

DC Biased Vital Relay

(Second Generation)

PN-150B

Part Numbers

N322500-	701	702	703	704	705	706					711		713
N322500-	801	802	803	804		806	807	808	809	810		812	
N322500-	901	902	903				907	908	909	910			

Revision Index

Revision Date

March, 1985
March, 1986
October, 1986
April, 1987
February, 1988
September, 2000

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1.1 INTRODUCTION

This service manual covers the PN-150B Plug-In DC Biased Relay used for line and logic circuit applications requiring contact capacities up to 4 amperes.

Since the relay is biased, it operates to ensure that the logic energy is of the proper polarity. This is especially important where some circuits are polarity responsive, such as switch repeating and polar line circuits.

PN-150B relays of earlier design are covered in Service Manual 4551 and its supplements. The earlier designed relay suffixes were -0XX, versus -7XX, -8XX and -9XX. For a given relay resistance and contact combination, these second generation PN-150B relays will fit into the same mounting base and have the same operating characteristics as the corresponding earlier design relay. The design of the PN-150B relay conforms to all applicable AREMA specifications.

1.2 DESCRIPTION

1.2.1 General

The relay is factory-calibrated to operate across a wide environmental range. All moving parts are enclosed in a sturdy, transparent, dust and moisture resistant cover. To ensure the relay is inserted in its proper mounting base, all relays have indexing pins. Relays lock securely in the plug-in position.

1.2.2 Coils

Coil resistance of PN-150B relay is dependent on part number. See Subsection 1.3.1 to correlate part numbers to coil resistance values. The resistance selected depends on the system voltage and circuitry.

1.2.3 Contacts

Contacts of the PN-150B relay are standard low-voltage silver-to-silver impregnated carbon front and silver-to-silver back. See Figures A-1 or A-3 for a pictorial representation of the contact assembly.

1.2.4 Shock Indicator (only applies to Part Number N322500-807)

WARNING

ANY RELAY SHOWING SHOCK INDICATOR ACTIVATION SHOULD BE SHOPPED BEFORE PLACING RELAY INTO SERVICE. FAILURE TO ASSURE PROPER FUNCTION OF THIS RELAY MAY RESULT IN SEVERE PERSONAL INJURY OR DEATH.

The shock indicator (P/N J680167-0012) shows red when the relay has been subjected to shock in excess of a safe level (i.e., dropped) during shipment or transport. This is an indication that the relay may have mechanical damage and may not meet electrical specifications.

1.3 SPECIFICATIONS

The following subsections provide the electrical and mechanical specifications of the PN-150B relays covered in this manual.

Note

The 900 series once referred to relays with Lexan covers, while the 800 series had covers made from a different material. This material is no longer used, so all relay covers are Lexan. The 900 series is obsolete and the 800 series is the direct replacement.

1.3.1 Electrical

Relay electrical specifications are tabulated below:

	Part No.			Contacts	Coil Resis. Ohms	Energization		System Voltages
	No Front Testing	With Front Testing	No Front Testing			Amps	Volts	
N322500	-801	-701	-901	6FB Std	400	0.0132	5.3	10
N322500	-802	-702	-902	6FB Std	800	0.0105	8.4	12-14
N322500	-803	-703	-903	6FB Std	1300	0.0082	10.7	16-24
N322500	-804	-704		6FB Std	100	0.0264	2.64	***
N322500		-705		6FB Std	240	0.0177	4.24	***
N322500	-806	-706		6FB Std	25	0.0504	1.26	***
N322500	-807		-907	4FB, 2F, 1B Std	1300	0.0082	10.7	16-24
N322500	-808		-908	4FB, 2F, 1B Std	800	0.0105	8.4	12-12
N322500	-809		-909	4FB, 2F, 1B Std	400	0.0132	5.3	10
N322500	-810		-910	6FB Std	4300	0.004	17.58	24
N322500		-711		2FB, 4F, 2B Std	400	0.0132	5.3	10
N322500	-812			6FB Std	400/400	0.023	9.0	12-14
N322500		-713		6FB Std	2730	0.0052	14.1	24

All relays are presently furnished with a Lexan cover.

***Normally used in series with another relay

Contacts - Standard (Std) 4 amps, low-voltage silver-to-silver impregnated carbon front and silver-to-silver back.

Mounting Base - N451376-0302 - improved style for all relays above.

- N433830 - old-style for relays N322500-807, -808, -809.

- N334266 - old-style for all other relays above.

TABLE 1-1. ELECTRICAL SPECIFICATIONS

1.3.2 Mechanical

The following mechanical specifications are common to all PN-I50B relays covered in this manual.

Relay Dimensions: Height 7-1/16" (17.93 cm)
 Width 2-7/16" (6.19 cm)
 Depth 8-7/32" (20.88 cm)

Temperature: -40° F (-40° C) to +185° F (+85° C)

Indexing: Refer to Section 2.3

Weight: 6-3/4 Lbs.

Mounting Base Weight: 17.5 oz. (Old-style Base)
 9.5 oz. (Improved Base)

Mounting Base Dimensions: Height 7-15/16" (20.16 cm)
 Width 2-7/16" (6.19 cm)
 Depth 2-7/16" (6.19 cm) (Old-Style Base)
 Depth 1-25/32" (4.52 cm) (Improved Base)

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2.1 GENERAL

Relays plug directly into a mounting base that is secured to a rack. The only installation instructions required are for the mounting base.

2.2 MOUNTING BASE

Secure the mounting base directly to the rack using the hardware furnished. All wiring terminates at the rear of the mounting base to solderless terminals (receptacle contact springs).

Mounting base details are shown in Figures A-2 (Old-Style Base) and A-4 (Improved Base) of the Appendix.

2.3 RELAY INDEXING

Relays are factory equipped with indexing pins to prevent insertion of an incorrect relay into a mounting base. Each relay is accompanied by an indexing plate that is applied to the mounting base at the time of initial installation. A typical plug-in relay with indexing pins and base with indexing plate is shown in Figure 2-1.

The following data defines the indexing that has been established for relays covered by this manual.

- a. The index code always consists of four figures (such as 0001, 0002, or 0101) and is used for both the relay and the indexing plate on the mounting base.
- b. The index code for each relay can be determined from the relay part number and its suffix, which is marked on the nameplate attached to the front of the relay. The first two digits of the index code are the last two digits of the part number, and the second two digits of the index code are the last two digits of the suffix. The index number should agree with the placement of the indexing pins in the numbered vertical rows on the back of the relay starting with the top pin and reading down.
- c. The index code for each mounting base is determined by the placement of the holes in the numbered vertical rows of the large white nylon indexing plate that is affixed to the front of the mounting base. This indexing plate should not be removed from the mounting base unless it is damaged or the indexing is to be purposely changed to accommodate a relay of a different part number. Discard the indexing plate that comes in a bag tied to the handle of all new relays, unless it is needed for replacement of damaged indexing plate or for application to a new mounting base.

WARNING

NEVER DRILL NEW HOLES IN A BASE INDEXING PLATE THAT WILL PERMIT APPLICATION OF RELAYS WITH DIFFERENT PART NUMBERS OR CHANGE INDEXING PINS ON THE BACK OF A RELAY UNLESS IT IS BEING CONVERTED TO A NEW PART NUMBER. OTHERWISE, A HAZARD WILL BE CREATED THAT MAY COMPROMISE SAFETY CIRCUIT FUNCTIONS.

2.4 RECEPTACLE CONTACT SPRINGS**2.4.1 *Old-Style Base Only***

The mounting base will normally be equipped with the required quantity of J680165 solderless receptacle contact springs, and will accommodate one or two #14 or #16 wires. It can, however, be equipped with receptacle contact springs for one or two #10 or #12 wires (J680181), or for one or two #18 or #20 wires (J680179). Make certain which type of solderless receptacle contact springs accompany the mounting base before proceeding with their installation.

2.4.2 *Improved One-Piece Base Only*

The one-piece mounting base with hardware (N451376-0302) includes a full complement of receptacle contact springs (M451142-2702) to accommodate one or two #14-#16 wires, mounting fasteners and tags. However, it may be equipped with receptacle contact springs for one or two #18-#20 wires (M451142-2701), or for one or two #10-#12 (M451142-2703) wires.

Each solderless receptacle contact spring should be inspected for physical damage and straightness before proceeding with installation.

The following is recommended when installing solderless receptacle contact springs:

- a. Receptacle contact springs must be inserted into the base cavity with the lock side down (See Figure 2-2).
- b. Make certain that the lanced tab is slightly compressed when the receptacle contact spring is inserted along the top of the cavity. The lanced tab could have been bent during handling, and therefore might not provide the required contact pressure after the relay is inserted. If the lanced tab does not touch, pull it up slightly using fingers or a suitable tool.
- c. After insertion, pull firmly on the wire to make certain the receptacle contact spring is locked in the cavity.

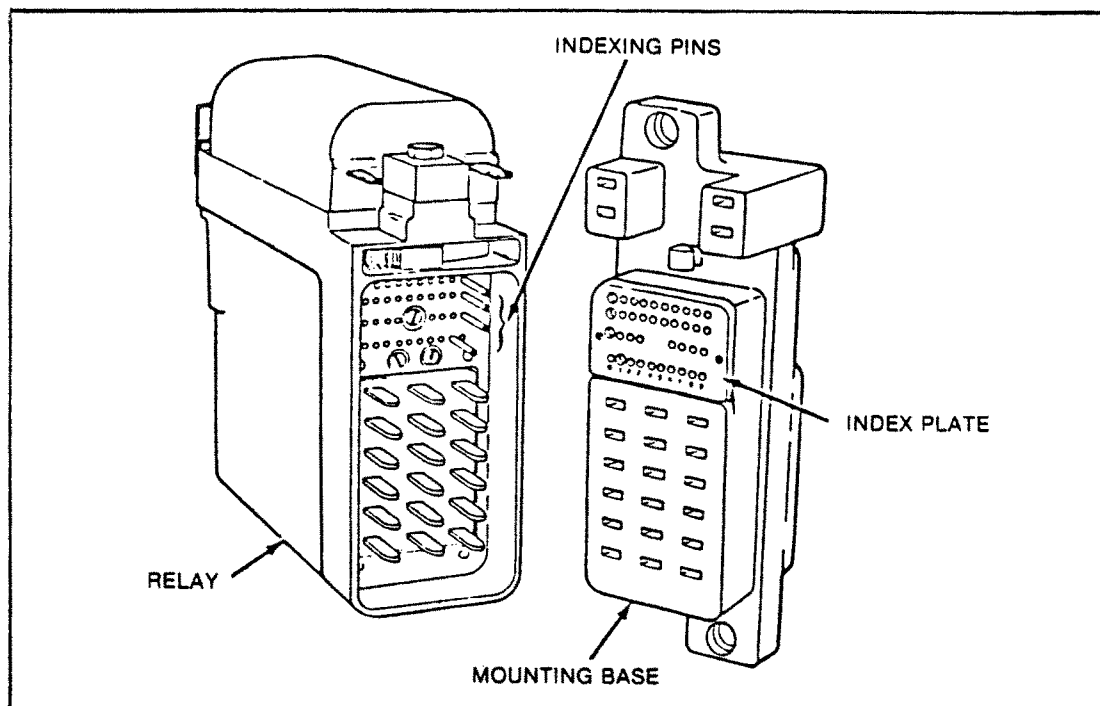


FIGURE 2-1. TYPICAL PLUG-IN RELAY AND MOUNTING BASE

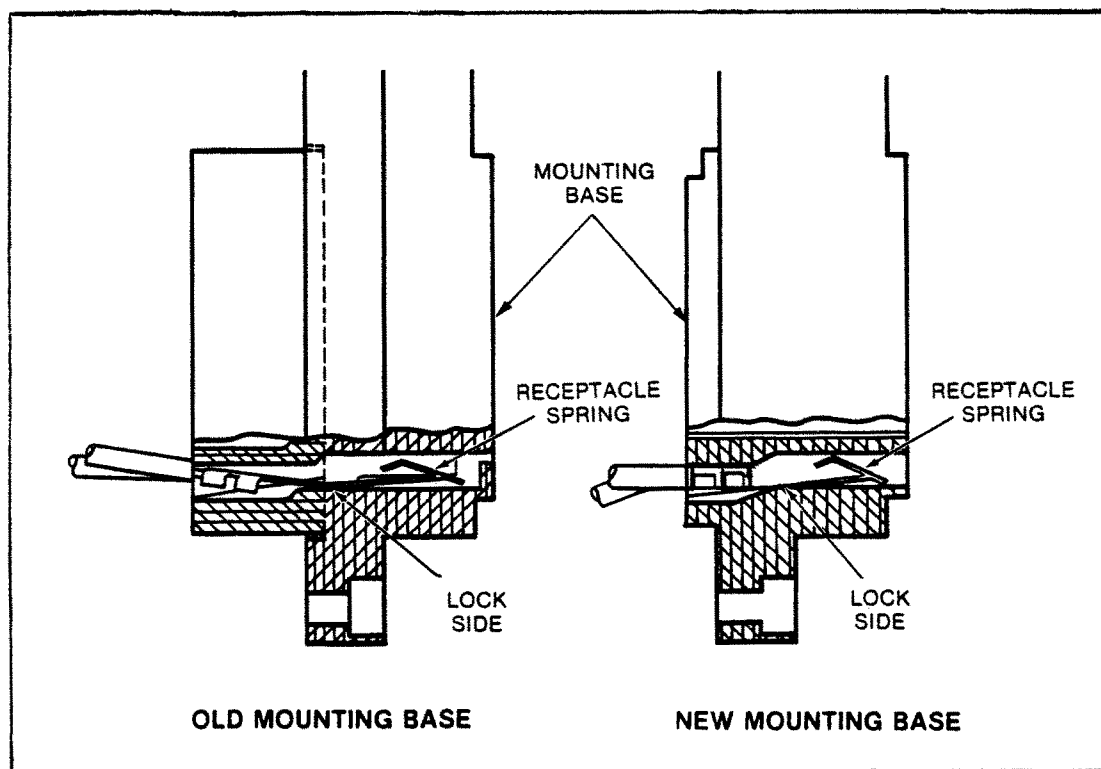


FIGURE 2-2. RECEPTACLE SPRING INSTALLED

2.4.3 Installing Wires in Receptacle Contact Springs

Use the following procedure to ensure a good electrical and mechanical connection between the conductor wire and the receptacle contact spring. The following table identifies the correct crimping tool to be used when installing wires in receptacle contact springs.

Crimping Tool	Wire Size	Old Style Receptacle Contact Spring	Improved Base Receptacle Contact Spring
(Amp Type)			
J397138	#10/#12 AWG	J680181	M451142-2703
J397139	#14/#16 AWG	J680165 (Std)	M451142-2702
J397188	#18/#20 AWG	J680179	M451142-2701

- Strip 3/16 in. (0.187 in. or 0.47 cm.) of insulation from the end of the wire.
- Place the receptacle contact spring into the jaws of the proper crimping tool. When using only one terminal, of any wire size, use the shortest terminal.
- Partially close the crimping tool jaws against the receptacle contact spring to hold it in place. (Do not crush the receptacle contact spring barrel at this time.)
- Insert the stripped end of wire all the way into the receptacle contact spring barrel. Squeeze the tool handles until crimping is completed and the jaws release. When using both terminals, it is more convenient to attach the first wire to the longest terminal.
- Remove the crimped receptacle contact spring from the tool and inspect the connection. Make certain that the wire is flush with the crimped barrel and that there are no loose strands of wire.

2.5 RELAY INSERTION

Orient the relay to the mounting base with the push rod to the left-hand side; then plug the relay into the base. The relay should be pushed firmly against the mounting base while depressing the latch rod. After the relay is completely seated in the base, release the latch rod and pull on the handle to ensure that the relay has locked in place.

3.1 INTRODUCTION

This section provides the necessary periodic preventive maintenance procedures which must be performed to ensure continuous, proper, and efficient operation of the PN-150B relays covered in this manual. Field maintenance covers periodic inspections and performance tests.

3.2 PERIODIC PERFORMANCE TEST

3.2.1 *Cleaning*

Before inspecting and testing the relay, if necessary use a soft cloth to clean the exterior to remove any dirt or dust that may have collected. A safe cleaning solution of alcohol and water may be used for removal of accumulated dirt, grease, etc.

3.2.2 *Service Requirements*

3.2.2.1 *General*

All vital relays must be inspected and tested at least once every four (4) years. The tests and inspections are to include: pick-up current, drop-away 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 of the cover, broken seal, and cracked or broken cover.

All vital relays installed in locomotive or car-carried equipment are to be removed from service and adjusted, repaired and tested at least once every six (6) years.

Relays not passing the above stated tests and inspections must be replaced and not returned to service until the operating characteristics and conditions are in accordance with US&S specifications.

3.2.2.2 *In-Service Test*

It is recommended that line relays in service be removed from service for shop repairs when one or more of the following conditions occur: (Use as a reference the calibration values given in Table 4-2.)

- a. If the Drop-Away value (D. A.) falls below 67% of the value given.
- b. If the Full-Drop-Away value (F. D. A.) falls below 33% of the value given.
- c. If the Full Stroke value (F. S.) increases to more than 110% of the value given.

3.2.2.3 *Test Procedures*

Test the operating characteristics of the PN-150B relays as given in Section 4.6 in this manual.

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4.1 INTRODUCTION

This section provides the information necessary to perform shop level repairs of the PN-150B style relays covered in this manual. In general, relays arriving at the shop for repair have been checked in the field and have been found to perform unacceptably or have been physically damaged.

4.2 CLEANING AND INSPECTION

Before inspecting the relay and initiating repairs, use a soft cloth to clean the exterior carefully to remove any dirt or dust that may have collected. A safe cleaning solution of alcohol and water may be used for removal of accumulated dirt, grease, etc.

Inspect the relay exterior for signs of physical damage, such as cracked or broken cover, cracked or damaged housing, and damaged and or missing contact block terminals and indexing pins. If severe damage is found, a careful inspection of the interior components should be made for physical damage.

Remove the cover and proceed with inspection, cleaning, stop pin conditioning and relay contact cleaning, using the following recommended cleaning materials:

Recommended Cleaning Materials	Order Reference
A relay contact cleaning kit, part number X451646-0901, is available that consists of the following three items, or which may be ordered individually:	
Burnishing Tool, P. K. Neuses Co. No. 3-316	J397187 (pkg. of 5)
Burnishing Tool, P. K. Neuses Co. No. N318 (Heavy Duty)	J397187-001 (pkg. of 5)
Paper Strip, strips cut from 67 pound white Springhill Vellum	
Bristol Paper	J793094 (pkg. of 50)
Also recommended:	
Emery Paper, Wet or Dry, 600 Grit, cut in strips	(Commercially Available)
Alcohol #1 Solvent (Ethyl Alcohol Proprietary 190 or Equivalent)	(Commercially Available)
Stop Pin Conditioning Graphite Stick	N451151-3203

4.2.1 Cleaning and Inspection Procedure

The following procedure (reference Figure 4-1) should be performed any time the cover is removed from the relay for inspection or any type of maintenance. Only after this procedure is performed may the cover be reinstalled on the relay. The cover should only be removed from the relay in a clean work area, i.e., an area free of any metal particles, dirt, or other material that may interfere with the proper operation of the relay.

NOTE

The use of an inspection magnifying lens is suggested for the following procedure.

1. Carefully examine the permanent magnet area (including the magnet extension) for any particles that may interfere with the proper operation of the relay, such as dirt, fibers, metal slivers, etc. Use compressed air to blow out the particles, or wipe the area to remove the particles.

CAUTION

MAINTAIN A LOW AIR PRESSURE (10 TO 50 PSI) OR ELSE DAMAGE MAY OCCUR TO THE CONTACT SPRINGS. CLEAN OR FILTERED AIR SHOULD BE USED AT ALL TIMES, OR ELSE CONTAMINATION MAY RESULT. CARE MUST BE TAKEN SO THAT PARTICLES ARE NOT MOVED TO ANOTHER PART OF THE RELAY.

2. Examine the stop pin counterbored hole (located on the bottom of the armature) for any particles. Use compressed air to blow out any particles. If the particle cannot be removed via compressed air, the particle should be checked to see if it is loose and has a possibility of becoming dislodged. This check can be performed by using a sharp tool (resembling an angled dental pick) to dislodge the particle.
3. Move the armature to the energized position and examine the space between the armature and the face of the magnet extension. This area must be clean and free of any particles. Pay special attention to the teflon tape (see note below) which is located on the bottom of the armature.

CAUTION

PARTICLES CAN BECOME EMBEDDED IN THE TEFLON TAPE. REMOVE ANY SUCH PARTICLES OR THEY MAY INTERFERE WITH THE PROPER OPERATION OF THE RELAY.

4. Move the armature to the deenergized position and examine the area between the armature and the pole faces. Use compressed air to blow out any particles. Examine the area of the hinge spring and safety stop for particles and clean when required.

NOTE

This area is difficult to inspect. Backlighting the area will help considerably.

5. Use the compressed air to blow out all relay surfaces.

CAUTION

DO NOT AIM THE AIRFLOW DIRECTLY ONTO THE CONTACT SPRINGS, AS THEY CAN BE DAMAGED OR MISALIGNED.

6. Use the compressed air to blow out the inside of the cover. If the air pressure does not sufficiently clean the cover, wipe the inside of the cover with a clean, lint-free cloth.
7. After cleaning is complete, perform the armature stop pin conditioning (Section 4.2.2). The relay surfaces should be blown out with compressed air to remove any stray graphite particles following the stop pin conditioning procedure.
8. When the relay is completely cleaned and inspected, the cover may be replaced and the seal and sealing wire installed.

CAUTION

THE SEALING WIRE MAY BE MAGNETIC. WHEN THE WIRE IS CUT (AFTER THE SEALS HAVE BEEN APPLIED) THE CUT-OFF PIECES CAN BE ATTRACTED TO THE PERMANENT MAGNETS OF ADJACENT RELAYS OR CAN FALL ONTO THE WORK SURFACE. KEEP ALL ADJACENT RELAYS COVERED AT ALL TIMES AND CLEAN UP THE CUT-OFF PIECES. GOOD HOUSEKEEPING PRINCIPLES APPLY AT ALL TIMES. ALSO, CARE MUST BE TAKEN THAT METALLIC PARTICLES ARE NOT ACCIDENTALLY CARRIED TO THE RELAY ON HAND TOOLS THAT HAVE BECOME MAGNETIZED. IF THESE PROCEDURES ARE NOT FOLLOWED, THE RELAY MAY NOT FUNCTION PROPERLY.

9. Perform a final visual inspection once the cover and seal have been applied. Pay particular attention to the permanent magnet area and the inside of the cover.

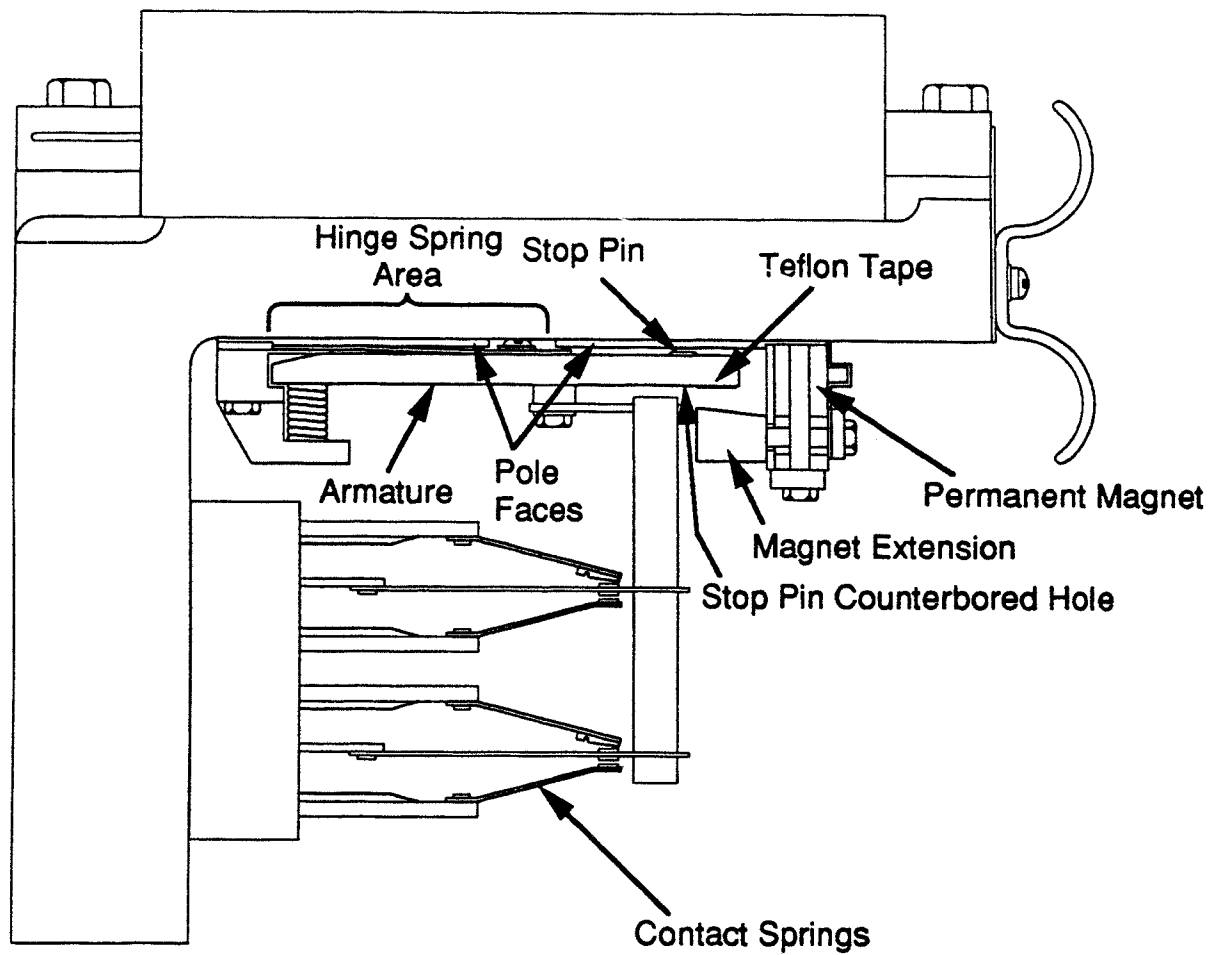


FIGURE 4-1. RELAY PARTS LOCATION

4.2.2 Armature Stop Pin Conditioning

The following instructions are for conditioning the armature stop pin (See Figure 4-2). This procedure should be followed wherever a relay is shipped for failure to meet its calibration specifications during scheduled field inspection and tests.

- a. After removing the cover, clean the stop pin and adjacent surface by saturating a paper strip (contained in J793094) with Alcohol #1 Solvent (Ethyl Alcohol Proprietary 190 or equivalent and then placing it between the armature and pole face. Apply moderate pressure on the armature and draw the paper out. Continue until no residue is removed from the surfaces. Dry the surfaces using a clean strip of paper.
- b. The next step is to apply a dry lubricant such as graphite to the relay stop pin and its point of contact on the pole face.

Insert the Stop Pin Conditioning Graphite Stick (N451151-3203) between the armature stop pin and its point of contact on the pole face with graphite against stop pin. While applying moderate pressure on the stick, pull the stick back and forth in a circular motion over the stop pin, continuing several seconds to ensure a sufficient amount of graphite transfer.

It is not necessary to observe a significant deposit of graphite since most of what is required can only be determined by means of a microscope.

- c. Recheck relay calibration and prepare relay for return to service.

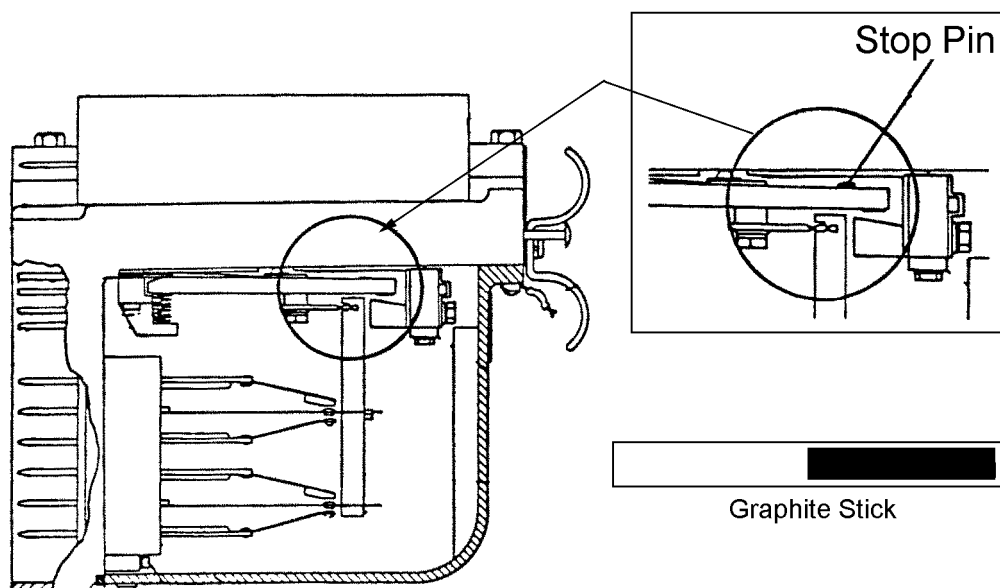


FIGURE 4-2. PN-150B RELAY

4.2.3 *Cleaning Relay Contacts*

This section covers recommended methods for the preparation and cleaning of relay contacts.

After contacts have been dressed and/or after adjustments have been made to meet calibration requirements, the contacts should be cleaned in accordance with the following procedures.

NOTE

In the final cleaning procedures outlined in the following sections, it is recommended that all silver contacts be cleaned first and then all silver impregnated carbon contacts in order not to contaminate the silver tips with residue that might adhere to the cleaning tool from cleaning the silver impregnated carbon contacts.

NOTE

When using the paper strip, clean the back contacts first, then the front contacts last. Discard the paper strips when dirty.

4.2.3.1 *Contacts That Are Severely Burned*

- a. Using a 600-grit emery paper strip folded with the grit side out so that both contacts can be burnished simultaneously, stroke the contacts in the direction of contact wipe.
- b. Using the burnishing tool, stroke the contacts several times in the direction of contact wipe.
- c. Place the paper strip between the open contacts, then close the contacts and withdraw the strip.
- d. Repeat step "c" several times, if necessary.
- e. Using the alcohol spray, give the contacts a degreasing/wash.
- f. Place the paper strip between the open contacts, then close the contacts and withdraw the strip.
- g. Repeat step "f" several times if necessary.

4.2.3.2 Contacts With Heavy Tarnish, Slightly Rough or Pitted

- a. Perform the procedure in Subsection 4.2.2.1, Steps "b" to "g".

4.2.3.3 Contacts With Surface Film or Oxidation (Not Pitted)

- a. Perform the procedure in Subsection 4.2.2.1, Steps "f" and "g".

4.3 CHECK-OUT PROCEDURE (PERFORMANCE TEST)

Perform calibration in accordance with Section 4.6.

4.4 REPAIRS AND REPLACEMENT**NOTE**

PN-150B relays manufactured after April, 1976, have been made using glass cloth epoxy laminate drivers. The date of manufacture can be found on the nameplate or on the calibration tag. These cloth epoxy drivers are tan in color and have fabric grain appearance. Older drivers were red brown or dark brown and had no grain or fabric appearance. Any relay field modified or repaired that has the older drivers should be assembled to include the glass epoxy drivers.

PN-150B relays are also manufactured in a style utilizing a molded driver instead of the individual drivers.

Since the contacts are the only wearing parts in this relay, in most cases the relay can be restored to proper operation by cleaning (Subsection 4.2.2) and readjusting them (Subsection 4.5.3).

4.4.1 Disassembly

Dismantle the relay only to the degree necessary to complete repairs. Refer to the parts list appendix for part information and location of parts. In general, to dismantle the plug-in relay, proceed with the following sequence:

- a. Remove relay cover seal.
- b. Carefully remove plastic cover.
- c. Remove/disassemble relay components as required.
- d. Remove contacts/contact block as required.
- e. Remove permanent magnet as required.

NOTE

These magnets are of a special alloy that permits retention of proper strength indefinitely if not abused. When not in place on relays, magnet assemblies should be kept separated from other magnetic objects and the screws, which hold the extension to the magnet, be kept tight. Should a magnet become weakened, it should be returned to the factory for recharging where there is special equipment to fully charge the magnet and then age it to its best working strength.

4.4.2 Reassembly

Reassembly is accomplished generally in the reverse order of disassembly. The following subsections provide additional instructions to be followed during reassembly of the relay.

4.4.3 General Parts Replacement

Do not overtighten or force parts when reassembling a relay. Upon completion of reassembly, calibrate the relay as directed in Section 4.6.

4.4.3.1 Replacing Contact Block

If the contact block is to be replaced by another, remove the old block, then use a small punch to remove the small dowel pins. Attach the new block with the four screws torqued to 10 ± 2 inch pounds. Run a #42 drill (0.0935 Dia.) thru the dowel pin holes into the epoxy contact block for a total depth of $9/16" + 1/32 - 0$.

NOTE

Replacement contact blocks **MUST** be of the same general design.

Carefully install the dowel pins, tapping in until they are flush with the surface.

If it is necessary to install a used contact block from another relay, remove only one of the dowel pins from the frame. Carefully press the block on the remaining pin and fasten in place with the screws torqued to 10 ± 2 inch pounds. One dowel pin will adequately hold the block in place.

Do not overtighten or force parts when reassembling a relay. Upon completion of reassembly, calibrate the relay as directed in Section 4.6.

4.4.3.2 Permanent Magnet

The polarity of the magnet should be such that the top end farthest from the two notched holes will attract the end of a compass needle which points toward geographic south.

The permanent magnet assembly should be applied to the relay as shown in Figure 4-3 making sure that the shunt between the magnet and the magnet extension is touching the pole piece. Tighten the two long screws holding the magnet assembly to the pole piece sufficiently to straighten the curved strap against the magnet. Bend the nut locks securely up against the sides of the screw heads after the adjustments are made.

4.5 ADJUSTMENTS

All adjusting and testing must be done with the relay in its normal upright position.

4.5.1 Recommended Tools and Test Equipment

Gap Gauge - 0.001 in. to 0.200 in.

Gram Gauge - 250 Grams

Screw Driver - Torque Measuring

4.5.2 Magnet and Magnet Extension

Insert a 0.117 inch spacer between the stop pin and the pole face and adjust the permanent magnet extension so that it touches the Teflon “back stop” tape or the back stop pins, whichever is present on the bottom of the armature.

After adjustment, the magnet and magnet extension should be centered on each other and on the armature. On relays without “back stop” pins, the bottom of the armature should fit flush on the surface of the magnet extension, with no air gaps. On relays with “back stop” pins, the air gap should be of uniform width across the surface of the magnet extension.

4.5.3 Contact Adjustments

NOTE

Contacts should be adjusted when a new contact block is installed or when the relay does not meet the calibration requirements

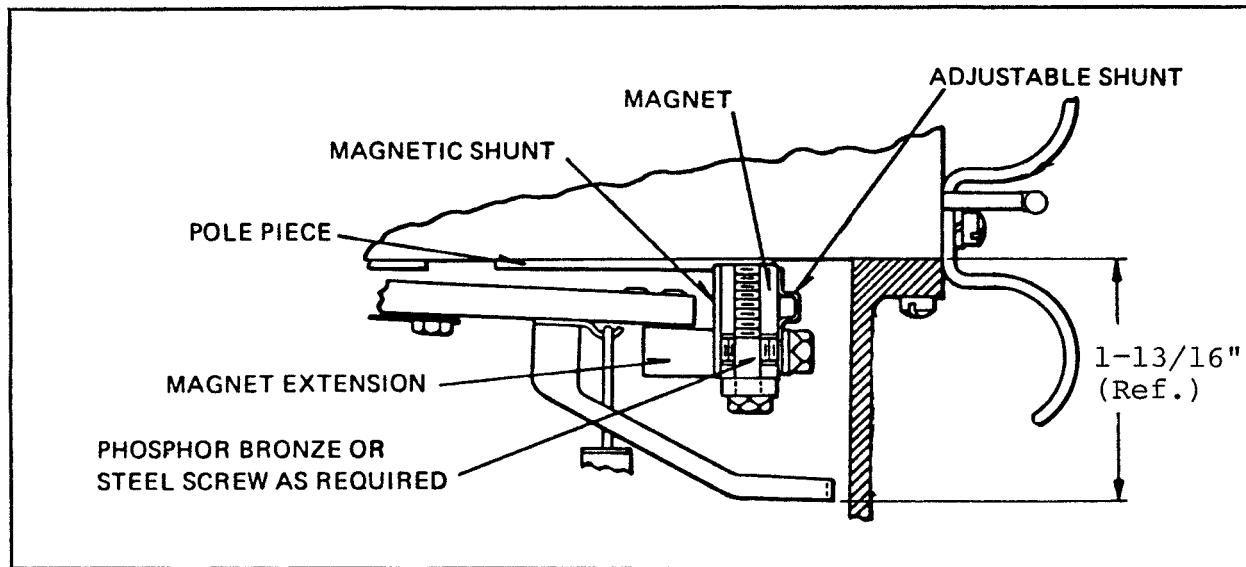


FIGURE 4-3. ASSEMBLY OF PERMANENT MAGNET AND ADJUSTMENT OF ARMATURE POSITION INDICATOR

4.5.3.1 Relays With Individual Contact Drivers

(Refer to Subsection 4.5.3.2 for relays with one-piece molded drivers.)

- a. If a new block is used, install contact block in relay frame. Torque mounting screws to 10 ± 2 inch pounds. On relays just being adjusted, check to see that mounting screws are also torqued to 10 ± 2 inch pounds.
- b. Align the fingers of the driver bracket with each other and parallel with the armature.

NOTE

When adjusting contact springs, do not bend the heavy members (terminals).

- c. Rough align the heel springs with each other and straighten, if necessary, to correct for bowed springs.
- d. Perform a bowing check of the contact drivers by laying the bowed side down on a flat surface and pushing down on one end. Check the other end with a 0.010 inch spacer and if the clearance is greater than 0.010, discard the driver.
- e. With the relay in its normal operating position, install the contact drivers and the driver clips loosely (to be removed later).

-
- f. Insert the nominal Front Closed spacer (Table 4-1) over the stop pin. With the relay energized against the spacer, adjust the front contacts so that they are all just closed with little or no pressure (both contact tips must be just touching).
 - g. Remove the spacer and insert the Back Closed spacer (Table 4-1). With the relay energized against the spacer, adjust the back contacts so that they are all closed with little or no pressure (both contact tips must be just touching).
 - h. Replace the spacer with the Heel Contact spacer (Table 4-1) and check for free play between the heel spring and the driver slot. There should be no binding of the drivers or excessive play.
 - i. Remove the driver clips and contact drivers. Adjust the heel springs by bending at the thin sections near the block so that light is visible (0.005 - 0.010 inches) between the front and back contacts and so that they are in line with each other.
 - j. With the Heel Contact spacer still inserted, install the contact drivers and check that the slots in the driver align with the heel springs and driver bracket. If necessary adjust the driver bracket.
 - k. Install the contact drivers and driver clips loosely. Mount the relay in its normal operating position.
 - l. Using the nominal Front Closed spacer (Table 4-1), adjust the front contacts to just closed.
 - m. Remove spacer and replace with the nominal Front Open spacer and adjust the front contacts to just opened.
 - n. Remove spacer and replace with the nominal Back Closed spacer and adjust the back contacts to just closed.
 - o. Remove spacer and replace with the nominal Back Open spacer and adjust the back contacts to just opened.
 - p. With the armature fully released, pull each contact driver toward the front of the relay and check that the slots in the driver remain properly engaged. The heel springs should engage at least 1/2 of each narrow slot of the driver and the large slot should fully engage the thick section of the bracket finger. The driver shall be free of any binding in all armature positions.

NOTE

New driver clips must be installed any time that the drivers have been removed.

- q. Recheck calibration, Section 4.7.

4.5.3.2 Relays with One-Piece Molded Driver

- a. If new block is used, install contact block in relay frame. Torque mounting screws to 10 ± 2 inch pounds. On relays just being adjusted, check to see that mounting screws are also torqued to 10 ± 2 inch pounds.
- b. Check heel springs for bow and adjust as required.
- c. With the relay in its normal operating position, place the molded contact driver in place on the relay.

NOTE

Nominal spacers are to be used for adjustments. The "min." or "max." spacers are to be used only for special calibration problems following the guide lines of Subsection 4.5.4.

When adjusting contacts using "closed" spacer, the contacts are to be adjusted to just touch. As a guide, there should be no more than 2 grams spring pressure between the contact tips. For any contact adjusted closed (using nominal spacers per Table 4-1), an 0.005" thicker spacer for the fronts and an 0.005" thinner spacer for the backs must allow the contacts to be open. Both contacts should be touching at the "closed" spacers. It is permissible for light to be perceptible on one tip, but both must be touching (no light perceptible) at full stroke.

- d. Insert the nominal Front Closed spacer (Table 4-1) over the stop pin. With the relay energized, adjust the front contacts so that they are all just closed with little or no pressure (both contact tips must be touching).
- e. Remove the spacer and insert the Back Closed spacer (Table 4-1). With the relay energized, adjust the back contacts so that they are all just closed with little or no pressure (both contact tips must be touching).
- f. Remove the contact driver from the relay. Adjust the heel springs by bending at the thin section near the block so that light is visible (0.005 - 0.010 inches) between the front and back contacts and so that they are in line with each other.
- g. Reinstall the driver on the relay.
- h. Using the nominal Front Closed spacer (Table 4-1), adjust the front contacts to just closed.
- i. Remove spacer and replace with the nominal Front Open spacer and adjust the front contacts to just opened.

-
-
- j. Remove spacer and replace with the nominal Back Closed spacer and adjust the back contacts to just closed.
 - k. Remove spacer and replace with the nominal Back Open spacer and adjust the back contacts to just opened.
 - l. Repeat adjustment 'h' to 'k' until each contact is open on its respective "open" spacer and closed on its respective "closed" spacer.
 - m. Check to see if heels are floating. Adjust heel clip as required.

NOTE

When the armature is held at mid-stroke with neither fronts nor backs making, all heel springs should ideally rest flat against the bottom edge of the driver slot. For those relays which do not meet the above condition, there is a maximum clearance allowable between the bottom of the heel spring and driver slot measureable by a (0.010) feeler gauge not going between the spring and the driver slot. Under no circumstances is the upper edge of the heel spring clip to be below the bottom of a driver slot. Also, no heel spring is permitted to rub against the sides of the driver. The driver clip on the armature has slotted holes to allow the clip to be adjusted so that no rubbing is evident.

- n. Recheck calibration, Section 4.7.

4.5.4 Adjustments To Meet Calibration Values

The contact adjusting spacers and armature stroke may vary from the values in Table 4-1 if the following rules are adhered to:

NOTE

It should be understood that the following listed variations from standard adjustments are permissible only when necessary to make individual relays meet calibration and timing requirements.

- a. The Back-Just-Make Spacer must always be at least 0.031" greater than the Front-Just-Make Spacer. (To provide 0.020" AREMA minimum transfer opening).
- b. The armature stroke must be at least 0.070" greater than the Front- Just-Make Spacer. (To provide 0.050" AREMA minimum contact opening).
- c. The difference between the front open and front closed, or back open and back closed should not exceed the values given in Table 4-1.

- d. The Front-Just-Make Spacer should never be less than 0.032" (80% of the 0.040 average value for PN-150B front contacts).
- e. The armature stroke should always be at least 0.030" greater than the Back-Just-Make Spacer (80% of the average 0.38" value for PN-150B backs).

4.5.5 *Hold-Down Force*

With the relay in the normal upright position and deenergized, a force of at least 190 grams (refer to Table 4-1) should be required to move the armature away from the permanent magnet assembly. This upward force should be measured with a gram gage at the bottom end of the centermost contact driver.

The hold down force can be increased, if necessary, by bending away from the permanent magnet the shunting strip which is fastened to its forward face. If one or both of the two vertical screws which fasten the permanent magnet assembly to the relay frame is steel, a further increase in hold-down force can be obtained by changing to bronze screws. The steel screw, J463078, has dull (tin) plating and its head is 3/32 inch thick. The bronze screw, M327179, has brighter (nickel) plating and its head is 1/8 inch thick.

Any change in the hold-down force will affect the relay calibration, as discussed in Sections 4.6 and 4.7.

4.5.6 *Contact Openings*

In obtaining proper calibration it is permissible to vary the adjustments given in the foregoing subsections, however:

- a. With the armature in its fully released position, the front contacts must be open at least 0.050 inch.
- b. When a front contact is just making, the corresponding back contact must be open more than 0.020 inch.

4.6 CALIBRATION

4.6.1 *Recommended Test Equipment*

Test Equipment

Power Supply, 0-70 Vdc
Digital Multimeter (two required)
DPDT (double pole, double throw-S1)
SPST Switch (S2)

4.6.2 Procedure

Connect the circuit as shown in Figure 4-4, and proceed as follows:

- a. Set ammeter to appropriate current range.
- b. Set voltmeter to appropriate voltage range.
- c. Set dc power supply to appropriate output range.
- d. Set switch S1 to Normal.
- e. Turn dc power supply on, and close S2.
- f. Observe ammeter and adjust dc power supply output control to obtain the charge current reading indicated in the Amps portion of the Charge column in Table 4-2. Note that relay energizes and remains energized as voltage is increased.
- g. Set switch S1 to Reverse. Relay should deenergize.
- h. Set switch S1 to Normal. Relay should again energize.
- i. Adjust dc power supply output control to reduce the current at a rate so as not to overshoot the actual value and measure the Dropaway, which is the value at which the front contacts open (refer to Table 4-2 for acceptable value).
- j. Further reduce the dc power supply output control setting at a rate so as not to overshoot the actual value and check Full Dropaway, which is the value at which the armature rests against the permanent magnet (refer to Table 4-2 for acceptable value).
- k. Reduce current to zero then open circuit momentarily using switch S2.
- l. Adjust dc power supply output control to increase current at a rate so as not to overshoot the actual value, and obtain Pickup, which is the value at which the front contacts make. Refer to Table 4-2 for acceptable values.
- m. Further increase the dc power supply output control at a rate so as not to overshoot the actual value to obtain the relay Full Stroke value, which is the value at which the armature is tight up to its stop pins. Frequently, Pickup and Full Stroke will be the same value.
- n. Test concluded. Disconnect test circuit, and return relay to service if it meets the calibration values. If relay does not meet calibration values, check adjustments per Section 4.5.

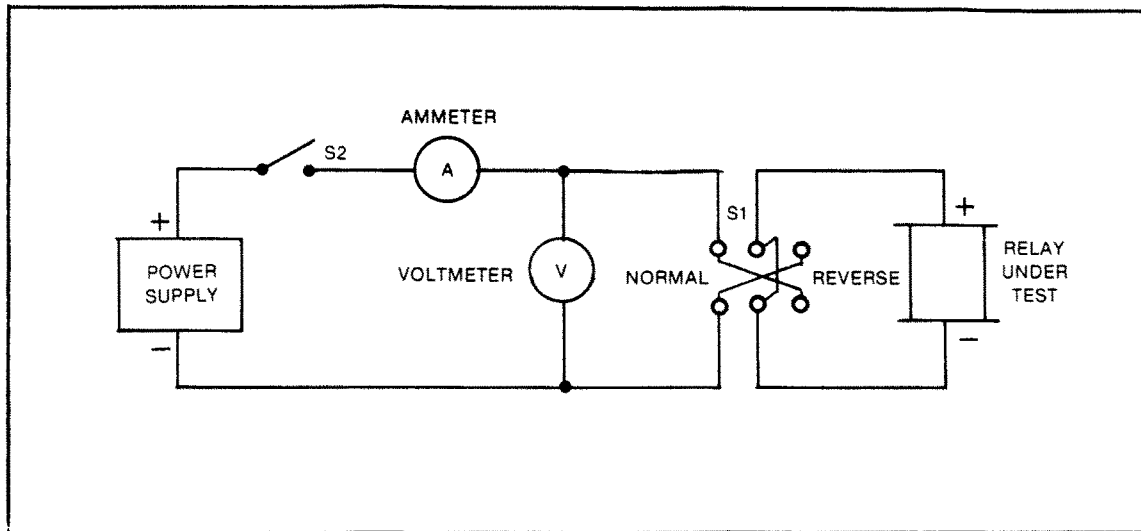


Figure 4-4. PN-150B Relay Test Circuit

4.7 CALIBRATION REQUIREMENTS

4.7.1 In-Service Test

Calibration requirements will be met when the relay adjustment values are the same as those given in Table 4-2 of this manual.

After any shop adjustments are made, check the calibration values (Section 4.6) and if they are not within the values given in Table 4-2 of this manual the relay should not be placed in service.

4.7.2 Contact Resistance

Resistance of front contacts should be measured with the armature in its full-stroke position, and resistance of back contacts should be measured with the armature fully released. Cleaned contact resistances should not exceed the following values.

<u>Type of Contacts</u>	<u>Ohms</u> <u>Front Contacts</u>	<u>Ohms</u> <u>Back Contacts</u>
Silver to Silver Impregnated Carbon	0.09	---
Silver to Silver	---	0.03

Contact surfaces should not be disturbed unless there is evidence of severe pitting from excessive loading or an accidental short through the contacts. When contacts must be dressed, refer to Subsection 4.2.3. Visually inspect per Subsection 4.2.1 prior to sealing.

Relay	Arm. Air Gap (in.)	Arm. Stroke	Min. Hold Down Grams	Adjusting Spacers (inches)				
				Front Contacts		Back Contacts		
				Closed	Open	Open	Closed	
PN-150B	0.026	0.117*	190	0.038	0.043	0.076	0.081	Nom.
				0.032	0.037	0.082	0.087	Min.
				0.042	0.047	0.078	0.083	Max.

* May be reduced to 0.110 to meet calibration values.

NOTE: Nominal spacers shall be used for standard adjustments. The minimum maximum spacers are used for special calibration problems. In that case, always maintain 0.020 transfer open and 0.050 full stroke.

TABLE 4-1. MECHANICAL ADJUSTMENTS AND HOLD-DOWN TORQUE

Style	Ohms	Charge		Minimum Drop-Away		Min. Full Drop-Away		Max. Pick-Up & Full Stroke	
		Volts	Amp.	Volts	Amp.	Volts	Amp.	Volts	Amp.
150B	1300	42.8	0.033	3.8	0.0029	2.53	0.0019	10.7	0.0082
150B	800	33.6	0.042	3.0	0.0037	2.0	0.0025	8.4	0.0105
150B	400	21.2	0.053	1.9	0.0047	1.25	0.0031	5.3	0.0132
150B	240	16.9	0.07	1.5	0.0063	1.0	0.0042	4.24	0.0177
150B	100	10.6	0.106	0.94	0.0094	0.63	0.0063	2.64	0.0264
150B	25	5.05	0.202	0.448	0.0179	0.299	0.0119	1.26	0.0504
150B	4300	70.3	0.016	6.29	0.0015	4.15	0.00096	17.58	0.004
150B**	400/400	36.0	0.09	4.5	0.011	3.0	0.0075	9.0	0.023
150B	2730	56.4	0.02	4.82	0.0018	3.2	0.0012	14.1	0.0052

** For this dual coil relay, each coil must be checked separately

TABLE 4-2. CALIBRATION VALUES

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A.1 Parts List for PN-150B Relay with Individual Contact Drivers (Figure A-1)

Item Number	Description	Part Number
1	Frame	M433355
2	Latch Rod	M388888
3	Roll Pin	J487087
4	Deleted	
5	Latch	M321728
6	Dowel Pin	J048716
7	Spring	M321861
8	Armature Assembly	N433399
9	Contact Driver	M433403
10	Driver Clip	M433404
11	Contact Block (Relays N322500-807, 808, 809)	N433831
11	Contact Block (For Relays not Listed Above)	N433354
12	Screws #6-32 x 3/4" FH SST	J5072980120
13	Armature Shim	M433358
14	Hinge Block	J026105-0401
15	Bolt Lock	J792919
16	Screw, #8-32 x 5/8 Hex. SST	J5072950120
17	Permanent Magnet Assembly	N435191
18	Strap	M321853
19	Washer SST .170 ID FLT	J4751210127
20	Seal, Vent	J790257
21	Handle	J561111
22	Lock Washer, #10 SHAK PF	J4751210125
23	Screw, #10-32 x 3/8 PH SST	J5072960129
24	Coil Complete 25-Ohm (For Relay N322500-706, 806)	N379650
24	Coil Complete 100-Ohm (For Relay N322500-704)	N321647-003
24	Coil Complete 240-Ohm (For Relay N322500-705)	N333975
24	Coil Complete 400-Ohm (For N322500-701 -711)	N321647
24	Coil Complete 400-Ohm (For Relays N322500-801, 809, 901, 909)	N433498
24	Coil Complete 800-Ohm (For N322500-702 Only)	N321647-001
24	Coil Complete 800-Ohm (For Relays N322500-802, 808, 902, 908)	N433498-001
24	Coil Complete 1300-Ohm (For N322500-703 Only)	N321647-002
24	Coil Complete 1300-Ohm (For Relays N322500-803, 807, and 903)	N433498-002
24	Coil, Complete 100-Ohm (For Relay N322500-804)	N433498-006
24	Coil Complete 4300-Ohm (For Relays N322500-810, 910)	N433498-012
24	Coil Complete 400/400-Ohm (For Relay N322500-812)	N436791
24	Coil Complete 2730-Ohm (For Relay N322500-713)	N321647-008
24	Shim	M434091
25		

A.1 PARTS LIST FOR PN-150B RELAY WITH INDIVIDUAL CONTACT DRIVERS (FIGURE A-1) (CONTINUED)

Item Number	Description	Part Number
26	Shim	M434092
27	Screw, 1/4-20 x 3/4 Hex. SST	J5000970112
29	Name Plate (Order should specify piece number of relay for which Name Plate is desired.)	J630654
30	Indexing Pin	J487090
31	Gasket	J047081
32	Cover, Lexan	J776596
35	Screw, 8-32 x 7/16, FH	J5072950119
36	Seal Wire	A043013
37	Seal	J079351
38	Armature Spring	M433411
39	Calibration Tag	S003665
39	Adhesive Film (for applying Ref. 39)	J791665
40	Washer, SST LK #6	J4751210107
41	Parts Bag (Relay N322500-701)	N330681-0001
41	Parts Bag (Relay N322500-702)	N330681-0002
41	Parts Bag (Relay N322500-703)	N332681-0003
41	Parts Bag (Relay N322500-704)	N330681-0004
41	Parts Bag (Relay N322500-705)	N330681-0005
41	Parts Bag (Relay N322500-706)	N332681-0006
41	Parts Bag (Relay N322500-807)	N330681-0007
41	Parts Bag (Relay N322500-808)	N330681-0008
41	Parts Bag (Relay N322500-809)	N332681-0009
41	Parts Bag (Relay N322500-810)	N330681-0010
41	Parts Bag (Relay N381500-711)	N330681-0011
41	Parts Bag (Relay N322500-812)	N330681-0012
41	Parts Bag (Relay N322500-713)	N330681-0013
44	Screw, #8-32 x 1-1/4 Hex. Hd. St. (Tin P1.)	J463078
45	Bolt, Hex. Hd. Bz.	M327179
46	Tag, Nomenclature	J075828
47	Screw, 4 x 3/16 Rd Hd	J052674
48	Shock Indicator (only for N322500-807)	J680167-0012

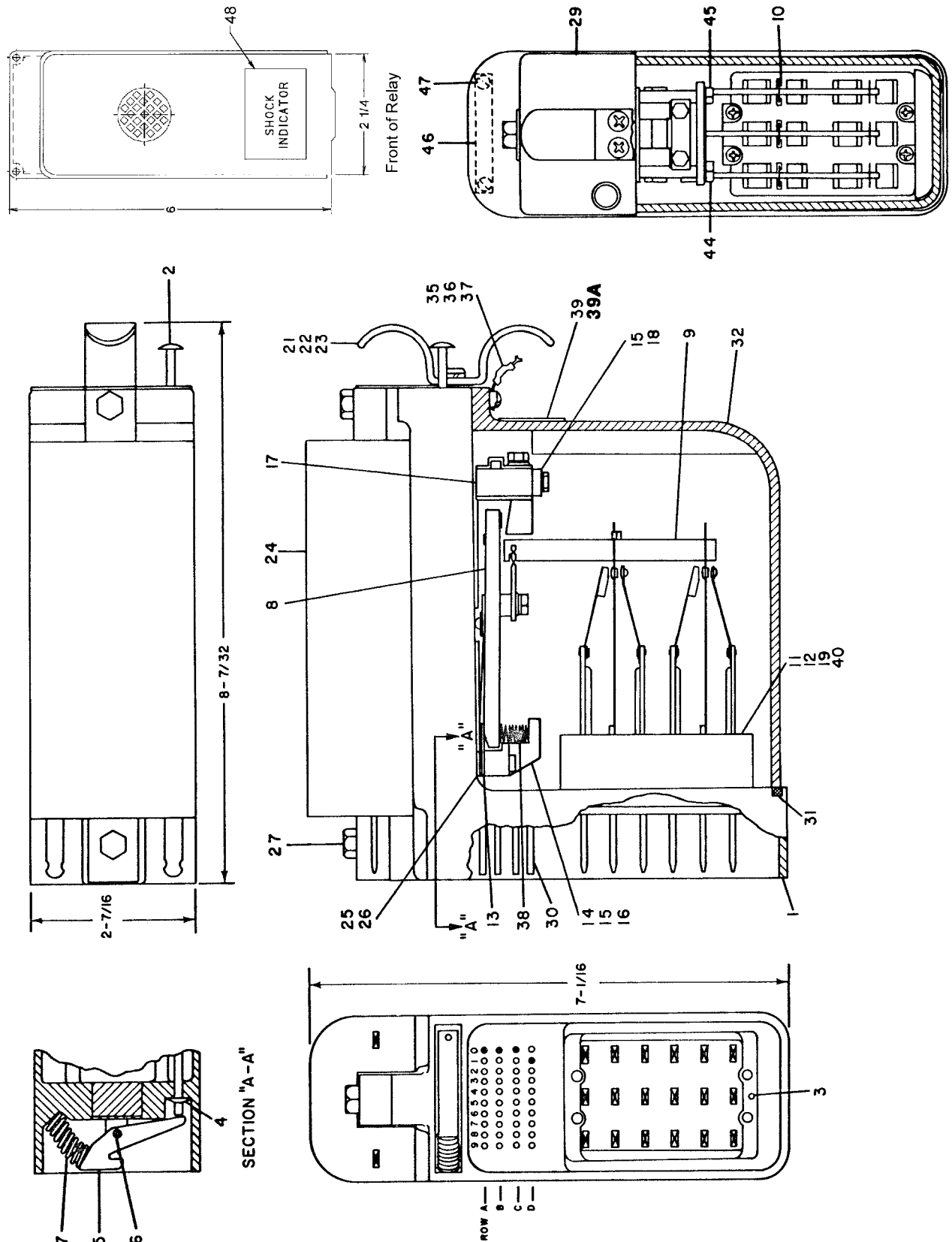


Figure A-1. PN-150B Relays With Individual Contact Drivers

A.2 PARTS LIST FOR OLD-STYLE MOUNTING BASE FOR PN-150B RELAYS (FIGURE A-2)

Item Number	Description	Part Number
	Base Complete for 6BF Relays (Note A)	N334266
	Base Only	N334266-099
	Base Complete for 4FB-2F-1B Relays (Note A)	N433830
	Base Only	N433830-099
1a	Receptacle Contact Springs, Solderless Type, for #18 to #20 Wire	J680179
1b	Receptacle Contact Springs, Solderless Type, for #14 to #16 Wire	J680165
1c	Receptacle Contact Springs, Solderless Type, for #10 to #12 Wire	J680181
2	Base, Basic Mounting	J078455
3	Plate, Contact Clamping (Order should specify piece number of mounting base for which contact clamping plate is desired.)	J078458
4	Plate, Coil Clamping (Order should specify piece number of mounting base for which coil clamping plate is desired.)	J078459
5	Strike	M321745
6	Tag	J075828
7	Screws, #4-40 x 3/16 Rd. Hd. (F) Self Tape (Tin Pl.)	J525024
* 8	Screws, 1/4-20 x 1—1/4 Rd. Hd. S. Mach. (Tin Pl.) (Not Shown)	J052667
* 9	Washers, Lock (M) (Not Shown)	J047775
*10	Washers, Plate 1/4 Stl. (Tin Pl.) (Not Shown)	J047501
*11	Nut, Hex 1/4 Stl. (Tin Pl.) (Not Shown)	J048002
*12	Washers (Not Shown)	J047711
13	Screws, #6-32 x 1-1/4 Fil. Hd. S. Mach. (Tin Pl.)	J052246
14	Nut	M267499
15	Screws, #6-32 x 5/8 Fil. Hd. S. Mach. (Tin Pl.)	J522090
16	Indexing Plate (Order should specify piece number of Relay for which indexing plate is desired.)	M322078
17	Meter Test Plug	N322965
18	Insulated Test Plug (For opening any coil or contact circuit and for removing receptacle springs)	J077931

* Hardware for attaching mounting base to rack.

NOTE A: When Mounting Base complete is ordered a muslin bag of parts 4-1/8" x 5 1/2" is included in the inner carton with the mounting base and instruction prints. Bag Contains: Tags (Item 6), Screws (Item 7), Items 8, 9, 10, 11 and 12 which are for attaching mounting base to rack, and required quantity of receptacle contact springs (solderless J680165 for #14 to #16 wire. If other wire size is used request the proper part number as shown in Item 1 when ordering base complete (i.e. N334266 except using receptacle contact springs, solderless J680181).

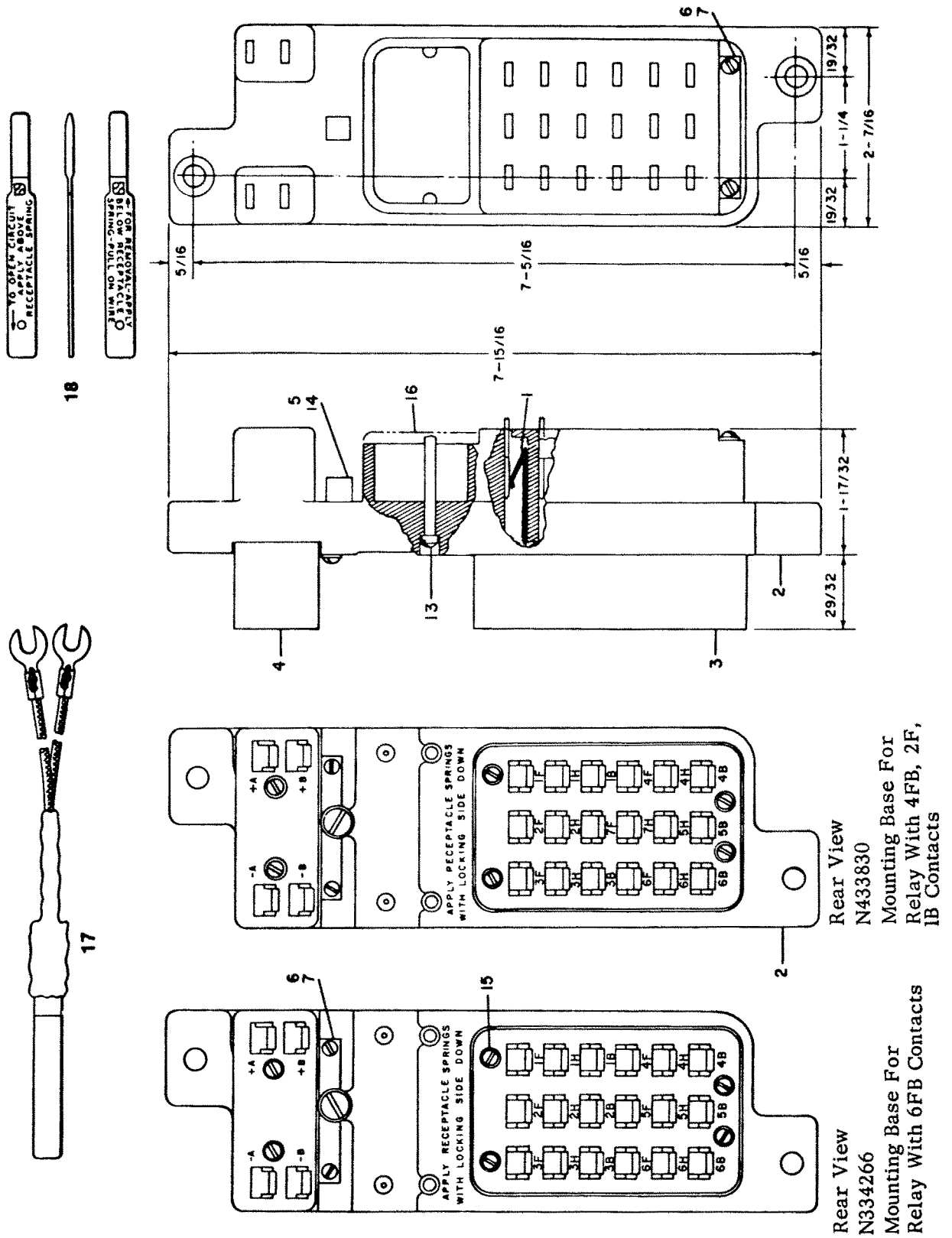


Figure A-2. Old-Style Mounting Base for PN-150B Relays

A.3 PARTS LIST FOR PN-150B RELAY WITH ONE PIECE MOLDED DRIVER (FIGURE A-3)

Item Number	Description	Part Number
1	Frame	M433355
2	Latch Rod	M388888
3	Roll Pin	J487087
4	Nut, .006 x 5/16 Steel Lock	M275388
5	Latch	M321728
6	Dowel Pin	J048716
7	Spring	M321861
8	Armature Assembly	N438599
9	Arm, Molded Operating	M373632-001
11	Contact Block (Relays N322500-907, 908, 909)	N438690
11	Contact Block (Relays N322500-711)	N438844
11	Contact Block (For Relays not listed above)	N437550
12	Screws SST #6-32 x 3/4" Phil. Fil. Hd.	J5072980120
13	Armature Shim	M433358
14	Hinge Block	J26105-0401
15	Bolt Lock	J792919
16	Screw, SST #8-32 x 5/8 Hex.	J5072950120
17	Permanent Magnet Assembly	N435191
18	Strap	M321853
19	SST Washer	J4751210127
20	Seal, Vent	J790257
21	Handle	J561111
22	Lock Washer, SST #10 SHAK PF	J4751210125
23	Screw, SST #10-32 x 3/8 PH	J5072960129
24	Coil Complete 25-Ohm (For Relay N322500-706, -806)	N379650
24	Coil Complete 100-Ohm (For Relay N322500-704)	N321647-003
24	Coil Complete 240-Ohm (For Relay N322500-705)	N333975
24	Coil Complete 400-Ohm (For Relay N322500-701, -711)	N321647
24	Coil Complete 400-Ohm (For Relay N322500-801, -809, -901, -909)	N433498
24	Coil Complete 800-Ohm (For Relay N322500-702 Only)	N321647-001
24	Coil Complete 800-Ohm (For Relay N322500-802, -808, -902, -908)	N433498-001
24	Coil Complete 1300-Ohm (For Relay N322500-703 Only)	N321647-002
24	Coil Complete 1300-Ohm (For Relay N322500-803, -807, -903)	N433498-002
24	Coil, Complete 100-Ohm (For Relay N322500-804)	N433498-006
24	Coil Complete 4300-Ohm (For Relay N322500-810, -910)	N33498-012
24	Coil Complete 400/400-Ohm (For Relay N322500-812)	N436791
25	Shim	M434091

A.3 PARTS LIST FOR PN-150B RELAY WITH 1-PIECE MOLDED DRIVER (FIGURE A-3) (CONTINUED)

Item Number	Description	Part Number
26	Shim	M434092
27	Screw, 1/4-20 x 3/4 Hex. SST	J5000970112
28	Spring, Operating Arm	M349785
29	Name Plate (Order should specify piece number of relay for which Name Plate is desired.)	J630654
30	Indexing Pin	J487090
31	Gasket	J047081
32	Cover, Lexan	J776596
35	Screw, 8-32 x 7/16, FH SST	J5072950119
36	Seal Wire	A043013
37	Seal	J079351
38	Armature Spring	M433411
39	Calibration Tag	S003665
39	Adhesive Film (for applying Ref. 39)	J791665
40	Washer, LK #6 SST	J4751210107
41	Parts Bag (Relay N322500-701, -801, -901)	N330681-0001
41	Parts Bag (Relay N322500-702, -802, -902)	N330681-0002
41	Parts Bag (Relay N322500-703, -803, -903)	N332681-0003
41	Parts Bag (Relay N322500-704, -804)	N330681-0004
41	Parts Bag (Relay N322500-705)	N330681-0005
41	Parts Bag (Relay N322500-706, -806)	N332681-0006
41	Parts Bag (Relay N322500-807)	N330681-0007
41	Parts Bag (Relay N322500-808, -908)	N330681-0008
41	Parts Bag (Relay N322500-809, -909)	N332681-0009
41	Parts Bag (Relay N322500-810, -910)	N330681-0010
43	Screw, #6-32 x 1/4 Hex. SST	J5072980121
44	Bolt, #8-32 x 1-1/4 Stl	J463078
45	Bolt, Hex. lid. Bz.	M327179
46	Tag, Nomenclature	J075828
47	SST Washer	J4751210127
48	Indicator, Arm. Pos.	M432380

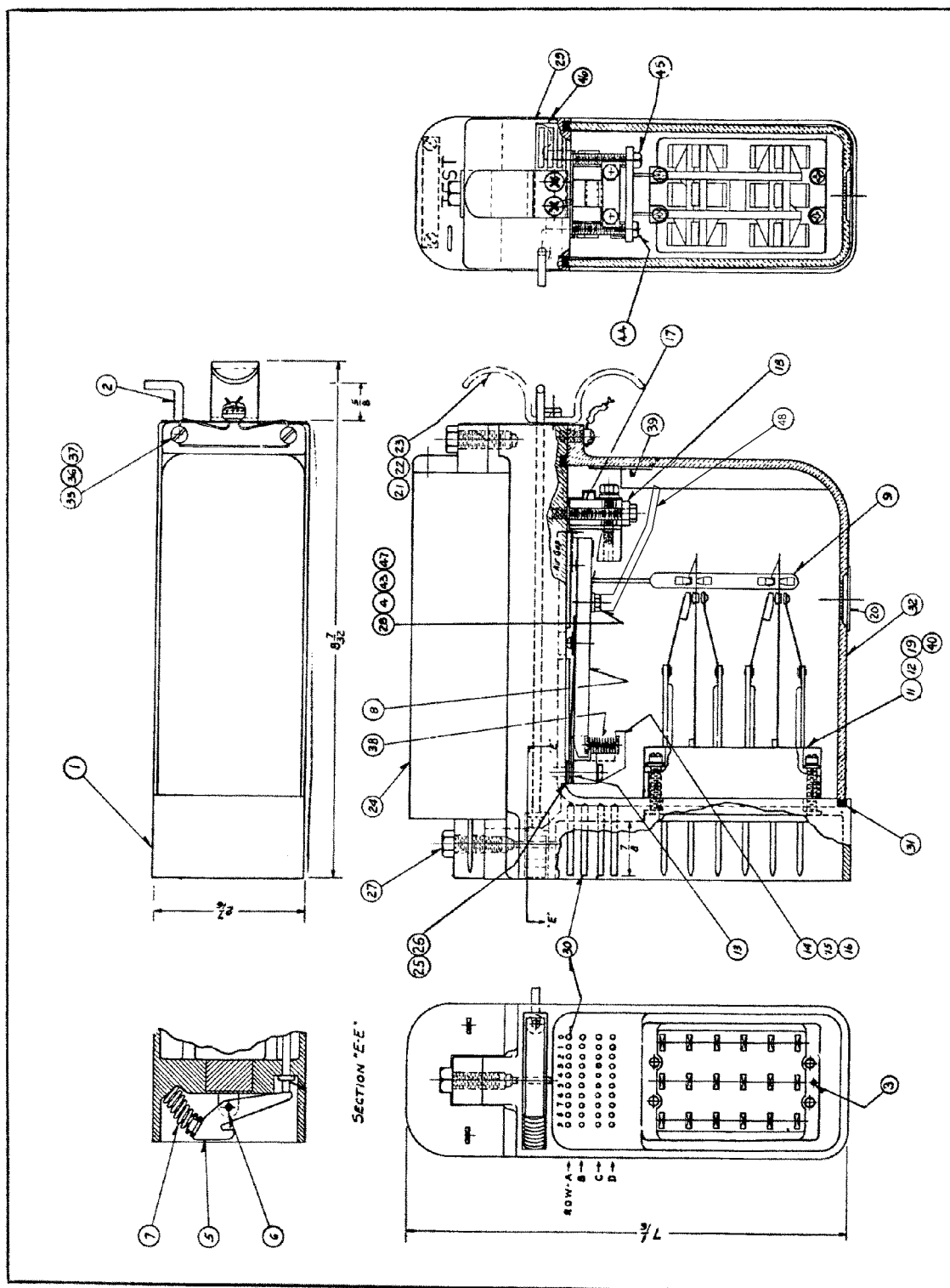


Figure A-3. PN-150B Relays With One Piece Molded Contact Driver

A.4 PARTS LIST FOR IMPROVED MOUNTING BASE PN-150B RELAYS (FIGURE A-4)

Item Number	Description	Part Number
1a	Base Complete for Wayside Relays (See Note A)	N451376-0302
1b	Base Only	N451376-0301
1c	Base Complete for Car Carrying Relays (See Note A)	N451376-0303
1d	Base-Mounting Molded	J780055
3	Strike-Relay	J792848
4	Nut-Speed Push-on	J480280
*5	Spring-Cont. Receptacle	M451142-2702
6	Screw, SST 1/4-20 x 1-1/4 Rd.	J5001360120
7	Washer, SST LOCK 1/4	J4751210111
8	Washer, SST 1/4 Plate	J4751200112
9	Nut, 1/4-20 SST Hex.	J4802110108
10	Tag, Relay Identification	J075951
11	Sheet, Instr. Form #8	S000008
12	Bag, Plastic	J078399
13	Extraction Tool	J772383

NOTE A: When Mounting Base complete is ordered, a plastic bag of parts is included in the inner carton with the mounting base and instruction prints.

Bag Contains: Tags (Item 10), Screws (Item 6), Items 6, 7, 8 and 9 which are for attaching mounting base to rack.

*Included receptacle contact springs are normally (M451142-2702) for #14 and #16 wire, unless otherwise specified. If other wire size is used, the proper part number (M451142-2701 for #18-20; M451142-2703 for #10-12) should be specified when ordering the complete base (i.e. N451376-0302, except using receptacle contact springs, solderless M451142-2703).

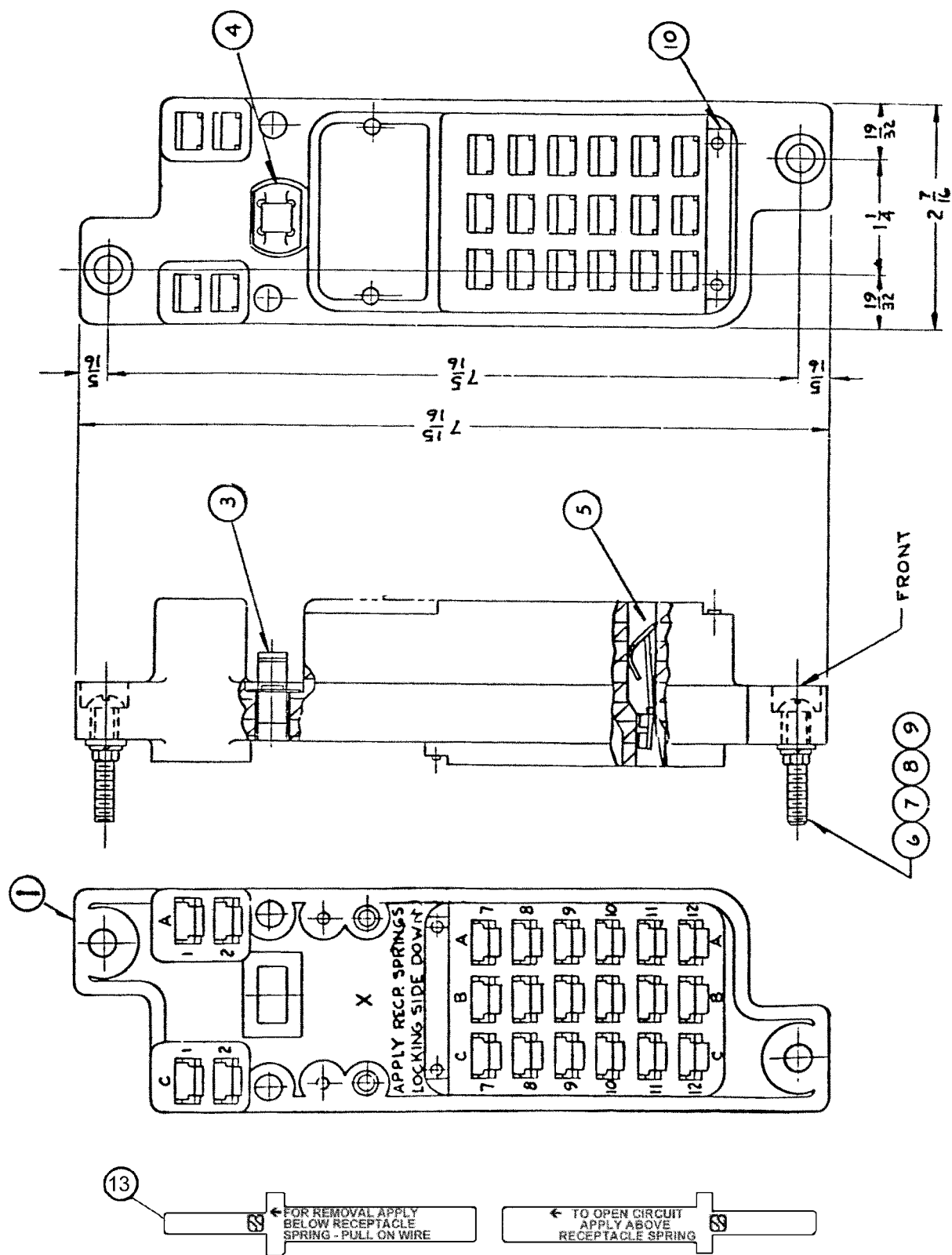


Figure A-4. Improved Mounting Base for PN-150B Relays

