure on the relay. Pressure greater than finger pressure could damage the relay or plugboard.

Table 3–2. B Relay Installation Procedure (Cont.)

Step	Procedure
8	Hold the relay in this position with one hand while putting on the knurled retaining nuts. The nuts should be tightened only until they just touch the end of the tube, but do not exert pressure against the relay.  **CAUTION** Do not use the retaining nuts to pull the insulators and prongs into engagement.
9	Screw on the lock nuts, holding the retaining nuts with the fingers to prevent their turning while tightening the lock nuts with an AAR wrench. 

4. SECTION 4 – PREVENTIVE MAINTENANCE

4.1. GENERAL

This section includes the preventive maintenance procedures associated with proper Type B relay operation. These procedures are provided as a minimum requirement, and may need to be modified due to local operational conditions or requirements.

Tests and inspections must include the following: measurement of PICKUP current and DROPAWAY current, timing of slow operating and timing relays, and visual inspection of contacts for damage or misalignment, corrosion or other contamination of parts, loose parts inside cover, broken seal, cracked, broken or discolored covers and wear particles on inside of cover.

WARNING

NOTIFY AND OBTAIN PERMISSION FROM CENTRAL CONTROL PRIOR TO PERFORMING ANY ELECTRICAL TESTS ON RELAYS. DURING THE ELECTRICAL TESTS RELAYS ARE INTENTIONALLY, MANUALLY ACTIVATED. THIS ACTIVATION AFFECTS THE RELAY CIRCUIT(S) AND POSES A POTENTIAL THREAT TO RAIL SAFETY. IT MAY PROVIDE FALSE INFORMATION, INTERRUPT OPERATION, AND CAUSE ALARMS TO INADVERTENTLY SOUND AND/OR BE DISPLAYED. TAKE ALL STEPS NECESSARY TO ENSURE THE SAFE PASSAGE OF TRAFFIC IS MAINTAINED.

NOTIFY CENTRAL CONTROL WHEN TESTING IS COMPLETE AND THE RELAY IS BACK IN OPERATION.

B relays identified as not passing inspection or meeting defined tolerances during the relay electrical test must be removed from service. To return a relay to service, the mechanical tests and adjustments provided in Section 6, Corrective Maintenance must be performed, followed by electrical tests to verify relay performance.

The following test and adjustment procedures require qualified maintenance personnel to test the relay portion of Type B relays.

Specifications for testing and inspecting all Alstom relays are given on relay Engineering Data (ED) sheets. Relay drawing and catalog numbers can be used with Appendix A to look up the Engineering Data (ED) Sheet number. To determine a relay's drawing or catalog number, refer to Heading 1.2.2., Identification. For copies of ED sheets, consult your Alstom Sales Representative or Alstom Customer Service.

Troubleshooting procedures are provided in Section 5, Troubleshooting. Mechanical tests and relay replacement procedures are provided in Section 6, Corrective Maintenance.

4.2. PREVENTIVE MAINTENANCE INTERVALS

Preventive maintenance procedures are performed on B relays with the covers on and sealed. The tests are a good check on the overall performance of the relay, and are completed easily and quickly.

Preventive maintenance consists of three procedures:

- Visual Inspection
- Electrical Test
- Timing Test, where applicable

Table 4–1 shows the recommended preventive maintenance time intervals.

Table 4–1. Preventive Maintenance Intervals

Relay Type	Preventive Maintenance Interval
Carborne Relays	Every 6 years
Vital Wayside Relays	Every 4 years
DC Polar and Vane Relays	Every 2 years
Master (or Primary) Relays, spring tension*	Every 2 years

* Any master or primary relay of the torque type, that depends on spring tension to return contacts to the de-energized position in noncoded continuous inductive automatic train stop or train control systems.

Vital wayside, DC Polar and Vane Relays can be inspected and tested while installed in racks or they may be removed from service and plugged on a shop test board for preventive maintenance. Electrical tests of relays in the relay racks are limited to measuring operating values and comparing the values to the specifications provided in the Engineering Data (ED) sheets. Relay drawing and catalog numbers can be used with Appendix A to look up the Engineering Data (ED) Sheet number. To determine a relay's drawing or catalog number, refer to Heading 1.2.2., Identification.

Carborne and Master Relays must be removed from service for inspection and testing. Relay removal and installation procedures are provided in Section 6, Corrective maintenance.

NOTE

Relays not passing any of the preventive maintenance tests or inspections must be replaced and not returned to service until the operating characteristics and conditions are in accordance with Alstom Engineering Data (ED) sheet specifications.

4.3. PREVENTIVE MAINTENANCE TOOLS

See Appendix C for a summary of B relay tools.

A specific wrench is used to turn the terminal nut on the current test post to open the coil circuit. Figure 4–1 shows a Spanner Nut Wrench (also called the "E" post wrench, P/N 55393-003-01).

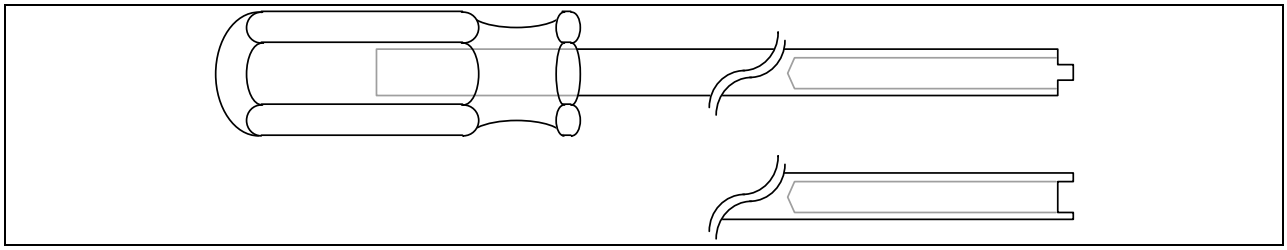


Figure 4–1. Spanner Nut Wrench

The Shop Test Rack, P/N 56573-002-01, is used to test relays in the shop. See Appendix C for details about the Shop Test Rack.

Electrical tests for operating values on Type B2 two element vane relays are made with the Vane Relay Test Unit, P/N 20182-111-01. See Appendix C for details about this test unit.

4.4. RELAY INSPECTION

All Type B relays must be visually inspected prior to performing electrical tests. Each Type B relay is in a clear plastic case and the parts to be inspected can be seen with the cover installed and sealed.

WARNING

BREAKING THE RELAY COVER SEAL VOIDS THE WARRANTY ON THE RELAY.

Visual inspection includes checking contacts for damage or misalignment, corrosion or other contamination of parts, loose parts inside cover, broken seal, cracked, broken or discolored covers and wear particles on inside of cover. The inspection procedure provided in Table 4–2 describes how to inspect a typical B1 Relay. Table 4–3 describes how to inspect a Vane Relay. Table 4–4 is a general relay inspection procedure applicable to all other relays.

NOTE

If any damage is detected, the relay must be removed from service and replaced.

Table 4–2. Typical B1 Relay Visual Inspection Procedure

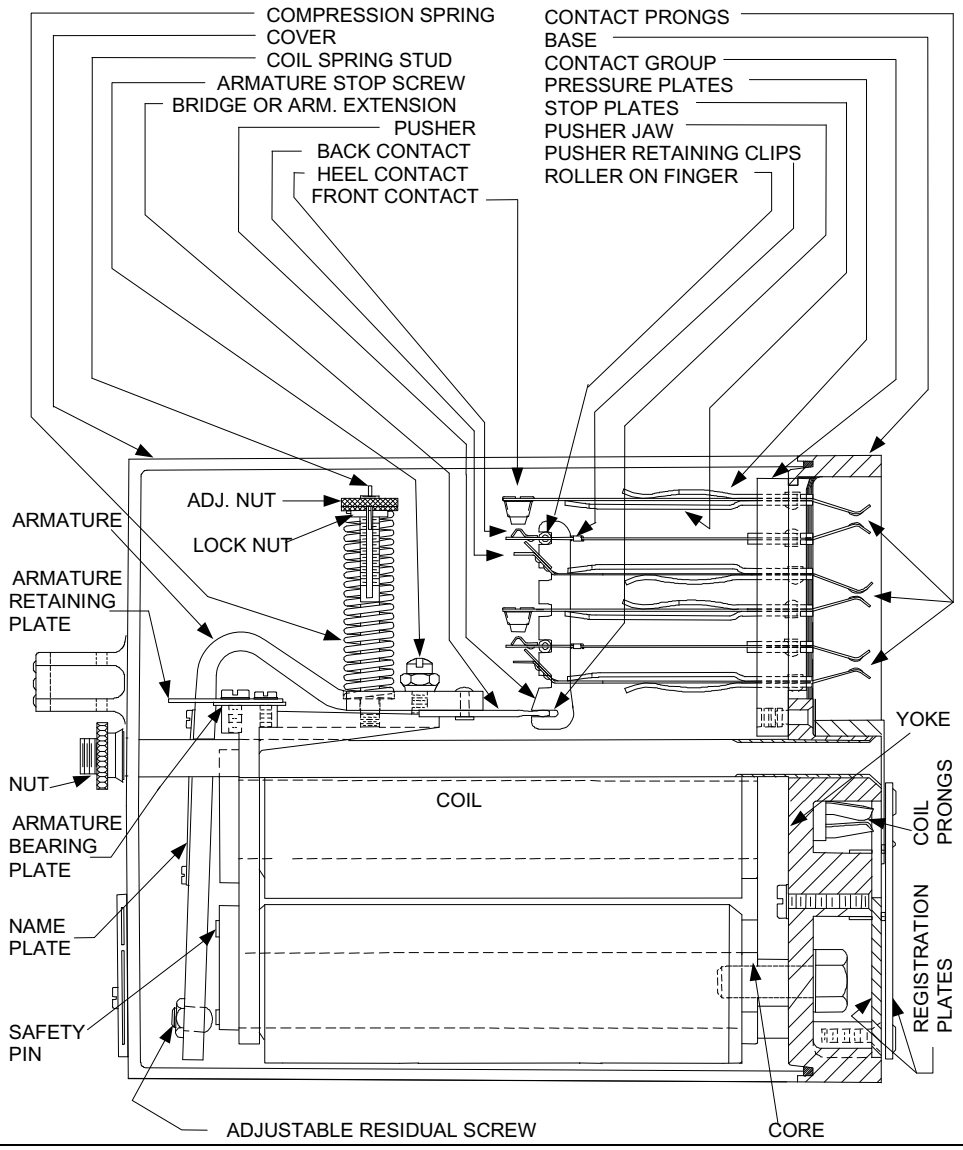
Step	Procedure
1	Check that the relay cover and seal are not cracked, broken or discolored.
2	Verify that relay components are not loose inside the cover. 
3	Verify the contacting surfaces are clean, smooth, and not bent or misaligned.

Table 4–2. Typical B1 Relay Visual Inspection Procedure (Cont.)

Step	Procedure
4	Verify that normally open co-acting contacts meet squarely and simultaneously when relay is energized. Contacts should have wipe as armature goes through to its front stop. When relay is deenergized, normally closed contacts should meet squarely and simultaneously. Contacts should have wipe as armature goes to its backstop. During pick up and drop away, armature must move freely on its bearing plate.
5	If components inside the cover are loose, mis-aligned, or required cleaning, remove and replace the relay.
6	If a relay is removed for any reason during the inspection procedure, the mechanical tests in Section 6 may be performed as specified. The relay may not be returned to service until the operating characteristics and conditions are in accordance with Alstom ED sheet specifications.

Table 4–3. Vane Relay Visual Inspection Procedure

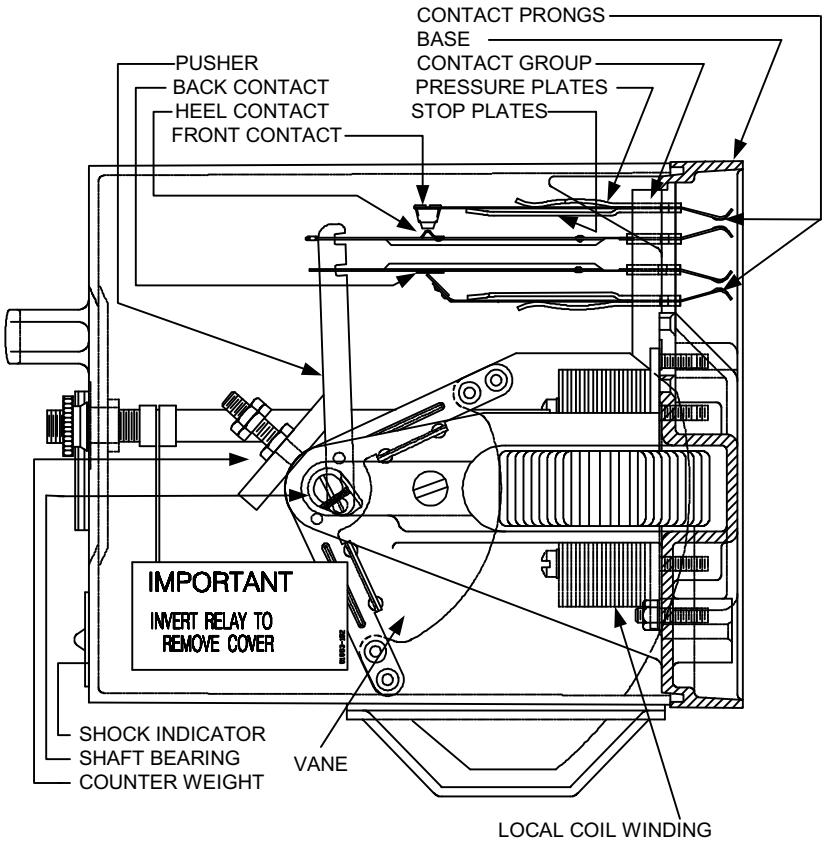
Step	Procedure
1	Check that the relay cover and seal are not cracked, broken or discolored.
2	Verify that relay components are not loose inside the cover. 
3	Verify the contacting surfaces are clean, smooth, and not bent or mis-aligned. Relay vane must not contact either local or track lamina in any position of the vane.
4	Verify that normally open co-acting contacts meet squarely and simultaneously when relay is energized. Contacts should have wipe as vane goes through to its front stop. When relay is deenergized, normally closed contacts should meet squarely and simultaneously. Contacts should have wipe as vane meets its backstop. During pick up and drop away, vane must move freely in its jewel bearings. There should be no indication of friction or binding in the bearings. If any friction or binding is observed the relay must be removed and replaced.

Table 4–3. Vane Relay Visual Inspection Procedure (Cont.)

Step	Procedure
5	If components inside the cover are loose, mis-aligned, or required cleaning, remove and replace the relay.
6	If a relay is removed for any reason during the inspection procedure, the mechanical tests in Section 6 may be performed as specified. The relay may not be returned to service until the operating characteristics and conditions are in accordance with Alstom ED sheet specifications.

Table 4–4. Miscellaneous Relay Visual Inspection Procedure

Step	Procedure
1	Check that the relay cover and seal are not cracked, broken or discolored.
2	Verify that relay components are not loose inside the cover. Many components are common to all B1 and B2 relays, reference Section 7 for drawings of specific relay components.
3	Verify any contacting surfaces are clean, smooth, and not bent or mis-aligned.
4	For relays with flexible connectors, the connectors must be intact and must not touch any adjacent parts. Any coils must be secured in place and in good condition.
5	Verify that normally open co-acting contacts meet squarely and simultaneously when relay is energized. Contacts should have wipe as armature goes through to its front stop. When relay is deenergized, normally closed contacts should meet squarely and simultaneously. Contacts should have wipe as armature goes to its backstop. During pick up and drop away, armature must move freely on its bearing plate.
6	If components inside the cover are loose, mis-aligned, or required cleaning, remove and replace the relay.
7	If a relay is removed for any reason during the inspection procedure, the mechanical tests in Section 6 may be performed as specified. The relay may not be returned to service until the operating characteristics and conditions are in accordance with Alstom ED sheet specifications.

4.5. ELECTRICAL TESTS

Electrical tests are made to verify the operating current values and to check contact resistances of the relay. If the relay does not operate at the proper values, readjust the relay to the readjustment values specified on the relay ED sheets. Relay drawing and catalog numbers can be used with Appendix A to look up the Engineering Data (ED) Sheet number. To determine a relay's drawing or catalog number, refer to Heading 1.2.2., Identification.

See Table 4–5 for a summary of relay specific electrical test procedures included in this manual.

WARNING

NOTIFY AND OBTAIN PERMISSION FROM CENTRAL CONTROL PRIOR TO PERFORMING ANY ELECTRICAL TESTS ON RELAYS. DURING THE ELECTRICAL TESTS RELAYS ARE INTENTIONALLY, MANUALLY ACTIVATED. THIS ACTIVATION AFFECTS THE RELAY CIRCUIT(S) AND POSES A POTENTIAL THREAT TO RAIL SAFETY. IT MAY PROVIDE FALSE INFORMATION, INTERRUPT OPERATION, AND CAUSE ALARMS TO INADVERTENTLY SOUND AND/OR BE DISPLAYED. TAKE ALL STEPS NECESSARY TO ENSURE THE SAFE PASSAGE OF TRAFFIC IS MAINTAINED.

NOTIFY CENTRAL CONTROL WHEN TESTING IS COMPLETE AND THE RELAY IS BACK IN OPERATION.

To power most B1 Relays, apply a variable current source to the coil leads, refer to the specific relay wiring diagram in Section 2.

Table 4–5. Electrical Test Procedures

Electrical Test Procedure	Table
AC Light-Out Relay Test Procedure	4–6
AC Vane Relay Test Procedure	4–7
Biased-Neutral Relay Test Procedure	4–8
Code-Responsive Relay Test Procedure	4–9
Code Rate Transmitter Relay Test Procedure	4–10
Magnetic-Stick Relay Test Procedure	4–11
Neutral Relay Test Procedure	4–12
Polarized Relay Test Procedure	4–13
Power-Transfer Relay Test Procedure	4–14
Switch-Overload Relay Test Procedure	4–15

4.5.1. AC Light-Out Relay Test

The AC Light-Out Relay is available in two coil configurations:

- A pair of low resistance coils wired in series
- A low resistance coil and high resistance coil

To obtain DROPAWAY, PICKUP, and WORKING current values follow the procedure in Table 4–6.

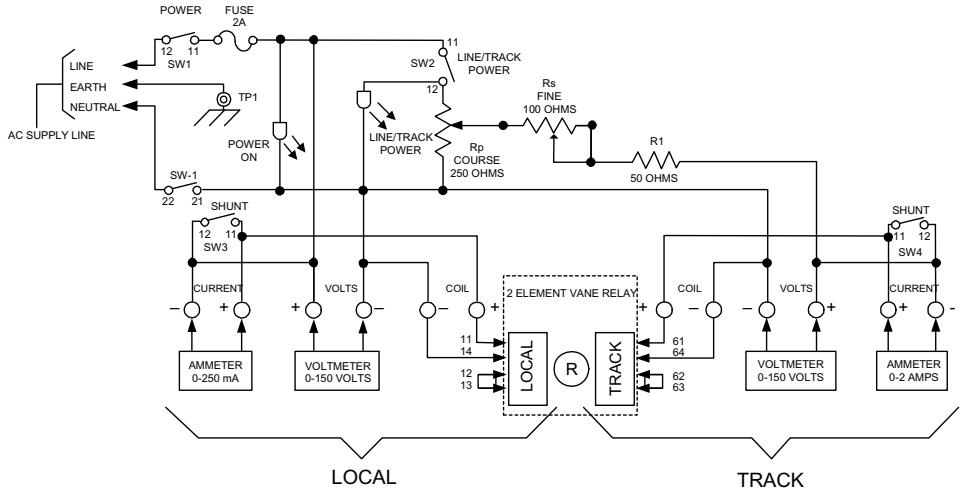
Table 4–6. AC Light-Out Relay Test Procedure

Step	Procedure
1	Perform the visual inspection procedure in Table 4–2.
2	Saturate the relay coils with current at the value shown on the Relays ED sheet. Coils are connected in series unless otherwise indicated.
3	Slowly decrease current and obtain DROPAWAY, which is the value at which the back contacts just make.
4	Open circuit.
5	Close circuit and slowly increase the current to obtain PICKUP, which is the value at which the front contacts just make.
6	Continue to slowly increase the current to obtain WORKING current, which is the value at which the armature is against the front stop. Frequently the PICKUP and WORKING current values are the same.

4.5.2. AC Vane Relay Test

To test a two-element AC Vane Relay follow the procedure provided in Table 4–7. To operate the text fixture see Appendix C.

Table 4–7. AC Vane Relay Test Procedure

Step	Procedure
1	Perform the visual inspection procedure in Table 4–3.
2	Connect the relay, meters and transformer, if required, to the Vane Relay Test Unit. 
3	Carefully adjust supply voltage (a tapped transformer is one means) so that the local element of the relay has the rated voltage imposed. Stabilize relay for at least one hour before taking electrical values with nominal voltage on the local element. Make allowance for the voltage drop across the milliammeter. Obtain local element readings.
4	Shunt the local milliammeter and adjust the local element voltage so that the rated voltage is impressed. Hold this value constant during test.
5	No voltmeter is required for the track element, as DROPAWAY, DROPAWAY to stop, PICKUP, and WORKING are expressed in current values.
6	While holding the voltage on the local element constant at its rated value and with the relay in its normal position, vary the track element current by moving the slider on the potentiometer or adjustable resistor. Determine the DROPAWAY, DROPAWAY to stop, PICKUP, and WORKING current values for the track element.

4.5.3. Biased-Neutral Relay Test

Use the procedure in Table 4–8 to verify biased-neutral relay performance.

Table 4–8. Biased-Neutral Relay Test Procedure

Step	Procedure
1	Perform the B1 relay visual inspection procedure in Table 4–2.
2	Saturate the relay coils with current at the value shown on the Relays ED sheet. Coils are connected in series unless otherwise indicated.
3	Slowly decrease current and obtain DROPAWAY, which is the value at which the back contacts just make.
4	Open circuit.
5	Close circuit and slowly increase the current to obtain PICKUP, which is the value at which the front contacts just make.
6	Continue to slowly increase the current to obtain WORKING current, which is the value at which the armature is against the front stop. Frequently the PICKUP and WORKING current values are the same.
7	All biased-neutral relays are designed to ensure that they will not pick up when 50 times normal WORKING voltage is applied in the reverse direction. Apply 50 times the normal WORKING voltage in the reverse direction. Relay should not pick up. If the relay picks up, remove it from service.

4.5.4. Code-Responsive Relay Test

To obtain operating values for the Code-Responsive Relay follow the procedure in Table 4–9.

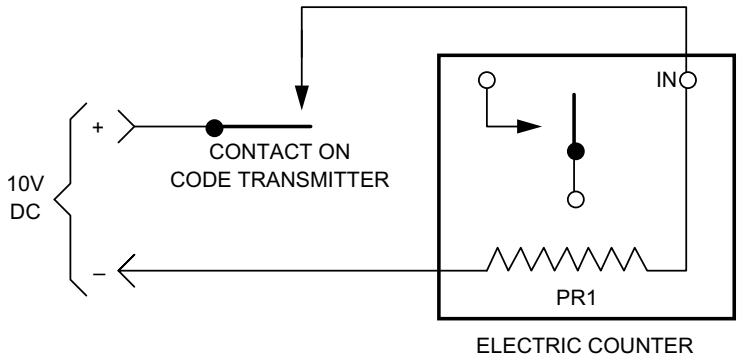
Table 4–9. Code-Responsive Relay Test Procedure

Step	Procedure
1	Perform the visual inspection procedure in Table 4–2.
2	Saturate relay coils at current value specified on specific ED sheet.
3	Operate relay several times by opening and closing circuit.
4	Slowly reduce current to obtain DROPAWAY value. Two readings of DROPAWAY values should be taken, one to close back contacts and the other to allow the armature to touch its backstop pin.
5	Open the circuit, close the circuit, and then slowly increase the current to obtain PICKUP and WORKING values. PICKUP is the current value at which the front contacts just close. WORKING is the current value at which the armature in the fully energized position is up against the stop.

4.5.5. Code Rate Transmitter Relay Test

To verify the code rate transmission in Cycles Per Minute (CPM), also referred to as the timing test, follow the procedure in Table 4–10.

Table 4–10. Code Rate Transmitter Relay Test Procedure

<table>
<tr><th>Step</th><th>Procedure</th></tr>
<tr><td>1</td><td>Perform the visual inspection procedure in Table 4–5.</td></tr>
<tr><td>2</td><td>Apply power to the relay: connect the electric counter through one set of contacts, operating the code rate transmitter relay at rated voltage (refer to the relay ED sheet).
 
</td></tr>
<tr><td>3</td><td>Connect a timer or oscilloscope to the time contacts. Verify that the time contacts remain closed at least 25.5 seconds during a one-minute run (42.5% min.).</td></tr>
<tr><td>3</td><td>Determine the number of times the circuit is closed during one minute, this value is the code rate.</td></tr>
<tr><td>4</td><td>With voltage at normal voltage, 10 percent below and 20 percent over normal rated voltage, and at 75% of rated voltage the code rate in Cycles Per Minute (CPM) must be held within the following limits unless the associated ED sheet indicates otherwise.
<table>
<tr><th>Nominal Code Rate</th><th>At Normal Volts</th><th>At 10% Under or 20% Over Normal Volts</th><th>At 75% of Rated Volts</th></tr>
<tr><td>50</td><td>±1</td><td>±2</td><td>±5</td></tr>
<tr><td>75</td><td>±2</td><td>±3</td><td>±5</td></tr>
<tr><td>120</td><td>±2</td><td>±3</td><td>±5</td></tr>
<tr><td>180</td><td>±2</td><td>±3</td><td>±5</td></tr>
<tr><td>220</td><td>±2</td><td>±3</td><td>±5</td></tr>
<tr><td>270</td><td>±2</td><td>±3</td><td>±5</td></tr>
</table></td></tr>
<tr><td>6</td><td>To check starting voltage, gradually increase the voltage across the coil terminals and note the voltage when the rotor begins oscillation. This voltage should be within the ED sheet limit.</td></tr>
</table>

4.5.6. Magnetic-Stick Relay Test

To verify the performance of the magnetic-stick relay, follow the procedure in Table 4–11.

Table 4–11. Magnetic-Stick Relay Test Procedure

Step	Procedure
1	Perform the visual inspection procedure in Table 4–5.
2	Stabilize relay by operating 5 to 10 times, alternately from NORMAL to REVERSE, at the saturation value specified on relays specific ED sheet.
3	Saturate Reverse at value specified on ED sheet.
4	Gradually reduce current to zero.
5	Reverse polarity and gradually increase current to point where armature moves to normal contacts. Without further increase in current, armature must proceed through to full normal position against stop. This is the NORMAL PICKUP and WORKING current and must be within the limits specified on ED sheet.
6	Saturate normal at value specified on ED sheet.
7	Gradually reduce current to zero.
8	Reverse polarity and gradually increase current to point where armature moves to Reverse contacts. Without further increase in current, armature must proceed through to full reverse position against stop. This is the REVERSE PICKUP and WORKING current and must be within the limits specified on the ED sheet.

4.5.7. Neutral Relay Test

To obtain DROPAWAY, PICKUP, and WORKING current values follow the procedure provided in Table 4–12.

Table 4–12. Neutral Relay Test Procedure

Step	Procedure
1	Perform the visual inspection procedure in Table 4–2.
2	Saturate the relay coils with current at the value shown on the Relays ED sheet. Coils are connected in series unless otherwise indicated.
3	Slowly decrease current and obtain DROPAWAY, which is the value at which the back contacts just make.
4	Open circuit.
5	Close circuit and slowly increase the current to obtain PICKUP, which is the value at which the front contacts just make.
6	Continue to slowly increase the current to obtain WORKING current, which is the value at which the armature is against the front stop. Frequently the PICKUP and WORKING current values are the same.

4.5.8. Polarized Relay Test

To obtain the operating values of Polarized Relays follow the procedure provided in Table 4–13.

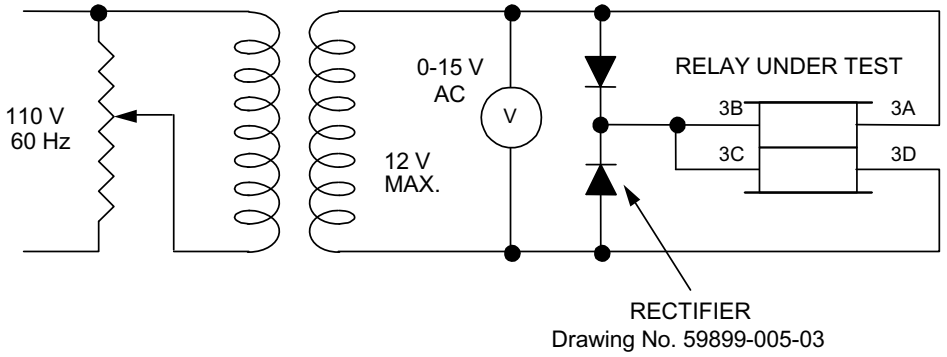
Table 4–13. Polarized Relay Test Procedure

Step	Procedure
1	Perform the visual inspection procedure in Table 4–2.
2	Stabilize relay by operating 5 to 10 times, alternately from Normal to Reverse, at the saturation value specified on relays specific ED sheet.
3	Saturate Reverse at value specified on ED sheet.
4	Gradually reduce current to zero.
5	Reverse polarity and gradually increase current to point where armature moves to normal contacts. Without further increase in current, armature must proceed through to full normal position against stop. This is the NORMAL PICKUP and WORKING current and must be within the limits specified on ED sheet.
6	Saturate Normal at value specified on ED sheet.
7	Gradually reduce current to zero.
8	Reverse polarity and gradually increase current to point where armature moves to reverse contacts. Without further increase in current, armature must proceed through to full reverse position against stop. This is the REVERSE PICKUP and WORKING current and must be within the limits specified on the ED sheet.

4.5.9. Power-Transfer Relay Test

Follow the procedure in Table 4–14 to test a Power-Transfer Relay. See specific ED sheet for exact details.

Table 4–14. Power-Transfer Relay Test Procedure

Step	Procedure
1	Perform the visual inspection procedure in Table 4–2.
2	Apply power to the relay.
3	Use this circuit for testing power-transfer relays: 
4	See specific ED sheet for specifications.

4.5.10. Switch-Overload Relay Test

The Switch-Overload Relay requires special adjustment. See specific ED sheet for exact details and operating values.

Table 4–15. Switch-Overload Relay Test Procedure

Step	Procedure
1	Perform the visual inspection procedure in Table 4–2.
2	See specific ED sheet for specifications.
3	Apply the minimum specified operating current to the terminals of the pick up winding (low resistance) with positive energy on 3C and negative energy on 3D. After 1½ minutes back off overpressure spring until relay picks. Lock spring at this setting.
4	Allow relay to cool at least 10 minutes.
5	Apply the minimum specified operating current to the terminals of the pick up winding for 1½ minutes. Relay must not pick. After 1½ minutes, quickly increase current to maximum pick up current. Relay must pick up. Remove power.
6	Check high resistance winding to insure the PICKUP and WORKING current value is within specified limits.

4.6. TIMING TESTS

4.6.1. Code Rate Transmitter Relay Timing Test

The Code Rate Transmitter Relay Timing Test is performed to check that the code rate transmitter relay contacts remain closed for the proper length of time. This test is included in Table 4–10, Code Rate Transmitter Relay Test Procedure.

THIS PAGE INTENTIONALLY LEFT BLANK.

5. SECTION 5 – TROUBLESHOOTING

5.1. GENERAL PHILOSOPHY

Troubleshooting helps to determine defective parts of equipment requiring repair or replacement. This is done through fault isolation diagrams and special instructions.

5.2. GENERAL TROUBLESHOOTING

General troubleshooting can be summarized as follows:

- Understand and define the problem.
- Confirm the problem.
- Isolate the fault.
- Perform corrective action.
- Verify system operation.

Standard troubleshooting, such as verifying wiring and energy, can be used to identify a failure.

It is recommended that the following items be checked when troubleshooting a Type B relay problem:

- Current Test Post (E Post) - check for tightness of spanner nut (if present, not all B relays have this post)
- Plugboard Contacts - check that relay is properly seated
- Voltage - check that it is provided to the coil

5.3. RELAY TROUBLESHOOTING TOOLS

See Appendix C for a summary of B relay tools.

5.4. FIELD TROUBLESHOOTING

Troubleshooting procedures are provided in a logical order. The procedures must be performed in the given order to be correct. Any deviation from the order can result in an incorrect diagnosis or indication. This section covers only those troubles most frequently encountered during equipment operation. If a specific concern occurs that does not appear in this section, refer to the appropriate functional description in Section 2, and isolate the problem to a listed functional area or to a defective assembly or subassembly.

Troubleshooting diagrams, in the form of fault isolation diagrams begin with a malfunction symptom. Then, based on observation/tests by the maintainer, the diagrams branch out to isolate probable causes of the malfunction. When a malfunction is external, a reference is given to refer the maintainer to the probable fault area for further troubleshooting.

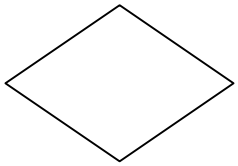
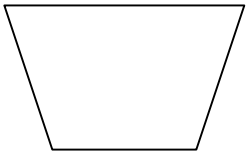
NOTE

After performing replacements, repairs, or adjustments the maintainer must repeat the troubleshooting procedure.

Troubleshooting symbols are described in Table 5–1. Fault isolation diagrams are provided as follows:

- Figure 5–1, DC Relay Does Not Pick
- Figure 5–2, DC Relay Does Not Release
- Figure 5–3, AC Vane Relay Does Not Pick
- Figure 5–4, AC Vane Relay Does Not Release

Table 5–1. Troubleshooting Symbols

Symbol	Explanation
	Malfunction statement as derived from operator's report.
	Basic instruction for preparation of a test, procedure, or observation. The action taken results in a diagnostic decision.
	Result from previous action, which is answered yes or no. If result is within tolerance, answer yes. If not, answer no. Do not consider any gray areas between yes and no.
	Final step of instructions involving corrective measures. Reference publication indicates suspected problem area.
	Special instruction for continuation of troubleshooting diagram at referenced location.

5.4.1. DC Relay Troubleshooting

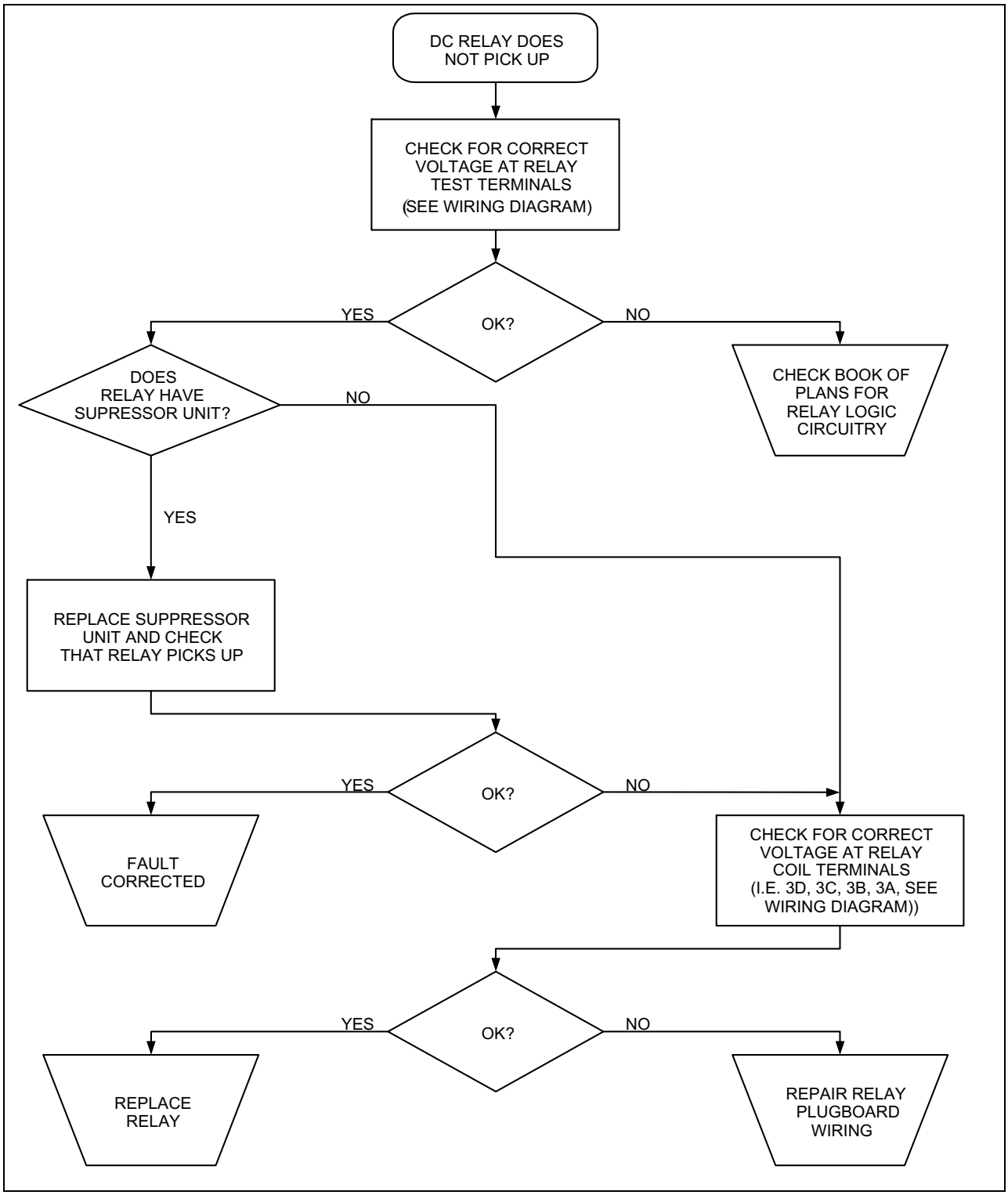


Figure 5–1. DC Relay Does Not Pick

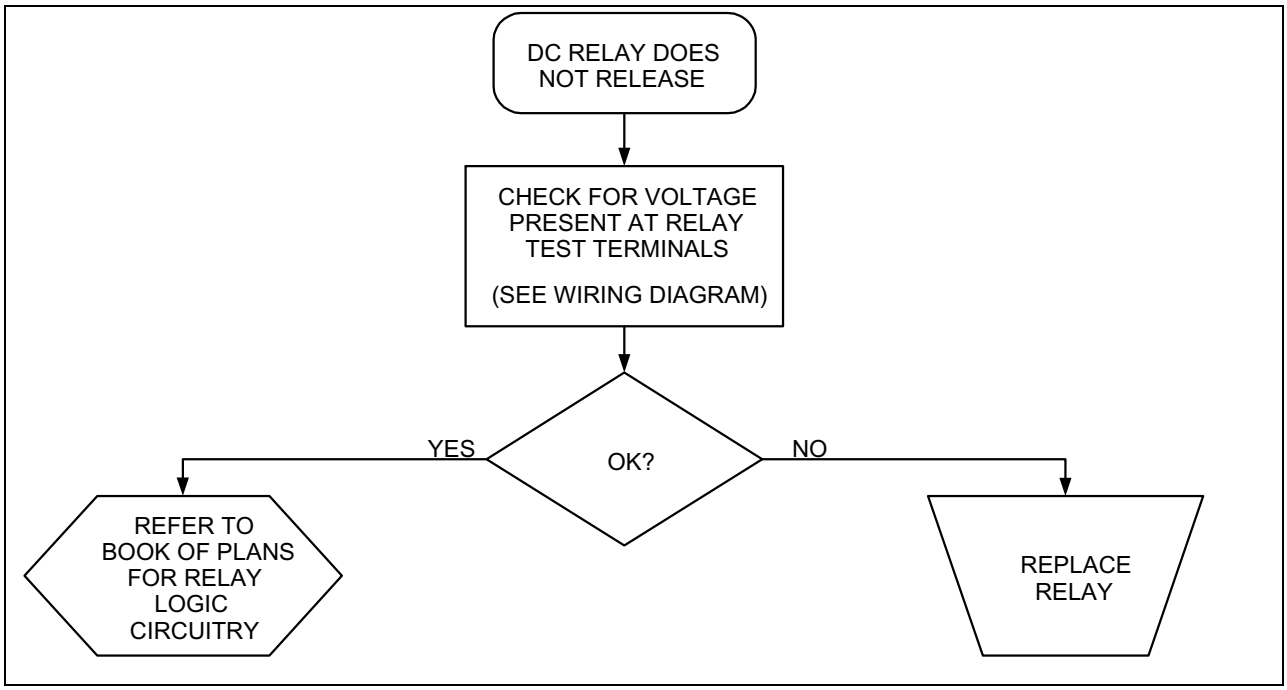


Figure 5–2. DC Relay Does Not Release

NOTE

Failure of a DC Relay to release with no voltage applied to the terminals could indicate a potential safety failure. Record the conditions and notify Alstom Signaling customer service as soon as possible.

5.4.2. AC Vane Relay Troubleshooting

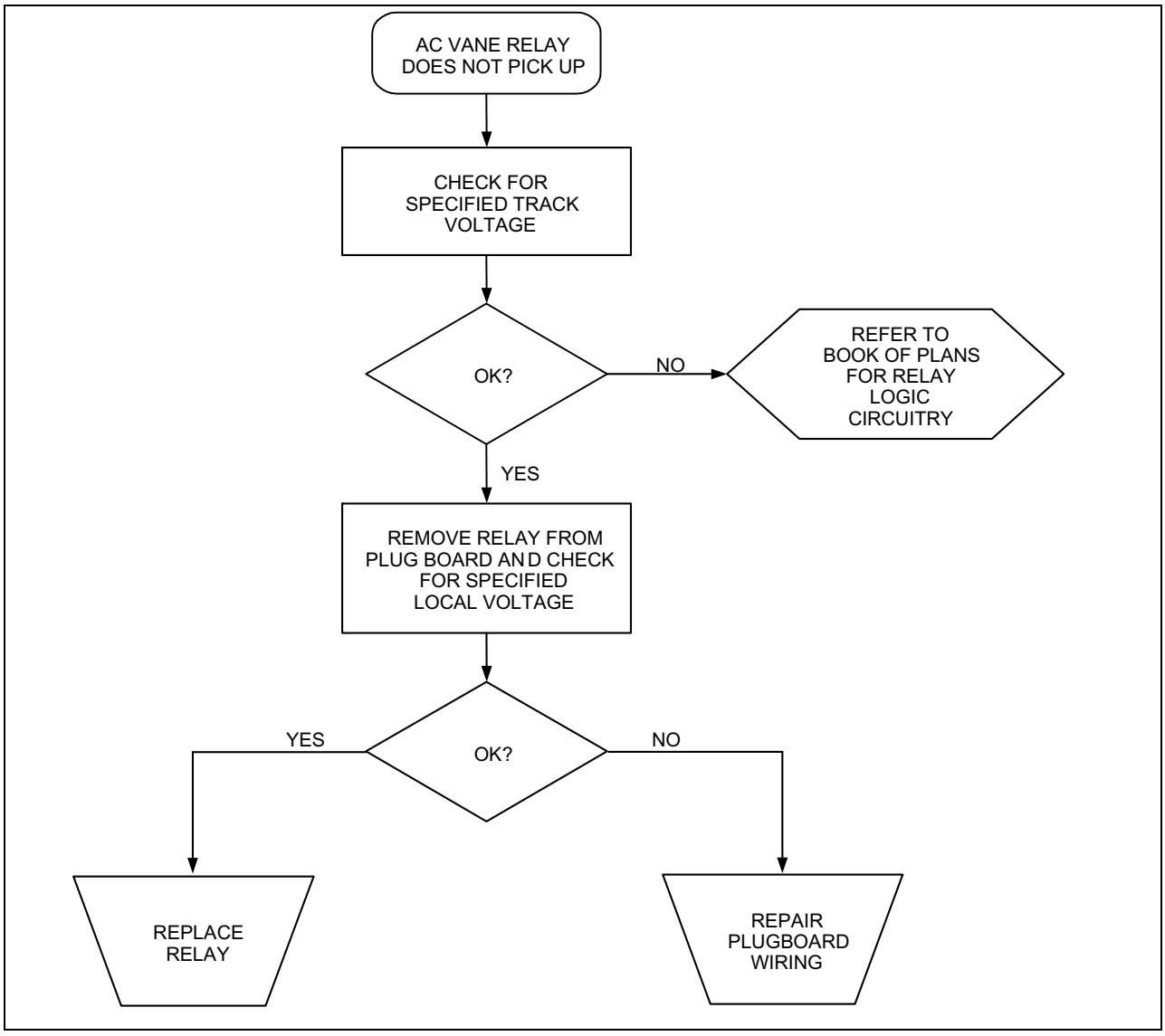


Figure 5–3. AC Vane Relay Does Not Pick

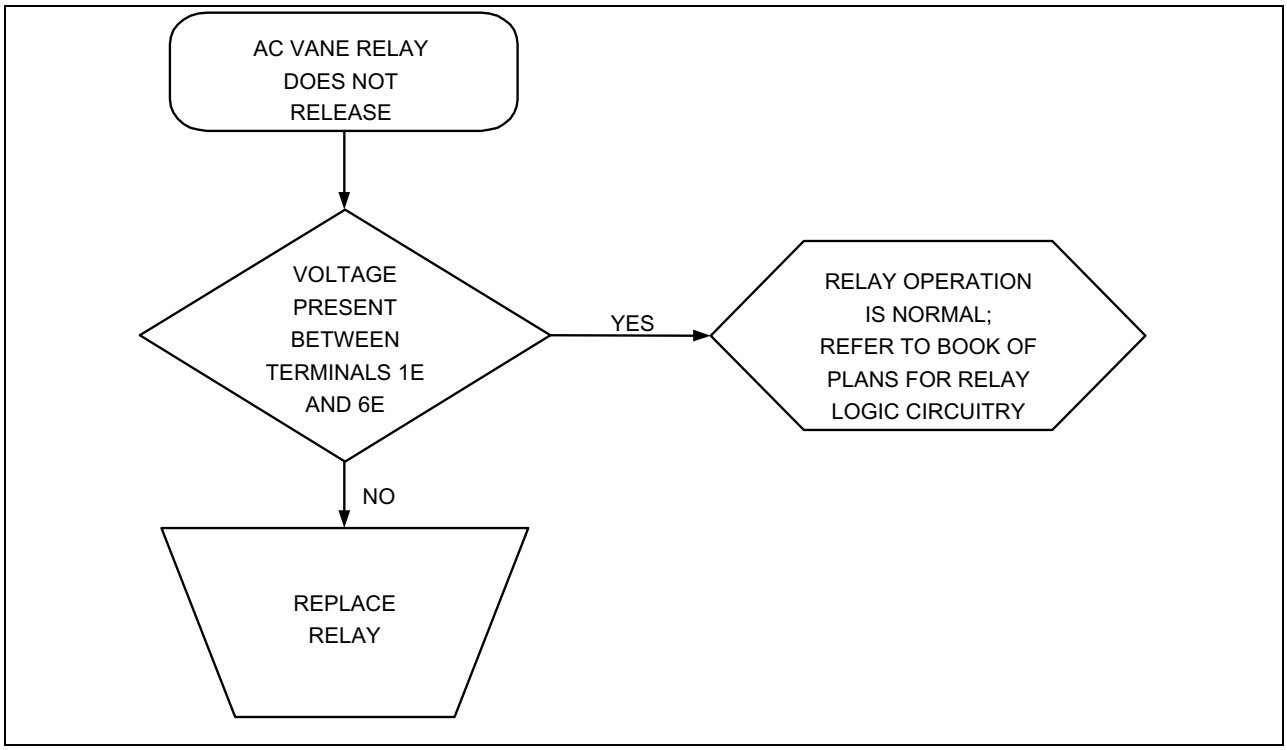


Figure 5–4. AC Vane Relay Does Not Release

NOTE

Failure of an AC Relay to release with no voltage applied to the terminals could indicate a potential safety failure. Record the conditions and notify Alstom Signaling customer service as soon as possible.

THIS PAGE INTENTIONALLY LEFT BLANK.

6. SECTION 6 – CORRECTIVE MAINTENANCE

6.1. GENERAL PURPOSE

This section describes corrective maintenance procedures for Type B relays. Corrective maintenance is intended to restore malfunctioning equipment to an operable condition as quickly as possible. The procedures included in this section include:

- Relay Removal and Replacement Procedures to remove relays not meeting inspection or electrical criteria
- Relay Wiring Change Procedures for plugboards and terminals
- Mechanical Test and Adjustment Procedures for relays removed from service

Specifications for testing and inspecting all Alstom relays are given on relay Engineering Data (ED) sheets. Relay drawing and catalog numbers can be used with Appendix A to look up the Engineering Data (ED) Sheet number. To determine a relay's drawing or catalog number, refer to Heading 1.2.2., Identification For copies of ED sheets, consult your Alstom Sales Representative or Alstom Customer Service.

Table 6–1. Corrective Maintenance Procedures

Description	Table
B Relay Removal and Replacement Procedure	6–2
Terminal Removal Procedure	6–3
Terminal Installation Procedure	6–4
Terminal Soldering Procedure	6–5
Terminal Crimping Procedure	6–6
Insulator Removal and Installation Procedure	6–7
Current Test Terminal Wiring Procedure	6–8
Voltage Test Terminal Wiring Procedure	6–9
Relay Structure Inspection Procedure	6–10
Mechanical Test and Adjustment Procedure (for standard B1 and B2 Relays)	6–11

6.2. CORRECTIVE MAINTENANCE TOOLS

See Appendix C for a summary of B relay tools.

The Shop Test Rack, P/N 56573-002-01, is used to test relays in the shop. See Appendix C for details about the Shop Test Rack.

6.3. REMOVAL AND REPLACEMENT PROCEDURES

6.3.1. B Relay Removal and Replacement

Table 6–2. B Relay Removal and Replacement Procedure

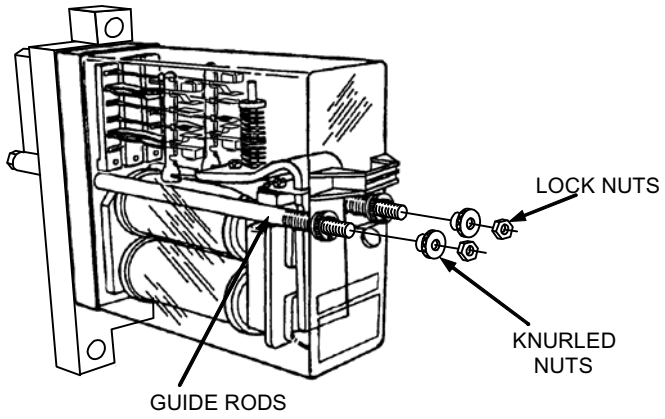
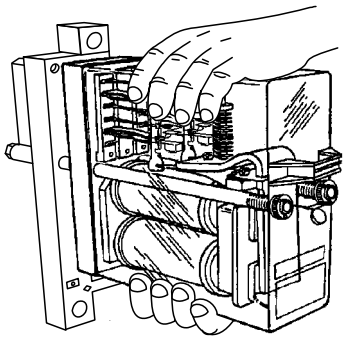
Step	Procedure
1	To remove the B relay, loosen and remove two lock nuts from two guide rods. 
2	Loosen and remove two knurled nuts from two guide rods.
3	Grasping relay top and bottom with both hands, rock slightly from side to side to release the relay from plug connection. Remove relay.  If an adjacent relay prohibits grasping the relay on top and bottom, use handle on front to pull relay along guide rods.

Table 6–2. B Relay Removal and Replacement Procedure (Cont.)

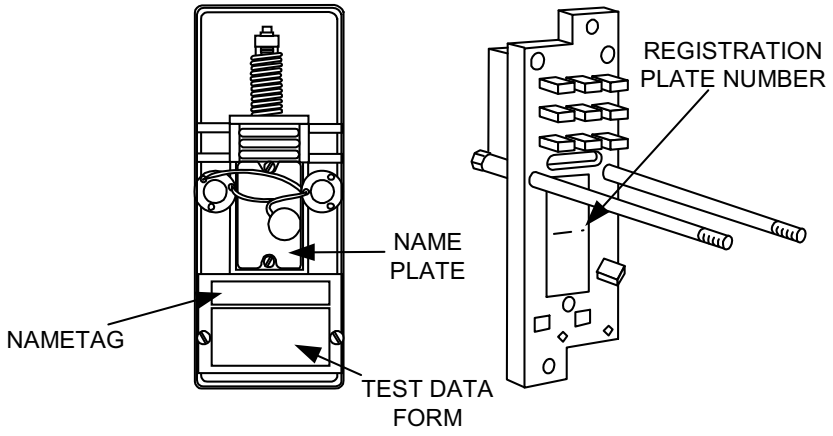
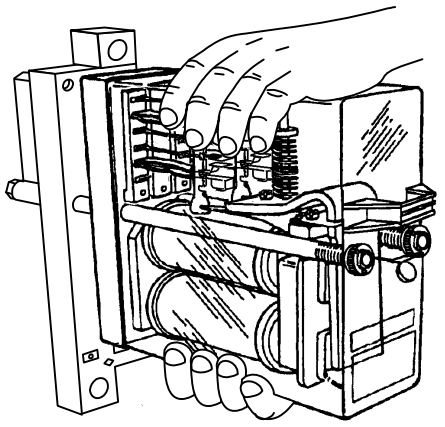
Step	Procedure
4	Check that the replacement relay is correct by verifying that the part number on the nameplate of relay matches the number on the plugboard registration plate. Remove nametag from defective relay and install on replacement relay. 
5	To replace the B relay, grasp the relay by the top and bottom of the cover; slide it onto the guide rods.  If adjacent relay prohibits grasping of relay on top and bottom, use the handle on the front to push the relay along the guides.

Table 6–2. B Relay Removal and Replacement Procedure (Cont.)

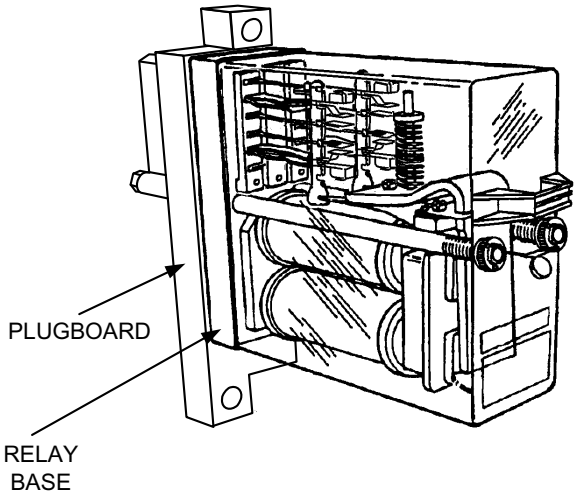
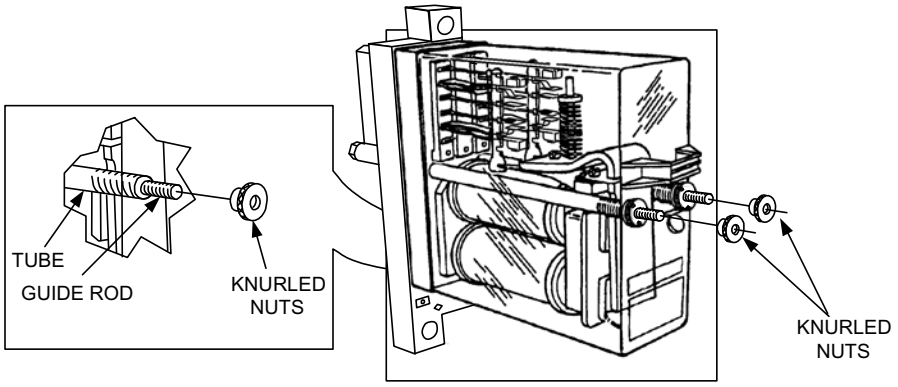
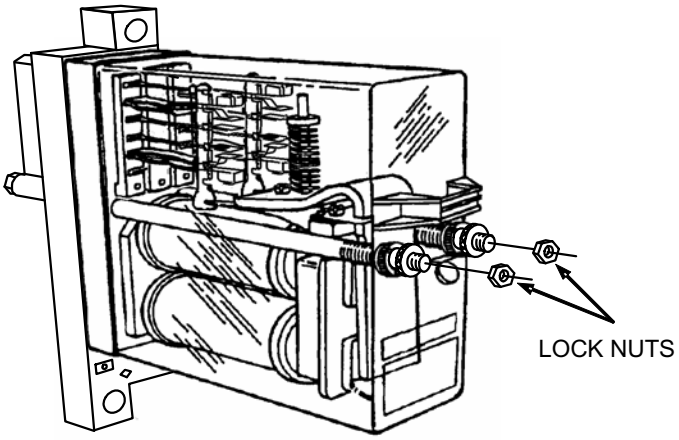
Step	Procedure
6	Press the relay firmly into place so that the back of the relay is snug against its plugboard.  **CAUTION** Do not exert excessive pressure on the relay. Pressure greater than finger pressure could damage relay or plugboard.
7	Hold the relay in this position with one hand while putting on the knurled retaining nuts. The nuts should be tightened only until they just touch the end of the tube, but do not exert pressure against the relay.  **CAUTION** Do not use the retaining nuts to pull the insulators and prongs into engagement.

Table 6–2. B Relay Removal and Replacement Procedure (Cont.)

Step	Procedure
8	Screw on the lock nuts, holding the retaining nuts with the fingers to prevent their turning while tightening the lock nuts with an AAR wrench. 

6.4. WIRING AND PLUGBOARD CHANGES

6.4.1. Terminal Removal and Installation

To remove a terminal, follow the procedure in Table 6–3 in the order provided.

Follow the procedure in Table 6–4 to install a terminal.

Table 6–3. Terminal Removal Procedure

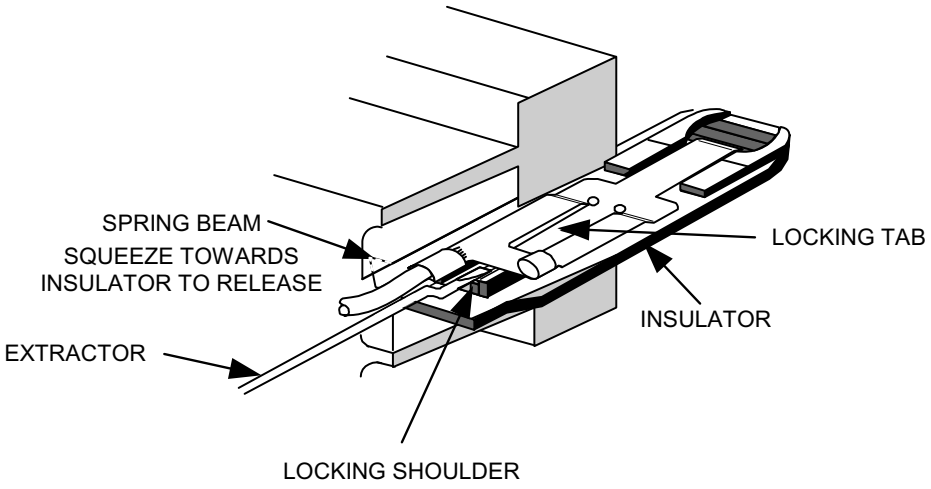
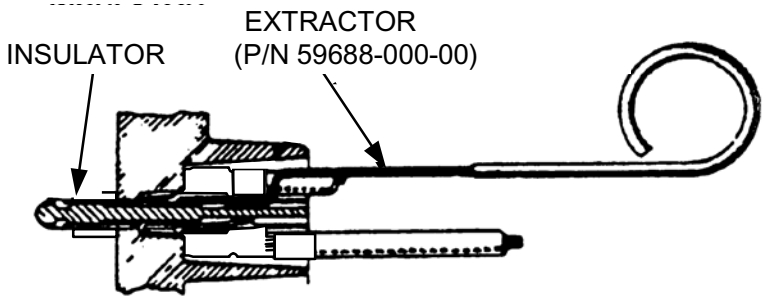
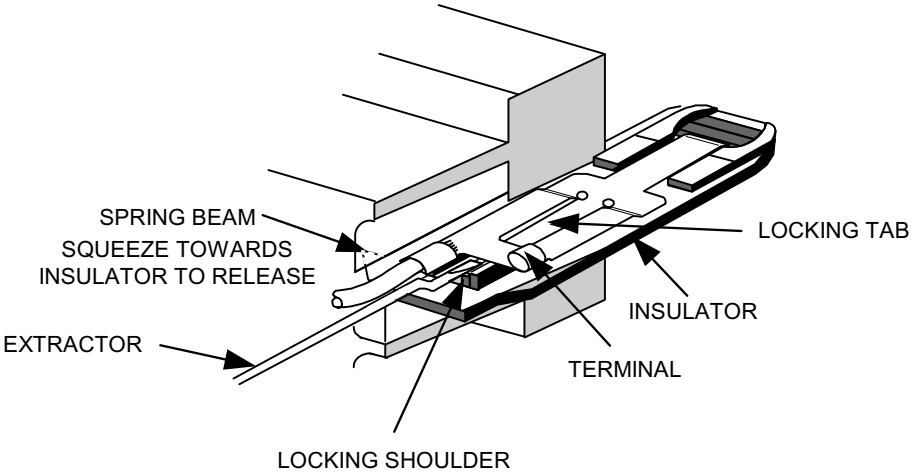
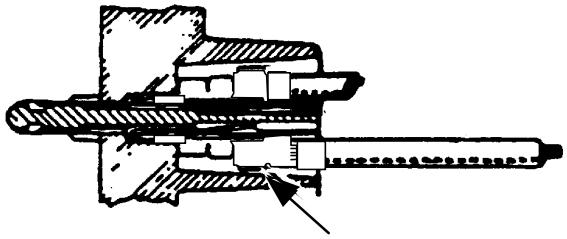
Step	Procedure
1	Insert extractor P/N 59688-000-00 to raise the lock tab of the terminal so that it clears the shoulder on the insulator. 
2	Pull on wire that is connected to terminal and withdraw terminal from plugboard. 
3	If no wire is attached to terminal, use long-nose pliers to extract terminal.

Table 6–4. Terminal Installation Procedure

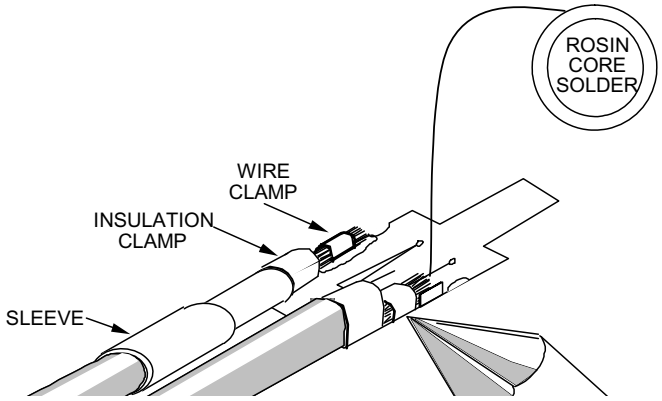
Step	Procedure
1	Determine in which plugboard slot the terminal belongs.
2	Insert terminal with lock tab against insulator.  Press in until lock tab clicks into place behind shoulder on insulator.
3	Pull on wire to see if terminal is properly locked. This check is particularly important when using No. 10 wire. 

6.4.2. Terminal Wiring

To wire a solder terminal, follow the procedure in Table 6–5.

Follow the procedure in Table 6–6 to wire a crimped terminal.

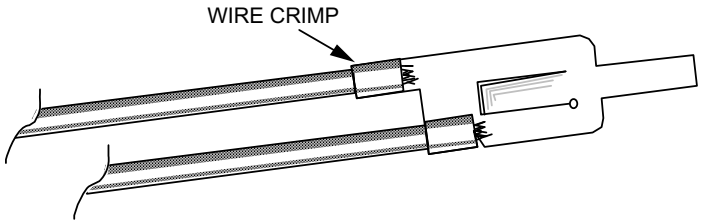
Table 6–5. Terminal Soldering Procedure

Step	Procedure
1	Ring out the circuit for the right wire. Tag the wire.
2	Strip wire insulation to expose 1/4 inch of bare wire. For wire sizes with outside diameters between 0.230 - .260 inches, strip off approximately 7/8 inch of the insulation and slide on rubber sleeve, P/N 35189-033-00, as shown: 
3	Clamp insulated portion of wire in one lug of terminal 55871-019-00.
4	Clamp bare wire in the other lug. **WARNING** MAKE SURE THAT ALL STRANDS OF THE WIRE ARE CLAMPED UNDER THE LUG. LOOSE STRANDS EXTENDING THROUGH THE INSULATOR'S SPRING BEAM SLOT COULD CAUSE A SHORT CIRCUIT TO THE TERMINAL ON THE OPPOSITE SIDE OF THE INSULATOR.
5	Heat the terminal at the bare wire until a small amount of solder flows to bond end of bare wire to terminal. Be aware that too much solder will jam lock tab.
6	Proceed the same way to attach a second wire to the same terminal (if required).
7	Inspect terminal to ensure no loose strands of wire are outside terminal lugs.

NOTE

For detailed instruction on use of crimp tool P/N 24745-148-00, including wire strip length, refer to Instructions Sheet 408-9904, produced by AMP, the tool manufacturer.

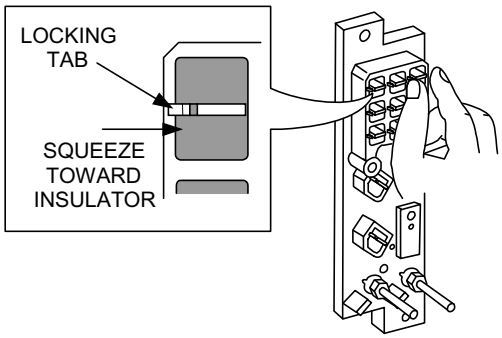
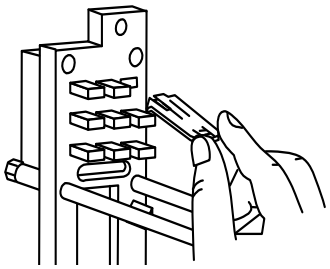
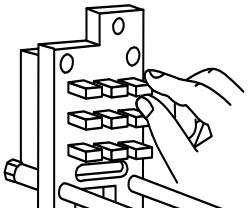
Table 6–6. Terminal Crimping Procedure

Step	Procedure
1	Strip wire insulation to expose bare wire to the length specified in the crimp tool's instruction sheet. Ring out circuit for this wire. Tag the wire.
2	Select terminal 55871-098-00 for 10 - 14 AWG wire; use terminal 55871-074-00 for 16 - 20 AWG wire.
3	Place terminal in crimp tool P/N 24745-148-00, centering the terminal over correct crimp for AWG wire.
4	Insert bare wire into terminal, keeping all strands inside barrel. 
5	Crimp wire in terminal.
6	Repeat Steps 1 through 5 to attach a second wire to other terminal barrel (if required).
7	Inspect crimps to ensure no loose strands of wire are outside the barrel of the terminal.

6.4.3. Insulator Removal and Installation

To remove and replace an insulator, follow the steps in Table 6–7 in the order provided.

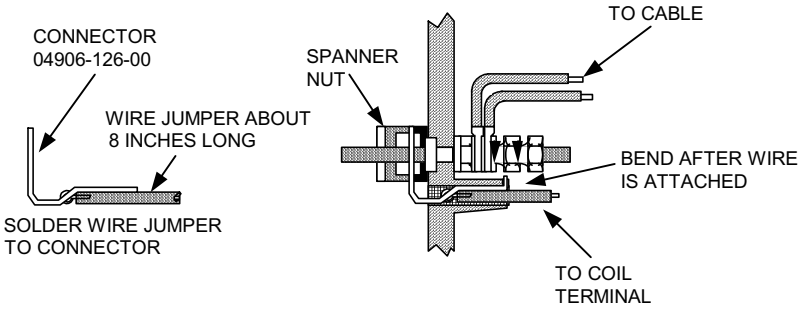
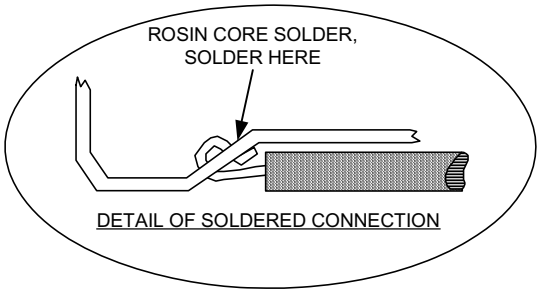
Table 6–7. Insulator Removal and Installation Procedure

Step	Procedure
1	From the rear of the plugboard, squeeze the locking tab toward the insulator and push the insulator forward. 
2	Remove the insulator from the front of the plugboard. 
3	From the front of the plugboard, insert the new insulator end with the locking tab first. Push until the insulator is seated and the locking tab engages. The locking tab clicks when it engages. 
4	From the front of the plugboard, tug on the insulator to verify that the locking tab has engaged.

6.4.4. Current Test Terminal Wiring

To wire a current test terminal follow the procedure provided in Table 6–8.

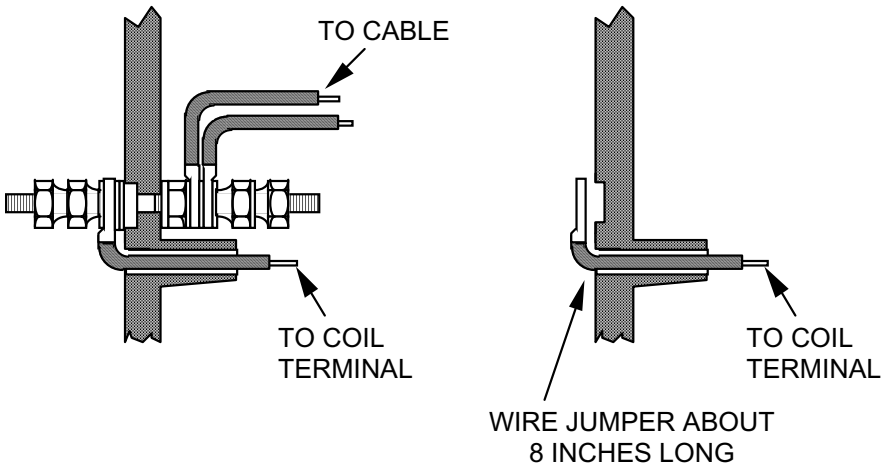
Table 6–8. Current Test Terminal Wiring Procedure

Step	Procedure
1	Solder a wire jumper about eight inches long to connector.
2	Pass wire from front of plugboard through hole next to current test terminal. On B1 plugboards this hole is to the right and below the one marked 3E. On B2 plugboards, it is to the left and below the one marked 6E.
3	Assemble current test terminal as shown:  
4	Slide connector into insulating bushing and at the same time push wire through hole.
5	Tighten spanner nut with spanner nut wrench, P/N 55393-003-01, for B Relay Current Test Post (E Post).
6	Bend end of connector against plugboard.
7	Cut jumper wire to proper length and connect it to plugboard terminal. Refer to the detailed wiring plan.
8	Put a terminal on the wire that comes from the cable and goes to that part of the test terminal that extends toward the back of plugboard. Connect them as shown in Step 3.

6.4.5. Voltage Test Terminal Wiring

To wire a voltage test terminal follow the procedure provided in Table 6–9.

Table 6–9. Voltage Test Terminal Wiring Procedure

Step	Procedure
1	Pass a wire jumper about eight inches long from front of plugboard through hole next to voltage test terminal. On B1 and B2 plugboards this hole is to the right and below the one marked 1E. Note that the space is provided on B2 plugboards for more than one test terminal in cases where the coils in a relay have independent circuits.
2	Put AAR ring terminals on wire and assemble to coil terminal as shown: 
3	Cut jumper wire to proper length and connect it to plugboard terminal. Refer to the detailed wiring plan.
4	Put terminals on the wires that come from cable and go to that part of test terminal that extends toward back of the plugboard. Connect them as shown.

6.5. MECHANICAL TEST PROCEDURES

The mechanical test procedures are performed to ensure that the relay structure is properly adjusted. Table 6–10 provides the Relay Structure Inspection Procedure. Table 6–11 provides the Mechanical Test and Adjustment Procedure.

The mechanical test and adjustment procedures take place with the B relay cover removed. These procedures include verification of armature air gap, bridge travel and contact group measurements. Components identified as not meeting defined tolerances during the relay mechanical test are adjusted during the test procedure. Mechanical adjustments must be followed by electrical tests to verify relay performance.

WARNING

BREAKING THE RELAY COVER SEAL VOIDS THE WARRANTY ON THE RELAY.

6.5.1. Relay Structure Inspection

Before performing any adjustments or tests on a relay, the relay structure must be visually inspected. Section 7, Parts List, provides a comprehensive list and illustrations for all of the components of the typical B relay. This procedure applies to typical B relays.

Table 6–10. Relay Structure Inspection Procedure

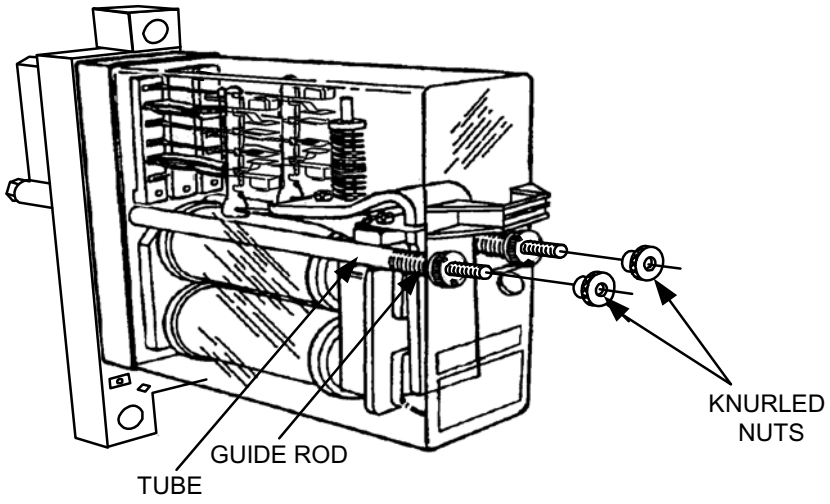
Step	Procedure
1	If any of the following conditions are not met, take note of the problem and correct it during the mechanical test. **NOTE** This procedure includes correcting identified problems. This procedure must be followed by relay mechanical and electrical tests.
2	Check that the relay cover and seal are not cracked, broken or discolored.
3	Break the cover seal and unscrew the knurled nuts. **WARNING** BREAKING THE RELAY COVER SEAL VOIDS THE WARRANTY ON THE RELAY. 
4	Remove the two round rubber washers and the cover.

Table 6–10. Relay Structure Inspection Procedure (Cont.)

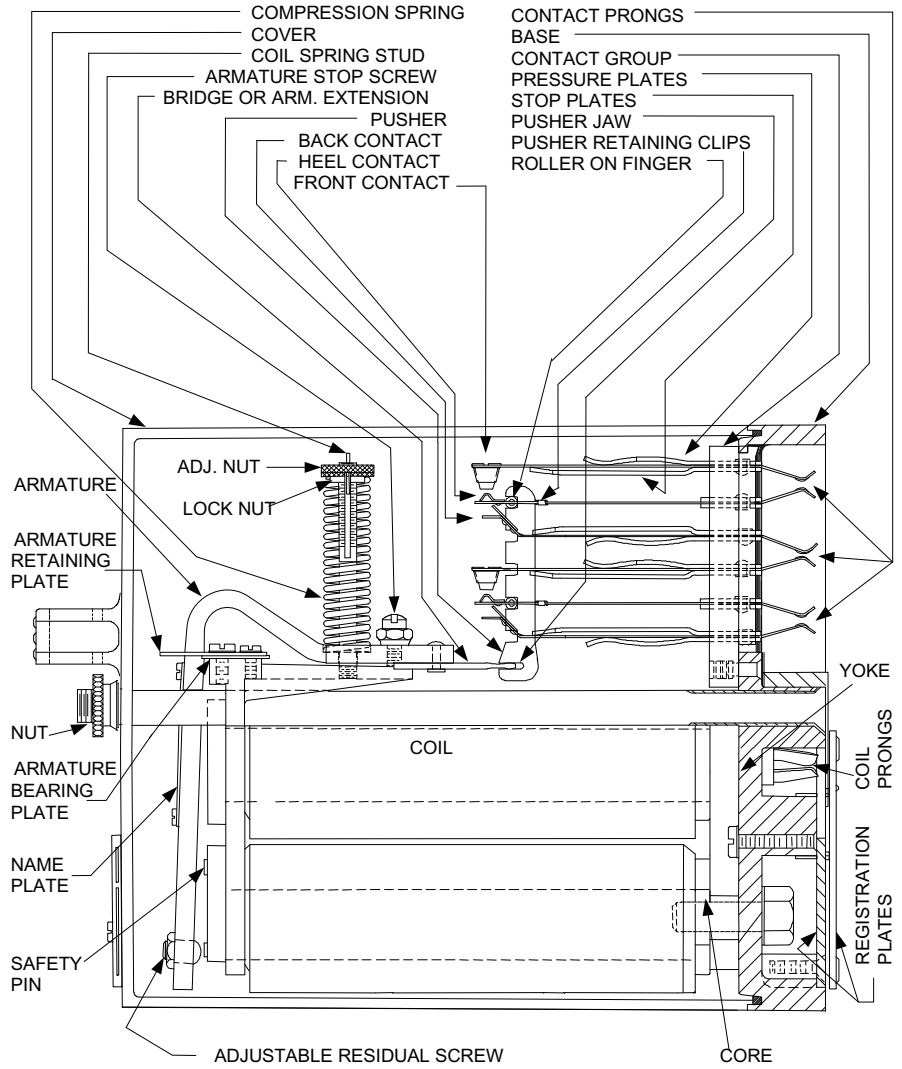
Step	Procedure
5	Remove contact group dust shield. Verify that the relay contact groups and mounting screws are tight. Tighten, if necessary. Replace contact group dust shield.  NOTE: SOME PARTS MAY DIFFER IN DETAIL FROM THOSE SHOWN ABOVE BUT NAME DESIGNATION REMAINS THE SAME.
6	Verify that the pusher retaining clips are properly assembled and do not bind on pusher, thus allowing free movement of pusher. The pusher clips cannot be adjusted or reassembled, replace if necessary.
7	Verify that the pusher is not bent, broken or cracked due to being forced on the bridge (armature extension). Replace, if necessary.

Table 6–10. Relay Structure Inspection Procedure (Cont.)

Step	Procedure
8	Verify that each pusher does not rub against the contact springs or stop in any position. Adjust, if necessary.
9	Verify that the armature does not bind, and rides properly on the armature bearing plate. Clearance between the front face of the armature and the edge of the armature retaining plate is .002 inches minimum and .004 inches maximum, for any position of the armature. Adjust, if necessary.
10	Verify that the compression spring does not rub on stud in any position of the armature. Adjust, if necessary.
11	Verify that the compression spring fits properly against shoulder on lock nut. Adjust, if necessary.
12	Verify that the lock nut is properly in place on coil spring stud. Reseat and tighten, if necessary.

6.5.2. Mechanical Test and Adjustment Procedure

The Mechanical Test and Adjustment Procedure provided in Table 6–11 applies to standard B1 and B2 Relays, not specialty relays.

Table 6–11. Mechanical Test and Adjustment Procedure

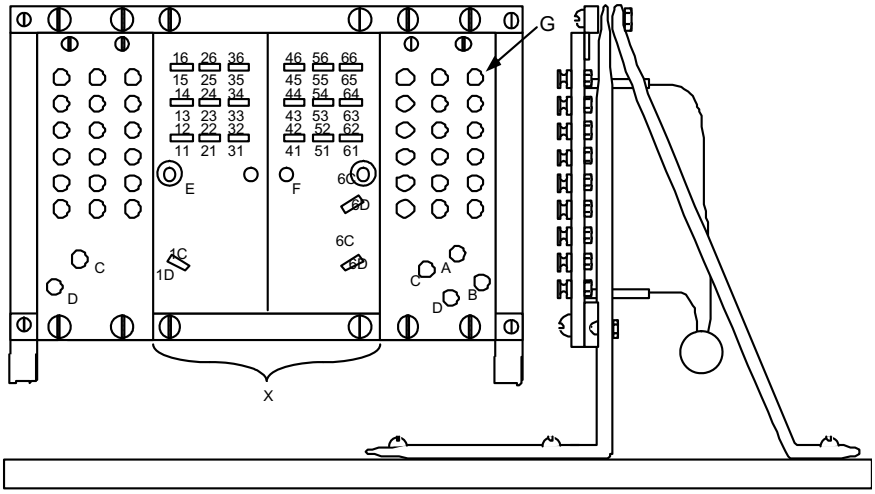
Step	Procedure
1	Inspect the relay components by following the procedure in Tables 6–10.
2	Mount the relay onto Shop Test Rack or on a plugboard, supporting it about 18 inches above a bench on a plugboard holding stand. Secure the relay with two retaining nuts to hold the relay in place. Example Shop Test Rack  This rack is designed for both B1 and B2 Relays. One of the guide rods is removable. For testing B1 Relays, screw the removable guide rod into location F. For testing B2 Relays, screw it into location E. Meter leads should have alligator clips for clipping on to terminal posts G.
3	Proceed with this procedure to check the following areas to verify that all adjustments are proper: armature air gap, bridge travel, back and front contact make and break, contact openings and pressures.
4	Energize the relay when required. To power the relay, apply a variable current source to the coil leads, utilizing a meter tip plug to interface the current source with the female cap connectors on the coil leads. Refer to the relay wiring diagram if necessary.

Table 6–11. Mechanical Test and Adjustment Procedure (Cont.)

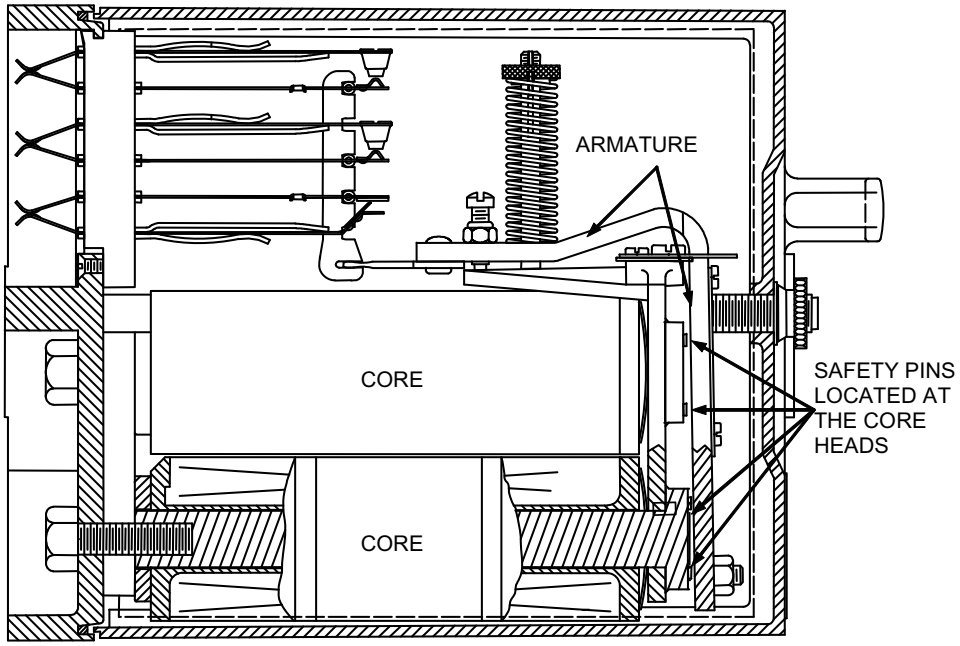
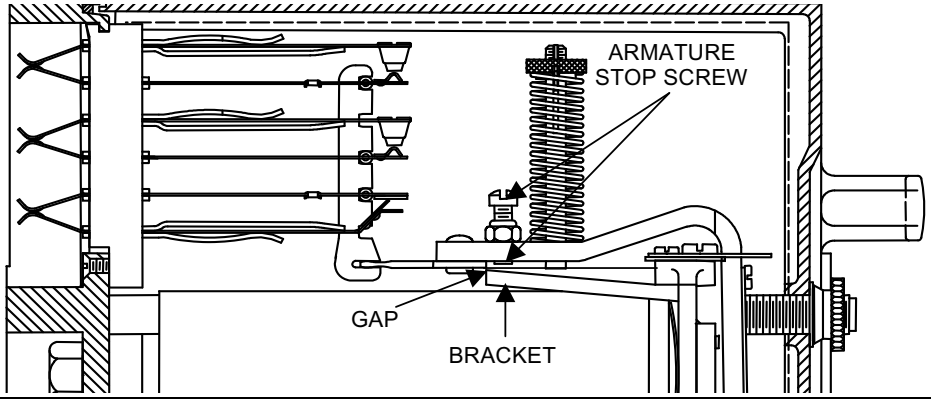
Step	Procedure
5	Verify the armature air gap measurement is as specified on the specific relay's ED sheet. A feeler gauge of the same thickness as the specified air gap must pass freely between the armature and core heads at any point, except at the fixed safety pins, when the relay is energized. 
6	If the armature air gap is not acceptable, adjust the armature gap with the adjustable residual screw to obtain the required air gap. The screw must be locked tight in place by the lock nut provided.
7	Verify the bridge travel measurement is as specified on the specific relay's ED sheet. Use a feeler gauge of the same thickness as the specified air gap to verify the air gap between the bracket and the armature stop screw when the relay is energized. 

Table 6–11. Mechanical Test and Adjustment Procedure (Cont.)

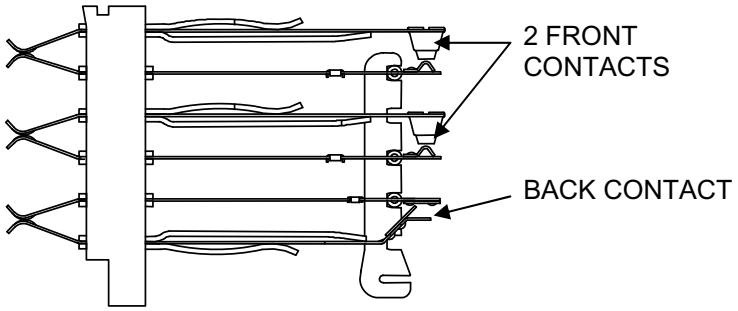
Step	Procedure
8	If the bridge travel is not acceptable, adjust the bridge travel. Turn the armature stop screw until the bridge travel measurement is within specification. The screw must be locked tight in place by the lock nut provided. Generally, operating values of a relay are easier to obtain when this air gap is held to the minimum value.
9	Make and break openings for front and back contacts are measured by inserting the proper thickness gauge between the adjustable residual screw and core face. • With the break gauge in place, all specified contacts are open. • With the make gauge in place, all specified contacts are closed. 
10	Verify the contact opening measurements meet the specifications indicated in the appropriate ED sheet.
11	If the contact opening measurements are not acceptable, bend the pressure plate forcing the contact spring to the proper position to meet the acceptable make and break values. With the contact spring properly positioned, the stop plate is bent toward the contact spring until it just touches the spring. Note that the spring bears against the pressure plate and touches the stop plate. If a pressure plate or stop plate is bent too far away from a contact spring, this can be corrected by bending the plate to stop a little too near the spring and then bend the plate away from the spring.
12	Use a pressure gauge to verify the contact pressure meets the specifications indicated in the appropriate ED sheet. When making contact pressure measurements, place the pressure as close to the contact as possible (at the center of the extreme outer end of the spring) to obtain a true reading. Back contact springs must move a minimum of 0.010 inch from the stop plate; this measurement is taken at the end of the stop plate.

Table 6–11. Mechanical Test and Adjustment Procedure (Cont.)

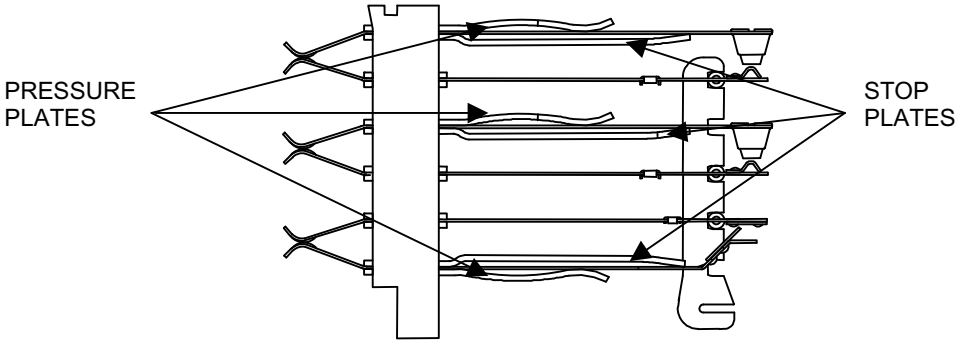
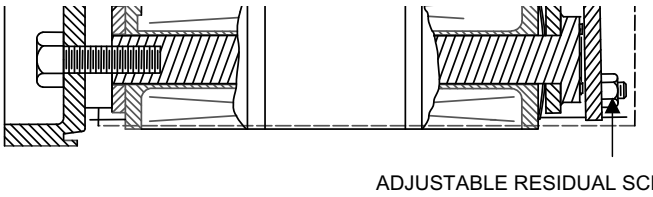
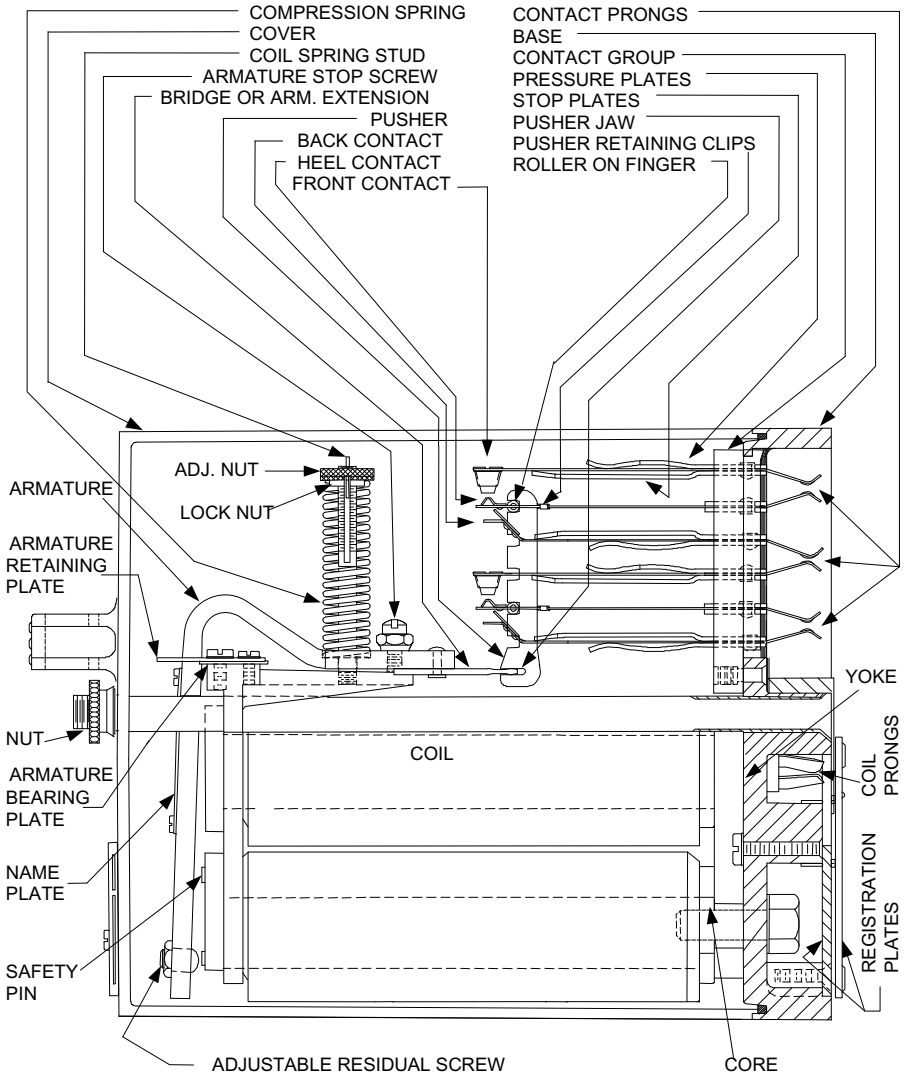
Step	Procedure
13	If the contact pressure is not acceptable, manually adjust the pressure plate and stop plate.  Contact pressure is created by contact follow resisted by the pressure plate. Contact follow is the total movement of the heel contact caused by the armature bridge raising the pusher (not affected by pressure or stop plates). Armature springs (heel contact spring) are adjusted with a down pressure before assembling the pusher. The adjustment of the contact group consists of positioning the pressure plate and stop plate on each stationary spring to ensure the correct amount of contact follow. Armature springs on all groups are adjusted with a down pressure.
14	Using a pressure gauge at the adjustable residual screw, check the pressure required to just raise the bridge stop screw from its stop. Compare pressure value to the requirements indicated on the ED sheet. Adjust if necessary. 

Table 6–11. Mechanical Test and Adjustment Procedure (Cont.)

Step	Procedure
15	Check that all armature springs on the contact block are adjusted with a down pressure. It is important to keep the down pressure about the same on all back contacts. Each roller on the contact spring bears on the bottom of its slot in the pusher, when the pusher is raised sufficiently to just open the back contacts.

Typical B Relay



NOTE: SOME PARTS MAY DIFFER IN DETAIL FROM THOSE SHOWN ABOVE BUT NAME DESIGNATION REMAINS THE SAME.

Table 6–11. Mechanical Test and Adjustment Procedure (Cont.)

Step	Procedure
16	Insert a .010 inch feeler gauge under the armature stop screw to hold the back contacts open. Using a smaller bar under the bottom of the pusher, gently push up on the bar to see that the pusher rises slightly, without moving the armature. While holding the armature in this position, verify that the roller on each heel spring rests on the bottom of the jaw in the pusher.
17	Adjust the springs, if necessary, so they always open the front contacts in case of a failure at the bottom end of the pusher.
18	Place the cover on the relay. Verify that the gasket in the base groove is seated properly and then assemble the two gasket washers over the relay support tubes. Install and tighten the knurled nuts and apply the seal.
19	Check the contact prong spacing on the back of the relay with the appropriate gauges: P/N 56260-008-01 and P/N 56260-010-01.
20	Follow the electrical test procedure for the relay, provided in Section 4.

7. SECTION 7 – PARTS CATALOG

7.1. GENERAL

This section identifies and lists the component parts that may be ordered to repair the Alstom family of B relays at the shop level. It also includes a list of the plugboards and other relay parts required for installation. Parts are identified by drawing number and catalog number (where available) except for common hardware items that are identified by a generic description. All drawing numbers consist of 10 digits. Drawing numbers are equivalent to part numbers. Some parts do not have a catalog number.

7.2. PARTS LIST

Each illustration of B relay components is followed by a parts list giving part description, drawing number and catalog numbers of replaceable parts. Index numbers are listed to locate referenced parts in the illustration. Where applicable, references are provided to other pages to better show where parts are located in the assembly. This section of the manual covers all currently manufactured parts.

Table 7–1. B Relay Drawings and Parts Lists

Description	Figure No.	Table No.
B1 Neutral and Biased-Neutral Relay	7–1, 7–2	7–2
B1 Code-Responsive Relay	7–3	7–3
B1 Slow Pickup, Slow-Release, Quick-Crossover and Electronically-Driven Highway Crossing Flasher Relay	7–4, 7–5	7–4
B2 Neutral Relay	7–6	7–5
B2 Biased-Neutral Relay	7–7	7–6
B2 AC Vane Relay	7–8, 7–9	7–7
B2 Code Rate Transmitter Relay	7–10	7–8
VTB Polar-Biased Relay	7–11	7–9
Coils and Springs	—	7–10
Contact Groups	7–12, 7–13	7–11
Contact Group Pushers and Clips	—	7–12
Plugboards and Supplies	7–14, 7–15	7–13
Registration Plates and Gaskets	7–16	7–14

7.3. B1 NEUTRAL RELAYS

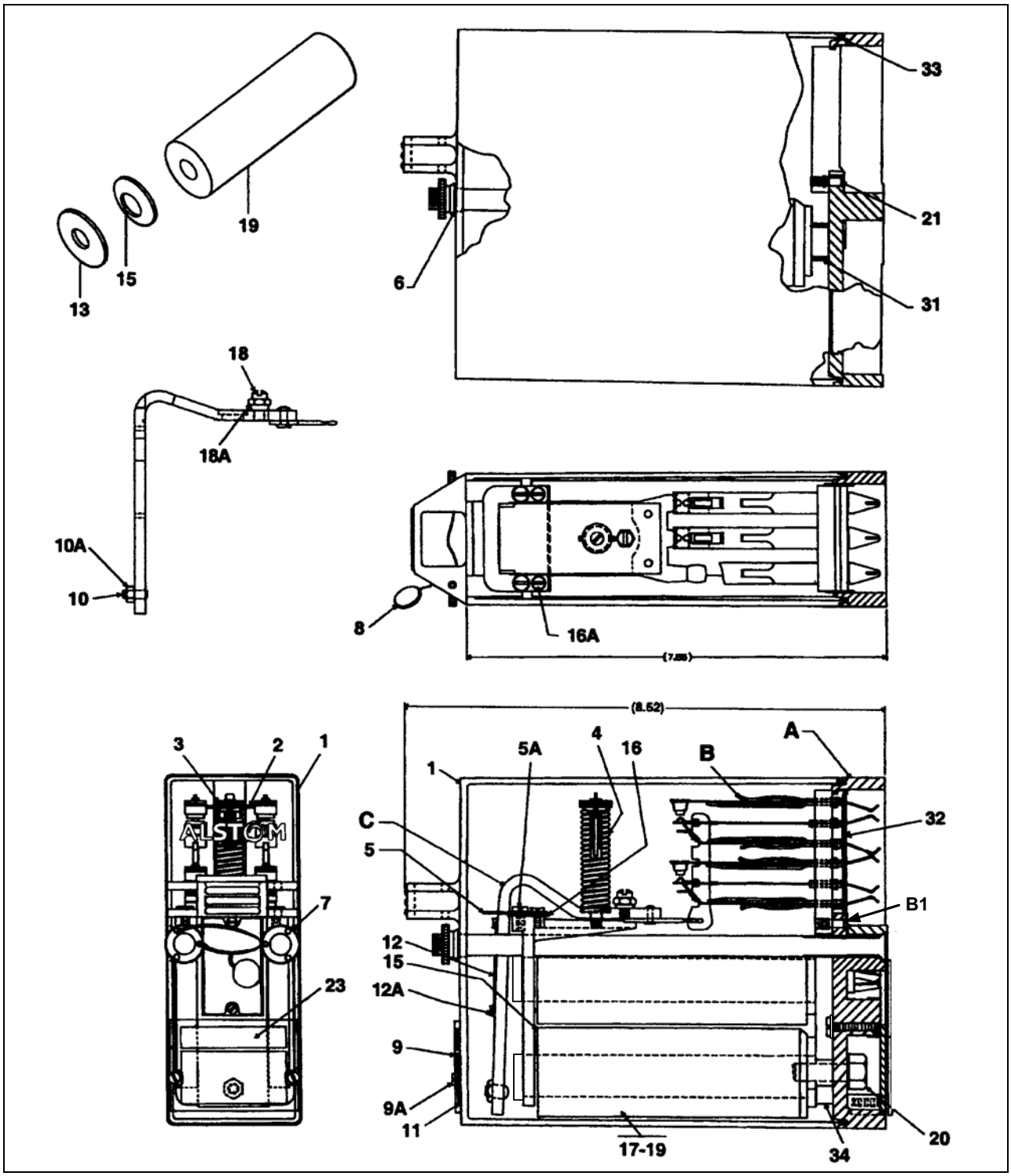


Figure 7–1. B1 Neutral Relays

7.4. B1 BIASED-NEUTRAL RELAYS

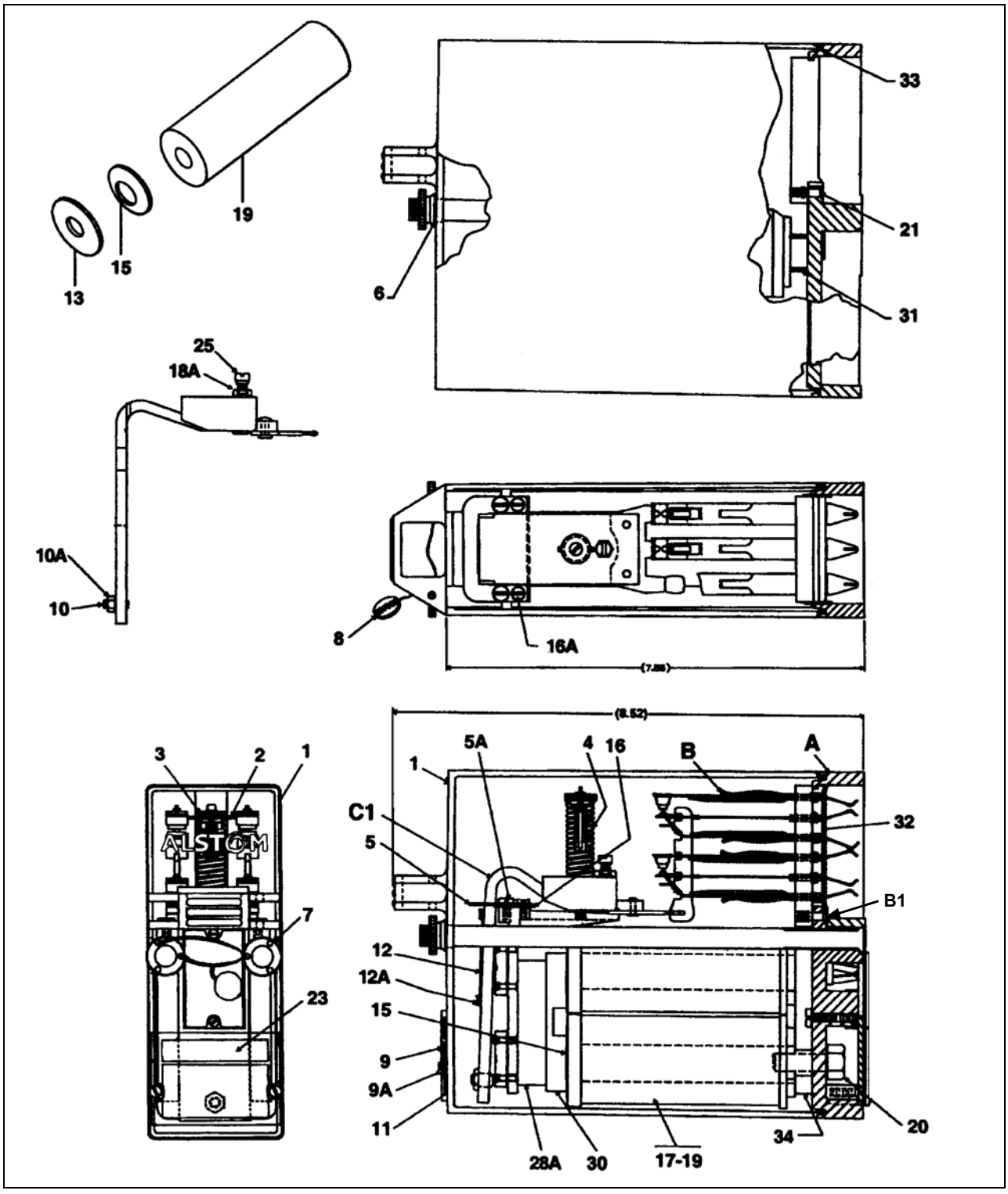


Figure 7–2. B1 Biased-Neutral Relays

Table 7–2. B1 Neutral and Biased-Neutral Relay Part Numbers

Ref.	Description	Drawing No.	Catalog No.
A	BASE, includes tubes for studs	56013-016-02	P62-0506
B	CONTACT GROUPS (See Figure 7–14 and Table 7–13)	—	—
B1	SCREW, for attaching contact groups,.138" –40X .625" long, flat head	03306-120-ON	P62-0200
C	ARMATURE, includes bridge and residual screw and all riveted parts; for all Type B1 Neutral Relays	39043-022-01	P62-0312
C1	ARMATURE, includes bridge and residual screw and all riveted parts; for all Type B1 Biased-Neutral Relays	39043-017-01	P62-0311
1	COVER	56029-096-00	P62-0579
2	NUT LOCK, for nut (Ref. 3)	56024-000-00	P62-0575
3	NUT, knurled	00846-023-00	P62-0142
4	SPRING, for setting over pressure (specify drawing no. of relay where part is used)	—	—
5	ARMATURE RETAINING PLATE	55914-001-00	P62-0473
5A	SCREW, slotted pan-head, .164" -32 x .31" long, with patch	02430-036-00	N/A
6	WASHER, rubber	30646-012-00	P62-0260
7	NUT, knurled, for holding cover in place	56026-004-00	P62-0578
8	SEAL, for relay	35285-000-00	P62-0299
9	HOLDER, for Test Data Form	50023-039-00	P62-0356
9A	SCREW, .112" –24 x .38" long, pan head, tap	06604-212-ON	P62-0593
10	RESIDUAL SCREW, .190" -48 x .33" long	20360-014-00	P62-0255
10A	NUT, for residual screw, .190" -48 x .09" thick, hex	00577-021-00	P62-0128
11	TEST DATA FORM	51553-088-00	P62-0383
11A	TEST DATA FORM for Switch-Overload Relay	51553-100-00	P62-0383
12	NAME PLATE BLANK	00401-942-00	P62-0110
12A	SCREW, .112" -40 x .19" long, pan head, Nylok	02430-038-00	P62-0442

Table 7–2. B1 Neutral and Biased-Neutral Relay Part Numbers (Cont.)

Ref.	Description	Drawing No.	Catalog No.
13	WASHER, for .563" diameter cores	01225-094-00	P62-0156
13A	WASHER, for .736" diameter cores	01225-103-00	P62-0157
13B	WASHER, fiber for .563" diameter cores	34017-031-00	P62-0293
15	SPRING WASHER, for .563" diameter cores	01225-104-00	P62-0158
15A	SPRING WASHER, for .736" diameter cores	01255-105-00	P62-0159
16	ARMATURE BEARING PLATE	55912-001-00	P62-0470
16A	SCREW, stainless steel, slotted, pan head, .112" -40 x .250" long, with patch	02430-037-00	N/A
17	COIL, top or bottom (specify drawing no. of relay where part is used)	—	—
18	ARMATURE SCREW, .164" -32 x .63" long, fillister head	01054-004-00	P62-0150
18A	NUT, thin hex elastic stop, .164" -32	42333-055-00	P62-0321
19	SLUG, full-length for .563" diameter core	54960-003-00	P62-0425
19A	SLUG, half-length for .563" diameter core	54960-004-00	P62-0426
19B	SLUG, full-length for .736" diameter core	54960-005-00	P62-0427
19C	SLUG, half-length for .736" diameter core	54960-006-00	P62-0428
20	SCREW, for mounting cores, .313" -24 x 1.0" long, SEMS	53141-025-00	P62-0844
21	SCREW, for mounting contact group, .138"-40 x .63" long, slotted, fillister head	03306-120-ON	P62-0215
23	TAG BLANK, for circuit designation contains 60 blank tags	55085-208-00	P62-0432
25	ARMATURE SCREW, .164" -32 x 1.0" long, fillister head	01054-011-00	P62-0151
28	MAGNET, for old-style relays, 2 required, charged to 84-86 points	53007-043-00	P62-0822
28A	MAGNET, replacement for new- and old-style relays,1 required	53007-058-00	P62-0818
30	LEAKAGE STRIP	58898-008-00	P62-0675
31	GASKET, for sealing coil cap opening	30646-005-00	P62-0276
32	SHIELD, for covering contact groups	50737-091-00	P62-0227

Table 7–2. B1 Neutral and Biased-Neutral Relay Part Numbers (Cont.)

Ref.	Description	Drawing No.	Catalog No.
33	GASKET, for between cover and base	13014-221-00	P62-0225
34	YOKE	01224-038-00	N/A

7.5. B1 CODE-RESPONSIVE RELAY

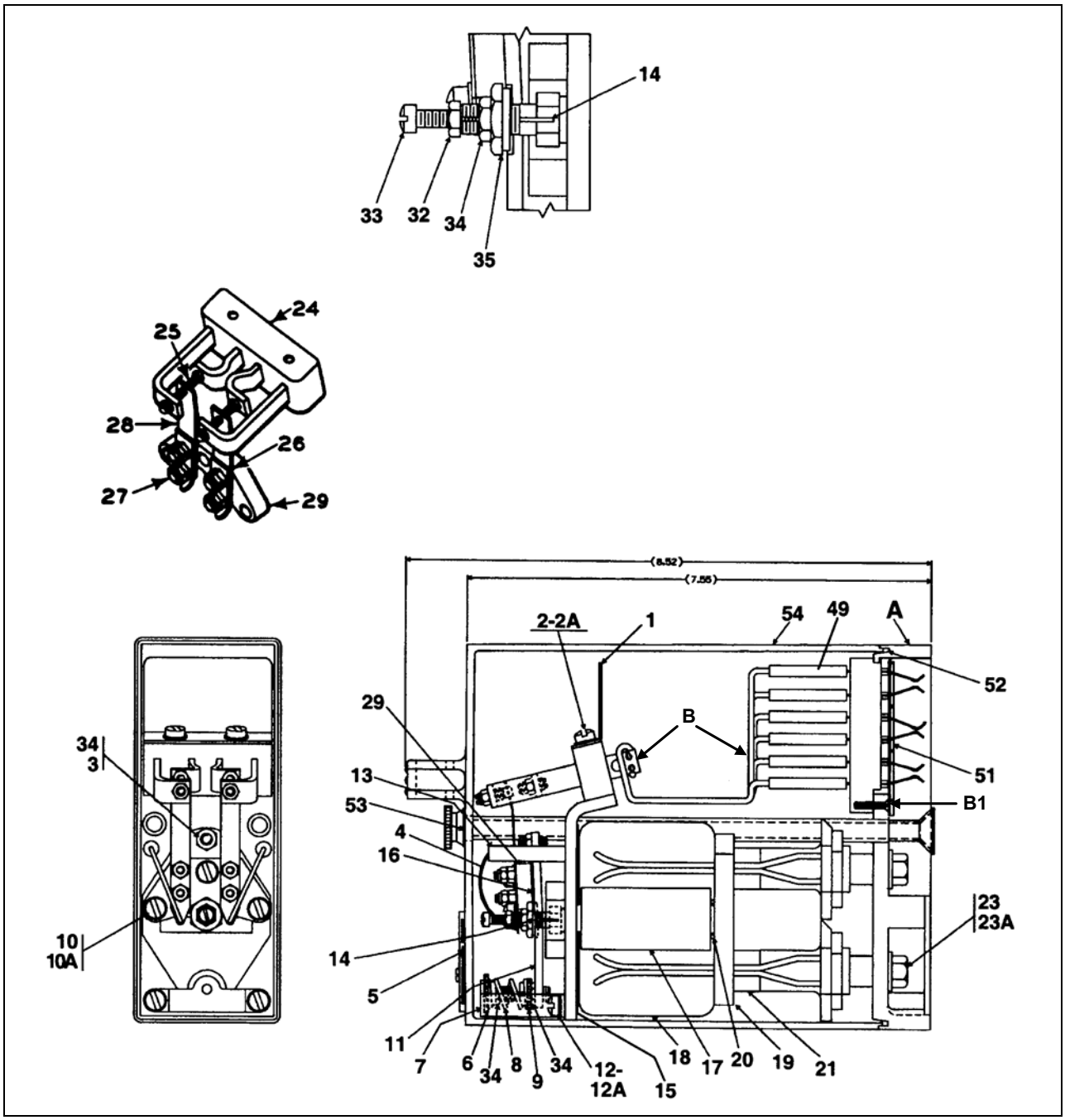


Figure 7–3. B1 Code-Responsive Relay

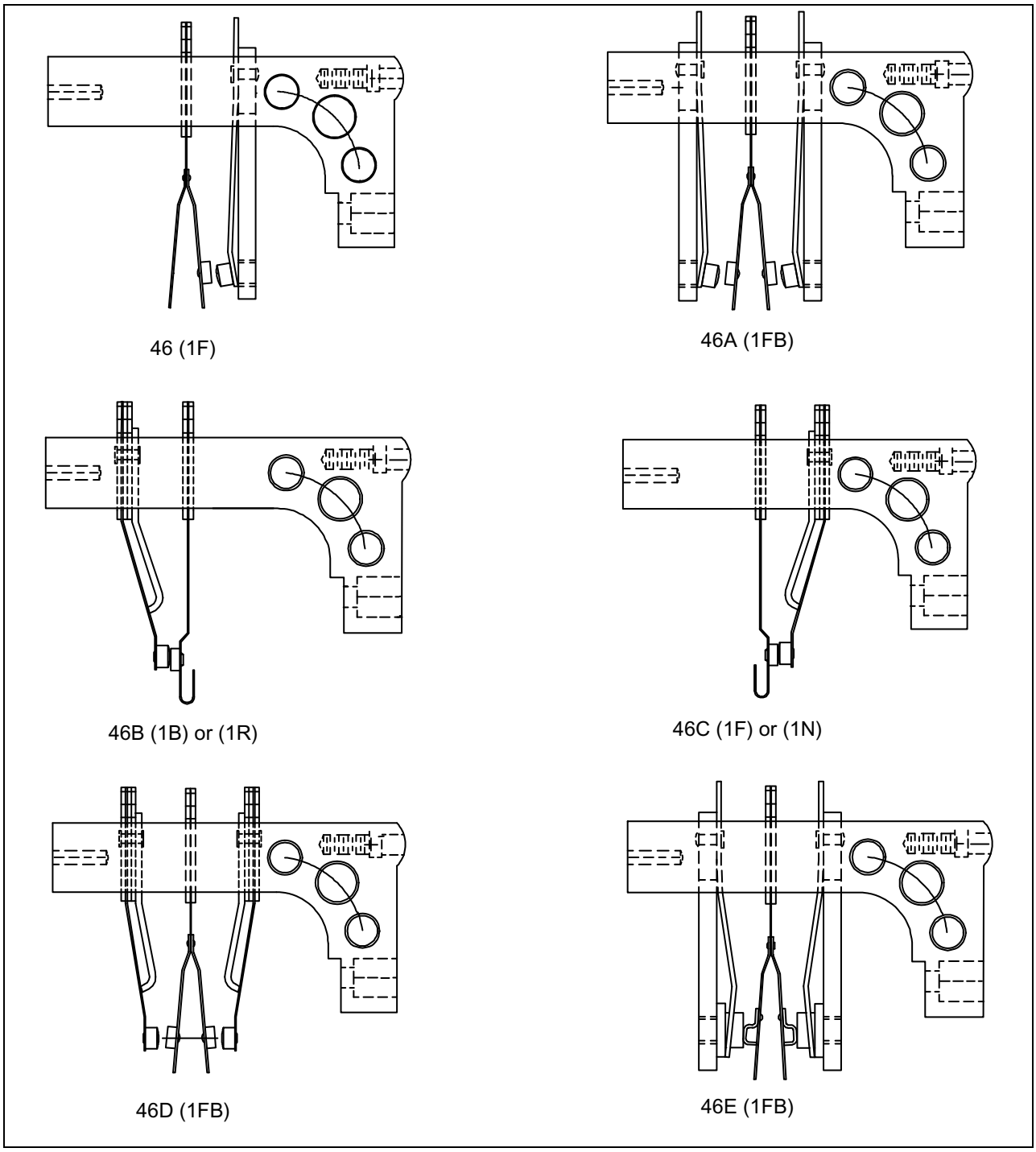


Figure 7–3. B1 Code-Responsive Relay (Cont.)

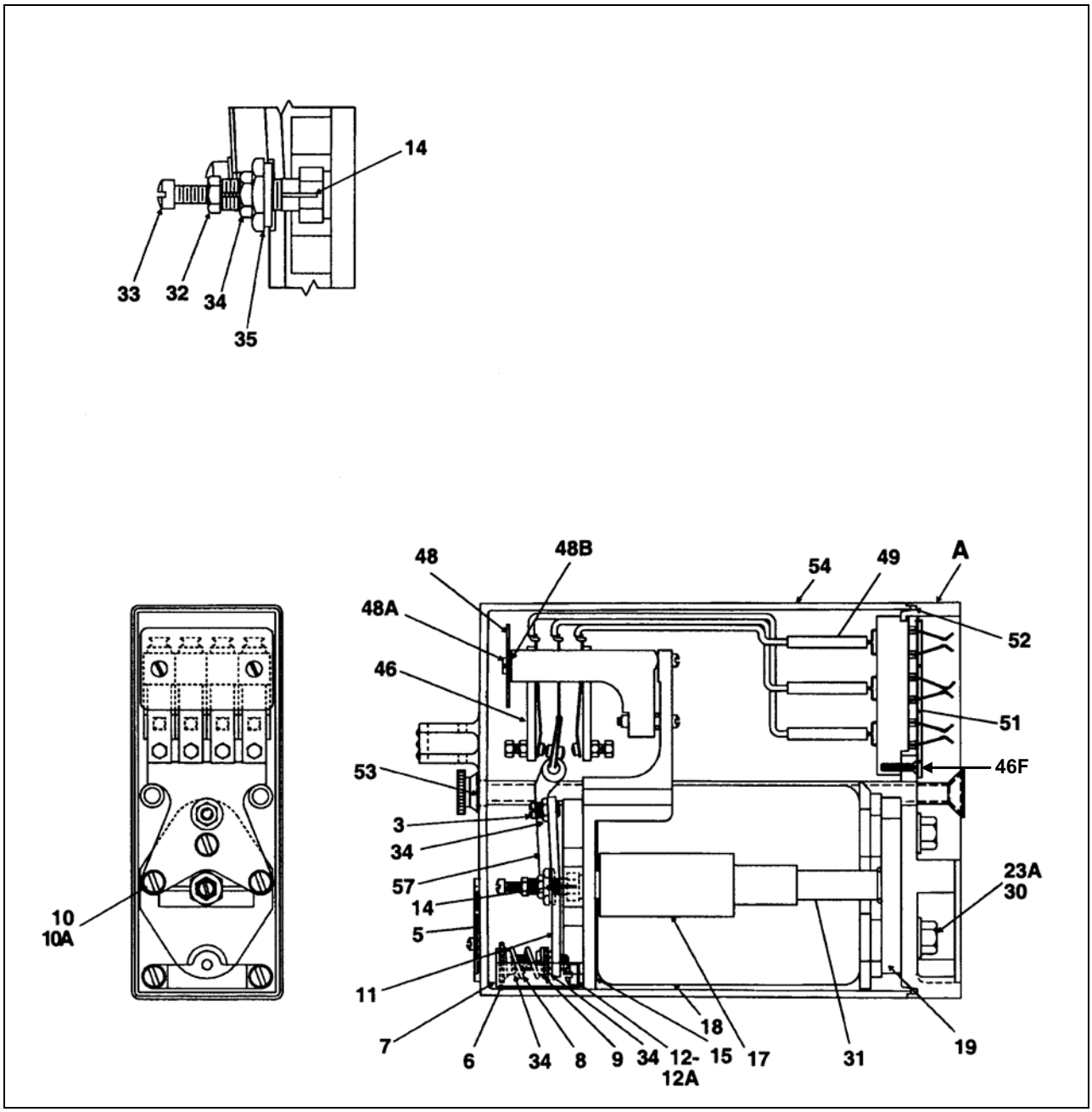


Figure 7–3. B1 Code-Responsive Relay (Cont.)

Table 7–3. B1 Code-Responsive Relay Part Numbers

Ref.	Description	Drawing No.	Catalog No.
A	BASE, complete, includes tubes	56013-016-04	P62-0508
B	CONTACT GROUP	57508-KN	N/A
B1	SCREW, for attaching contact groups, .138" -40 x .625" long, flat head	03306-120-ON	P62-0200
1	NAME PLATE	00401-281-00	P62-0113
2	SCREW, slotted, fillister head .190" -32 x 1.25" long	03410-140-ON	P62-0219
2A	WASHER, internal tooth, .190" I.D., .381" O.D., .025" thick	53029-003-00	P62-0973
3	RESIDUAL ARMATURE SCREW, headless, .242" -40 x .34" long	05100-033-00	P62-0198
4	CONNECTOR, flexible, copper, approx. 1-foot long	42760-112-01	P62-0327
5	TEST DATA FORM, paper	51553-048-00	P62-0387
5A	TEST DATA FORM, for Polar-Stick Relays, paper	51553-049-00	P62-0388
6	NUT, for spring (Ref. 8), .242" -40 x .190" thick	00846-039-00	P62-0693
7	SUPPORT, for spring (Ref. 8)	54302-004-01	P62-0417
8	ARMATURE SPRING, for all Code-Responsive Relays except the following:	00586-149-00	P62-0135
8A	ARMATURE SPRING, for A62-0323 (56001-670-13), A62-0519 (56001-679-06)	00586-138-00	P62-0782
8B	ARMATURE SPRING, for A62-0567 (56001-681-06), A62-0655 (56001-670-02), A62-0679 (56001-675-01)	00586-145-00	P62-0848
9	SCREW, for spring (Ref. 8), .242" -40 x .190" long	46453-002-00	P62-0340
10	TERMINAL BLOCK MOUNTING SCREW, .164" -32 x .30" long, fillister head	55160-033-00	P62-0440
10A	WASHER, .174" I.D., .293" O.D., .031 " thick	01273-003-ON	P62-0334
11	ARMATURE	29523-051-00	P62-0272
11A	ARMATURE, for Polar-Stick Relays	29523-072-00	P62-0273

Table 7–3. B1 Code-Responsive Relay Part Numbers (Cont.)

Ref.	Description	Drawing No.	Catalog No.
12	SCREW, stainless steel, slotted, .164" -32 x .31 " long	03408-010-ON	P62-0435
12A	WASHER, internal tooth, .176" I.D., .340" O.D., .023" thick	53029-068-00	P62-0402
13	TUBE, for connector	43131-049-00	P62-0335
14	ARMATURE BEARING PLATE	55912-006-00	P62-0472
15	WASHER, for coils	01225-170-00	P62-0163
16	INSULATED TERMINAL BLOCK PLATE	30220-038-00	P62-0274
17	MAGNET (specify drawing no. of relay where part is used)	—	—
18	COIL, top or bottom (specify drawing no. of relay where part is used)	—	—
19	RELAY YOKE	01224-020-00	P62-0153
20	SPRING, for magnets	00586-153-00	P62-0136
21	BUSHINGS, for cores	06714-263-00	P62-0206
23	SCREW, for short core, .313" -24 x 2.75" long, hex head cap	03440-044-00	P62-0181
23A	LOCK WASHER, internal tooth for a .313" screw	53029-076-00	P65-0729
24	CONTACT BLOCK, with four contact supports (no contacts)	57506-001-01	P62-0652
25	CONTACT, silver-platinum	51321-023-00	P62-0361
25A	CONTACT, tungsten	51321-024-01	P62-0849
26	PLATE, for contact fingers	55911-013-00	P62-0467
27	SCREW, for fastening fingers to insulation	55718-001-00	P62-0456
27A	NUT, for screw (Ref. 27), .138" -40 x .09" thick, hex	03614-007-00	P62-0183
27B	LOCK WASHER, for screw (Ref. 27)	01601-122-00	P62-0173
28	FINGER, heel, with silver-platinum contacts	54614-034-01	P62-0421
28A	FINGER, heel, with tungsten contacts	54614-034-02	P62-0850
29	TERMINAL BLOCK	47508-128-00	P62-0343
30	SCREW, for long core, .313" -24 x 1.0" long, hex head cap	03440-085-00	P62-0851
31	SPACER, for magnets	38165-064-00	P62-0306

Table 7–3. B1 Code-Responsive Relay Part Numbers (Cont.)

Ref.	Description	Drawing No.	Catalog No.
32	NUT, for screw (Ref. 33), .138" -40 x .09" thick, hex	03614-007-00	P62-0183
33	SCREW, slotted, fillister head .138" -40 x .75" long	03406-124-ON	P62-0454
34	NUT, for screws (Ref. 3,33), .242" -40 x .09" thick, hex	53084-003-00	P62-0411
35	NUT, for screw (Ref. 33) .242" -40 x .16" thick, hex	39549-008-00	P62-0315
46	CONTACT GROUP, 1 independent front, (tungsten)	58641-011-05	N/A
46A	CONTACT GROUP, 1 dependent front & back (tungsten)	58641-011-02	P62-0855
46A	CONTACT GROUP, 1 dependent front (silver platinum), 1 dependent back (tungsten)	58641-011-03	N/A
46A	CONTACT GROUP, 1 dependent front & back (silver platinum)	58641-011-01	P62-0854
46B	CONTACT GROUP, 1 independent front or normal (silver platinum)	58641-012-02	P62-0857
46C	CONTACT GROUP, 1 dependent back or reverse (silver platinum)	58641-012-01	P62-0856
46D	CONTACT GROUP, 1 dependent front & back (silver platinum)	58641-011-04	N/A
46E	CONTACT GROUP, 1 dependent front & back (silver-impregnated carbon to silver)	58641-010-01	P62-0663
46F	SCREW, for attaching contact groups, .138" -40 x .625" long, flat head	06606-120-ON	P62-0200
48	NAME PLATE	00401-612-00	P62-0116
48A	SCREW, self-tapping, slotted .112" x .25" long	54392-001-00	P62-0419
48B	WASHER, .156" I.D., .313" O.D., .031" thick	01250-004-ON	P50-0422
49	TUBING, 5mm x 1.25" long	55557-000-00	P62-0450
49A	TUBING, 7mm x 1.25" long	55557-004-00	P62-0451
51	DUST SHIELD, for contact groups	50737-091-00	P62-0227
52	GASKET, for between cover and base	13014-221-00	P62-0225

Table 7–3. B1 Code-Responsive Relay Part Numbers (Cont.)

Ref.	Description	Drawing No.	Catalog No.
53	GASKETS, for between cover and knurled nut	30646-012-00	P62-0277
54	COVER, with integral handle	56029-096-00	P62-0579
57	PUSHER	58643-000-00	P62-0664

7.6. B1 SLOW PICKUP, SLOW-RELEASE AND QUICK CROSSOVER RELAYS

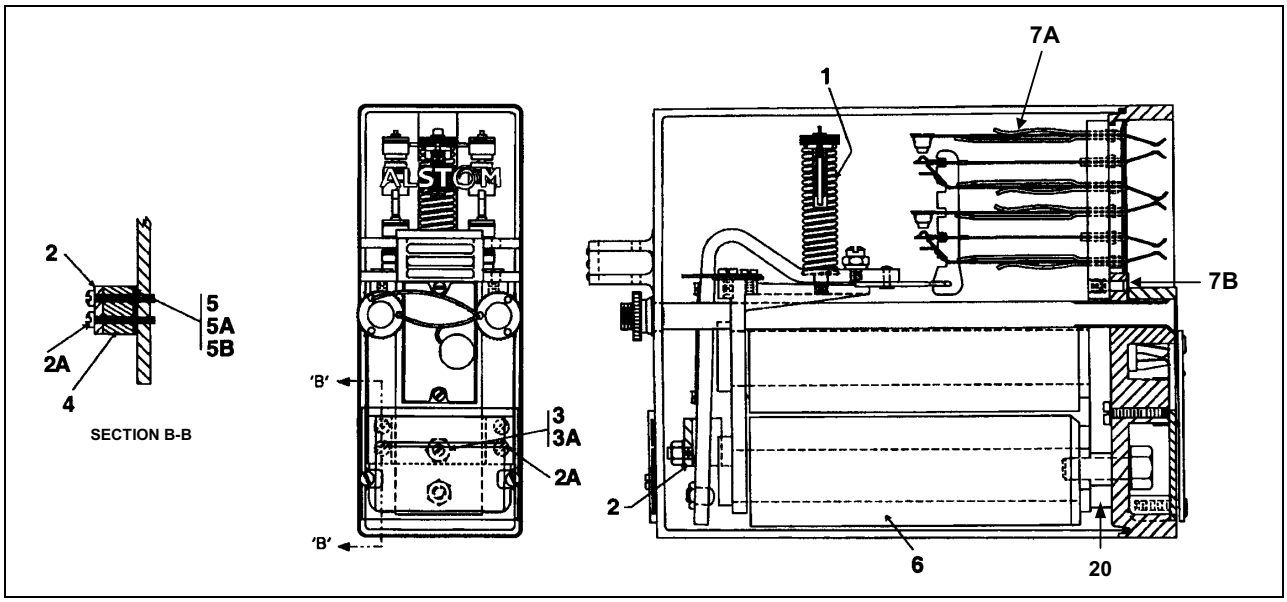


Figure 7–4. B1 Slow Pickup, Slow-Release and Quick Crossover

7.7. B1 ELECTRONICALLY DRIVEN HIGHWAY CROSSING RELAY AND FLASHER MODULE

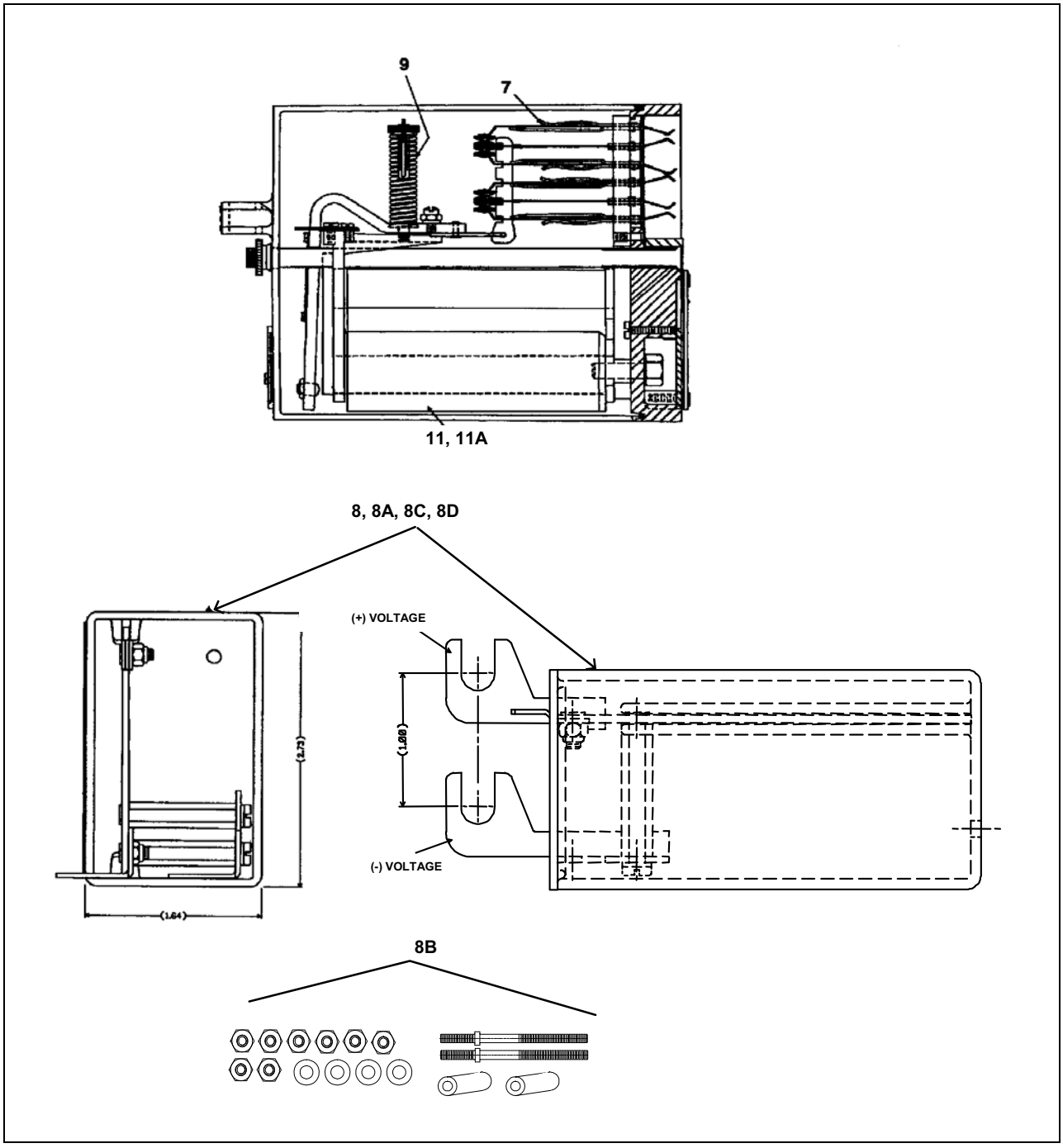


Figure 7–5. B1 Electronically Driven Highway Crossing Relay and Flasher Module

Table 7–4. B1 Slow Pickup, Slow-Release, and Quick-Crossover and Electronically Driven Highway Crossing Relay and Flasher Part Numbers

Ref.	Description	Drawing No.	Catalog No.
1	SPRING, for setting back-contact pressure	00586-095-00	P62-0131
2	YOKE	01224-025-00	P62-0154
2A	SCREW, .138" -40 x .88" long, slotted fillister head	03406-128-ON	P62-0453
3	SCREW, stop for armature, .242" -40 x .344" long, flat point	05100-033-00	P62-0198
3A	NUT, for armature stop screw, .242" -40 x .13" thick, hex	53084-001-00	P62-0410
4	SHUNT STRIP, two required	17378-023-00	P62-0243
5	SHIM, 0.002" thick, eight required	53879-017-00	P62-0413
5A	SHIM, 0.003" thick, eight required	53879-018-00	P62-0414
5B	SHIM, 0.010" thick, four required	53879-019-00	P62-0415
6	COIL, bottom, 124 ohms	56015-012-14	P62-0531
6A	COIL, bottom, 230 ohms	56015-011-15	P62-0530
7	CONTACT GROUP, 2FB (silver-cadmium-oxide)	56012-108-40	P62-0500
7A	CONTACT GROUP (See Figure 7–14 and Table 7–13)	—	—
7B	SCREW, for attaching contact groups, .138" -40 x .625" long, flat head	03306-120-ON	P62-0200
8	RELAY FLASHER MODULE, electronic, 48-54 flashes per minute, includes modification kit for attaching module to relay plugboard. Can drive 1, 2 or 3 60 ohm Alstom FLASHER RELAYS. (SEE NOTE.)	30733-003-01	P62-0769
8A	RELAY FLASHER MODULE, same as Ref. 8, except 56-64 flashes per minute. (SEE NOTE.)	30733-003-02	P62-0784
8B	KIT, modification kit containing hardware for mounting module: long e-posts, spacers, AAR nuts, AAR washers.	17550-071-01	P62-0816

Table 7–4. B1 Slow Pickup, Slow-Release, and Quick-Crossover and Electronically Driven Highway Crossing Relay and Flasher Part Numbers (Cont.)

Ref.	Description	Drawing No.	Catalog No.
8C	RELAY FLASHER MODULE, electronic, 48-54 flashes per minute, includes modification kit for attaching module to relay plugboard. Can drive one 18 ohm Alstom FLASHER RELAY. (SEE NOTE.)	30733-003-03	P62-0861
8D	RELAY FLASHER MODULE, same as Ref. 8C, except 56-64 flashes per minute. (SEE NOTE.)	30733-003-04	P62-0862
9	SPRING, for setting back-contact pressure	00586-056-00	P62-0130
11	COIL, 18.0 ohms	56015-022-10	P62-0770
11A	COIL, 60.0 ohms	56015-008-27	N/A
12	YOKE	01224-037-00	P62-0824

NOTE

For additional information on Alstom flasher modules, request Sales Bulletin SB-00003-001-00 from your Sales Representative or Alstom Customer Service.

7.8. B2 NEUTRAL RELAY

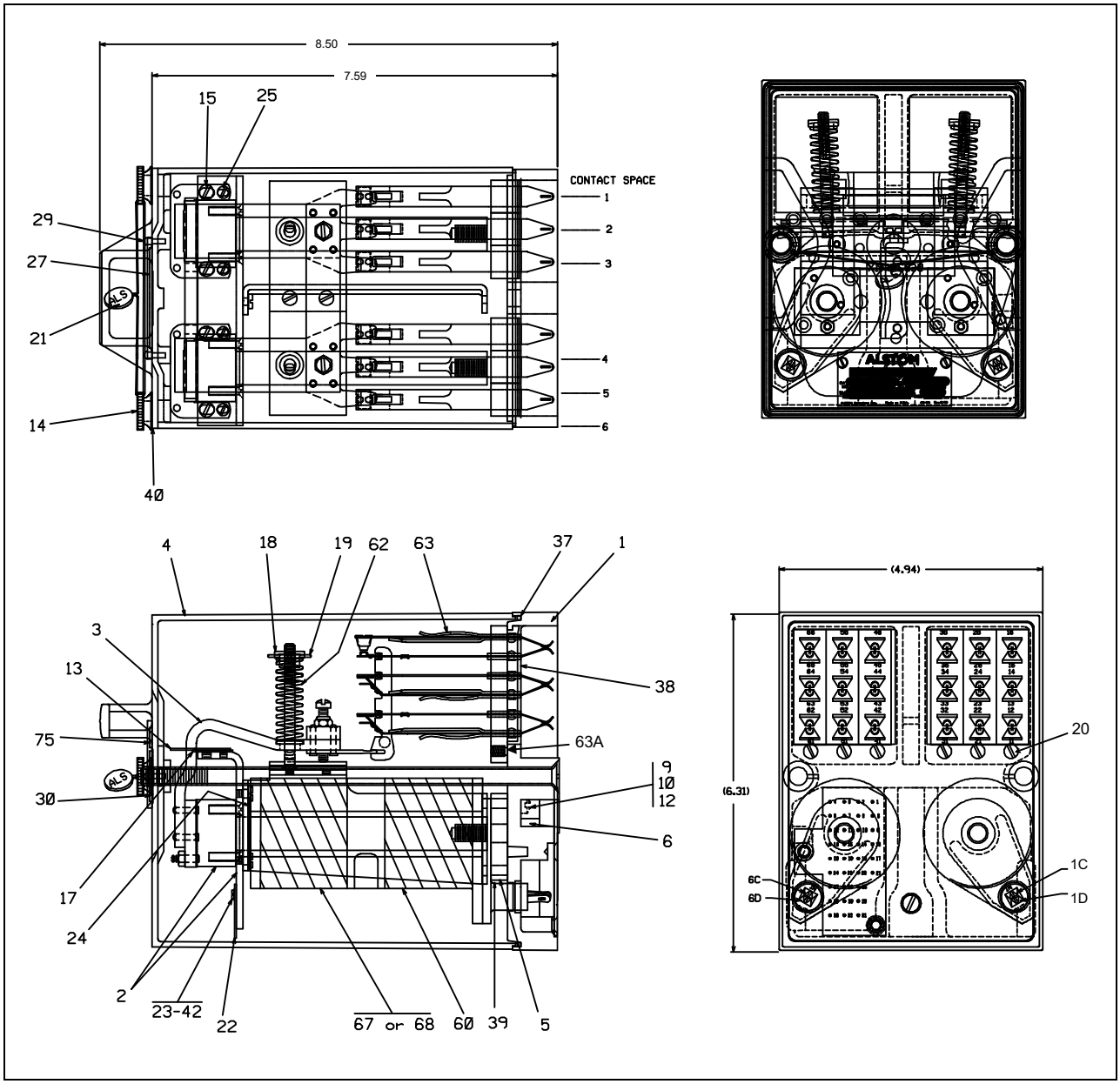


Figure 7–6. B2 Neutral Relay

Table 7–5. B2 Neutral Relay Part Numbers

Ref.	Description	Drawing No.	Catalog No.
1	BASE, complete	56013-019-02	P62-0510
2	CORE & BRACKET	56014-004-01	N/A
3	ARMATURE, includes residual screw with jam nut, bridge travel screw with jam nut, bridges and safety pins	39043-013-03	P62-0310
4	COVER, w/Handle	56029-102-00	N/A
5	YOKE	01224-012-00	P62-0830
6	SCREW, for mounting cores, .313" -24 x 1.125" long, SEMS	53141-025-00	P62-0844
9	SCREW, .164-32 x .875 long with patch	02430-033-00	N/A
10	NUT, .164-32 x .130 thick, hex	01272-005-ON	P85-0276
12	WASHER, flat, .172" I.D., .375" O.D., .031" thick	01250-006-ON	P62-0696
13	ARMATURE RETAINING PLATE	55914-002-00	P62-0474
14	NUT, knurled, for holding cover in place	56026-004-00	P62-0578
15	SCREW, .164" -32 x .313" long with patch	02430-036-00	N/A
17	ARMATURE BEARING PLATE	55912-002-00	P62-0471
18	NUT, .190-32 x .187 thick, lock, knurled	00846-023-00	P62-0142
19	NUT, lock	56024-000-00	P62-0575
20	SCREW, to hold contact groups, .138" -40 x ,625" long, flat head	03306-120-ON	P62-0200
21	RELAY SEAL	35285-000-00	P62-0299
22	NAME PLATE	00401-194-00	P62-0111
23	SCREW, for name plate, .086" -56 x .188" long	03602-006-ON	P62-0442
24	SPRING WASHER, to keep coils tight	01225-105-00	P62-0159
25	SCREW, .112" -40 x .25" long, with patch	02430-037-00	N/A
27	HOLDER	50023-039-00	P62-0356
29	SCREW, for holder (Ref. 10), .112" -40 x .375" long, self-tapping	06604-212-ON	P62-0594
30	TEST DATA FORM	51553-088-00	P62-0383
37	GASKET, between cover and base	13014-222-00	P62-0226
38	SHIELD, for contact groups	50737-091-00	P62-0227

Table 7–5. B2 Neutral Relay Part Numbers (Cont.)

Ref.	Description	Drawing No.	Catalog No.
39	GASKET, for coils	30646-005-00	P62-0276
40	GASKET, between nut (Ref. 14) and cover (Ref. 4)	30646-012-00	P62-0277
42	WASHER, internal tooth, .086" I.D., .200" O.D., .015" thick	53029-064-00	P62-0408
60	COIL (specify drawing no. of relay where part is used)	56015 KN	N/A
62	SPRING (specify drawing no. of relay where part is used)	00586 KN	N/A
63	CONTACT GROUP (specify drawing no. of relay where part is used)	56012 KN	N/A
63A	SCREW, for attaching contact groups, .138" -40 x .625" long, flat head	03306-120-ON	P62-0200
67	WASHER, Copper (specify drawing no. of relay where part will be used)	01225 KN	N/A
68	SLUG, Copper (specify drawing no. of relay where part is used)	54960 KN	N/A
75	TAG BLANK, for circuit designation contains 60 blank tags	55085-208-00	P62-0432

7.9. B2 BIASED-NEUTRAL RELAY

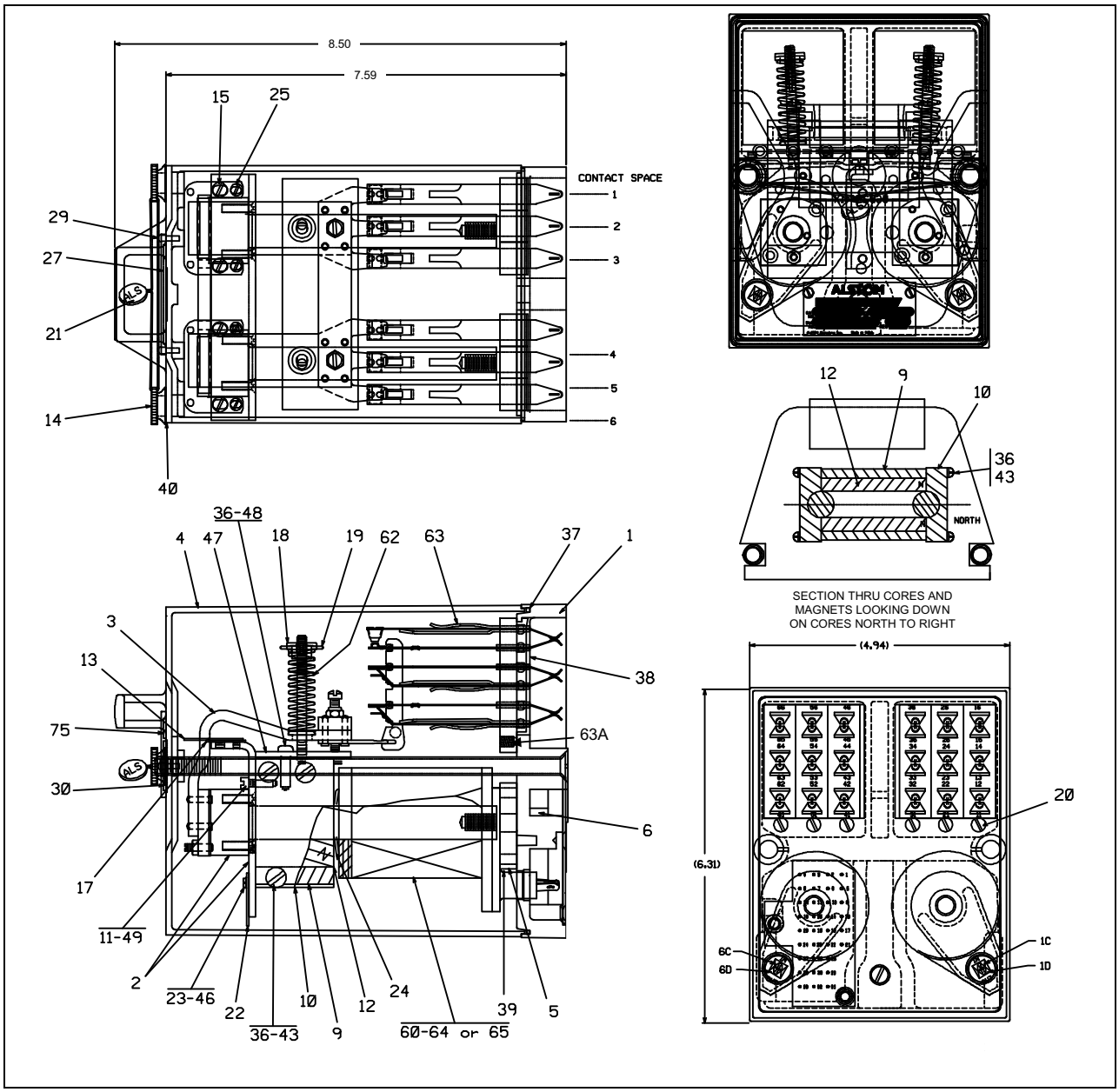


Figure 7–7. B2 Biased-Neutral Relay

Table 7–6. B2 Biased-Neutral Relay Part Numbers

Ref.	Description	Drawing No.	Catalog No.
1	BASE, complete	56013-019-02	P62-0510
2	CORE & BRACKET	56014-018-01	N/A
3	ARMATURE, includes residual screw with jam nut, bridge travel screw with jam nut, bridges and safety pins	39043-013-03	P62-0310
4	COVER, w/Handle	56029-102-00	N/A
5	YOKE	01224-012-00	P62-0830
6	SCREW, for mounting cores, .313" -24 x 1.125" long, SEMS	53141-025-00	P62-0844
9	LEAKAGE STRIP	58898-007-00	P62-0674
10	BRACKET	58897-002-00	P62-0672
11	WASHER, for Ref. 49	01273-022-ON	N/A
12	MAGNET (specify drawing no. of relay where part is used)	53007-029-00	P62-3099
13	ARMATURE RETAINING PLATE	55914-002-00	P62-0474
14	NUT, knurled, for holding cover in place	56026-004-00	P62-0578
15	SCREW, .164" -32 x .313" long with patch	02430-036-00	N/A
17	ARMATURE BEARING PLATE	55912-002-00	P62-0471
18	NUT, .190-32 x .187 thick, lock, knurled	00846-023-00	P62-0142
19	NUT LOCK	56024-000-00	P62-0575
20	SCREW, to hold contact groups, .138" -40 x .625" long, flat head	03306-120-ON	P62-0200
21	RELAY SEAL	35285-000-00	P62-0299
22	NAME PLATE	00401-194-00	P62-0111
23	SCREW, for nameplate, .086" -56 x .125" long	03602-004-ON	P62-0695
24	WASHER, .653 I.D., 1.391 O.D., .022 thick, spring	01225-104-00	P62-0158
25	SCREW, .112" -40 x .25" long, with patch	02430-037-00	N/A
27	HOLDER	50023-039-00	P62-0356
29	SCREW, for holder (Ref. 27), .112" -40 x .375" long, self-tapping	06604-212-ON	P62-0594
30	TEST DATA FORM	51553-088-00	P62-0383

Table 7–6. B2 Biased-Neutral Relay Part Numbers (Cont.)

Ref.	Description	Drawing No.	Catalog No.
36	WASHER, internal tooth, .190" I.D., .381" O.D., .025" thick, shk'proof	53029-003-00	P62-0973
37	GASKET, between cover and base	13014-222-00	P62-0226
38	SHIELD, for contact group	50737-091-00	P62-0227
39	GASKET, for coils	30646-005-00	P62-0276
40	GASKET, between nut (Ref. 14) and cover	30646-012-00	P62-0277
43	SCREW, slotted, pan head, .190" -32 x .88" long	03610-128-ON	P62-0178
46	WASHER, internal tooth, .086" I.D., .200" O.D., .015" thick	53029-064-00	P62-0408
47	SUPPORT	54385-031-01	P62-0418
48	SCREW, .190-32 x .38" Long, pan head	03610-112-ON	P65-0200
49	SCREW, .164-32 x .44" long, fillister head	03408-014-ON	P62-0436
60	COIL (specify drawing no. of relay where part is used)	56015 KN	N/A
62	SPRING (specify drawing no. of relay where part is used)	00586 KN	N/A
63	CONTACT GROUP (specify drawing no. of relay where part is used)	56012 KN	N/A
63A	SCREW, for attaching contact groups, .138" -40 x .625" long, flat head	03306-120-ON	P62-0200
64	WASHER, Copper (specify drawing no. of relay where part is used)	01225 KN	N/A
65	SLUG, Copper (specify drawing no. of relay where part is used)	54960 KN	N/A
75	TAG BLANK, for circuit designation contains 60 blank tags	55085-208-00	P62-0432

7.10. B2 AC VANE RELAY, 2F-2B, TWO POSITION

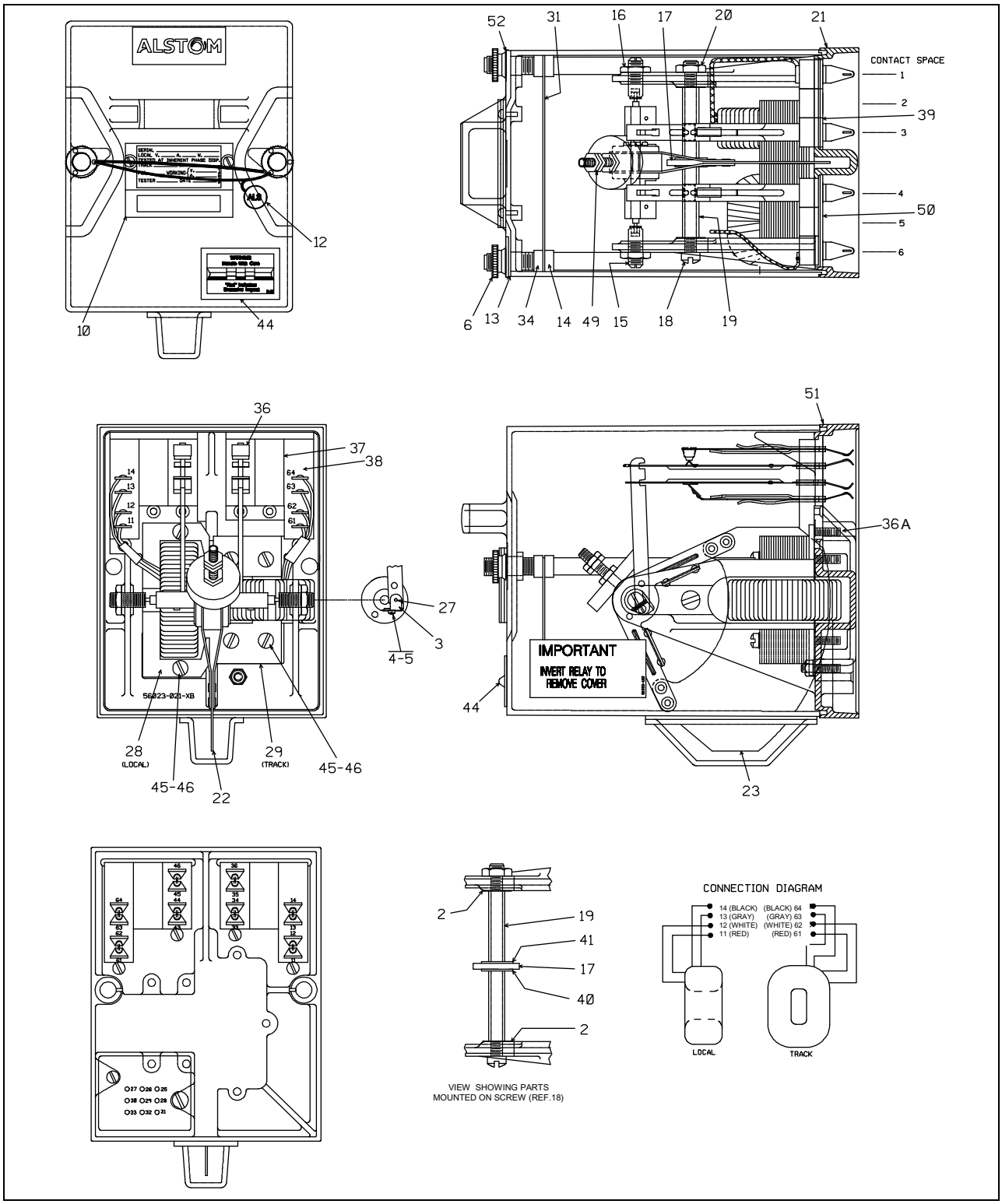


Figure 7–8. B2 AC Vane Relay, 2F-2B, Two Position

Table 7–7. B2 Vane Relay, 2F-2B, Two Position Part Numbers

Ref.	Description	Drawing No.	Catalog No.
2	WASHER, .266 ID, .625 OD, .010 Thk Flat	01148-005-00	P62-0152
3	CLIP, Locking	18547-080-00	P62-0246
4	SCREW, .086-56 x .25 Lg Pan Hd	03602-008-ON	N/A
5	WASHER, .086 ID, .200 OD, .015 Thk Shk'prf	53029-064-00	P62-0408
6	NUT, .375-32 For Cover	56026-004-00	P62-0812
10	FORM, for test data	51553-036-00	P62-0382
12	SEAL, Plastic	35285-001-00	N/A
14	NUT, .375-32 x .19 Thk Sq	42835-011-00	P62-0322
15	BEARING COMP, Jewel	51527-001-03	N/A
16	NUT, .313-32 x .13 Thk Hex	12578-002-00	P62-0222
17	STOP	56563-003-00	P62-0597
18	SCREW, .250-28 x 4.13 Lg Fill Hd	55470-019-00	P62-0447
19	SPACER	49655-214-00	P62-0352
20	NUT, .250-28 x .16 Thk Hex	01472-008-00	P62-0166
21	BASE COMP	56013-014-01	P62-0505
23	COVER COMP (W/Holder Assembled)	57287-002-12	N/A
27	PIN, Bearing .091 x .750 Lg	00504-388-00	P62-0126
31	PLATE, Name	00401-955-00	P62-0117
34	NUT, .375-32 x .13 Thk Spanner	00846-028-00	P62-0143
40	SPACER	49655-215-00	P62-0353
41	WASHER, .254 ID, .687 OD, .036 Thk Flat	01148-006-00	P62-0698
44	SHOCK INDICATOR	29006-004-00	N/A
--	CARTON, SG 381-1	65191-014-05	N/A
--	Z-PAD, SG 381-2	65191-015-05	N/A
--	INSERT, SG 323-3	65191-054-05	N/A
45	SCREW, .164-32 x 1.50 Lg, Pan Hd	03608-048-ON	N/A
46	WASHER, Stainless Steel	53029-068-00	P62-0402
49	NUT, 10-32 x .125 Thk, Hex	00577-002-00	P62-0127
49	NUT, 10-32 x .125 Thk, Hex	01272-007-ON	P76-0129
50	WIRE (Per 82J0004)	80599-003-01	N/A

Table 7–7. B2 Vane Relay, 2F-2B, Two Position Part Numbers (Cont.)

Ref.	Description	Drawing No.	Catalog No.
THE FOLLOWING PARTS ARE TO BE SPECIFIED ON ORDERING SHEETS WHEN REQUIRED			
22	VANE COMP	51507 KN	N/A
28	MAGNET COMP. (Local)	51508 KN	N/A
29	MAGNET COMP. (Track)	51508 KN	N/A
35	REGISTRATION PLATE ASSEM.	58879 KN	N/A
36	CONTACT GROUP SPACE #1-6	56012 KN	N/A
37	GASKET GROUP	57108 KN	N/A

7.11. B2 AC VANE RELAY, 4F-4B, TWO POSITION

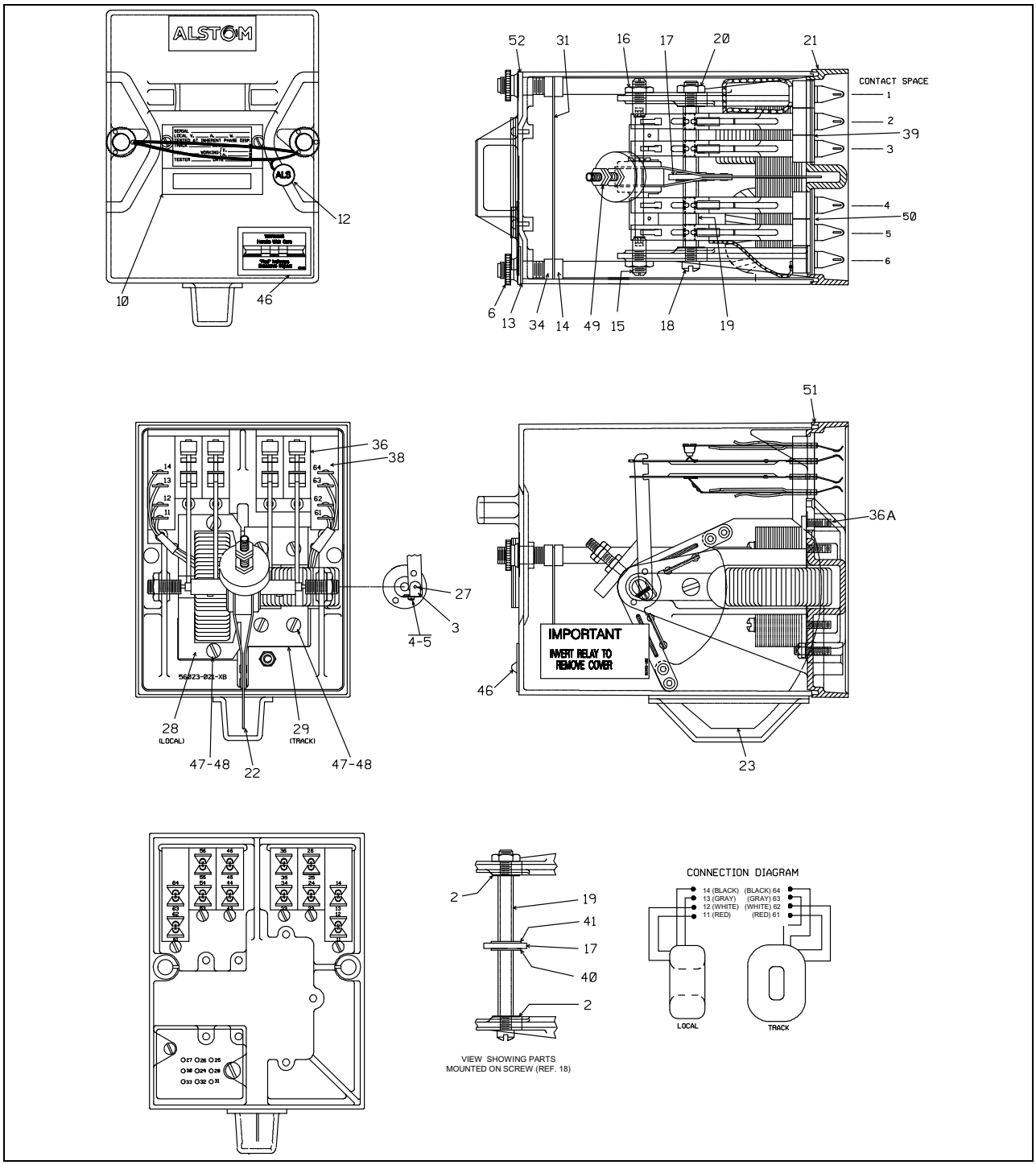


Figure 7–9. B2 AC Vane Relay, 4F-4B, Two Position

Table 7–8. B2 Vane Relay, 4F-4B, Two Position Part Numbers

Ref.	Description	Drawing No.	Catalog No.
2	WASHER, .266" I.D., .625" O.D., .010" thick, flat	01148-005-00	P62-0152
3	CLIP, locking	18547-080-00	P62-0246
4	SCREW, .086" -56 x .25" long, slotted pan head	03602-008-ON	N/A
5	WASHER, internal tooth, .086" I.D., .200" O.D., .015" thick	53029-064-00	P62-0408
6	NUT, knurled, for holding cover in place	56026-004-00	P62-0578
10	TEST DATA FORM	51553-036-00	P62-0382
12	SEAL, tamper evident seal	35285-000-00	P62-0299
14	NUT, .375-32" x .19" thick, sq	42835-011-00	P62-0332
15	JEWEL BEARING, for shaft	51527-001-03	N/A
16	NUT, for bearing, .313" -32 x .13" thick, hex	12578-002-00	P62-0222
17	STOP, resilient, for vane	56563-003-00	P62-0597
18	SCREW, for stop, .250" –28 x 4.13" long, fillister head	55470-019-00	P62-0447
19	SPACER	49655-214-00	P62-0352
20	NUT, .250-28" x .16" thick, hex	01472-008-00	P62-0166
21	BASE, includes tubes for studs	56013-014-01	P62-0505
22	VANE , complete (for relays with 2F-2B contacts)	51507-013-02	P62-0374
22	VANE, complete (for relays with 4F-4B contacts)	51507-013-03	N/A
23	COVER, with holder assembled	57287-002-12	N/A
27	PIN, BEARING, .091" x .750" long	00504-388-00	N/A
28	MAGNET COMP. (Local) (specify drawing no. of relay where part is used)	51508 KN	N/A
29	MAGNET COMP. (Track) (specify drawing no. of relay where part is used)	51508 KN	N/A
31	NAME PLATE	00401-955-00	P62-0117
34	NUT, spanner, .375" -32 x .13" thick	00846-028-00	P62-0143
36	CONTACT GROUP, 1F (AgC-S) – 1B (S-S) (specify quantity required)	56012-108-11	P62-0493

Table 7–8. B2 Vane Relay, 4F-4B, Two Position Part Numbers (Cont.)

Ref.	Description	Drawing No.	Catalog No.
36A	SCREW, for attaching contact groups, .138" -40 x .625" long, flat head	03306-120-ON	P62-0200
37	CONTACT GROUP, blank	56012-046-01	P62-0700
38	CONTACT GROUP, (with solder tabs)	56012-038-01	P62-0699
40	SPACER, for stop	49655-215-00	P62-0353
41	WASHER, flat, .254" I.D., .687" O.D., .036" thick	01148-006-00	P62-0698
44	SHOCK INDICATOR	29006-004-00	N/A
45	SCREW, .164"-32 x 1.50" long, slotted pan head	03608-048-ON	N/A
46	WASHER, internal tooth lock, for a .190-32" .164" screw	53029-068-00	P62-0402
49	NUT, .190" -32 x. 13" thick	01272-007-ON	P76-0129
39	GASKET (for right hand three contact groups- rear view)	13014-280-00	P62-0229
50	GASKET (for left hand three contact groups- rear view)	13014-279-00	P62-0228
51	GASKET (for base)	13014-222-00	P62-0226
52	GASKET (for cover – two required per relay)	30646-012-00	P62-0277

7.12. B2 CODE RATE TRANSMITTER RELAY

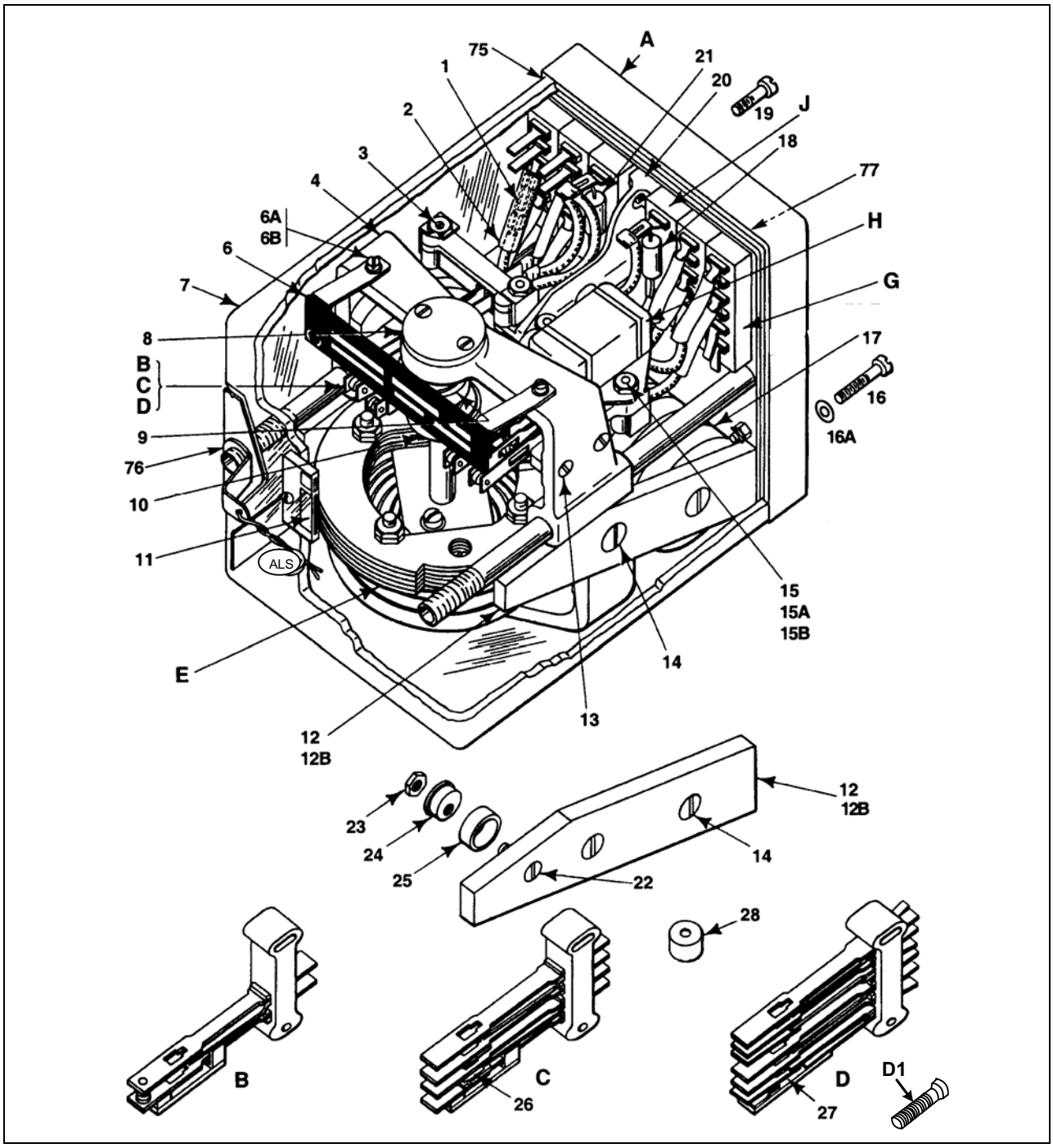


Figure 7–10. B2 Code Rate Transmitter Relay

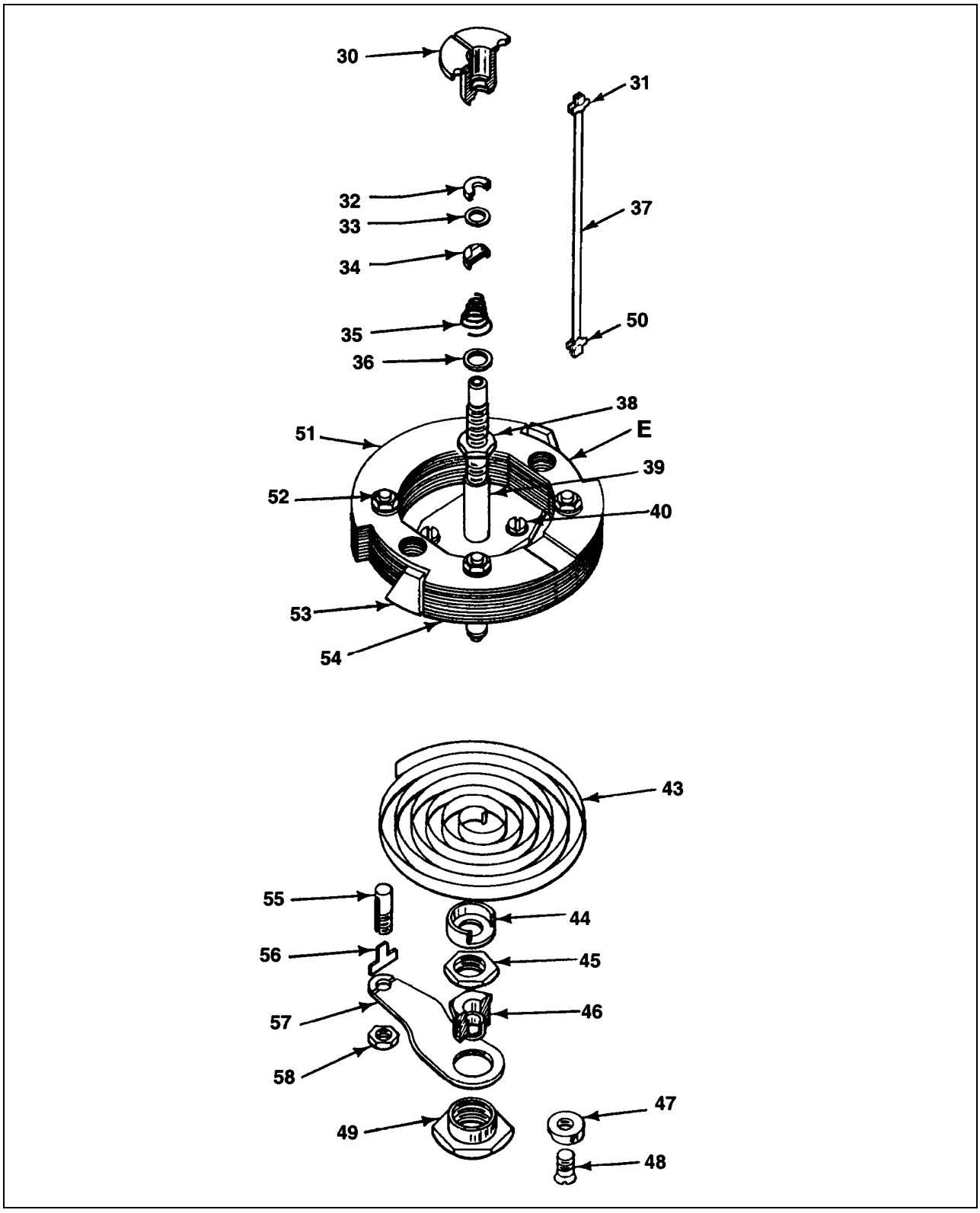


Figure 7–10. B2 Code Rate Transmitter Relay (Cont.)

Table 7–9. B2 Code Rate Transmitter Relay Part Numbers

Ref.	Description	Drawing No.	Catalog No.
A	BASE, includes tubes for studs	56013-026-01	P62-0513
B	CONTACT GROUP, coil, IF contact (silver-platinum)	57016-013-01	P62-0599
C	CONTACT GROUP, 2F and 2B, (silver-platinum)	57016-013-02	P62-0600
C1	CONTACT GROUP, 2F and 2B, (tungsten)	57016-013-03	P62-0601
D	CONTACT GROUP, 2FB contacts (silver-platinum)	57016-013-04	P62-0602
D1	SCREW, for attaching contact groups, .138" -40 x .625" long, flat head	03306-120-ON	P62-0200
E	ROTOR, COMPLETE, 75 rate	57094-009-01	P62-0612
E1	ROTOR, COMPLETE, 120 rate	57094-009-02	P62-0613
E2	ROTOR, COMPLETE, 180 rate	57094-009-03	P62-0614
E3	ROTOR, COMPLETE, 50 rate	57094-009-06	N/A
E4	ROTOR, COMPLETE, 270 rate	57094-009-04	N/A
E5	ROTOR, COMPLETE, 220 rate	57094-009-05	N/A
E6	ROTOR, COMPLETE, 96 rate	57094-009-07	N/A
G	CONTACT GROUP, with soldering lugs	56012-028-01	P62-0491
H	CAPACITOR, COMPLETE, arc suppression	56644-001-03	P62-0598
J	RESISTOR MOUNTING BLOCK	57277-001-02	P62-0636
1	TERMINAL WIRE	55083-012-00	P62-0431
2	SLEEVING, 5mm dia. x 1.25" long	55557-000-00	P62-0450
3	SCREW, for mounting contact blocks, .138" -40 x 2.0" long	23308-008-00	P62-0265
3A	SCREW, for mounting contact blocks, .138" -40 x 1.625" long	23308-005-00	P62-0264
3B	NUT, for screws (Ref. 3, 3A), .138" -40 x .09" thick, hex	03614-007-00	P62-0183
3C	LOCK WASHER, for nut (Ref. 3B)	01601-037-00	P62-0170
4	FRAME	57491-001-00	P62-0651

Table 7–9. B2 Code Rate Transmitter Relay Part Numbers (Cont.)

Ref.	Description	Drawing No.	Catalog No.
6	NAME PLATE	00401-956-00	P62-0112
6A	SCREW, for nameplate, .138" -40 x .25" long, slotted, fillister head	03406-108-ON	P62-0189
6B	LOCK WASHER, internal tooth, .141" I.D., .295" O.D., .021" thick	53029-067-00	P62-0406
7	COVER	57287-002-11	P62-0643
8	COVER, for bearing	18575-000-00	P62-0248
8A	SCREW, slotted, flat head, .138" -40 x .375"	03306-112-ON	P62-0104
9	UPPER CAM	58728-001-02	P62-0850
10	LOWER CAM	58728-001-01	P62-0849
11	TEST DATA FORM	51553-051-00	P62-0389
12	POLE, right-hand	57091-001-00	P62-0605
12B	POLE, left-hand	57091-002-00	P62-0606
13	SCREW, .164" -32 x .50" long, slotted, flat head	03308-016-ON	P62-0297
14	SCREW, for fastening pole to frame, .250" -28 x .50" long, fillister head	55370-001-00	P62-0835
15	SCREW, headless, for mounting contact blocks, .138" -40 x 1.188" long	23308-004-00	P62-0263
15A	WASHER, internal tooth, .141" I.D., .295" O.D., .021" thick	53029-067-00	P62-0406
15B	WASHER, flat, .172" I.D., .375" O.D., .031" thick	01250-006-ON	P62-0696
16	SCREW, for attaching Ref. 12 and 12A, .190" -32 x .75" long, slotted fillister head	03410-124-ON	P65-0208
16A	LOCK WASHER, internal tooth, .195" I.D., .381" O.D., .025" thick	53029-069-00	P62-0401
17	COIL, 150.0 ohm	31066-135-01	P62-0286
18	RESISTOR, 150.0 ohm	59723-124-00	P62-0685
19	SCREW, for attaching Ref. 20, .190" -32 x .50" long, slotted, fillister head	03410-116-ON	P62-0214
20	BRACKET, frame	54297-003-00	P62-0416
21	RESISTOR, 1000 ohm, used in multiple with coil, for arc suppression	59723-000-00	P62-0714

Table 7–9. B2 Code Rate Transmitter Relay Part Numbers (Cont.)

Ref.	Description	Drawing No.	Catalog No.
22	SCREW, .190" -32 x .63" long, slotted, flat head	03310-120-ON	P50-0431
23	NUT, .190" -32 x. 13" thick	01272-007-ON	P76-0129
24	STOP	17185-000-00	P62-0237
25	BUSHING	07350-261-00	P62-0209
26	PUSHER, for Contact Group (Ref. C)	57019-000-00	P62-0716
27	PUSHER, for Contact Group (Ref. D)	57019-003-00	P62-0717
28	BUSHING, for Contact Groups	07350-275-00	P62-0210
30	UPPER BEARING	57092-009-01	P62-0609
31	UPPER CLAMPING PLATE, for ribbon	55911-036-00	P62-0469
32	SHIM WASHER, .222" I.D., .417" O.D., .050" thick	00975-007-00	P62-0715
33	SHIM WASHER, .222" I.D., .417" O.D., .005" thick	00975-005-00	P62-0146
33A	SHIM WASHER, .222" I.D., .417" O.D., .008" thick	00975-006-00	P62-0147
34	GUIDE, for spring	18559-000-00	P62-0247
35	SPRING, for upper bearing	51055-008-00	P62-0359
36	WASHER, .297" I.D., .432" O.D., .020" thick	01225-199-00	P62-0164
37	RIBBON, COMPLETE	22148-000-02	P62-0256
38	NUT, for locking cams in place, .313" -32 x .125" thick, hex	12578-002-00	P62-0221
39	ROTOR, with shaft, hub and roll-pin	57094-010-01	P62-0603
40	SCREW, .190" -32 x .375" long, slotted, fillister head	03410-112-ON	P62-0218
40A	LOCK WASHER, internal tooth, .190" I.D., .381" O.D., .025" thick	53029-069-00	P62-0401
42	ROLL PIN	17188-000-00	P62-0238
43	SPRING, for rotor	34956-004-00	P62-0295
44	CUP WASHER, for nut	22539-008-00	P62-0257
45	NUT, for holding spring on rotor, .50" -32 x .125" thick, hex	06358-011-00	P62-0205
46	LOWER BEARING	57092-008-01	P62-0608
47	CLAMP	54847-011-00	P62-0423

Table 7–9. B2 Code Rate Transmitter Relay Part Numbers (Cont.)

Ref.	Description	Drawing No.	Catalog No.
48	SCREW, .190" -32 x .50" long, slotted fillister head	03310-116-ON	P62-0176
49	NUT, for lower bearing	39549-013-00	P62-0316
50	LOWER CLAMPING PLATE, for ribbon	55911-035-00	P62-0468
51	WEIGHT RING, .063" thick, nine required for 50 rate transmitters; eight required for 75 rate transmitters ; three required for 96 rate transmitters	43712-008-00	P62-0336
51A	WEIGHT RING, .031 " thick, one required for 75 rate; four required for 120 rate ; one required for 96 rate transmitters	43712-011-00	P62-0338
52	SCREW, .190" -32 x .88" long, slotted, fillister head	03410-128-ON	P62-0217
52A	NUT, .190" -32 x. 13" thick, hex	01272-007-ON	P62-0129
52B	FLAT WASHER, .438" O.D., .200" I.D., .03" thick	01250-009-ON	P76-0247
52C	LOCK WASHER, internal tooth, .190" I.D., .381" O.D., .025" thick	53029-069-00	P62-0401
53	ARMATURE	57110-000-00	P62-0625
54	BASE RING, one required for 50, 75, 96, 120 and 180 rate transmitters	43712-009-00	P62-0337
55	STUD, for fastening stationary end of spring to arm	20247-004-00	P62-0254
56	STOP, for fastening end of spring on stud	38316-002-00	P62-0308
57	ARM, for stud and stop	54818-014-00	P62-0422
58	NUT, jam .250" -28 x .156" thick, hex	01472-007-00	P62-0165
75	GASKET, between cover and base	13014-222-00	P62-0226
76	NUT, cover	56026-011-00	P62-0578
76A	GASKET, cover	30646-012-00	P62-0277
77	SHIELD, for contact groups	50737-091-00	P62-0227

7.13. TYPE VTB POLAR-BIASED RELAY

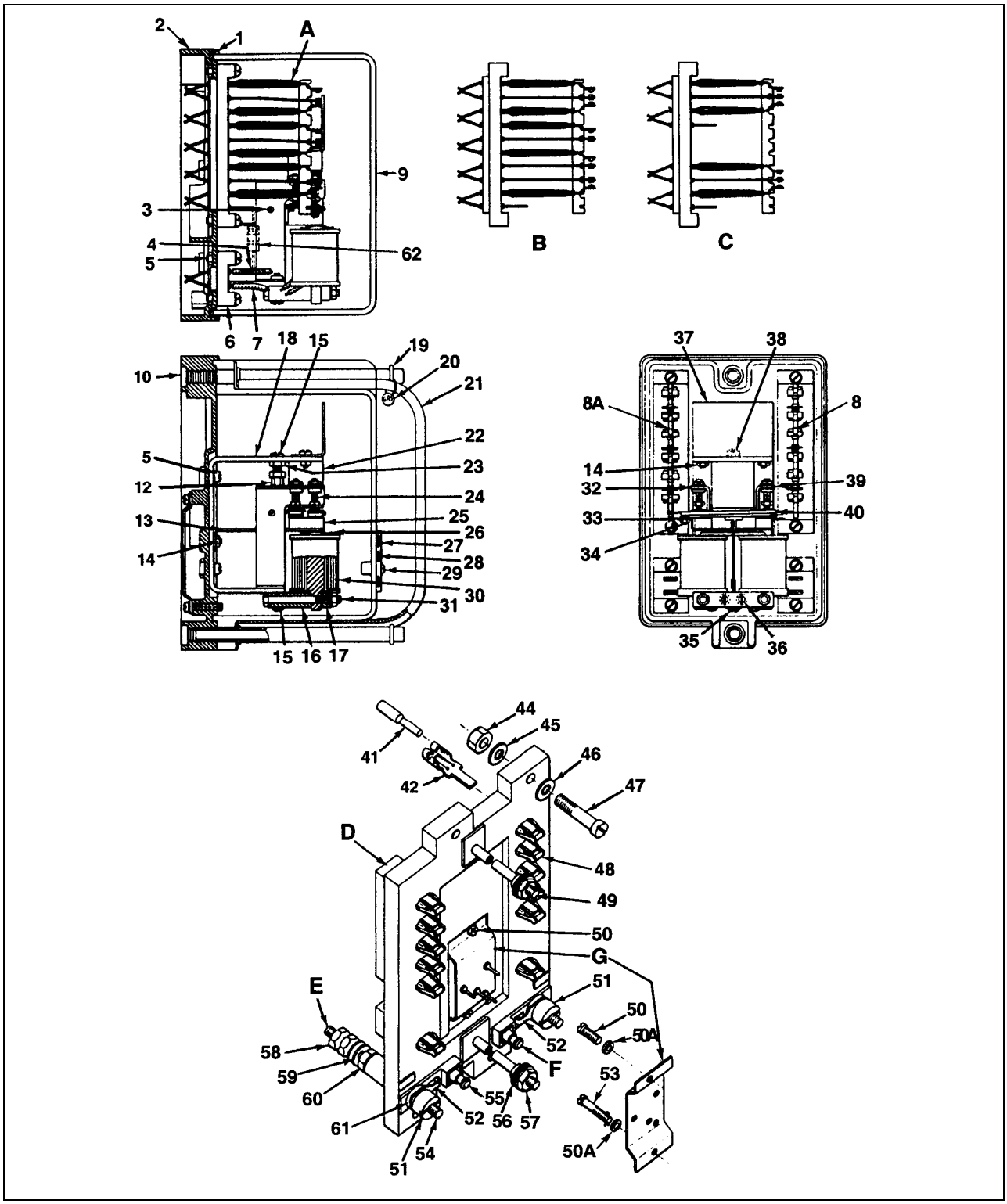


Figure 7–11. Type VTB Polar-Biased Relay

Table 7–10. VTB Polar Biased Relay Part Numbers

Ref.	Description	Drawing No.	Catalog No.
A	CONTACT GROUP, three dependent front and back silver-platinum contacts	56012-109-04	P62-0499
B	CONTACT GROUP, one dependent front back, two dependent fronts and one dependent back silver-platinum contacts	56012-109-02	P62-0497
B1	CONTACT GROUP, except with one dependent front back, one dependent front, one dependent back silver-platinum contacts	56012-109-05	P62-0760
B2	CONTACT GROUP, except with one dependent front back silver-platinum, one dependent back silver-platinum, one dependent front tungsten, one dependent back tungsten.	56012-109-06	P62-0836
C	CONTACT GROUP, two dependent front and back silver-platinum contacts	56012-109-03	P62-0498
1	GASKET, for cover	13014-312-00	P62-0230
2	BASE, for relay	56023-034-00	P62-0574
3	SCREW, .112"-40 x .25" slotted pan head	03604-008-ON	P62-0759
3A	WASHER, .115" I.D., .270" O.D., .019" thick, internal tooth lock	53029-066-00	P65-0730
4	TERMINAL	55083-012-00	P62-0431
5	SCREW, .164"-32 x .88" long. slotted pan head	03606-028-ON	N/A
5A	NUT, .164"-32 x .13" thick, hex	03891-011-00	P62-0186
5B	WASHER, .168" I.D., .340" O.D., .023" thick., internal tooth lock	53029-068-00	P62-0402
6	CONTACT GROUP, for coil connections	56012-060-01	P62-0496
7	SLEEVING, for coil connections	55557-000-00	P62-0450
8	PUSHER, for contact groups, has slot in back for right-hand contact group on double armature relays	55863-053-00	P62-0465
8A	PUSHER, has slot in front edge, for single armature relays and for left-hand contact group on double armature relays	55863-052-00	P62-0464

Table 7–10. VTB Polar Biased Relay Part Numbers (Cont.)

Ref.	Description	Drawing No.	Catalog No.
8B	CLIP, two required per contact group (USE ONLY ONCE)	56025-001-00	P62-0577
9	COVER, for relay	56029-031-00	P62-0581
10	BUSHING, for tube	45896-029-00	P62-0754
12	SPACER	50514-012-00	P62-0755
13	BRACKET COMPLETE	18470-001-01	P62-0746
14	SCREW, .138" - 32 x .31" long., slotted pan head	03606-010-ON	P85-0464
14A	NUT, .138" - 32 x. 25" thick, hex	01272-010-ON	P65-0498
14B	WASHER, .141" I.D., .295" O.D., .021" thick, internal tooth lock	53029-081-00	P62-0837
15	SCREW, .190" - 32 x .75" long., slotted pan head	03610-124-ON	P65-0208
16	BLOCK, for cores, for double-armature relays	53336-012-00	P62-0758
17	YOKE, for cores	01224-034-00	P62-0740
18	FRAME, only	18476-000-00	P62-0748
19	TUBE, for fastening relay to plugboard	29474-047-00	P62-0270
20	SEAL	35285-000-00	P62-0299
21	HANDLE, for relay	41909-022-00	P62-0319
22	MAGNET (specify drawing no. of relay where part is used)	53007-060-00	P62-0838
23	NUT, .190" - 32 x .13" thick x .38" hex	01272-007-ON	P76-0129
24	SCREW, .164" - 32 x .63" long, crowned head	07499-002-00	P62-0211
24A	NUT, .164" - 32 x .13" thick, hex	03891-011-00	P62-0186
24B	WASHER, .168" I.D., .340" O.D., .023" thick	53029-068-00	P62-0402
25	CORE, for double armature relay	29514-173-00	P62-0750
25A	CORE, for single-armature relay	29514-172-00	P62-0749
26	SPRING, pressure, for coils	13108-030-00	P62-0233
27	HOLDER, for test data form	50023-039-00	P62-0356

Table 7–10. VTB Polar Biased Relay Part Numbers (Cont.)

Ref.	Description	Drawing No.	Catalog No.
28	FORM, test data	51553-095-00	P62-0839
29	SCREW, .112" - 40 x .3" long, slotted pan head self tapping	56190-003-00	P62-0593
30	COIL, right or left hand, 0.10 ohms	59857-004-05	P62-0687
30A	COIL, right or left hand, 0.12 ohms	59857-004-04	P62-0686
30B	COIL, right or left hand, 2.0 ohms	59857-004-09	P62-0764
30C	COIL, right or left hand, 4.0 ohms	59857-004-06	P62-0763
30D	COIL, right or left hand, 17.0 ohms	59857-005-06	P62-0688
30E	COIL, right or left hand, 100.0 ohms	59857-005-07	P62-0689
31	SCREW, for block and yoke, .190"-32 x 1.88" long, hex	13006-063-00	P62-0743
31A	NUT, .190"-32 x .13" thick x .38" hex	01272-007-ON	P76-0129
31B	WASHER, internal tooth shakeproof washer for a .190" screw	53029-069-00	P62-0401
32	BRACKET, left-hand	18470-000-01	P62-0744
33	PLATE, clamping	18475-000-00	P62-0747
34	SCREW, .112"-40 x .25" long slotted fillister head	03404-008-ON	P62-0445
34A	NUT, .112"-40 x .25" hex x .09" thick	01272-002-ON	P62-0765
34B	WASHER, .115" I.D., .270" O.D., .019" thick, internal tooth lock	53029-066-00	P65-0730
35	SCREW, .164"-32 x .75" long, slotted pan head	03608-024-ON	P62-0175
35A	WASHER, .168" I.D., .340" O.D., .023" thick, internal tooth lock	03610-124-ON	P65-0208
36	SCREW, .138"-40 x .25" long. slotted pan head	03606-108-ON	P62-0753
37	NAME PLATE	00401-309-00	P62-0015
38	SCREW, for supporting magnet, .190"-32 x 1.38" long. fillister head	12563-020-00	P62-0742
38A	NUT, .190" -32 x .385" x .38" Sq. x .13" thick	31784-001-00	P62-0751
38B	WASHER, .190" I.D., .381" O.D., .025" internal tooth lock washer	53029-069-00	P62-0401

Table 7–10. VTB Polar Biased Relay Part Numbers (Cont.)

Ref.	Description	Drawing No.	Catalog No.
39	BRACKET, right-hand	18470-000-02	P62-0745
40	ARMATURE COMPLETE	18472-001-01	P62-0245
41	SLEEVE, molded rubber, used with #10 AWG wire on plugboards	35189-033-00	P62-0298
42	TERMINAL, solder-type, two required per insulator	55871-019-00	P62-0466
44	NUT, .250" -28 hex	01472-003-00	P62-0167
45	WASHER, spring lock for a .250" screw	01273-006-ON	P81-0121
46	WASHER, flat for a .250" screw	01250-029-ON	P85-0050
47	SCREW, .250" -28 x 1.25" slotted fillister head	55470-004-00	P62-0448
48	INSULATOR, for plugboard	55862-024-00	P62-0457
49	STUD, for plugboard	48813-007-00	P62-0347
49A	NUT, .250" -28 hex, elastic stop	42333-065-00	P62-0320
49B	WASHER, flat washer for a .250" screw	01250-011-ON	P50-0157
50	SCREW, .164" -32 x .375", slotted fillister head	03408-012-ON	P85-0870
50A	WASHER, .168", 340" O.D., .023" thick, internal tooth shakeproof	53029-068-00	P62-0402
51	NUT, for current test posts .242" -24	00578-015-00	P62-0129
52	CONNECTOR, for current test posts	04906-150-00	P62-0191
53	SCREW, .164" -32 x .88" long. fillister head for fastening registration plate to relay	28989-046-00	P62-0268
54	SCREW, used as current test post, .242" -24 x 3.75" long	00374-010-00	P62-0108
55	SCREW, used a voltage test post, .242" -24 x 3.38" long	00376-013-00	P62-0109
56	NUT, for fastening relay to plugboard	00846-029-00	P62-0144
57	NUT, for locking nut (Ref. 56)	01472-008-00	P62-0166
58	NUT, for lest posts, .242" -24 x .313" thick	42843-001-00	P76-0131
59	WASHER, for test posts	01225-002-00	P76-0108
60	NUT, .242" -24 x.188" thick	42839-005-00	P62-0333
61	BUSHING, insulating, for connectors	06347-031-00	P62-0203

Table 7–11. B Relay Coil and Compression Spring Part Numbers

	Coil Used For Relay		Coil		Compression Spring	
Nominal Res. Ohms	**Top or Bottom**	**Used with Catalog No.**	**Drawing No.**	**Catalog No.**	**Drawing No.**	**Catalog No.**
105	Either	A62-205	56015-023-01	P62-547	00586-095-00	P62-131
0.12	Either	A62-211	56015-022-07	P62-543	00586-095-00	P62-131
0.2	Either	A62-213	56015-022-06	P62-542	00586-095-00	P62-131
450	Top	A62-215	56015-008-15	P62-519	00586-095-00	P62-131
0.45	Bottom	A62-215	56015-022-05	P62-541	00586-095-00	P62-131
450	Top	A62-217	56015-008-15	P62-519	00586-095-00	P62-131
0.069	Bottom	A62-217	56015-056-01	P62-563	00586-095-00	P62-131
450	Top	A62-221	56015-008-15	P62-519	00586-095-00	P62-131
0.12	Bottom	A62-221	56015-022-07	P62-543	00586-095-00	P62-131
450	Top	A62-231	56015-008-15	P62-519	00586-095-00	P62-131
0.2	Bottom	A62-231	56015-022-06	P62-542	00586-095-00	P62-131
450	Top	A62-236	56015-008-15	P62-519	00586-095-00	P62-131
0.61	Bottom	A62-236	56015-022-01	P62-545	00586-095-00	P62-131
0.9	Either	A62-260	56015-022-03	P62-540	00586-095-00	P62-131
2.0	Either	A62-261	56015-022-02	P62-539	00586-095-00	P62-131
250	Either	A62-262	56015-008-14	P62-518	00586-095-00	P62-131
250	Either	A62-277	56015-008-14	P62-518	00586-095-00	P62-131

Table 7–11. B Relay Coil and Compression Spring Part Numbers (Cont.)

	Coil Used For Relay		Coil		Compression Spring	
Nominal Res. Ohms	**Top or Bottom**	**Used with Catalog No.**	**Drawing No.**	**Catalog No.**	**Drawing No.**	**Catalog No.**
3.0	Either	A62-293	56015-022-14	P62-546	00586-056-00	P62-130
42	Either	A62-295	56015-009-10	P62-521	00586-095-00	P62-131
450	Either	A62-296	56015-008-14	P62-519	00586-095-00	P62-131
175	Either	A62-300	56015-008-13	P62-517	00586-095-00	P62-131
42	Either	A62-305	56015-009-10	P62-521	00586-095-00	P62-131
450	Either	A62-308	56015-008-15	P62-519	00586-095-00	P62-131
175	Either	A62-309	56015-008-13	P62-517	00586-095-00	P62-131
250	Either	A62-310	56015-008-14	P62-518	00586-095-00	P62-131
450	Either	A62-311	56015-008-15	P62-519	00586-095-00	P62-131
450	Top	A62-312	56015-008-15	P62-519	00586-095-00	P62-131
8	Bottom	A62-312	56015-022-01	P62-733	00586-095-00	P62-131
42	Top	A62-313	56015-009-10	P62-521	00586-095-00	P62-131
1.6	Bottom	A62-313	56015-037-02	P62-552	00586-095-00	P62-131
4.5	Either	A62-314	56015-037-03	P62-553	00586-095-00	P62-131
29.5	Top	A62-315	56015-035-03	P62-551	00586-095-00	P62-131
20.5	Bottom	A62-315	56015-009-08	P62-520	00586-095-00	P62-131
50	Either	A62-317	56015-008-10	P62-515	00586-095-00	P62-131
900	Either	A62-318	56015-009-17	P62-523	00586-095-00	P62-131

Table 7–11. B Relay Coil and Compression Spring Part Numbers (Cont.)

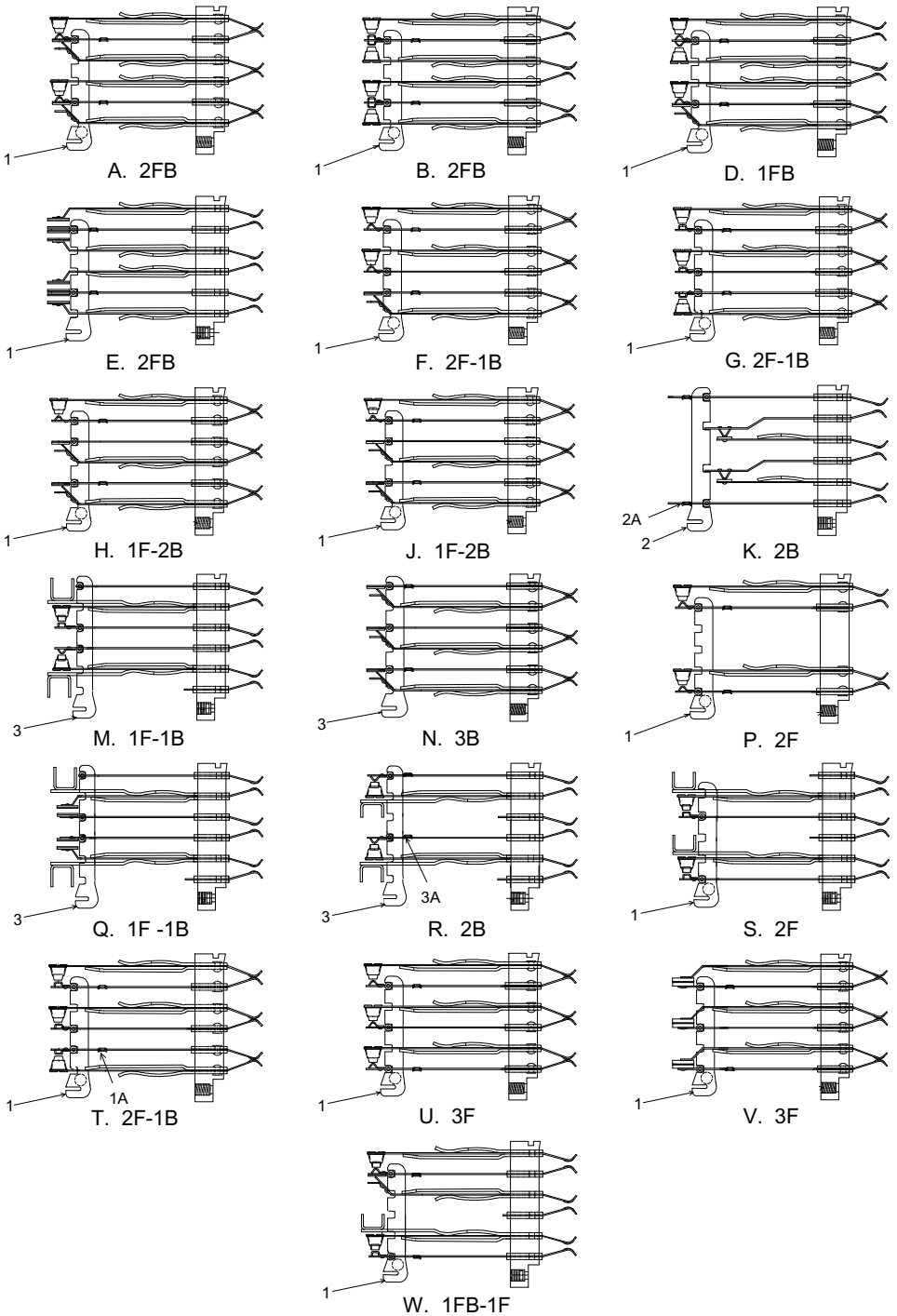
	Coil Used For Relay		Coil		Compression Spring	
Nominal Res. Ohms	**Top or Bottom**	**Used with Catalog No.**	**Drawing No.**	**Catalog No.**	**Drawing No.**	**Catalog No.**
900	Either	A62-320	56015-009-17	P62-523	00586-095-00	P62-131
28.5	Top	A62-325	56015-022-11	P62-776	00586-095-00	P62-131
135	Top	A62-335	56015-021-04	P62-538	00586-095-00	P62-131
65	Bottom	A62-335	56015-021-03	P62-537	00586-095-00	P62-131
300	Bottom	A62-341	56015-012-16	P62-533	00586-095-00	P62-131
220	Bottom	A62-345	56015-011-15	P62-530	00586-095-00	P62-131
194	Bottom	A62-350	56015-012-15	P62-532	00586-095-00	P62-131
460	Bottom	A62-353	56015-012-17	P62-534	00586-095-00	P62-131
450	Bottom	A62-355	56015-008-15	P62-519	00586-095-00	P62-131
**194	Bottom	A62-357	56015-012-15	P62-532	00586-095-00	P62-131
194	Bottom	A62-358	56015-012-15	P62-532	00586-095-00	P62-131
**194	Bottom	A62-359	56015-012-15	P62-532	00586-095-00	P62-131
**194	Bottom	A62-360	56015-012-15	P62-532	00586-095-00	P62-131
12	Either	A62-365	56015-045-10	P62-691	00586-110-00	P62-133
300	Bottom	A62-369	56015-012-16	P62-533	00586-095-00	P62-131
800	Bottom	A62-370	56015-009-21	P62-525	00586-095-00	P62-131
400	Bottom	A62-372	56015-012-17	P62-534	00586-095-00	P62-130

** For use with relays containing aluminum slugs.

Table 7–11. B Relay Coil and Compression Spring Part Numbers (Cont.)

	Coil Used For Relay		Coil		Compression Spring	
Nominal Res. Ohms	**Top or Bottom**	**Used with Catalog No.**	**Drawing No.**	**Catalog No.**	**Drawing No.**	**Catalog No.**
40	Either	A62-380	56015-023-05	P62-548	00586-095-00	P62-131
50-00	Either	A62-401	56015-008-10	P62-515	00586-104-00	P62-132
100	Either	A62-406&407	56015-008-12	P62-516	00586-056-00	P62-130
1.7	Top	A62-410	56015-015-04	P62-536	00586-095-00	P62-131
2.2	Bottom	A62-410	56015-014-03	P62-535	00586-095-00	P62-131
220	Bottom	A62-415	56015-011-15	P62-530	00586-095-00	P62-131
0.045	Top	A62-424	56015-056-03	P62-779	00586-056-00	P62-130
450	Bottom	A62-424	56015-008-15	P62-519	00586-056-00	P62-130
250	Either	A62-427	56015-008-14	P62-518	00586-095-00	P62-131
250	Either	A62-429	56015-041-06	P62-554	00586-110-00	P62-133
135	Top	A62-430&431	56015-011-14	P62-529	00586-056-00	P62-130
0.064	Bottom	A62-430&431	56015-063-01	P62-568	00586-056-00	P62-130
1225	Top	A62-432	56015-029-01	P62-777	00586-056-00	P62-130
0.068	Bottom	A62-432	56015-030-01	P62-778	00586-056-00	P62-130
220	Top	A62-433	56015-011-15	P62-530	00586-169-00	P62-783
1.85	Bottom	A62-433	56015-067-01	P62-781	00586-169-00	P62-783
40	Either	A62-519	31066-101-08	P62-279	00586-138-00	P62-782
460	Top	A62-521	56015-012-17	P62-534	00586-095-00	P62-131
1.0	Bottom	A62-522	56015-065-02	P62-780	00586-138-00	P62-782

7.14. B RELAY CONTACT GROUPS



Three different pushers are used, each pusher is identified as 1, 2, or 3.
Three different clips are used, example clips are identified as 1A, 2A, or 3A. These numbers refer to the ref. numbers used in Table 7-14, B Relay Group Pusher and Clip Part Numbers.
See Table 7-13 for contact group combinations and descriptions for the above references A through W.

Figure 7–12. B Relay Contact Groups

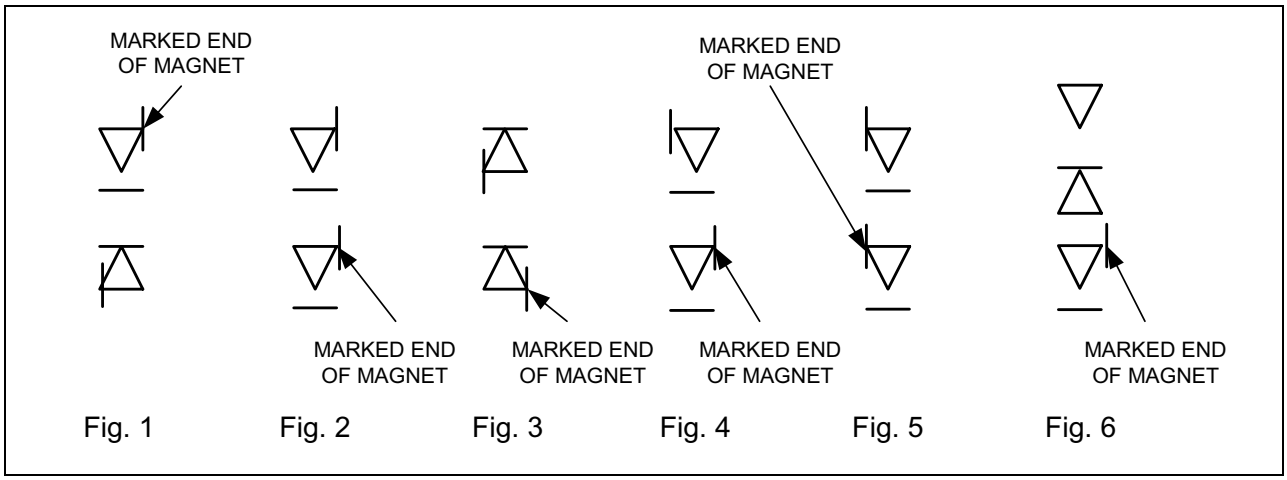


Figure 7–13. B Relay Extra Heavy-Duty (EHD) Contact Group Magnet Detail

Figures 7–12 and 7–13, combined with Tables 7–12 and 7–13, provide contact, pusher and clip details for the typical B relay contact group combinations. B2 Code Rate Transmitter Relay contact group part numbers are summarized in Table 7–9 and VTB relay contact groups are included in Table 7–10.

- Figure 7–12 shows the contacts groups identified by a reference letter that corresponds to Table 7–12's Ref. column. The illustrations also include a reference numbers that correspond to the Ref. column in Table 7–13.

- Figure 7–13 contains six illustrations of extra heavy-duty (EHD) contact groups identified by Fig. numbers corresponding to references in Table 7–12 Combination column.

- Table 7–12 provides drawing and catalog numbers for the various B relay contact combinations.

- Table 7–13 provides the three combinations of contact group pusher and clip part numbers used in the B relay combinations.

Table 7–12. B Relay Contact Group Part Numbers

Ref.	Combination	Front Contacts	Back Contacts	Drawing No.	Catalog No.
A	2FB	AgC to S (MD)	S to S (MD)	56012-108-06	P62-0484
B	2FB	AgC to S (HD)	S to S (HD)	56012-108-09	P62-0488
B	2FB	S to S (HD)	S to S (HD)	56012-108-08	P62-0487
B	2FB	AgC to S (HD)	S to AgC (HD)	56012-108-07	P62-0485
D	1FB 1FB	S to S (HD) AgC to S (MD)	S to S (HD) S to S (MD)	56012-108-35	P62-0486
E	2FB[2]	SCdO to SCdO (HD)	SCdO to SCdO (HD)	56012-108-40	P62-0500
F	2F-1B	AgC to S (MD)	S to S (MD)	56012-108-02	P62-0479
G	2F-1B	AgC to S (HD)	S to S (HD)	56012-108-03	P62-0480
H	1F-2B	AgC to S (MD)	S to S (MD)	56012-108-05	P62-0482
J	1F-2B	S to S (MD)	S to S (MD)	56012-108-34	P62-0483
K	2B	-	S to S (HD)	56012-108-25	P62-0495
M[1]	1F-1B (Fig. 1)	AgC to S (EHD)	S to S (EHD)	56012-108-12	P62-0803
N	3B	-	S to S (MD)	56012-108-33	P62-0481
P	2F	S to S (MD)	-	56012-108-36	P62-0489
Q[1]	1F[2]-1B[2] (Fig. 1)	SCdO to SCdO (EHD)	SCdO to SCdO (EHD)	56012-108-13	P62-0494
R[1]	2B (Fig. 3)	-	S to S (EHD)	56012-108-38	P62-0805
S[1]	2F (Fig. 2)	AgC to S (EHD)	—	56012-108-37	P62-0804
S[1]	2F (Fig. 4)	AgC to S (EHD)	—	56012-108-42	P62-0809
S[1]	2F (Fig. 5)	AgC to S (EHD)	—	56012-108-43	P62-0810
T	2F-1B	AgC to S (HD)	S to AgC (HD)	56012-108-04	P62-0847
U	3F	AgC to S (MD)	—	56012-108-22	N/A
V	3F[2]	SCdO to SCdO (HD)	—	56012-108-01	N/A
W[1]	1FB-1F[2] (Fig. 6)	AgC to S (MD) SCdO to SCdO (EHD)	S-SMD	56012-108-46	N/A

Legend:
AgC to S = Silver-Impregnated Carbon to Silver
HD = Heavy-Duty
EHD = Extra Heavy-Duty, with magnetic blowouts
S to S = Silver to Silver
MD = Medium Duty
SCdO = Silver Cadmium Oxide

See the 2 notes on the next page.

NOTE 1

When ordering contact groups shown in Table 7–12 Ref. M, Q, R, S or W, be sure to identify the drawing number of the relay on which the contact group will be used, so magnets can be magnetized and assembled correctly.

NOTE 2

Be aware that the following references have a minimum current rating of 0.300 amps for reliable contact operation:
- Reference E, 2FB combination with front-back contacts of SCdO (HD)
- Reference Q, 1F-1B combination with front and back contacts of SCdO to SCdO (EHD)
- Reference V, 3F combination with SCdO (HD) contacts
- Reference W, 1F SCdO to SCdO

Table 7–13. B Relay Contact Group Pusher and Clip Part Numbers

Ref.	Description	Drawing No.	Catalog No.
1	PUSHER, for contact groups Refs. A, B, D, E, F, G, H, J, P, S T, U, V and W (Fig 7-14)	55863-089-00	P62-0811
1A	CLIP, for above, two required (USE ONLY ONCE, DO NOT REUSE)	56025-001-00	P62-0577
2	PUSHER, for contact group Ref. K (Fig 7-14)	55863-050-00	P62-0463
2A	CLIP, for above, two required (USE ONLY ONCE, DO NOT REUSE)	56025-001-00	P62-0577
3	PUSHER, for contact group Refs. M, N, Q and R (Fig 7-14)	55863-009-00	P62-0458
3A	CLIP, for above, two required (USE ONLY ONCE, DO NOT REUSE)	56025-001-00	P62-0577

7.15. B RELAY PLUGBOARDS AND INSTALLATION SUPPLIES

Table 7–14 lists the common B relay installation materials. The items listed may be used during the installation procedure, depending on the specific relay. Figures 7–14 and 7–15 show example materials. Kits include plugboard, two relay mounting guide rods, terminals, insulators, current test terminal and mounting bolts.

For a listing of installation tools and a tool kit, refer to Appendix C.

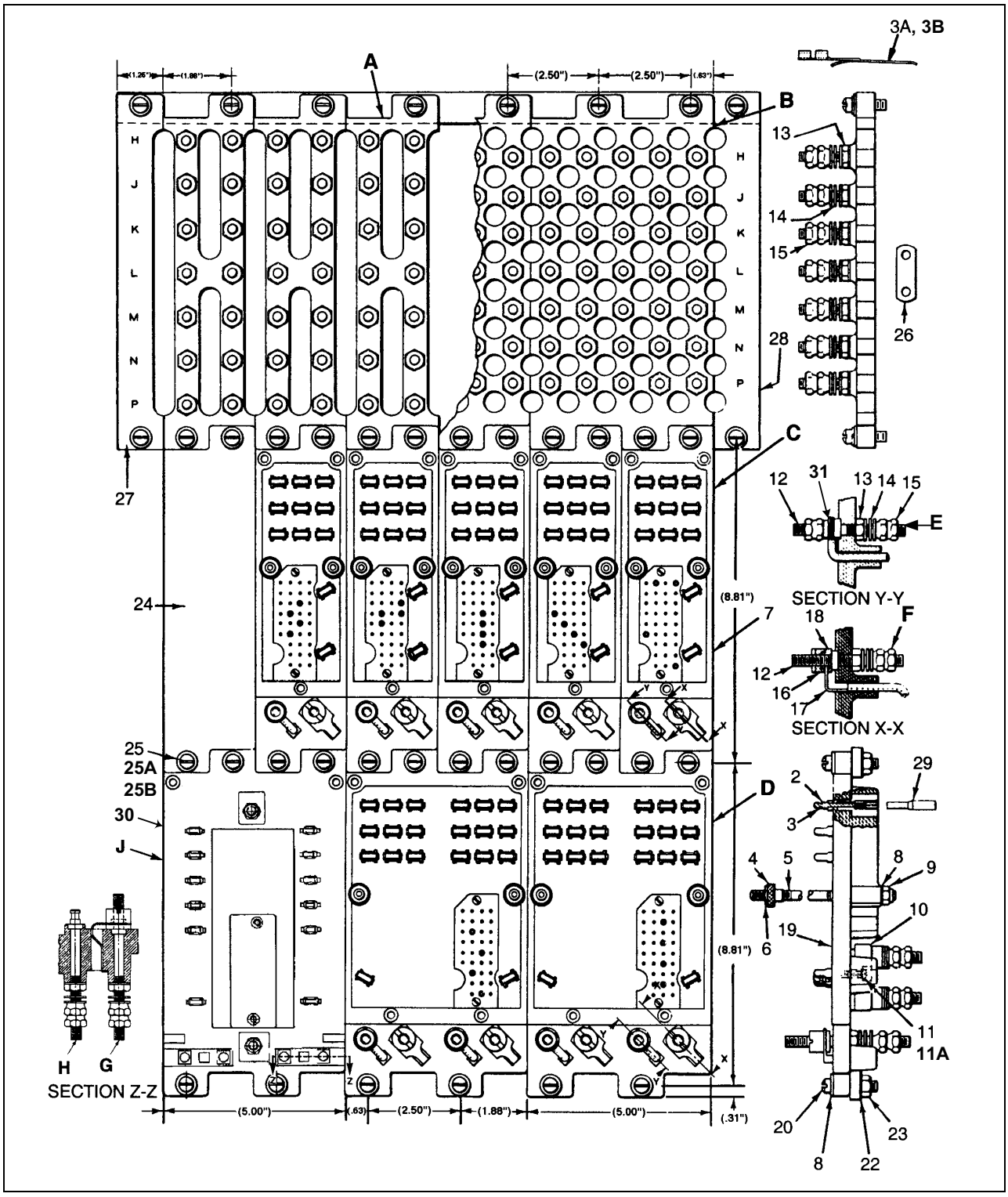


Figure 7–14. B Relay Plugboards and Installation Supplies

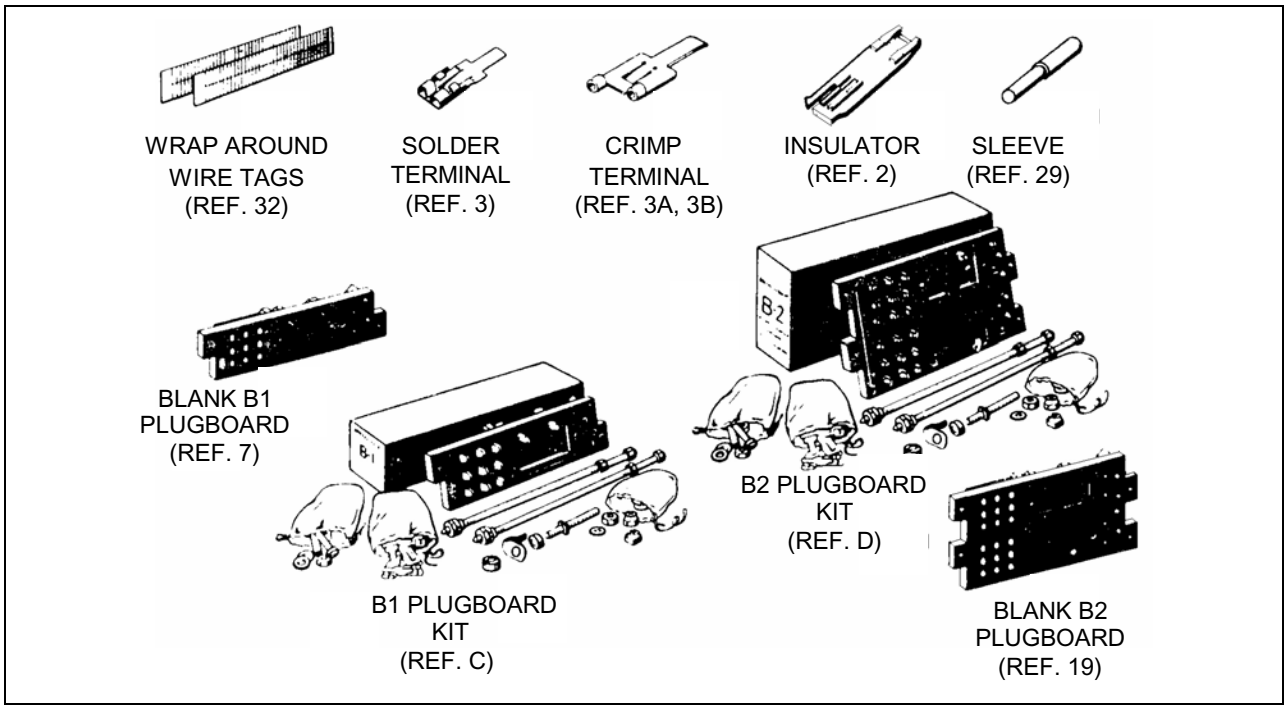


Figure 7–15. Example Installation Supplies

Table 7–14. B Relay Plugboard and Terminal Board Part Numbers

Ref.	Description	Drawing No.	Catalog No.
A	TERMINAL, BOARD COMPLETE, with fourteen terminal posts, includes post nuts and washers, and mounting hardware	59861-005-01	P62-0680
B	TERMINAL BOARD COMPLETE, includes thirty-five terminal posts, includes post nuts and washers and mounting hardware	59861-002-01	P62-0679
C	PLUGBOARD KIT, for all Type B, Size 1 Relays, includes insulators Ref. 2; solder terminals Ref. 3; relay mounting studs with nuts and washers, Refs. 4, 5, 6, 8, 9; plugboard Ref. 7; current test post Ref. F; mounting bolts, nuts and washers Refs. 8, 20, 22 and 23. Does not include registration plates or voltage post, Ref. E	59686-005-01	A62-0506
C1	PLUGBOARD KIT, Same as Ref. C except has #16-20 AWG crimp type terminals	59686-005-05	A62-0586

Table 7–14. B Relay Plugboard and Terminal Board Part Numbers (Cont.)

Ref.	Description	Drawing No.	Catalog No.
C2	PLUGBOARD KIT, Same as Ref. C except has #10-14 AWG crimp type terminals	59686-005-04	A62-0650
C3	PLUGBOARD KIT, Same as Ref. C except without terminals Ref. 3	59686-005-08	A62-0686
D	PLUGBOARD KIT, for all Type B, Size 2 Relays except B2 Vane and VTB, includes insulators Ref. 2; solder terminals Ref. 3; relay mounting studs with nuts and washers Refs. 4, 5, 6, 8, 9; plugboard Ref. 19, current test post Ref. F, mounting bolts, nuts and washers Refs. 8, 20, 22 and 23. Does not include registration plates, voltage post, Ref. E, or terminal block, Ref.10	59686-007-01	A62-0508
D1	PLUGBOARD KIT, Same as Ref. D except has #16-20 AWG crimp type terminals	59686-007-06	A62-0587
D2	PLUGBOARD KIT, Same as Ref. D except has #10-14 AWG crimp type terminals	59686-007-04	A62-0635
D3	PLUGBOARD KIT, Same as Ref. D except without terminals Ref. 3	59686-007-10	A62-0685
D4	PLUGBOARD KIT, Same as Ref. D except for Type B2 Vane Relay	59686-007-02	A62-0509
D5	PLUGBOARD KIT, Same as Ref. D4 except has #16-20 AWG crimp type terminals	59686-007-07	A62-0588
D6	PLUGBOARD KIT, Same as Ref. D4 except has #10-14 AWG crimp type terminals	59686-007-05	A62-0636
D7	PLUGBOARD KIT, Same as Ref. D4 except without terminals	59686-007-16	N/A
D9	PLUGBOARD KIT, Same as Ref. D except with #16-20 AWG crimp type terminals	59686-007-14	A62-0692
E	VOLTAGE TEST POST COMPLETE, includes screw, nuts, washers and terminal, for measuring coil(s) voltage	42788-001-02	A62-0515

Table 7–14. B Relay Plugboard and Terminal Board Part Numbers (Cont.)

Ref.	Description	Drawing No.	Catalog No.
F	CURRENT TEST POST COMPLETE, includes screw, nuts, washers, bushing and connector, for opening coil circuit to measure coil(s) current	42788-001-01	A62-0525
G	CURRENT TEST POST FOR VTB RELAYS, includes screw, nuts , washers, for measuring coil(s) current	42788-002-01	A62-0328
H	VOLTAGE TEST POST FOR VTB RELAY, includes screw, nuts , washers, for measuring coil(s) voltage	42788-002-02	A62-0329
J	PLUGBOARD KIT FOR VTB RELAY, Size 2, includes insulators Ref. 2; solder terminals Ref. 3; relay mounting studs with nuts and washers, Refs. 4, 5, 6, 8, 9; plugboard Ref. 30; (2) current test posts Ref. F; (2) voltage test posts Ref. E; mounting bolts; nuts and washers refs. 8, 20, 22, and 23. Does not include registration plates.	59686-014-01	A62-0510
J1	PLUGBOARD KIT, Same as Ref. J except with #10-14 AWG crimp type terminals	59686-014-02	A62-0651
J2	PLUGBOARD KIT, Same as Ref. J except with #16-20 AWG crimp type terminals	59686-014-03	A62-0652
2	INSULATOR, for holding terminal Ref. 3 in position on plugboard	55862-024-00	P62-0457
3	TERMINAL, solder type, two required per insulator	55871-019-00	P62-0466
3A	TERMINAL, crimp type for #16 – 20 AWG wire, two required per insulator	55871-074-00	P03-0326
3B	TERMINAL, crimp type for #10 – 14 AWG wire, two required per insulator	55871-098-00	P03-0327
4	NUT, knurled, for holding relay to plugboard	00846-029-00	P62-0144
5	STUD, for holding relays except VTB Relay to plugboards	48813-006-00	P62-0346
5A	STUD, Same as Ref. 5 except for VTB Relay	48813-007-00	P62-0347

Table 7–14. B Relay Plugboard and Terminal Board Part Numbers (Cont.)

Ref.	Description	Drawing No.	Catalog No.
6	NUT, for locking nut Ref. 4	01472-008-00	P62-0166
7	PLUGBOARD, only, for all Type B1 Relays, does not include terminals, insulators, test posts or mounting studs	56022-049-00	P62-0572
8	WASHER, flat .266" I.D., .500" O.D., .031" thick	01250-011-ON	P50-0157
9	NUT, .250" -28 hex, elastic stop	42333-065-00	P62-0320
10	TERMINAL BLOCK COMPLETE	46048-053-01	P62-0339
11	SCREW, .164" -32 x .75" long. slotted pan head self tapping (For mounting Ref. 10 block)	07608-224-ON	P62-0596
11A	WASHER, internal tooth lock .164" I.D., .340" O.D., .023" thick	53029-068-00	P62-0402
12	SCREW, used as terminal post for current and voltage test posts	00376-009-00	P62-0107
13	NUT, .242" -24 x .19" thick, hex	42839-005-00	P62-0333
14	WASHER, for terminal posts, .266" I.D., .188" O.D., .04" thick	01225-002-00	P76-0108
15	NUT, .242" -24 x .31 " thick, hex	42843-001-00	P76-0131
16	NUT, .242" -24 x .375", spanner, for current test post	00578-015-00	P62-0129
17	CONNECTOR, for current test post terminals	04906-126-00	P62-0190
18	BUSHING, insulating, for current test post	06347-031-00	P62-0203
19	PLUGBOARD, only, for all Type B, Size 2 Relays, does not include terminals, insulators, test post or mounting screws	56022-021-00	P62-0571
20	SCREW, .250" -28 x 1.25" long., fillister head	55470-004-00	P62-0448
22	WASHER, .250" I.D., .487" O.D., .062" thick, spring lock	01273-006-ON	P81-0121

Table 7–14. B Relay Plugboard and Terminal Board Part Numbers (Cont.)

Ref.	Description	Drawing No.	Catalog No.
23	NUT, .250" -28 X .22" thick, hex	01472-003-00	P62-0167
24	PLATE, filler for blank spaces	42812-000-00	P62-0331
25	SCREW, .250" -28 x .75" long. fillister head	55470-008-00	P62-0449
25A	NUT, .250" -28 x .22" thick, hex	01472-003-00	P62-0167
25B	WASHER, .250" I.D., .487" O.D., .062" thick, spring lock	01273-006-ON	P81-0121
26	CONNECTOR, 1" centers, for Ref. B	04906-020-00	P76-0110
26	CONNECTOR, 1.250" centers, horizontal for Ref. A	04906-006-00	P03-0107
26	CONNECTOR, 1.125" centers, vertical for Ref. A	04906-021-00	P03-0108
27	BOARD, designation, single, without lettering	59683-010-01	P62-0766
28	BOARD, designation, single, without lettering	59683-006-01	P62-0767
29	SLEEVE, rubber, insulating	35189-033-00	P62-0298
30	PLUGBOARD ONLY, for VTB, size 2 relay, does not include terminals, insulators, test post or mounting screws	56022-031-00	N/A
31	AAR RING CRIMP TERMINAL, Red, #16-22 AWG for Tefzel wire	59825-223-00	N/A
31	AAR RING CRIMP TERMINAL, Blue, #14-16 AWG for Tefzel wire	59825-222-00	N/A
31	AAR RING CRIMP TERMINAL, Yellow, #10-12 AWG for Tefzel wire	59825-199-00	N/A
32	WRAP AROUND WIRE TAGS, for B1 relays, columns 1-3	59539-405-00	P03-0305
32	WRAP AROUND WIRE TAGS, for B2 relays, columns 4-6	59539-406-00	P03-0306

7.16. B RELAY REGISTRATION PLATES AND GASKETS

Figure 7–16 and Table 7–14 summarize the B relay registration plates and gaskets for most B relays. See Figure 7–11 and Table 7–9 for the VTB Polar Biased Relay registration plate and gaskets.

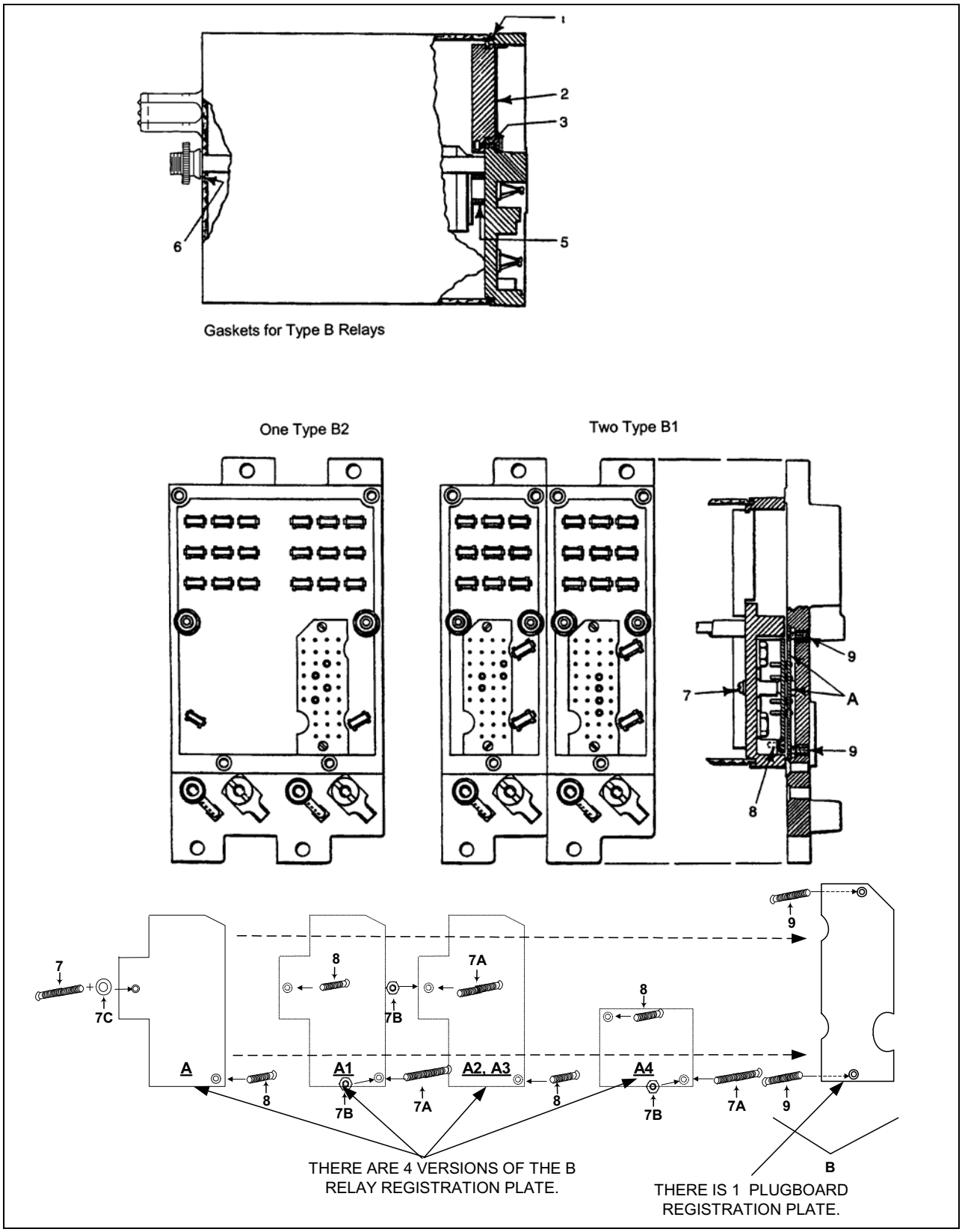


Figure 7–16. B Relay Registration Plates and Gaskets

Table 7–15. B Relay Registration Plate and Gasket Part Numbers

Ref.	Description	Drawing No.	Catalog No.
A	REGISTRATION PLATE ASSEMBLY, includes plugboard and relay registration plates and mounting hardware, for all Type B, Size 1 relays except Code-Responsive and Magnetic-Stick	58879-000-51*	P62-0720*
A1	Same as Ref. A, except for Code-Responsive and Magnetic-Stick Relays	58879-005-05*	P62-0670*
A2	REGISTRATION PLATE ASSEMBLY, includes plugboard and relay registration plates and mounting hardware, for all Type B, Size 2 code transmitter	58879-005-04*	P62-0671*
A4	Same as Ref. A, except for Type B, Size 2 Vane Relay	58879-000-05*	P62-0669*
A5	Same as Ref. A, except for VTB Relay, see Figure 7–13	58879-009-51	N/A
B	PLUGBOARD REGISTRATION PLATE ASSEMBLY, includes one registration plate with 2 screws (Ref. 8)	58876-000-51	N/A
1	Gasket, for cover of Type B1 Relays	13014-221-00	P62-0225
1A	Same as Ref. 1, except for cover of Type B2 Relays	13014-222-00	P62-0226
2	SHIELD, for back of contact blocks, for all relays except Type B2 Vane	50737-091-00	P62-0227
2A	Same as Ref. 2, except for contact spaces 4 to 6 of Type B2 Vane	13014-279-00	P62-0228
2B	Same as Ref. 2, except for contact spaces 1 to 3 of Type B2 Vane	13014-280-00	P62-0229
3	SCREW, for attaching contact group, .138-40 x .625" long, flat head	03306-120-ON	P62-0200
5	GASKET, for coils of Type B1 and B2 Neutral Relays	30646-005-00	P62-0276
6	GASKET, for front of cover	30646-012-00	P62-0277

* When ordering registration plates include the Catalog or Drawing Number of the relay that the registration plates are intended.

Table 7–15. B Relay Registration Plate and Gasket Part Numbers (Cont.)

Ref.	Description	Drawing No.	Catalog No.
7	SCREW, stainless steel, .164-32 x 1.0" long slotted pan head, for fastening registration plate to base of Type B1 Relay	03608-032-ON	P76-0257
7A	SCREW, stainless steel, .164-32 x 1.187" long slotted flat head, for fastening registration plate to base of Type B2 Relay	18746-033-00	P62-0249
7B	NUT, for Ref. 7, .164-32, elastic stop	42333-046-00	N/A
7C	WASHER, for Ref. 7, .174" I.D., .293" O.D., .040" thick, lock	01273-022-ON	N/A
8	SCREW, stainless steel, .138-32 x .375"long, slotted flat head	03306-012-ON	P62-0193
9	SCREW, stainless steel, .138-32 x .50"long, slotted flat head self tapping	06306-016-ON	P62-0192

THIS PAGE INTENTIONALLY LEFT BLANK.

A. APPENDIX A – RELAY ENGINEERING DATA (ED) SHEET LIST

A.1. GENERAL

This appendix includes two tables listing the B relay Engineering Data (ED) sheet numbers. For your convenience, the information is provided in two formats. Table A–1 provides the ED sheet numbers by catalog number and cross-references drawing number. Table A–2 provides the ED sheet numbers by drawing number and cross-references catalog number.

NOTE

ED60-1 is a generic ED sheet that applies to most relays. It provides general instructions covering customer adjustments and tests for Neutral, Biased-Neutral, and Polar Relays.

To find a relay's drawing or catalog number, refer to Heading 1.2.2., Identification.

Table A–1. ED sheets Listed By Catalog Number

Catalog No.	Drawing No.	ED sheet No.
A62-120	56001-921-09	ED56601-921-09
A62-122	56001-921-07	ED56001-921-07
A62-125	56001-922-07	ED56001-922-07
A62-126	56001-921-02	ED56001-921-02
A62-129	56001-925-10	ED60-143
A62-130	56001-921-05	ED56001-921-05
A62-131	56001-921-14	ED56001-921-14
A62-132	56001-921-10	ED56001-921-10
A62-140	56001-922-05	ED60-274
A62-145	56002-719-01	ED56002-719-01
A62-150	56002-720-01	ED56002-720-01
A62-155	56001-663-07	ED56001-663-07
A62-156	56001-672-01	ED60-189
A62-157	58640-172-03	ED60-108
A62-161	56001-672-03	ED60-256
A62-162	56001-674-01	ED60-113
A62-163	56001-674-02	ED56001-674-02
A62-164	58640-179-22	ED58640-179-22
A62-170	57490-095-05	ED57490-095-05
A62-171	57490-096-04	ED57490-096-04
A62-172	57490-097-04	ED57490-097-04
A62-173	57490-098-01	ED57490-098-01
A62-175	57490-091-05	ED57490-091-05
A62-176	57490-092-01	ED57490-092-01
A62-177	57490-093-01	ED57490-093-01
A62-178	57490-094-01	ED57490-094-01
A62-205	56001-880-01	ED56001-880-01
A62-211	56001-785-35	ED56001-785-35
A62-213	56001-785-55	ED56001-785-55
A62-215	56001-785-59	ED56001-785-59
A62-217	56001-785-61	ED56001-785-61

Table A–1. ED sheets Listed By Catalog Number (Cont.)

Catalog No.	Drawing No.	ED sheet No.
A62-221	56001-873-01	ED56001-873-01
A62-231	56001-785-10	ED56001-785-10
A62-236	56001-865-01	ED56001-865-01
A62-245	58645-172-06	ED58645-172-06
A62-246	58645-172-04	ED60-110
A62-247	58645-172-05	ED60-163
A62-260	56001-714-03	ED60-257
A62-261	56001-714-01	ED60-286
A62-262	56001-762-02	ED56001-762-02
A62-275	56001-787-02	ED60-129
A62-276	56001-787-01	ED56001-787-01
A62-277	56001-783-02	ED60-131
A62-293	56001-785-91	ED60-101
A62-295	56001-785-31	ED60-277
A62-296	56001-762-01	ED60-297
A62-300	56001-789-05	ED60-130
A62-305	56001-785-37	ED60-194
A62-308	56001-783-01	ED56001-783-01
A62-309	56001-822-06	ED56001-822-06
A62-310	56001-822-02	ED56001-822-02
A62-311	56001-822-01	ED60-195
A62-312	56001-785-83	ED60-219
A62-314	56001-785-12	ED60-145
A62-315	56001-872-01	ED56001-872-01
A62-317	56001-789-03	ED60-152
A62-318	56001-875-01	ED56001-875-01
A62-319	56001-787-05	ED56001-787-05
A62-320	56001-908-01	ED60-138
A62-323	56001-670-13	ED60-215
A62-324	56001-911-01	ED60-228
A62-325	56001-838-01	ED60-295

Table A–1. ED sheets Listed By Catalog Number (Cont.)

Catalog No.	Drawing No.	ED sheet No.
A62-330	56002-703-01	ED56002-703-01
A62-331	56002-710-01	ED60-270
A62-335	56001-909-01	ED56001-909-01
A62-341	56001-790-01	ED56001-790-01
A62-345	56001-736-01	ED60-287
A62-350	56001-851-01	ED60-140
A62-353	56001-830-01	ED56001-830-01
A62-355	56001-808-26	ED56001-808-26
A62-357	56001-792-02	ED56001-792-02
A62-358	56001-778-01	ED56001-778-01
A62-359	56001-780-01	ED56001-780-01
A62-360	56001-774-01	ED56001-774-01
A62-365	56001-904-01	ED60-172
A62-369	56001-817-01	ED56001-817-01
A62-370	56001-792-01	ED56001-792-01
A62-372	56001-785-85	ED60-205
A62-380	56001-759-01	ED56001-759-01
A62-401	56001-721-01	ED60-319
A62-406	56001-745-01	ED56001-745-01
A62-407	56001-745-02	ED56001-745-02
A62-410	56001-785-36	ED56001-785-36
A62-415	56001-738-01	ED60-288
A62-417	56001-901-01	ED60-211
A62-424	56001-785-99	ED56001-785-99
A62-425	56001-785-80	ED56001-785-80
A62-427	56001-917-01	ED56001-917-01
A62-429	56001-926-01	ED56001-926-01
A62-430	56001-916-02	ED56001-916-02
A62-431	56001-916-01	ED56001-916-01
A62-432	56001-785-01	ED56001-785-01
A62-433	56001-937-01	ED60-328

Table A–1. ED sheets Listed By Catalog Number (Cont.)

Catalog No.	Drawing No.	ED sheet No.
A62-485	56005-100-08	ED60-170
A62-486	56005-100-09	ED60-126
A62-490	59301-101-01	ED60-812
A62-491	59301-151-02	ED59301-151-02
A62-492	59301-151-05	ED59301-151-05
A62-493	59301-201-12	ED59301-201-12
A62-494	59301-201-14	ED59301-201-14
A62-495	59301-251-01	ED59301-251-01
A62-498	59301-151-04	ED59301-151-04
A62-519	56001-679-06	ED56001-679-06
A62-519	56001-679-06	ED56001-679-06
A62-522	56001-931-02	ED56001-931-02
A62-530	59301-251-04	ED59301-251-04
A62-532	59301-251-02	ED59301-251-02
A62-533	59301-201-01	ED59301-201-01
A62-534	59301-201-03	ED59301-201-03
A62-536	59301-101-02	ED59301-101-02
A62-537	59301-151-06	ED59301-151-06
A62-538	59301-101-04	ED60-802
A62-541	56002-723-01	ED56002-723-01
A62-542	56001-950-01	ED56001-950-01
A62-543	56001-922-02	ED56001-922-02
A62-544	56001-763-02	ED56001-763-02
A62-545	56001-785-21	ED56001-785-21
A62-546	56001-881-01	ED56001-881-01
A62-547	56005-100-01	ED56005-100-01
A62-548	56005-100-18	ED56005-100-18
A62-549	56001-922-01	ED56001-922-01
A62-550	56001-922-10	ED60-336
A62-552	56001-927-01	ED56001-927-01
A62-553	56001-928-01	ED56001-928-01

Table A–1. ED sheets Listed By Catalog Number (Cont.)

Catalog No.	Drawing No.	ED sheet No.
A62-554	56001-932-01	ED56001-932-01
A62-555	56001-933-01	ED56001-933-01
A62-557	56001-762-04	ED56001-762-04
A62-559	56001-910-08	ED60-268
A62-560	56001-914-01	ED60-155
A62-565	56001-709-06	ED56001-709-06
A62-566	56001-935-01	ED56001-935-01
A62-575	56001-672-05	ED56001-672-05
A62-578	56001-946-01	ED56001-946-01
A62-579	56001-947-01	ED56001-947-01
A62-580	56001-951-01	ED56001-951-01
A62-589	56001-670-10	ED56001-670-10
A62-595	58640-172-01	ED58640-172-01
A62-597	56005-100-20	ED56005-100-20
A62-598	58640-171-04	ED58640-171-04
A62-599	56001-952-01	ED56001-952-01
A62-601	56001-886-01	ED56001-886-01
A62-603	56001-938-01	ED60-106
A62-604	56001-942-01	ED56001-942-01
A62-605	56001-943-01	ED56001-943-01
A62-606	56002-717-02	ED60-253
A62-607	56002-722-01	ED56002-722-01
A62-608	56001-953-01	ED56001-953-01
A62-610	58640-172-04	ED58640-172-04
A62-613	56001-956-01	ED56001-956-01
A62-614	56001-957-01	ED56001-957-01
A62-616	56001-959-01	ED56001-959-01
A62-617	56001-960-01	ED56001-960-01
A62-620	56002-725-01	ED56002-725-01
A62-622	58640-171-03	ED58640-171-03
A62-623	56001-956-02	ED56001-956-02

Table A–1. ED sheets Listed By Catalog Number (Cont.)

Catalog No.	Drawing No.	ED sheet No.
A62-624	56001-921-04	ED56001-921-04
A62-626	58645-172-08	ED58645-172-08
A62-629	59301-251-05	ED59301-251-05
A62-633	56001-961-01	ED56001-961-01
A62-634	56001-962-01	ED56001-962-01
A62-637	56001-963-01	ED56001-963-01
A62-638	58645-172-09	ED58645-172-09
A62-639	56001-965-01	ED56001-965-01
A62-642	57490-121-01	ED57490-121-01
A62-643	57490-122-01	ED57490-122-01
A62-644	56005-100-21	ED56005-100-21
A62-654	56001-968-01	ED56001-968-01
A62-655	56001-670-02	ED56001-670-02
A62-658	56001-969-01	ED56001-969-01
A62-659	56001-664-05	ED56001-664-05
A62-660	56001-664-06	ED56001-664-06
A62-661	56001-970-01	ED56001-970-01
A62-662	59301-151-01	ED59301-151-01
A62-663	59301-200-03	ED60-811
A62-664	59301-101-08	ED60-814
A62-665	56001-945-01	ED56001-945-01
A62-667	56001-971-01	ED56001-971-01
A62-669	56001-972-01	ED56001-972-01
A62-670	56001-973-01	ED56001-973-01
A62-672	56001-975-01	ED56001-975-01
A62-676	58640-179-29	ED58640-179-29
A62-677	56001-944-01	ED60-326
A62-678	56001-672-02	ED60-203
A62-679	56001-675-01	ED56001-675-01
A62-680	58640-169-06	ED58640-169-06
A62-681	56001-978-01	ED56001-978-01

Table A–1. ED sheets Listed By Catalog Number (Cont.)

Catalog No.	Drawing No.	ED sheet No.
A62-694	56005-100-19	ED56005-100-19
A62-715	56001-927-02	ED56001-927-02
A62-716	56001-675-02	ED56001-675-02
A62-717	56001-762-08	ED56001-762-08
A62-718	56001-981-01	ED56001-981-01
A62-719	56001-911-02	ED56001-911-02
A62-720	56001-922-13	ED56001-922-13
A62-721	56001-926-03	ED56001-926-03
A62-722	56001-928-02	ED56001-928-02
A62-723	56005-100-22	ED56005-100-22
A62-724	56005-100-23	ED56005-100-23
A62-725	57490-080-10	ED57490-080-10
A62-733	57490-119-02	ED57490-119-02
A62-736	56001-982-01	ED56001-982-01
A62-740	57490-080-09	ED57490-080-09
A62-741	56001-983-01	ED56001-983-01
A62-743	56001-984-01	ED56001-984-01
A62-763	56001-986-01	ED56001-986-01
A62-764	56001-987-01	ED56001-987-01
A62-765	56001-745-03	ED56001-745-03
A62-766	56001-916-03	ED56001-916-03
A62-767	56001-921-15	ED56001-921-15
----	56001-988-01	ED56001-988-01

Table A–2. ED sheets Listed By Drawing Number

Drawing No.	Catalog No.	ED sheet No.
56001-663-07	A62-155	ED56001-663-07
56001-664-05	A62-659	ED56001-664-05
56001-664-06	A62-660	ED56001-664-06
56001-670-02	A62-655	ED56001-670-02
56001-670-10	A62-589	ED56001-670-10
56001-670-13	A62-323	ED60-215
56001-672-01	A62-156	ED60-189
56001-672-02	A62-678	ED60-203
56001-672-03	A62-161	ED60-256
56001-672-05	A62-575	ED56001-672-05
56001-674-01	A62-162	ED60-113
56001-674-02	A62-163	ED56001-674-02
56001-675-01	A62-679	ED56001-675-01
56001-675-02	A62-716	ED56001-675-02
56001-679-06	A62-519	ED56001-679-06
56001-679-06	A62-519	ED56001-679-06
56001-709-06	A62-565	ED56001-709-06
56001-714-01	A62-261	ED60-286
56001-714-03	A62-260	ED60-257
56001-721-01	A62-401	ED60-319
56001-736-01	A62-345	ED60-287
56001-738-01	A62-415	ED60-288
56001-745-01	A62-406	ED56001-745-01
56001-745-02	A62-407	ED56001-745-02
56001-745-03	A62-765	ED56001-745-03
56001-759-01	A62-380	ED56001-759-01
56001-762-01	A62-296	ED60-297
56001-762-02	A62-262	ED56001-762-02
56001-762-04	A62-557	ED56001-762-04
56001-762-08	A62-717	ED56001-762-08
56001-763-02	A62-544	ED56001-763-02

Table A–2. ED sheets Listed By Drawing Number (Cont.)

Drawing No.	Catalog No.	ED sheet No.
56001-774-01	A62-360	ED56001-774-01
56001-778-01	A62-358	ED56001-778-01
56001-780-01	A62-359	ED56001-780-01
56001-783-01	A62-308	ED56001-783-01
56001-783-02	A62-277	ED60-131
56001-785-01	A62-432	ED56001-785-01
56001-785-10	A62-231	ED56001-785-10
56001-785-12	A62-314	ED60-145
56001-785-21	A62-545	ED56001-785-21
56001-785-31	A62-295	ED60-277
56001-785-35	A62-211	ED56001-785-35
56001-785-36	A62-410	ED56001-785-36
56001-785-37	A62-305	ED60-194
56001-785-41	A62-684	ED60-225
56001-785-55	A62-213	ED56001-785-55
56001-785-59	A62-215	ED56001-785-59
56001-785-61	A62-217	ED56001-785-61
56001-785-80	A62-425	ED56001-785-80
56001-785-83	A62-312	ED60-219
56001-785-85	A62-372	ED60-205
56001-785-91	A62-293	ED60-101
56001-785-99	A62-424	ED56001-785-99
56001-787-01	A62-276	ED56001-787-01
56001-787-02	A62-275	ED60-129
56001-787-05	A62-319	ED56001-787-05
56001-789-03	A62-317	ED60-152
56001-789-05	A62-300	ED60-130
56001-790-01	A62-341	ED56001-790-01
56001-792-01	A62-370	ED56001-792-01
56001-792-02	A62-357	ED56001-792-02
56001-808-26	A62-355	ED56001-808-26

Table A–2. ED sheets Listed By Drawing Number (Cont.)

Drawing No.	Catalog No.	ED sheet No.
56001-817-01	A62-369	ED56001-817-01
56001-822-01	A62-311	ED60-195
56001-822-02	A62-310	ED56001-822-02
56001-822-06	A62-309	ED56001-822-06
56001-830-01	A62-353	ED56001-830-01
56001-838-01	A62-325	ED60-295
56001-851-01	A62-350	ED60-140
56001-865-01	A62-236	ED56001-865-01
56001-872-01	A62-315	ED56001-872-01
56001-873-01	A62-221	ED56001-873-01
56001-875-01	A62-318	ED56001-875-01
56001-880-01	A62-205	ED56001-880-01
56001-881-01	A62-546	ED56001-881-01
56001-886-01	A62-601	ED56001-886-01
56001-901-01	A62-417	ED60-211
56001-904-01	A62-365	ED60-172
56001-908-01	A62-320	ED60-138
56001-909-01	A62-335	ED56001-909-01
56001-910-08	A62-559	ED60-268
56001-911-01	A62-324	ED60-228
56001-911-02	A62-719	ED56001-911-02
56001-914-01	A62-560	ED60-155
56001-916-01	A62-431	ED56001-916-01
56001-916-02	A62-430	ED56001-916-02
56001-916-03	A62-766	ED56001-916-03
56001-917-01	A62-427	ED56001-917-01
56001-921-02	A62-126	ED56001-921-02
56001-921-04	A62-624	ED56001-921-04
56001-921-05	A62-130	ED56001-921-05
56001-921-07	A62-122	ED56001-921-07
56001-921-09	A62-120	ED56601-921-09

Table A–2. ED sheets Listed By Drawing Number (Cont.)

Drawing No.	Catalog No.	ED sheet No.
56001-921-10	A62-132	ED56001-921-10
56001-921-14	A62-131	ED56001-921-14
56001-921-15	A62-767	ED56001-921-15
56001-922-01	A62-549	ED56001-922-01
56001-922-02	A62-543	ED56001-922-02
56001-922-05	A62-140	ED60-274
56001-922-07	A62-125	ED56001-922-07
56001-922-10	A62-550	ED60-336
56001-922-13	A62-720	ED56001-922-13
56001-925-10	A62-129	ED60-143
56001-926-01	A62-429	ED56001-926-01
56001-926-03	A62-721	ED56001-926-03
56001-927-01	A62-552	ED56001-927-01
56001-927-02	A62-715	ED56001-927-02
56001-928-01	A62-553	ED56001-928-01
56001-928-02	A62-722	ED56001-928-02
56001-931-02	A62-522	ED56001-931-02
56001-932-01	A62-554	ED56001-932-01
56001-933-01	A62-555	ED56001-933-01
56001-935-01	A62-566	ED56001-935-01
56001-937-01	A62-433	ED60-328
56001-938-01	A62-603	ED60-106
56001-942-01	A62-604	ED56001-942-01
56001-943-01	A62-605	ED56001-943-01
56001-944-01	A62-677	ED60-326
56001-945-01	A62-665	ED56001-945-01
56001-946-01	A62-578	ED56001-946-01
56001-947-01	A62-579	ED56001-947-01
56001-950-01	A62-542	ED56001-950-01
56001-951-01	A62-580	ED56001-951-01
56001-952-01	A62-599	ED56001-952-01

Table A–2. ED sheets Listed By Drawing Number (Cont.)

Drawing No.	Catalog No.	ED sheet No.
56001-953-01	A62-608	ED56001-953-01
56001-956-01	A62-613	ED56001-956-01
56001-956-02	A62-623	ED56001-956-02
56001-957-01	A62-614	ED56001-957-01
56001-959-01	A62-616	ED56001-959-01
56001-960-01	A62-617	ED56001-960-01
56001-961-01	A62-633	ED56001-961-01
56001-962-01	A62-634	ED56001-962-01
56001-963-01	A62-637	ED56001-963-01
56001-965-01	A62-639	ED56001-965-01
56001-968-01	A62-654	ED56001-968-01
56001-969-01	A62-658	ED56001-969-01
56001-970-01	A62-661	ED56001-970-01
56001-971-01	A62-667	ED56001-971-01
56001-972-01	A62-669	ED56001-972-01
56001-973-01	A62-670	ED56001-973-01
56001-975-01	A62-672	ED56001-975-01
56001-976-01	A62-689	ED56001-976-01
56001-978-01	A62-681	ED56001-978-01
56001-979-01	A62-682	ED56001-979-01
56001-980-01	A62-690	ED56001-980-01
56001-981-01	A62-718	ED56001-981-01
56001-982-01	A62-736	ED56001-982-01
56001-983-01	A62-741	ED56001-983-01
56001-984-01	A62-743	ED56001-984-01
56001-986-01	A62-763	ED56001-986-01
56001-987-01	A62-764	ED56001-987-01
56001-988-01	----	ED56001-988-01
56002-703-01	A62-330	ED56002-703-01
56002-710-01	A62-331	ED60-270
56002-717-02	A62-606	ED60-253

Table A–2. ED sheets Listed By Drawing Number (Cont.)

Drawing No.	Catalog No.	ED sheet No.
56002-719-01	A62-145	ED56002-719-01
56002-720-01	A62-150	ED56002-720-01
56002-722-01	A62-607	ED56002-722-01
56002-723-01	A62-541	ED56002-723-01
56002-725-01	A62-620	ED56002-725-01
56005-100-01	A62-547	ED56005-100-01
56005-100-08	A62-485	ED60-170
56005-100-09	A62-486	ED60-126
56005-100-18	A62-548	ED56005-100-18
56005-100-19	A62-694	ED56005-100-19
56005-100-20	A62-597	ED56005-100-20
56005-100-21	A62-644	ED56005-100-21
56005-100-22	A62-723	ED56005-100-22
56005-100-23	A62-724	ED56005-100-23
57490-080-09	A62-740	ED57490-080-09
57490-080-10	A62-725	ED57490-080-10
57490-091-05	A62-175	ED57490-091-05
57490-092-01	A62-176	ED57490-092-01
57490-093-01	A62-177	ED57490-093-01
57490-094-01	A62-178	ED57490-094-01
57490-095-05	A62-170	ED57490-095-05
57490-096-04	A62-171	ED57490-096-04
57490-097-04	A62-172	ED57490-097-04
57490-098-01	A62-173	ED57490-098-01
57490-119-02	A62-733	ED57490-119-02
57490-121-01	A62-642	ED57490-121-01
57490-122-01	A62-643	ED57490-122-01
58640-169-06	A62-680	ED58640-169-06
58640-171-03	A62-622	ED58640-171-03
58640-171-04	A62-598	ED58640-171-04
58640-172-01	A62-595	ED58640-172-01

Table A–2. ED sheets Listed By Drawing Number (Cont.)

Drawing No.	Catalog No.	ED sheet No.
58640-172-03	A62-157	ED60-108
58640-172-04	A62-610	ED58640-172-04
58640-179-22	A62-164	ED58640-179-22
58640-179-29	A62-676	ED58640-179-29
58645-172-04	A62-246	ED60-110
58645-172-05	A62-247	ED60-163
58645-172-06	A62-245	ED58645-172-06
58645-172-08	A62-626	ED58645-172-08
58645-172-09	A62-638	ED58645-172-09
59301-101-01	A62-490	ED60-812
59301-101-02	A62-536	ED59301-101-02
59301-101-04	A62-538	ED60-802
59301-101-08	A62-664	ED60-814
59301-151-01	A62-662	ED59301-151-01
59301-151-02	A62-491	ED59301-151-02
59301-151-04	A62-498	ED59301-151-04
59301-151-05	A62-492	ED59301-151-05
59301-151-06	A62-537	ED59301-151-06
59301-200-03	A62-663	ED60-811
59301-201-01	A62-533	ED59301-201-01
59301-201-03	A62-534	ED59301-201-03
59301-201-12	A62-493	ED59301-201-12
59301-201-14	A62-494	ED59301-201-14
59301-251-01	A62-495	ED59301-251-01
59301-251-02	A62-532	ED59301-251-02
59301-251-04	A62-530	ED59301-251-04
59301-251-05	A62-629	ED59301-251-05

THIS PAGE INTENTIONALLY LEFT BLANK.

B. APPENDIX B - GLOSSARY

B.1. CONTACT DEFINITIONS

Back – (B) Relay contact that is made when relay is de-energized (normally closed).

Break - All front or back contacts are just open when a gauge of a specific dimension is inserted between the armature residual screw and the core face with the relay energized.

Break-before-make -In a dependent front-heel-back contact the back contact will break before the front contact makes as the relay is energized.

Contact Application

- D = Dry Circuit
- EHD = Extra Heavy-Duty
- HV = High Voltage
- HD = Heavy-Duty
- LD = Light Duty
- MD = Medium Duty
- S = Safety
- XHD = Heavy-Duty with Blowout Magnets

Contact Materials

- AgC = Silver Impregnated Carbon
- AgPt = Silver Platinum
- G = Gold
- S = Silver
- SCdO = Silver Cadmium Oxide
- T = Tungsten

Front – (F) Relay contact that is normally open when relay is de-energized.

Heel – (H) Contact that is driven by pusher.

Make - Specified dimension that will cause all front or back contacts to be just made (closed) when a gauge of this dimension is inserted between the armature residual screw and core face with the relay energized.

Makes-before-break – (MB) In a dependent front-heel-back contact the front contact will make before the back contact breaks.

B.2. GENERAL DEFINITIONS

Approximate - on relay ordering sheets the abbreviation "approx." When used with armature air gap, it indicates that this air gap is to be adhered to as closely as possible. In no case should this value be less than the minimums given in Section 1.4 (armature air gap) of ED60-1.

NOTE

ED60-1 is a generic ED sheet that applies to most relays. It provides general instructions covering customer adjustments and tests for Neutral, Biased-Neutral, and Polar Relays.

Armature Air Gap - The closest point between armature and core face measured when the relay is energized.

Coil Resistance - This is total coil resistance of relay under test.

Contact Resistance - Total resistance of the individual contact as measured at the terminals of the relay under test. Resistance to be measured at 1 amp contact current. Back (NC) measurements made with relay de-energized. Front (NO) measurements made with relay energized to normal WORKING current.

Down Pressure - Pressure put on fingers so that when contact group is assembled on relay, all front contacts will be open and all heel contacts will just be making contact with the back contacts. In addition, each roller must sit on the bottom of its slot when the pusher is raised to just open the back contacts.

DROPAWAY – (DA) Current or voltage specified on Ordering sheet at which relay just makes its back contacts. This value is taken after the relay is saturated to a specified value of current.

Hi-Pot Test (B1 and B2) - The insulation of coils and contacts shall withstand 3000V at 60 Hz.

NOTE

For subsequent tests, voltage should be reduced 20 percent each time.

Overpressure -

- Dead Weight - Pressure applied at the residual screw to just raise the bridge stop screw from its stop with the overpressure compression spring ineffective.

- Final Pressure - Pressure applied at the residual screw to just raise the bridge stop screw from its stop with the overpressure compression spring effective.

Pick Up Transition Time - Crossover time from break back to make front contact.

PICKUP Current or Voltage – (PU) Specified current or voltage at which the relay just makes its front contacts.

PICKUP Time - Time required for a relay to make any one of its front contacts after Pick Up current or voltage is applied.

Release Time - Time required for a relay to break any one of its front contacts after the relay is de-energized.

Release Transition Time - Crossover time from break front to make back contacts.

Saturation – (Sat) Current necessary to saturate magnetic structure of relay.

Trapped Pressure - Pressure required to just lift a contact off the stop plate without contacting the pressure plate.

WORKING Current or Voltage – (WC) Current or voltage specified on ordering sheet needed to energize relay to its front stop.

THIS PAGE INTENTIONALLY LEFT BLANK.

C. APPENDIX C – TOOLS AND KITS

C.1. GENERAL

This section summarizes the tools and tool kits used for B relay installation, maintenance, and troubleshooting. See Section 7 for a listing of installation plugboards and supplies.

C.2. CORRECTIVE MAINTENANCE TOOLS AND TOOL KITS

Table C–1 lists the tools required to perform the test and adjustment procedures on typical B relays; tools for special purpose relays are not listed. Figure C–1 includes many of the tools listed in Table C–1. Consult Alstom Signaling Inc. customer service if additional tools are required.

Table C–2 lists the tools required to perform the test and adjustment procedures on typical B relays that are not available from Alstom.

For relay specific items such as terminals, insulators, and tags, see the specific parts list.

Table C–1. Alstom B Relay Tools

Ref.	Description	Alstom Part Number
1	AAR Ring Terminal Hand Crimp Tool, for AWG. 10-20 wire	24745-145-00
2	AAR Wrench	15194-010-02
3	Burnishing Tool, used to clean off B relay AgC contacts only	55411-003-00
4	Extractor, for plugboard terminal	59688-000-00
5	Gauge, Pronging, for checking alignment gap, use with: - Gauge, Indexer (for B1 Relays) - Gauge, Indexer (for B2 Relays)	56260-014-01 56260-008-01 56260-010-01
6	Gauge, Step, .033- .040- .140 -.118- .113, for setting bridge travel and makes/breaks for .125 inch front contact opening relays	36183-064-00
7	Gauge, Step, .033- .040- .120 -.098- .093, for setting bridge travel and makes/breaks for .125 inch front contact opening relays	36183-065-00
8	Hand Crimp Tool, B relay terminal, for AWG. 10-20 wire	24745-148-00
	Shop Test Rack (See Fig. C–2)	56573-002-01

Table C–1. Alstom B Relay Tools (Cont.)

Ref.	Description	Alstom Part Number
9	Spanner Nut Wrench for B Relay 3E Post	55393-003-01
10	Standard Tool Kit; contains the following minimum tools/gauges required to readjust Alstom type B1 and B2 neutral and biased-neutral relays:	59649-206-01
	A. Gauge, Pressure, 50-6-50 grams, for checking pressures	(55412-000-00)
	B. Gauge, Pressure, 150-15-150 grams, for checking pressures	(55412-004-00)
	C. Gauge, Step, .026-.029-.073-.056-.053, for setting bridge travel and makes/breaks	(36183-062-00)
	D. Gauge, Step, .033-.040-.087-.065-.060, for setting bridge travel and makes/breaks	(36183-063-00)
	E. Tool, Alignment, for aligning contact springs so contacts meet square	(47951-021-00)
	F. Tool, Combination, to bend inside contact group pressure/stop plates and to align heel springs	(47951-058-00)
	G. Tool, to bend/align contact springs	(47951-024-00)
	H. Tool, to bend stop and pressure plates	(47951-025-00)
	I. Handle for stop and pressure plate bender	(35718-003-00)
11	Tool, for bending bridge extension	47951-023-00
	Vane Relay Test Unit (See Fig. C–3)	20182-111-01

Most tools with Alstom part numbers are special order items. Check with Alstom Signaling Inc. customer service for price and delivery information.

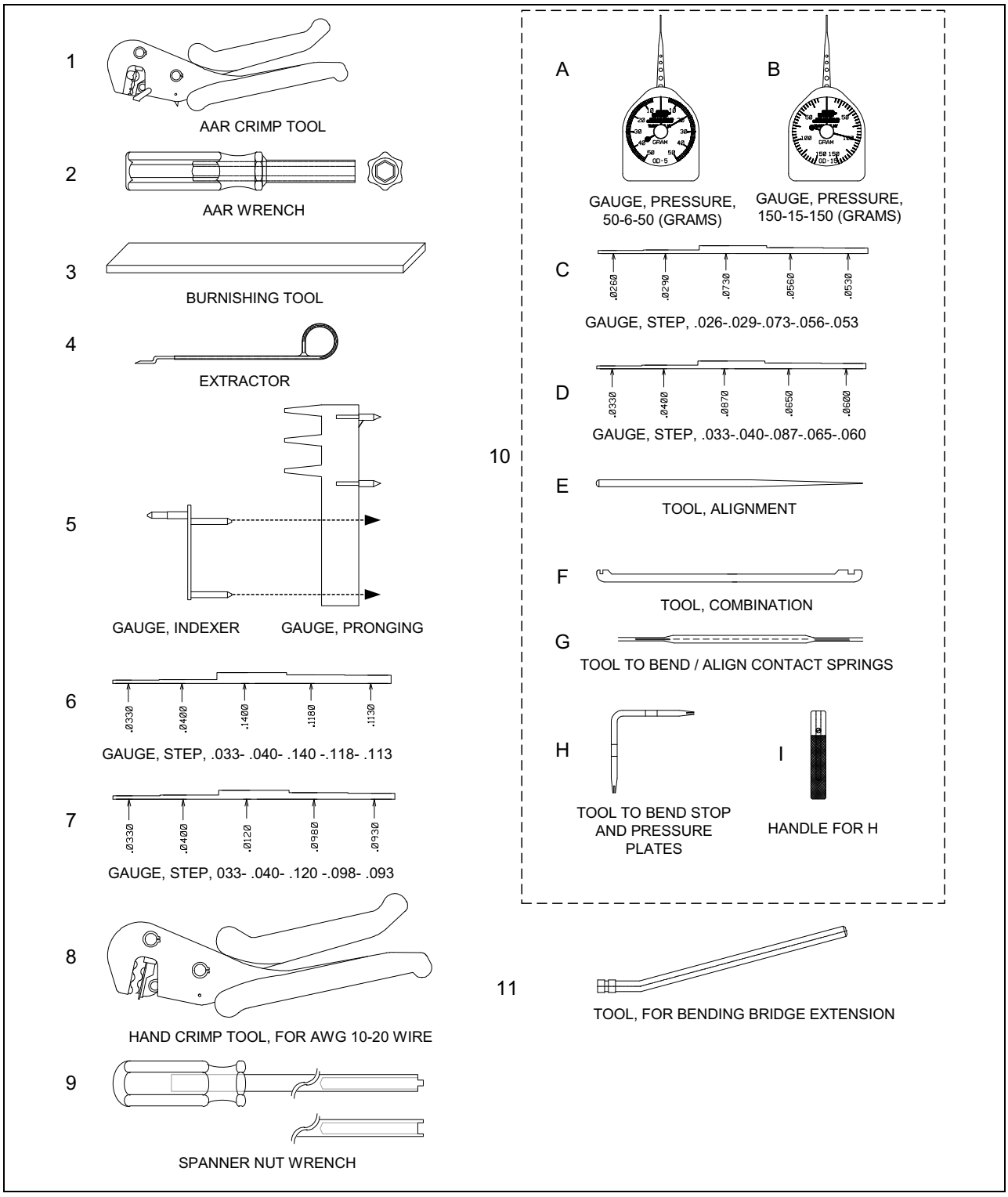


Figure C–1. Alstom B Relay Tools

Table C–2. B Relay Tools Not Available From Alstom

Description
Bond Paper (for cleaning carbon contacts)
Gauge, Feeler .002 Through .035 (for setting air gap)
Gauge, Feeler, Combination .002 and .004 (for checking air gap between armature and retaining plate)
Glue, Pliobond 20, McMaster Carr (to glue top end of contact groups to base)
Magnifier, Illuminated Magna-Lite Model 100 (5 Power) (to inspect relays)
Multimeter/DMM Fluke 87 or equivalent
Pin Gauge, .050 inch (for checking front contact openings)
Pin Gauge, .090 inch (for checking front contact openings)
Pin Gauge, .125 inch (for checking front contact openings)
Screw Drivers, Standard (for tightening screws)
Seal Press, 5 Inch Bulldog Seal Press (for applying seal to relay) order from American Casting, Inc. Also order custom dies for press to identify adjuster/property
Solder, Rosin Core, 60% tin, 40% lead
Soldering Iron, 120-volt, 50-watt
Wire Cutter
Wire Stripper
Wrenches, Open End, 11/32" - 5/16" (for tightening armature air gap and bridge travel jam nuts)

C.3. SHOP TEST RACK

The Shop Test Rack, P/N 56573-002-01, is used to test relays in the shop. When complete tests are necessary, the relay is taken out of service and tested by plugging it on the test rack, Figure C–2.

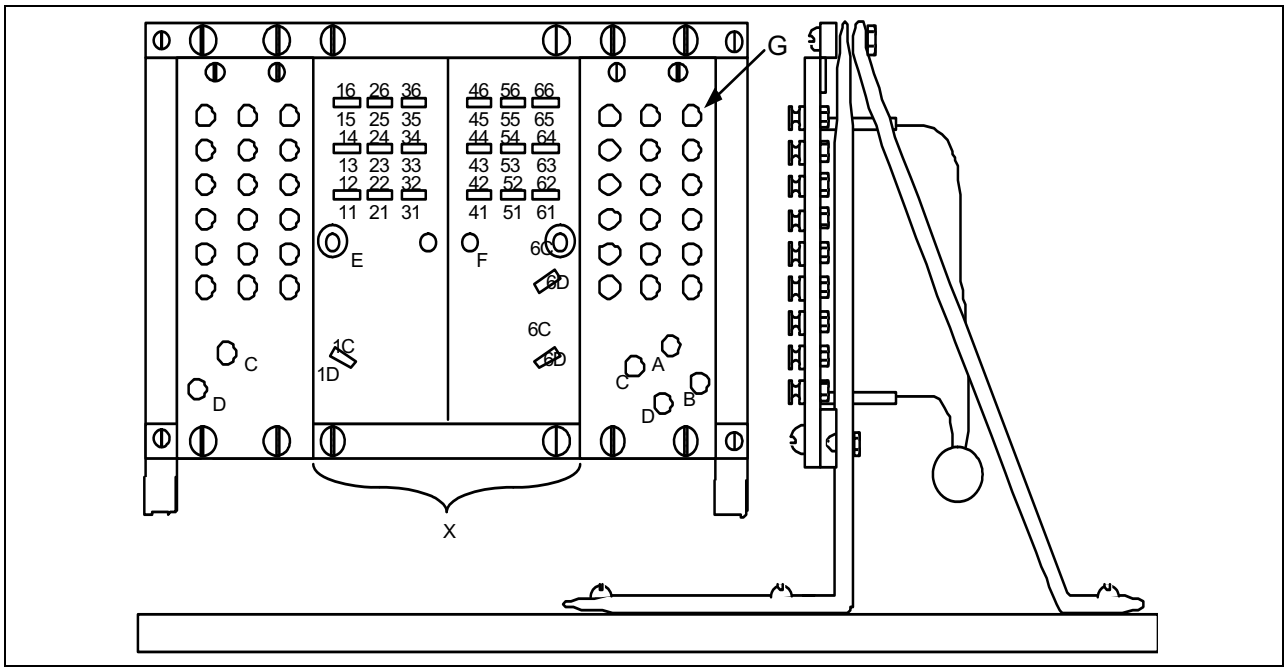


Figure C–2. Shop Test Rack

This rack is designed for both B1 and B2 Relays. One of the guide rods is removable. When testing B1 Relays, position the guide rod in location F. For testing B2 Relays, position location E. Meter leads should have alligator clips for clipping on to terminal posts G.

C.4. VANE RELAY TEST UNIT

Electrical tests for operating values on Type B2 two element Vane Relays are made with the test unit shown in Figure C–3 (P/N 20182-111-01). This test unit does not include the ammeters or volt meters required to read relays local and track operating values.

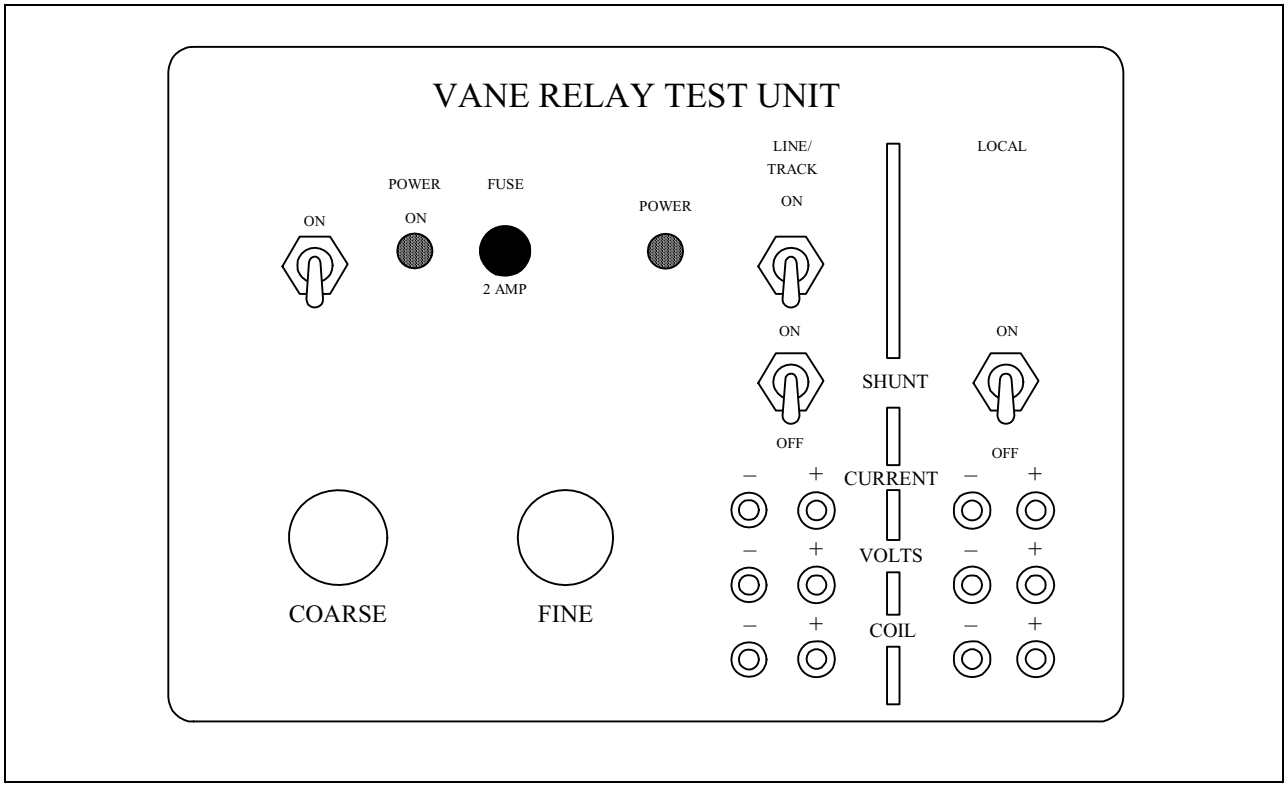


Figure C–3. Vane Relay Test Unit, Front Panel

Unit dimensions are 10" high by 17" wide by 5" deep. Major board components are as follows:

- Two non-inductive adjustable resistors
- One 50-ohm fixed resistor
- Fuse clips and 2-ampere fuse
- Track element power switch
- Short circuiting switches
- Test jacks for meter hookup

The Vane Relay test unit's circuit, meter connections, and Vane Relay connections are shown in Figure C–4. The unit can be powered form a variable 120 VAC source or the user can add a tapped transformer to adjust the supply line to the current LOCAL winding voltage. The user provides the ammeters and voltmeters for measuring the Vane Relay's DROPAWAY, PICKUP, and WORKING currents and voltages. Two potentiometers and series resistance control the current and voltage to the controlled element of the Vane Relay under test. Potentiometer Rp is 250 ohms and potentiometer Rs is 100 ohms, both are non-inductive resistances. Rp is connected directly across the supply line and Rs is connected as a variable series resistance. Rp gives a coarse wide range adjustment, and Rs gives a fine adjustment, to be used near the DROPAWAY, PICKUP, and WORKING values of the relay.

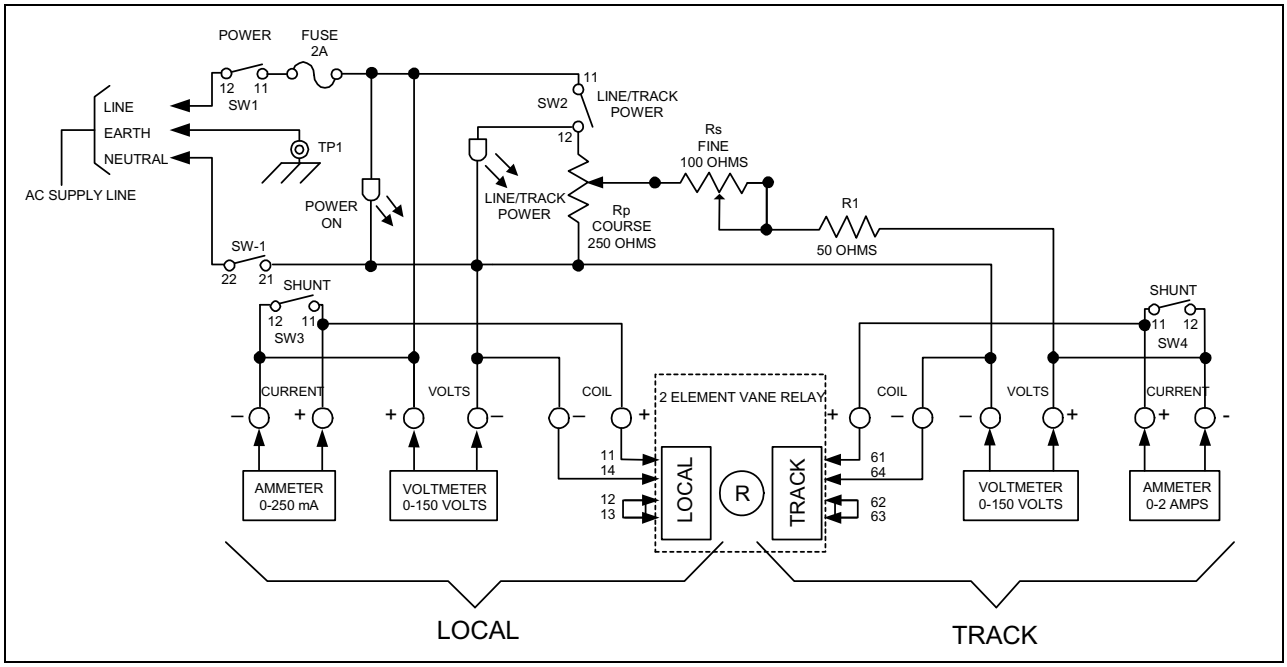


Figure C–4. Vane Relay Test Unit Circuit with Relay

The Vane Relay picks when there is a current phase difference between the LOCAL winding and the TRACK winding. To pick the Vane Relay with the Vane Relay Test Unit the phase angle is induced. To create the current phase difference and cause the vane relay to pick, the test unit's LOCAL winding, powered off the supply line, has an inherent phase shift in that the current lags the voltage by 70 or 80 degrees depending on the relay type. Refer to the Alstom Engineering Data (ED) sheets for the Vane Relay to determine the relay's Inherent Phase Angle value, see listing in Appendix A. The test unit's TRACK winding voltage is reduced from the supply line by a very large series resistance relative to the impedance of the track winding, so it demonstrates almost no current/voltage phase shift. Since the current in the LOCAL winding lags the current in the TRACK winding, this provides the phase difference to pick the relay.

Using this test unit allows the user to measure current/voltage values that closely match the operating values of the Vane Relay under service conditions.

In testing some Vane Relays, a transformer may have to be inserted in the circuit. For example testing relays with 5 volt TRACK windings requires adding a Universal Transformer, P/N 31094-000-01 (Cat. A95-50) to step up the Track voltage. Refer to the Vane Relay's ED sheet for details. A list of ED sheets is provided in Appendix A.

FOR QUESTIONS AND INQUIRIES, CONTACT CUSTOMER SERVICE AT
1-800-717-4477
OR
WWW.ALSTOMSIGNALINGSOLUTIONS.COM

ALSTOM SIGNALING INC.
1025 JOHN STREET
WEST HENRIETTA, NY 14586