RELAYS (NONWIRE SPRING-TYPE), 197-TYPE SWITCHES, CROSSBAR SWITCHES, AND KS-13835 (AMA) READER REPLACING CONTACTS

1. GENERAL

1.01 This section covers procedures for replacing contacts on springs of E-, EA-, F-, H-, M-, R-, T-, U-, UA-, UB-, Y-, 229-, 230-, 245-, 254-, 263-, 264-, and step-by-step-type relays; 197-type switches; 300- to 338-type crossbar switches; and the KS-13835 reader.

1.02 This section is reissued to:

- Add the 578K contact stripping pliers to the List of Tools and Materials
- Replace the P long-nose pliers with the B long-nose pliers
- Revise Table A and the note following Table A. The note is designated with an asterisk(*).
- Add paragraph 4.10(2)(c).

1.03 The procedures herein apply only to those contacts which are located near the ends of the spring ▶and the inner contacts (located 3/8-inch from end of straight springs) on U- and Y-type relays.◀

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

1.05 It may be advantageous before attempting to weld contacts on working apparatus to practice doing the work on spare apparatus, if available.

1.06 ***Caution: In order to avoid burning of the electrodes, do not leave the 577A and 577B welding pliers without a guide in place.***

1.07 Reference shall be made to Section 069-310-801 for a description of the 1004A and 1004B tool kits, maintenance information for the 102A and 102B current supply sets, and for the 577A and 577B welding pliers.

1.08 Reference shall be made to Section 069-310-804 for the use of silver and No. 1 metal replacement contacts on certain apparatus in circuits where heavy contact erosion or frequent contact opens occur.

1.09 The P-478608 contact for general use and the P-485120 contact for use on UB-type relays are entirely replaced by the P-16A189 contact. However, stocks of the former contacts may be used except on brass springs where the P-16A189 contact must be used in all cases.

2. TOOLS AND MATERIALS

CODE OR SPEC NO.	DESCRIPTION
TOOLS	
418A	5/16- and 7/32-Inch hex. open-end flat wrench
476A	3/16-Inch hex. offset-socket wrench
485A	Smooth-jaw pliers
510C	Test lamp, equipped with 561A straight tip and W2CB (24 volts) or W2BL (48 volts) cord
538A	9/32-Inch hex. offset socket wrench
539A	1/4-Inch hex. open double-end wrench

544A	1/4-Inch hex. offset socket wrench
563A	90-Degree offset screwdriver
564A	45-Degree offset screwdriver
578B	Contact stripping pliers
578C	Contact stripping pliers
578G	Contact stripping pliers
578H	Contact stripping pliers
◗578K◖	Contact stripping pliers
614A	Card remover (UB relays)
640A	Spring spreader (KS-13835 reader)
1004A or 1004B (see note)	Tool kit
KS-6320	Orange stick
KS-6854	3-1/2 Inch screwdriver
R-1005	Jeweler's screwdriver
R-1051	Pillar file
R-2671	1/8-Inch Allen socket screw wrench
—	Graver, flat, William Dixon Inc, No. 40
—	Handle, graver, William Dixon Inc, No. 15
—	3-Inch C screwdriver
—	5-Inch diagonal pliers
—	B Scissors
AT-7860	◗B Long-nose pliers◖

MATERIALS

KS-2423	Cloth
KS-7188	Bell Seal bond paper, substance No. 20, 1/4 inch by 2-1/2 inches
KS-7404	Abrasive cloth
KS-14666	Cloth
KS-19578,L1	Trichloroethane
P-16A189	Contact (all apparatus) (replaces P-478608 and P-485120 contacts—see 1.09)
—	Round hardwood toothpicks
—	Rubber pencil eraser
—	Plastic electrical tape
—	Single-edged razor blade

Note: Table A, which covers the application of all electrodes and guides, includes electrodes and guides not furnished with the 1004A and 1004B tool kits. Ordering information for all guides and electrodes is covered in Section 069-310-801.

3. PREPARATION

PREPARATION OF APPARATUS

3.01 ***General:*** In preparing for the replacement of contacts on certain apparatus covered in this section, it is necessary to remove parts from the apparatus or the apparatus from its mounting, as covered in 3.02 through 3.05.

3.02 ***Crossbar Switches:*** The arrangement of the selecting off-normal springs of crossbar switches is such that access with the contact stripping and contact welding pliers to the contacts on these springs cannot be obtained directly. To replace contacts on these springs, proceed as follows. Tag and unsolder the leads. Then remove the spring assembly from the switch, using the 538A wrench if 9/32-inch head screws are provided and the 544A wrench when 1/4-inch head screws are provided. Place the spring assembly in a vise with the springs vertical for replacement of the contacts.

3.03 ***Step-by-Step Relays:*** In order to replace contacts on certain springs of step-by-step

relays, it is necessary to remove the relay armature. To do this, loosen the armature yoke screw with the 476A wrench or the 563A and 564A offset screwdrivers and lift the armature from the relay. To replace contacts on 225-type relays, remove the switch from the shelf as described in the Division 030 section covering Piece-Part Data and Replacement Procedures for 197- and 198-type switches. Then remove the rear switch cover using the 3-inch C screwdriver. Remove the relay mounting screws using the 3-inch C screwdriver but do not unsolder the leads. Position the relay as required for replacement of the contacts.

3.04 ***UB-Type Relays***

(1) Replacement of contacts on UB-type relays necessitates removal of the card associated with the springs having contacts to be replaced. Before removing the card, note the location of the springs in the card slots to insure proper location of the springs when the card is remounted.

(2) Remove the card as follows. Slide the slots in the jaws of the 614A card remover over the front end of the balancing spring at the left of the card. If the spring does not fully enter the slots in the remover, or the remover binds on entering, operate the relay manually. This will move the balancing spring away from the adjacent contact spring and provide sufficient clearance for the jaws of the remover.

(3) While maintaining an inward pressure on the remover toward the contact springs, bend the tip of the balancing spring approximately 30 degrees to the left. The pressure on the remover is required to prevent the bending operation from removing the tension from the main portion of the spring. If adjacent apparatus on the panel is mounted too close to the relay to permit a 30-degree swing of the remover, loosen the mounting nuts or screws of this apparatus and move the apparatus aside to provide adequate clearance for the swing of the remover. In the same manner, apply the remover to the balancing spring at the other end of the card; and while maintaining pressure toward the contact springs, bend the tip of the balancing spring approximately 30 degrees to the right and remove the card.

(4) To remount a card, hold it so the small notch on the side opposite the contact spring notches is toward the armature. Then, mount the card over the balancing spring at the left so the lip of the card is over the tongue of the cutout portion of the spring. Working from the left, engage the springs in their proper notches in the card, using the KS-6320 orange stick. Place the right end of the card in the balancing spring at the right. Then, while holding the card in position with a finger, bend the tips of the balancing springs back into line with the main portion of the spring using the 614A card remover. Take care not to bend the tips more than the required amount to avoid weakening the springs at the tips.

3.05 ***KS-13835 Reader:*** To replace contacts on the reading or control unit springs of the KS-13835 reader, remove the reader in accordance with accounting center practices. Loosen the two thumbscrews on the cover over the springs on which contacts are to be replaced. If the control unit cover is to be removed, loosen the thumbscrews that hold the tape chute in place, swing the chute back, and remove the cover. Next, dismount the tape chute assembly by removing the two screws that secure the chute assembly to the reader unit, using the R-2671 wrench. Upon completion of contact replacements, remount the tape chute, if it has been removed, and then remount the cover.

PREPARATION OF TOOLS AND MATERIALS

Protective Apron

3.06 In order to prevent contacts from falling into adjacent apparatus, it may be desirable to use a protective apron, described in 3.07 and 3.08. In the case of 229- and 230-type relays, it may be desirable to place a KS-14666 cloth on the apparatus directly below the relay being worked on.

3.07 ***Apron for E-, F-, H-, M-, R-, T-, U-, Y-, EA-, UA-, and UB-Type Relays:*** Before replacing contacts on these relays, make an apron with a KS-14666 cloth in the following manner. Make a 6-inch fold and stitch the sides of the fold so as to form a pocket the full width of the cloth. Just above the pocket at about the center of the apron, cut a hole which, after turning back the edges and hemming to prevent unravelling, will finish to a size of about 1-1/4 inches square, as shown in Fig. 1.

3.08 ***Apron for Step-by-Step Relays and Crossbar Switches:*** Before replacing contacts on this apparatus, make an apron in the following manner. Use a piece of KS-14666 cloth cut to approximately 6 inches square and stitch the edges to prevent unravelling. Make a 2-1/2 inch fold to form the pocket, and cut a hole to finish to a size of approximately 7/8 inch square. In order to mount this apron preparatory to welding contacts on crossbar switches, it is necessary to first remove the selecting bar associated with springs involved in the welding operations. For this purpose, use a 418A, 476A, or 539A wrench, depending upon whether 1/4-, 3/16-, or 5/16-inch nuts are used. Before replacing the apron over relays on a step-by-step switch equipped with a guide post, first remove this post.

3.09 Place the apron over the apparatus on which the contacts are to be replaced as shown in Fig. 1, and adjust the apron so the contacts that are removed will fall into it. Clip the plastic holder on which the contacts are furnished to the apron or other convenient support adjacent to the apparatus being worked on. Fig. 1 shows the holder clipped to the apron.

Orange Sticks and Toothpicks

3.10 In certain cases, orange sticks or round hardwood toothpicks are required for blocking relay springs to gain access to them for welding operations. Prepare orange sticks for this purpose as follows. Cut off each end of the orange stick about 1 inch from the tip. Cut a slot extending about 3/8 inch from the beveled end of the 1-inch length. In some cases (such as step-by-step relays in 4.15) it is preferable to use a 1-3/4 inch length of orange stick without a slot. The use of either of the prepared orange sticks depends upon the apparatus being worked on and available space.

578B and 578G Contact Stripping Pliers

3.11 Before using these pliers to remove contacts from 229- and 230-type relays, insulate the outside of the plier jaws as follows (see note). Cut two pieces of plastic electrical tape, each approximately 1 inch long, for each pair of pliers. Place the tape on the outside of each jaw of the pliers extending backward from the tip of each jaw and trim the tape to conform with the sides of the jaws, using a single-edged razor blade. If the plate of the 578G pliers is mounted on the

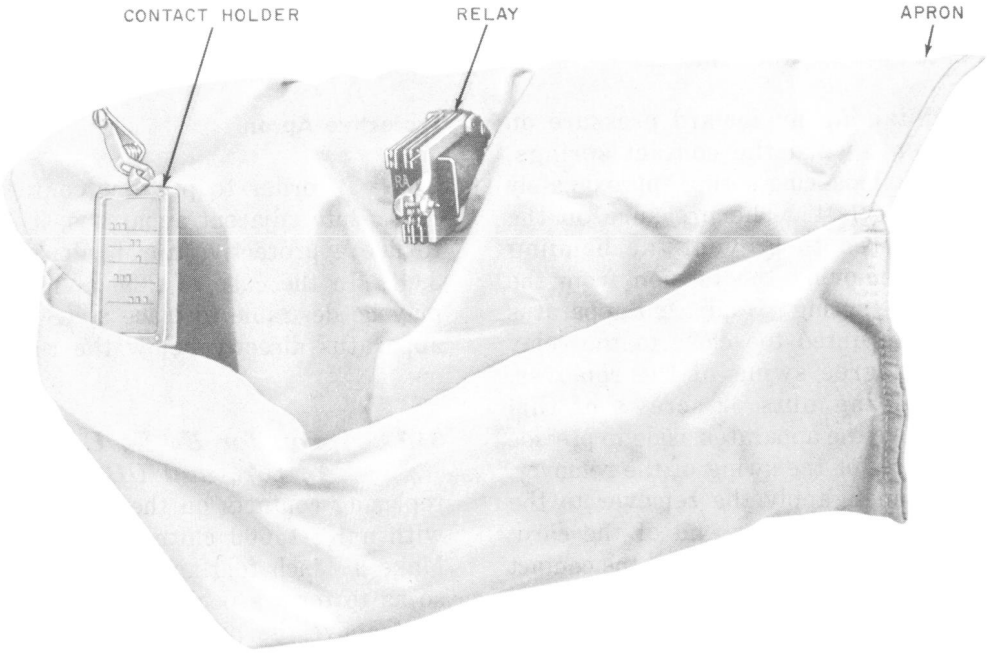


Fig. 1—Apron and Contact Holder in Working Position

nonshearing jaw (see note), make sure the tape covers the plate mounting screw and outer portion of the jaw.

Note: If the 578G pliers are to be used for removing contacts from transfer break springs, before insulating the plier jaws, position the plate which is normally mounted on the handle of the pliers as follows. Using the jeweler's screwdriver, remove the plate from the handle. Mount the plate on the inner surface of the nonshearing jaw of the pliers with the beveled edge of the plate as shown in Fig. 2. The plate in this position will prevent distorting the spring while removing the contact. Return the plate to its position on the handle when using the pliers on all other springs.

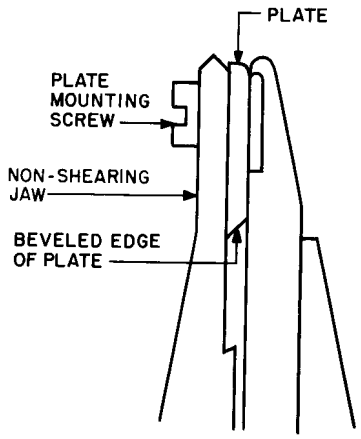


Fig. 2—Plate Mounted on Jaw of 578G Pliers

KS-8511 Tweezers

3.12 Blunt the KS-8511 tweezers used for handling contacts being welded by filing off the points slightly with the R-1051 file. Clip off the pin in the tweezers using the 5-inch diagonal pliers.

Electrodes and Guides

3.13 Check that the proper electrodes are attached to the welding pliers in accordance with the information covered in Table A. If necessary to replace the electrodes, proceed as covered in 3.15 and 3.16.

Modifying No. 22 Movable Electrode

3.14 To modify the movable electrode, remove this electrode from the welding pliers as covered in 3.16. Clamp the electrode in a vise as shown in Fig. 3 so the tip of the electrode is approximately 1/2 inch above the jaws of the vise. Place the tips of the B long-nose pliers over the electrode just behind the contact button at the points designated in the figure for making the first bend. Bend the tip of the electrode in the direction of the contact button so the tip is at an angle of approximately 25 degrees with the main portion of the electrode. Then, place the tips of the pliers over the contact button at the points designated in the figure for making the second bend. Bend the tip of the electrode back so the contact button is approximately parallel to the main portion of the electrode as shown in the figure. With this bend the contact button should be offset approximately 3/32 inch from the main portion of the electrode. After bending, make sure the main portion of the electrode has a slight convex bow on the side of the contact buttons as provided during manufacture. This bow insures close contact between the electrode and the jaw of the welding pliers when the electrode is mounted on the jaw. After modifying the electrode, insulate the electrode as follows. Cut a piece of plastic electrical tape approximately 3/4 inch long. Place the tape on the electrode approximately 1/8 inch below the contact button and trim the tape to conform with the sides of the electrode using a single-edged razor blade.

3.15 ***Fixed Electrode:*** Fig. 4—To replace a fixed electrode, compress the handles of the welding pliers to open the jaws. Loosen the clamping stud carefully by turning it in a clockwise direction with the 3-inch C screwdriver just enough to permit the electrode to be removed. Place the slotted end of the replacing electrode in position so the electrode positioning stud on the pliers fits into the slot on the electrode, and then push the electrode toward the back of the pliers as far as the stud permits. Turn the clamping stud in a counterclockwise direction until the electrode is held securely.

Caution: Take care not to apply excessive pressure in tightening the clamping stud.

3.16 ***Movable Electrode:*** Fig. 4—To replace a movable electrode, first remove the fixed

TABLE A
ELECTRODES AND GUIDES – DESIGNATIONS

TYPE OF APPARATUS	TYPE OF SPRING	ELECTRODE DESIGNATIONS FIXED	ELECTRODE DESIGNATIONS MOVABLE	GUIDE DESIGNATIONS
Relays				
E- and Similar-Type Relays	All	11	20	D
U-, Y-, and UA-Type Relays	All	11	20	A
U- and Y-type relays	Inner contacts	23*	20	BB*
UB-Type Relays	Solid	12	21	P
	Bifurcated	12	21	N
Step-by-Step Type Relays	L-Shaped	10	20	E
	Straight	10	20	F
229- and 230-Type Relays	Front Contact Spring	15*	22*	W* and U*
	Armature Spring	15*	22*	V* and X*
	Transfer Break Spring	15*	22*	W* and U*
245-and 254-Type Relays	Solid	11	20	H
	Bifurcated	11	20	J
263- and 264-Type Relays	Solid	11	20	A
	Bifurcated	11	20	B
197-Type Switches				
VON Springs	Movable (Lever) Stationary	14*	22*	S* T*
Rotary Interrupter Springs†	Movable Stationary	14*	22*	S* T*
300- to 303-Type Crossbar Switches				
Select Off-Normal	Solid	11	21	H
	Bifurcated	11	21	J
Hold Off-Normal	All	11	21	C
Cross-points	Solid	11	21	A
	Bifurcated	11	21	L
304- to 308-, 314-, 315-, and 318-Type Crossbar Switches				
Select Off-Normal	Solid	11	21	H
	Bifurcated	11	21	J
Hold Off-Normal	All	11	21	A
Cross points	Solid	11	21	M
	Bifurcated	11	21	L
324-, 325-, 328-, 334-, and 338-Type Crossbar Switches				
Select Off-Normal	Solid	11	21	H
	Bifurcated	11	21	J
Hold Off-Normal	#	11	21	A
Cross-points	Solid	11	21	M
	Bifurcated	11	21	M§
KS-13835 Reader				
Control Springs	All	11	22*	A
Reading Springs	Solid (Movable)	11	22*	R*

* The No. 14, 15, 22, and →23← electrodes and the R, S, T, U, W, X, and →BB← guides are not included in the 1004A and 1004B tool kits. Ordering information for these electrodes and guides is covered in Section 069-310-801. For replacement contacts on 229- and 230-type relays, the No. 22 electrode should be modified as covered in 3.14

† The outer pair of contacts on transfer springs is not replaceable because guides for this purpose are not available.

\# All springs except those of the 2-break combinations on 324-, 325-, and 328-type switches. In the case of the 2-break combination, replace the spring assembly.

§ Where the switch is provided with crosspoint springs having overhanging contacts the AA guide shall be used.

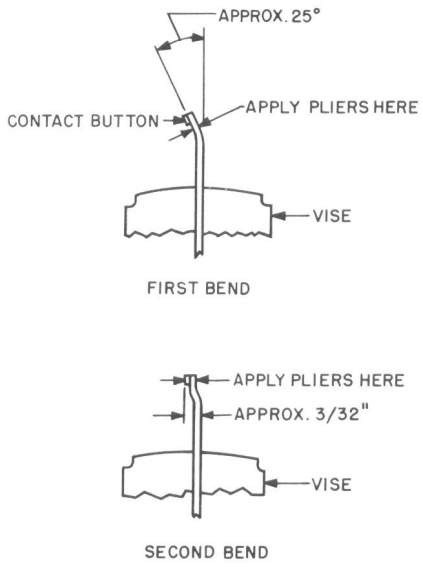
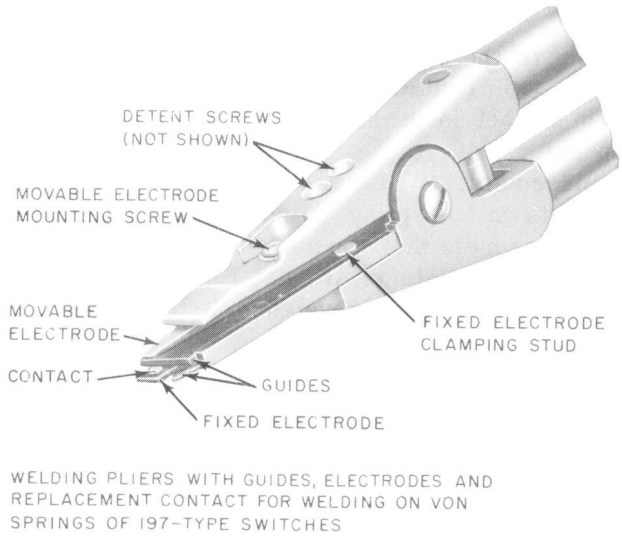


Fig. 3—Modifying No. 22 Electrode



WELDING PLIERS WITH GUIDES, ELECTRODES AND REPLACEMENT CONTACT FOR WELDING ON VON SPRINGS OF 197-TYPE SWITCHES

Fig. 4—577A and 577B Welding Pliers

electrode as covered in 3.15. Remove the screw that holds the movable electrode in place using the 3-inch C screwdriver and exercising care not to lose the associated stud and two washers. To mount the proper movable electrode, insert the stud in the electrode so the shoulder of the stud rests in the recess in the electrode. Compress the handles of the welding pliers and mount the electrode so the protruding end of the stud is in the hole in the longer jaw of the pliers. Holding the electrode in position, place the plain washer in the recess on the opposite side of the jaw. Mount the screw with the lockwasher on it in the stud, and tighten the screw so the electrode is securely in place but may be swung from side to side by moving the tip.

3.17 ***Cleaning Electrode:*** Before replacing contacts, note that the surface of the electrode on which the replacing contact will rest and the contact button on the movable electrode are clean. If necessary, clean these parts with a rubber pencil eraser followed by wiping with a piece of dry KS-2423 cloth. If this procedure does not prove adequate in the case of the fixed electrode, clean the surface with a few light strokes of the abrasive cloth placed over the end of an orange stick.

3.18 ***Mounting Guides on Fixed Electrode:*** Place the proper guide on the fixed electrode in accordance with the information covered in Table A. Take care the guide is pushed back so it rests against the shoulder of the electrode. In the case of the fixed electrode required for welding contacts on 197-type switches and 229- and 230-type relays, two guides are used as follows.

(1) ***197-Type Switches—VON and Rotary Interrupter Springs:*** For welding contacts on the movable springs, the S guide is placed on the outside of the fixed electrode and the T guide on the inside facing the movable electrode as shown in Fig. 4. For welding contacts on stationary springs, the two guides are interchanged.

(2) ***229- and 230-Type Relays***

(a) ***Front Contact and Transfer Break Springs:*** For welding contacts on these springs the W guide is placed on the outside of the fixed electrode and the U guide on the inside facing the movable electrode.

(b) ***Armature Springs:*** For welding contacts on these springs, the X guide is placed on the outside of the fixed electrode and the V guide on the inside facing the movable electrode.

3.19 Center the movable electrode. Check whether the detent screws (see Fig. 4) are properly positioned for limiting the movement of the movable electrode to match the contact locating slots in

the fixed electrode. If the wider tip electrode (No. 10) is used, the detent screw nearer the tip of the movable electrode should be turned in fully. The other detent screw should be backed out 1-1/2 turns from this position to prevent its rubbing on the movable electrode. If either of the narrower tip fixed electrodes (No. 11, 12, or 13) is used, both detent screws should be turned in fully.

3.20 During the welding operations it may be necessary from time to time to change the guides depending on the type of spring on which the contact is being replaced. For example, in the case of step-by-step relays, one guide (E) is used for L-shaped springs, and the other guide (F) is used for the straight springs. This usually means that in replacing a pair of contacts, one contact will be replaced using one guide, and the mating contact using the second guide. When using the D guide in replacing the contacts of E-, F-, H-, M-, R-, and T-type relays, it is advisable to reverse the position of the guide from time to time in order to equalize the wear in the slots of the fixed electrode.

Contact Welding Equipment

3.21 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 insure 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 cases downward. The bottom of the carrying case is that side to which the cover hinge is attached. Position the 586A holder on the carrying case and strap it in place.

3.22 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.

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

3.24 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 When replacing a point- or disc-type contact, its mating contact must also be replaced. Also, if there is a point-type contact on the opposite side of the spring from the contact to be replaced, the contact on the opposite side and its mate must also be replaced. On step-by-step relays with dome-shaped contacts and on relays equipped with springs having single bar contacts, do not replace the mating contact if it is not necessary. In the case of a dome-shaped contact mating with a bar contact, the width of the bar contact must lie wholly within the periphery of the dome and the dome must be wholly within the length of the bar. If this alignment is not obtained, remove the dome contact and weld a bar contact perpendicular to the other bar contact.

4.02 In the case of twin contacts, if one of the twin contacts is satisfactory and the other twin contact on the same spring is not satisfactory, do not replace these contacts until both require replacement. When necessary to replace twin contacts on one spring, do not replace their mating contacts unless they are also unsatisfactory. When the mating contacts are not replaced, condition them, if necessary, as covered in Section 069-306-801.

4.03 When replacing contacts on bifurcated springs of 263- and 264-type relays, the mating fixed contact must first be removed (even if it does not require replacement) to permit replacement of the bifurcated spring contacts. After removing the fixed contact, remove and weld contacts on the bifurcated spring and then replace the fixed contact.

4.04 Replacement contacts must be positioned on the springs as covered in (1) through (5).

(1) When replacing bar-type contacts, the position of the new contact should be the same as that of the contact which was removed with the following exceptions.

(a) ***Multiple Strip Contacts on Crossbar Switches:*** While the original contacts on this type of multiple were vertical, as shown in Fig. 5(A), the replacement contacts must

be placed in a horizontal position. This requires replacement of the mating contact on the associated bifurcated spring which must be replaced in a vertical position. Replacement of contacts on the type of multiple shown in Fig. 5(B) are placed in the same positions as the original contacts. When replacing bar-type contacts, take care contacts of a mating pair are approximately at right angles to each other.

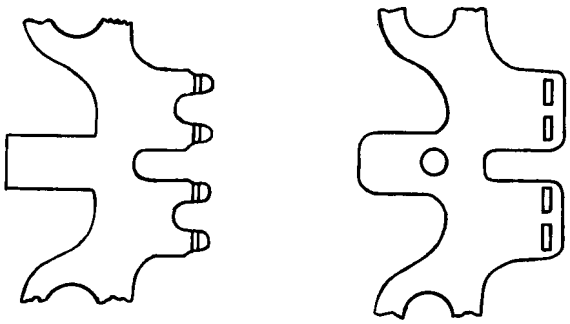


Fig. 5—Crosspoint Contact Multiples Used on Crossbar Switches—Types A and B

(b) ***Overhanging Crosspoint Contacts on Crossbar Switches:*** Where the contacts on crosspoint bifurcated springs overhang the end of the spring, as shown in Fig. 6(A), the replacement contacts will be positioned as shown in Fig. 6(B) using the AA guide.

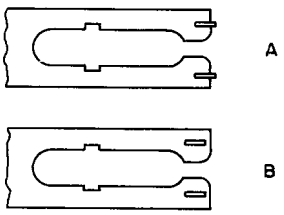


Fig. 6—Crosspoint Bifurcated Spring Contacts Used on Crossbar Switches

(2) On single-contact relays, in general, the horizontal contact is placed on the movable spring and the vertical contact on the fixed or spoolhead spring.

(3) In the case of springs which are mounted horizontally, such as the selecting off-normal springs of crossbar switches, the longitudinal contacts are considered horizontal and the transverse contacts are vertical.

(4) On rotary interrupter and VON spring assemblies on 197-type switches, the vertical contacts are placed on the movable (lever) springs and the horizontal contacts are placed on the stationary springs.

(5) On step-by-step relays, the vertical contacts are placed on the L-shaped springs. On step-by-step relays, if the contact was previously riveted on a spring, weld the replacement contact over the hole in the spring.

Removing Contacts

4.05 ***General:*** Contacts to be replaced must first be removed from their springs as covered in 4.09 through 4.12. Remove all contacts to be replaced before starting the welding of new contacts.

4.06 Before removing contacts, place the protective apron or cloth described in 3.06 through 3.08 on the apparatus if it can be used advantageously. Position the apron as covered in 3.09.

4.07 For removing contacts on certain apparatus, the adjustable stop plate on the notched jaw of the 578C contact stripping pliers must be positioned as covered in (1) and (2).

(1) In removing contacts from L-shaped springs in step-by-step relays, make sure the adjustable stop plate has been rotated clockwise as far as possible. This position of the plate will prevent the hooked jaw of the pliers from engaging the inner edge of the spring tip instead of the contact.

(2) In removing contacts from springs on multicontact relays, HON and SON springs on crossbar switches, and offset springs on E-, U-, etc, type relays, make sure the adjustable stop plate has been rotated counterclockwise as

far as possible. This position of the plate will prevent damaging the springs.

4.08 For removing certain contacts on 229- and 230-type relays, the plate of the 578G contact stripping pliers must be positioned as covered in 3.11. Also, the outside of the jaws of both the 578B and 578G pliers must be insulated as covered in 3.11.

4.09 To remove a contact from springs, place the hooked jaw of the proper contact stripping pliers just back of the contact to be removed. Hold the pliers approximately in line with the spring as shown in Fig. 7, except on L-shaped springs of step-by-step relays where the pliers are held at right angles to the tip of the spring. Except on L-shaped springs, see that the front end of the spring is seated in the notched jaw of the pliers. If there is a contact on the side of the spring opposite to that from which a contact is to be removed, take care to position the contact on the opposite side in the notched jaw of the pliers. Remove the contact by compressing the pliers.

4.10 ***Crossbar Crosspoint Contacts:*** For removing contacts on crosspoint springs, the contact stripping pliers must be positioned as covered in (1) and (2).

(1) ***Overhanging Contacts:*** Place the hooked jaw of the 578H contact stripping pliers just back of the overhanging contact to be removed. Hold the plier handles in a horizontal position. Center the overhanging contact of the bifurcated spring on the white guide line located on the hooked jaw of the pliers. Remove the contact by compressing the pliers.

(2) ***All Contacts Except Overhanging Contacts***

(a) To remove a contact, using the 578C contact stripping pliers, proceed as covered in 4.09.

(b) To remove a contact, using the 578H contact stripping pliers, proceed as follows. Place the hooked jaw of the 578H contact stripping pliers just back of the contact to be removed. Hold the plier handles in a horizontal position. Center the contact on the red guide line located on the hooked jaw of the pliers. Remove the contact by compressing the pliers.

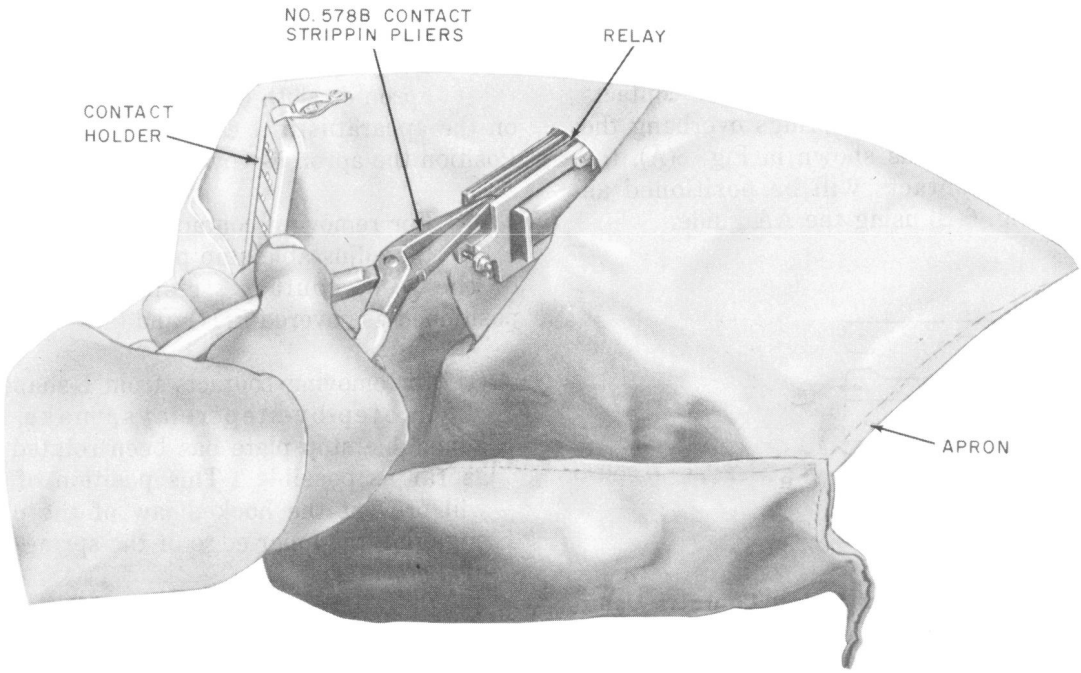


Fig. 7—Removing Contact With 578B Contact Stripping Pliers

(c) ▶To remove the inner contacts on U- and Y-type relays, using the 578K contact stripping pliers, proceed as covered in 4.09. If interference occurs with adjacent contact springs, insulate according to 3.11.◀

4.11 After removing a contact, check that all contact metal has been removed by the pliers. If it has not, repeat the procedure described in 4.09 and 4.10 until all contact metal has been removed.

4.12 During removal of contacts from springs, the pressure required may distort the tips of the spring. In this case, flatten the end of the spring, using the 485A pliers.

Cleaning Springs

4.13 In order to obtain a good weld, check that the spring is clean before welding a new contact in position. If there is oil or grease on the surface of the spring on which the contact is to be welded, place a KS-2423 cloth over the end of an orange stick, moisten the cloth with KS-19578 L1 trichloroethane and remove the oil or grease. In all cases, burnish this surface of the spring with a piece of abrasive cloth placed over the end of a KS-6320 orange stick.

Caution: Failure to adhere to this procedure, particularly the burnishing of the spring with an abrasive cloth, may result in damage to the spring.

4.14 ***KS-13835 Reader:*** Examine the fixed contact springs of the control unit of these readers in cases where the spring is bonded to a fiber strip to determine if there is any bonding adhesive on the spring particularly adjacent to the fiber. If there is adhesive present, scrape it off the spring with the tip of the No. 40 flat graver. Take care not to loosen the fiber strip bonded to the spring.

Blocking Springs

4.15 Where space permits, it is advisable to block the spring on which the contact is to be welded so there is a clearance between this spring and adjacent contacts on each side. For this purpose, place the slotted 1-inch section of orange stick (3.10) with the slot over the spring on which the contact is to be replaced or over adjacent springs, whichever provides the necessary space. In some cases, it may be necessary to use the 1-3/4 inch section of orange stick or the round hardwood toothpick (3.10) inserted between the springs just in front of the spoolhead. In the case of spoolhead springs mounted to the right of the armature on E- and similar-type relays, the toothpicks may be inserted between the spoolhead and the spring tang. Do not disturb the springs more than necessary to permit the electrodes to be placed on the spring. In blocking step-by-step relays, insert the 1-3/4 inch length of orange stick in back of the stud.

4.16 In the case of some springs, such as those on 245- and similar-type relays and on crossbar switch crosspoints, it may not be possible to block springs as described in 4.15. In these cases, the movable springs may be pushed to one side with the KS-6320 orange stick to permit inserting the welding electrodes between the springs. However, it is generally easier to insert the tips of the electrodes between the springs by holding the pliers at a slight angle to the right or left of the horizontal axis of the springs and giving the pliers a slight rocking motion.

4.17 ***KS-13835 Reader:*** Before blocking springs on these readers, rotate the dial to give maximum contact separation. To block springs in the control unit, insert the 640A spring spreader between the springs on which contacts are to be replaced as follows. Insert the spreader over or under the springs to be worked on, depending on whether these springs are among the upper or lower springs in the paired pile-ups. With the offset portion of the spring spreader toward the contacts, place this portion of the spreader between the springs by rotating the spreader 90 degrees clockwise if the spreader is over the springs, or counterclockwise if the spreader is under the springs. Then, draw the spreader forward toward the contacts as far as possible. This will spread the springs sufficiently for inserting and withdrawing the welding tool.

Welding Contacts

4.18 Before welding contacts, refer to 4.01 through 4.04 for the proper positioning of replacement contacts.

4.19 Determine the proper slot in the fixed electrode in which the contact is to be inserted. Replace the horizontal bar contact first.

This will tend to avoid dislodging the second bar contact from the electrode. In the case of twin contacts, replace the upper bar contact on the spring first. Fig. 8 illustrates the slot arrangement and indicates the position of the contacts.

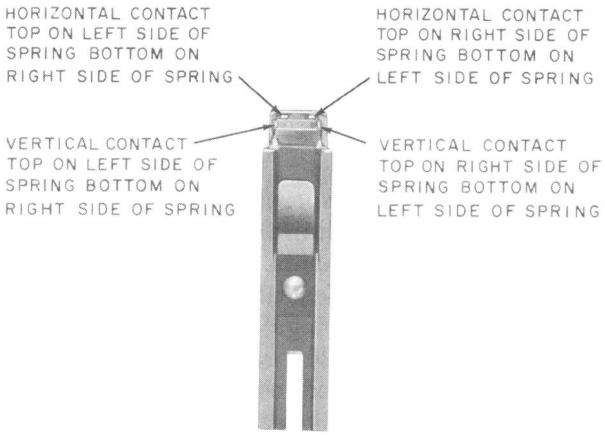


Fig. 8—Fixed Electrode Showing Slot Arrangement

4.20 Place a contact on the proper fixed electrode (Table A) as follows. Move the movable electrode away from the slot in which the contact is to be placed. Pick up a contact with the tweezers, grasping it so the tang on the contact will be in the correct position for the proper slot in the fixed electrode as shown in Fig. 9. Hold the contact so its flat face is toward the surface of the fixed electrode and the ribbed face toward the movable electrode and insert the tang of the contact in the proper slot in the fixed electrode. Using the tweezers, flatten the contact against the electrode.

Caution: Do not force the end of the contact into the slot before flattening the contact with the tweezers as this might cause subsequent breakage of the tang.

4.21 With the welding pliers open, move the movable electrode so the contact button is directly above the contact. Then allow the pliers to close. Check that the welding plier leads are not twisted.

4.22 ***All Springs Except 197-Type Switch VON and Rotary Interrupter Moving Springs and 229- and 230-Type Relay Front Contact and Transfer Break Springs:*** Place the welding pliers over the spring so the end of the spring starts into the notch in the guide. Then, open the pliers and slide them into position, taking care not to dislodge the contact. Proceed as covered in 4.24.

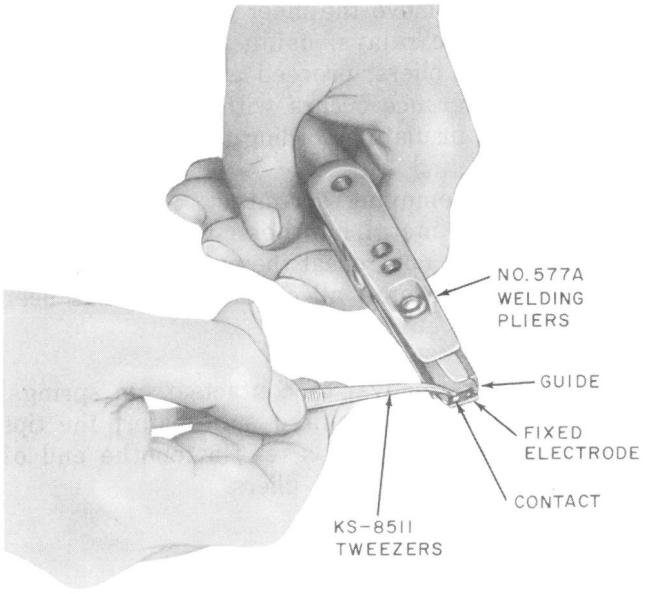


Fig. 9—Placing Contact in Fixed Electrode

4.23 ***197-Type Switch VON and Rotary Interrupter Moving Springs and 229- and 230-Type Relay Front Contact and Transfer Break Springs:*** In welding contacts on these springs the adjacent stationary or armature spring is used to guide the pliers instead of the spring on which the contact is to be welded. In these cases, open the pliers and place them over the spring on which the contact is to be welded so this spring is between the two electrodes, and the adjacent stationary or armature spring starts into the notch of the guide (S or W) on the outside of the fixed electrode. Then, slide the pliers forward, taking care not to dislodge the contact, until the stationary or armature springs rest in the notch of the guide. Then, proceed as covered in 4.24.

4.24 After positioning the pliers, as covered in 4.22 or 4.23, shift them slightly so the end of the spring is firmly seated in the notch in the guide. Then, release the pressure on the plier handles, thus holding the contact firmly in position on the spring. (See Fig. 10 and 11.)

Caution: It is extremely important that the end of the spring enters all the way into the guide and that it does not bind or ride on the guide on either edge. If the spring fails to go all the way home in the guide, the contact may be welded flush with the front of the spring, in which case subsequent removal of the contact will be difficult; in the case of thin bifurcated springs, the entire tip of the spring may be sheared off in attempting to remove the contact. If the edge of the spring rides on the side of the guide, the resistance between the electrode and the spring may cause the spring to be burned when the welding current is applied.

4.25 Hold the plier handles in a horizontal position with the center line of the pliers in line with the spring as shown in Fig. 10 and, with all hand pressure removed from the handles, depress and release the control button. Holding the control button operated has no effect since the time control relay is held locked until the control button is released. Do not operate the control button more than once for any one welding operation.

Caution: Failure to adhere to the following procedures will cause either a poor weld or burning of the spring. In welding the second of two contacts on a bifurcated or solid spring, it is necessary to prevent any of the welding current from passing through the first contact in order to obtain a good weld of the second contact. On nickel-silver springs this can usually be done by tilting the pliers just enough from the horizontal position to insure slight clearance between the fixed electrode and the first contact welded. However, on solder-coated or plain brass springs, it is recommended that the first contact welded be insulated from the fixed electrode during welding of the second contact as follows. Insert a strip of KS-7188 paper between the guide and fixed electrode so it covers the portion of the electrode on which the first contact was positioned prior to welding. Insert the paper sufficiently to touch the shoulder on the electrode and make sure it clears the second contact to be welded. Shifting the paper slightly from side to side will facilitate inserting it. Then cut the paper

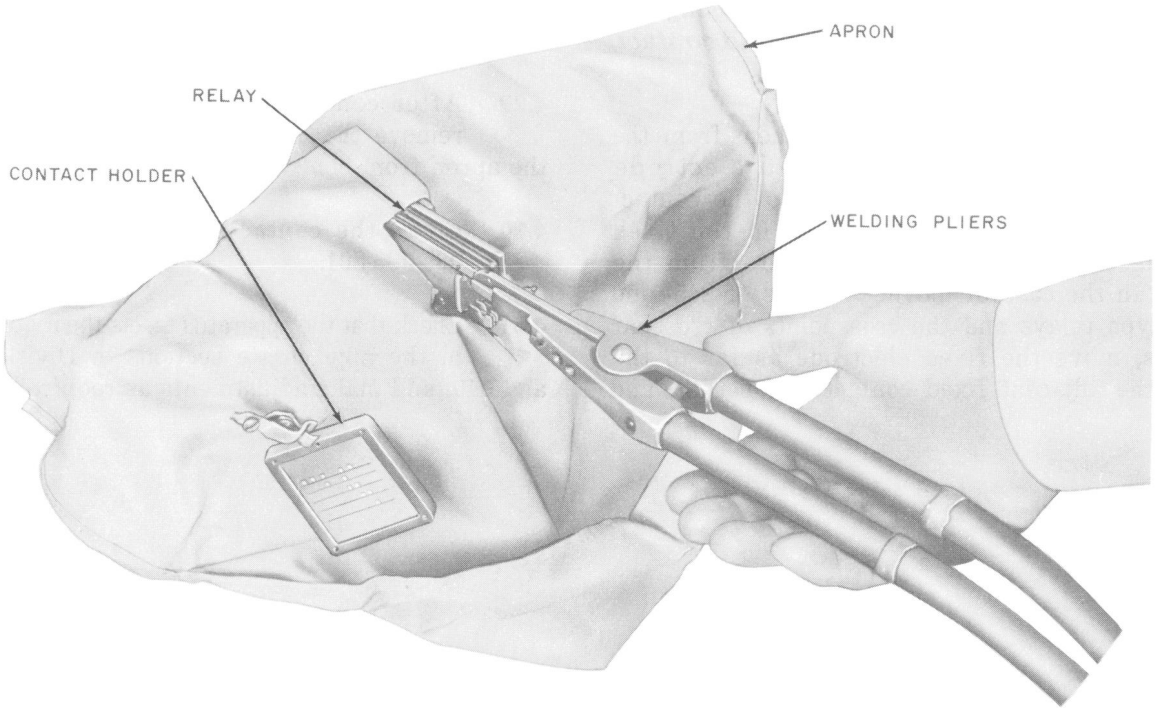


Fig. 10—Welding Pliers in Position for Welding Contact

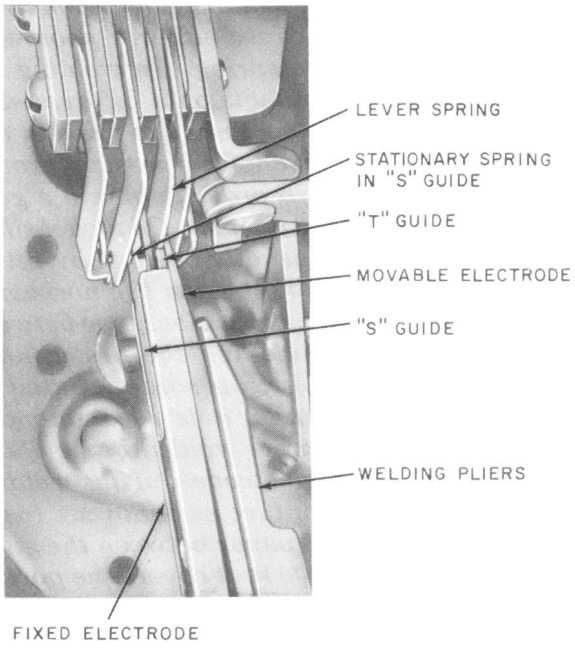


Fig. 11—Welding Contact on Movable (lever) Spring of VON Assembly of 197-Type Switch Using 577A or 577B Welding Pliers

as close as possible to the guide using the scissors. After welding the second contact, remove the paper.

4.26 Open the pliers and remove them from the spring by moving the fixed electrode horizontally away from the spring so the contact tang is withdrawn from the notch in the fixed electrode. Then, withdraw the pliers from the spring. In the case of moving springs of 245- and similar-type relays and the crosspoints of crossbar switches, move the fixed electrode as far to the left as the adjacent fixed contact will permit, and separate the tip of the moving spring from the electrode with a KS-6320 orange stick. Then, withdraw the pliers from the spring. The use of the orange stick will facilitate the withdrawal of the contact tang from the electrode in other cases such as the bifurcated tips of the moving springs of U-, Y-, and UA-type relays.

Removing Contact Tangs and Checking Contact Welds

4.27 Removal of a contact tang constitutes a check of the contact weld. Break off the contact tang by bending it back and forth a few times with the KS-8511 tweezers. Take care not to drop the tang while removing it.

4.28 Failure to obtain a satisfactory weld may be due to poor contact between the spring and the replacing contact, between the fixed electrode and the contact, or between the movable electrode and the spring. Check the surface of the spring which contacts the movable electrode and the surface of the spring to which the contact is to be welded. If either surface appears dirty, clean as covered in 4.13 and 4.14. Check that the contacting surfaces of the electrodes are clean. If necessary, clean them as covered in 3.17.

Final Procedures

4.29 After completing the welding operations, remove the orange sticks or toothpicks and the apron from beneath the apparatus.

4.30 Clean the contacts as covered in Section 069-306-801.

4.31 Check that the apparatus meets the requirements in the appropriate sections in Divisions 030 and 040, and make adjustments as required.