

**RELAYS HAVING NO KS DESIGNATIONS**  
**WARD LEONARD COMPANY, ALLEN-BRADLEY COMPANY**  
**AND WESTINGHOUSE CORPORATION**  
**REQUIREMENTS AND ADJUSTING PROCEDURES**

**1. GENERAL**

**1.01** This section covers the following relays not covered separately by KS designations. This information is a consolidation of information covered in Sections 026-356-701 and 026-365-701.

**WARD LEONARD**  
Bulletin 105  
Bulletin 106  
Bulletin 130  
Bulletin 131  
Bulletin 132

**ALLEN-BRADLEY**  
Bulletin 200  
Bulletin 700

**WESTINGHOUSE**  
Type SG  
Type TI2

**1.02** Reference shall be made to Section 020-010-711 covering general requirements and definitions for additional information necessary for the proper application of the requirements listed herein.

**1.03 Asterisk (\*)**: Requirements are marked with an asterisk when to check for them would necessitate dismantling or dismounting of apparatus, or would affect the adjustment involved, or other adjustments. No check need be made for these requirements unless the apparatus or part is made accessible for other reasons, or its performance indicates that such a check is advisable.

**1.04** For the purpose of this section, contacts are *normally open* (NO) or *normally closed* (NC) depending on their position when no operating current is flowing through the coil and not on their normal position for a particular application which may involve continuous operating current through the coil under normal circuit conditions. NO and NC contacts are sometimes referred to as front and back contacts, respectively.

**1.05 Operate**: A relay is said to operate if, when current is connected to its winding, the armature moves sufficiently to meet the following conditions.

- (a) All NO contacts close and all NC contacts open.
- (b) The armature rests against the core.

**1.06 Release**: A relay is said to release when the armature has moved sufficiently for NO contacts to open and NC contacts to close with reliable contact.

**1.07 Nonoperate**: A relay is said to nonoperate when, with current flowing through the coil, the armature has not moved sufficiently for NO contacts to close or to reduce the pressure of NC contacts enough to cause unreliable contact.

**1.08 Caution**: *If this type relay is in a circuit where 150 volts or more are applied across the contact terminals on the relay, the voltage should be removed from the terminals before performing any work on the relay or checking requirements other than electrical requirements. In circuits where less than 150 volts are applied across the contact terminals, service may be maintained while working on the relay by bridging and insulating the contacts as covered in 3.002. In some cases, it may be necessary to disconnect leads to maintain service.*

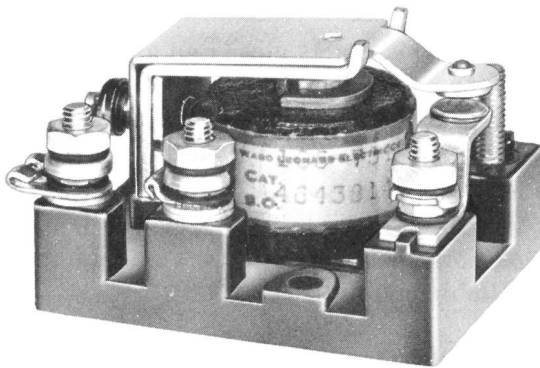
**1.09 Caution**: *If the relay operates in an automatic control circuit, before work is started on the relay, the automatic control should be made inoperative as described in the appropriate section covering the apparatus.*

**1.10** Relays should not be handled by the contact springs.

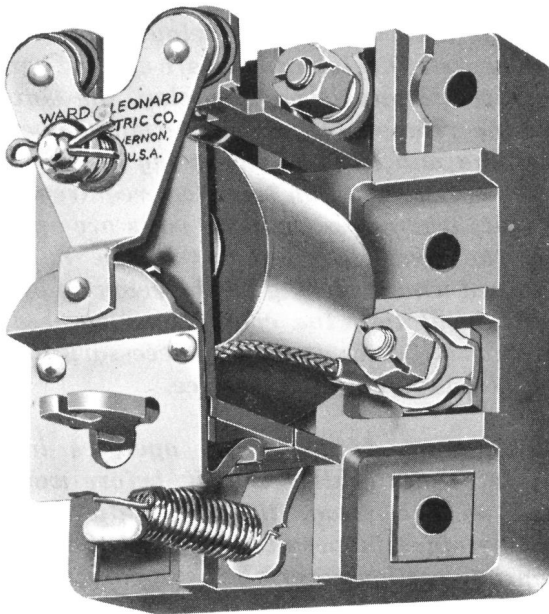
**SECTION 040-811-701**

**1.11** Where the construction is such that adjustments are not practicable, failure of a relay to operate satisfactorily should be corrected by replacing the appropriate parts or the entire relay.

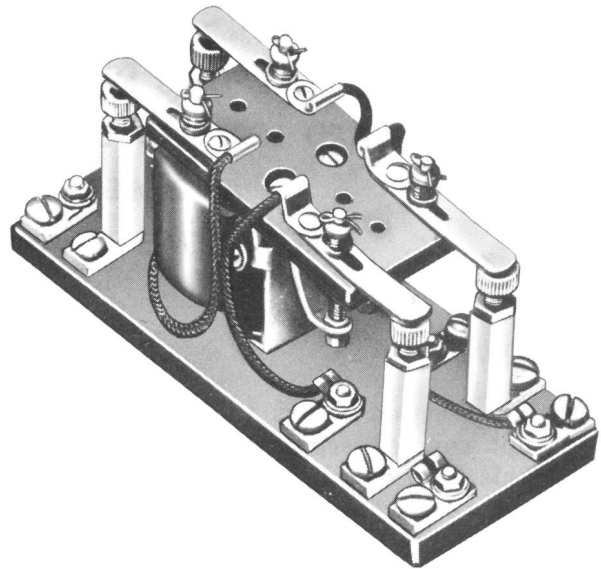
**1.12** Orders for parts needed for replacement should give the nameplate data of the contactor, including manufacturer's name, type or bulletin number, serial number, and list numbers if any, together with a description of the part.



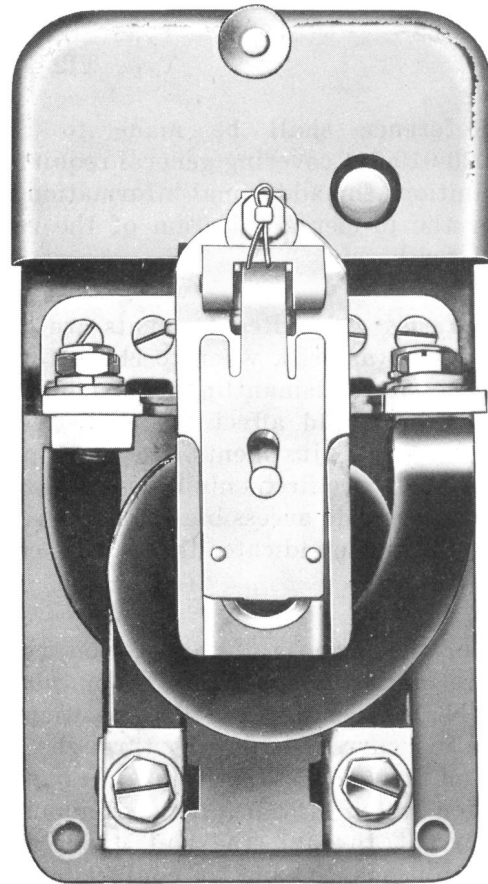
**Fig. 1 – Relay, Ward Leonard Bulletin 105**



**Fig. 2 – Relay, Ward Leonard Bulletin 106**



**Fig. 3 – Relay, Ward Leonard Bulletin 131**



**Fig. 4 – Relay, Westinghouse Type TI-2**

1.13 Requirements 2.01 through 2.07 have general application, except as otherwise specified. The following requirements apply to particular apparatus and are to be considered in connection with the general requirements.

#### Requirement

Allen-Bradley Relays (2.08)

Westinghouse Type TI-2 Relay (2.09)

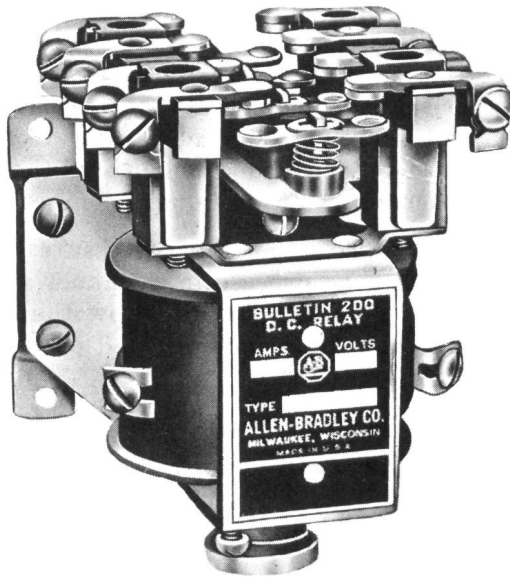


Fig. 5 – Relay, Allen-Bradley Bulletin 200

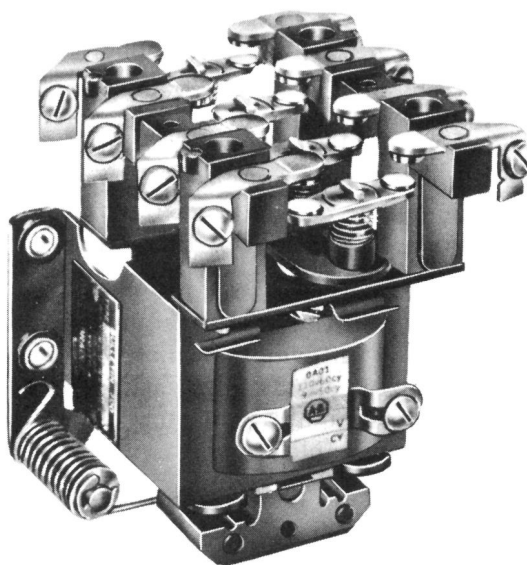


Fig. 6 – Relay, Allen-Bradley Bulletin 700

## 2. REQUIREMENTS

**2.01 Cleaning Contacts and Removing Build-Ups:** Contacts shall be clean and free from build-ups which might interfere with reliable contact.

Gauge by eye.

**2.02 Relay Mounting and Tightness of Component Parts**

- (a) The relay shall be securely mounted.
- (b) The component parts shall be held together securely.

Gauge by feel.

**Caution:** Do not touch or short-circuit live terminals or parts.

**2.03 Contact Alignment:** Each pair of contacts shall be aligned so that when the relay is operated, the outer edge of one contact does not overlap the outer edge of the other by more than one-eighth of its diameter or width, at turnover, and not more than one-fourth, during life. For large contacts the overlap shall not exceed 1/8 inch.

Gauge by eye.

**2.04 Contact Sequence**

- (a) All NO contacts shall make at approximately the same time.
- (b) All NC contacts shall break at approximately the same time.

Gauge by eye or use an 81A test set (buzzer) as necessary.

**2.05 Contact Separation** (Ward Leonard relays only)

- (a) The minimum separation between mating contacts when open shall be as specified in the circuit requirements table.

When checking, use the gauges as follows.

SEPARATION	GAUGE
1/16 inch	89
3/32 inch	161A
1/8 inch	TP91681M
5/32 inch	R-8550 scale

To check this requirement, the contacts must be disconnected from the power supply.

**SECTION 040-811-701**

(b) If the contact separation is not specified, like contacts on the same relay shall have approximately the same separation. In no case shall the separation be so small that the arc formed at the opening of the circuit is not readily extinguished.

Gauge by eye.

(c) To measure the separation of single-throw type contacts, move the armature as required with the KS-6320 orange stick. On relays having movable contacts arranged for transfer (double-throw contacts), measure the separation of each contact while its associated contact is just made, without any follow or flexing of the contact pressure spring.

**2.06 Contact Pressure and Follow**

(a) Contact pressure, measured with the contacts closed, shall be as specified in the circuit requirements table.

Use the 68B fan-type gauge, the 79B or 79C push-pull tension gauge, or the R-2481 spring balance, as applicable.

To check this requirement, the contacts must be disconnected from the power supply.

(b) There shall be additional movement of the operating mechanism after contacts touch. This additional movement usually results in sliding of the contacts or increase in the contact pressure and is known as follow.

Gauge by eye.

(c) When not specified in the circuit requirements table, the contact pressure or follow shall be as specified in the following table.

RELAYS	CONTACT PRESSURE OR FOLLOW	
<b>Allen-Bradley</b> (see 2.08)		
Bulletin 200	1/16-inch	follow
Bulletin 700	1/16-inch	follow
<b>Ward Leonard</b>		
	CONTACTS	MIN GRAMS
Bulletin 105	NO	50
	NC	25
Bulletin 106	NO	20
	NC	10
Bulletin 130, 131, and 132	NO	50
	NC	45

RELAYS	CONTACT PRESSURE OR FOLLOW	
<b>Westinghouse</b>		
Type SG	NO	55
	NC	30
Type TI-2 (see 2.09)	NC	40

(d) *To measure* the contact pressure of the **NO** contacts, hold the armature securely against the pole face with a screwdriver, taking care not to press on any part of the contact spring which supports the moving contact or to force the armature out of alignment. Place the gauge against the contact spring as near to the moving contact as possible and exert a pressure with the gauge away from the stationary contact. Read the gauge as the moving contact leaves the stationary contact.

(e) *To measure* the contact pressure of the **NC** contacts, proceed in a manner similar to that outlined in (d), but allow the armature to be held in its nonoperated position by the pull of its spring.

(f) **Allen-Bradley Relays:** When checking the contacts for follow, close the relay slowly by hand, observing the distance the support can move after the contact is first made.

**2.07 Electrical Requirements**

(a) The relay shall meet the electrical requirements specified in the circuit requirements table or other job information.

(b) Where electrical requirements are not specified in the circuit requirements table, operation of the relay shall be checked at any voltage available within the voltage range on the relay nameplate. Where a specific value of voltage is given, the checking voltage shall be within  $\pm 10$  per cent of this value.

(c) Where electrical requirements are not specified in the circuit requirements table or other job information, normal operation of the relay is considered a satisfactory check where no nameplate range or other operate values are available.

(d) Check of electrical requirements may be at the temperature at which the relay is found, unless H (hot) or C (cold) is specified in the circuit requirements table.

(e) Where H is specified in the circuit requirements table without heating instructions, the relay coil shall be energized for at least 1 hour prior to the test.

(f) Where C is specified in the circuit requirements table without cooling instructions, the relay shall be de-energized for at least 2 hours prior to the test.

**\*2.08 Allen-Bradley Relays:** Check for follow. (See 2.06 and 3.08.)

**\*2.09 Westinghouse Type TI-2 Relay:** Disregard 2.03 and 2.04, and adjust the relay as covered in 3.09.

**3. ADJUSTING PROCEDURES**

**3.001 List of Tools, Gauges, Materials, and Test Apparatus**

CODE OR SPEC NO.	DESCRIPTION
<b>TOOLS</b>	
46	3/8-Inch Hex. Single-End Socket Wrench
365 (as reqd)	Connecting Clip
373D	Contact Burnisher Holder
374A	Contact Burnisher Blade
417A (2 reqd)	1/4- and 3/8-Inch Open Double-End Flat Wrench
418A	5/16- and 7/32-Inch Open Double-End Flat Wrench
KS-2662	File
KS-6015	Duckbill Pliers
KS-6278 (as reqd)	Connecting Clip (jaws insulated with 108 cord tip)
KS-6320	Orange Stick
KS-6780 (as reqd)	Connecting Clip (jaws insulated with 108 cord tip)
KS-6854	3-1/2 Inch Screwdriver
KS-14208 (2 reqd)	Brush
—	3-Inch C Screwdriver
—	4-Inch E Screwdriver

CODE OR SPEC NO.	DESCRIPTION
<b>GAUGES</b>	
68B	70-0-70 Gram Gauge
79B	0-1000 Gram Push-Pull Tension Gauge
79C	0-200 Gram Push-Pull Tension Gauge
89	1/16- and 1/64-Inch Round Thickness Gauge
161A	0.050- and 0.094-Inch Thickness Gauge
TP91681M	0.160- and 0.180-Inch Thickness Gauge
R-2481	0-30 Pounds Spring Balance
R-8550	6-Inch Steel Scale
—	Voltmeter, AC, Weston Model No. 528, Ranges 300-150
—	Voltmeter, DC, Weston Model No. 931, Ranges 300-150-75-30 (if 35-type test set is not equipped with a voltmeter)
<b>MATERIALS</b>	
KS-2423	Cotton Twill Cloth
KS-7187	Bond Paper
KS-8372	Stabilized Trichloroethylene
—	Abrasive Cloth, 150 Grade
—	No. 14 Gauge, AM-14, Wire
—	1-Ounce Bottle
<b>TEST APPARATUS</b>	
35 Type	Test Set
81A	Test Set
—	893 Cord, 3 Feet Long, Each End Equipped With a 360A Tool (1W13A cord) and a 365 or KS-6278 Connecting Clip
—	893 Cord, 6 Feet Long, Each End Equipped With a 360A Tool (1W13B cord) and a 365 or KS-6278 Connecting Clip
—	Autotransformer, Continuous Tap (Variac, 2.5-amp, 230-volt input, type V-5HMT, General Radio Co, or equivalent)

**3.002 Maintaining Service While Working on Relay**

(1) **General:** If less than 150 volts are applied across the contact terminals and it is not practicable to disconnect the relay from the power supply (see 1.08 and 1.09), bridge the current-carrying contacts and insulate live parts as covered in (2) and (3), respectively.

**Caution:** Use care when working in close quarters with live parts.

(2) **Bridging Contacts:** To maintain service while work is being done affecting closed contacts carrying current in working circuits, bridge the contacts at the most convenient points in the circuit other than at the relay, if practicable. The 893 cords (3 or 6 feet long) each end equipped with a 360A tool and a 365 connecting clip or KS-6278 connecting clip (jaws insulated with 108 cord tips) are satisfactory for strapping purposes. Lengths of No. 14 gauge insulated wire or flexible cord such as is commonly used in lighting circuits, with KS-6780 connecting clips (jaws insulated with 108 cord tips), are equally satisfactory.

(3) **Insulating Contacts and Parts:** KS-7187 bond paper should be used for insulating live parts and should be shaped or bent as necessary to provide protection with minimum interference to the work being done. To prevent closure of open contacts in a live circuit, insert a strip of bond paper between the movable and stationary contacts or a lead shall be disconnected.

(4) **Removal of Relay:** If it becomes necessary to remove the relay from its mounting in order to obtain access to the parts, proceed as follows. Patch through any working circuit and disconnect all power supply from the relay winding and contact circuits by opening switches, if provided, or by removing the fuse or fuses. Then disconnect the leads from the relay terminals using a suitable screwdriver or wrench. Remove the relay mounting screws with a suitable screwdriver.

**3.003 Closing Open Contacts:** To close an NO contact, hold the armature against the pole face with the KS-6320 orange stick, taking care not to disturb the alignment of the arma-

ture. NC contacts of a relay which is found operated in a working circuit may be closed by opening one connection to the coil, after first bridging or insulating the other contacts, as necessary.

**3.004 Caution:** Unless otherwise stated in the procedures, do not make adjustments or perform work on live contacts or parts.

**3.01 Cleaning Contacts and Removing Build-Ups (Reqt 2.01)**

(1) **General:** The purpose of cleaning contacts is to remove any gummy or dirty substance that would interfere with reliable contact. The oxide which forms on silver contacts is not objectionable and does not interfere with the contact. It is not necessary or desirable to keep contacts polished or shining.

(a) Before cleaning contacts or removing build-ups, disconnect the power supply from the contacts as covered in 1.08 and 1.09.

(b) Contacts which are badly worn should be replaced, together with their associated springs if attached by riveting.

(2) **Cleaning Contacts:** To remove dirt and gummy substance, clean the contacts with KS-8372 trichloroethylene as covered in (a) and (b) and then brush them with a dry, clean KS-14208 brush as covered in (c).

(a) Pour a small quantity of the trichloroethylene into a 1-ounce bottle. It is important to avoid the use of contaminated trichloroethylene in cleaning the contacts. Therefore, discard the trichloroethylene as soon as it appears slightly dirty.

(b) Dip the hairs of a clean KS-14208 brush their full length in the trichloroethylene. Remove excess fluid by wiping the brush on the edge of the bottle. Then, with the pair of contacts open, brush the entire surface of the contact to be cleaned with the moist brush.

(c) Brush the contacts with a dry, clean KS-14208 brush. If necessary, burnish the contacts with the 374A burnisher blade as covered in (d).

(d) To burnish the contacts, insert the 374A burnisher blade held in the 373D contact burnisher holder between the contacts. Do not burnish live contacts. If the contacts are normally open, press them together by holding the armature firmly against the pole face with the KS-6320 orange stick. Draw the burnisher blade back and forth until the contacts are clean as determined by visual inspection. After burnishing, brush the contacts with a dry, clean KS-14208 brush.

(3) **Removing Build-Ups:** There shall be as little smoothing of contacts as is consistent with satisfactory operation. Contacts should be smoothed while closed where practicable. If the contacts are normally open, hold the armature firmly against the pole face with the KS-6320 orange stick, taking care not to touch the contact springs.

(a) For contacts in live circuits of 150 volts or more to ground, remove the voltage from the terminals as outlined in 1.08 and 1.09 before removing build-ups.

(b) To remove build-ups in dead circuits, use a strip of 150 grade abrasive cloth, the KS-2662 file, or the 374A burnisher blade held in the 373D contact burnisher holder. For contacts in live circuits of less than 150 volts to ground, use abrasive cloth only.

(c) To burnish the contacts, insert the abrasive cloth, file, or blade between the contacts. Draw the cloth, file, or blade back and forth until the build-ups are reduced enough to insure reliable contact. Exercise care to avoid reducing the height of the contact. After burnishing, brush the contacts with a dry KS-14208 brush.

### 3.02 **Relay Mounting and Tightness of Component Parts** (Reqt 2.02)

(1) Tighten loose screws with the appropriate screwdriver or wrench.

**Note:** Be sure that the coil positioning screw on the Allen-Bradley Bulletin 200 relay is secured and the coil terminals are positioned away from the frame of the relay.

### 3.03 **Contact Alignment** (Reqt 2.03)

(1) Where feasible, shape with pliers a contact spring that is slightly bent. Any contact spring that becomes badly bent out of shape should be removed and reshaped, or replaced with a new contact spring. Similarly, a fixed contact supported on a stud which has become bent out of line should be realigned by straightening the stud.

(2) If alignment cannot be obtained, install new contacts or a new relay.

### 3.04 **Contact Sequence** (Reqt 2.04)

(1) If contacts do not make or break at approximately the same time, inspect the group for any that are out of alignment with the others. Correct by shaping the contact springs with the pliers or raising or lowering stationary contact assemblies, as required, to bring them into alignment with the others of the group. When the contacts are supported by heavy members which cannot be shaped with the pliers, check for mechanical trouble which may require the replacement of parts. Check 2.03, 2.05, 2.06, and 2.07 after any change.

### 3.05 **Contact Separation** (Ward Leonard relays only) (Reqt 2.05)

(1) To adjust the contact separations of relays having both NO and NC contacts, or NC contacts only, raise or lower the stationary NC contacts by rotating them, if mounted on screws. Retighten the locknut before leaving. Contacts mounted on flat strips may be adjusted by forming the strips with pliers. Where only NO contacts are present, the work should be done in a similar manner on the stationary contacts or the armature backstop should be adjusted.

(2) After any change in a contact separation, check the separations of the other contacts of the relay and 2.03, 2.04, 2.06, and 2.07.

### 3.06 **Contact Pressure and Follow** (Reqt 2.06)

(1) In readjusting, it is desirable to have as much tension as possible on the various springs consistent with meeting other requirements. In adjusting the contact springs, ten-

sion the corresponding springs of the assemblies on both sides of the armature so that the tensions are approximately equal, unless difference is necessary to meet other requirements. When one contact spring has been shaped or otherwise changed, or when the position of a stationary contact is changed, recheck the contact pressure on all the contacts on the relay.

(2) Contact pressure may be adjusted by relocating the stationary contacts. This should be resorted to in the case of NC contacts only after getting whatever adjustment is available by changing the tension of the armature spring. The details of this procedure are different, depending upon the manufacturer of the relay, and can be determined by inspection. In general, the spring is terminated on a screw which can be turned to increase or decrease the tension as required, and finally locked in position by a nut or other means.

(3) In cases where the construction does not permit adjustment of contact pressure, low pressure should be corrected by the replacement of the appropriate parts such as springs or badly worn contacts.

(4) In general, correction for the lack of follow involves either the adjustment of contacts to increase the contact pressure or if this is not feasible, the replacement of weakened springs or other appropriate parts.

### 3.07 *Electrical Requirements* (Reqt 2.07)

(1) A check of the operation of a voltage rated relay is made as follows.

(a) *AC Relays:* With power removed from the relays as covered in 1.08 and 1.09, connect the coil of the relay to be tested across the output of a continuous tap autotransformer. Connect the Weston Model No. 528 voltmeter across the output of the autotransformer. Connect the input of the autotransformer to the ac supply through 3-ampere fuses. Adjust the output of the autotransformer to the values specified in the circuit requirements table.

(b) *DC Relays:* With power removed from the relay as covered in 1.08 and 1.09, connect the coil of the relay across the output of a 35-type test set equipped with voltmeter. Adjust the output of the 35-type test set to the value specified in the circuit requirements table.

(2) *Operate:* If the armature moves toward the core, as the operate current is applied, but fails to pull all the way up to the core or to the stop pin, it is an indication of excessive contact pressure, a bind in the moving parts, an obstruction in the armature gap, or excessive armature spring tension. Remove obstructions and binding or make adjustments as outlined in 3.06.

(3) *Release:* If the relay does not release, check the armature for binding, and clean or replace it. Check the armature spring to see that it has sufficient tension to return the armature to the nonoperated position. Replace it if sufficient tension cannot be obtained by adjusting the armature spring. In a dc relay, if the stop pin, which is in the face of the armature, fails to prevent the armature coming in direct contact with the pole face and permits it to stay there after the voltage is removed from the coil, replace the armature if feasible; otherwise, replace the relay.

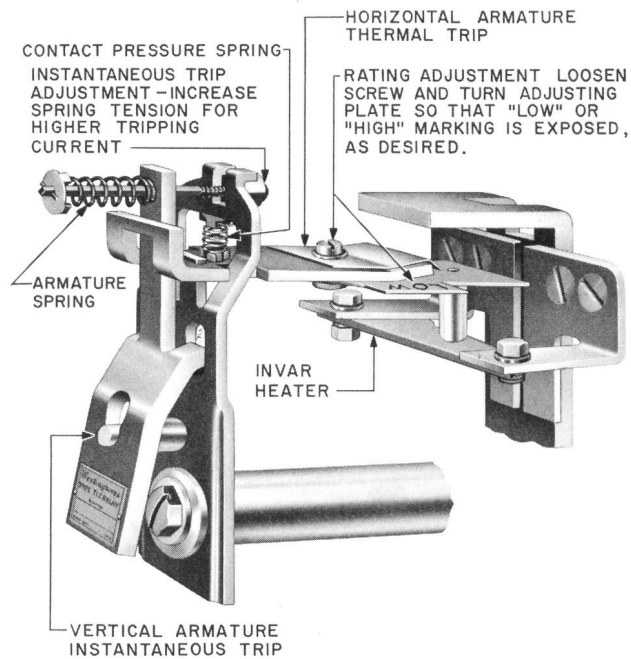
(4) In some cases, the armature or pole face may require cleaning with KS-8372 trichloroethylene on a KS-2423 cloth wrapped around the KS-6320 orange stick.

(5) When any change is made in mechanical settings during adjustment for electrical requirements, recheck requirements 2.03 through 2.06.

### 3.08 *Allen-Bradley Relays* (Reqt 2.08)

(1) The contacts may be cleaned as covered in 3.01. Little other maintenance of the contacts is possible and in the case of operating difficulties, either the contacts or the entire relay should be replaced.





**Fig. 7 - Adjusting TI-2 Relay**

### 3.09 *Westinghouse Type TI-2 Relay* (Req't 2.09)

- (1) To adjust the instantaneous overload trip, change the tension in the armature spring by moving the adjusting nut in or out on the screw as required.
- (2) To adjust the thermal overload trip, proceed according to the instructions given in Fig. 7.
- (3) To obtain access to the contacts, remove the cover at the top of the relay, which is held in place by a knurled nut.
- (4) If the contact pressure is below the minimum, stretch the contact pressure spring as required.