

## RELAYS (WIRE-SPRING TYPE) REPLACING CONTACTS

### 1. GENERAL

**1.01** This section covers procedures for replacing contacts on springs of AF-, AG-, AJ-, AK-, AL-, AM-, 286-, 287-, and 288-type relays.

**1.02** This section is reissued to:

- Incorporate information contained in the Addendum
- Revise List of Tools and Materials
- Revise *Caution* following List of Tools and Materials
- Revise *Caution* preceding 3.22
- Add *Note* preceding 3.22.

**1.03** Before making replacement of contacts on the apparatus covered herein, remove the circuit from service in accordance with approved procedures. In order to prevent adverse service reactions, it may be necessary to remove associated circuits from service or to isolate the springs on which contacts are to be replaced.

**1.04** Before attempting to weld contacts on working apparatus, it may be advantageous to practice doing the work on spare apparatus if available.

**1.05** Reference shall be made to Section 069-310-801 for a description of the 1004B and 1013A tool kits.

### 2. TOOLS AND MATERIALS

CODE OR  
SPEC NO.

DESCRIPTION

TOOLS

578J

Contact removing pliers

669A

Contact separator (for use on 286-, 287-, and 288-type relays)

### TOOLS

674A

Spring lifter (for use on 286-, 287-, and 288-type relays)

675A

Spring holder (for use on upper half of AK- and AM-type relays)

675B

Spring holder (for use on lower half of AK- and AM-type relays)

684A

Insulator (for use on AK- and AM-type relays)

688A

Spring holder (for use on upper half of AK- and AM-type relays)

688B

Spring holder (for use on lower half of AK- and AM-type relays)

1004B

Tool kit

◆1013A

Tool kit

R-1051

Pillar file

AT-7860

B long-nose pliers

—

5-inch diagonal pliers

### MATERIALS

KS-2423

Cloth

KS-14666

Cloth

P-10A949

U-shaped contact (for use on all fixed springs, AF-, AG-, AJ-, AK-, AL-, and AM-type relays)

P-16A180

Contact tape (used on all movable twin springs)

P-19A353

U-shaped contact (used on all fixed springs, 286-, 287-, and 288-type relays)

840054787

Contact for replacement of silver contacts on multicontact relays

CODE OR SPEC NO.	DESCRIPTION
---------------------	-------------

**MATERIALS**

- Flat toothpick (flat at one end, pointed at the other)
- Rubber pencil eraser
- No. 320 aloxite cloth

**Caution:** *When replacing contacts on multicontact relays, both twins and fixed will be replaced. The replacement contacts are palladium, and mating surfaces must be like material.*

**3. PREPARATION**

**PREPARATION OF APPARATUS**

**General**

**3.01** In preparing for the replacement of contacts on wire-spring type relays, it is necessary to remove the contact cover and crosstalk shield (if provided) of the relay on which contacts are to be replaced. It is also necessary, in all cases, to disengage both legs of the balancing spring from the card.

**All Relays**

**3.02 Contact Cover:** Remove the contact cover from the relay to be worked on. Do not remove the covers from any other relays.

**3.03 Crosstalk Shield:** After removing the contact cover, remove the crosstalk shield, if provided, by grasping the upper or lower right side of the shield with the B long-nose pliers and pulling the shield straight out from the relay.

**AF-, AG-, AL-, and 12-Position AJ-Type Relays**

**All Contacts**

**3.04 Disengaging Balancing Spring Legs:**

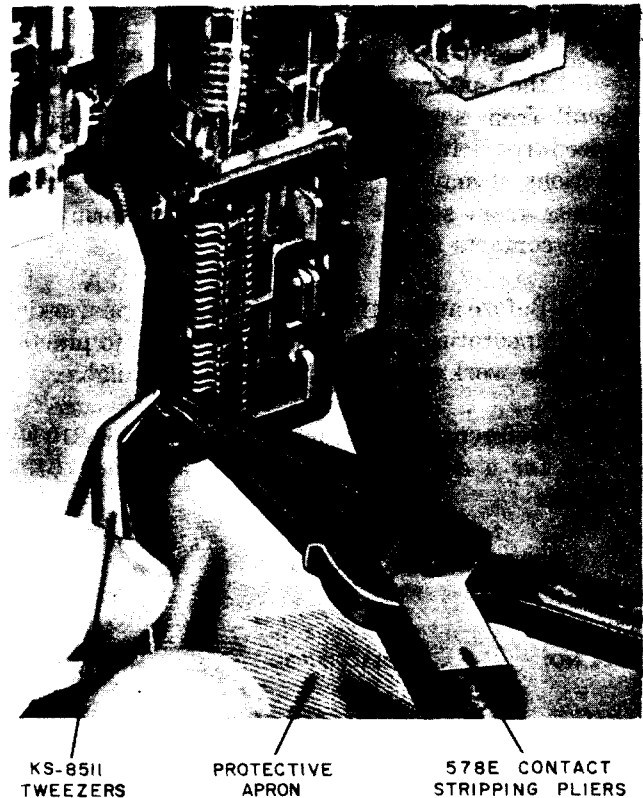
Disengage both balancing spring legs from the card as follows.

- (1) Block the relay operated using the 768A tool. Hold the 628A balancing spring lifter in the left hand, and insert the spring lifter next to the upper leg of the balancing spring with the end of the lifter just behind the comb. Roll the end of the lifter under this leg of the spring so the spring rests in the groove of the

lifter. Then draw the lifter forward as far as possible.

- (2) With the right hand, place the end of the KS-6320 orange stick on the edge of the card in line with the fixed contacts. Raise the spring with the spring lifter and, at the same time, press the card downward with the orange stick. When the spring clears the top of the card, move it toward the left so it is free of the card. Withdraw the spring lifter.

- (3) Disengage the lower leg of the spring in the same manner, except use the opposite end of the spring lifter. Roll this end of the lifter over the top edge of the leg, and push downward with the lifter while pressing upward with the orange stick against the bottom edge of the card. After both legs of the balancing spring are disengaged, remove the blocking tool. Figure 1 shows the balancing spring legs disengaged from the card.



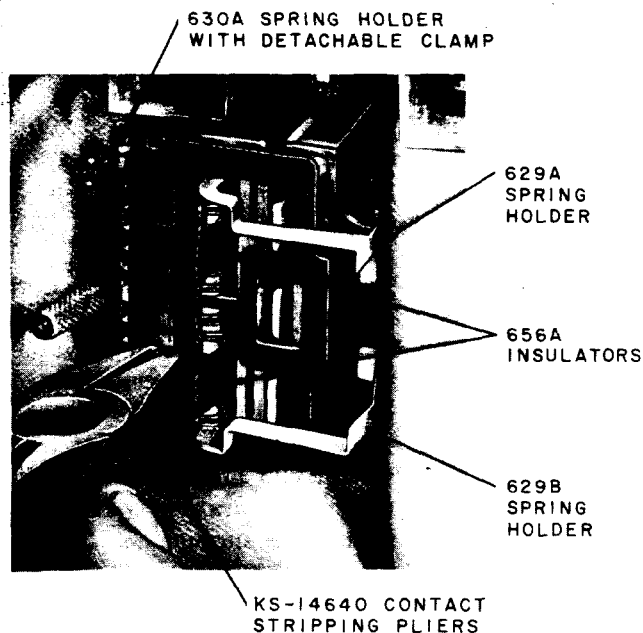
**Fig. 1—Removing Contact From Movable Twin Spring**

**Contacts on All Movable Twin Springs**

**3.05** No further preparation is required for replacing the contacts on these springs.

**Contacts on Fixed Springs****3.06 Relays Having Contact Cover Spring and Normally Closed (Break) Contacts**

- (1) On these relays, insert a 656A insulator to prevent shorting of the movable break contact springs with the contact cover spring during replacement of fixed contacts. If the relay has break contacts in both the 1 through 6 and 7 through 12 position groups, use two insulators. If only one of these groups has break contacts, only one insulator is required.
- (2) To insert a 656A insulator, hold the tab of the insulator with the offset portion toward the contact cover spring. Insert the insulator between the contact cover spring and the movable break contact springs until the insulator touches the spoolhead. Figure 2 shows the insulators in position.



**Fig. 2—Removing Contact From Fixed Spring**

- (3) Continue preparation of the relay as covered in 3.07.

**3.07 Relays Having Normally Closed (Break) Contacts**

- (1) On these relays, spring holders are required to hold the break contact springs away from the fixed contacts during replacement of fixed contacts. The 629A spring holder is used for positions 7 through 12 and the 629B spring holder for positions 1 through 6. If the relay has break contacts in both the 1 through 6 and 7 through 12 position groups, use both spring holders. If only one of these groups has break contacts, only the spring holder for that group is required.
- (2) To insert the 629A or B spring holder, proceed as follows. Hold the spring holder in one hand and, with the other hand, push the card to the right to open the gap between the fixed and break contacts sufficiently to insert the holder. Insert the notched leg of the holder into the gap with the six notches in line with the six positions (1 through 6 or 7 through 12) on the relay. Swing the outer end of the holder to the right, engaging each pair of twin break contact springs in the proper notches. Move the holder to the right, and clip the holder on the core plate. Release the card, and make sure each pair of twin springs is engaged by the proper notch in the spring holder. Figure 2 shows both spring holders in position.

**3.08 Relays Having Normally Open (Make) Contacts**

- (1) After the insulators and break contact spring holders, if required, have been positioned on the relay, use the 630A spring holder with detachable clamp to hold the make contact springs away from the fixed contacts as covered in (2), (3), and (4).
- (2) Pry the card from its position on the armature with the KS-6320 orange stick as follows. Place one end of the orange stick over the end of the center leg of the armature and under the adjacent edge of the card. Tilt the card outward with the orange stick so it can be moved over the ends of the armature legs, and remove the orange stick. With the right hand, push the card to the left to open the gap

between the fixed and make contacts sufficiently to permit the insertion of the spring holder without the clamp. With the left hand, insert the spring holder through this gap with the handle at the bottom and the notches facing away from the relay. Turn the handle to the left and release the card. Position the spring holder so its large projection is centered between positions 6 through 7 on the relay, and the pairs of twin make springs are engaged by the proper notches in the holder.

(3) After positioning the spring holder on the relay, place one end of the KS-6320 orange stick between the armature and adjacent edge of the card. Tilt the card inward with the orange stick so the card can be moved over the ends of the armature lugs. Then, with the orange stick, push the card inward against the core plate.

(4) Hold the clamp of the spring holder by the handle with the notch of the clamp pointing downward. Place the metal loop at the top of the clamp on the end of the spring holder that extends above the make contact springs. Move the clamp downward so that the notch in the bottom of the clamp engages the pin near the bottom of the spring holder. The clamp will hold the make contact springs in their proper notches in the spring holder.

(5) Using the 628A balancing spring lifter, place the outer end of the top leg of the balancing spring in the notch at the top of the spring holder. Similarly place the outer end of the bottom leg of the balancing spring in the notch at the bottom of the spring holder. Figure 2 shows the spring holder and clamp in position.

#### 24-Position AJ- and AL-Type Relays

##### All Contacts

**3.09 *Disengaging Balancing Spring Legs:***  
Disengage both balancing spring legs from the card as covered in 3.04.

##### Contacts on Twin Movable Springs

**3.10 *Springs in Positions 1 Through 12 (Left Row):*** No further preparation is required for replacing contacts on these springs.

#### **3.11 *Springs in Positions 13 Through 24 (Right Row)***

(1) Insert the pointed end of a modified KS-6320 orange stick between the two front molded assemblies as covered in (2) to provide sufficient clearance for the use of the stripping and welding pliers on contacts of these springs.

(2) Cut a piece, approximately 1 1/2 inches long, from one end of the orange stick. Insert the pointed end of this piece of orange stick in the space to the right of the left fixed contact springs of the relay so the tip of the orange stick just touches the comb of the right-hand molded section as follows. If contacts are to be replaced on twin movable springs in positions 13 through 18, insert the short length orange stick approximately midway between the upper and center legs of the card. If contacts are to be replaced on twin movable springs in positions 19 through 24, insert the orange stick approximately midway between the lower and center legs of the card. To prevent damaging the teeth of the comb, take care in using the orange stick not to exert pressure against the teeth. Move the orange stick to the left until it engages the side of the left molded assembly. Push this assembly to the left sufficiently to insert approximately 1/8 inch of the orange stick between the two assemblies. If the orange stick is inserted in the upper half of the relay, tilt it upward; if in the lower half, tilt it downward.

##### Contacts on Fixed Springs

**3.12 *Springs in Positions 1 Through 12 (Left Side):*** Position the 630A spring holder with detachable clamp to hold the left twin movable contact springs away from their associated fixed contacts as covered in 3.08.

**3.13 *Springs in Positions 13 Through 24 (Right Side):*** No further preparation is required for replacing contacts on these springs.

##### AK- and AM-Type Relays

##### All Contacts

**3.14 *Disengaging Balancing Spring Legs:***  
Disengage the balancing spring legs from the upper card as covered in 3.15 if replacing contacts in positions 8 through 12, or from the

lower card as covered in 3.16 if replacing contacts in positions 1 through 5. (See Fig. 3.)

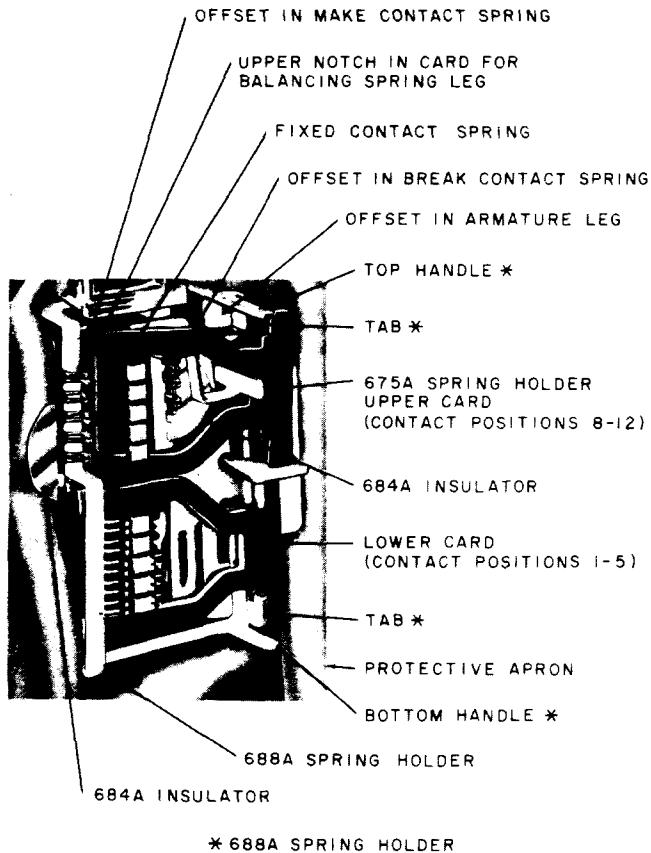


Fig. 3—688 Spring Holder Mounted on AK-Type Relay

### 3.15 *Balancing Spring Legs Engaging Upper Card*

(1) Block the associated armature in the operated position with the 768A tool. Hold the 628A spring lifter in the left hand, and insert the lifter next to the outer leg of the balancing spring with the end of the lifter just behind the comb. Roll the end of the lifter under this leg of the spring so the leg rests in the groove of the lifter. Then draw the lifter forward as far as possible.

(2) With the right hand, place the end of the KS-6320 orange stick on the top edge of the card adjacent to the notch for the balancing spring leg. Raise the spring with the spring lifter and, at the same time, press the card

downward with the orange stick. When the leg of the spring clears the top of the card, move it toward the left so it is free of the card. Withdraw the spring lifter.

(3) To disengage the inner balancing spring leg from the card, hold the orange stick in the right hand and insert it between the two cards so the end of the orange stick is against the front molded section. Rotate the orange stick to separate the cards. With a second orange stick, push down on the end of the balancing spring leg and disengage it from the notch in the card. After both legs of the balancing spring are disengaged, remove the blocking tool. Figure 3 shows the balancing spring legs disengaged from the upper card.

### 3.16 *Balancing Spring Legs Engaging Lower Card:*

Disengage the balancing spring legs from the lower card by following procedures similar to those covered in 3.15. In this case, however, roll the end of the spring lifter over the top edge of the outer leg of the balancing spring, and push this leg downward while pushing the card upward with the orange stick. Disengage the inner leg from the card by separating the cards with one orange stick and pushing the end of the leg upward with the second orange stick.

### Contacts on Movable Twin Break Springs

3.17 To prepare for replacing the contacts, proceed as follows.

(1) Insert a 684A insulator to prevent shorting of the movable break contact springs with the contact cover spring or the core plate. To do this, hold the insulator with the offset end to the right and insert the other end between the comb and core plate so the insulator passes to the left of the contact cover spring. Push the insulator inward until the beginning of the offset touches the core plate. Moving the insulator laterally while inserting it may facilitate positioning. Make sure the insulator is positioned so it will insulate all the break contact springs. Figure 3 shows the insulator in position.

### Contacts on Movable Twin Make Springs

3.18 To prepare for replacing these contacts, proceed as follows.

(1) If there is an AF-, AG-, AJ-, AK-, AL-, or AM-type relay mounted at the left, insert the 684A insulator to prevent shorting of the movable make contact springs against the core plate of the adjacent relay when these springs are held out of the comb grooves for replacement of contacts. If the relay is mounted adjacent to other apparatus against which the make contact springs may be shorted, insert a 684A insulator between the adjacent apparatus and one or both of the disengaged balancing spring legs as necessary.

(2) To insert a 684A insulator to prevent shorting of the make contact springs, proceed as follows. Using a KS-6320 orange stick, move the inner balancing spring leg to the right. Hold the insulator with the offset end to the left, and insert the other end between the balancing spring leg and the core plate of the adjacent relay. Release the balancing spring leg so it presses against the insulator. With the KS-8511 tweezers, position the insulator so it will insulate all make contact springs from the core plate. With the protective apron in place around the relay, the outer portion of the insulator should rest against the apron as shown in Fig. 3. Due to variations in positioning of the apron, it would be undesirable to rely on the apron to insulate the make contacts.

**Contacts on Fixed Springs**

**3.19 Relays Having Normally Closed (Break) Contacts**

(1) On these relays, insert a 684A insulator, as covered in 3.17, to prevent shorting of the movable break contact springs with the contact cover spring or core plate during replacement of fixed contacts.

(2) After positioning the insulator as covered in (1), insert spring holders to hold the break contact springs away from the fixed contacts. The 675A spring holder is used for break contact springs in the upper half of the relay (positions 8 through 12) and the 675B spring holder for break contact springs in the lower half (positions 1 through 5). Each of the spring holders has five notches to engage the five pairs of break contact springs with which it may be used. It is important that the pairs of springs are engaged by the proper notches in the holder.

(3) To mount the 675A or B spring holder, proceed as follows. With the right hand, apply the KS-6320 orange stick to the right inner edge of the card and move the card as far to the right as possible. Holding the spring holder in the left hand, insert the notched section of the holder behind the break contacts. Release the card. Swing the handle of the spring holder to the right, and position the holder so each pair of break contact springs is engaged by the proper notch and the inner end of the handle is clipped in the core plate slot directly in front of the armature. Make sure the notched section of the holder is against the comb. Figure 3 shows the 675A spring holder in position in the upper half of the relay.

**3.20** Continue preparation of the relay as covered in 3.21.

**3.21 Relays Having Normally Open (Make) Contacts**

(1) Insert a 684A insulator, as covered in 3.18, if there is an AF-, AG-, AJ-, AK-, AL-, or AM-type relay mounted at the left to prevent shorting of the movable make contact springs against the core plate of the adjacent relay during replacement of fixed contacts.

(2) After the insulators and break contact spring holders, if required, have been positioned on the relay, use the 688A and B spring holders to hold the make contact springs away from the fixed contacts as covered in (3), (4), and (5). The 688A spring holder is used for break contact springs in the upper half of the relay (positions 8 through 12) and the 688B spring holder for the break contact springs in the lower half (positions 1 through 5). Each of the spring holders has five notches to engage the five pairs of make contact springs with which it may be used. It is important that the pairs of springs are engaged by the proper notches in the holders. Each of the spring holders has a top and a bottom handle. On the 688A spring holder, the bottom handle is adjacent to the unnotched section; while on the 688B, it is adjacent to the notched section.

(3) To mount the 688A or B spring holder, first disengage the card from the armature legs as follows. Apply the KS-6320 orange stick to the right side of the outer leg of the armature

behind the card, and hold the armature in the unoperated position. Grasp the upper section of the card with the KS-8511 tweezers. Move the card to the right to disengage it from the armature leg, and then pull the card forward so it is in front of the armature legs. Remove the orange stick and tweezers.

(4) With the right hand, apply the KS-6320 orange stick to the right side of the card and move the card as far to the left as possible. With the other hand, hold spring holder by the bottom handle and insert the notched section of the holder between the make contacts so that it touches the card. Swing the handle of the holder to the right, and position the notched section behind the make contacts. Release the card. Then, using both hands, grasp the top and bottom handles of the spring holder. Position the holder so its tab is adjacent and in front of the card, and the pairs of make contact springs are engaged in the proper notches. Then, with the springs in the notches, move the holder to the left, and position it so each tab rests against the left side of the adjacent armature leg. Make sure the notched section of the holder is against the offset in the make contact springs, and the inner edge of each tab is against the offset in the armature legs.

(5) Apply the orange stick to the right side of the outer leg of the armature behind the notch for the card, and hold the armature in the unoperated position. Grasp the upper section of the card with the tweezers, and move the card to the right and back so the card is in line with the notch in each armature leg. Then remove the orange stick from the armature, and guide the card in the notches. Figure 3 shows the 688A spring holder position.

## 286-, 287-, and 288-Type Relays

### Contacts on All Movable Twin Springs

◆**Note:** The movable (twin) silver contacts are 0.025 inch thick on relays manufactured prior to third quarter 1974 (date is stamped under code on side-arm bracket) and 0.015 inch thick thereafter and may be tarnished dull black. Original movable (twin) palladium contacts are 0.010 inch thick and have a bright gold overlay. Replace both movable (twin)

contacts and associated fixed contact with the following replacement contacts:

P-19A353—fixed—all cases

P-16A180—movable—replaces all 0.010-inch contacts and 0.015-inch silver

840054787—movable—replaces 0.025-inch silver◆

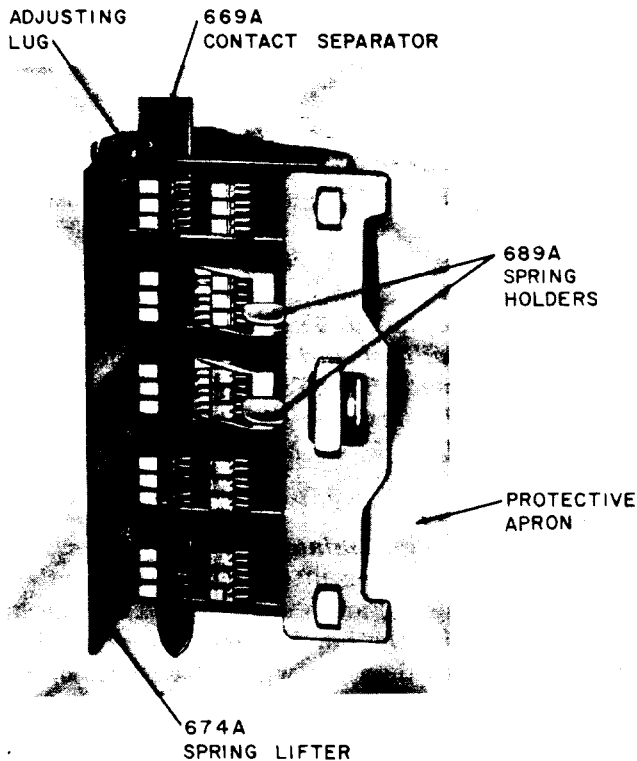
**Caution:** *When replacing contacts on multicontact relays, both twins and fixed will be replaced. The replacement contacts are palladium and mating surfaces must be like material. ◆The following codes will probably have original silver contacts: 286G, H, J, K, L, M, 287E, F, G, H, and 288C.◆*

**3.22 Disengaging Balancing Spring Legs:** Place the 674A spring lifter against the right side of the cover spring and the ends of the balancing spring legs with the bevel toward the card. Hold the card toward the right with the KS-6320 orange stick, and move the spring holder slightly to the left to disengage the balancing spring legs from the card. Then insert the spring lifter between the adjusting lugs and the cover spring and balancing spring legs until the outer edge of the lifter is in line with the outer edge of the cover spring. Push the card inward against the core plate using the orange stick. Figure 4 shows the 674A spring lifter in position.

**3.23** No further preparation is required for replacing the contacts on these springs.

### Contacts on All Fixed Springs

**3.24 Inserting 669A Contact Separator:** Insert the 669A contact separator between the fixed and the movable contact spring as follows. When working on 286-type relays or the top unit of 287- and 288-type relays, insert the separator from the top; when working on the bottom unit of 287- and 288-type relays, insert the separator from the bottom. Hold the separator with the hook portion at the left, and carefully insert the tip of the separator behind the card and between the fixed and movable contact springs of the vertical row on which the fixed contact is to be replaced. Then place the end of the KS-6320 orange stick so it bears lightly against both the right edge of the separator and the adjacent edge of the card to guide the separator during insertion. Slowly insert the separator while maintaining light pressure



**Fig. 4—287- and 288-Type Relay—Preparing Relay for Replacing Fixed Contacts in Left Vertical Row**

on the orange stick. Keep the separator vertical so the movable contact springs will remain in their proper horizontal positions, and move the separator downward or upward, as required, only far enough to separate all contacts in the 3-position group below the group in which the fixed contact is to be replaced. However, if the card is pushed forward due to the separator touching adjacent apparatus, insert the separator sufficiently to clear the apparatus. Figure 4 shows the separator in position for replacing fixed contacts in the left vertical row.

### **3.25 Disengaging Balancing Spring Legs:**

Disengage the balancing spring legs as covered in 3.22.

**3.26** No further preparation is required for replacing contacts in the right row. If replacing contacts in the left row, continue preparation of the relay as covered in 3.27 and 3.28.

### **Left Vertical Row of Fixed Contacts**

#### **3.27 Inserting 689A Spring Holder:**

Hold the 689A spring holder with the legs that are in line with the handle toward the right. Insert the vertical portion of the holder between the fixed and movable contacts in the group containing the fixed contact to be replaced. With the vertical portion behind the offset in the movable contact springs, swing the spring holder to the right so the vertical portion engages each pair of movable contact springs in the group. Insert the legs of the holder in the extreme right rectangular opening in the card with the movable contact springs between the legs, and push the holder inward as far as possible.

**3.28** If the top of bottom fixed contact of a 3-position group is to be replaced, insert a second 689A spring holder, as covered in 3.27, in the 3-position group adjacent to the contact to be replaced. Figure 4 shows two 689A spring holders in position.

### **PREPARATION OF TOOLS AND MATERIALS**

#### **3.29 Protective Apron**

- (1) Before replacing contacts, make a protective apron using a KS-14666 cloth as covered in (2), and position it on the relay as covered in (3) to prevent contacts from falling into adjacent apparatus.
- (2) Make a 6-inch fold with the KS-14666 cloth, and stitch the sides of the fold to form a pocket the full width of the cloth. Just above the pocket, at about the center of the cloth, cut a hole which, after turning back the edges and hemming to prevent unraveling, will be about 1 3/4 inches square, for use on AF-, AG-, AJ-, AK-, AL-, and AM-type relays; or about 2 inches by 3 inches for use on 286-, 287-, and 288-type relays.
- (3) Place the apron on the relay on which contacts are to be replaced so the relay extends through the square hole in the apron. Using the KS-6320 orange stick, push the edges of the apron around the hole to a position back of the front molded section of the relay. Arrange the apron so contacts removed from the relay will fall into the pocket.



**3.30 *KS-8511 Tweezers:*** Blunt the KS-8511 tweezers to be used for handling contacts by filing off the points slightly with the R-1051 file. Clip off the pin in the tweezers using the 5-inch diagonal pliers.

**3.31 *Cleaning Electrodes:*** Before welding contacts, make sure the surfaces of the electrode which engage the contact and the grooves in the electrodes which hold the spring in position for welding are clean. If necessary, clean these parts with a narrow rubber pencil eraser, followed by wiping with a clean KS-2423 cloth. If this procedure does not prove adequate for the electrode grooves, clean the grooves with a few light strokes of the aloxite cloth. If the electrodes are worn or damaged, replace them as covered in Section 069-310-801.

#### **Contact Welding Equipment**

**3.32** Locate the welding equipment so the apparatus on which the contacts are to be replaced can be reached easily with the welding pliers. In order to ensure proper operation of the relays in the current supply set circuit, the set must be in a horizontal position with the bottom of the carrying case downward. The bottom of the carrying case is that side to which the cover hinge is attached. Position the 586B holder on the carrying case and strap it in place.

**3.33** If the carrying case is to be mounted on a rolling ladder, secure it to the ladder by passing the strap around both side rails of the ladder and through each loop of the carrying case and 586A holder and fasten the strap.

**3.34** Connect the plug of the current supply set to a source of 50- to 60-cycle, 105- to 125-volt ac supply.

**3.35** Check the functioning of the circuit by holding the electrodes of the welding pliers open, and then depressing and releasing the control button. Note that the relays operate and release as determined by the sound. If the relays fail to operate, check that the current supply set is properly connected to the ac supply, and if necessary, check to see whether the fuse has operated.

## **4. CONTACT REPLACEMENT**

### **GENERAL**

**4.01** If a contact on one of a pair of movable twin springs is satisfactory and the contact on the other spring of the pair is not satisfactory, do not replace these contacts until both require replacement. When necessary to replace contacts on a pair of movable twin springs, do not replace their mating fixed contact unless it also is unsatisfactory. When the mating contact is not replaced, condition it, if necessary, as covered in Section 069-306-801.

**4.02** Complete the replacement of contacts on movable twin springs of the relay before starting the replacement of contacts on fixed springs, or vice versa, in order to avoid repeating the mounting and removing of spring holders.

**4.03** Remove and weld each pair of contacts on movable twin springs in sequence, starting from the lowest position. In order to avoid the possibility of overlooking missing contacts, do not remove contacts to be replaced on movable twin springs before starting the welding of replacing contacts.

**4.04** Before proceeding with the replacement of contacts, prepare the relay as covered in Part 3.

### **REMOVING CONTACTS**

#### **All Relays Except 24-Position AJ- and AL-Type Relays**

##### **Contacts on Movable Twin Springs**

**4.05** To remove the contact from a movable twin spring, grasp the spring with the KS-8511 tweezers just behind the bend as shown in Fig. 1. Move the spring out of the comb sufficiently to apply the contact stripping pliers as covered in 4.06.

**4.06** Open the 578E contact stripping pliers, and place them on the spring so the slotted jaw straddles the short offset portion of the spring behind the contact as shown in Fig. 1. Position the pliers so the end of the spring rests against the end of the slot and only the contact projects above the surface of the jaw. In this position, the hooked jaw of the pliers is directly behind the

contact. Hold the pliers in line with the end of the spring as shown in the figure. Remove the contact by compressing the pliers.

**4.07** Use the 578J contact stripping pliers to remove the 25 mil high contacts on multicontact relays. Procedure is the same as 4.06.

**Caution:** *To avoid damage to the spring, take care the end of the spring does not project above the surface of the jaw of the pliers before compressing the pliers.*

**4.08** After removing the contact, check that all contact metal has been removed by the pliers. If it has not, repeat the procedure described in 4.06 until all contact metal has been removed. Then place the spring in its proper groove in the comb.

#### **Contacts on Fixed Springs**

##### **4.09 All Contacts Except Those in Left Vertical Row of 286-, 287-, and 288-Type Relays:**

Place the KS-14640 contact stripping pliers on the spring with the groove in the hooked jaw engaging the left side of the spring just behind the contacts as shown in Fig. 2. Hold the pliers in line with the spring, and position the pliers so the longer side of the notch in the straight jaw touches the contact. If the contact is a replacement (U-shaped) contact, position the pliers so the leg of the U rests in the notch in the straight jaw of the pliers. Remove the contact by compressing the pliers.

**4.10 Contacts in Left Vertical Row of 286-, 287-, and 288-Type Relays:** Remove the contact as covered in 4.08 except apply the hooked jaw of the pliers on the right side of the spring.

#### **24-Position AJ- and AL-Type Relays**

##### **Contacts on Movable Twin Springs**

**4.11** Remove contacts from movable twin spring positions 1 through 12 (left row) as covered in 4.05, 4.06, and 4.07. To remove contacts from movable twin springs in positions 13 through 24 (right row), move the spring out of the comb with a toothpick sufficiently to apply the 578E contact stripping pliers. Remove the contact as covered in 4.06 and 4.07.

##### **Contacts on Fixed Springs**

**4.12** Remove contacts from springs in positions 1 through 12 (left row) as covered in 4.08. To remove contacts from fixed springs in positions 13 through 24 (right row), move the mating pair of movable twin springs out of the comb with a toothpick sufficiently to apply the KS-14640 contact stripping pliers. Remove the contact as covered in 4.08, except apply the hooked jaw of the pliers on the right side of the spring.

##### **All Relays**

**4.13** If the contact removed is the original contact and not a replacement (U shaped) contact, cut the stripped end of the fixed contact spring as covered in 4.14 and 4.15 to obtain a better alignment between the replacing (U shaped) contact on the fixed spring and mating contacts on the movable springs.

**4.14** On all fixed contact springs except those in the left vertical row of 286-, 287-, 288-type relays and positions 13 through 24 (right row) of 24-position AJ- and AL-type relays, apply the hooked jaw of the KS-16735 L1 pliers on the left side of the spring when cutting off the end of the spring as covered in 4.15. On fixed contact springs in the left vertical row of 286-, 287-, and 288-type relays, apply the hooked jaw of the pliers to the right side of the spring. On fixed contact springs in positions 13 through 24 (right row) of 24-position AJ- and AL-type relays, move the mating pair of movable twin springs out of the comb with a toothpick sufficiently to apply the hooked jaw of the pliers to the right side of the fixed spring.

**4.15** Open the KS-16735 L1 cutting pliers so the end of the hooked jaw just clears the straight jaw of the pliers. Place the pliers on the spring so the end of the hooked jaw rests on the proper side of the spring (see 4.14), and push the pliers forward to bottom the end of the spring in the recess in the end of the straight jaw. Hold the pliers in line with the spring and cut off the portion of the spring in the recess by compressing the pliers.

**Caution:** *This procedure does not apply to springs from which a replacement (U-shaped) contact has been removed.*

## WELDING CONTACTS

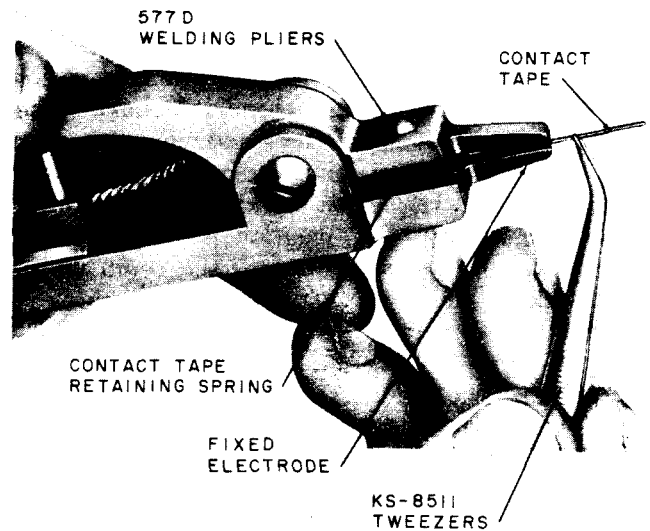
**4.16** Place the contact on the proper electrode as covered in 4.17 and 4.18. In all cases, make sure the welding pliers, when not being used, are latched in the open position to prevent damage to the electrodes. Before using the welding pliers, check that the welding cords are not twisted or tangled.

**Caution:** *The 840056584 electrode will only be used with the 840054787 multicontact tape, and P-16A180 tape will only be used with the P-10A887 electrode. Failure to observe these rules will result in damage to the welding pliers. The slot depth in the P-10A887 electrode is 0.006 inches and in the 840056584 electrode is 0.021 inches.*

### Positioning Contact on Welding Pliers Electrode

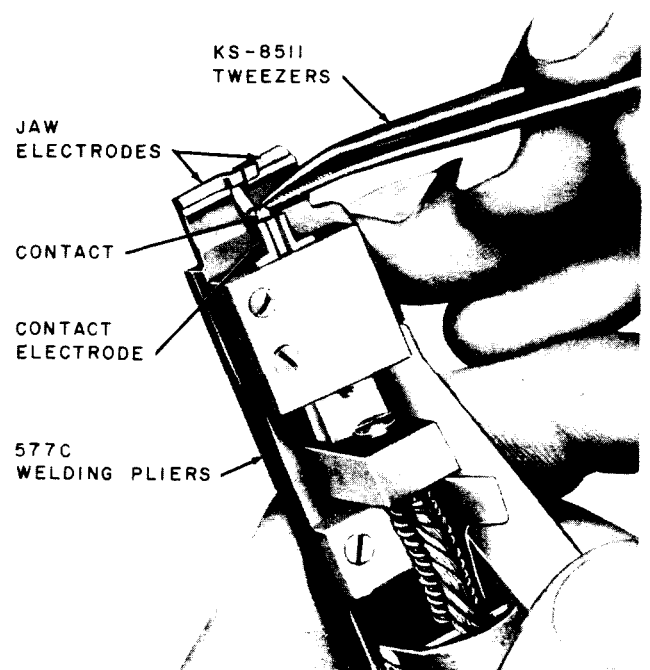
**4.17 577D Welding Pliers (For Contacts on Movable Spring):** Grasp the contact tape approximately 1 inch from one end with the KS-8511 tweezers. Then, while holding the welding pliers with the electrode jaws fully open, place the flat surface of the contact tape in the groove in the fixed electrode with the beaded surface of the tape toward the movable electrode. Insert the tape under the retaining spring as shown in Fig. 5. Push the tape inward with the tweezers until its end is flush with the end of the electrode. Then, using the tweezers as pliers, press the tape against the electrode so it lies flat in the groove. If difficulty is encountered in properly seating the tape in the groove, remove the tape and bow it slightly with the beaded surface on the outside of the bow. If the pliers are not to be used immediately, make sure the pliers are latched in the open position.

**4.18 577C Welding Pliers (For Contacts on Fixed Springs):** Make sure the contact electrode is in its latched position. Grasp the contact at the base of the U with the KS-8511 tweezers so the sides of the U will be properly positioned for placing the contact on the electrode. In the case of the P-19A353 contact for 286-, 287-, and 288-type relays, position the U so its thicker side (gold overlay) will be toward the jaws of the pliers for welding the contact on a spring in the left vertical row of the relay and away from the jaws for welding in the right vertical row. Place the contact on the electrode so the sides of the



**Fig. 5—Positioning Contact Tape in 577D Welding Pliers**

U straddle the end of the electrode as shown in Fig. 6. After placing the contact on the electrode, use the side of the handle end of the tweezers to push it fully against the electrode.



**Fig. 6—Positioning U-Shaped Contact in 577C Welding Pliers**

**Welding Contacts on Movable Twin Springs**

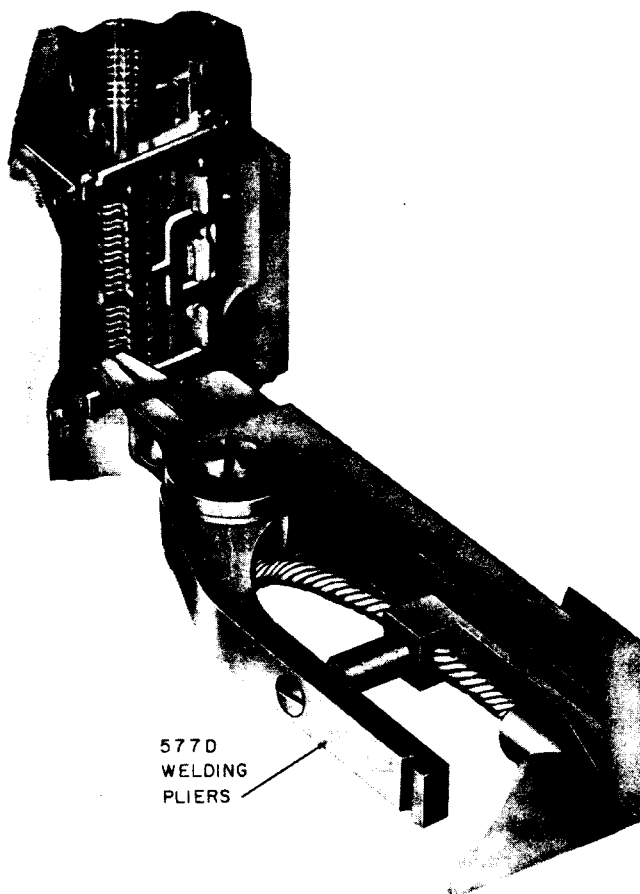
**4.19** To weld a contact on a movable twin spring, grasp the spring behind its short offset portion with KS-8511 tweezers, and move the spring out of the comb sufficiently to permit the use of the welding pliers. When working on twin springs in the right row of 24-position AJ- and AL-type relays, move the spring out of the comb with a toothpick as there is insufficient space in this case to use the tweezers.

**4.20** With the contact tape positioned in the 577D welding pliers as covered in 4.16, hold the pliers with the latch released and the jaws of the pliers slightly open. Place the pliers over the spring so the slot in the movable electrode straddles the short offset portion of the spring as shown in Fig. 7. Hold the pliers horizontally and in line with the end of the spring as shown in the figure. Make sure the offset portion of the spring is seated in the slot of the electrode, and that the front end of the spring rests fully in the recess in the electrode. If necessary, move the pliers slightly until the spring is firmly seated in the electrode. Then release the pressure on the handles of the pliers to close the jaws, and hold the contact firmly in position on the contact spring as shown in the figure. Remove the tweezers from the spring.

**4.21** Hold the pliers in a horizontal position in line with the end of the spring as shown in Fig. 7 with no hand pressure on the handles of the pliers. Depress and release the control button of the current supply set. Do not operate the control button more than once for any one welding operation. Holding the control button depressed will have no effect since the time control relay in the current supply set is held locked until the control button is released.

**Caution:** *Failure to carefully follow these procedures may cause either a poor weld or burning of the spring.*

**4.22** Compress the handles of the pliers to open the jaws, and withdraw the pliers from the spring by moving them horizontally away from the spring for a distance of approximately 1 inch. In doing this, the contact tape is pulled along the fixed electrode which serves as a check of the weld. Cut off the contact tape even with the end



**Fig. 7—Welding Contact on Movable Twin Spring**

of the spring using the KS-14641 cutting pliers as shown in Fig. 8.

**4.23** Latch the jaws of the welding pliers in the open position. Push the contact tape inward with the tweezers until the end of the tape is flush with the electrode.

**Welding Contacts on Fixed Springs**

**4.24** With a contact positioned in the 577C welding pliers as covered in 4.14 and with the contact electrode in the latched position, open the jaws of the pliers sufficiently to engage the end of the fixed spring. Except in the case of fixed springs in the left row of 286-, 287-, and 288-type relays and fixed springs in the right row of 24-position AJ- and AL-type relays, covered in 4.25 and 4.26, hold the pliers at an angle toward the right with the jaw electrodes just to the left of the fixed

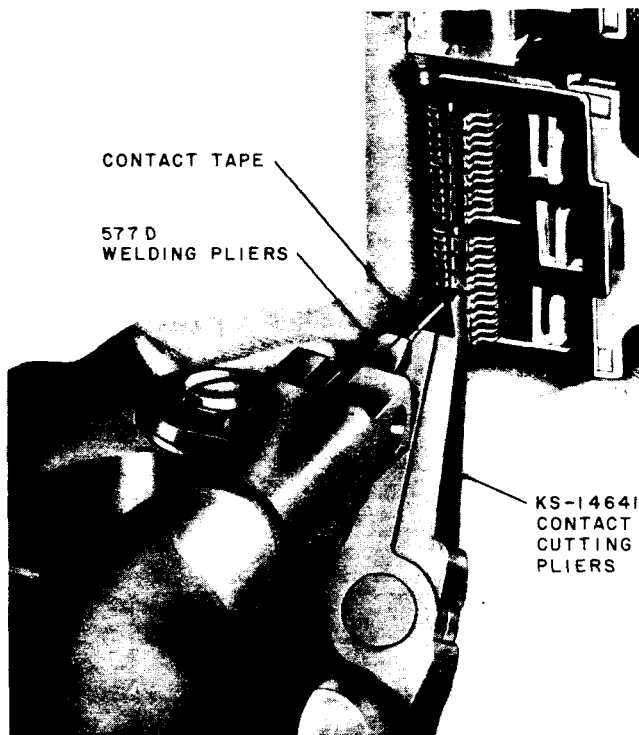


Fig. 8—Cutting Contact Tape

spring on which the contact is to be welded. Position the pliers so the projections on the jaw electrodes are behind the adjacent fixed contacts, and the opening between the electrodes is in line with the spring. Hold the welding pliers horizontally, and move them toward the spring until the end of the spring is between the grooves of the jaw electrodes. Then move the pliers inward so the electrodes touch the card. Release the pressure on the handles of the pliers. Make sure the end of the spring is firmly seated in the jaw electrode grooves, and the insulators on the electrodes are behind the adjacent fixed contacts.

**4.25** In welding a contact on a spring in the left vertical row of 286-, 287-, and 288-type relays, hold the welding pliers with the jaw electrodes to the right of the fixed spring on which the contact is to be welded and position the jaw electrode on the spring as covered in 4.24.

**4.26** In welding a contact on a fixed spring in the right row of 24-position AJ- and AL-type relays, use a toothpick to block the twin movable springs associated with the fixed spring away from the fixed contacts. Place the toothpick under the

offset portion of the pair of twin movable springs, and move the toothpick to the left. Position the toothpick against the other movable twin springs in the row to hold the two springs in the blocked open position. Hold the welding pliers with the jaw electrodes to the right of the fixed spring on which the contact is to be welded. Position the jaw electrodes on the spring as covered in 4.24.

**4.27** After positioning the pliers as covered in 4.24 through 4.26, hold them so the side of the jaw electrodes is parallel to the fixed contacts. Hold the pliers in line with the spring, and release the latch to move the contact electrode forward to the welding position as shown in Fig. 9. Then, with all hand pressure removed from the handles of the pliers, depress and release the control button of the current supply set. Do not operate the control button more than once for any one welding operation. Holding the control button depressed has no effect since the time control relay of the current supply set is held locked until the control button is released.

**Caution:** *Failure to carefully follow these procedures may cause either a poor weld or burning of the spring.*

**4.28** After welding, remove the pliers from the fixed spring as follows. Latch the contact electrode. Compress the handles of the pliers to open the jaws sufficiently to clear the fixed spring. Remove the pliers by moving them sideways to the left or right, horizontally, until the jaw electrodes clear the fixed spring. Withdraw the pliers, tilting them if necessary.

#### Aligning Welded Contacts

**4.29 General:** After welding, check the alignment of the welded contact and adjust, if necessary, as covered in 4.30 and 4.31. Since adjusting for contact alignment introduces the possibility of damaging the spring or contact, extreme care should be exercised during the welding operation to minimize the need for aligning the contact. Adjustment for contact alignment will not be necessary in most cases, if the welding procedures have been followed properly.

**4.30 Contacts on Movable Twin Springs:** If the contact welded on a movable twin spring is tilted sideways (to the left or right), compared with the contacts on other movable twin springs

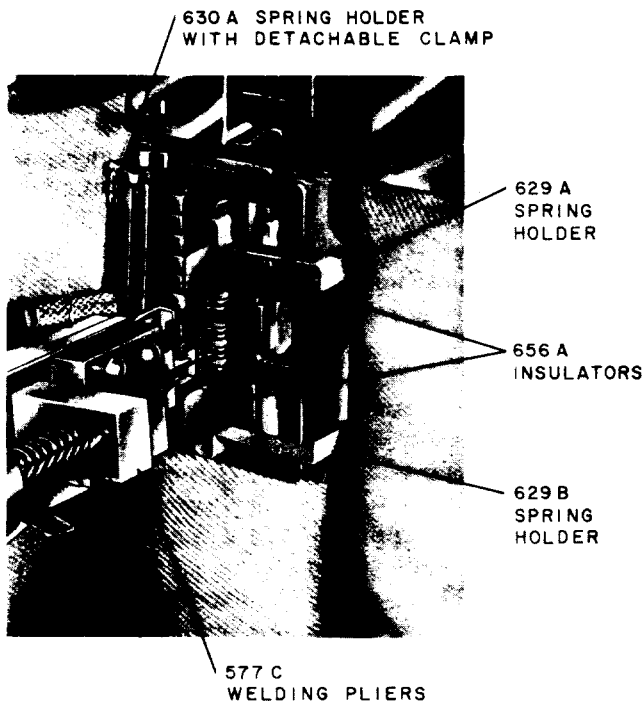


Fig. 9—Welding Contact on Fixed Spring

in the row, align the contact as follows. Place the slot in the side of the 638A adjuster on the short offset portion of the movable twin spring as shown in Fig. 10. Hold the adjuster horizontally, and bend the offset portion of the spring slightly to the left or right as required. While making the adjustment, avoid lifting the spring out of the comb, and maintain slight pressure on the adjuster toward the contact end of the spring in order to prevent distorting the main body of the spring. Remove the adjuster and recheck the alignment. If necessary, repeat the procedure. Do not adjust the spring more than necessary, as repeated adjustments may distort the spring.

**4.31 *Contacts on Fixed Springs:*** If the sides of the U-shaped contact welded on a fixed spring are not in line vertically with the sides of contacts on other fixed springs in the row, align the sides of the U using the 638A adjuster for the contact on all except 286-, 287-, and 288-type relays (P-10A949 contact) and the 638B adjuster for the contact on 286-, 287-, and 288-type relays (P-19A353 contact) as follows. Place the slot in the end of the 638A adjuster on the side of the U to be adjusted as shown in Fig. 11. Hold the

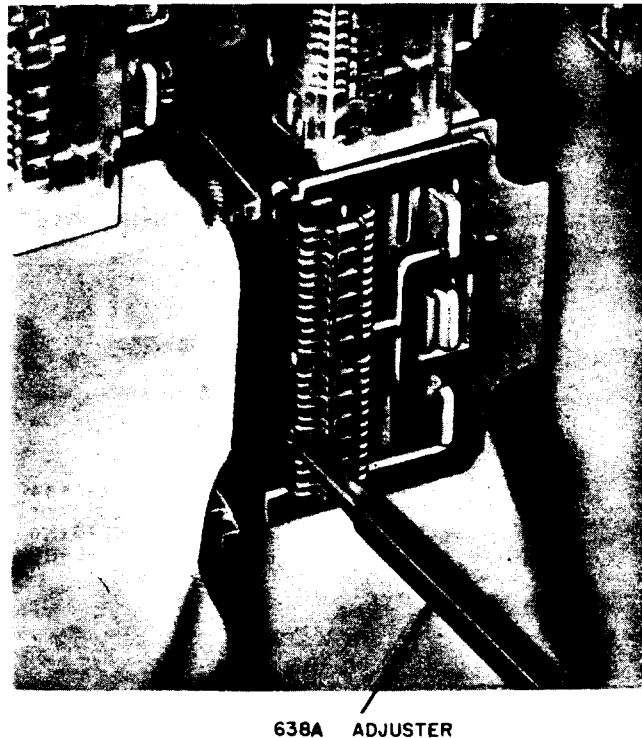


Fig. 10—Aligning Contact on Movable Twin Spring

adjuster horizontally, and bend the side of the U slightly to the left or right as required. Remove the adjuster and recheck the alignment. If necessary, repeat the procedure. Do not adjust more than necessary, as repeated adjustment may weaken the side of the contact.

**4.32** If the contact cannot be aligned as covered in 4.31 due to incorrect positioning of the contact on the spring during welding, remove the contact as covered in 4.09, 4.10, or 4.12 and weld a new contact as covered in 4.24 through 4.28.

#### Checking Contact Welds

**4.33** Contact welds on movable twin springs are checked by withdrawal of the welding pliers as described in 4.23. Contact welds on fixed springs are checked by the alignment adjustment on the sides of the U-shaped contact as covered in 4.31. If U-shaped contacts do not require alignment adjustment, check the weld by applying light pressure with a toothpick at the top edge of the base of the U.

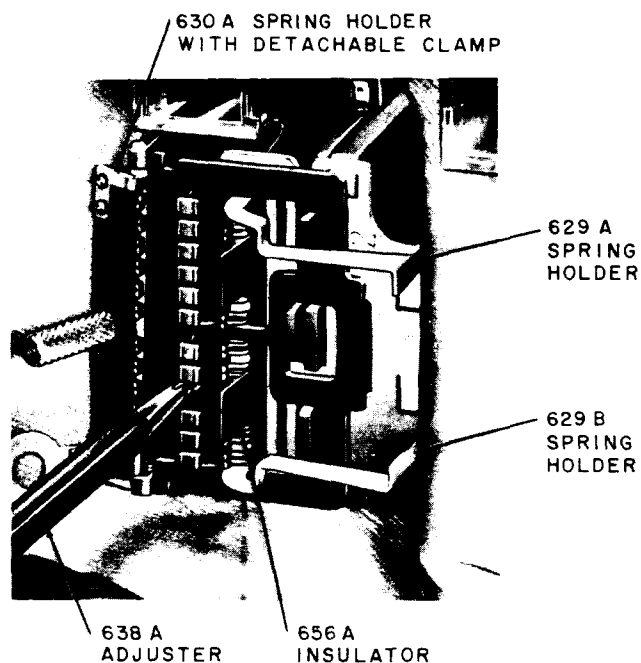


Fig. 11—Aligning Tang of Fixed Contact

**4.34** Failure to obtain a satisfactory weld may be due to the welding pliers not latching open, the associated welding pliers not being used, or to poor contact between the spring and the replacing contact, between the electrode and contact, or between the electrode and spring. Check the welding pliers not being used, latching them open, if necessary. Check the surface of the electrodes and clean them, if necessary, as covered in 3.35. If electrodes are worn or damaged, replace them as covered in Section 069-310-801.

#### FINAL PROCEDURES

##### Removing Tools and Reengaging Balancing Spring Legs

##### AF-, AG-, AJ-, and AL-Type Relays

**4.35** *630A Spring Holder With Detachable Clamp:* Grasp the handle of the 630A spring holder with the left hand, and move it slightly to the left. With the balancing spring holder in the other hand, disengage the top leg of the balancing spring and then the bottom leg from the notches of the holder. Carefully move the spring holder to the right, permitting the movable make contact springs to enter their proper grooves

in the comb. Remove the clamp from the spring holder. Pry the card from its position on the armature with the KS-6320 orange stick as follows. Place one end of the orange stick over the end of the center leg of the armature and under the adjacent edge of the card. Tilt the card outward so it can be moved over the ends of the armature legs. With the right hand, push the card to the left to open the gap between the fixed and movable contacts sufficiently to permit withdrawing the spring holder. Swing the holder to the right and withdraw it. Release the card. Place one end of the orange stick between the armature and adjacent edge of the card. Tilt the card inward using the orange stick so the card can be moved over the ends of the armature legs. Then, with the orange stick, push the card inward against the core plate.

**4.36** *629A and B Spring Holders:* Push the card to the right. Unclip the holder from the core plate and move it to the left, permitting the movable break contact springs to enter their proper grooves in the comb. Swing the holder to the left, and withdraw it through the gap between the fixed and movable contacts. Release the card. Make sure each movable break contact spring is in its proper groove in the comb.

**4.37** *656A Insulator:* Grasp the tab of the insulator, and remove it by pulling it out from the relay.

**4.38** *Reengaging Balancing Spring Legs:* Block the relay operated with the 768A tool. Reengage the ends of the balancing spring legs in their respective notches in the card, employing a method similar to that covered in 3.04 for disengaging the spring. Remove the blocking tool. Make sure the card is properly engaged on the armature.

##### Other Tools

**4.39** Remove the orange stick, toothpick, and apron from the apparatus if these were used.

##### AK- and AM-Type Relays

**4.40** *675A and B Spring Holders:* With the left hand, apply the KS-6320 orange stick to the left portion of the card and hold the card against the front molded section of the relay. Grasp the handle of the spring holder with the right hand, and move the holder outward so the notched section is against the offset in the springs.

Move the holder to the left, and guide the movable break springs into their proper comb grooves. Then, still holding the spring holder, apply the orange stick to the left side of the card, and move the card to the right as far as possible while keeping the card against the front molded section. Move the spring holder to the left against the fixed contact springs, and withdraw it by moving it vertically upward from the upper half of the relay or downward from the lower half.

**4.41 688A and B Spring Holders**

(1) First, make sure the card is against the front molded section of the relay, and the notched section of the holder is against the offset in the make contact springs. Using both hands, grasp the handles of the holder, and carefully pull them outward to disengage the holder tabs from the armature legs. With the notched section of the holder against the offset in the make contact springs so that the notched section clears the card, carefully move the holder to the right, and guide the springs into their proper comb grooves. Then disengage the notched section of the holder from the springs.

(2) Disengage the card from the armature legs as follows. Apply the KS-6320 orange stick to the right side of the outer leg of the armature behind the card, and hold the armature in the unoperated position. Grasp the upper section of the card with the KS-8511 tweezers, and move the card to the right and outward to disengage it from the armature legs. With the orange stick applied to the right side of the card, hold the card as far as possible to the left. Grasp the bottom handle of the holder, swing it outward, and carefully withdraw the notched section through the gap between the make contacts. Release the card.

(3) Remount the card in the armature leg notches as follows. Apply the KS-6320 orange stick to the right side of the outer leg of the armature behind the notch for the card, and hold the armature in the unoperated position. Grasp the upper section of the card with the KS-8511 tweezers, and move the card to the right and back so the card is in line with the notches in each armature leg. Remove the orange stick from the armature, and guide the card into the notches.

**4.42 Engaging Balancing Spring Legs on Card:**

Block the relay operated using the 768A tool. Engage the outer balancing spring leg in its associated notch in the card employing a method similar to that covered in 3.18 for disengaging the spring leg. Engage the other balancing spring leg in its associated notch in the card by separating the cards with a KS-6320 orange stick as covered in 3.18. Then grasp the end of the leg with the KS-8511 tweezers, align the leg in the notch, and remove the orange stick. Make sure the leg properly engages the notch in the card. Remove the wedge from the relay, and check that the card is properly engaged in the notches of the armature legs.

**4.43** Remove the protective apron.

**286-, 287-, and 288-Type Relays**

**4.44 689A Spring Holder:** Unclip the legs of the holder from the card, and carefully move the holder to the left making sure the movable break contact springs enter their proper comb grooves. Swing the holder to the left, and withdraw it through the gap between the fixed and movable contacts. Check for proper positioning of the movable break contact springs in their comb grooves.

**4.45 674A Spring Lifter:** Grasp the spring lifter, and remove it by pulling it out from the relay. Position the card so the balancing spring legs engage the associated legs of the card.

**4.46 669A Contact Separator:** Grasp the top edge of the separator and remove it, taking care to keep it in a vertical position while removing it. Make sure the movable contact springs are in their proper comb grooves.

**4.47** Remove the protective apron.

**Cleaning Contacts and Checking Relay Adjustment**

**4.48** After completing welding of contacts and removing all tools, clean the contacts as covered in Section 069-306-801.

**4.49** Check that the relay meets the requirements in the Division 040 section covering the apparatus, and make adjustments as required.

**4.50** Remount the relay cover and crosstalk shield if provided.