

KS-20489, 48-VOLT RECTIFIER

S3 SWITCH

TESTS, INSPECTIONS, CLEANING, AND ADJUSTMENTS

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1. GENERAL

1.01 This section provides a maintenance procedure for testing, inspecting, cleaning, and adjusting the DC OUTPUT (S3) switch (Fig. 1) of the KS-20489 rectifier.

1.02 This section is reissued to:

- (a) Add new test jacks
- (b) Provide the use of an external voltmeter

(c) Delete the word not, line 1, in the admonishment after sub-subparagraph 3.05(c) (3), and delete line 5 in subparagraph 3.06(c)

(d) Update admonishments to the latest standard.

Revision arrows are used to emphasize the more significant changes. This reissue does not affect the Equipment Test List.

1.03 The S3 switch should be tested and inspected at an interval specified in the Equipment Test List for the Bell System Practice concerned or more often if experience indicates the need.

⚠ Danger: ⚠ *The voltages in this unit exceed 150 volts to ground. Avoid all contact with terminals. Do not allow a test pick to touch two metal parts at the same time as destructive and dangerous short circuits may occur. Disconnect the ac input power to the rectifier before working on the unit except when necessary to make tests.*

2. LIST OF TOOLS, TEST APPARATUS, AND MATERIALS

| CODE OR SPEC NO. | DESCRIPTION |
|------------------|--------------------------------|
| TOOLS | |
| R-1032 | Thermometer |
| R-8950 | Syringe, Rubber |
| KS-14220, L14 | 7/16-Inch Socket Wrench |
| — | Ratchet Wrench, 3/8-Inch Drive |

NOTICE

Not for use or disclosure outside the Bell System except under written agreement

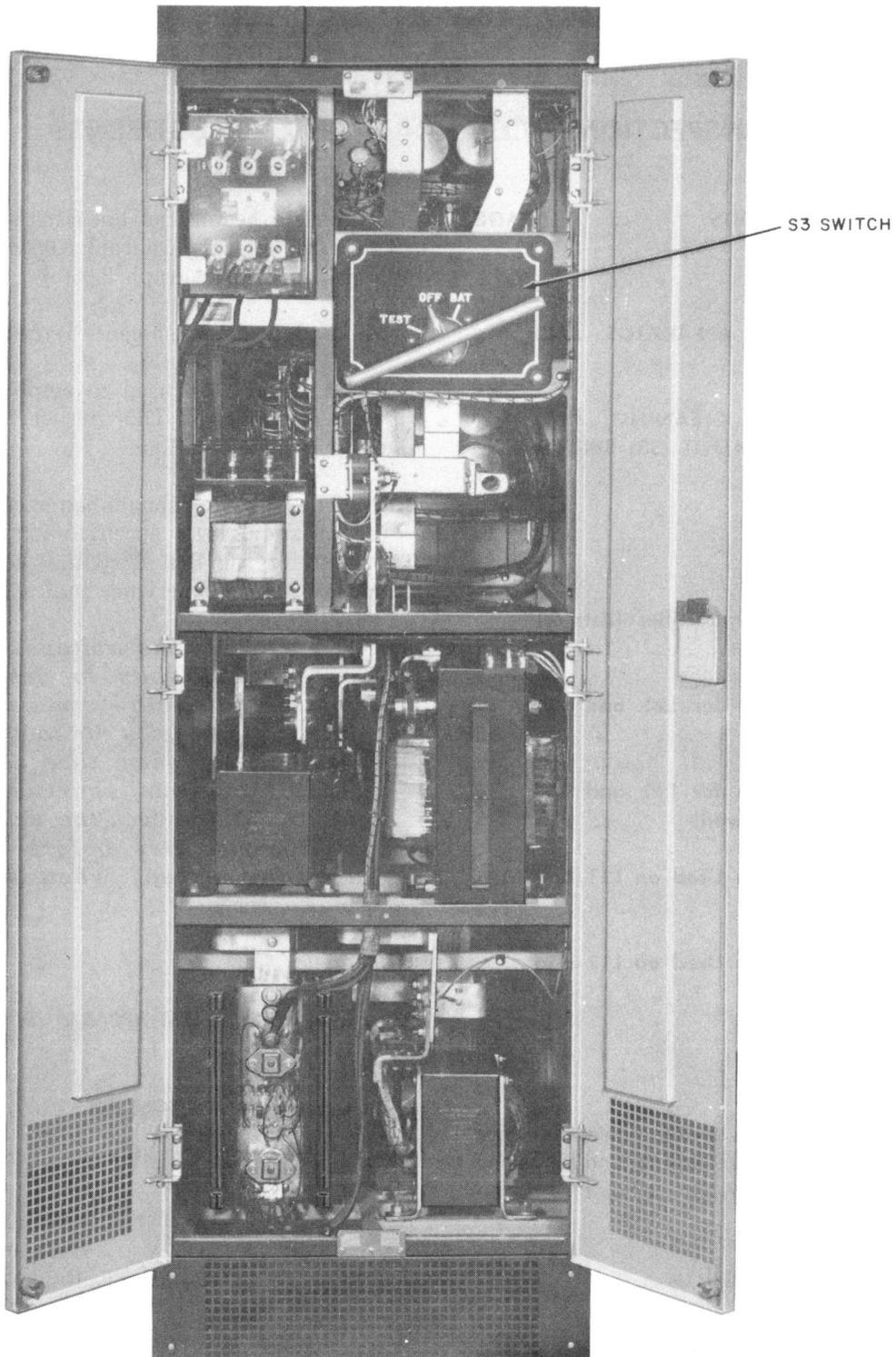


Fig. 1—S3 Switch on KS-20489 Rectifier (Lists 21 and 22)

- Torque Wrench (0-150 ft. lb. capacity)
- Adapter to Fit Torque Wrench
- KS-6909 Gauge

TEST APPARATUS

- KS-8039 ♦DC Volt-Milliammeter♦
- KS-20538 Volt-Milliammeter, or
- Digital Multimeter, Weston Model 1240

MATERIALS

- KS-14666 or KS-2423 Cloth, Cleaning
- KS-19578, L1 Trichloroethane
- KS-16736, L1 Compound
- Cloth, Crocus
- Rouge, Jewelers
- ♦REFRASIL*♦
- Chemically Pure Petrolatum
- KS-19589, L2 Lubricant

* Registered trademark of Hitco Materials Division.

3. TESTS, INSPECTIONS, CLEANING, AND LUBRICATION OF DC OUTPUT (S3) SWITCH

3.01 Switch Inspection:

- (a) Open all doors on the cabinet to maximum open position. Remove the guards. This gives maximum working space plus maximum visibility of the switch.

♦Warning:♦ *The S3 switch has battery potential on it. Unless the battery potential is removed, extreme care must be used when performing inspections or maintenance to avoid a short circuit between the switch and other metal parts of the rectifier*

cabinet. The switch should be insulated from surrounding parts using canvas, plastic sheeting, or other appropriate insulating material before cleaning. Use insulated tools and equipment.

- (b) Visually inspect the electrical contact surfaces of the switch for evidence of discoloration indicating excessive heat. If the contacts are purple, bluish gray, or black, clean and lubricate only those switch contacts in accordance with the cleaning procedure in paragraph 3.05. Test the switch, fuse, and bus bar arrangements in accordance with the procedures for electrical and thermal tests if the contacts remain purple, bluish gray, or black after being thoroughly cleaned. If the contacts are judged to be in good condition, proceed to (c).

- (c) Remove the rectifier from service in accordance with the following:

- (1) Remove the rectifier from plant operation in accordance with the associated power plant Bell System Practice.
- (2) Operate the POWER ON/OFF (S1) switch to the POWER OFF position. The POWER OFF (white) lamp lights and the POWER ON (blue) lamp extinguishes.
- (3) Operate the associated switch and fuse unit in the bus duct or in the power service cabinet to the OFF position.
- (4) Operate the DC OUTPUT (S3) switch to the OFF position. RECT FAIL lamp lights and rectifier failure alarm is activated.

Note: When the rectifier is shut down, the output filter capacitors should fully discharge through discharge resistors in approximately 1 minute.

♦Warning:♦ *The output filter capacitors in the rectifiers must be charged to the approximate battery or battery plus end-cell voltage before operating the DC OUTPUT (S3) switch to the BAT (all rectifiers) or EC (L11 and L12 rectifiers only) position.*

(d) To charge the output filter capacitors, continue as follows:

- (1) Connect a 10-ohm 50-watt minimum resistor; a 6-ampere 125-volt dc rated fuse; and a 15-ampere 125-volt dc rated switch (operated to the OFF position) in series.

◆Warning:◆ *When connecting the resistor, fuse, and switch combination to the rectifier, always connect the combination to the charge and discharge side of the BAT or EC bus bar last to prevent shorts from occurring.*

- (2) Connect the resistor, fuse, and switch combination between the—TEST lug (terminal E10) and the charge and discharge side of the BAT bus bar (terminal E8).

- (3) Operate the switch of the resistor, fuse, and switch combination to the ON position.

- (4) When the OUTPUT VOLTAGE (M2) voltmeter ◆ZE option, or the KS-8039 volt-milliammeter connected at the + OUTPUT VOLTAGE (TP1) and - OUTPUT VOLTAGE (TP2) test jacks, YJ option,◆ indicates the approximate battery voltage, operate the DC OUTPUT (S3) switch to the BAT position.

Note: The voltage indicated on the OUTPUT VOLTAGE (M2) voltmeter ◆or the KS-8039 volt-milliammeter,◆ before the DC OUTPUT (S3) switch is operated to the desired position will be slightly lower than the nominal battery or battery plus end-cell voltage.

- (e) With the output filter capacitors charged as in (d), operate the S3 switch from the OFF to the BAT position five or six times. Then return the switch to the OFF position. Wipe contacts clean and lubricate.

◆Warning:◆ *When disconnecting the resistor, fuse, and switch combination from the rectifier, always disconnect both ends of the combination from the rectifier at the same time to prevent shorts from occurring.*

- (f) On the lists 11 and 12 rectifiers, remove the resistor and fuse capacitor charging circuit. Wait 1 minute. Connect the charging

circuit from the switch (terminal E10) to the charge and discharge side of the EC bus bar. Operate the switch of the resistor, fuse, and switch combination to the ON position. When the voltmeter reading indicates approximately battery plus end-cell voltage, the S3 switch may be operated to the EC position without switch damage.

- (g) Operate the S3 switch from the OFF (open) to the EC position five or six times. These actions clean the blade and clip assembly surfaces.

- (h) Operate the S3 switch to the BAT or EC position (normal operation) and remove the resistor and fuse capacitor charging circuit.

- (i) Operate the associated switch and fuse unit in the bus duct or in the power service cabinet to the ON position.

- (j) Return the rectifier to normal operation in accordance with the appropriate power plant Bell System Practice.

3.02 S3 Switch Electrical Tests:

◆Warning:◆ *The millivoltmeter should be isolated from ground. Do not use a meter with a 3-wire cord without first disconnecting the ground wire. If possible use a 3-wire to 2-wire adapter.*

Note: Verify that the POWER ON/OFF (S1) switch is in the POWER OFF position before operating the DC OUTPUT (S3) switch from one position to another. If the DC OUTPUT switch is operated from one position to another while the POWER ON/OFF (S1) switch is in the POWER ON position, the rectifier shuts down and locks out. To restart the rectifier after a shutdown occurs, operate the POWER ON/OFF switch to the POWER OFF position to release the relays and operate the switch back to the POWER ON position to restart the rectifier.

- (a) **Switch in BAT Position:** Remove the plastic guards from the top and sides of the switch. After the rectifier has been delivering full load for 4 hours or more with the S3 switch in the BAT position (Fig. 2 and 3), the maximum allowable voltage drop (as measured with the

KS-20538 volt-ohm-milliammeter) between the contact stud (Fig. 4) on the S3 switch and the stationary clip (Fig. 4) representing BAT position on the base shall be 12 millivolts dc (with ambient temperature stabilized).

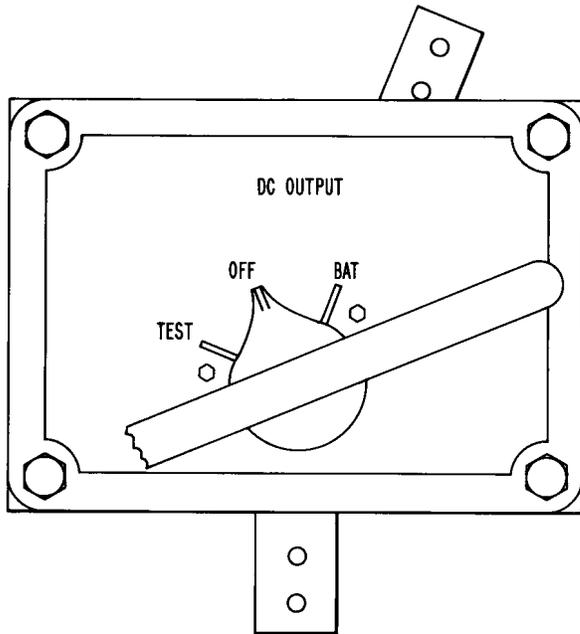


Fig. 2—Faceplate of S3 Switch for L21 and L22 Rectifiers

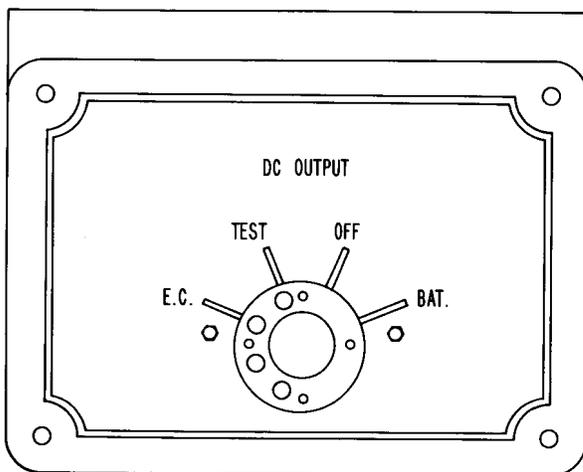


Fig. 3—Faceplate of S3 Switch for L11 and L12 Rectifiers (Handle Removed)

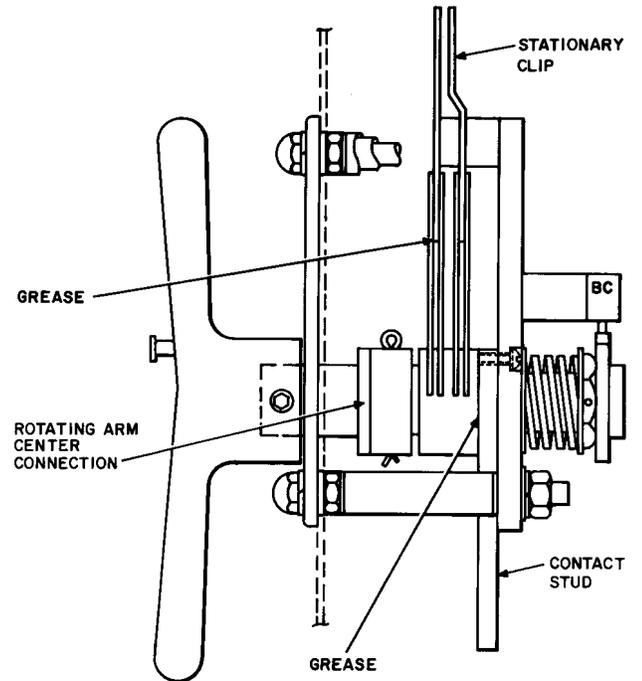


Fig. 4—Side View of S3 Switch Used on L21 and L22 Rectifiers

(b) **Switch in EC Position:** After the rectifier has been delivering full load for 4 hours or more with the S3 switch in the EC position, the maximum allowable voltage drop (as measured with the KS-20538 volt-ohm-milliammeter) between the contact stud (Fig. 5) on the S3 switch and the stationary clip (Fig. 5) representing the EC position on the base shall be 12 millivolts dc (with ambient temperature stabilized).

3.03 S3 Switch Temperature Rise Tests:

(a) Using a suitable heat insulating material, such as REFRASIL, hold and secure the R-1032 thermometer (or equivalent) against the following points:

- (1) Stationary clips on the base representing BAT when the switch is in the BAT position, EC when the switch is in the EC position.
- (2) Switch arm blade when in full contact with BAT or EC stationary clips on the base.

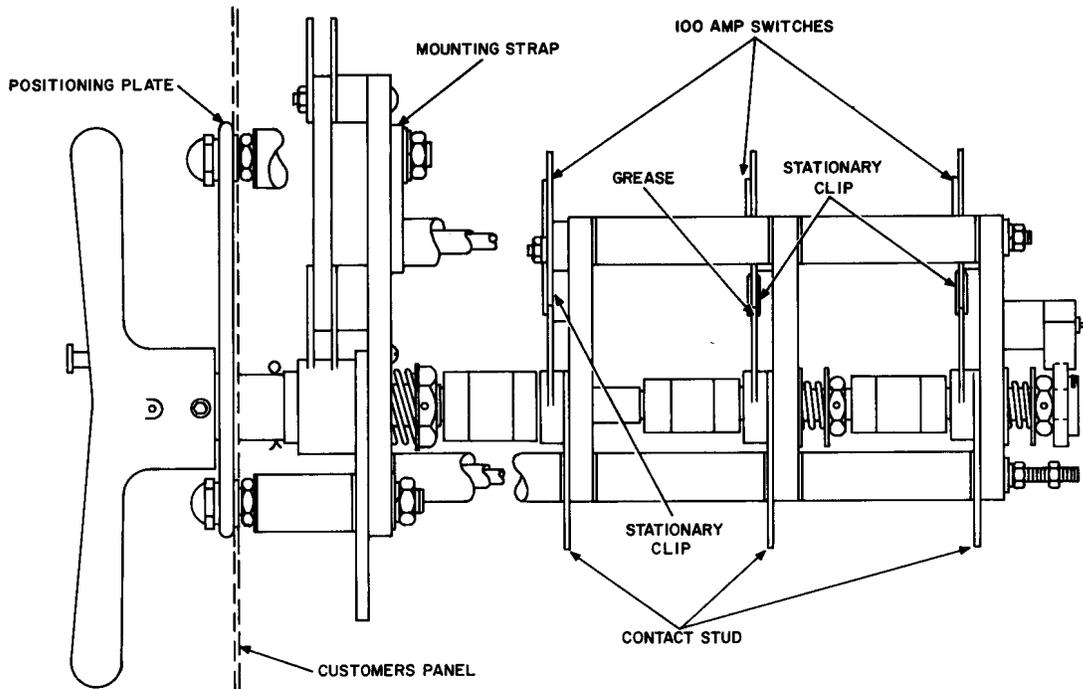


Fig. 5—Side View of S3 Switch Used on L11 and L12 Rectifiers

- (3) The rotor blade contact stud on the hinge post.
- (b) ♦Wrap the thermometer in REFRASIL, leaving the tip to the bulb exposed,♦ and hold the thermometer against each of the check points. Make sure none of the ♦REFRASIL♦ comes between the thermometer bulb and the surface to be checked. If this should happen, the ♦REFRASIL♦ would act as a thermal insulator and improper readings would be obtained.
- ♦**Danger: Do not use asbestos. REFRASIL (Hitco Materials Division) is a recommended noninjurious replacement for asbestos.**♦
- (c) The temperature rise (temperature obtained from check point minus the ambient temperature in the area of the rectifier cabinet) of each check point shall not exceed 30°C for the copper, unplated surfaces, or 55°C, for the silver-plated surfaces.

Example: With an ambient room temperature of 25°C, the temperature of the silver plated switch shall not exceed 80°C, that is, 25°C

+ 55°C. This temperature (80°C) is equivalent to a temperature reading of 176°F allowable under these conditions [using °F = 9/5 (°C) + 32°].

Note: Do not convert the two Centigrade readings separately to Fahrenheit and add the separate Fahrenheit readings since this gives an incorrect value.

3.04 Requirements and Corrective Actions (if Needed):

Requirement 1: If all measurements in paragraphs 3.02 and 3.03 are within limits, no further action is necessary. However, the contacts should be cleaned annually in accordance with paragraph 3.05 even if the checks in paragraphs 3.02 and 3.03 are within limits.

Requirements 2: If any of the measurements in paragraphs 3.02 and 3.03 exceed the specified limits, clean and lubricate only the switch contacts in accordance with paragraph 3.05 without removing the switch from the rectifier. Then repeat the tests in paragraphs 3.02 and 3.03.

Requirement 3: If after performing Requirement 2, the voltage drop and temperature rise measurements are not within limits, the S3 switch must be disassembled, cleaned, and adjusted in accordance with paragraphs 3.07, 3.08, and 3.09. Repeat paragraphs 3.02 and 3.03.

Requirement 4: If after performing Requirement 3, the voltage drop and temperature rise measurements are not within limits, the defective switch must be replaced and the defective unit handled in accordance with local instructions.

3.05 *Cleaning and Lubrication of S3 Contacts (Fixed and Rotary):*

- (a) Remove the rectifier from service in accordance with the appropriate power plant Bell System Practices.

Warning: *Make sure the POWER ON/OFF (S1) switch is in the POWER OFF position. The POWER OFF (white) lamp lights. Operate the associated switch and fuse unit in the bus dust or in the power service cabinet to the OFF position.*

- (b) Operate the S3 (DC OUTPUT) switch to the OFF position.

Warning 1: *The S3 switch has battery potential on it. Extreme care must be used when performing inspections or maintenance to avoid a short circuit between the switch and other metal parts of the rectifier cabinet.*

Warning 2: *The switch clip representing the BAT position and the switch clip representing the EC position have battery potential. It is preferred to clean the switch with no battery potential on it. This can be accomplished by disconnecting the charge leads. If it is impracticable to remove the battery power, exercise extreme caution when cleaning the switch. Surround live parts with canvas or other insulating material.*

- (c) Clean the **copper** switch contact surfaces as follows:

(1) The mating surfaces of the contacts should be shiny-bright for cool operation. If the rotating member is plain copper (not annealed), both it and the fixed mating contact should be degreased and cleaned of all tarnish. The copper members become oxidized through lack of use or because of corrosive atmosphere. The copper members should be cleaned with KS-19589, L2, lubricant to improve current carrying-capacity since copper oxide is an insulator.

(2) Check the contacts for discoloration. If they are discolored (blue to black), check to make sure that all the connecting nuts are securely tightened. Check and, if necessary, tighten all locknuts to make sure that the fixed contacts are tight against the base plate.

(3) Wipe all accessible contact surfaces clean with a clean KS-14666 cleaning cloth moistened with KS-19578, L1, trichloroethane. It may be necessary to place a cloth under the switch to keep dirt off the parts under the switch. Apply KS-16736, L1, compound liberally to all accessible contact surfaces with a scrubbing motion.

Warning: *If battery potential was removed from the S3 switch, the output filter capacitors must be charged as in subparagraph 3.01(d) before operating the switch to the closed position.*

- (4) Clean the contacts by operating the switch as in subparagraphs 3.01(e), (f), and (g).

(5) Apply the KS-16736 compound to all accessible contact surfaces to replace the compound removed by the operation of the switch.

(6) After a half-hour interval, remove all of the cleaning compound from the switch using a clean KS-14666 cloth. Then using a cloth moistened with KS-19578, L1, trichloroethane, wipe clean all accessible contact surfaces.

- (7) Apply a light coat of chemically pure petrolatum on the contact surfaces of the switch.
 - (8) A light-weight oil should be used sparingly on the other noncurrent carrying moving parts of the switch.
- (d) Clean the **silver plated** switch contact surfaces as follows:
- (1) Be sure the procedure in subparagraph 3.01(d) is followed before operating the S3 switch to the OFF position.
 - (2) Operate the S3 switch to the OFF position.
 - (3) Using a clean KS-14666 cloth soaked with KS-19578, L1, trichloroethane, wipe all contact surfaces clean. Using a clean cloth, wipe all surfaces dry. Continue cleaning until all surfaces are clean.
 - (4) If black (sulfated) tarnish is present, remove with crocus cloth or jeweler's rouge. Wipe all surfaces clean and dry.
 - (5) Using a clean cloth, apply chemically pure petrolatum to the inner surfaces of the contact clips.
 - (6) If the switch is connected to battery potential, charge output capacitors in accordance with subparagraph 3.01(d).
 - (7) Operate the S3 switch to the BAT position. Wipe the excess petrolatum from the BAT clips.
 - (8) Then operate the switch to the EC (Lists 11 and 12 rectifiers) position [making sure output capacitors are charged as in subparagraph 3.01(d)]. Wipe off the excess petrolatum from the EC clips.
 - (9) Operate the S3 switch to OFF and back to EC six times to clean the hinge joint. Do the same between the BAT position and OFF [making sure output capacitors are charged as in subparagraph 3.01(d)].
 - (10) Disconnect the capacitor charging leads and restore the rectifier to normal operation.

3.06 *Cleaning the Rotating Arm—Center Connection:*

- (a) Clean the joint (Fig. 4) using KS-19578, L1, trichlorethane. With the switch (S3) disconnected from battery potential or with the output capacitors charged as in subparagraph 3.01(d), rotate the joint back and forth through its complete excursion while applying the cleaner. It may be necessary to place a cloth under the switch to keep dirt off the parts under the switch.
- (b) After cleaning, lubricate the joint with KS-19589, L2, lubricant. Rotate the switch again to facilitate oil penetration.
- (c) The switch will operate without trouble for longer periods of time between cleanings if it is operated [with the power off and the capacitors charged as in subparagraph 3.01(d)] through its complete excursion six times at intervals of every 6 months.

3.07 *Disassembly of the S3 Switch:*

Note: In general, disassembly of these switches at operating locations is not recommended. Switches requiring disassembly should be replaced and sent to the factory. However, should disassembly for any model become necessary, proceed as follows:

The stationary contacts are tightened against the plastic panel via studs and nuts. Separate the switch (Fig. 4 and 5) by removing the four nuts, one at each corner, from the screws through the mounting supports. The rotor nut must be removed from the drive shaft. An insulated spacer is used to separate the front plate from the base. Clean the holes through which the drive shaft passes and lubricate with petrolatum. Do not ream or enlarge the hole in the base. This will increase the shaft clearance and allow unneeded axial movement. On Lists 11 and 12 rectifiers, the reaming of the hole in the base will allow one deck of the switch assembly to move before the next one starts to move.

3.08 *Working on Disassembled S3 Switches:*

- (a) ***Cleaning the Rotary Contact Surfaces:***
The rotary contact surfaces may be cleaned when the decks have been separated. First,

loosen the nut that is compressing the spring that applies force to the contacting surfaces. This nut is prevented from turning by a set screw. Remove the nut, washers, and spring. This will allow the contacting surfaces to be separated and cleaned. Clean the contact surfaces using KS-16736, L1, cleaning compound. When the switch has silver-plated areas, use crocus cloth to clean the areas. If the surfaces are galled or have a burr raised by the seizing action, use a fine flat file to remove the peaks of the burrs so that nothing projects above the average plane. Lubricate the contact surfaces with chemically pure petrolatum.

(b) **Inspecting, Adjusting, and Lubricating the Switch:** Check the condition of the contact clips on the end of the rotary arm. They should be shiny bright and free of arc burn projections. A requisite of a proper operating switch is alignment and proper fit on the contacts. The blades must be parallel with the surface of the base and the clip should be flat and parallel with the center line of rotor blade leaves and free of pitting or burn marks. If the rotor blades or clip are mistreated and become distorted, the blades should be checked at the point of entry to the clip. The opening at the outer end of the rotor blade should be approximately 1/16-inch less than the thickness of the clip. The rotor blade should engage the clip so that each leaf of the blade deflects approximately 1/32-inch. The blade leaves should be evenly spaced to allow uniform contact pressure on both sides of the clip leaves. If a clip leaf is not parallel with blade alignment, the leaf may be adjusted by tapping it down toward the base

surface with a plastic tip hammer, or pulling it upward from the base surface by placing the point of a screwdriver between the clip leaf end and the base. A practical method of inspection is to attempt to pass a nonmetallic feeler gauge (0.003 inches) between the blade leaf and the clip. The maximum depth reached around the periphery of the blade and clip should be 1/8-inch with the gauge. Adjustment is considered good when both leaves of rotor blade make contact with the clip. Spring washers on the blades provide an even pressure on the clips and take up the wear. The rotary and stationary clips should be lubricated with petrolatum.

3.09 Switch Reassembly: After the switch decks have been cleaned and inspected, reassemble the switch in the reverse order of disassembly. Rotate the final assembly to see that all decks engage their respective contacts at the same time. When the rotary clips of each deck are engaged, they should completely cover their fixed contact. It is allowable if the rotary contact is 1/16-inch ahead or behind the fixed contact. The complete assembly may now be replaced in the rectifier and the harness wires securely reconnected.

3.10 Preventive Maintenance for S3 Switches: To prevent gradual buildup of oxides or other nonconductive materials that may cause switch failure, operate the switch [with the power off and the output filter capacitors fully charged as in subparagraph 3.01(d)] through its entire range about six times at intervals of every 6 months.