UNION SWITCH & SIGNAL

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PV-250 Track Relay

(60 Hz, 115-Volt Local)

US&S Part No.
N342555809
N342555909

- Installation
- Operation
- Maintenance

Proprietary Notice

Important Notice

US&S constantly strives to improve our products and keep our customers apprised of changes in technology. Following the recommendations contained in the attached service manual will provide our customers with optimum operational reliability. The data contained herein purports solely to describe the product, and does not create any warranties.

Within the scope of the attached manual, it is impossible to take into account every eventuality that may arise with technical equipment in service. Please consult your local US&S Account Executive in the event of any irregularities with our product.

We expressly disclaim liability resulting from any improper handling or use of our equipment, even if these instructions contain no specific indication in this respect. We strongly recommend that only approved US&S spare parts be used as replacements.

Revision History

Rev.	Date	Nature of Revision
*	September 1982	Original Issue
*	March, 2000	Revision
2	February 2005	Incorporated ECO R-1150. Test and maintenance procedures in the manual were updated. Reformatted manual.
3	April 2005	Corrected resistor values in Figure 3-1; clarified contact block information in Figure 4-1; and clarified contact assignments in Table 3-4.

* Revisions were identified by date only; no numbers were assigned to revisions.

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Section 1. Introduction

This manual covers the PV-250 Plug-In AC Vane Relay used for track circuit applications. Since the relay is a two-element AC vane type, it must be provided with the appropriate equipment to provide the adequate phase displacement between the local and control (track windings). The earlier and later design relays have the same operating characteristics and fit into the same mounting base. The design of the PV-250 Relay conforms to all applicable AREMA specifications.

1.1. Shock Indicators

WARNING

Any relay showing Shock Indicator activation should be serviced before placing the relay into service. Failure to assure proper function of this relay may result in severe personal injury or death.

The shock indicator shows red when the relay was subjected to shock in excess of safe levels (e.g., dropped) during shipment or transport. This is an indication that the relay may have mechanical damage and may not meet electrical specifications.

The relay should be opened and visually inspected for damage (i.e., kinked springs). Mechanical settings should be checked, re-calibrated, and tested according to specifications by a qualified individual.

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

This relay uses single-wound coil for the control element and a local element that presents the impedance to meet the specifications of Table 3-1, Table 3-2, and Table 3-3.

1.2.3. Contacts

Contacts of the PV-250 relay are standard low-voltage silver-to-silver impregnated carbon front and silver-to-silver back. See Figure 4-2 for an illustration of the contact block assembly.

1.3. Specifications

This manual provides operating values and parts lists specific to PV-250 Track Relay N342555-809/909. This relay has the following general specifications:

115V Local, 60 Hertz
2F-2B Contacts
Local 0.165 Amperes @ 115 Volts

The following subsections provide the electrical and mechanical specifications of the PV-250 relays covered in this manual.

1.3.1. Electrical

Electrical specifications for the PV-250 Track Relay are summarized in Table 3-1, Table 3-2, and Table 3-3.

1.3.2. Mechanical

The mechanical specifications for the relay are shown in Table 1-1.

Table 1-1 - Mechanical Specifications

Dimensions	**Height**	7-1/16" (17.93 cm)
	Width	4-15/16” (12.54 cm)
	Depth	8-3/8 (2½ cm)
Temperature		-40°F (-40° C) to +185°F (85°C)
Indexing		5509
Weight		8.0 lbs. (3.63 kg)
Mounting Base		N434647-009 (Old-Style) - 37 oz.
		N438689-003 (New-Style) - 18 oz.
Mounting Base Dimensions	**Height**	7-15/16” (20.1 cm)
	Width	4-15/16” (12.54 cm)
	Depth	2-7/16” (6.19 cm) - (Old Style Base)
	Depth	1-29/32” (4.8 cm) – (New Style base)

Section 2. Installation

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.

2.1.1. Care in Handling

It is very important that these vane relays be handled carefully so that undue stresses are not applied to the vane structure, which might throw the vane out of adjustment. A piece of twine, which firmly holds the vane, is applied to the relay when it leaves the factory, via a tapped hole in the rear of the relay. The twine must be removed when the relay is placed in service. A plug screw 8-32 x ¼ (included) should be installed in this hole.

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 (contact receptacles). Mounting base details are shown in Figure 4-4.

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 corresponding 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 5509) 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 thus obtained 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.

WARNING

Never drill new holes in a base indexing plate that will permit application of relays with different part numbers. Never 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 N434647 mounting base normally will be equipped with the required quantity of J680165 solderless receptacle contact springs and will accommodate one or two #14 or #16 wires. However, it can 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 the type of solderless receptacle contact springs that accompany the mounting base are the appropriate ones before proceeding with their installation.

2.4.2. Improved One-Piece Base Only

The new one-piece mounting base (N438689-003) with hardware includes a full complement of receptacle contact springs (M451142-2702) to accommodate one or two #14 - #16 wires, mounting fasteners, and tags. It can, however, be equipped with receptacle contact springs for one or two #10 - #12 wires (M451142-2703), or for one or two #18 - #20 (M451142-2701). Make certain the type of solderless receptacle contact springs that accompany the mounting base are the appropriate ones before proceeding with their installation.

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

The following is recommended when installing solderless receptacle contact springs after crimping wires:

a. Receptacle contact springs must be inserted into the base with the lock side down or lanced tab up (refer to Figure 2-2).

b. Make certain the lanced tab is slightly compressed as the receptacle contact spring is inserted along the top of the cavity. The lanced tab could have been bent during handling and, if so, would 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.

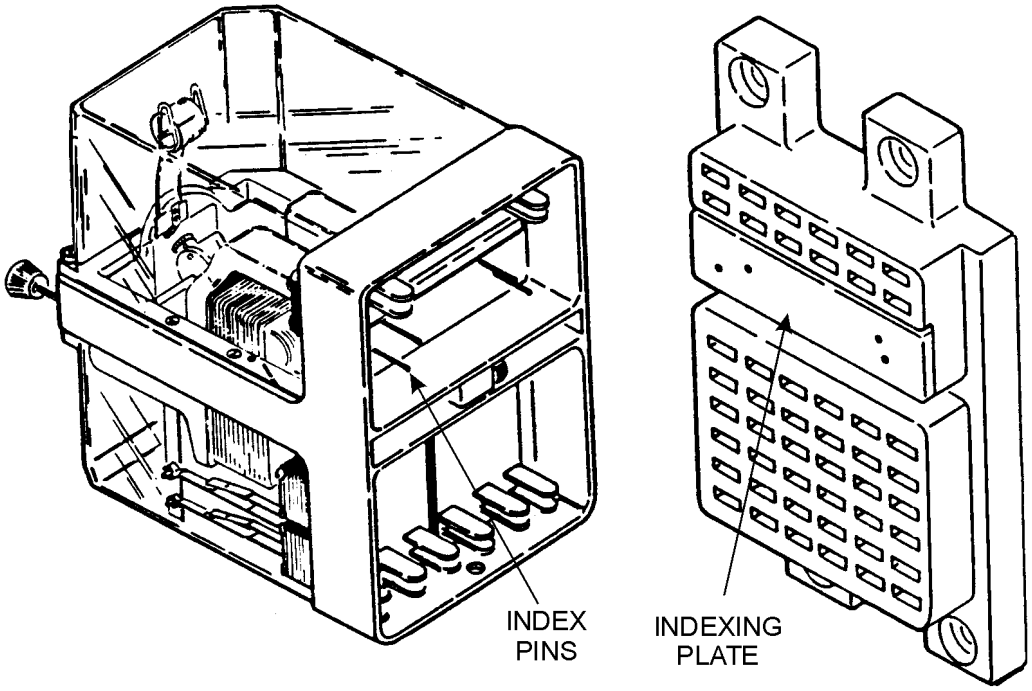


Figure 2-1 - Typical Plug-In Relay and Mounting Base

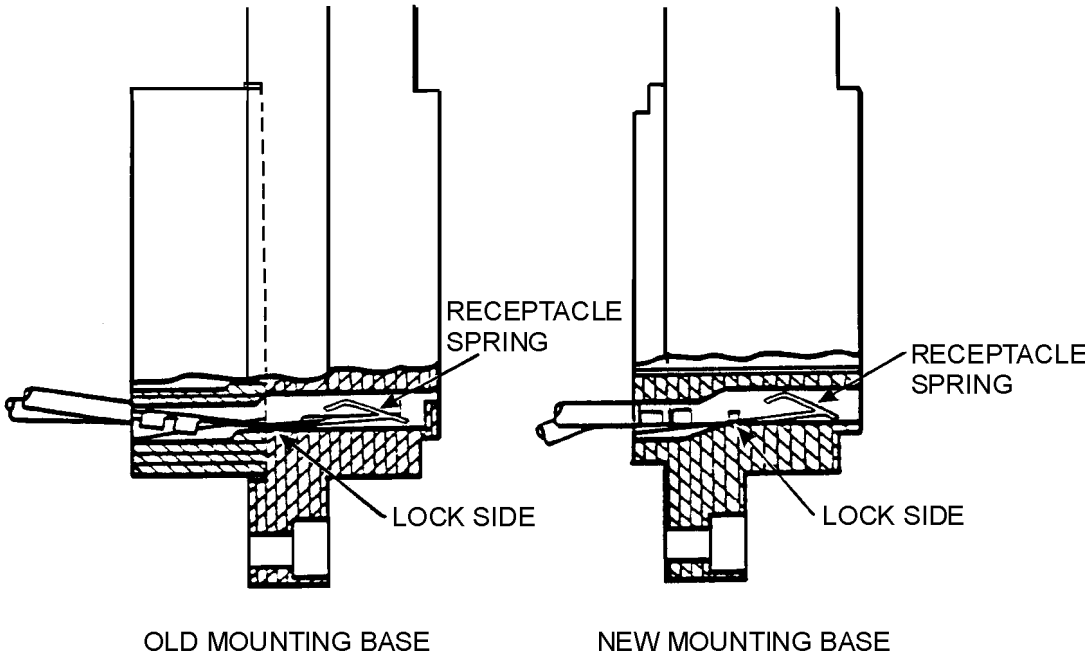


Figure 2-2 - Receptacle Contact Springs Installed

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. Table 2-1 identifies the correct crimping tool to be used when installing wires in a receptacle contact spring.

Table 2-1 - Crimping Tools

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

1. Strip 3/16 in. (0.187 in. or 0.47 cm.) of insulation from the end of the wire.

2. 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.

3. 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.)

4. 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.

5. 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 name plate right side up; 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.

Section 3. Maintenance

This section provides the necessary periodic preventive maintenance procedures that must be performed to ensure continuous, proper, and efficient operation of the PV-250 style relays covered in this manual. This maintenance section covers periodic inspections and performance tests.

3.1. Periodic Performance Test

3.1.1. Cleaning

Before inspecting and testing the relay, 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 or common laundry detergent may be used for removal of accumulated dirt, grease, etc.

3.1.2. Service Requirements

3.1.2.1. General

Track relays must be inspected and tested at least every two (2) 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.

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.

3.1.2.2. Testing

Calibration Table 3-1 should be used for factory/shop environment only.

Calibration Table 3-3 should be used for field testing relays. This includes initial in-service testing prior to going into service.

Relays that do not meet test and/or calibration specifications must be removed from service for shop repair.

3.2. Calibration

3.2.1. Recommended Test Equipment

Two Variable Autotransformers (Variac) - 115 VAC @ 1.0 amp.

AC Ammeter (True RMS)

AC Voltmeter (True RMS)

Resistor - 1500 ohms, ±10%, 25 watts

SPST switch

3.2.2. Shop Calibration Test Procedure

Note

When performing calibration, set local voltage as specified to within ± 1%. When checking relay calibration, current (Amps) readings are to be used. The voltage range shown in the table is for REFERENCE ONLY. If the current and the voltage are measured simultaneously it is possible for one of the readings to be out of the acceptable range. If this is the case, as long as the current (Amps) reading is within the specified range the relay is acceptable.

Connect the circuit shown in Figure 3-1.

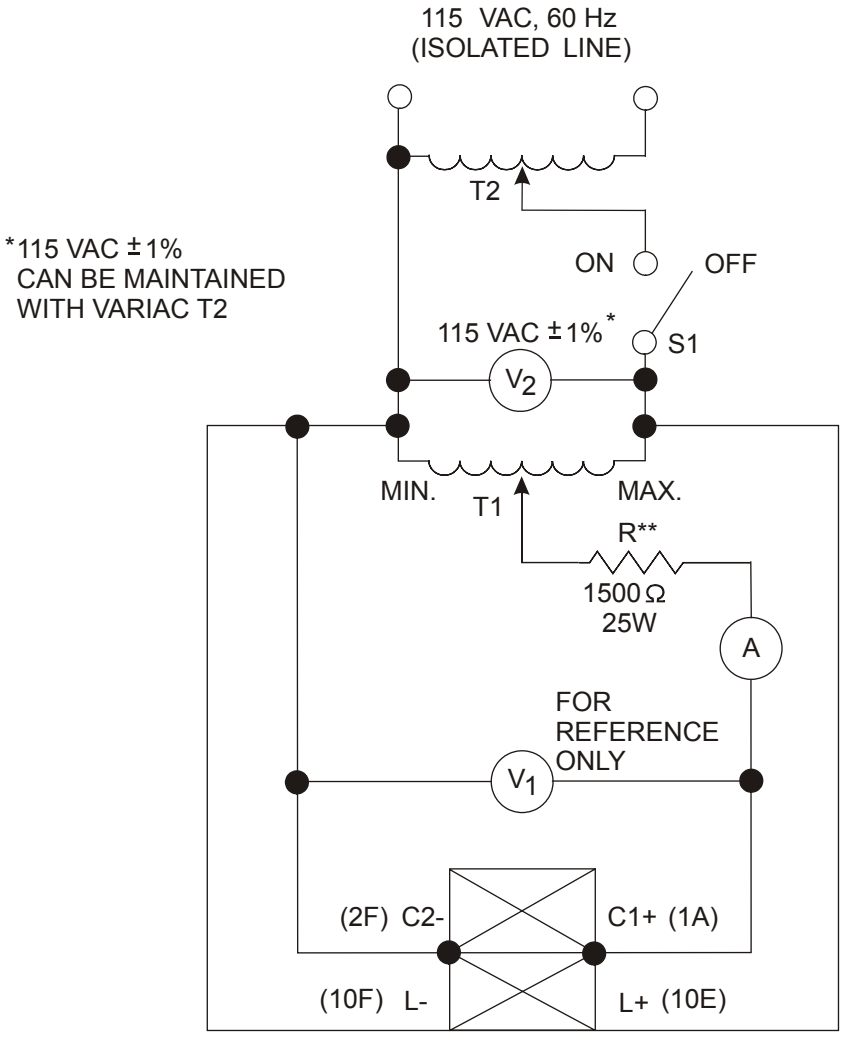
1. Set switch S1 to its OFF position.
2. Connect the circuit to a 115VAC, 60 Hz isolated line.
3. Set Variac (T1) to its minimum output setting.
4. Set switch S1 to the ON position.
5. Adjust Variac T2 to obtain 115 VAC ±1% across Variac T1 as read by voltmeter V2. This voltage must be maintained throughout this test.
6. Slowly adjust Variac T1 to increase its output until all front contacts of the relay being calibrated just close. Record the value indicated on ammeter A; this is the pick-up current value and should be within the pick-up current range specified in Table 3-1**.**

   Pick-up (PU) Current Value _____
7. Again slowly increase the output of Variac T1 until the vane in the relay just touches the top roller. Record the value indicated on ammeter A; this is the full stroke current value and should be within the full-stroke current range specified in Table 3-1**.**

   Full Stroke (FS) Current Value _____
8. Slowly adjust Variac (T1) to decrease the output until all front contacts of the relay open. Record the ammeter A reading; this is the drop-away (DA) current value. It should be within the percentage range, as specified Table 3-1, of the actual pick-up current value measured in Step 6.

   Drop Away (DA) Current Value _____
9. Calculate the DA percentage of actual PU (DA%). It must be within the range shown Table 3-1 (DA% = Step 8 Value ÷ Step 6 Value ×100).

10. When the track energy is reduced to 1.7 volts or .028 amp, the vane must have touched the lower roller stop.



RELAY UNDER TEST
(New Style Base Contacts Shown with Parentheses)
Old Style Base Contacts Shown without Parentheses

** The resistance value of R is selected to ensure that when the Variac is set to its Maximum setting the value of current, as measured on meter A, is approx. 10% higher than the maximum Full Stroke current. For the purposes of this test circuit the resistor is fixed, however, it can be a potentiometer and set to a value that permits a 10% higher than the maximum Full Stroke current value.

Figure 3-1 - AC Vane Relay Test Circuit

Table 3-1 - Shop Test Operating Values @ 70-74°F

Vane Torque (Inch Grains)	Pick-Up (PU)		Full Stroke (FS)		Drop Away % of Actual PU
	Volts (for ref. only)	Amps*	Volts (for ref. only)	Amps*	Shop
325	2.9 – 3.3	0.048 – 0.053	3.3 – 3.6	0.053 – 0.059	85 to 95

Note: Table 3-1 values represent nominal calibration values ± 5%. See Table 3-3 for In-Service and Field Calibration Operating Values.

* The digital ammeter should be set to display to only three decimal places. Values beyond three decimal place accuracy are insignificant to the calibration and should be ignored. When the track energy is reduced to 1.7 volts or .028 amp, the vane must have touched the lower roller stop. The values in

Table 3-1 are 13% higher than ideal and apply to test from single-phase supply with resistance in series with the track winding.

It's recommended that relays be taken out of service if the Drop-Away falls below the value shown for field test.

Note

Shop Test operating values may be affected by fluctuations of local voltage, temperature, and test equipment being used.

Table 3-2 - Operating Values at Ideal Phase Relations

(Values shown are for technical use and for calibration tag information **only**.
Not to be used for normal calibration purposes.)

Pick-Up (PU)		Full-Stroke (FS)		Drop-Away % of Actual PU
Volts	Amps*	Volts	Amps*	
2.60 – 2.88	0.042 – 0.046	2.9 – 3.20	0.047 – 0.052	85 to 95

Note: Table 3-1 values represent nominal calibration values ± 5%.

* The digital ammeter should be set to display to only three decimal places. Values beyond three decimal place accuracy are insignificant to the calibration and should be ignored.

Table 3-2 values are based on ideal phase relations; track volts lead local volts by 90° and track amperes lead local volts by 24°.

Table 3-4 lists the contact assignments for the relay.

3.2.3. In-Service and Field Calibration Test Procedure

The following procedure should be used anytime a relay is tested in the field. For example: when a relay has been in operation for any period of time or during initial in-service testing prior to going into service, or when the environment of temperature, voltage and frequency is not controlled, as it is in a shop or factory environment.

Connect the circuit shown in Figure 3-1.

1. Set switch S1 to its OFF position.

2. Connect the circuit to a 115VAC, 60 Hz, isolated line.

3. Set Variac T1 to its minimum output setting.

4. Set switch S1 to its ON position.

5. Adjust Variac T2 to obtain 115 VAC ±1% across Variac T1 as read by voltmeter V2. This voltage must be maintained throughout this test.

6. Slowly adjust Variac T1 to increase its output until all front contacts of the relay being calibrated just close. Record the value indicated on ammeter A; this is the pick-up current value and should be within the pick-up current range specified in Table 3-3.

   Pick-up (PU) Current Value _____

7. Again slowly increase the output of Variac T1 until the vane in the relay just touches the top roller. Record the value indicated on the ammeter; this is the full stroke current value and should be within the full-stroke current range specified in Table 3-3.

   Full Stroke (FS) Current Value _____

8. Slowly adjust Variac (T1) to decrease the output until all front contacts of the relay open. Record the ammeter A reading; this is the drop-away (DA) current value. It should be equal to or greater than 80% of the actual pickup current value measured in Step 6.

   Drop Away (DA) Current Value _____

9. Calculate the DA percentage of actual PU (DA%). It must be equal to or greater than 80% of the actual PU value noted in Step 6. (DA% = Step 8 Value ÷ Step 6 Value ×100).

10. When the track energy is reduced to 1.7 volts or 0.028 amp, the vane must have touched the lower roller stop.

Table 3-3 - In-Service and Field Calibration Operating Values

	Current (Amps)	Acceptance Criteria*
Pick Up (PU)	0.048 Min. – 0.053 Max.	Front contacts should be “closed”
Full Stroke(FS) Max.	0.053 Min. – 0.059 Max.	Vane should touch upper roller
Min. Drop Away (DA) % of Actual PU is 80%	Equal to or Greater Than 80% × PU	Front contacts should be “open”
Full Drop Away (FDA)	0.028 Amps Min.	Vane touches the lower roller stop

***** If relays don’t meet the Acceptance Criteria they must be shopped for readjustment and recalibration.

Table 3-4 - Contact Assignments

Coil Connections			Contacts*		
WINDING	Old Style Base Location	New Style Base Location	Type	Old Style Base Location	New Style Base Location
Local	L+	10E	Fronts	7F (Front) 7H (Heel)	11B (Front) 12B (Heel)
	L-	10F		8F (Front) 8H (Heel)	11C (Front) 12C (Heel)
Control	C1+	1A	Backs	9H (Heel) 9B (Back)	11E (Heel) 12E (Back)
	C2-	2F		10H (Heel) 10B (Back)	11F (Heel) 12F (Back)

* Contacts are standard low-voltage silver-to-silver impregnated carbon fronts and silver-to-silver backs

3.3. 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 resistance should not exceed the values shown in Table 3-5.

Table 3-5 - Contact Resistance (Ohms)

Type of Contact	Front Contacts	Back Contacts
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 Sections 3.4.2 and 3.5.

3.4. Shop Maintenance

This section provides the information necessary to perform shop level repairs of the PV-250 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.

3.4.1. 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 external damage is found, a careful inspection of the interior components should be made for obvious physical damage. Proceed with relay contact cleaning, using the following recommended cleaning materials.

3.4.2. Recommended Cleaning Materials

The following tools are recommended for cleaning the relay. They are available as a special cleaning kit (X451646-0901).

Tool	US&S Part Number
Burnishing Tool, P.K. Neuses Co. No. 3-316	**J397187**
Burnishing Tool, P.K. Neuses Co., No. N318 (Heavy Duty)	**J397187-001**
Paper Strip, strips cut from 67# white Springhill Vellum Bristol Paper	**J793094**

Individual items from the kit are also available by ordering the part number designated beside each item.

Also recommended (commercially available):

Emory Paper (Wet or Dry): 600 Grit, cut in strips
Alcohol #1 Solvent (Ethyl Alcohol Proprietary 190 or Equivalent)

Note

In the final cleaning procedures outlined in the following sections, it is recommended that all silver contacts be cleaned first, followed by all silver impregnated carbon contacts, to prevent contamination of the silver tips with residue that adheres to the cleaning tool after cleaning the silver impregnated carbon contacts.

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

3.5. Contact Cleaning Procedure

3.5.1. Contacts that are Severely Burned

1. Using a 600-grit emery paper strip, folded with grit side out so that both contacts can be burnished simultaneously, stroke the contacts in the direction of the contact wipe.
2. Using the burnishing tool, stroke the contacts several times in the direction of the contact wipe.
3. Place the paper strip between the open contacts, then close the contacts and withdraw the paper strip.
4. Repeat Step 3 several times, if necessary.
5. Using the alcohol spray, give the contacts a degreasing/wash.
6. Place the paper strip between the open contacts, then close the contacts and withdraw the paper strip.
7. Repeat Step 6 several times, if necessary.

3.5.2. Contacts with Heavy Tarnish, Slightly Rough or Pitted Surface

1. Perform the procedure in Section 3.5.1, Steps 2 through 7.

3.5.3. Contacts with Surface Film or Oxidation (not Pitted)

1. Perform the procedure in Section 3.5.1, Steps 6 and 7.

3.6. Check-Out Procedure (Performance Test)

1. Conduct the contact adjustment procedure in Section 3.7.5.
2. Conduct the electrical calibration procedure in Section 3.

The above steps must be done before returning the relay to service.

3.7. Repairs, Replacement and Adjustment of Relay Components

Since the contacts are the major wearing parts in this relay, in most cases the relay can be restored to proper operation by dressing and readjusting them.

3.7.1. Recommended Tools and Test Equipment

Screw Driver - Torque Measuring

Thickness Gauges - 0.001 - 0.060 in.

3.7.2. Vane Removal

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

1. Remove seal and seal wire.
2. Carefully remove plastic cover.
3. Remove the vane assembly as required.
4. Remove contact block as required.
5. Remove Local/Control Field as required.

3.7.2.1. Vane Assembly Removal

1. Remove the bottom roller stop by bending the left bracket, looking at the relay, about 1/4” to the left. Do not move the brackets forward or to the rear.
2. Disengage the contact operating arms from the clips on the heel contact springs by pulling the arms forward at the lower ends.
3. Remove all bushings and pins from the contact operating arms.
4. Remove the counterweight nuts from the front end of the vane assembly and loosen the lock nuts from the trunnion screws.
5. Place the relay on its mounting surface with the contacts forward.
6. Insert a piece of paper in the air gap on each side of the vane to protect it from being scratched by the pole pieces during removal.
7. Turn the trunnion screws out until they are flush with the inside surface of the support casting.
8. Remove the trunnion lock nuts from the shaft.
9. Lower the shaft until the vane edge rests on the machined slot of the contact blocks.
10. Move the vane shaft forward and up until the upper back contact heel springs (No. 4 and 5 can be pushed in back of the shaft). Note: The operating arms must be held clear of the heel springs.
11. Rotate the counterweight stud toward the contacts and slide the hub out between the heel springs and the roller stop guide. Note: This will require a slight deflection of the upper front heel contact springs. The crank pins and contact operating arms can then be removed after the vane is out of the relay.

3.7.3. Vane Installation

Vane installation is accomplished generally in the reverse order of disassembly. Do not overtighten or force parts. The following subsections provide additional instructions to be followed during reassembly. Upon completion of reassembly, calibrate the relay as directed in Section 3.2.

3.7.3.1. Installing Vane Assembly

1. Check the pivots and trunnion bearings for excessive wear. Clean them with a dry, lintless cloth and treat them with lubricant J041099 before installing the vane.

2. Assemble the contact operating arms and crank pins on the vane cranks first.

3. Insert the vane. At least one of the trunnion screw lock nuts should be started on the trunnion screws in advance, but it may be found necessary to slide the other nut on one end of the vane shaft in order to bring it into position.

4. Tighten the trunnion screws carefully so as not to damage the pivots. These screws should be adjusted to center the vane in the air gap and to provide 0.010” to 0.016” endplay of the vane shaft. With the endplay taken up on each side, rotate the vane and inspect to ensure that the minimum clearance from the vane to the pole face is 0.012”. If the vane clearance is less than 0.012” reset the endplay and recheck the clearance. After the endplay has been set tighten the trunnion lock nuts.

5. Adjust the stroke of the vane by adjusting the roller stop brackets to permit maximum travel of the vane. In either extreme position of the vane, as permitted by the roller stops (rollers at the top of the slot), the buffer clips on the vane should be 3/32 inch from the cores. This adjustment allows maximum travel of the vane and prevents the buffer clips from becoming wedged in the air gap.

6. Check that the heads of the crank pins have at least 1/16” clearance from the lock nuts on the trunnion screws when the pin and vane shaft are shifted to make this clearance minimum. Check that the crank pins are securely locked at the split ends so that this clearance cannot be reduced.

7. Check to ensure that the operating arms swing freely without any tendency to bind.

3.7.3.2. Operating Arms Installation Procedure

1. Check Operating Arms to see that warpage does not exceed 0.010". Discard any that are warped greater than 0.010".

2. Assemble the operating pins and bushings and push them into the clips on the heel contact springs. The lower clips should have moderate tension to hold the bushings in place once they are assembled.

3. Adjust the heel spring clips with a pair of pliers as shown in Figure 3-2 and Figure 3-3. All bushings should be positioned with the flanges against the heel clips.

4. Bend the heel spring supporting members sideways using alignment tool J397164-0020, as shown in Figure 3-4, so that there is clearance of not less than 0.005” nor more than 0.055” to each contact bushing. Note: Take up the side play of the operating arm in either direction

before they are bent. The jaw of the tool should be applied over the portion of the supporting member where it is riveted to the contact spring.

5. Check to be sure that all split pins in the operating arm connections are properly spread.

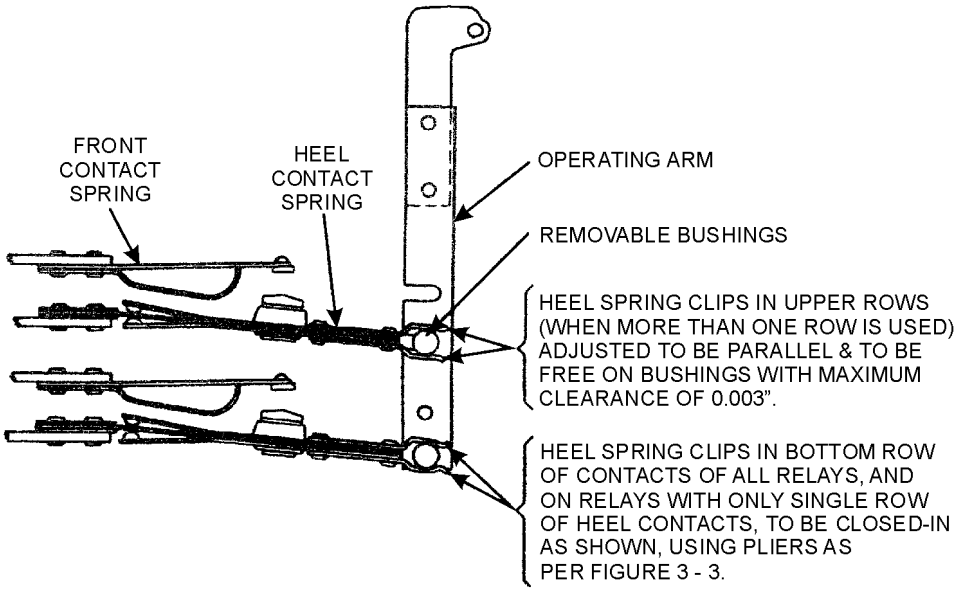


Figure 3-2 - Adjustment of Heel Spring Clips

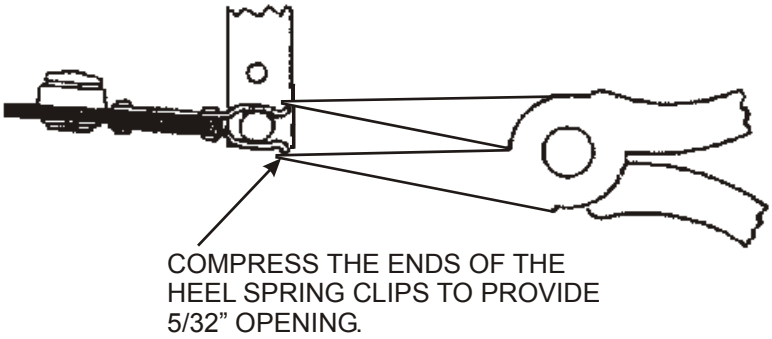


Figure 3-3 - Method of Closing in of Lower Heel

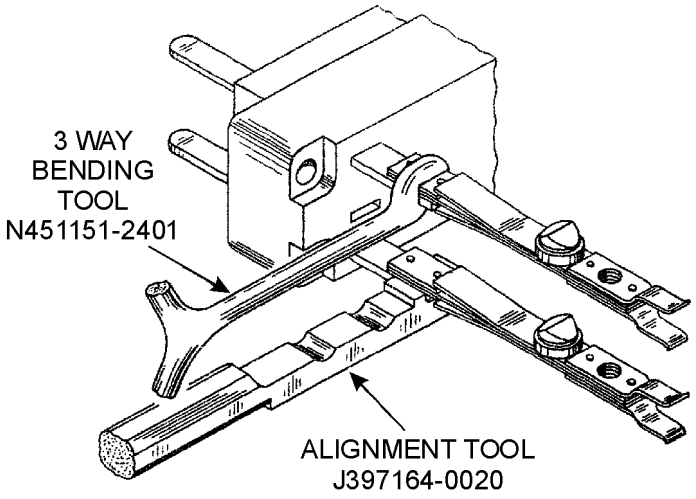


Figure 3-4 - Application of Bending Tools

3.7.4. Contact Block Replacement and Adjustment

3.7.4.1. Contact Block Replacement Procedure

1. Remove the old block.
2. Use a small punch to remove the small dowel pins.
3. Attach the new block with the four screws.
4. Drill a (#42 drill, 0.0935” Diameter) through the dowel pin holes into the contact block for a total depth of 9/16” +1/32 -0.

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

5. Install the dowel pins by carefully tapping them in until they are flush with the aluminum surface. If it is necessary to install a used contact block from another relay, remove only one of the dowel pins from the aluminum frame. Carefully press the block on the remaining pin and fasten in place with the screws. One dowel pin will adequately hold the block in place. Install the contact block mounting screws and torque them to 10 ±2 inch-pounds.
6. Do not over-tighten or force parts during reassembly.

3.7.5. Contact and Counterweight Adjustment Procedure

All adjustments of contacts should be made by bending the brass support member with the bending tool applied between the rivets that fasten the contact spring to it. Because of the effect of the weight of the contact tips, all checks of contact adjustment should be made with the relay in the normal upright position.

3.7.5.1. Recommended Tools

The recommended tools for shop maintenance are:

1. Gap Gauge - 0.001” to 0.060”
2. Gram Scale - 0 to 30 grams
3. Pliers (For Heel Clip)
4. Bending Tool - (J397164-0020)
5. Bending Tool - (N451151-2401)
6. Adjustable Torque Arm

3.7.5.2. Initial Contact Adjustment

a. Front and Back Contacts

1. Adjust all front and back contact springs to have an initial pressure of 20 grams (10 grams each tip). This may be reduced to 12 grams, corresponding to 6 grams at each tip, as required to meet calibration values.

2. Apply a gram scale at the center of the contact tip, on the back contact springs, to just barely move the flexible bronze spring away from the curved stop member. The stop member should be bent if necessary, not the spring, in obtaining this adjustment. In order to make this check on the front contact springs, using the gram scale, the spring assembly will have to be checked in the inverted position and the pressure should be 18 grams (9 grams each tip), to compensate for the weight of-the contact tip. The contact buttons of the bifurcated springs should close at the same instant.

b. Heel Contacts

1. The design of heel contact provides a flexible hinge arrangement with a rigid assembly on the outer part of the member. The thin center spring should be straight and the projection on the upper and lower pressure plates should both bear against the thin center spring. This heel spring assembly should deflect through its full motion - with very slight pressure from the operating arm. The heel spring has to be handled carefully in order not to distort the thin center member.

2. Adjust the heel springs so that when the relay is held with the base horizontal and the contact springs pointing downward, the heel spring will take a free position when not connected to the operating arm without appreciable bias either toward the front or back contacts.

3.7.5.3. Final Contact Adjustment Procedure

The normal contact adjustment provides 0.031" compression of the front contacts with the vane just touching the upper roller stop, 0.025" compression of the back contacts when the vane just touches the lower roller stop, and 0.025" opening of the back contacts with the fronts just barely closed. These adjustments can be obtained by using the proper section of three-way bending tool N451151-2401 applied as shown in Figure 3-4.

1. Align the front and back contact springs with their associated heel springs using alignment tool J397164-0020 as explained for the heel contact springs.

2. Adjust the front contacts to have 0.055" opening with the vane resting against the lower roller stop.

3. Adjust the back contacts so that they have 0.025" opening with the fronts just barely closed.

4. Move the vane up against the upper roller stop, the opening of the back contacts should be approximately 0.055". As a further check, each front contact spring should have approximately 0.010” opening from its stop spring.

5. Move the vane to touch the lower roller stop. Each back contact spring should have approximately 0.010” opening from its stop spring.

6. Check electrical calibration per Section 3.2.

3.7.5.4. Counterweight Adjustment Procedure

The values for vane torque given in

Table 3-1 refer to the counterweight torque needed to just balance the vane so that the front contacts just barely close when the relay is in the normal mounted position without current in the windings and the case is tapped lightly. Unless the adjustment of the counterweight nut or the heel contact springs has been changed, or the operating values are not met, this check will not ordinarily have to be made. In general, it is permissible for the torque to be more than the value shown, provided the operating values are correct.

1. Attach the “adjustable torque arm” (Figure 3-5) onto the vane shaft of the relay with the opening of the slot at the bottom, as shown.

2. Hold the “adjustable torque arm” in place by turning the arm, which is threaded on the end, until it is tight against the vane shaft.

3. Move the small weight that is attached to the “adjustable torque arm” to give the desired counterweight as specified in Table 3-1.

4. Adjust the counterweight nuts on the relay so that the front contacts will just make, with the "adjustable torque arm" in a horizontal position. This can be easily determined by tapping the relay case lightly.

   The notches on the arm are spaced to provide the counterweights ordinarily used. With the small weight in the notch nearest the vane shaft a counterweight of 100 inch-grains is indicated; in the second notch 125 inch-grains; in further 25 inch-grain steps to 300 inch-grains and 50 inch-grain steps to 600 inch-grains, except an extra notch at 375 inch-grains.

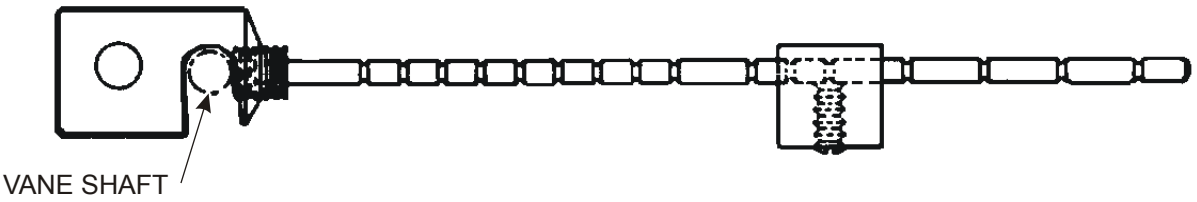


Figure 3-5 - Table Torque Arm

5. Adjust the counterweight nuts on the vane so that a torque as specified in Table 3-1 is required to just close the front contacts. This torque should be measured with the relay in its normal operating position and with all operating arms connected to the heel contacts, using an adjustable torque arm. At least 1/16" clearance should exist between the end of the counterweight screw and the main support casting.

6. Lock the counterweight lock nut securely and spread the end of the screw slightly to prevent the nuts backing off.

3.7.5.5. Inspection for Loose Counterweights and Loose Trunnion Screw Locknuts

WARNING

The following procedure involves the opening of a vital relay. Only individuals qualified to work on vital relays should perform this procedure.

1. Remove the bottom cover from the relay. This exposes the contact assembly. Exercise extreme caution not to disturb the adjustment of the contacts.

2. Remove nameplate to gain access to the counterweight assembly on the vane crank.

3. Rotate the vane so that the counterweight assembly is visible. This will reveal one or more counterweights, with or without a locknut, on the counterweight screw.

4. As shown in the figure below, check to determine if:

   a. The counterweight and locknut are tight.

b. At least two threads are visible on the counterweight screw end.

c. The split screw end is slightly spread apart. Tighten any loose counterweights and locknut.

5. Conduct a visual inspection of the relay. Check for:
   a. Rubbing vane.
   b. Debris inside the relay.
   c. Obviously misaligned contacts.
   d. Check to see that the vane is approximately centered and that it has the correct amount of end play (0.010 to 0.016 inch). Readjust if required.
   e. Check the vane for freedom of movement.
   f. Check to see that the operating arms, clips, and bushings are in the proper position and are free to move.
   g. Using a wrench, check the trunnion locknuts for tightness. Tighten any that are loose.
6. Perform an electrical calibration test in accordance with Section 3.2.2. If the relay passes the In-service/Field Calibration requirements apply glyptal to the exposed threads of the counterweight screw and trunnion locknut, as shown in Figure 3-6.
7. Install gaskets and covers and seal with a new wire and lead seal.

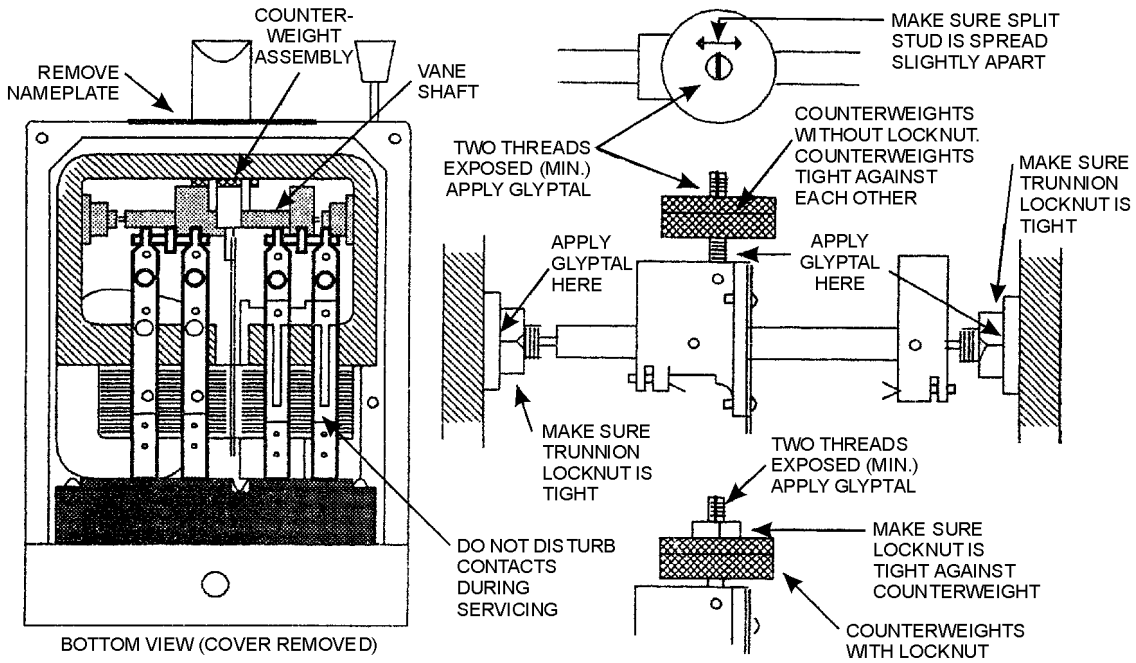


Figure 3-6 - Inspecting Loose Counterweights and Loose Trunnion Screw Locknuts

3.7.6. Test for Balanced Magnetic Circuit

With the relay standing on its back so that the vane hangs down with front and back contacts open, apply normal voltage and frequency to the local winding. There should not be any appreciable movement of the vane, particularly no tendency to close the front contacts.

Section 4. Parts List

4.1. PV-250 Track Relay (N342555-809 and N342555-909)

Table 4-1 - Parts List for the PV-250 Track Relay, 60 Hz

Item No.	Description	Part No.
1	Frame	M433493
2	Latch Rod	M375913
3	Knob, Knurled	J770536
4	Nut, 1/8 Heavy	M395496
5	Latch	M321728
6	Roll Pin, SS	J048716
7	Plated Spring	M321861
8	Roll Pin - 3/32” D x 3/8”	J487087
9	Screw - 8-32 x 7/16, SS	J507295-0119
10	Cover, Molded	J776304-0001
11	Screw - 8-32 x 7/16	J522042
12	Rubber Gasket	J047081
13	Screw - 8-32 x 1/4	J052639
14	Handle	J561111
15	Washer, #10, SS	J475121-0125
16	Screw - 10-32 x 3/8, SS	J507296-0129
17	Vent Seal	J790257
18	Tag	S002036
19	Not Used	
20	Wire seal (# 23 AWG)	A043013
21	Lead Seal	J079351
22	Name Plate	M437859
23	Screw - 4–40 x 3/16, Pan Hd, SS	J525024
24	Support Bracket	M375890
25	Screw - 10-32 x ½	J052091
26	Field Control	N385961
27	Field Local	N251094
28	Vane Assembly	N434594
29	Screw, Trunnion	N124889
30	Not Used	

Item No.	Description	Part No.
31	Bushing	M232934
32	Insulation	M283459
33	Roller	M069693
34	U Roller Bracket	M397483
35	Roller Bracket	M161753
36	Clip, 1/8 x ½, Brass	M090506
37	Lock Bracket	M109074
38*	RTV	J0498132
39	Not Used	
40	Pin	M381123
41	Washer, Lock #8, SS	J047714
42	Pin, 1/8 steel	M381129
43	Pin, Bronze	M232031
44	Pin	M232935
45	Terminal Block	PM433457
46	Screw - 8-32 x 1/2, SS	J500132-0108
47	Roll Pin, 3/32D x 1-1/8	J487090
48	Not Used	
49	Bag Parts	N349711-5509
50	Not Used	
51	Contact Block	N433482
52	Screw - 8-32 x 1, SS	J500132-0116
53	Operating Arm	N390324
54	Counterweight	M451175-0301 M451175-0302 M451175-0305
55	Nut, Hex. .312, Brass	M029956
56	Cover Molded	J776598
57	Screw - 6-32 x !/4	J052485
58	Washer, #6	J047713
320*	Nylon String, #30	A061039
899*	Clip	J680167-0012

* = Not shown in Figure 2-1

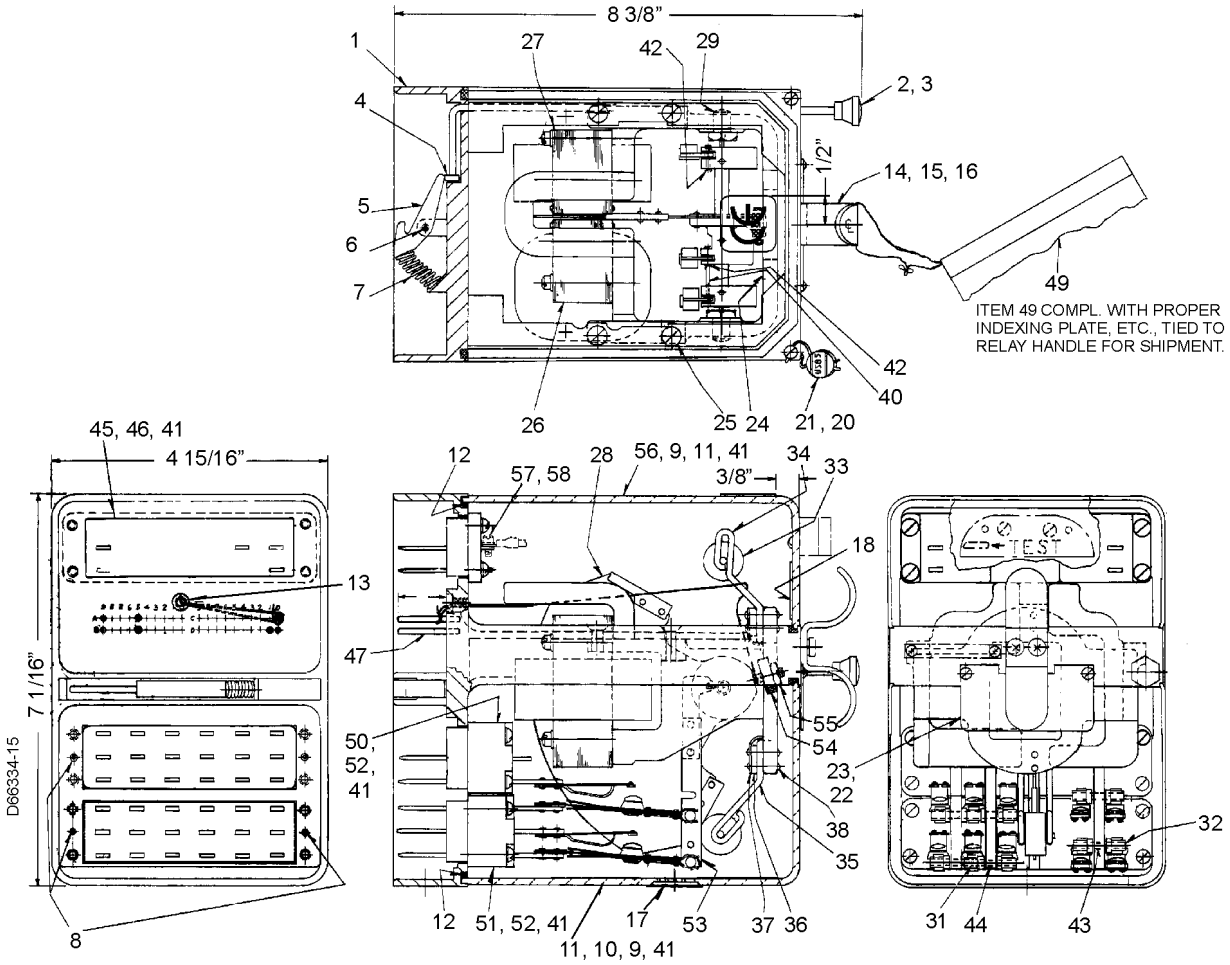


Figure 4-1 - PV-250 Relay Typical Top Assembly (N342555-809)
(For specific contact block arrangement, please refer to Table 4-2, Table 4-3, and Figure 4-2.)

4.2. Contact Block Assemblies (N433482)

Table 4-2 - Contact Block Arrangement

Contact Block	Contact Section Row					
	6	5	4	3	2	1
N433482	K	K	--	J	J	--

Table 4-3 - Contact Block Assembly Parts List

Item	Description	US&S Part No.
1	---	---
2	Spring, Contact	N376006
3	Spring, Contact	N376007
4	Spring, Contact	N376002
5	---	---
6	Finger, Contact	M375981
7	Spring, Contact	N376003

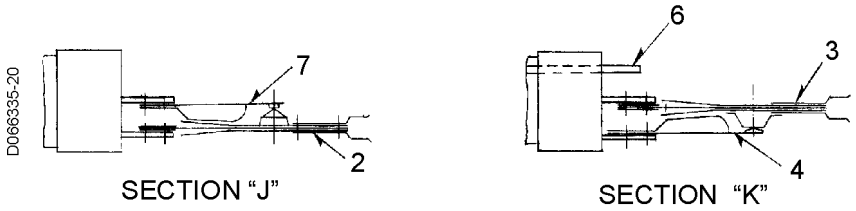


Figure 4-2 - Contact Block Assemblies

4.3. Relay Mounting Base Assembly (N438689-003 and N434647)

4.3.1. New Style Mounting Base (N438689-003)

Table 4-4 - New Style Mounting Base Parts List

Item	Description	US&S Part No.
1	Molded Base	J780054
2	Strike, Relay	J792848
3	Nut, Speed Type	J480280
4	Spring Contact	M451142-2702
5	Tag, Relay ID	J075951
6	Screw - 1/4-20 x 1-1/4", SS	J500136-0120
7	Washer, # 1/4 Lock, SS	J475121-0111
8	Washer, #1/4 Plate, SS	J475120-0112
9	Nut, 1/4-20 Hex, SS	J480211-0108
10	Extraction Tool	J772383
--	Contact Receptacle Spring -#18 - #20 Wire	M451142-2701
--	Contact Receptacle Spring -#14 - #16 Wire	M451142-2702
--	Contact Receptacle Spring -#10 - #12 Wire	M451142-2703

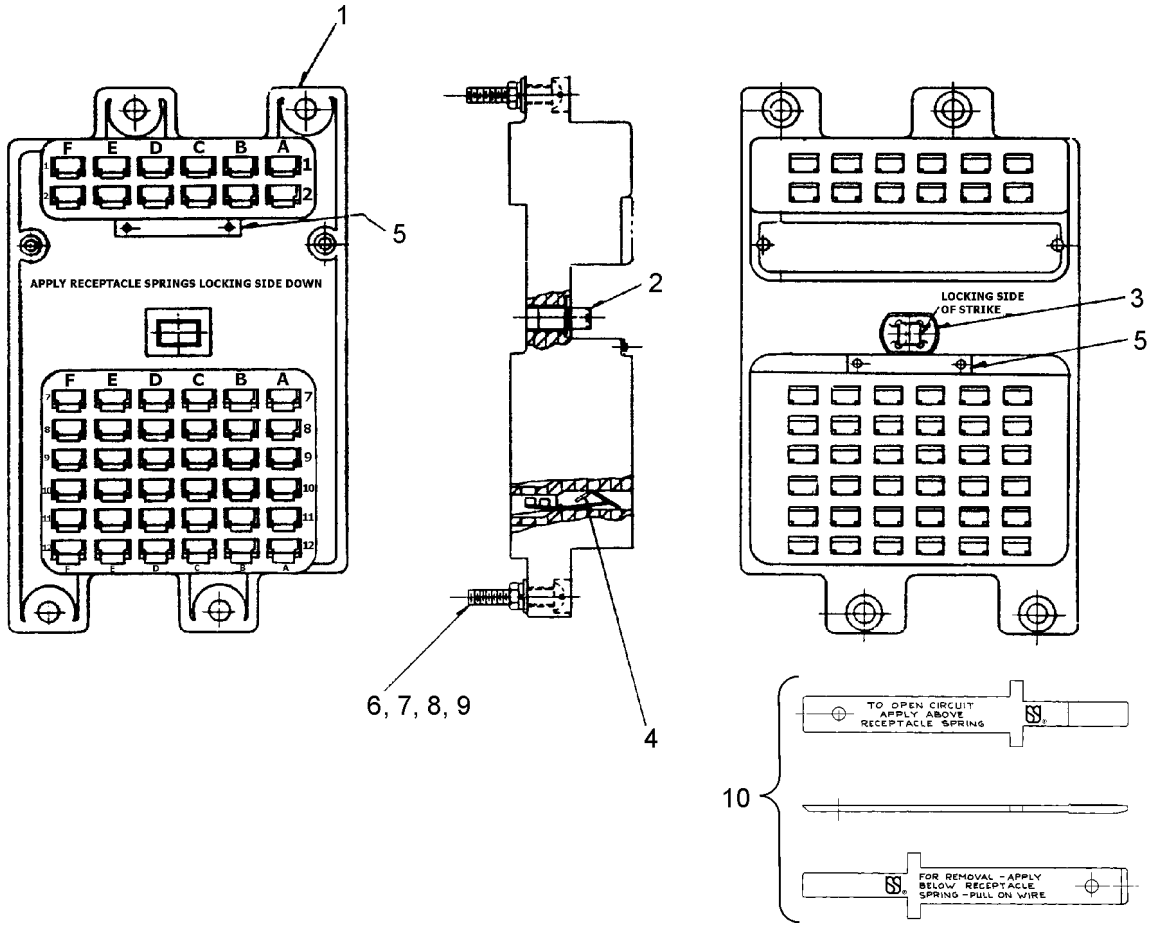


Figure 4-3 - New Style Mounting Base Assembly (N438689-003)

4.3.2. Old Style Mounting Base (N434647)

Table 4-5 - Old Style Mounting Base Parts List

Item	Description	US&S Part No.
1	Molded Base	J776306
2	Coil Clamping Plate	J776318
3	Contact Clamping Plate	J776308
4	Screw - 6-32 x 3/8	J525061
5	Strike	M321745
6	Nut	M267499
7	Tag	J075828
8	Screw - 4 x 3/16	J052674
9	Meter Test Plug	M322965
10	Extraction Tool	J077931

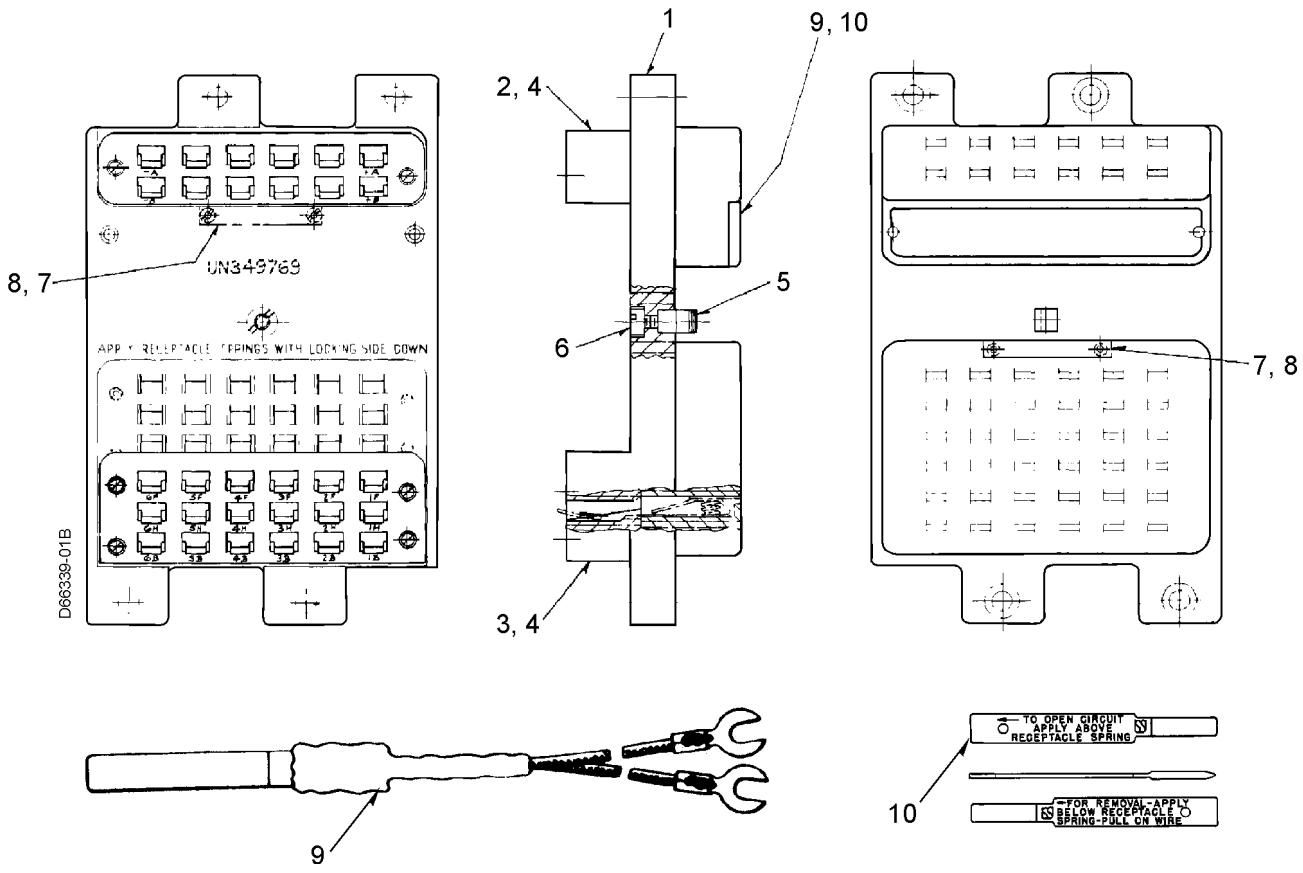


Figure 4-4 - Old Style Mounting Base Assembly (N434647)

Section 5. RAIL Team and Technical Support

The *Rapid Action Information Link (RAIL) Team* is comprised of a group of experienced product and application engineers ready to assist and resolve any technical issues concerning any US&S product.

Any questions regarding the contents of this Service Manual can be answered by contacting the RAIL Team toll free at 800-652-7276 or via Internet e-mail: railteam@switch.com.