

## RELAY CONTACTS AND PARTS CONTACTS ON SIMILAR APPARATUS EXCEPT KEYS AND JACKS CLEANING AND RECONDITIONING

### 1. GENERAL

**1.01** This section covers cleaning procedures to be followed in cleaning relay contacts and parts, and contacts in general except key and jack contacts. It also covers the procedures to be followed in reconditioning of contacts having pits and buildups.

**1.02** This section is reissued to incorporate material from the addendum in its proper location. In this process marginal arrows have been omitted.

**1.03** Since the failure of a circuit to function properly is often caused by dirty contacts or dirty or gummy parts, it is essential that contacts and parts be kept clean. Therefore, it is important that the inside of relay covers, both of the individual and group types, switch covers, contact covers on wire-spring relays, and other apparatus covers should be kept free of loose dust and should not be left off longer than absolutely necessary. Also, cabinet doors covering switches, relays, etc, should not be kept open unnecessarily.

**1.04** *Telegraph Transmission Relays:* The term telegraph transmission relays for the purpose of this section applies only to 209FG, 215H, and 228A per D-160118 and 255A relays.

**1.05** This section covers typical examples of methods used to condition contacts on various types of relays. The methods described may be used on similar contacts on other types of relays or other apparatus except keys and jacks.

### 2. LIST OF TOOLS AND MATERIALS

CODE OR SPEC NO.	DESCRIPTION
<b>TOOLS</b>	
265C	Contact Burnisher Holder (Includes No. 266C and 266E Tools)
266C	Wire Burnisher
266D	Contact Burnisher Blade
266E (or the replaced No. 266B except on wire-spring-type relays)	Contact Burnisher Blade
340	Adjusting Key
373D	Contact Burnisher Holder
374A	Contact Burnisher Blade
374C	Contact Burnisher Blade
477A	Make-busy Tool
510C	Test Lamp [Equipped With No. 561A Straight Tip and W2CB (24V) or W2BL (48V) Cord]
527A	Build-up Remover
655B	Build-up Remover
KS-2662 or KS-2663	Contact Burnishing File
KS-6320	Orange Stick
KS-8511	4-1/2 Inch Bent Tweezers
KS-14208 (2 Req'd)	Brush
R-1446	File Cleaner
—	3-inch Cabinet Screwdriver
—	P-Long-nose Pliers
—	Arkansas Stone, Hard, Norton HB13, or Equivalent

**SECTION 069-306-801**

CODE OR SPEC NO.	DESCRIPTION
<b>TOOLS (Cont)</b>	
—	Piece of Thin Stiff Metal for Cleaning Pole Pieces (Preferably Nonmagnetic)
—	Equipment for Arc Cleaning Con- tacts to be Prepared Locally — See 4.17
—	5-inch Diagonal Pliers
<b>MATERIALS</b>	
KS-2423	Cloth
KS-6528	Relay Cleaning Tape
KS-6948	Battery
KS-7187	Bell Seal Bond Paper, Substance No. 20, 1/2 by 2-1/2 Inches
KS-7188	Bell Seal Bond Paper, Substance No. 20, 1/4 by 2-1/2 Inches
KS-7404	Abrasive Cloth
KS-7860	Petroleum Spirits
KS-8372	Trichloroethylene
—	Friction Tape
—	1-ounce Bottle

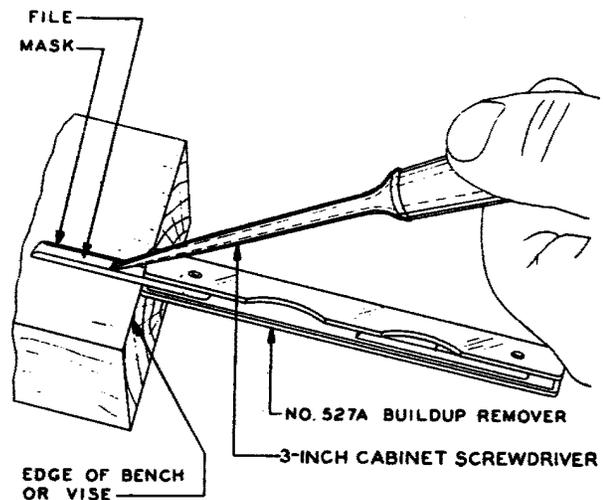
**3. CARE OF TOOLS USED IN CONTACT  
MAINTENANCE**

**3.01** The blades of contact burnishers, burnishing files, and any thickness gauges which may be used on the contacts must be kept clean. Avoid touching or rubbing the blades with the fingers. Wipe off the burnisher blades, files, and gauges with a clean, dry KS-2423 cloth before placing them against the contacts and wipe them frequently with a clean KS-2423 cloth dampened with KS-7860 petroleum spirits.

**3.02** It is important to keep the KS-14208 brush clean. Therefore, when the brush is not in use, keep it in the case provided with the brush. Avoid contacting the brush with oil or grease. Examine the brush before using it. If dirty, dip the hairs of the brush once their full length in clean KS-8372 trichloroethylene and then wave the brush until it is dry. Then, lightly wipe the brush on a clean, dry KS-2423 cloth and inspect the cloth. If the cloth is discolored, reclean the brush as covered above before using the brush. This procedure should also be fol-

lowed before using a new brush. After cleaning a number of contacts observe the brush, and if discolored, clean it as covered above.

**3.03** Clean the file portion of the No. 527A build-up remover before each usage. To do this, remove the file from the mask by placing the blade face down on the edge of a bench or vise with the handle extending over the edge. Then place the blade of the 3-inch cabinet screwdriver in back of the file as indicated in Fig. 1 and tap the handle of the screwdriver lightly, using the handle of another screwdriver or similar object, thus forcing the file from the mask.



**Fig. 1 – Method of Removing File From Mask**

**3.04** Using the R-1446 file cleaner, brush the surface of the file at right angles to its length until all embedded material has been removed. As an alternative method, the file may be cleaned by using a piece of soft brass and rubbing it across the file at right angles to its length. After removing the embedded material, wipe off all surfaces of the file with a KS-2423 cloth slightly moistened with KS-7860 petroleum spirits. After wiping the grease and dirt from the file with the cloth, do not touch the cutting surfaces of the file with the fingers.

**3.05** Remount the file in the mask by inserting the end of the file which is not beveled into the mask and gently tap the file into position, using the screwdriver or similar object. When a file has become worn to a point where it is no

longer effective for removal of buildups, replace it, removing the old file, as covered in 3.03, and inserting the new one as covered above.

**3.06** Clean the file and grooved portions of the No. 655B build-up remover before each usage. Using the R-1446 file cleaner, brush the file portion at right angles to its length until all embedded material has been removed. Exercise care not to damage the insulation on the tool. After brushing, wipe the file and grooved portion with a clean KS-2423 cloth slightly moistened with KS-7860 petroleum spirits. Folding the cloth over the end of a KS-6320 orange stick will facilitate cleaning the groove. After wiping the file portion, take care not to touch the surface of the file with the fingers.

#### 4. CLEANING CONTACTS

##### General

**4.01** Three methods are provided for cleaning contacts.

(a) **Brush Method** (4.02 through 4.05).

*The brush method is the only method recommended for general use in cleaning contacts.*

(b) **Burnishing Method** (4.06 through 4.15): Burnishing of contacts, although immediately effective, may result in subsequent unsatisfactory contact performance and therefore is recommended only in the relatively few cases where the brush method proves ineffective. Thus, except for UB-type relays, the contacts of which are inaccessible for brush cleaning, the burnishing method should be used only if the trouble persists after brushing.

(c) **Arc Method:** (VON contacts 3—4 on digit-absorbing selector, SD-32183-01 only) (4.16 through 4.18).

If brushing and burnishing of VON contacts 3—4 on digit-absorbing selector SD-32183-01 does not eliminate the trouble, these contacts may be cleaned by the arc method.

##### Brush Cleaning of Contacts

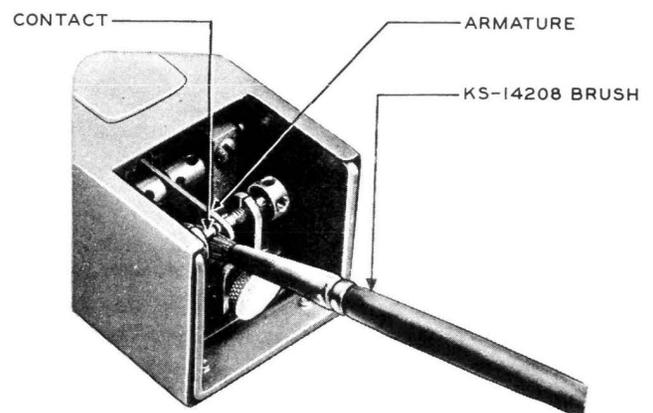
##### 4.02 General

(a) Contacts should be wet brushed as covered in 4.03 and 4.04 using a clean KS-14208 brush dampened by dipping it into

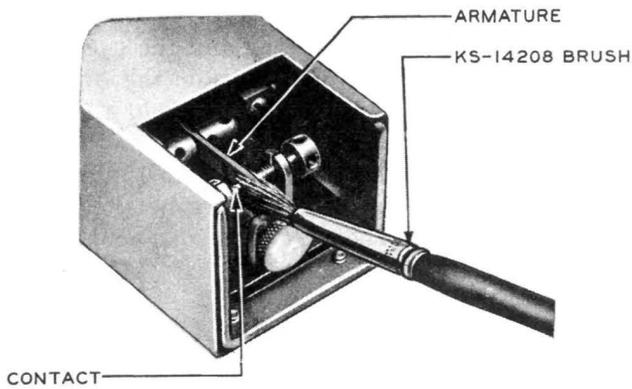
KS-8372 trichloroethylene and the excess fluid removed by wiping the brush on the side of the container. It is important to avoid the use of contaminated trichloroethylene in cleaning contacts. Therefore, place a small quantity of trichloroethylene in a 1-ounce bottle and discard the trichloroethylene as soon as it appears slightly dirty.

(b) Immediately after wet brushing, the contacts should be dry brushed as described in 4.03 and 4.04 using a clean, dry KS-14208 brush.

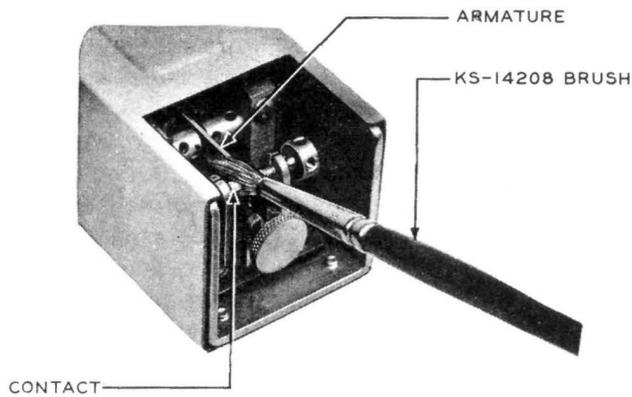
**4.03 All Relays Except Wire-Spring and UB-type Relays:** Hold the KS-14208 brush so that the center of the hairs is as shown in Fig. 2, directly under the contacts to be cleaned. Brush the contacts by gradually working the brush up between the contacts, using a back and forth (sawing) motion as shown in Fig. 3, 4, and 5. The contacts will be cleaned as the hairs pass between them. Repeat this operation two or three times. When cleaning normally closed contacts, operate the relay manually. To brush contacts on 207-type relays, it will be necessary to use a locally modified brush having the ferrule bent at approximately a 90-degree angle about 1/2 inch from the bottom as shown in Fig. 6.



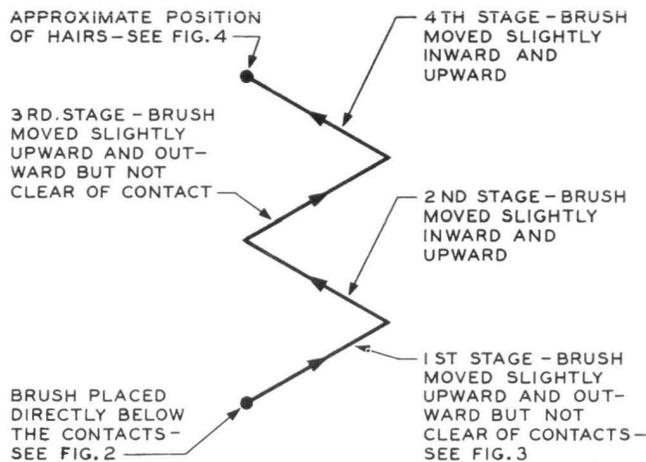
**Fig. 2**—Position of KS-14208 Brush Hairs When Brush Is Below the Contacts on a 239-type Relay



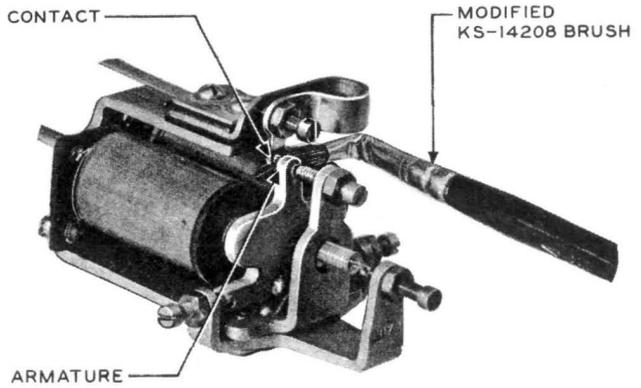
**Fig. 3 — Position of KS-14208 Brush Hairs After Brush Has Been Moved Slightly Upward and Outward on a 239-type Relay**



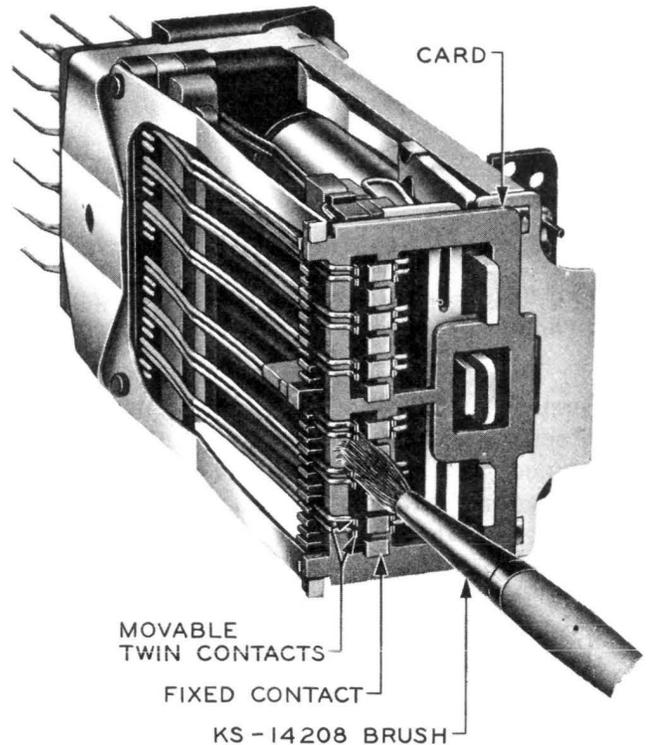
**Fig. 4 — Position of KS-14208 Brush Hairs After Brush Has Been Moved Upward Through the Contacts on a 239-type Relay**



**Fig. 5 — Diagram Showing Movement of KS-14208 Brush in Cleaning Contacts**



**Fig. 6 — Cleaning Contacts on a 207-type Relay With Modified KS-14208 Brush**



**Fig. 7 — Method of Brush Contacts on Wire-spring Relays**

**4.04 Wire-Spring-type Relays (AF-, AG-, AJ-, AK-, 286-, 287-, and 288-type Relays)**

**General**

(a) Due to the proximity of adjacent contact positions on wire-spring relays, it is impracticable to confine brushing to the contacts in one position when adjacent positions are equipped with contacts. Therefore, it is necessary in some cases to brush contacts in

positions other than that of the contacts requiring cleaning. For example, if the relay is equipped with contacts in positions 1, 2, 4, 5, and 6 and the contacts in position 5 require cleaning, the brushing operation will extend over the contacts in positions 4, 5, and 6. In this case, the brush is withdrawn directly above the contacts in position 6 without brushing the contacts in position 7 in the upper group of contacts of the relay.

#### Brushing Normally Open Contacts

(b) To brush normally open contacts in any position on wire-spring relays, proceed as follows. Place the brush at the first position unequipped with normally open contacts below the contacts to be cleaned. If there is no lower unequipped position in the group, place the brush directly below the lowest position in the group. Hold the brush so that the hairs are directly under the contacts and the tips of the hairs extend approximately to the face of the card as shown in Fig. 7. Gradually work the brush upward between the contacts with a back and forth (sawing) motion as diagrammed in Fig. 5. Continue the brushing operation upward through the contacts to be cleaned until either a position unequipped with contacts or the top position in the group is reached. Then withdraw the brush without brushing contacts in a higher position. Repeat the operation two or three times

#### Brushing Normally Closed Contacts

(c) To brush normally closed contacts, block the armature in the operated position and proceed as covered in (b).

**4.05 UB-type Relays:** Because of the design of UB-type relays, it is impracticable to clean contacts on these relays by the brush method. In this case clean the contacts by the burnishing method described in 4.11.

#### Burnishing Contacts

**Note:** Do not attempt to burnish contacts unless the wet-brush dry-brush method covered in 4.01 (a) proves ineffective.

**4.06** To burnish contacts use a clean No. 266D, 266E, 374A, or 374C blade, whichever is specified. The No. 266D and 266E blades are used with the No. 265C contact burnisher holder and the No. 374A and 374C blades with the No. 373D contact burnisher holder. When using the No. 266E blade on relays other than wire-

spring types, insert the blade in the No. 265C contact burnisher holder with the wide end outward. It is very important to keep the blades of contact burnishers and any thickness gauges that are used on the contacts *clean* (see 3.01).

**4.07** In burnishing contacts, the desired result is usually obtained by rubbing the burnisher between the contacts two or three times. After burnishing, contacts should always be brushed with a clean, dry KS-14208 brush as covered in 4.03 and 4.04.

**4.08** In burnishing normally open contacts, place the blade of the burnisher between the contacts. Press them together with the KS-6320 orange stick as indicated in Fig. 8 or operate the relay manually, giving a slight pressure against the blade of the burnisher and at the same time move the blade back and forth. Fig. 8 to 16, inclusive, illustrate methods for some typical relays. Burnish similar contacts on other types of relays in the same general manner. In the case of the normally closed contacts, the tension of the springs themselves will usually furnish sufficient pressure against the burnisher. On springs having heavy tension, lift one of the springs away sufficiently to insert the burnisher. Additional details on methods of burnishing contacts on several types of relays are described in 4.10 to 4.13, inclusive.

**4.09** If, after burnishing a bar-type contact as described in 4.08, the desired results are not obtained, the difficulty may be due to a burr on the ends of the contact. Using the No. 510C test lamp (with the tip removed), examine the ends of the contact, and if a burr is present carefully remove it with the KS-2662 or KS-2663 file. In filing normally open contacts, hold the file parallel to the surface of the contact and use only enough strokes to remove the burr as determined by visual inspection with the aid of the No. 510C test lamp. While removing the burr, exercise **EXTREME CAUTION** not to reduce the height of the contact or the adjacent contact in the case of twin contacts. Avoid removing metal from the mating contact by keeping the file away from this contact. In order to do this, maintain slight pressure with the file on the contact from which the burr is being removed. When removing a burr from a normally closed contact, operate the relay to keep the contacts open during the operation. After removing the burr, burnish the contact as covered in 4.06 to 4.08, inclusive, and brush the contact with a clean, dry KS-14208 brush as covered in 4.03 and 4.04.

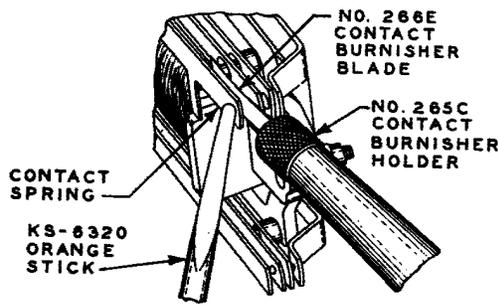


Fig. 8 — Method of Burnishing Contacts on A-, AB-, E-, EA-, F-, H-, R-, and T-type Relays

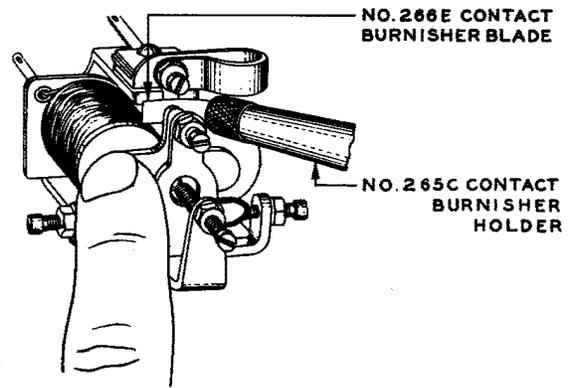


Fig. 11 — Method of Burnishing Contacts on 207-, 213-, and 268-type Relays

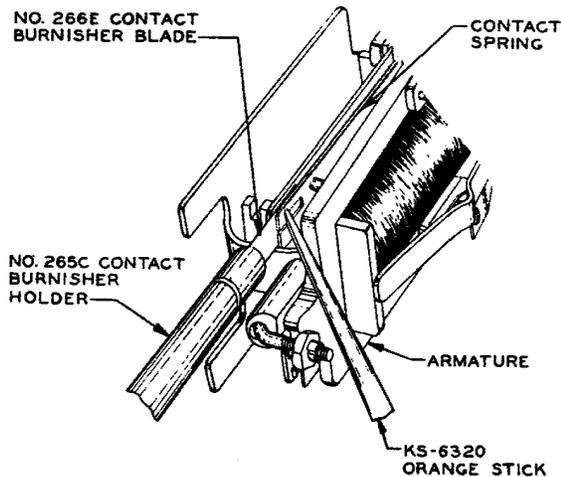


Fig. 9 — Method of Burnishing Contacts and U- and Similar-type Relays

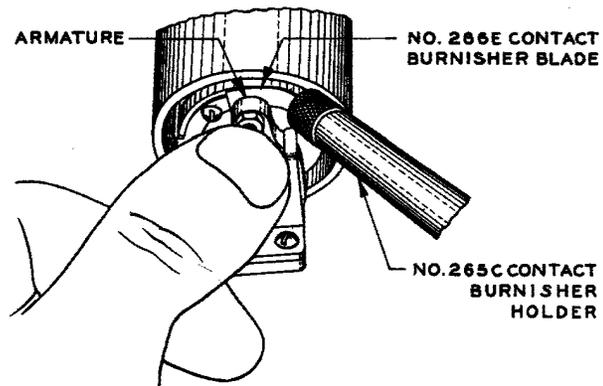


Fig. 12 — Method of Burnishing Contacts on 89-, 101-, 105-, 108-, 118-, 172-, and 190-type Relays

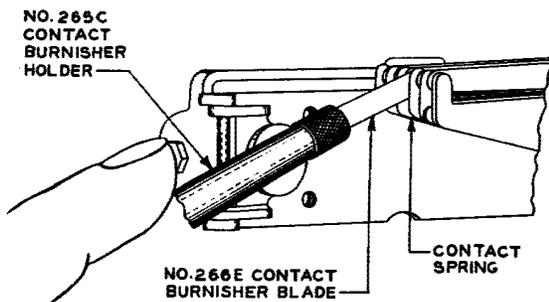


Fig. 10 — Method of Burnishing Contacts on 221-, 222-, 223-, 224-, 225- (Except When Used in Z Position on Step-by-Step Switch), 247-, 248-, 251-, and 252-type Relays

**4.10 Wire-Spring-type Relays (AF-, AG-, AJ-, AK-, 286-, 287-, and 288-type Relays):**

The life expectancy of gold overlay or other precious metal contacts will be severely shortened by indiscriminate burnishing. If the contacts cannot be cleaned by the wet-brush dry-brush method, insert the No. 266E blade in the No. 265C contact burnisher holder with the narrow end outward. In the case of normally open contacts, place the blade between the contacts so that both of the twin contacts will rest on one surface of the blade when the relay is operated or the contacts are pressed together. Insert the blade only to the inner edge of the contacts to insure that the blade will clear the card at all times. Manually operate the relay or press the contacts together with the flat portion of the KS-6320 orange stick applied to

the twin springs at the point where they rest on the card as shown in Fig. 13. Then move the burnisher back and forth to burnish the contacts. To burnish normally closed contacts, manually operate the relay, insert the blade between the contacts, release the relay, and burnish the contacts as described above.

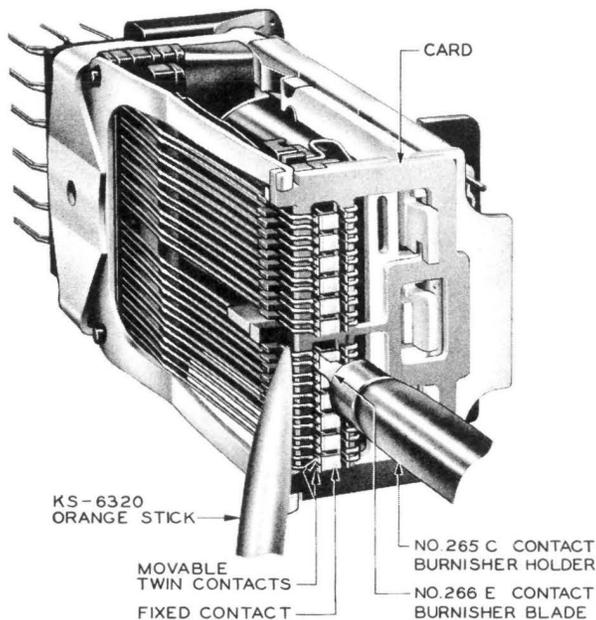


Fig. 13 - Method of Burnishing Contacts on Wire-spring Relays

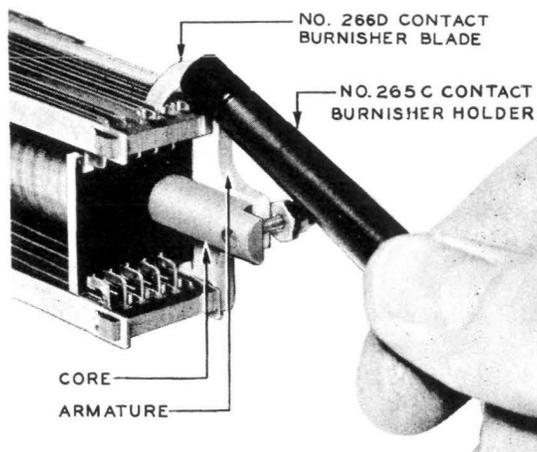


Fig. 14 - Method of Inserting Contact Burnisher Blade on UB-type Relays

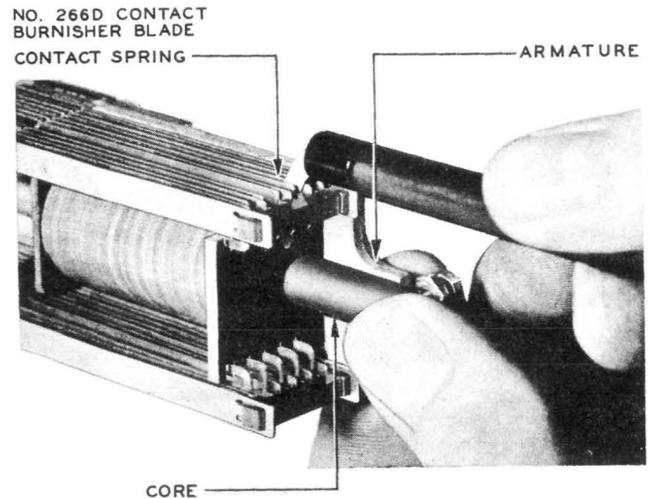


Fig. 15 - Method of Burnishing Contacts on UB-type Relays

**4.11 UB-type Relays:** Insert the No. 266D blade in the No. 265C contact burnisher holder so that the outer tip of the blade extends approximately at right angles to the holder as shown in Fig. 14. In burnishing normally open contacts, insert the burnisher blade between the contacts so that the blade is over both contacts on the bifurcated spring. Operate the relay manually, giving a slight pressure against the blade, and at the same time move the blade up and down as shown in Fig. 15. In the case of normally closed contacts, operate the relay manually, insert the blade between the contacts and then release the relay. The tension of the springs themselves will usually furnish sufficient pressure against the burnisher blade.

**4.12 206-, 209-, 215-, 231-, 239-, 255-, and 280-type Relays (Except Telegraph Transmission Relays) Equipped With Solid Armature Illustrated by Fig. 17 or Standard Type of Flexible Contact Springs Illustrated by Fig. 18:** Insert the No. 266E blade in the No. 265C contact burnisher holder with the wide end outward. Insert the contact burnisher blade horizontally between the armature and the stationary contact as indicated in Fig. 16. If necessary, back off the contact screws equally with the No. 340 adjusting key far enough to permit the burnisher blade to enter easily between the armature and the contact. If necessary, hold the armature or flexible contact against the contact burnisher with the KS-6320 orange stick (in the case of flexible

contact springs, flatten the end of the orange stick and insert it between the springs) and burnish the contacts. While rubbing the contact burnisher back and forth, take care to hold it parallel to the armature. Do not attempt to produce a rounded surface on the stationary contact. If the position of the contact screws was disturbed, readjust the screws as covered in the appropriate section covering requirements and adjusting procedures for the apparatus.

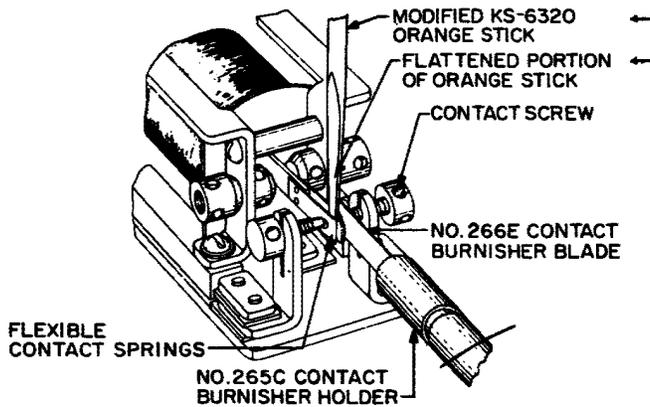


Fig. 16 - Method of Burnishing Contacts on 206-, 209-, 215-, 231-, 239-, 255-, and 280-type Relays

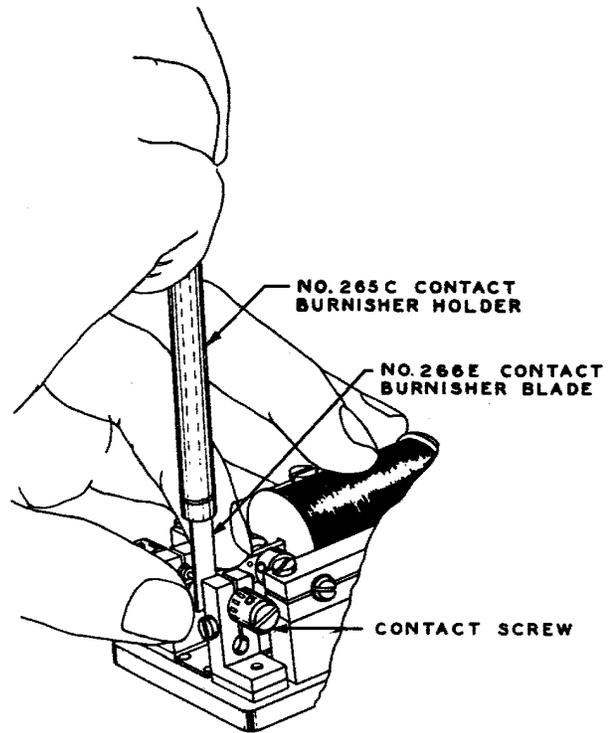


Fig. 20 - Method of Cleaning Contacts on 209-type Relays Equipped With Duckbill-type Contact Springs

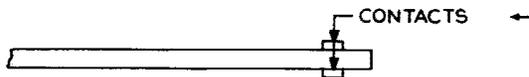


Fig. 17 - Solid Armature on 206- and Similar-type Relays

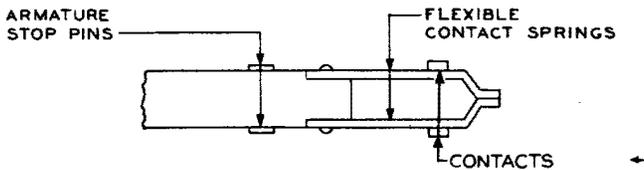


Fig. 18 - Standard Type of Flexible Contact Springs on 206- and Similar-type Relays

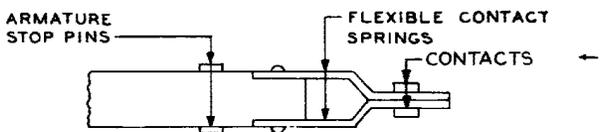


Fig. 19 - Duckbill Type of Flexible Contact Springs - 209-type Relays

4.13 *209-type Relays Equipped With the Duckbill Type of Flexible Contact Springs Illustrated by Fig. 19:* Insert the No. 266E blade in the No. 265C contact burnisher holder with the wide end outward. Insert the contact burnisher blade approximately vertically between the armature and the stationary contact as shown in Fig. 20. If necessary, back off the contact screws equally to permit the burnisher blade to enter between the armature and the contact. Hold the end of the flexible contact springs with the thumb and forefinger as shown in Fig. 20, to resist the movement of the armature in a vertical plane, and burnish the contacts by rubbing up and down while holding the armature lightly against the burnisher. Take care that the contacts are burnished so that their surfaces remain parallel to the armature. Do not attempt to reproduce a rounded surface on the stationary contact. If the position of the contact screws was disturbed, readjust the screws as covered in the section covering requirements and adjusting procedures for the apparatus.

**4.14 225-type Relay in Z Position on Step-by-Step Switch:** Insert the No. 374A or 374C in the No. 373D contact burnisher holder. Use the blade which can be more easily inserted between the contacts on the relay. In burnishing normally open contacts, place the blade of the burnisher between the contacts. Operate the relay manually, giving a slight pressure against the blade of the burnisher and at the same time move the blade up and down. In the case of normally closed contacts operate the relay manually, insert the blade between the contacts and then release the relay. The tension of the springs themselves will usually furnish sufficient pressure against the burnisher blade.

**Caution:** Take care not to remove excessive contact metal when using the No. 374A or 374C burnisher blade.

**4.15** After burnishing any contact, check whether or not the contact follow and contact separation requirements are still met since burnishing tends to increase the contact separation and to reduce the follow. If necessary, adjust the springs as covered in the appropriate section covering requirements and adjusting procedures for the apparatus.

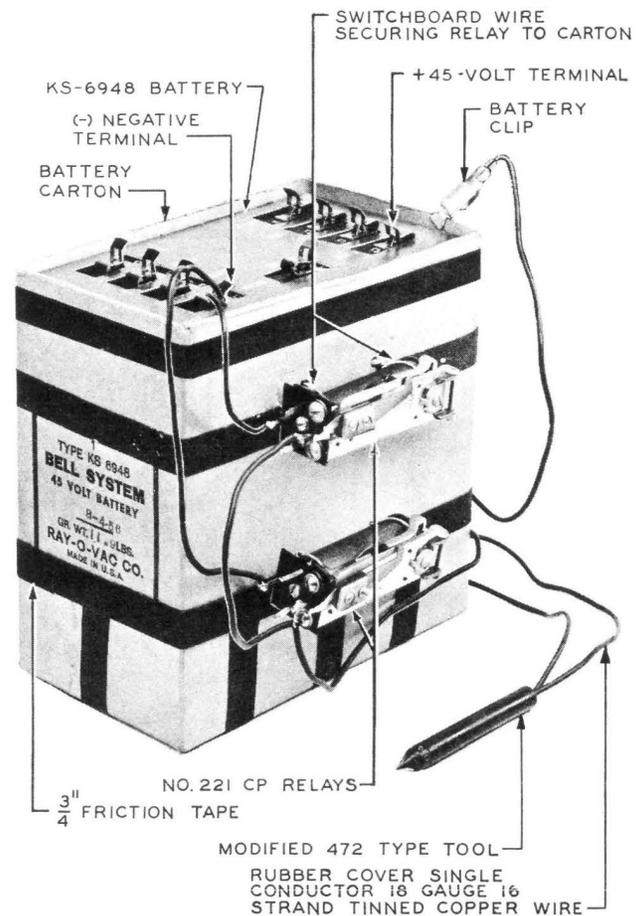
#### Arc Method of Cleaning Contacts

**4.16** The arc method of cleaning contacts covered in 4.18 applies only to cleaning VON contacts 3—4 of the digit-absorbing selector, SD-32183-01.

**4.17 Arcing Equipment Required:** The equipment shown in Fig. 21 is required for the arc cleaning method and should be prepared locally. This equipment is wired as shown in Fig. 22 and provides means of producing an arc across the VON contacts when the contacts are broken. Referring to Fig. 21 and 22, two No. 221CP relays are connected in parallel between a KS-6948 battery and a modified 472-type tool. The modified tool is used to connect the arcing circuit across the VON contacts at the test jack of the switch. This equipment may be prepared as follows.

(a) In order to make the arcing equipment a convenient self-contained unit, a KS-6948 battery carton may be used to mount the relays as shown in Fig. 21. To prepare the carton for this purpose, remove the four cover flaps and reinforce the sides and bottom of

the carton with friction tape as shown in the figure. Punch holes in one side of the carton just above two of the strips of tape and secure the relays to the carton by switchboard wire passed through the holes as shown in the figure.



**Fig. 21 – Equipment for Arc Method of Cleaning VON Contacts 3 — 4 on Digit-absorbing Selector, SD-32183-01**

(b) Modify a 472-type tool as follows. Unscrew both tips from the tool and discard the all-metal tip. Unsolder the winding leads from the terminals in the other tip. Using the 5-inch diagonal pliers clip off the shank, extending from the tip, adjacent to the inner spoolhead of the winding and discard the winding.

(c) Wire the arcing equipment as follows.

Skin two 13-foot lengths of No. 18 rubber-covered wire approximately 3/8 inch from each end. Solder one end of each lead to a terminal of the tool tip. Pass both leads through the shell of the tool and screw the shell on the tip. Using the No. 18 wire, wire the equipment as shown in Fig. 22 connecting a battery clip to one of the 13-foot leads from the modified tool.

In using the arcing equipment as described in 4.18, it may be placed on a test wagon to facilitate moving it to locations convenient for cleaning contacts.

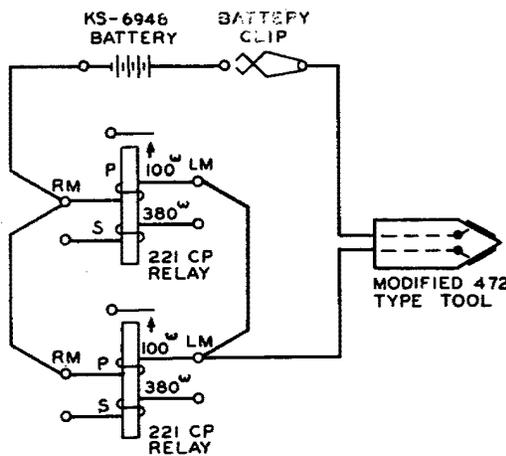


Fig. 22 - Wiring Diagram for Arcing Equipment Shown in Fig. 21

#### 4.18 *Cleaning VON Contacts by Arc Method:* Clean the contacts as follows.

- (a) First make the switch busy by inserting the rounded end of the No. 477A make-busy tool between springs 3 and 4 of the switch test jack.
- (b) Connect the lead from the modified 472-type tool to the +45 volt terminal of the battery. Insert the tip of the tool between the contacts on springs 5 and 6 of the test jack on the switch so that one metal segment on the tip is in contact with one spring, and the other segment is in contact with the other spring. Insert the tip sufficiently to open the contacts on the springs, but avoid excessive bending of the springs. Raise and lower the

switch shaft five times noting that the relays in the arcing equipment release and operate each time the shaft is raised and lowered. Operation and release of the arcing relays may be checked by ear. Failure of the relays to operate or release may be due to improper insertion of the tool tip between the test jack springs.

(c) Remove the tool from the test jack and rotate it 180 degrees to reverse the polarity of the arcing current. Reinsert the tool between the test jack springs and repeat the procedure covered in (b).

(d) To insure effective cleaning of the contacts, replace the KS-6948 battery after completing work on two bays of 160 switches each.

### 5. RECONDITIONING CONTACTS HAVING BUILDUPS OR PITS (EXCEPT TELEGRAPH TRANSMISSION RELAYS)

#### General

5.01 Buildups and pits on the contacts of relays and other apparatus result from the action of electric current as the contacts make and break. Built-up or pitted contacts are not necessarily an indication that the end of the useful life of the contact has been reached. If contact erosion has reached a point on one of the contacts of the mating pair so that contact is made on the base metal to which the contact is welded and this condition cannot be corrected by removing a buildup, replace the contacts if they are replaceable. Refer to Section 069-310-801 to determine if replacement of contacts on the apparatus is covered in the associated sections. If the apparatus is not covered in these sections, replace the apparatus. However, if the apparatus has twin contacts, do not replace the apparatus unless one contact of each mating pair of the twin contacts is worn through to the base metal. When necessary, recondition contacts which are not worn through to the base metal by removing buildups and reconditioning pits as covered in 5.05 to 5.13, inclusive.

5.02 *Buildups:* Buildups assume various forms as shown in Fig. 23 to 26, inclusive, which illustrate some of the types encountered on relays. If necessary, remove buildups as covered in 5.05 to 5.07, and 5.09. Buildups in pits similar

to the one on the lower contact in Fig. 26 cannot, however, be removed by this method. In this case, recondition the contact as covered in 5.08. Sharp-pointed buildups similar to the one shown in Fig. 23 may result in the mechanical locking of the contacts in the operated or closed positions.

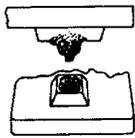


FIG. 23

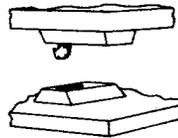


FIG. 24

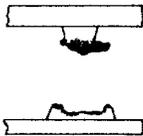


FIG. 25

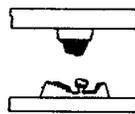


FIG. 26

**5.03 Pits:** Fig. 27 represents a nonpitted bar-type contact. Fig. 28 and 29 illustrate progressive stages of pitting. Fig. 28 illustrates a pitted contact which can be reconditioned, and Fig. 29, a pitted contact where replacement is necessary, Fig. 30, 31, and 32 illustrate corresponding conditions for a disc-type contact.

**5.04** To determine whether buildups or pits are present, inspect the contact surfaces using a No. 510C test lamp. If the inspection indicates that the contact erosion is of such a nature that reconditioning the contact is required, proceed as covered in 5.05 to 5.13, inclusive.

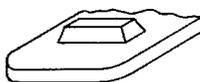


FIG. 27



FIG. 28



FIG. 29



FIG. 30



FIG. 31



FIG. 32

### Removing Buildups

**5.05 Tools for Removing Buildups:** The following tools are provided for removing buildups on contacts.

(a) The No. 527A build-up remover is provided with two blades, each consisting of a small masked file, for removing buildups from particular types of contacts. The mask on each blade is designed to avoid excessive removal of contact metal when using the tool. The label in the handle indicates the contacts on which the associated blade may be used. Do not attempt to use the tool for removing buildups from contacts other than those indicated.

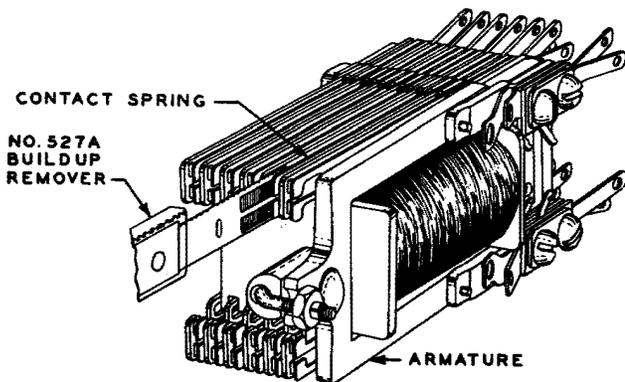
(b) For removing buildups on certain contacts not indicated on the handle of the No. 527A build-up remover, such as extra heavy point and disc contacts on E- and R-type relays, use the No. 374A contact burnisher blade inserted in the No. 373D contact burnisher holder. Exercise **EXTREME CAUTION** in using this tool to avoid reducing the height of the contact.

(c) The No. 655B build-up remover is provided for use on the contacts of wire-spring-type relays. One side of the tool consists of a file used for removing the buildups. The other side is grooved to provide a guide for properly positioning the tool while removing buildups. The handle of the tool is insulated.

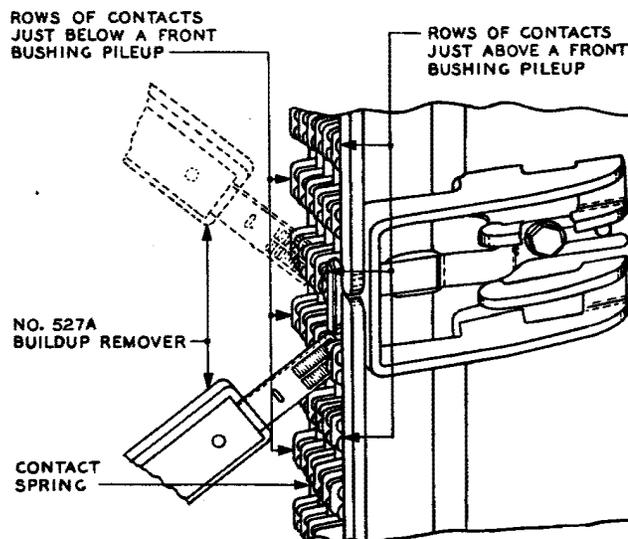
**5.06** Except for contacts of tungsten and No. 4 contact metal which are covered in 5.12 and 5.13 and contacts on wire-spring-type relays which are covered in 5.09, the procedures for removing buildups are as follows. Place the proper blade of the No. 527A build-up remover over the contact from which the buildup is to be removed. Exercise care when inserting the blade between the contacts to avoid applying pressure which may force the contact off the spring. In the case of bifurcated springs, make sure that both contacts are seated in the two slots in the mask of the No. 527A build-up remover. Hold the build-up remover so that the blade is approximately parallel to the center line of the spring as shown in Fig. 33 except in the case of the bifurcated springs on 245-, 254-, 263-, and 264-type relays. In these cases, hold the blade at an angle of approximately 30 degrees with the horizontal center line of the spring, so that the tip of the

build-up remover is pointed toward the pile-up as shown in Fig. 34. This will prevent long strokes of the build-up remover which would remove excessive contact metal.

**5.07** After properly positioning the build-up remover exert a slight pressure toward the contact, taking care to hold the build-up remover parallel to the surface of the spring to which the contact is welded. Move the build-up remover back and forth to remove the buildup. In working on normally open contacts, place the blade of the build-up remover between the contacts. Press the contacts toward the blade with the KS-6320 orange stick or operate the relay manually to give a slight pressure against the

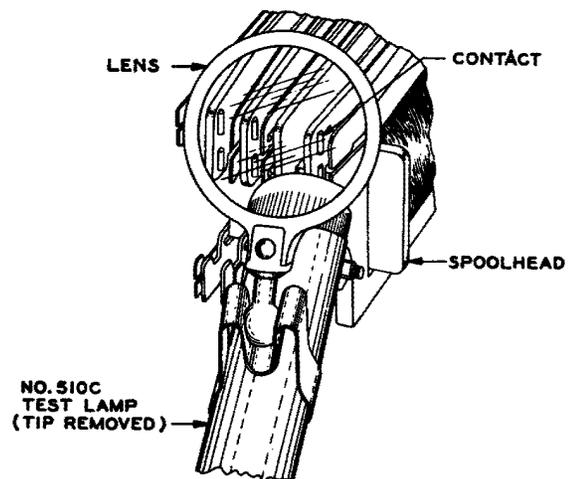


**Fig. 33 – Method of Removing Buildups From U- and Similar-type Relay Contacts**



**Fig. 34 – Method of Removing Buildups on 245- and Similar-type Relay Contacts**

blade of the build-up remover. Then move the blade back and forth. After two or three strokes, remove the build-up remover and inspect the contact surface using the No. 510C test lamp (with the tip removed) as shown in Fig. 35. If the buildup has not been completely removed, repeat the operation. Use only sufficient strokes with the build-up remover to remove the buildup as determined by visual inspection with the aid of the No. 510C test lamp. After the buildup has been removed burnish the contacts, using the No. 266E blade in the No. 265C contact burnisher holder, and then follow this procedure by brushing the contact with a clean, dry KS-14208 brush as covered in 4.03. If necessary, recondition the mating contact as described in 5.08 and 5.10.

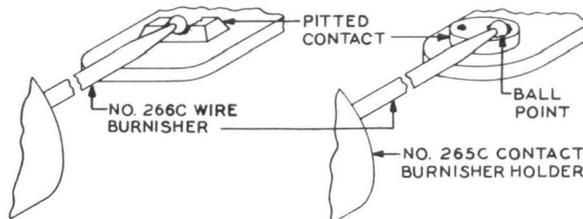


**Fig. 35 – Method of Inspecting Contacts for Pits and Buildups**

**5.08 Removing Buildups From Pitted Contacts:**

**Fig. 36** — Remove the buildup in the pit, using the No. 266C wire burnisher in the No. 265C contact burnisher holder. To do this, place the ball point of the burnisher in the pit as illustrated in Fig. 36. If the pit is small, rotate the barrel of the tool between the thumb and forefinger and at the same time apply a slight pressure toward the contact. Apply this pressure by means of the tool itself. Inspect the contacts, using the No. 510C test lamp (with the tip removed), and repeat this operation if necessary with the burnisher held at various angles until the entire surface of the pit has been cleaned. If the pit is large, the burnishing operation may be accomplished by moving the ball point of the

wire burnisher over the surface of the pit with a circular motion. After burnishing the pit, burnish the contact using the No. 266E blade in the No. 265C contact burnisher holder and then follow this procedure by brushing the contact with a clean, dry KS-14208 brush as covered in 4.03 and 4.04.



**Fig. 36 – Method of Removing Buildup From Pitted Contacts**

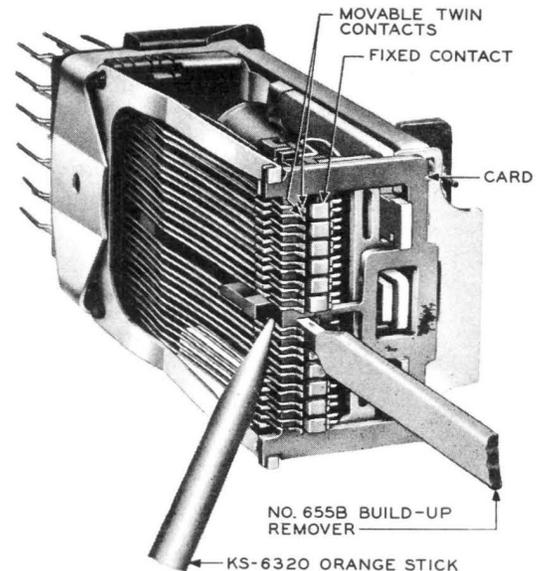
**5.09 Removing Buildups on AF-, AG-, AJ-, AK-, 286-, 287-, and 288-type Relays (Wire Spring Type):** To remove buildups from contacts on these relays proceed as follows.

**(a) Contacts on Movable Twin Springs**

(1) Insert the No. 655B build-up remover between the twin and fixed contacts with the fixed contact seated in the groove of the build-up remover. On normally closed contacts, operate the relay manually, insert the build-up remover and release the relay. Exercise care when inserting the build-up remover to avoid pushing on the outer end of the contacts since this may distort the spring or force the contact off the spring. Insert the build-up remover only to the inner edge of the contacts to insure that it will clear the card at all times.

(2) Press the twin contacts lightly against the build-up remover by applying the flat portion of the KS-6320 orange stick to the springs at the point where they rest on the card as shown in Fig. 37.

(3) Move the build-up remover back and forth against the contacts to remove the buildup, being careful to keep the build-up remover approximately perpendicular to the front of the relay. After two or three strokes, withdraw the build-up remover and inspect the contact surface with the aid of the No. 510C test lamp (with the tip removed).



**Fig. 37 – Method of Removing Buildups on Twin Contacts of AF-, AG-, and AJ-type Relays (Wire Spring Type)**

If the buildup is at the front or rear of the contact, its removal will be facilitated by slightly swinging the build-up remover to the left or right as required to more effectively reach the buildup. If the buildup has not been completely removed, repeat the operation.

**Caution:** The No. 655B build-up remover is not provided with a mask to limit the amount of contact material which can be removed. Therefore, take care to use only enough strokes to remove the buildup as determined by visual inspection with the aid of the test lamp.

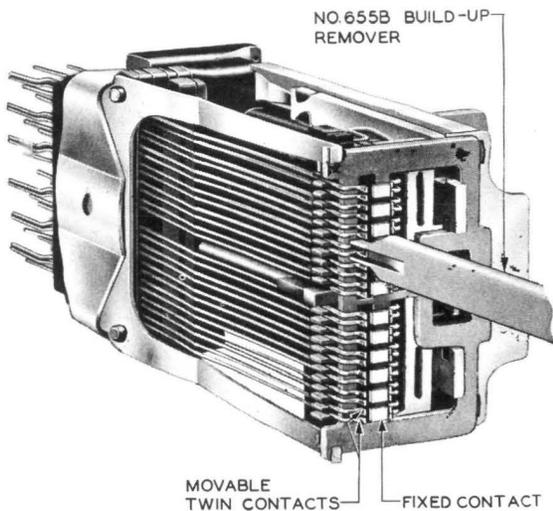
(4) After the buildup has been removed, burnish the contact as covered in 4.10. Then using a clean, dry KS-14208 brush, brush this contact and also all contacts below it on the relay as covered in 4.04.

**(b) Contacts on Fixed Springs**

(1) Insert the No. 655B build-up remover between the twin and fixed contacts with the twin contacts seated in the groove of the build-up remover as shown in Fig. 38. On normally closed contacts operate the relay manually, insert the build-up remover and release the relay. Exercise care when inserting the build-up remover to avoid

pushing on the outer end of the contacts. Insert the build-up remover only to the inner edge of the contacts to insure that it will clear the card.

- (2) Press the build-up remover lightly against the fixed contact and proceed as described in (a) (3) and (4).



**Fig. 38 – Method of Removing Buildups on Fixed Contacts of AF-, AG-, and AJ-type Relays (Wire Spring Type)**

#### Reconditioning Pitted Contacts

**5.10** Except for contacts of tungsten and No. 4 contact metal which are covered in 5.12 and 5.13, the procedures for reconditioning pitted contacts are as follows. Burnish the contacts having pits, using the No. 266E blade in the No. 265C contact burnisher holder. In burnishing, do not attempt to remove the pit from the contact but burnish only sufficiently to insure that the flat contacting surface surrounding the pit is cleaned.

#### Check of Relay

**5.11** After burnishing and brushing, check whether the contact follow and contact separation requirements, covered in the appropriate section covering requirements and adjusting procedures for the apparatus, are met since burnishing tends to increase the contact separa-

tion and reduce the follow. If necessary, readjust the spring.

#### Relays Equipped With Contacts of Tungsten and No. 4 Contact Metal

**5.12** On 206-, etc, type relays equipped with contacts of tungsten and No. 4 contact metal, recondition contacts having buildups or pits as covered in Part 6 for telegraph transmission relays. The contact metal on these relays may be identified as follows. If the contact screw is equipped with tungsten contact metal, the letter W or T is stamped on the head of the screw, and if it is equipped with No. 4 contact metal, the numeral 4 is stamped on the head of the screw. If the contact screws are equipped with tungsten contact metal, the armature is equipped with No. 4 contact metal except for the No. 239KA, 239KB, 280ER, and 280FC relays. In these latter cases, the armature is equipped with No. 2 contact metal. If the contact screws are equipped with No. 4 contact metal, the armature is also equipped with No. 4 contact metal.

#### 5.13 Reconditioning Screws and Armatures Equipped With No. 4 Contact Metal Contacts:

Examine the contacts to determine whether filing is necessary on both armature and stationary contacts or on only one or the other. If both contacts require filing, insert the KS-2662 or KS-2663 file horizontally between the armature and the stationary contact as shown for the burnisher in Fig. 39. Place the flattened point of the KS-6320 orange stick between the flexible contact springs and hold the spring against the file so that the file is held between the armature and the associated contact screw. File both contacts in this manner until the pits and buildups are entirely removed from both the contacts. While filing, take care to hold the file parallel to the armature. Take care not to remove contact metal unnecessarily. If, after the pit has been removed from one contact, the other contact requires additional filing or if only one contact is to be reconditioned, file this contact separately. In the case of armature contacts, use the orange stick as a stop. After the pits or buildups have been removed from both contacts, burnish the contacts as described in 6.02 and then brush them as covered in 4.03. Do not in any case attempt to produce a rounded surface on the stationary contacts.

## 6. RECONDITIONING CONTACTS — TELEGRAPH TRANSMISSION RELAYS

**Note:** Part 6 applies only to 209FG, 215H, 228 type per D-160118 and 255A relays used for telegraph transmission. No cleaning procedures are specified for these relays.

### Reconditioning Contacts

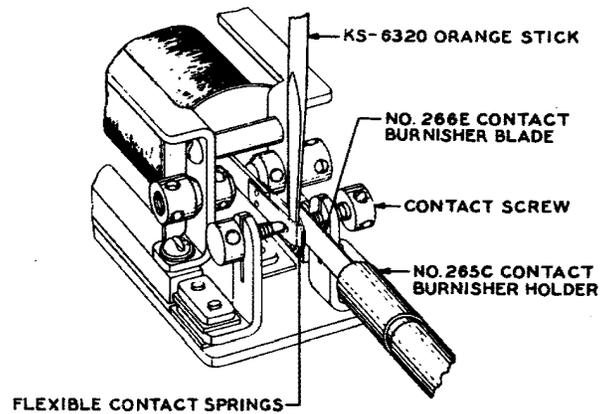
**6.01** Using the No. 340 adjusting key, back off the contact screws far enough to permit the contact burnisher or the file to enter easily between the armature and the stationary contact. If the pits and buildups are small, burnish the contacts as covered in 6.02. If the pits and buildups are large, file the contacts as covered in 6.03. After burnishing or filing the contacts, brush them with a clean, dry KS-14208 brush as covered in 4.03. The use of the No. 510C test lamp will facilitate inspection of the contacts.

**Note:** If the condition of the contacts is such that excessive filing will be required to remove all buildups and pits as covered in 6.03, replace either or both the contact screws and armature as covered in the Division 069 section on the apparatus.

**6.02 Burnishing Contacts:** Insert a clean No. 266E blade (see 3.01) in the No. 265C contact burnisher holder with the wide end outward. Insert the blade horizontally between the armature and the stationary contacts as shown in Fig. 39. Place the flattened end of the KS-6320 orange stick between the flexible contact springs and hold the flexible contact spring against the burnisher, as shown in the figure. Burnish the contacts by moving the burnisher back and forth. While burnishing, take care to hold the burnisher parallel to the armature.

### 6.03 Filing Contacts

(a) **Tungsten Contact Screw in Place on Relay:** File the tungsten contact screw and the No. 4 contact disc on the armature separately, using the KS-2662 or KS-2663 file. In the case of the armature contact disc, use the KS-6320 orange stick inserted between the leaves of the flexible contact spring as a stop. Smooth the contacts by burnishing them as de-



**Fig. 39 — Method of Burnishing Contacts on 206-, 209-, 215-, 231-, 239-, 255-, and 280-type Relays**

scribed in 6.02 and then brush them as covered in 4.03. Do not in any case attempt to produce a rounded surface on the stationary contacts.

(b) **Tungsten Contact Screw Removed From Relay:** Remove the contact screw from the relay with the No. 340 adjusting key. Immerse the Norton Arkansas stone HB13 in a container of water and then shake it to remove the excess water. Lay the stone on a flat surface. Hold the contact screw with the fingers so that the contact is against the stone and the screw is approximately perpendicular to the stone. Rub the contact on the stone with a rotary motion until the buildup or pit is removed. Do not attempt to produce a rounded surface. After the contact has been conditioned, wipe the contact with a clean KS-2423 cloth and then brush it with the KS-14208 brush. After conditioning a contact, immerse the stone in water and then wipe it with the KS-2423 cloth. However, before conditioning another contact always immerse the stone in water. Avoid handling the stone with the fingers as much as possible to keep the surface of the stone free of dirt and grease. When the stone is not in use, keep it in the box furnished with the stone.

**6.04** Following the burnishing or filing operation, check that the relay meets the requirements covered in the appropriate section covering the apparatus and make adjustments as required.

7. CLEANING RELAY PARTS

**Relay Parts Equipped With Paper Armature Stops, Separators, Paper Backstops, or Teflon Separators**

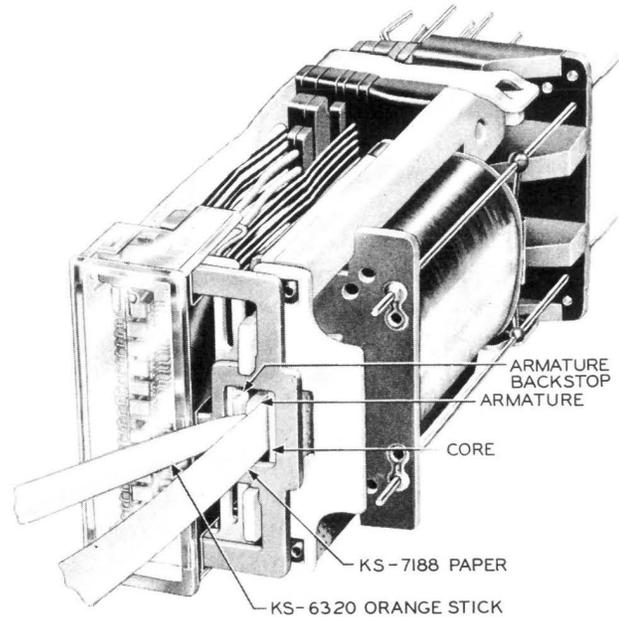
7.01 Do not attempt to clean relay parts equipped with paper armature stops, separators, paper backstops, or attachable magnetic separators because of the possibility of damaging them.

**Armatures, Cores, or Pole Pieces**

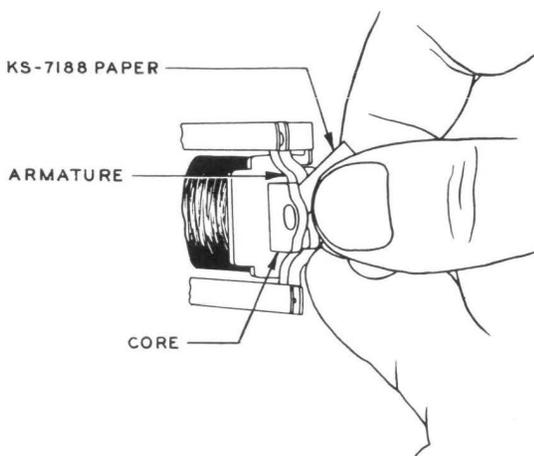
7.02 *General:* Take care that the surfaces of the core face (or pole piece) and armature are cleaned at all points where they may touch each other. On relays having stop pins (known as residual screws on 221-, 222-, 223-, 224-, 225-, 247-, and 248-type relays), it is only necessary to clean the stop pins and the core where the stop pins strike it. On B- and G-type relays having only one stop pin on the armature, it will be also necessary to clean those portions of the armature and the core which may touch.

7.03 *Armatures and Cores of A-, AB-, AF-, AG-, AJ-, AK-, 286-, 287-, 288-, E-, EA-, F-, H-, R-, T-, U-, UA-, UB-, and Y-type Relays:* Insert KS-7188 paper between the armature and the core (or between the armature and the tip of the adjustable stop pin on F-type relays). Press the armature manually toward the core so that the paper is held with a slight pressure

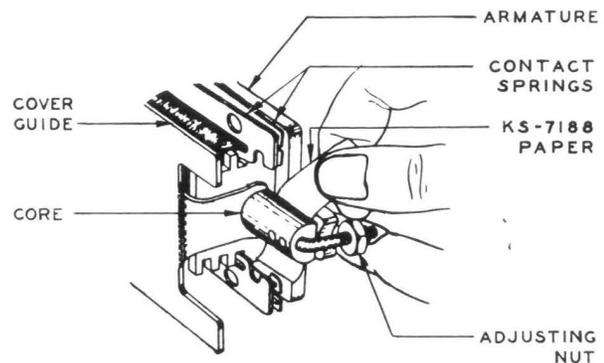
between these parts and then withdraw the paper. Examine the paper for evidence of dirt. Using a clean piece of paper each time, repeat the operation until the paper shows no evidence of dirt when it is removed (see Fig. 40, 41, 42, and 43).



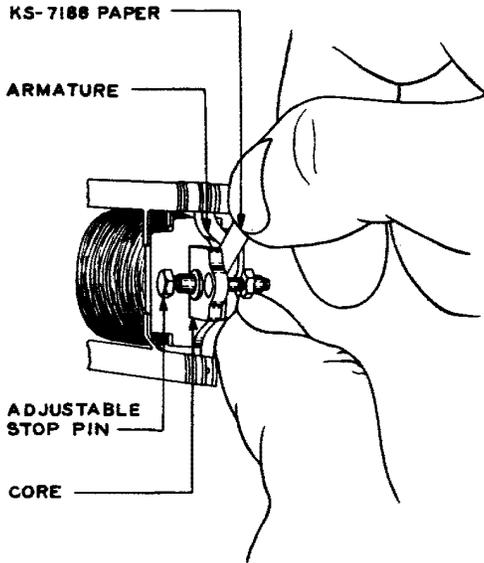
**Fig. 41 – Method of Cleaning Armature and Core on AF-, AG-, and AJ-type Relays (Wire Spring Type)**



**Fig. 40 – Method of Cleaning Armature and Core on A-, AB-, E-, EA-, F-, H-, R-, and T-type Relays**

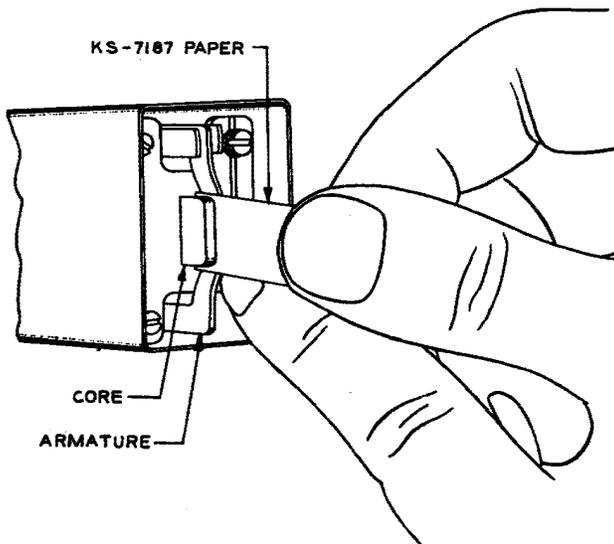


**Fig. 42 – Method of Cleaning Armature and Core on U- and Similar-type Relays**

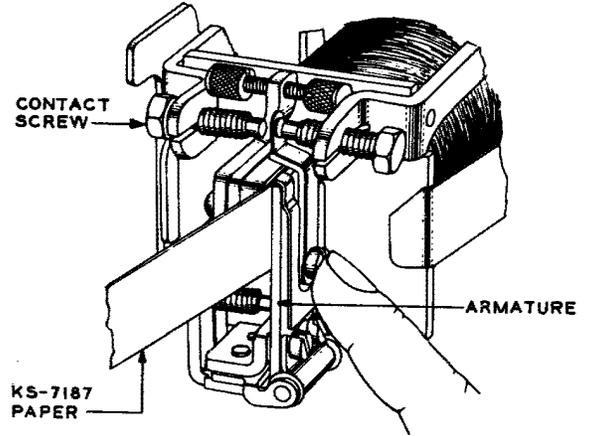


**Fig. 43 – Method of Cleaning Armature and Adjustable Stop Pin on F-type Relays**

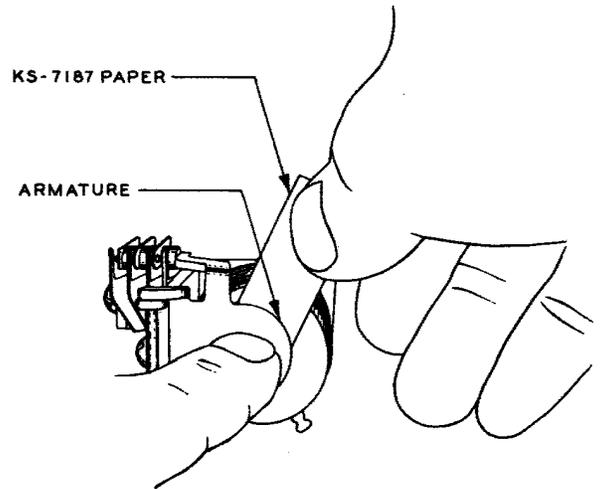
**7.04 Armatures, Cores, or Pole Pieces of B-, G-, J-, L-, N-, S-, 177-, 203-, 221-, 222-, 223-, 224-, 225-, 247-, 248-, 251-, and 252-type Relays:** Proceed as covered in 7.03 using KS-7187 paper instead of KS-7188 paper (see Fig. 44, 45, and 46).



**Fig. 44 – Method of Cleaning Armature and Core on B- and G-type Relays**



**Fig. 45 – Method of Cleaning Armature and Core on L-, N-, and S-type Relays**



**Fig. 46 – Method of Cleaning Armature and Core on Step-by-Step Relays**

**7.05 Armature and Pole Pieces of 111-, 121-, 122-, 125-, 149-, 162-, 163-, 178-, and 179-type Relays:** Thread KS-7187 paper between the armature and pole piece. If the relay mounting does not permit this to be done with the fingers, use the KS-8511 tweezers or the P-long-nose pliers. Press the armature toward the pole piece with a KS-6320 orange stick so that a slight pressure exists between the strip of paper and the parts being cleaned and then withdraw the paper

(see Fig. 47). Take care not to tear the paper as it is being removed. Repeat the operation until the paper shows no evidence of dirt when it is removed. Use a clean piece of paper for each operation.

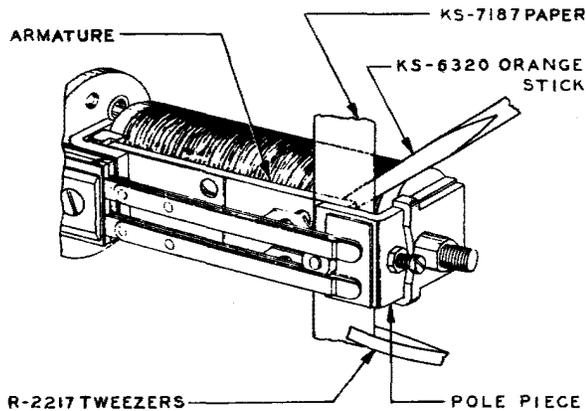


Fig. 47 – Method of Cleaning Armature and Pole Piece on 178- and Similar-type Relays

**7.06 Armature and Shell on 114-, 124-, 126-, 174-, and 198-type Relays:** Insert KS-7187 paper between the armature and shell as indicated in Fig. 48. Operate the relay manually and withdraw the paper. Repeat the operation until all surfaces between the armature and shell have been cleaned and the paper shows no evidence of dirt when it is removed. Use a clean piece of paper for each operation.

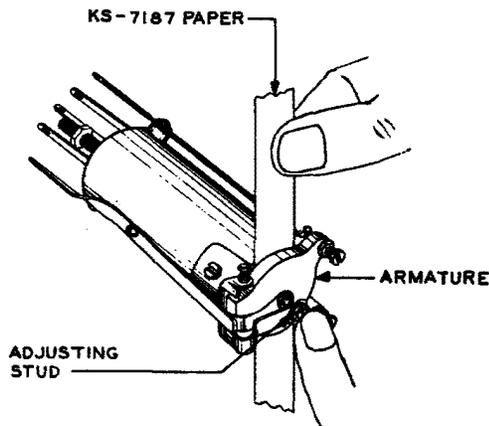


Fig. 48 – Method of Cleaning Armature and Shell on 114- and Similar-type Relays

**7.07 Tips of Flexible Contact Springs on 209-, 215-, 228-, and 255-type Relays:** When necessary to clean the surfaces of the flexible contact springs which bear against each other, proceed as follows. Cut off a piece of KS-7404 abrasive cloth approximately 2 inches long. Back off the contact screws two or more full turns. To clean standard armatures (Fig. 18), fold the cloth crosswise with the abrasive outward and insert the corner of the folded end in the opening between the contact spring. Draw the cloth forward, at the same time exerting a downward pressure so that the cloth passes between the front ends of the contact springs as shown in Fig. 49. Move the cloth backward and forward taking three or four strokes and then remove the cloth. Use a new piece of cloth for each operation. To clean armatures of the duckbill type (Fig. 19), use a single thickness of cloth in the same manner as described above except that the operation is performed twice, once with the abrasive surface of the cloth to the right and once with it to the left.

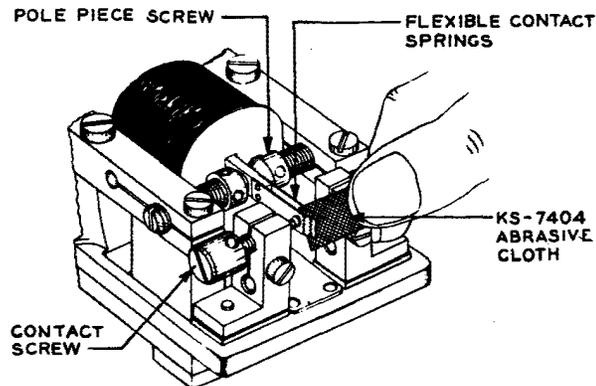
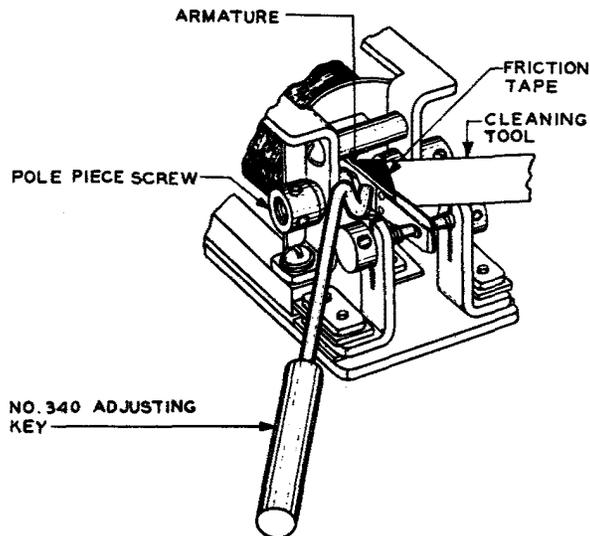


Fig. 49 – Method of Cleaning Tips of Flexible Contact Springs on 209-type Relays

**Pole-piece Screws on 206-, 209-, 215-, 227-, 228-, 231-, 239-, 255-, and 280-type Relays**

**7.08** Clean the pole-piece screws when necessary in accordance with the following procedures. Back off the pole-piece screws as far as possible from the armature, using the No. 340 adjusting key, as covered in the appropriate section covering requirements and adjusting procedures for the apparatus, to permit the insertion of the cleaning tool described in 7.09. Also, back off the contact screws in accordance with the

individual sections until the armature will not touch either contact when the cleaning tool is inserted between the armature and either pole-piece screw.

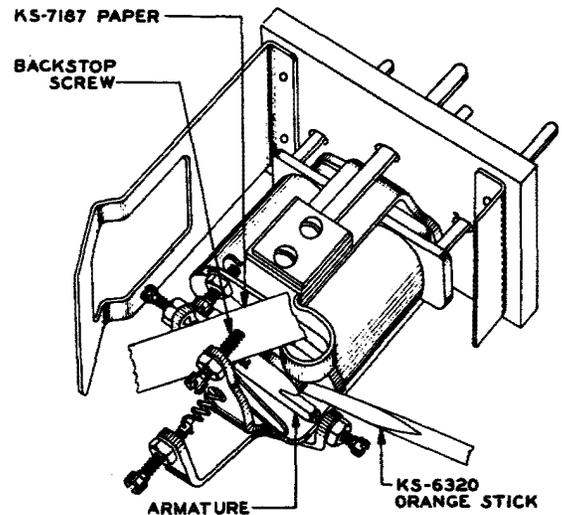


**Fig. 50 – Method of Cleaning Pole-piece Screws on 206-, 209-, 215-, 227-, 228-, 231-, 239-, and 280-type Relays**

**7.09** To remove metallic particles from the pole-piece screws, use a tool made out of a piece of thin stiff metal (preferably nonmagnetic) over which is wrapped a layer of friction tape with the stickier side toward the blade. Place the taped portion of the tool between the pole-piece screw and the armature. Using the No. 340 adjusting key, press the armature against the taped portion of the cleaning tool, as shown in Fig. 50, so as to cause any particles present to adhere to the tape. Do not rub the tape over the screw and armature as this tends to leave a residue from the tape on these parts. Do not use the tape after it has lost its tackiness.

#### **Backstops on 207-, 213-, and 268-type Relays**

**7.10** To clean the backstop, insert a piece of KS-7187 paper between the armature and backstop screw, and while holding the armature against the backstop screw, withdraw the paper (see Fig. 51). Repeat this operation until the paper shows no evidence of dirt when it is withdrawn.



**Fig. 51 – Method of Cleaning Backstops on 207-, 213-, and 268-type Relays**

#### **Backstop Screws on No. 218B Relays**

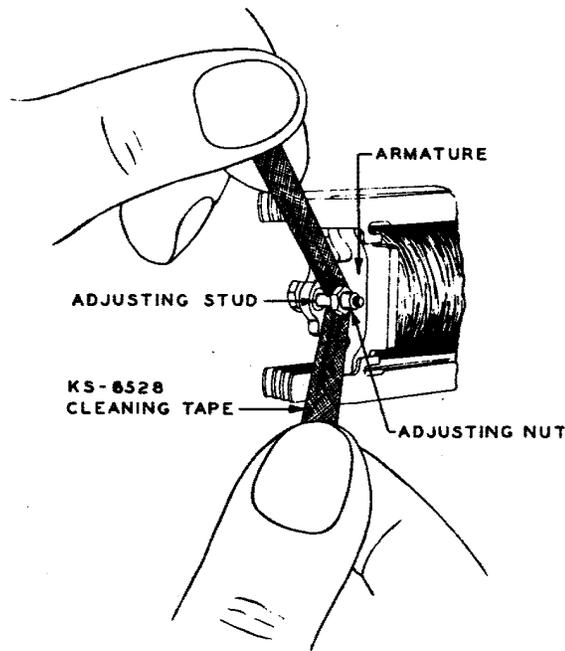
**7.11** To clean the backstop screw on No. 218B relays, insert a piece of KS-7188 paper between the armature and the backstop screw. Hold the armature against the paper and withdraw the paper from between the armature and the backstop screw. Repeat this operation as required until the paper shows no evidence of dirt when it is withdrawn. Use a clean piece of paper for each operation.

#### **Armature and Adjusting Nut on A-, AB-, E-, EA-, F-, H-, R-, T-, U-, UA-, UB-, and Y-type Relays**

**7.12** Clean the armature and adjusting nut by passing a piece of KS-6528 cleaning tape back and forth between the armature and the adjusting nut around the adjusting stud, thereby removing whatever dirt there may be on the back of the armature, the adjusting nut, and the adjusting stud (see Fig. 52). For EA-type relays not equipped with an adjusting nut, see 7.13.

#### **Armature and Backstops on EA-type Relays Not Equipped With an Adjusting Nut**

**7.13** Clean the armature and the portions of the spoolhead where the armature rests in the unoperated position with a piece of KS-7188 paper as follows. Operate the relay manually and insert the paper between the armature and spoolhead. Release the relay and



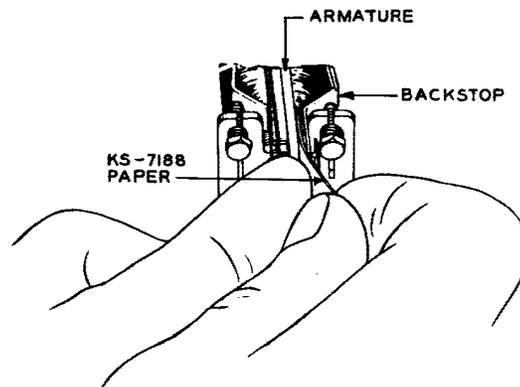
**Fig. 52 – Method of Cleaning Adjusting Nut and Stud on A-, AB-, E-, EA-, F-, H-, R-, T-, U-, UA-, UB-, and Y-type Relays**

then withdraw the paper. Repeat the operation until the paper shows no evidence of dirt when it is removed. Use a clean piece of paper for each operation.

**7.14 Backstops and Armatures of AF-, AG-, AJ-, and AK-type Relays (Wire Spring Type):** To clean the backstop and the surface of the armature with which it comes in contact, operate the relay manually; insert KS-7188 paper between the armature and the backstop; release the relay; and then withdraw the paper. Examine the paper for evidence of dirt. Using a clean piece of paper each time, repeat the operation until the paper shows no evidence of dirt when it is removed.

#### **Frontstops and Backstops on B-, G-, and J-type Relays**

**7.15** Clean the front and back stops with a piece of KS-7188 paper as shown in Fig. 53 while holding the armature operated or unoperated as required.



**Fig. 53 – Method of Cleaning Front and Back Stops on B-, G-, and J-type Relays**

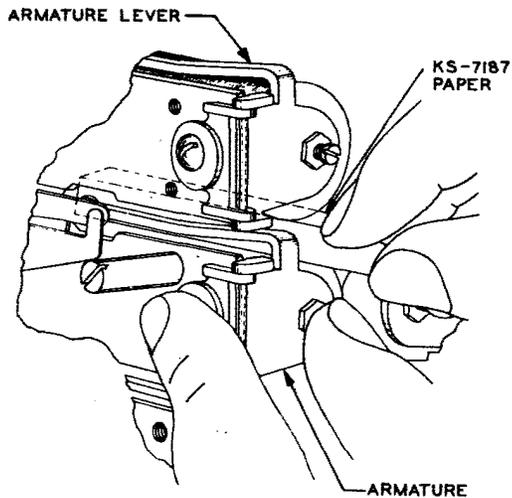
**Backstops on 221-, 222-, 223-, 224-, 225-, 247-, 248-, 251-, and 252-type Relays**

**7.16** Fold a piece of KS-7187 paper in half lengthwise. Insert one side of the folded paper between the armature lever and the backstop as illustrated by Fig. 54, at the same time holding the armature operated to permit the paper to enter easily. Hold the armature against the backstop with a force sufficient to give a slight pressure between the armature lever and the backstop and then withdraw the paper. Repeat the operation until the paper shows no evidence of dirt when it is removed. Use a clean piece of paper for each operation.

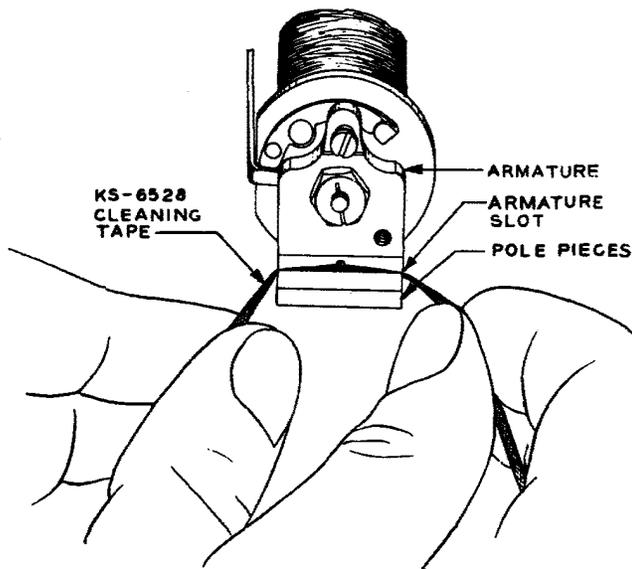
**Armature Slots, Armature Knife-edges, Front Contact Screws, Frontstops, Backstop Screws, Adjusting Studs, and Adjusting Nuts on 89-, 101-, 105-, 108-, 118-, 172-, and 190-type Relays**

**7.17** Clean the armature slot, the knife-edge of the armature, the front contact screw, the frontstop, the backstop screw, the adjusting stud and the adjusting nut with a piece of KS-6528 cleaning tape as covered in 7.18, 7.19, and 7.20.

**7.18** To clean the armature slot and the armature knife-edge, fold the tape lengthwise and pass it back and forth in the slot with the folded edge (not the outer edge) of the tape in the slot. Use the tape in the slot, both in front and in back of the armature, as shown in Fig. 55 and 56, respectively. After cleaning, see that the armature is properly seated in the slot.

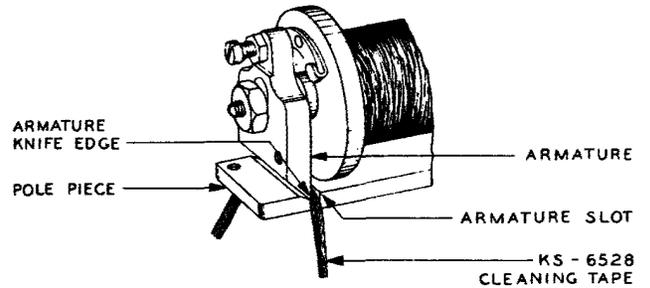


**Fig. 54 – Method of Cleaning Backstop on 221-, 222-, 223-, 224-, 225-, 247-, 248-, 251-, and 252-type Relays**

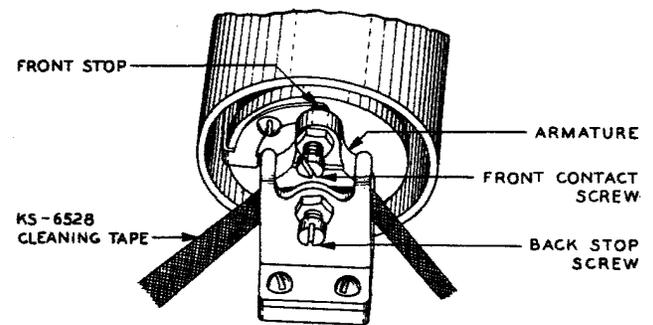


**Fig. 55 – Method of Cleaning Front Portion of Armature Slot and Armature Knife-edge on 89-, 101-, 105-, 108-, 118-, 172-, and 190-type Relays**

**7.19** To clean the front contact screw and front-stop, fold the tape lengthwise and, while holding the armature in the operated position, pass it between the screw and the frontstop. To clean the backstop screw, fold the tape lengthwise and pass it between the screw and the armature as shown in Fig. 57.

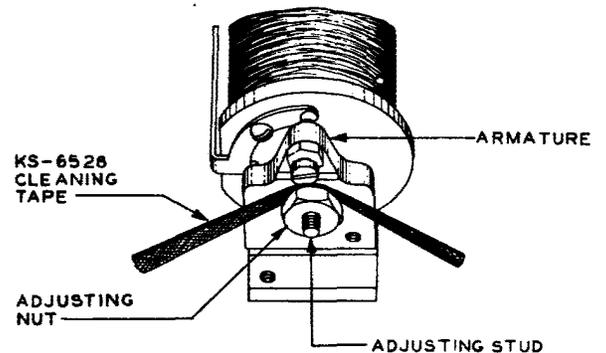


**Fig. 56 – Method of Cleaning Back Portion of Armature Slot and Armature Knife-edge on 89-, 101-, 105-, 108-, 118-, 172-, and 190-type Relays**



**Fig. 57 – Method of Cleaning Backstop Screws on 89-, 101-, 105-, 108-, 117-, 118-, and 190-type Relays**

**7.20** To clean the adjusting stud and adjusting nut, pass the tape back and forth between the armature and the nut above and below the adjusting stud as shown in Fig. 58, holding the armature in the unoperated position while drawing the tape through.



**Fig. 58 – Method of Cleaning Adjusting Stud and Adjusting Nut on 89-, 101-, 105-, 108-, and 172-type Relays**

**SECTION 069-306-801**

**Armature Pivot Screws and Bearings on 114-, 124-, 126-, 127-, 198-, and Earlier 225-type Relays**

**7.21** Clean the armature pivot screws as follows. Remove the pivot screws as covered in the appropriate section covering requirements and adjusting procedures for the apparatus. Clean the screws and bearings with a KS-2423 cloth moistened with KS-8372 trichloroethylene. After the parts have become thoroughly dry, reassemble the relay.

**Contact Covers of Wire-spring-type Relays**

**7.22** When the contact cover of a wire-spring-type relay has been removed for any reason, and upon inspection is found to be dirty,

son, and upon inspection is found to be dirty, fold several layers of KS-2423 cloth over the end of a KS-6320 orange stick and wipe out the cover, using fresh portions of the cloth until all the dirt has been removed.

**Check of Relay**

**7.23** After cleaning relay parts, check that the relay meets the requirements covered in the appropriate section covering requirements and adjusting procedures for the apparatus.