

**EO 40-20CA-2**

**ROYAL CANADIAN AIR FORCE**



**HANDBOOK WITH PART LIST**

**DIFFERENTIAL RELAY GENERATOR CONTROL  
TYPE AN 3025-1 PART NO. 7A5930G1**

**WESTINGHOUSE**

**This EO Replaces Interim Publication**

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## FOREWORD

Every effort has been made to review the contents of this EO before reproduction to ensure that it meets RCAF Standards so that technicians may derive from it the information necessary to maintain and service this equipment.

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## SECTION I

### INTRODUCTION

1. This publication contains installation, operation, service, and overhaul instructions, with parts catalog, for the Generator Control Relay (Differential) Switch, part No. AN3025-1, manufactured by the Westinghouse Electric and Manufacturing Company, Lima, Ohio.

2. The Westinghouse Electric and Manufacturing Company's designation for this relay is type AVR117A, part No. 7A5930G1, and style No. 1171246A.

3. The terminal end of the unit will be considered as the *top* when the cover is in place. (See figure 1.)

4. The terminal end of the unit will be considered as the *bottom* when the cover has been removed. (See figure 2.)

5. The side of the unit on which the generator terminal strap is located will be considered the front; the side on which the battery terminal strap is located will be considered the right side; and the polarized relay side will be considered the left side. (See figure 2.)

## SECTION II

### DESCRIPTION

#### I. GENERAL DESCRIPTION.

a. The generator control relay (differential) switch prevents interchange of current between generators of an aircraft multigenerator electrical system when the system is operating at light loads. It accomplishes this by connecting the generator which it controls to the battery or bus load when the generator voltage is sufficient to supply the load, and disconnecting the generator from the battery or load bus when reverse current tends to drive it as a motor. It connects the generator which it controls to the system when the generator voltage is 0.35 to 0.65 volt above the bus voltage. The bus voltage may be at any voltage above 22 volts. A reverse current of 15 to 25 amperes (depending upon the setting of the relay) will cause the differential relay switch to disconnect the generator from the system.

b. The generator control relay (differential) switch will not connect the generator which it controls to an *open* bus. This fact must be given proper consideration during bench tests. A fraction of an ampere load, however, will cause the generator control relay (differential) switch to connect the generator which it controls to a bus on which there is no other voltage when the generator voltage is above 22 volts. A load is required to complete the circuit on the differential coil. There is no need for the generator to be connected to the bus if there is no load connected to the bus.

c. One generator control relay (differential) switch is required for each generator in an aircraft multigenerator electrical system. The device is designed to operate with any d-c generator having a normal regulated voltage of 28.0 volts and a current rating up to

300 amperes. It occupies a space 4 inches wide, 4 inches deep, and 4 inches high.

d. The terminals are located at the top of the unit so that cables may be attached from any direction. The unit is entirely enclosed for protection against dust and moisture conditions of the most extreme nature.

e. The unit is designed to operate satisfactorily at temperatures of from  $-55^{\circ}\text{C}$  ( $67^{\circ}\text{F}$ ) to  $+70^{\circ}\text{C}$  ( $158^{\circ}\text{F}$ ) and from sea level to 50,000 feet altitude.

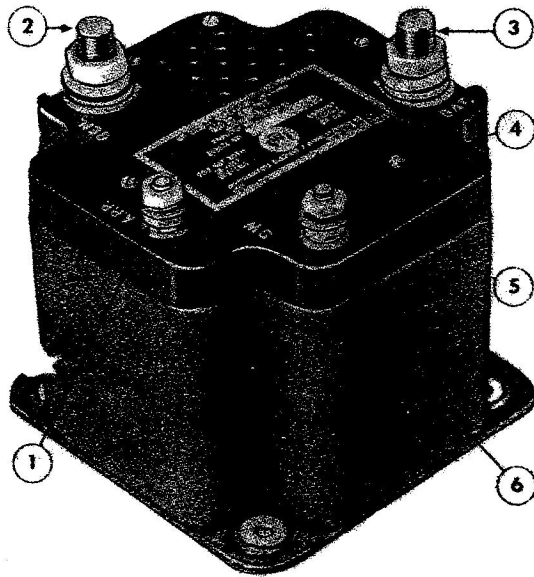
f. Weight and dimensions are as follows:

Over-all height .....	4 inches
Over-all width .....	4 inches
Over-all depth .....	4 inches
Total weight .....	2 pounds, 6 ounces

#### 2. DETAILED DESCRIPTION.

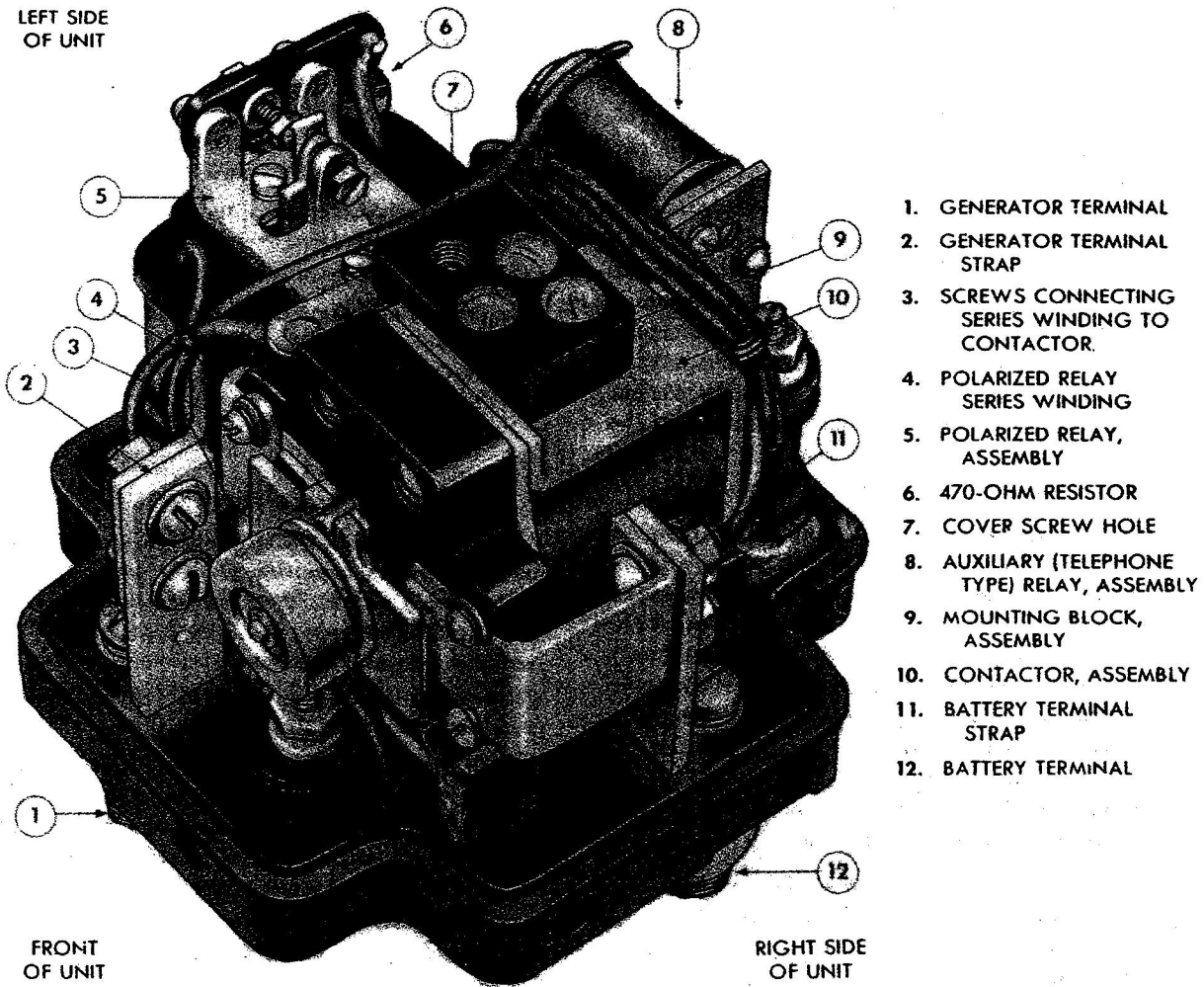
a. MAIN ASSEMBLIES. (See figures 3 and 4.)—Four main assemblies comprise the generator control relay (differential) switch. These are the auxiliary relay, contactor, polarized relay, and base assemblies. The auxiliary relay assembly consists of two telephone-type relays which prevent the differential-voltage winding of the polarized relay from overheating. (See figure 4.)

b. POLARIZED RELAY ASSEMBLY. (See figure 3.)—The polarized relay consists of a square spool containing three windings, a permanent magnet (1) for polarizing the relay assembly, an armature (3) mounted on jewel bearings, contact screw (4) and stop screw (5) for controlling the movement of the armature. The inner winding on the square spool is the differential-voltage winding, connected between the generator positive terminal and the battery positive terminal through



1. AUXILIARY POWER PLANT TERMINAL  
(SEE FIGURE 5)
2. GENERATOR TERMINAL
3. BATTERY TERMINAL
4. RECTIFIER COVER
5. SWITCH TERMINAL
6. GENERATOR CONTROL RELAY  
(DIFFERENTIAL) SWITCH COVER

Figure 1—Generator Control Relay (Differential) Switch



1. GENERATOR TERMINAL
2. GENERATOR TERMINAL STRAP
3. SCREWS CONNECTING SERIES WINDING TO CONTACTOR.
4. POLARIZED RELAY SERIES WINDING
5. POLARIZED RELAY, ASSEMBLY
6. 470-OHM RESISTOR
7. COVER SCREW HOLE
8. AUXILIARY (TELEPHONE TYPE) RELAY, ASSEMBLY
9. MOUNTING BLOCK, ASSEMBLY
10. CONTACTOR, ASSEMBLY
11. BATTERY TERMINAL STRAP
12. BATTERY TERMINAL

Figure 2—Generator Control Relay (Differential) Switch—Cover Removed

the contacts of the two auxiliary relays. The intermediate winding on the square spool is a holding winding, in series with a 470-ohm resistor, and is connected between the polarized relay contacts and ground. The outer winding (6) on the square spool is a single turn of copper strap connected between the generator positive terminal and the generator side of the contactor and is called a series winding.

c. CONTACTOR ASSEMBLY. (See figure 9.)—The contactor assembly consists of a frame (6), a contactor coil (5), a pick-up spring (7), a contact bar assembly (3), a contact bar spring (2), and a contact bar spring retainer (1). The contactor coil is composed of a main or pick-up winding and a holding winding.

d. AUXILIARY RELAY ASSEMBLY. (See figure 4.)—This assembly consists of two telephone-type relays mounted on a bracket. Each telephone-type relay in the assembly has two contacts in parallel for added reliability in completing the low voltage differential circuit. The bottom relay (11) is normally open and is in series with a rectifier, mounted in a well in the base. The upper relay (4) is normally closed and is connected

across the differential-voltage winding. When the voltage on this winding exceeds 4 volts, an 82-ohm resistance is inserted in the circuit.

e. BASE ASSEMBLY. (See figure 15.)—The base assembly is molded from a plastic material and incorporates a well for the rectifier, a webbing for strengthening purposes, and necessary holes and recesses for mounting the rectifier cover and terminal screws, and generator and battery terminal straps. The straps prevent possible loosening of the generator and battery terminal assemblies which might otherwise result if the terminal screws were used as conductors.

f. RECTIFIER. (See figure 10.)—The rectifier (9) is mounted externally to provide added cooling. It is connected to the normally open telephone-type relay through a rectifier tab (1) and lead (12, figure 14) through the base.

g. COVER.—The cover (6, figure 1) is of metal with wrinkle finish and is held in place with a single screw with drilled head for safety wire. A gasket between the cover and the base seals the unit against moisture and dust.

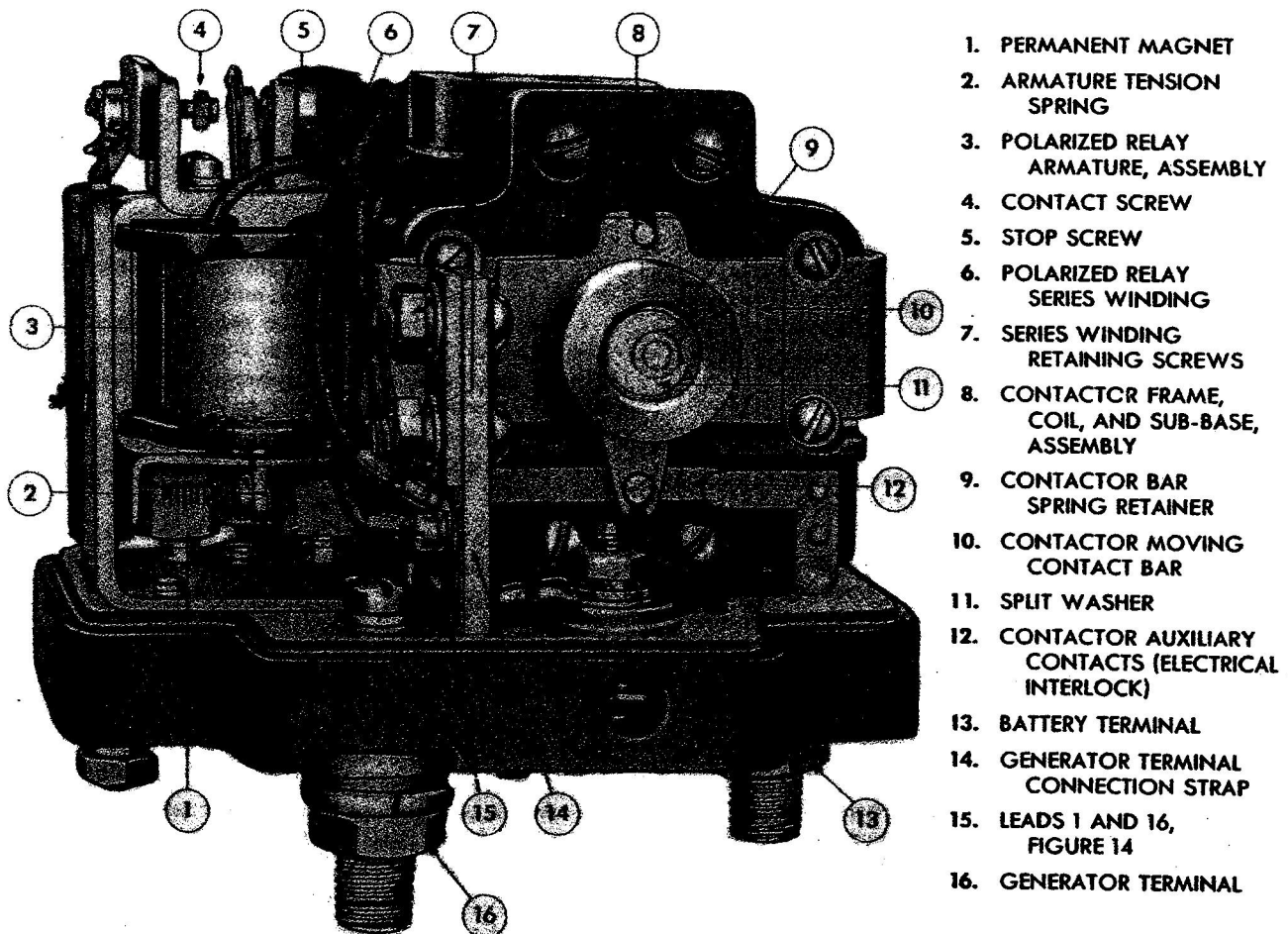


Figure 3—Polarized Relay and Magnetic Contactor Assemblies

1. LEAD 21, FIGURE 14
2. LEAD 20, FIGURE 14
3. LEAD 9, FIGURE 14
4. NORMALLY CLOSED CONTACTS
5. LEAD 19, FIGURE 14
6. LEAD 18, FIGURE 14
7. LEAD 17, FIGURE 14
8. LEAD 16, FIGURE 14
9. SCREWS SECURING RELAYS TO BRACKET
10. MOUNTING BRACKET
11. NORMALLY OPEN CONTACTS

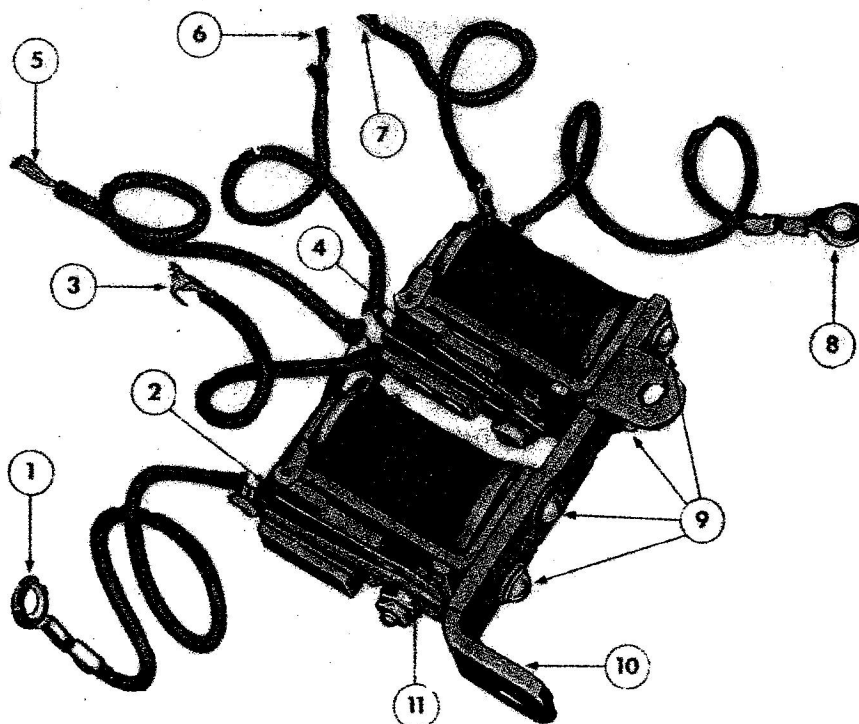


Figure 4—Auxiliary (Telephone-Type) Relay Assembly

## SECTION III INSTALLATION

### 1. PREINSTALLATION INSPECTION.

Carefully inspect the screw attaching the cover of the generator control relay (differential) switch to the mounting block assembly to see that it is tight and securely locked in place with the safety wire. (See figures 2 and 12.)

### 2. INSTALLATION.

a. Four mounting holes are provided for mounting the unit in aircraft. (See figure 12.) The ground connection (negative) is made through the mounting screws. Therefore, the relay must be mounted on a grounded metal member, or a lead must be connected from one of the mounting bolts to the grounded structure to complete the negative connection. The surface around the mounting holes, where the finish has been removed, must be clean and the mounting bolts must be tight for a good electrical connection.

#### Note

Mount the unit in a horizontal position, if possible. However, it will operate satisfactorily if mounted in a vertical position. Secure the unit with No. 10-24 roundhead or fillister-head screws. Length of screws will depend on thickness of the mounting base.

b. Place the terminal of the load bus or battery cable

on the stud marked "BAT." (figures 1 and 5) next to the copper strap which comes through the molded base. Install flat washer, lock washer, and nut.

c. Place the terminal of the generator cable on the stud marked "GEN." (figures 1 and 5) next to the copper strap which comes through the molded base. Install flat washer, lock washer, and nut.

d. Place the switch lead on the terminal marked "SW." and install flat washer, lock washer, and nut.

#### Note

If there is no auxiliary power plant, omit the connection to the terminal marked "A.P.P."

e. Make sure that all connections are made as indicated in the wiring diagram. (See figure 5.)

### 3. INSTALLATION TEST.

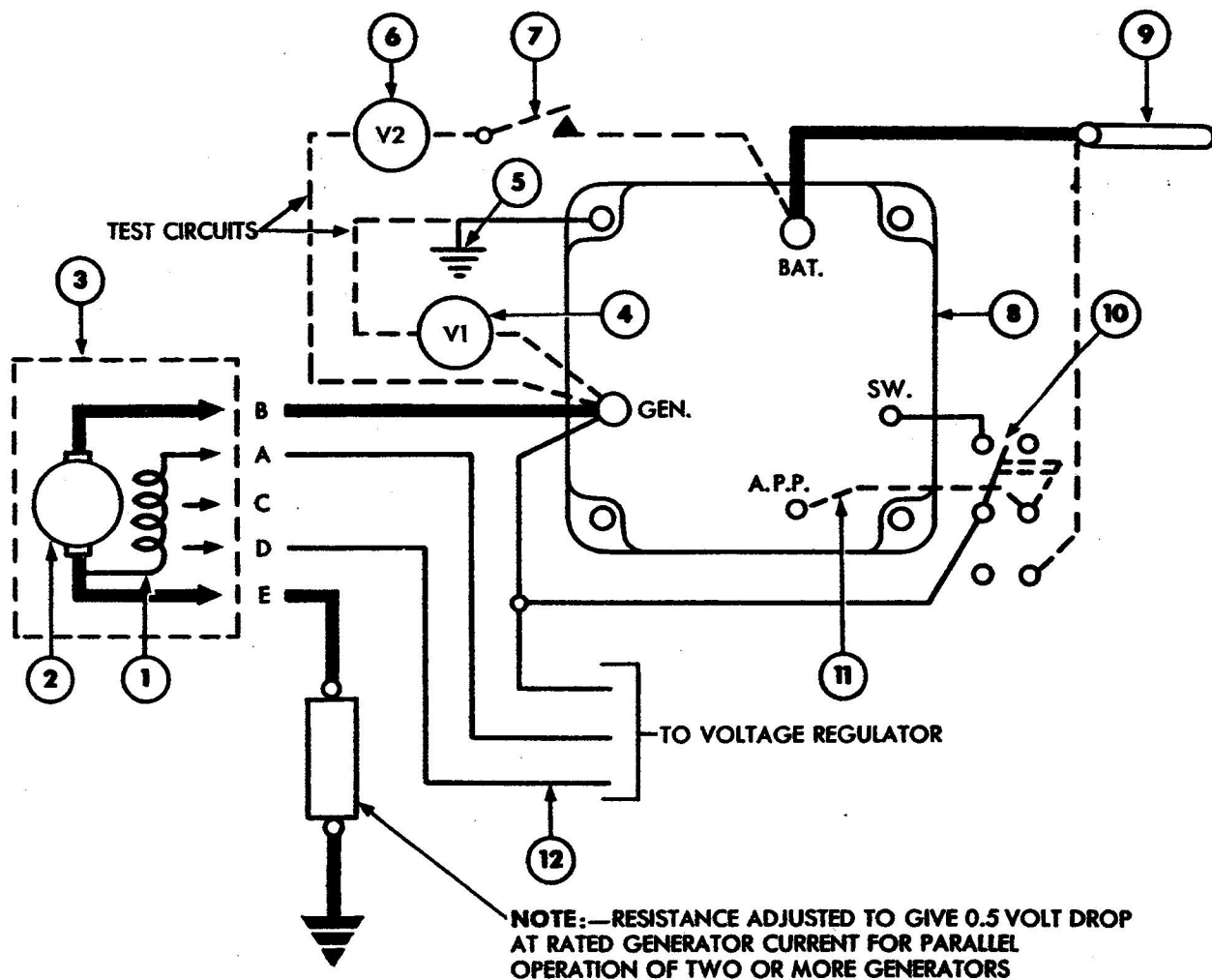
(See dotted lines marked "TEST CIRCUIT" in figure 5.)

a. INSTRUMENTS REQUIRED.—The pilot's main line switch and the ammeter on the pilot's instrument panel will be in the circuit during the test. Additional instruments required are:

One 0-30-volt, d-c, voltmeter V1 (4, figure 5).

One 0-1-volt, d-c, voltmeter V2 (6, figure 5).

One single-pole, single-throw, switch S1 (7, figure 5).



1. GENERATOR FIELD
2. ARMATURE (GENERATOR)
3. GENERATOR
4. 0-30-VOLT DIRECT CURRENT VOLTMETER, V1
5. GROUND OR NEGATIVE CONNECTION, MADE THROUGH MOUNTING BOLT
6. 0-1-VOLT DIRECT CURRENT VOLTMETER, V2
7. SINGLE POLE, SINGLE THROW SWITCH, S1 (MOMENTARY)
8. GENERATOR CONTROL RELAY (DIFFERENTIAL)
9. LOAD BUS
10. PILOT'S MAIN LINE SWITCH
11. CONNECTIONS USED WITH AUXILIARY POWER PLANT
12. OMIT THIS CONNECTION FOR SINGLE GENERATOR INSTALLATIONS

**Figure 5—Installation Wiring Diagram of Generator Control Relay (Differential) Switch**



b. **BUS VOLTAGE CHECK.**—Connect the 0-30-volt, d-c, voltmeter V1 between the battery terminal and ground and note the bus voltage. It should be above 22 volts.

c. **OPERATION TEST PROCEDURE.**

(1) Connect the momentary switch S1 and the 0-1 voltmeter V2 between the battery terminal and generator terminal as shown by dotted lines in figure 5.

(2) Connect the 0-30 voltmeter V1 between the ground and generator terminal as shown by dotted lines in figure 5.

(3) Bring the generator speed up to a point where its terminal voltage is 0.5 volt below the observed bus voltage.

(4) Hold the momentary switch S1 closed and increase the generator voltage slowly, noting the voltage reading on the 0-1 voltmeter V2 at which the relay operates. The operating point is indicated by an audible

snap or a sudden dropping of the voltage on the 0-1 voltmeter V2 to zero.

(5) Release the momentary switch S1 and lower the generator voltage until the generator control relay (differential) switch drops out. The reverse current required to cause the unit to disconnect the generator from the bus is read on the ammeter on the pilot's instrument panel. The panel ammeter will read forward current at first during this operation; then, as the generator voltage is decreased, it will decrease through zero and show reverse current. The generator control relay (differential) switch disconnects the generator from the bus at the moment that the panel ammeter returns to zero after showing reverse-current reading.

(6) Repeat this procedure at least three times. The generator control relay (differential) switch should pick up between 0.35 and 0.65 volt, reading on the 0-1 voltmeter V2, and drop out between 15 to 25 amperes as shown on the panel ammeter. If the unit does not operate within these limits, it must be replaced.

## SECTION IV

### OPERATION

#### I. PRINCIPLES OF OPERATION.

##### a. NORMAL OPERATION. (See figures 6, 7, and 8.)

(1) Turn switch (S, figure 6) to the No. "1" position. The generator control relay (differential) switch is then ready for operation.

(2) When the generator speed increases until the terminal voltage is 22 volts, the normally open telephone-type relay A1 (figure 7) closes and completes the circuit between the generator positive terminal and battery positive terminal through the differential-voltage winding (RCD, figure 6) (inner winding on the square spool of the polarized relay assembly). With a battery voltage of 26.5 volts, there will be 4.5 volts across the differential-voltage winding RCD. Since this voltage is applied to the normally closed telephone-type relay A2 (figure 6), the relay contacts open and insert the 82-ohm resistor in series with RCD. (With the resistor in the circuit, less current flows through RCD, preventing overheating.)

(3) As the generator voltage increases, the voltage across the differential-voltage circuit decreases. When the generator voltage equals battery voltage, there is no voltage on the coil of the telephone-type relay A2, and this relay releases and returns to its normally closed position, cutting the 82-ohm resistor out of the circuit. There is then only the low resistance differential-voltage winding RCD to limit the current in the differential-voltage circuit.

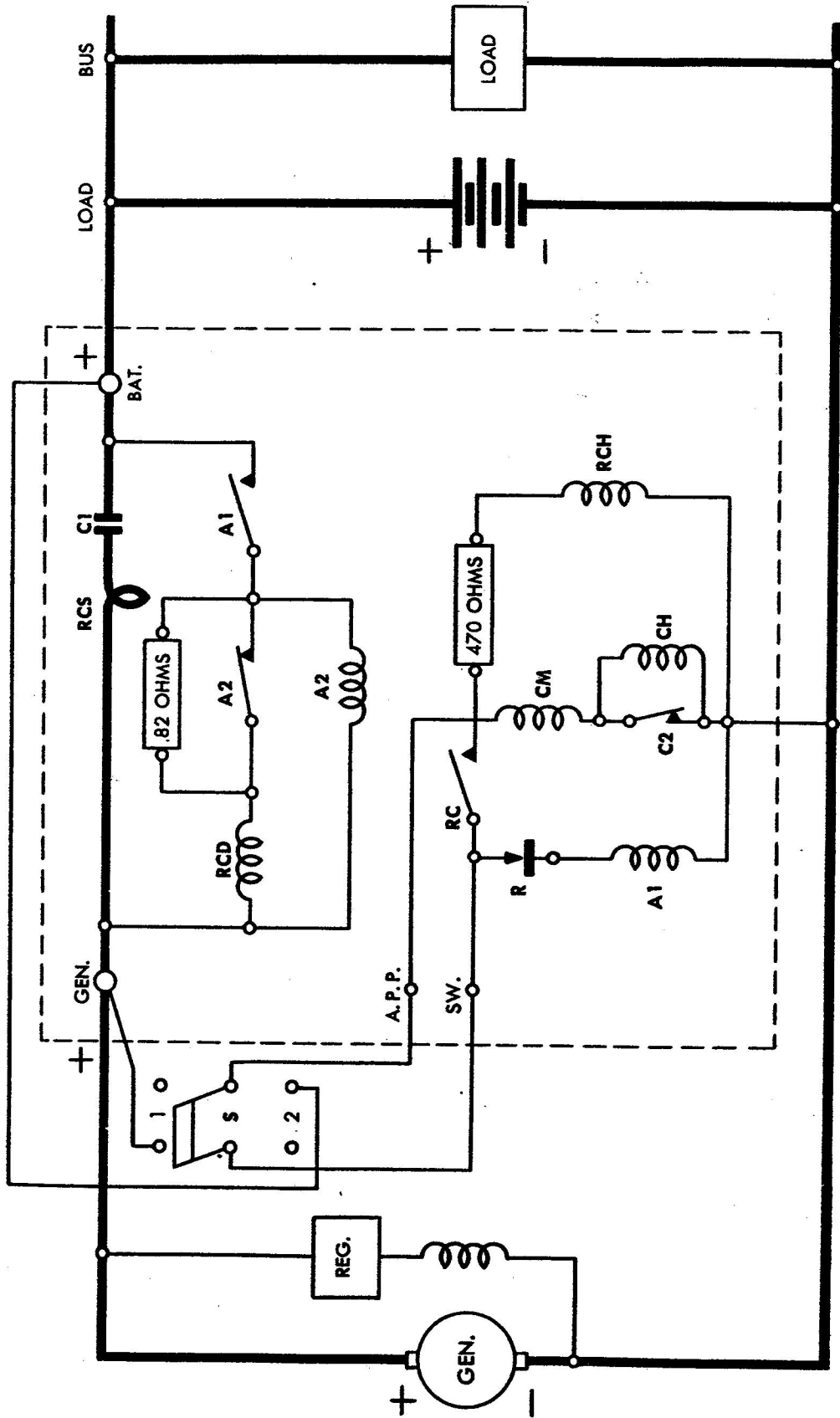
(4) When the generator voltage reaches 0.35 to 0.65 volt above the battery voltage, the polarized relay contacts (RC, figure 6) close, energizing the holding

winding (RCH) (intermediate winding on the square spool of the polarized relay) and also the main or pick-up winding (CM) on the contactor coil.

(5) With generator voltage of the correct polarity applied to the differential-voltage winding RCD of the polarized relay (A, figure 8), the contact end of the relay armature becomes of *south* polarity and the opposite end becomes of *north* polarity. The end of the armature with *south* polarity is attracted to the *north* pole of the relay, while the end of the armature with *north* polarity is repelled by the *north* pole of the relay, and attracted by the *south* pole. Thus, the armature rotates clockwise against the pull of the relay tension spring. Normally, adjustment is made so that, when 0.5 volt of the correct polarity is applied to the differential-voltage winding RCD, the magnetic pull overcomes the spring force and allows the contacts to close. If the stop screw is screwed toward the left, the armature is moved closer to the poles which attract it, and less voltage is required to overcome the spring force.

(6) The energized main or pick-up winding (CM, figure 6) of the contactor coil closes the contactor main contacts (C1, figure 6). (See 3, figure 9.) At the same time, an electrical interlock (C2, figure 6) and (9, figure 9) opens and places the holding winding (CH, figure 6) of the contactor coil in series with the main or pick-up winding (CM) of the contactor coil. The contact force thus obtained by the two coils in series is 4 pounds per contact, which produces a voltage drop from the generator terminal to the battery terminal of 90 millivolts at 300 amperes.





- A1—NORMALLY OPEN RELAY (TELEPHONE TYPE)
- A2—NORMALLY CLOSED RELAY (TELEPHONE TYPE)
- C1—CONTACTOR MAIN CONTACTS
- C2—CONTACTOR AUXILIARY CONTACTS (ELECTRICAL INTERLOCK)
- CH—HOLDING WINDING, CONTACTOR COIL
- ...—MAIN OR PICK-UP WINDING, CONTACTOR COIL

- RC—POLARIZED RELAY CONTACTS
- R—RECTIFIER
- RCD—DIFFERENTIAL-VOLTAGE WINDING, POLARIZED RELAY COIL
- RCH—HOLDING WINDING, POLARIZED RELAY COIL
- RCS—SERIES WINDING, POLARIZED RELAY COIL
- S—SWITCH

Figure 6--Schematic Wiring Diagram of Generator Control Relay (Differential) Switch

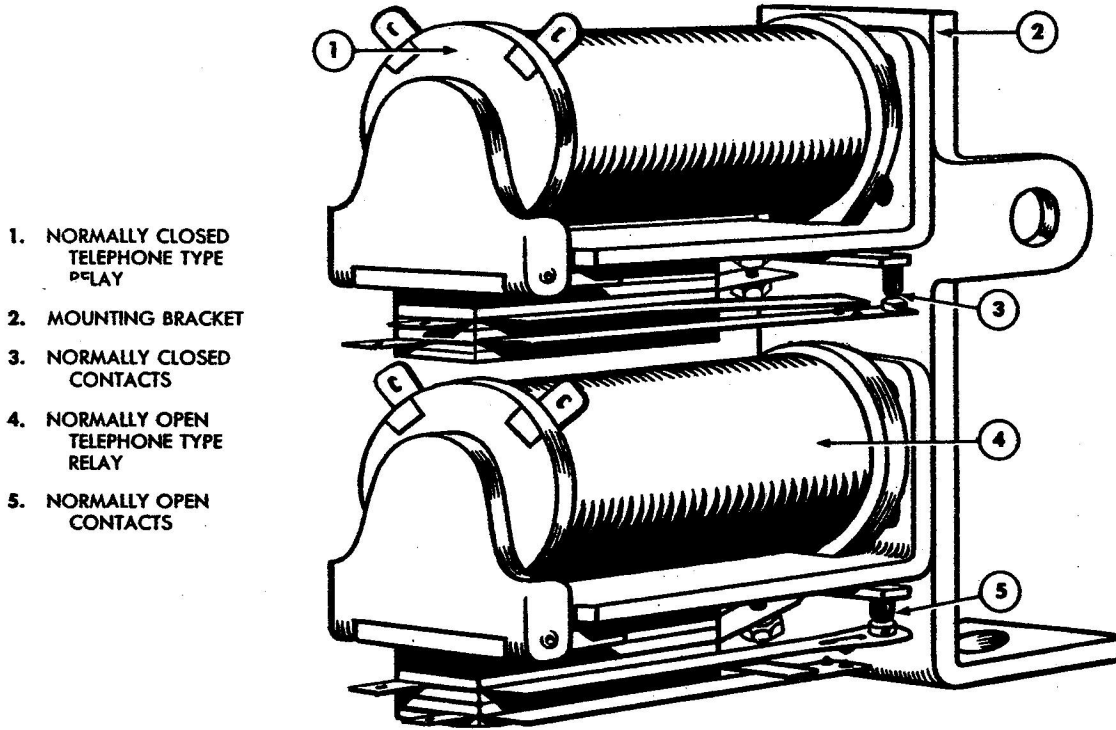


Figure 7—Auxiliary Relay Assembly

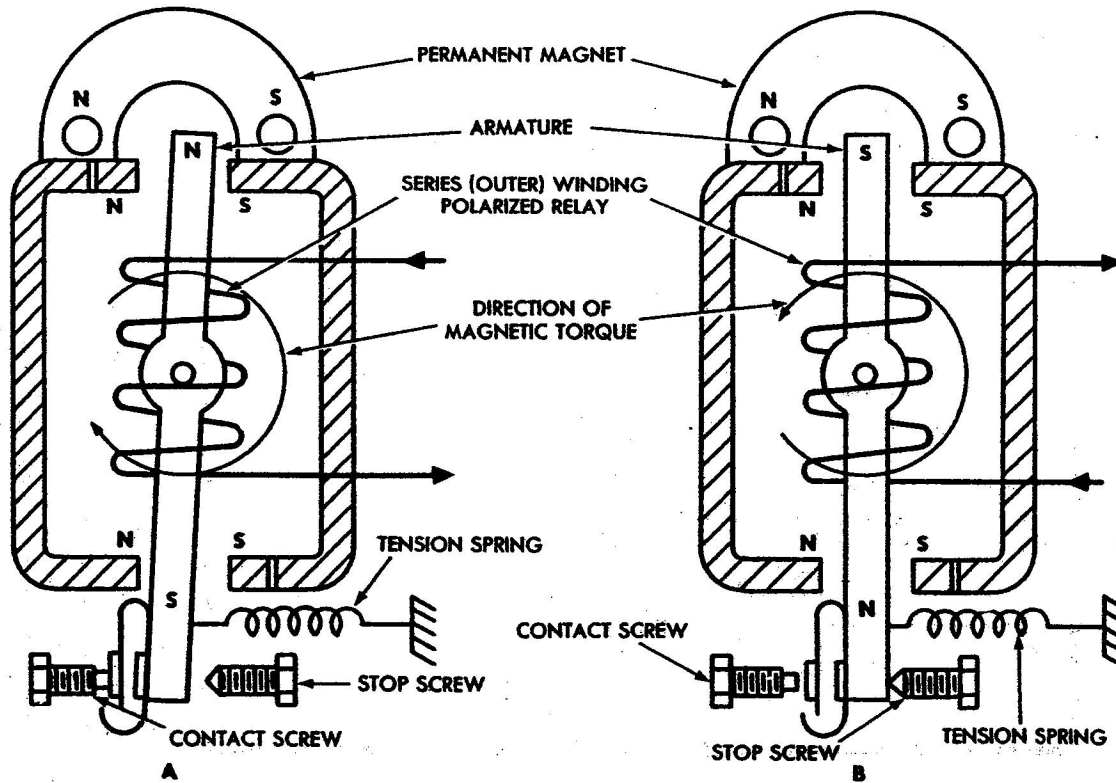


Figure 8—Schematic Illustration of Polarized Relay Operation

1. CONTACT BAR SPRING RETAINER

2. CONTACT BAR SPRING

3. MOVING CONTACT BAR, ASSEMBLY (MAIN CONTACT)

4. SUB-BASE

5. CONTACT COIL

6. FRAME

7. PICK-UP SPRING

8. ARMATURE

9. CONTACTOR AUXILIARY CONTACTS (ELECTRICAL INTERLOCK)

10. SPLIT WASHER

11. GUIDE PIN

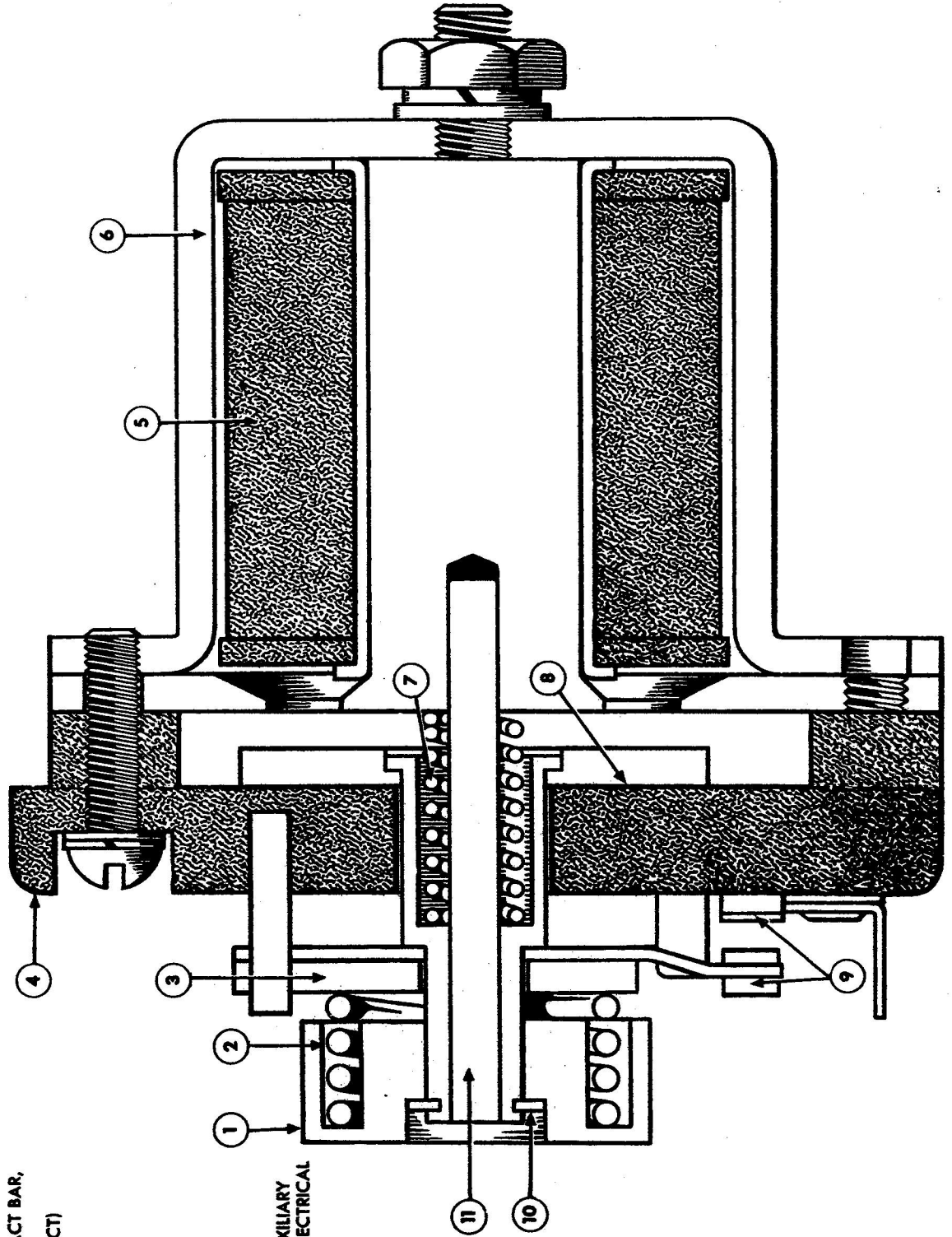


Figure 9—Cross Section of Contactor Assembly

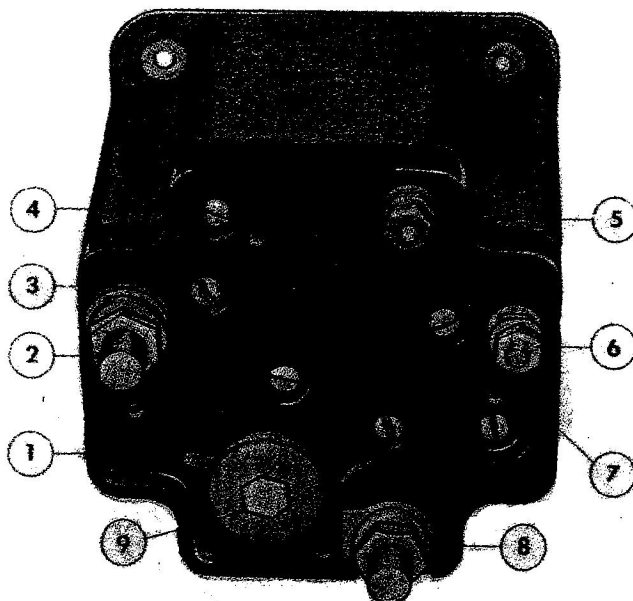
b. REVERSE-CURRENT ACTION.—If the speed of one of the generators of an aircraft multigenerator electrical system decreases so that the voltage regulator controlling this generator can no longer maintain normal voltage, reverse current will flow from the battery or another generator into the slow generator. The series winding RCS (outer copper strap on the square spool of the polarized relay coil) will magnetically oppose the intermediate winding RCH on the square spool, decreasing the strength of the *south* polarity of the contact end of the armature. This has the same effect as reversing the polarity of the polarized relay armature. (See B, figure 8.) The contact end of the armature becomes of *north* polarity, and is attracted by the *south* pole of the relay. The opposite end of the armature becomes of *south* polarity and is repelled by the *south* pole of the relay, and attracted by the *north* pole. The resultant action is that the armature swings to the position shown in B, figure 8, to open the polarized relay contacts (RC, figure 6). The holding winding (RCH) on the polarized relay is thus deenergized, and the pick-up winding (CM) and holding winding (CH) on the contactor coil are also deenergized. The contactor releases, thus pre-

venting the reverse current from reaching the slow generator. The polarity of the polarized relay armature is actually reversed when a heavy surge of reverse current flows through the series winding (RCS).

c. REVERSED-POLARITY PROTECTION.— If a generator loses its residual magnetism, or has the polarity of its residual magnetism reversed; or, if its field has been flashed in the reverse direction, the generator could build up with its polarity reversed. If this condition prevails, the differential relay switch protects the system by keeping the generator disconnected. To choose the correct polarity, this relay uses a rectifier (figures 10 and 11) which acts as a d-c valve in series with the operating coil of the normally open telephone-type relay A1. The rectifier will block the current to relay A1 when the generator has reversed polarity. Since relay A1 will not be energized, the differential relay switch will not operate.

## 2. OPERATION INSTRUCTIONS.

The differential relay switch is completely automatic in operation and, therefore, requires no operation instructions.



1. RECTIFIER TAB
2. BATTERY TERMINAL
3. CONTACTOR MOUNTING SCREWS
4. 82-OHM RESISTOR MOUNTING BOLT
5. SWITCH CONNECTION
6. AUXILIARY POWER PLANT TERMINAL
7. POLARIZED RELAY MOUNTING SCREWS
8. GENERATOR TERMINAL
9. RECTIFIER

Figure 10—Rectifier, Cover Removed

1. BASE
2. RECTIFIER
3. STEEL WASHER
4. NUT
5. LOCK WASHER
6. RECTIFIER TAB

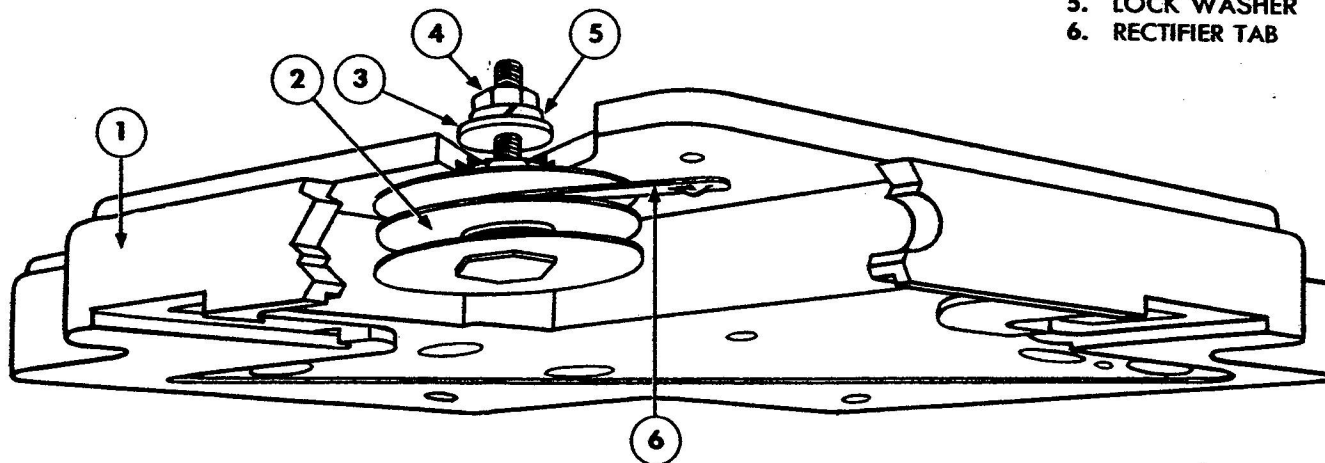


Figure 11—Cutaway View of Rectifier Well, Showing Rectifier Installation

## SECTION V

### SERVICE INSPECTION, MAINTENANCE, AND LUBRICATION

#### 1. SERVICE TOOLS REQUIRED.

No special tools are required.

#### 2. SERVICE INSPECTION.

##### Note

In accordance with T.O. 00-20A-2, a summary of the periodic inspections prescribed herein will be entered on the Master Airplane Maintenance Forms maintained on the back of Form 41B for the airplanes affected.

#### COLUMN 22 IGNITION AND ELECTRICAL

##### Preflight Inspection

Check the generator control relay (differential) switch for corroded connections, loose mounting screws, damaged cover, and loose terminals.

Check the ammeter on the pilot's instrument panel to see that the unit is operating. With the pilot's main line switch closed, the battery connected to the system, and all generators dead except the one whose generator control relay (differential) switch is being checked, bring the generator up to normal speed. The ammeter should show a charging current.

Decrease the generator speed and note the approximate reverse current required for the differential relay switch to disconnect its generator from the system. This value of reverse current should be under 25 amperes.

#### 250-Hour Inspection

Check the differential voltage required to cause the unit to connect the generator it controls to the load bus, and the reverse current required to cause the unit to disconnect its generator from the system.

Connect a 50-0-50-ampere, d-c, ammeter in the positive generator line to the unit. Connect a second generator to the system and adjust the regulator of the second generator to 28.0 volts. With the first generator's main line switch open, adjust its voltage to between 27.5 and 28.0 volts. Connect an 0-1-volt, d-c, voltmeter across the generator and battery terminals of the unit, and slowly increase the first generator's voltage by adjusting the voltage regulator. Note the differential voltage at which the generator control relay (differential) switch connects its generator to the system on the 0-1 voltmeter. This voltage should be between 0.35 and 0.6 volt. Disconnect the 0-1 voltmeter.

Slowly decrease the first generator's voltage by adjusting the voltage regulator. Note the reverse current on the 50-0-50-ampere, d-c, ammeter at which the differential relay switch disconnects the first generator from the load bus. This reverse-current value should be less than 25 amperes and more than 15 amperes.

#### 3. MAINTENANCE.

a. If the unit is faulty in operation, it will be removed from its mounting and returned to the depot for repairs. To remove unit, disconnect leads from the

terminal screws, remove the mounting screws, and remove unit from air frame.

b. For installation instructions, refer to paragraph 2, section III.

#### 4. LUBRICATION.

Use no lubricants of any kind on either the bearings or the contacts of the differential relay switch. They are designed to operate dry, and the presence of oil or grease will seriously affect their normal functioning.

#### 5. SERVICE TROUBLES AND REMEDIES.

<i>Trouble</i>	<i>Probable Cause</i>	<i>Remedy</i>
UNIT FAILS TO OPERATE	Not properly connected	Check installation. Refer to section III.
	Bus voltage higher than generator voltage	Increase generator voltage or place additional load on the bus.
	No connected load	Turn on lights or interphones.
	Battery switch open	Close battery switch.
	Polarity of voltage reversed	Faulty generator.
	Generator voltage does not build up	Faulty generator. Faulty regulator.

### SECTION VI

#### DISASSEMBLY, INSPECTION, REPAIR, AND REASSEMBLY

##### 1. OVERHAUL TOOLS REQUIRED.

No special tools are required.

##### 2. DISASSEMBLY INTO MAJOR SUBASSEMBLIES.

###### Note

The unit should be bench tested before disassembly to determine the repairs needed. Refer to section VII, paragraph 1.

##### a. REMOVAL OF AUXILIARY (TELEPHONE-TYPE) RELAY.

(1) Remove safety wire from cover attaching screw. (See *figure 12*.) Remove screw and lift off generator control relay (differential) switch cover.

(2) Cut away lacing thread from leads. (See *figure 13*.)

(3) Remove screw and flat washer which attach the polarized relay lead (1) and lead (16, *figure 14*) from the outside coil terminal of the top relay to the generator terminal connection strap (*figure 3*), and screw and flat washer which attaches lead (21, *figure 14*) from the inside terminal of the contacts of the bottom relay to battery terminal connection strap. (See

*figure 13*.) In each case, the screw is the bottom one on the terminal strap.

(4) Unsolder the three leads from the ground strap located in the mounting block assembly. (See *figure 16*.)

(5) Unsolder polarized relay coil lead (2) and lead (18, *figure 14*) from inside contact of top relay from the top terminal of the 82-ohm resistor.

(6) Unsolder leads (17 and 19, *figure 14*) from inside coil terminal and outside contact terminal of the top relay from the bottom terminal of the 82-ohm resistor.

(7) Unsolder lead (12, *figure 14*) from rectifier tab from the outside coil terminal of the bottom relay. (See *figure 13*.)

(8) Remove screw and flat washer which secure the auxiliary relay bracket to the contactor assembly. (See *figure 13*.)

(9) Remove nut, lock washer, flat washer, and insulation washer from the top of the 82-ohm resistor mounting bolt (*figure 13*), and lift off resistor.

(10) Remove second insulation washer from mounting bolt, unscrew mounting bolt from the bottom side of base, and remove nut, lock washer, flat washer, and relay assembly from the top side.

EO 40-20CA-2

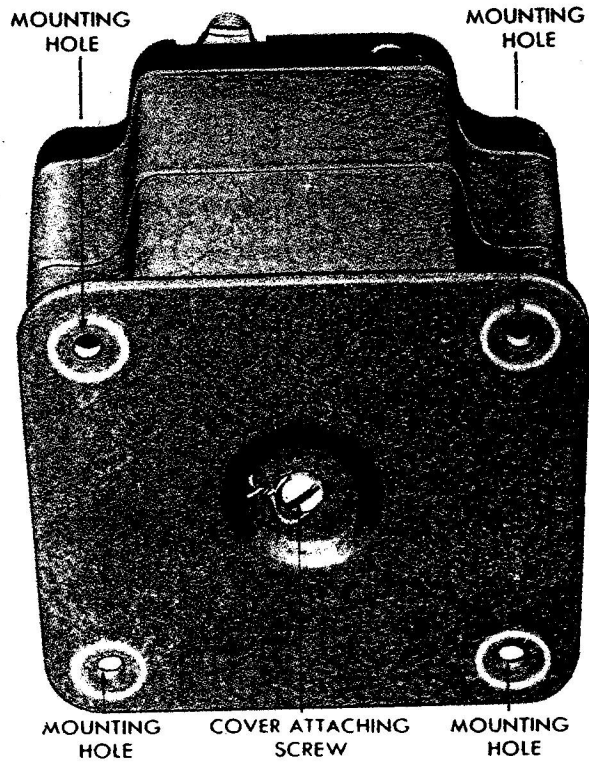


Figure 12—Cover Attaching Screw

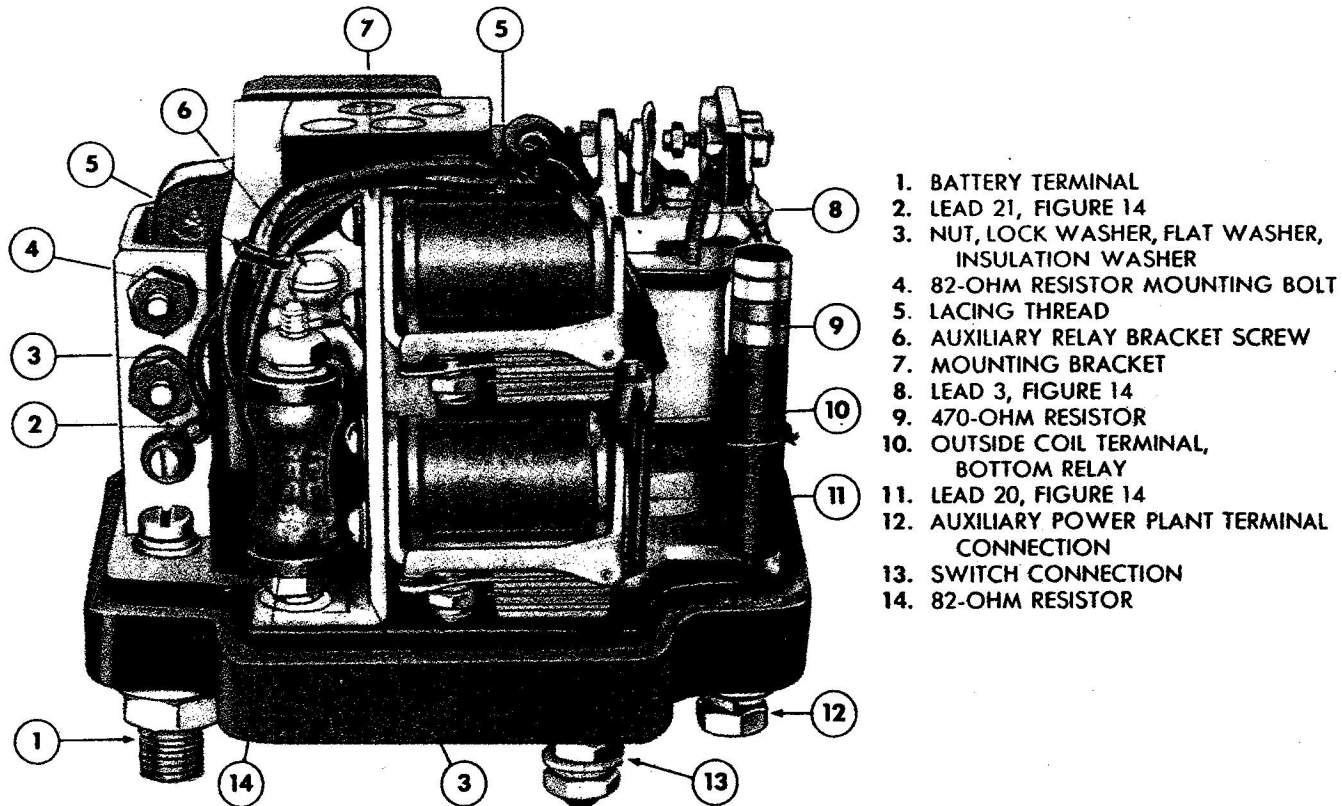
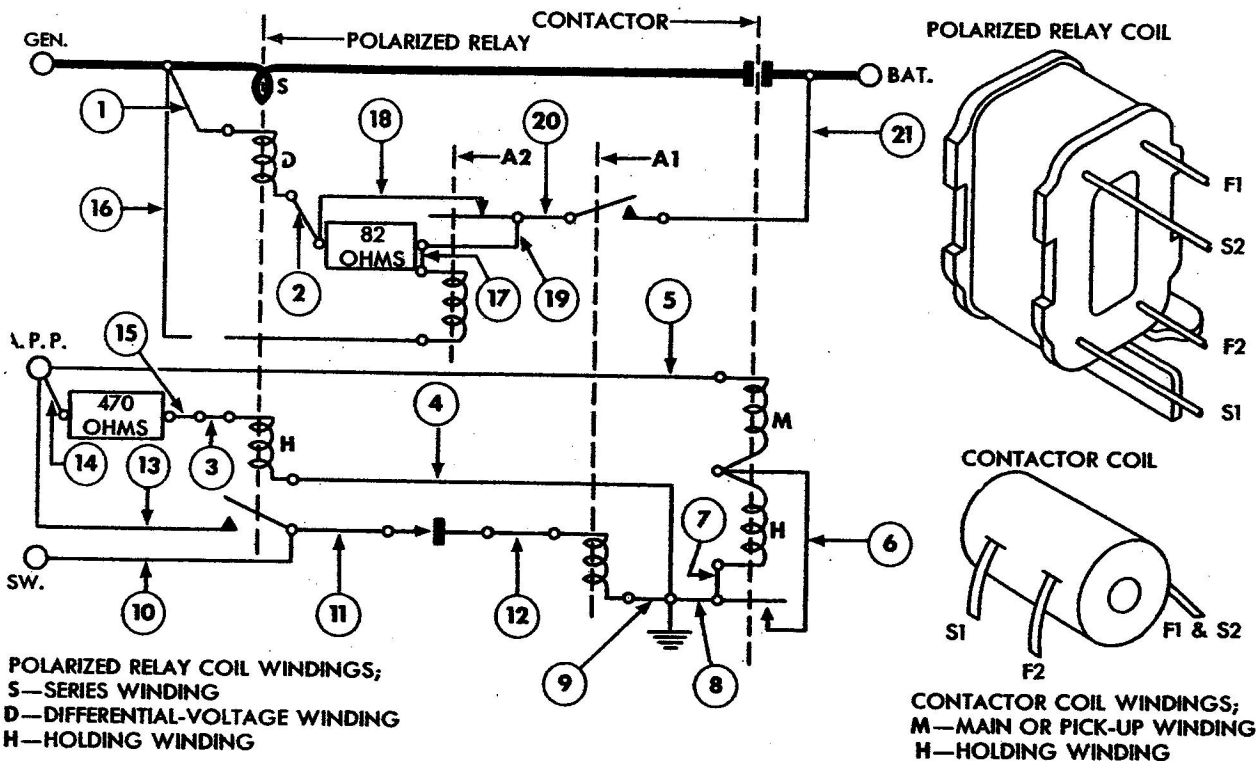


Figure 13—Auxiliary (Telephone-Type) Relay

1. BATTERY TERMINAL
2. LEAD 21, FIGURE 14
3. NUT, LOCK WASHER, FLAT WASHER, INSULATION WASHER
4. 82-OHM RESISTOR MOUNTING BOLT
5. LACING THREAD
6. AUXILIARY RELAY BRACKET SCREW
7. MOUNTING BRACKET
8. LEAD 3, FIGURE 14
9. 470-OHM RESISTOR
10. OUTSIDE COIL TERMINAL, BOTTOM RELAY
11. LEAD 20, FIGURE 14
12. AUXILIARY POWER PLANT TERMINAL CONNECTION
13. SWITCH CONNECTION
14. 82-OHM RESISTOR





1. POLARIZED RELAY COIL S1 LEAD TO CONNECTION STRAP FROM "GEN" TERMINAL
2. POLARIZED RELAY COIL F1 LEAD TO TOP TERMINAL OF 82-OHM RESISTOR
3. POLARIZED RELAY COIL S2 LEAD TO TERMINAL CLIP ON INSULATION BRACKET
4. POLARIZED RELAY COIL F2 LEAD TO GROUND STRAP IN MOUNTING BLOCK ASSEMBLY
5. CONTACTOR COIL S1 LEAD TO TERMINAL CLIP ON A.P.P. TERMINAL SCREW
6. CONTACTOR COIL F1 AND S2 LEAD TO AUXILIARY STATIONARY CONTACT ON SUB-BASE
7. CONTACTOR COIL F2 LEAD TO RIVET PLATE ON SUB-BASE
8. LEAD 11-D-5787-P2 FROM RIVET PLATE ON SUB-BASE TO GROUND STRAP IN MOUNTING BLOCK ASSEMBLY
9. LEAD 11-D-5938-P8 FROM GROUND STRAP IN MOUNTING BLOCK ASSEMBLY TO INSIDE COIL TERMINAL OF BOTTOM RELAY 9-D-5823, P1
10. LEAD, 11-D-5767-GR 4 FROM TERMINAL CLIP ON TOP OF SW TERMINAL SCREW TO TOP SCREW ON INSIDE OF POLARIZED RELAY MOUNTING BRACKET
11. LEAD, 11-D-5768-GR 2, FROM RECTIFIER SCREW TO BOTTOM SCREW ON INSIDE OF POLARIZED RELAY MOUNTING BRACKET
12. LEAD, 11-D-5938-P2 FROM TERMINAL CLIP IN BASE (FROM RECTIFIER) TO OUTSIDE COIL TERMINAL OF BOTTOM RELAY 9-D-5823, P2
13. LEAD, 11-D-5838-P8, FROM TERMINAL CLIP ON A.P.P. TERMINAL SCREW TO TERMINAL CLIP ON POLARIZED RELAY CONTACT SCREW

14. BOTTOM LEAD FROM 470-OHM RESISTOR TO TERMINAL CLIP ON A.P.P. TERMINAL SCREW
  15. TOP LEAD FROM 470-OHM RESISTOR TO TERMINAL CLIP ON INSULATION BRACKET.
  16. LEAD, 11-D-5767-GR 6, FROM CONNECTION STRAP FROM "GEN" TERMINAL TO OUTSIDE COIL TERMINAL OF TOP RELAY 9-D-5823, P2
  17. LEAD, 11-D-5809-P10, FROM INSIDE COIL TERMINAL OF TOP RELAY 9-D-5823 P2 TO BOTTOM TERMINAL OF 82-OHM RESISTOR
  18. LEAD, 11-D-5938-P12, FROM TOP TERMINAL OF 82-OHM RESISTOR TO INSIDE TERMINAL OF THE CONTACTS OF TOP RELAY, 9-D-5823, P2
  19. LEAD, 11-D-5938-P1, FROM BOTTOM TERMINAL OF 82-OHM RESISTOR TO OUTSIDE TERMINAL OF THE CONTACTS OF TOP RELAY, 9-D-5823, P2
  20. LEAD, 11-D-5938-P6, FROM OUTSIDE TERMINAL OF THE CONTACTS OF TOP RELAY, 9-D-5823 P2 TO THE OUTSIDE TERMINAL OF THE CONTACTS OF THE BOTTOM RELAY, 9-D-5823, P1
  21. LEAD, 11-D-5767-GR 5 FROM CONNECTION STRAP FROM "BAT" TERMINAL TO INSIDE TERMINAL OF THE CONTACTS OF BOTTOM RELAY 9-D-5823, P1
- A1. NORMALLY OPEN (TELEPHONE-TYPE) RELAY  
 A2. NORMALLY CLOSED (TELEPHONE-TYPE) RELAY

Figure 14—Wiring Diagram for Assembly



### b. REMOVAL OF CONTACTOR AND POLARIZED RELAY ASSEMBLIES.

(1) Remove the two nuts, two lock washers, four flat washers, and two screws which attach the polarized relay series winding to the generator terminal connection strap. (See *figure 3*.)

(2) Remove the two nuts, two lock washers, two flat washers, and two screws which attach the right-hand contactor stationary contact to the battery terminal connection strap. (See *figure 17*.)

(3) Remove nut, lock washer, and flat washer from the rectifier screw, and lift off clip of lead (11, *figure 14*) from bottom screw on inside of polarized mounting bracket. (See *figure 19*.)

(4) Remove rectifier cover and remove the three screws with lock washers and flat washers which secure the polarized relay assembly to the base, and the two screws with lock washers and flat washers which secure the contactor assembly to the base. (See *figure 10*.)

(5) Remove four nuts, four lock washers, and four flat washers from auxiliary power plant and switch terminals, and lift the polarized relay and contactor assemblies off the base.

### c. SEPARATION OF POLARIZED RELAY ASSEMBLY AND CONTACTOR ASSEMBLY.

(1) Unsolder the auxiliary power plant terminal screw from the 470-ohm resistor.

(2) Unsolder contactor coil lead (5) and lead (13, *figure 14*) from the polarized relay contact screw from the auxiliary power plant terminal screw. (See *figure 15*.)

(3) Remove two screws with lock washers and flat washers which connect the polarized relay series winding to the contactor assembly. (See *figure 2*.) The polarized relay and contactor assemblies are then separated from each other.

## 3. DISASSEMBLY OF MAJOR SUBASSEMBLIES.

### a. AUXILIARY (TELEPHONE-TYPE) RELAY.

(1) Unsolder lead (20, *figure 14*) connecting the two outside relay contact terminals.

(2) Remove screws and flat washers attaching relays to the bracket (*figure 4*) and separate relays from bracket.

### b. POLARIZED RELAY.

(1) Cut lacing thread which ties the 470-ohm resistor to the polarized relay coil washers. (See *figure 16*.)

(2) Unsolder resistor from the insulation bracket terminal clip (*figure 16*), and remove resistor.

(3) Unsolder lead (3, *figure 14*) from the polarized relay coil from the terminal clip on the insulation bracket. (See *figure 13*.)

(4) Remove two screws with lock washers and flat washers attaching the insulation bracket to the

polarized relay armature bracket assembly (*figure 16*) and remove insulation bracket.

(5) Remove two countersunk screws with externally toothed lock washers from left side of the relay mounting bracket.

(6) Remove leads (10 and 11, *figure 14*) from the top and bottom screws on the inside of the polarized relay mounting bracket.

(7) Remove bracket from the relay assembly.

(8) Remove the armature tension spring which holds the lower end of the polarized relay armature (See *figure 3*.)

(9) Remove the two screws with lock washer and flat washers which attach the permanent magnet to the relay assembly, and remove magnet and spacer.

(10) Remove the four armature bracket mounting screws with lock washers and flat washers which attach the relay armature bracket to the magnet frame. (See *figure 16*.)

(11) Lift out relay armature bracket and lift off magnet frames.

(12) Remove shunt wire from relay armature.

(13) Loosen the two setscrews which hold the two bearing screws in the relay armature frame, and remove the bearing screws.

### c. CONTACTOR ASSEMBLY.

(1) Unsolder contactor coil lead (7, *figure 14*) from rivet plate on sub-base.

(2) Unsolder contactor coil lead (6, *figure 14*) from auxiliary stationary contact on sub-base.

(3) Pull out left-hand stationary contact. (See *figure 18*.)

(4) Remove two screws with lock washers and flat washers which attach the right-hand stationary contact to the contactor sub-base, and remove the stationary contact. (See *figure 17*.)

(5) Press down on the contactor bar spring retainer (*figure 3*) and remove the split washer. Lift off contact bar spring and contact bar. (See *figure 16*.)

(6) Remove the four screws with lock washers and flat washers which attach the contactor sub-base to the contactor frame assembly (*figure 18*), remove the sub-base assembly, and lift face plate off contactor frame.

(7) Remove the three screws which attach the mounting block assembly to the contactor frame assembly (*figure 16*), and remove the block.

### d. BASE ASSEMBLY.

(1) Remove rectifier cover. (See *figure 1*.)

(2) Unsolder rectifier tab from lead extending through base. (See *figure 11*.)

(3) Remove nut, lock washer, flat washer, and clip of lead from bottom screw on inside of polarized relay mounting bracket (11, *figure 14*) from the rectifier screw (*figure 19*) and lift out rectifier.

**4. CLEANING, INSPECTION, TESTING, AND REPAIR.**

**a. AUXILIARY (TELEPHONE-TYPE) RELAY.**

(1) **CLEANING.**—Clean relay contacts.

(2) **INSPECTION.**—Make sure top relay contacts remain normally closed and bottom relay contacts normally open. Check screws for tightness.

(3) **TESTING.**—Check voltage values obtained during bench testing before disassembly (refer to section VII, paragraph 1) at which normally open relay closed and opened, and normally closed relay opened.

(4) **REPAIR.**—If bench testing before disassembly shows either relay to be faulty, replace.

**b. POLARIZED RELAY.**

(1) **CLEANING.**—Clean contacts of armature assembly, contact, and stop screws. Clean ends of series winding. See that lead clips are clean.

(2) **INSPECTION.**

(a) Carefully inspect all parts, making sure that none is bent, broken, nor cracked.

(b) Check the clearance of the flexible moving contact on the relay armature. With the contact free, a clearance of 0.001 to 0.005 inch is correct. If necessary, bend the contact to the proper clearance, making sure that it remains in proper alignment.

(c) Fit the ends of the armature assembly pivot into the jeweled bearings and make sure that there is no play.

(3) **TESTING.**

(a) Check voltage values obtained during bench testing before disassembly (refer to section VII, paragraph 1) at which the generator control relay (differential) switch picked up and dropped out.

(b) Test the polarity of the permanent magnet with a compass. Looking at the magnet as it appears in figure 3, the right-hand pole must attract the north-seeking end of the compass needle.

(c) Check resistance of polarized relay coil at a temperature of 25°C (77°F), as follows:

<i>Average Ohms</i>	<i>Maximum Ohms</i>	<i>Minimum Ohms</i>
1st section 2.50	2.62	2.38
2nd section 80.0	88.0	72.0

(4) **REPAIR.**—Replace any parts found to be defective.

**c. CONTACTOR ASSEMBLY.**

(1) **CLEANING.**—Carefully clean all contact surfaces, including the moving contact bar assembly, right- and left-hand stationary contacts, the frame face plate, and contactor auxiliary contacts.

(2) **INSPECTION.**—Check all parts to make sure that none is bent, cracked, nor broken.

(3) **TESTING.**

(a) Check voltage values obtained during bench testing before disassembly (refer to section VII, paragraph 1) at which contactor picked up and dropped out.

(b) Check resistance of contactor coil at 25°C (77°F) as follows:

<i>Average Ohms</i>	<i>Maximum Ohms</i>	<i>Minimum Ohms</i>
1st section 7.70	8.20	7.20
2nd section 194.0	206.0	182.0

(4) **REPAIR.**—Replace frame, coil, and base plate assembly if coil is defective. Install new contact and pick-up springs. Replace moving contact bar assembly.

**d. BASE ASSEMBLY.**

(1) **CLEANING.**—Carefully clean the rectifier screw.

(2) **INSPECTION.**—Carefully inspect outside of rectifier for cracks or breaks. See that rectifier tab is not bent.

(3) **TESTING.**—Connect the rectifier terminal to one side of a 2000-ohm resistor. Connect the other side of the 2000-ohm resistor to the positive line from a 60-volt, d-c, source. Connect the rectifier screw to the negative line of a 60-volt, d-c, source. With this connection, the rectifier must not pass more than 8 milliamperes.

(4) **REPAIR.**—Replace rectifier if found to be defective by the reverse-voltage test.

**5. REASSEMBLY OF MAJOR SUBASSEMBLIES.**

**a. BASE ASSEMBLY.**

(1) Solder rectifier tab to lead 12 (*figure 14*).

(2) Place rectifier in position in base, inserting lead 12 (*figure 14*) through small hole in the bottom of the rectifier well. Install flat washer, lock washer, and nut on rectifier screw.

**b. CONTACTOR ASSEMBLY.**

(1) Assemble mounting block assembly to the contactor frame assembly.

(2) Assemble the contactor sub-base to the contactor frame assembly.

(3) Place contact bar, contact bar spring, and contact bar spring retainer in position on the pin. (See *figure 9*.) Press down on the retainer and install the split washer.

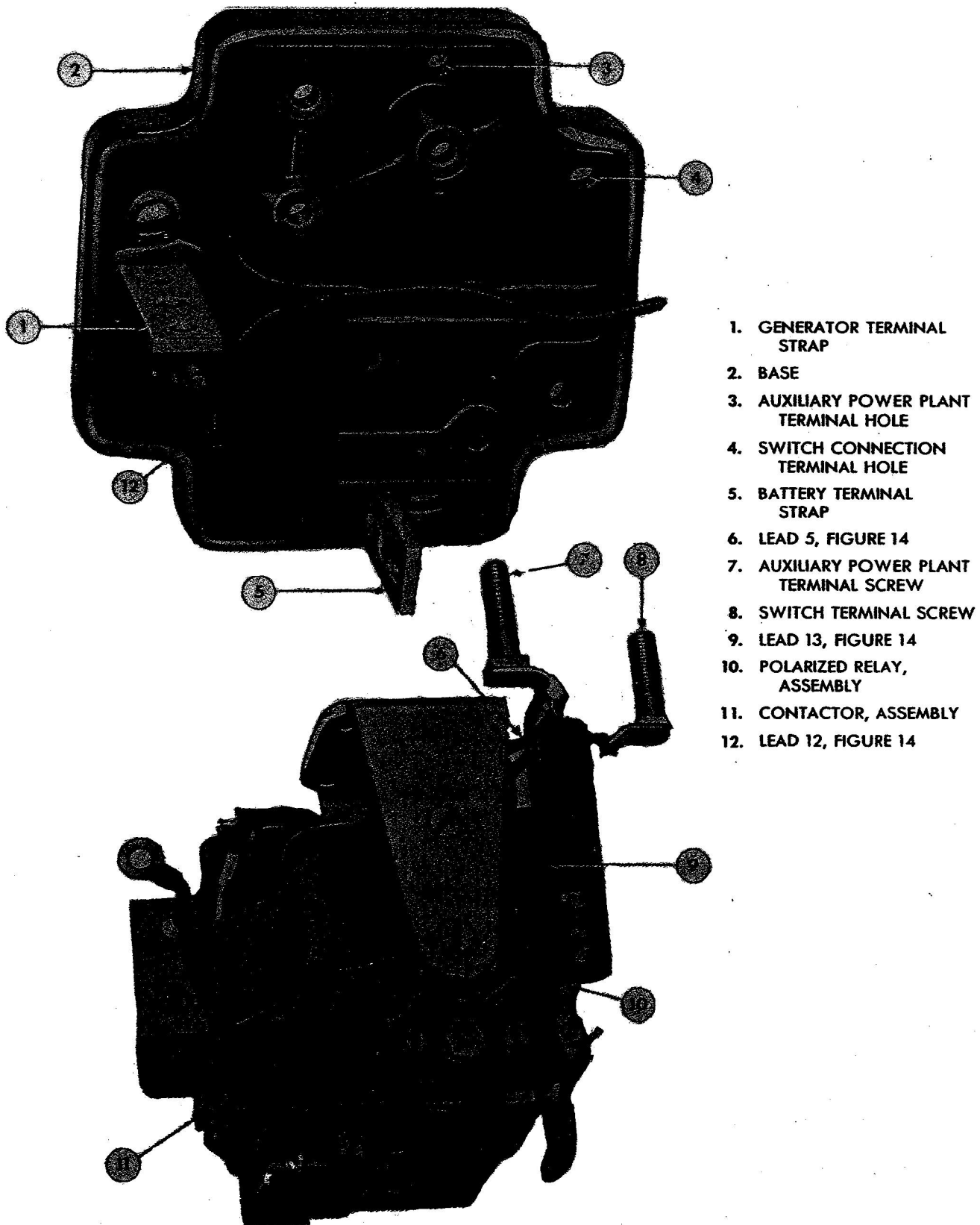
(4) Install left-hand stationary contact.

(5) Solder contactor coil lead (6, *figure 14*) to the auxiliary stationary contact on the sub-base.

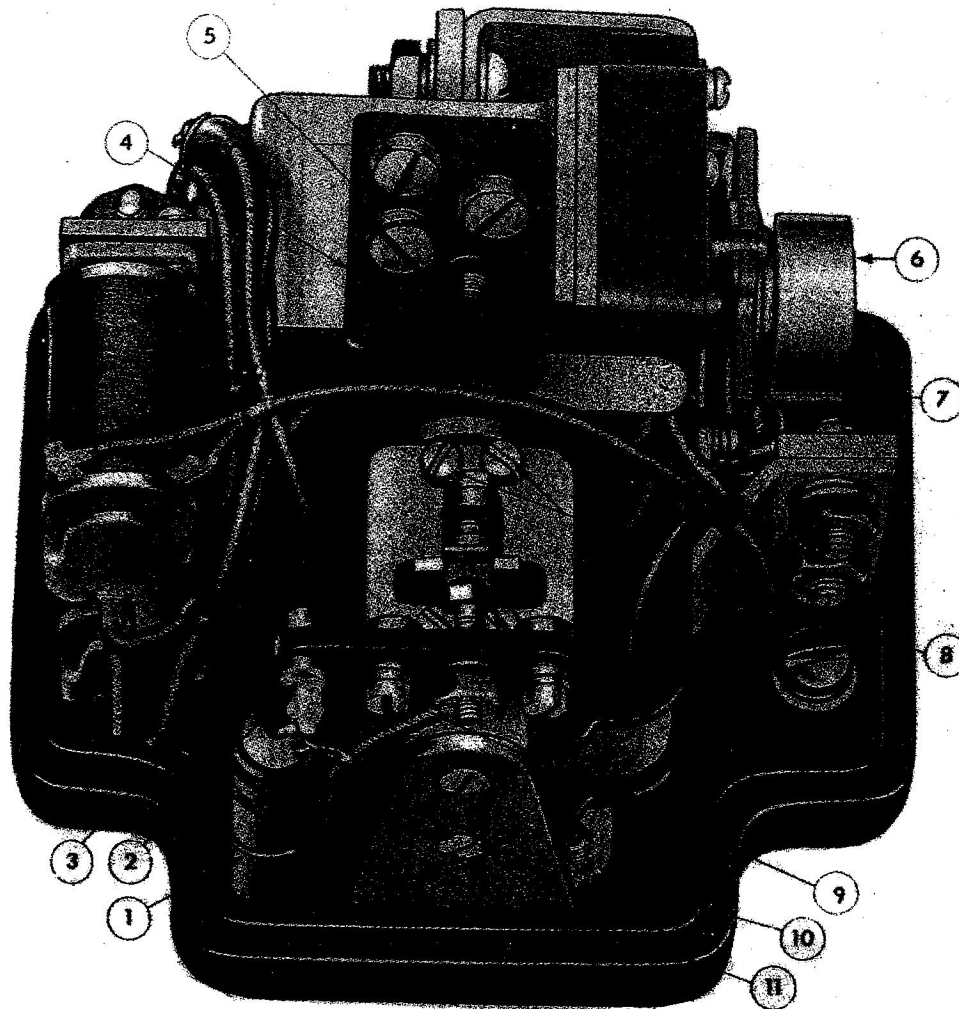
(6) Solder contactor coil lead (7, *figure 14*) to rivet plate on the sub-base.

**c. POLARIZED RELAY ASSEMBLY.**

(1) Place the armature in position in the relay armature frame, and install the bearing screws. Adjust the bearing screws so that the armature works freely



**Figure 15—Alining Switch and Auxiliary Power Plant Terminal Screws**



1. LACING THREAD
2. INSULATION BRACKET  
TERMINAL CLIP
3. INSULATION BRACKET
4. MOUNTING BLOCK,  
ASSEMBLY
5. MOUNTING  
BLOCK SCREWS
6. CONTACT BAR  
SPRING RETAINER
7. GROUND STRAP
8. ARMATURE BRACKET  
MOUNTING SCREWS
9. INSULATION BRACKET  
MOUNTING SCREWS
10. COUNTERSUNK HEAD  
SCREWS, RELAY  
MOUNTING BRACKET
11. RELAY MOUNTING  
BRACKET

Figure 16—Polarized Relay

in the frame without end play. Make sure the armature is exactly centered in the frame. Install setscrews, and solder shunt wire to armature frame.

**Note**

Use a minimum amount of solder.

(2) Place magnet frame and relay armature bracket in position in relay coil, and secure with four screws, lock washers, and flat washers. (See figure 16.)

(3) Place the permanent magnet spaces and permanent magnet in position on the assembly, and secure with two screws, two lock washers, and two flat washers.

(4) Install the armature tension spring. (See figure 3.)

(5) Place coil in the polarized relay mounting bracket and install the two countersunk screws with internal toothed washers on each arm of the bracket.

(6) Attach clip of lead (10, figure 14) from switch terminal screw under the top screw on the inside of the polarized relay mounting bracket.

(7) Attach lead (11, figure 14) under the bottom screw on the inside of the polarized relay mounting bracket.

(8) Place insulation bracket in position on the armature bracket assembly, and secure with two screws, two lock washers, and two flat washers.

(9) Solder lead (3, figure 14) from the polarized relay coil to the terminal clip on the insulation bracket. (See figure 13.)

(10) Solder the 470-ohm resistor to the terminal clip on the insulation bracket, and lace resistor to the polarized relay coil washers.

**d. AUXILIARY (TELEPHONE-TYPE) RELAY.**

(See figure 14.)

(1) Install relays on bracket; normally closed relay at the top, normally open relay at the bottom.

(2) Solder lead (20) connecting the outside relay contact clips. If new relays are being installed, solder the leads listed below to the assembly as follows:

(a) Lead 9—Inside coil terminal of bottom relay to ground strap.

(b) Lead 16—Outside coil terminal of top relay to generator terminal connection strap.

(c) Lead 17—Inside coil terminal of top relay to bottom terminal of 82-ohm resistor.

(d) Lead 18—Inside terminal of the contacts of top relay to top terminal of 82-ohm resistor.

(e) Lead 19—Outside terminal of the contacts of top relay to bottom terminal of 82-ohm resistor.

(f) Lead 21—Inside terminal of the contacts of bottom relay to battery terminal connection strap.

## 6. REASSEMBLY OF MAJOR SUBASSEMBLIES INTO COMPLETE UNIT.

### a. POLARIZED RELAY ASSEMBLY AND CONTACTOR ASSEMBLY.

(1) Secure the polarized relay series winding to the contactor assembly with two screws, two lock washers, and two flat washers.

(2) Solder contactor coil lead (5) and lead (13, *figure 14*) from terminal clip on polarized relay contact screw to the terminal clip on top of the auxiliary power plant terminal screw as shown in *figure 15*. Make sure that the soldering is done so the two terminal screws aline properly with the terminal screw holes.

(3) Place the two assemblies in position on the base and install the five screws together with lock washers and flat washers which secure them to the base. Install four nuts, four lock washers, and four flat washers on the auxiliary power plant and switch terminal screws.

(4) Install rectifier cover.

(5) Remove flat washer, lock washer, and nut from rectifier screw. Place clip of lead (11, *figure 14*) from bottom screw on inside of polarized mounting bracket on the rectifier screw and install flat washer, lock washer, and nut.

(6) Attach the right-hand contactor stationary contact to the battery terminal connection strap with two screws, two flat washers, two lock washers, and two nuts.

(7) Attach the polarized relay series winding to the generator terminal connection strap with two screws, four flat washers, two lock washers, and two nuts.

### b. AUXILIARY (TELEPHONE-TYPE) RELAY.

(1) Place flat washer on 82-ohm resistor mounting bolt and start the bolt through the base from the bottom side.

(2) As the mounting bolt emerges on the upper side of the base, install, in order, auxiliary relay bracket, flat washer, lock washer, and nut. Tighten nut on mounting bolt.

(3) Place flat washer on auxiliary relay bracket screw and attach relay assembly to the contactor assembly. (*See figure 13.*)

(4) Install, in order, insulation washer, 82-ohm resistor, insulation washer, flat washer, lock washer, and nut on the resistor mounting bolt.

(5) Solder lead (12, *figure 14*) from rectifier tab which extends through the base to the outside coil terminal of the bottom relay. (*See figures 13 and 15.*)

(6) Solder polarized relay coil lead (2) and lead (18, *figure 14*) from inside contact terminal of top relay to the top terminal of the 82-ohm resistor.

(7) Solder leads (17 and 19, *figure 14*) from the inside coil terminal and outside contact terminal of the top relay to the bottom terminal of the 82-ohm resistor.

(8) Solder polarized relay coil lead (4) and lead (8) from the rivet plate on the contactor sub-base and lead (9, *figure 14*) from the inside coil terminal of the bottom relay to the ground strap in the mounting block assembly.

(9) Screw clips of polarized relay coil lead (1) and lead (16, *figure 14*) from the outside terminal of the top relay to the bottom screw of the generator terminal connection strap.

(10) Screw clip of lead (21, *figure 14*) from the inside terminal of the contacts of the bottom relay to the bottom screw on the battery terminal connection strap.

(11) Lace leads as shown in *figure 13*.

## 7. SETTING DIFFERENTIAL VOLTAGE.

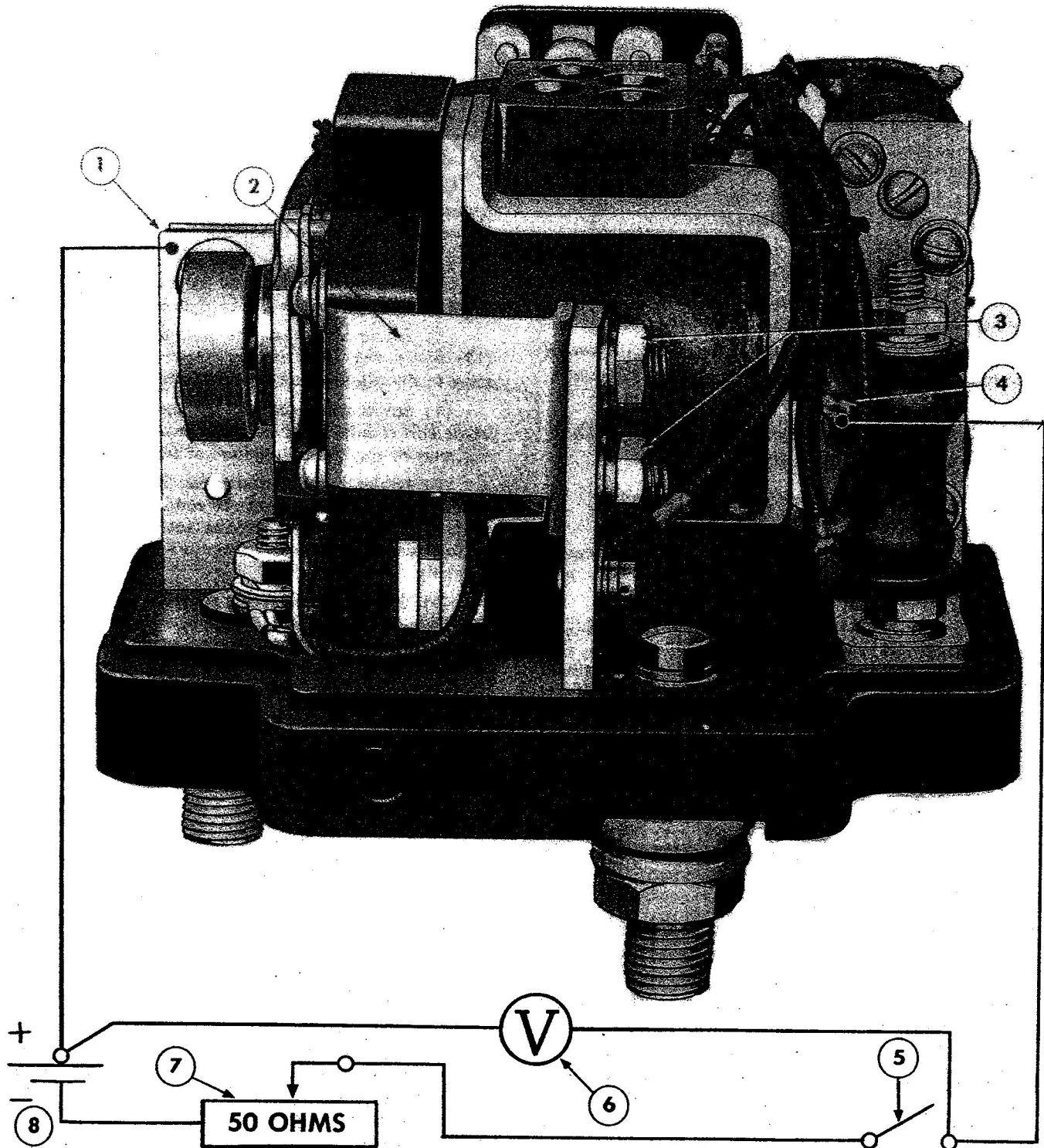
a. Arrange an 0-1-volt, d-c, voltmeter, a 50-ohm rheostat, a 2-volt, 1-cell storage battery, and a switch in a test circuit as shown in *figure 17*. Clip one end of the test circuit to the generator terminal connection strap, and the other end to the top terminal of the 82-ohm resistor.

b. Adjust the stop screw on the polarized relay assembly so that the armature is approximately centered in the air gap. (*See figure 18.*) Look at both ends of the armature to judge when it is nearest central position in both gaps.

c. Close the switch and vary the voltage with the rheostat.

d. Adjust the stop screw until the relay picks up between 0.475 and 0.525 volt.

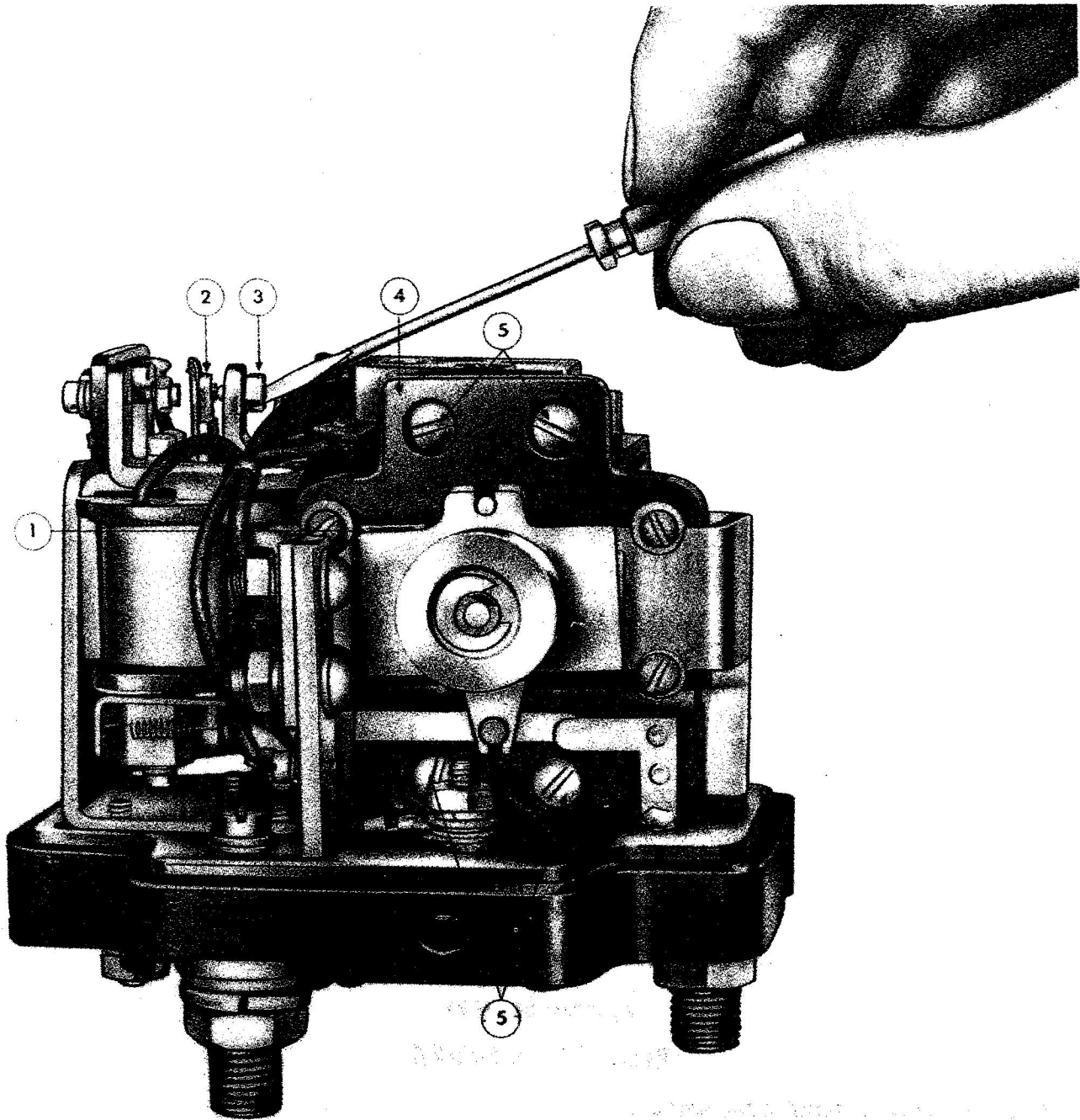
e. Press cover down firmly over base against gasket on base, and install mounting block attaching screw and safety wire.



- |   |                                      |
|---|--------------------------------------|
| 1. GENERATOR TERMINAL CONNECTION STRAP            | 4. TOP 82-OHM RESISTOR TERMINAL      |
| 2. CONTACTOR RIGHT-HAND STATIONARY CONTACT        | 5. SWITCH                            |
| 3. CONTACTOR STATIONARY CONTACT CONNECTING SCREWS | 6. 0-1-VOLT DIRECT CURRENT VOLTMETER |
|   | 7. RHEOSTAT                          |
|   | 8. 1-CELL 2-VOLT STORAGE BATTERY     |

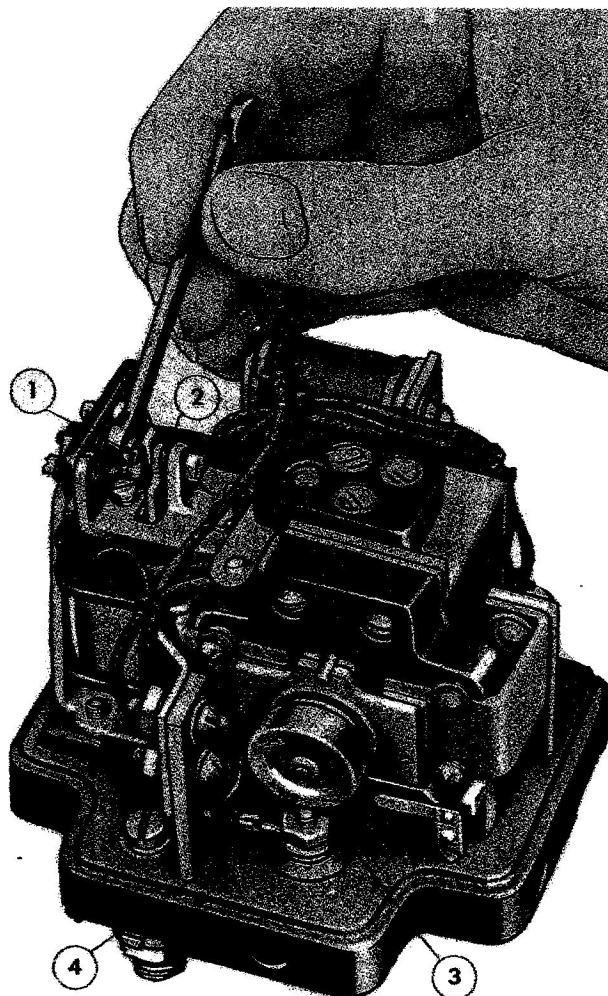
Figure 17—Test Circuit for Setting Differential Voltage





- |  |                              |
|--|------------------------------|
| 1. CONTACTOR LEFT-HAND<br>STATIONARY CONTACT | 3. STOP SCREW                |
| 2. POLARIZED RELAY ARMATURE                  | 4. CONTACTOR SUB-BASE        |
|  | 5. CONTACTOR SUB-BASE SCREWS |

**Figure 18—Adjusting Stop Screw, Polarized Relay**



1. CONTACT SCREW
2. POLARIZED RELAY ARMATURE
3. NUT, LOCK WASHER, FLAT WASHER,  
ON RECTIFIER SCREW
4. LEAD 11, FIGURE 14

Figure 19—Adjusting Contact Screw, Polarized Relay

## SECTION VII

### TEST PROCEDURE

#### 1. BENCH TESTING BEFORE DISASSEMBLY.

a. GENERAL.—When a generator control relay (differential) switch has been removed from an aircraft multigenerator electrical system and sent to a depot for repair, it should be given a bench test before disassembly to determine the extent of the repairs needed. Before testing the unit, see that the surface around the mounting holes where the finish has been removed is clean, and also that the mounting block attaching screw is tightly in place.

#### Note

It may be desirable to conduct the tests with the cover removed. To do so, stand the unit on its terminal screws on a suitable piece of insulating material. Connect the negative lead to the ground strap extending from the mounting block. (See figure 16.)

b. WIRING AND INSTRUMENT CONNECTIONS. (See figure 20.)

(1) Connect 0-30-volt, d-c, voltmeters (V1 and V2).





- (2) Connect an 0-1-volt, d-c, voltmeter (V3).
- (3) Connect an 0-30-ampere, d-c, ammeter (A1).
- (4) Connect an 0-300-ampere, d-c, ammeter (A2).
- (5) Connect generator, load, and battery.

c. TEST PROCEDURE. (See figure 20.)

(1) NORMALLY OPEN TELEPHONE-TYPE RELAY.

(a) With switches (S2, S3, and S4) in the "OPEN" position, close switch (S1) in the No. "1" position. Slowly increase the generator voltage until the normally open telephone-type relay closes. Closing the relay is indicated when the voltmeter (V2) suddenly shows approximately the same voltage as shown by the voltmeter (V1).

(b) Decrease the generator voltage and observe when the normally open telephone-type relay drops out. This point is determined by noting when the voltage on voltmeter (V2) suddenly drops to zero. The normally open telephone-type relay must pick up below 22 volts and drop out above 12 volts.

(2) NORMALLY CLOSED TELEPHONE-TYPE RELAY.—Close switch (S5) in the No. "1" position. Close switch (S3) and increase the generator voltage until the voltage on V1 is 0.5 volt below V2. Slowly decrease the generator voltage, and note reading on the 0-30-ampere, d-c, ammeter. Ammeter A1 will increase to approximately 1.6 amperes, and then decrease to zero. When the reading drops to zero, the normally closed telephone-type relay operates. The pick-up voltage is the difference between the readings of the two 0-30-volt, d-c, voltmeters, or V2 minus V1. The relay must pick up below 4.5 volts.

(3) POLARIZED RELAY.

(a) Increase the generator voltage to 0.5 volt below the reading on voltmeter (V2) and close switch (S2). Slowly increase the generator voltage and note the voltage on the 0-1-volt, d-c, voltmeter (V3) at which the generator control relay (differential) switch operates. The unit should pick up between 0.35 and 0.65 volt, read on voltmeter (V3). To obtain an accurate reading of the differential voltage setting, the generator voltage must be varied carefully. At the factory, this adjustment is made with battery voltage. (See figures 17 and 18.) If the generator voltage is not varied carefully and smoothly, the reading on voltmeter (V3) will be in error. Also, a generator with an excessive amount of "hash" (instantaneous irregularities in the generator voltage which do not show on the voltmeter) will cause the generator control relay (differential) switch to operate when only a small differential voltage is shown on the voltmeter.

(b) Open switch (S2) and decrease the generator voltage until the generator control relay (differential) switch drops out. Read the reverse current required to cause the unit to drop out on the 0-30-ampere, d-c, ammeter (A1). The unit should drop out at 20 to 25 amperes reverse current with a battery or

bus voltage of 28.0 volts. Repeat this operation several times. Adjust the reverse current drop-out setting by adjusting the contact screw. (See figure 19.)

(c) CHATTERING TEST. The following test will be made to insure that the relay will not chatter when turned on when installed in the airplane:

(1) Close switch (S4), figure 20, through a 50 ohm, 10 watt load. Increase generator voltage to one-half volt above voltage which closes the relay switch.

(2) Operate switch (S1) a number of times. Note if relay chatters when switch is turned on. If chattering occurs make the following adjustments:

(a) Tighten the stop screw shown in figure 8, by one-half turn.

(b) Introduce more tension on the tension spring by slightly bending the spring tab to which the spring is attached.

(c) Adjust the contact screw 1, figure 19, to obtain proper reverse current drop-out.

(d) Check to insure that the differential voltage and reverse current calibrations are within the limits specified. Also check to insure that the relay switch will close when connected to the 50 ohm, 10 watt load at a generator voltage of 22, plus or minus 2 volts.

(3) After making the above adjustments close switch (S1), figure 20, a number of times. If chatter still occurs repeat the above adjustments until chatter is not observed.

(4) CONTACTOR.

(a) Decrease the generator voltage to 10 volts or below. Place switch (S1) in the No. "2" position, and leave all other switches open. Increase the generator voltage and note the voltage on the voltmeter (V1), at which the contactor operates. The contactor must pick up below 18 volts.

(b) Decrease the generator voltage and note the voltage on voltmeter (V1), at which the contactor drops out. The contactor must drop out below 7 volts.

(c) With switch (S1) in the No. "1" position, switch (S5) in No. "2" position, switch (S2) open, and switches (S3 and S4) closed, increase the generator voltage until the generator control relay (differential) switch operates. Connect an 0-100 millivoltmeter between the generator and battery terminals and increase the load until the 0-300-ampere ammeter (A2) reads 300 amperes. The millivoltmeter should read below 100 millivolts. To check the millivolt drop, use an 0-100 millivoltmeter with prod leads. Place the prods on the connection straps which extend through the molded base, and NOT on the terminal studs or cable terminals.

2. TESTING AFTER REASSEMBLY.

Bench test the generator control relay (differential) switch in accordance with instructions outlined in paragraph 1 of this section.

## SECTION VIII

### INTRODUCTION

#### 1. GENERAL.

a. This Part List lists and describes parts for the Generator Control Relay (Differential) Type AVR-117-A, manufactured by the Westinghouse Electric and Manufacturing Co., Lima Works, Lima, Ohio, and is comprised of two sections as shown in the Table of Contents.

b. The Group Assembly Parts List (section IX) consists of the complete unit divided into five assemblies. Each assembly listed is followed immediately by its component parts properly indented thereunder to show their relationship to the assembly. Component parts of the complete unit which are not included in any assembly, but which are used in conjunction with, or attach one assembly to another, are listed immediately following the last detail of that assembly and in line with the major assembly or part.

c. The quantities listed in the "Units per Ass'y" column of the Group Assembly Parts List are, in the case of assemblies, the quantity used per unit at the location indicated, while the component parts indented under the assemblies are the quantity used per assembly. The quantities specified, therefore, are not necessarily the total used per unit.

d. The figure and index numbers appearing on the illustrations are used to facilitate identification of parts.

e. All dimensions shown herein are nominal and are inserted to facilitate identification for ordering and are not to be construed as restrictive in inspection.

#### 2. DEFINITIONS.

a. Right and left are determined by viewing the unit from the contractor spring retainer side.

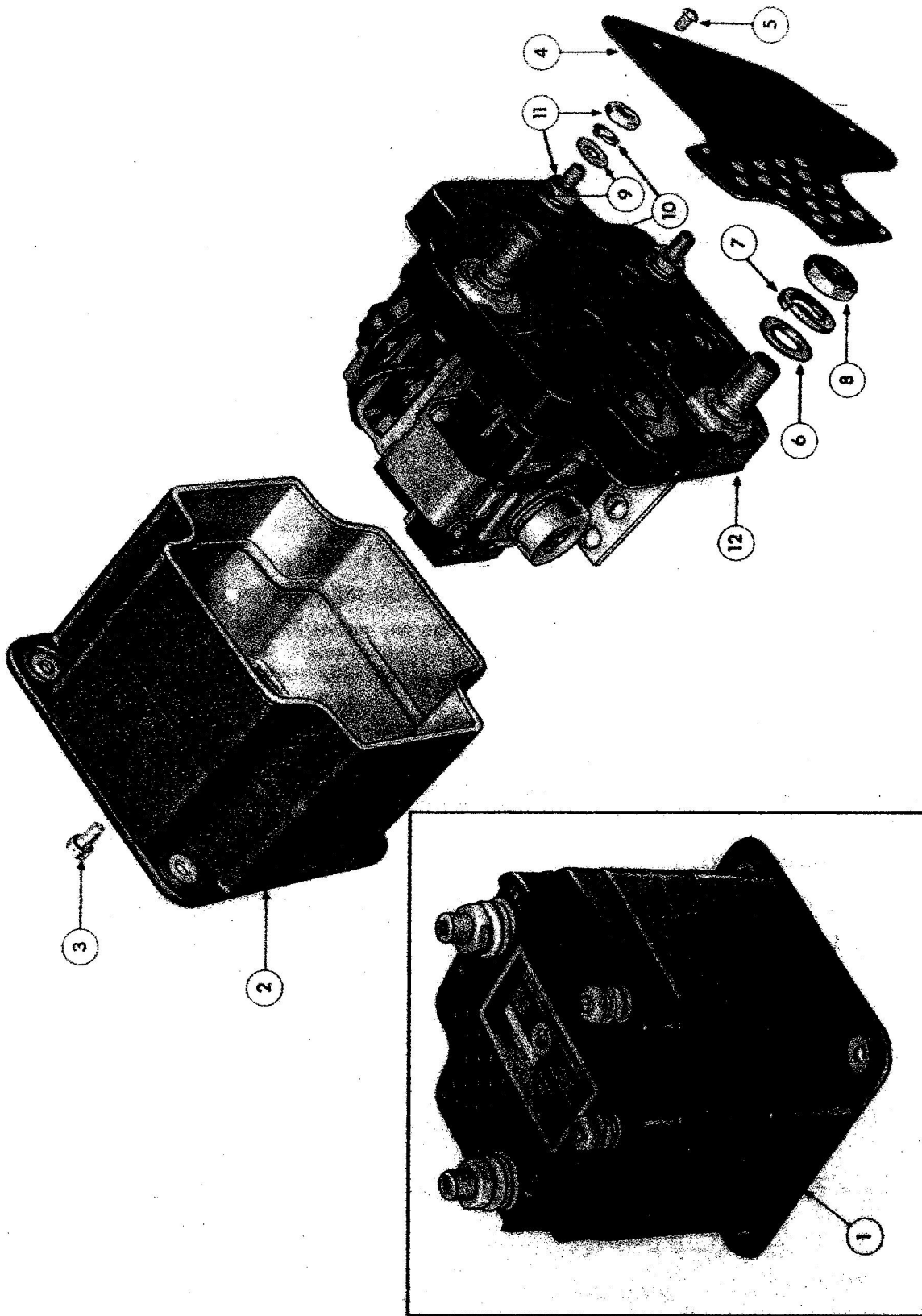
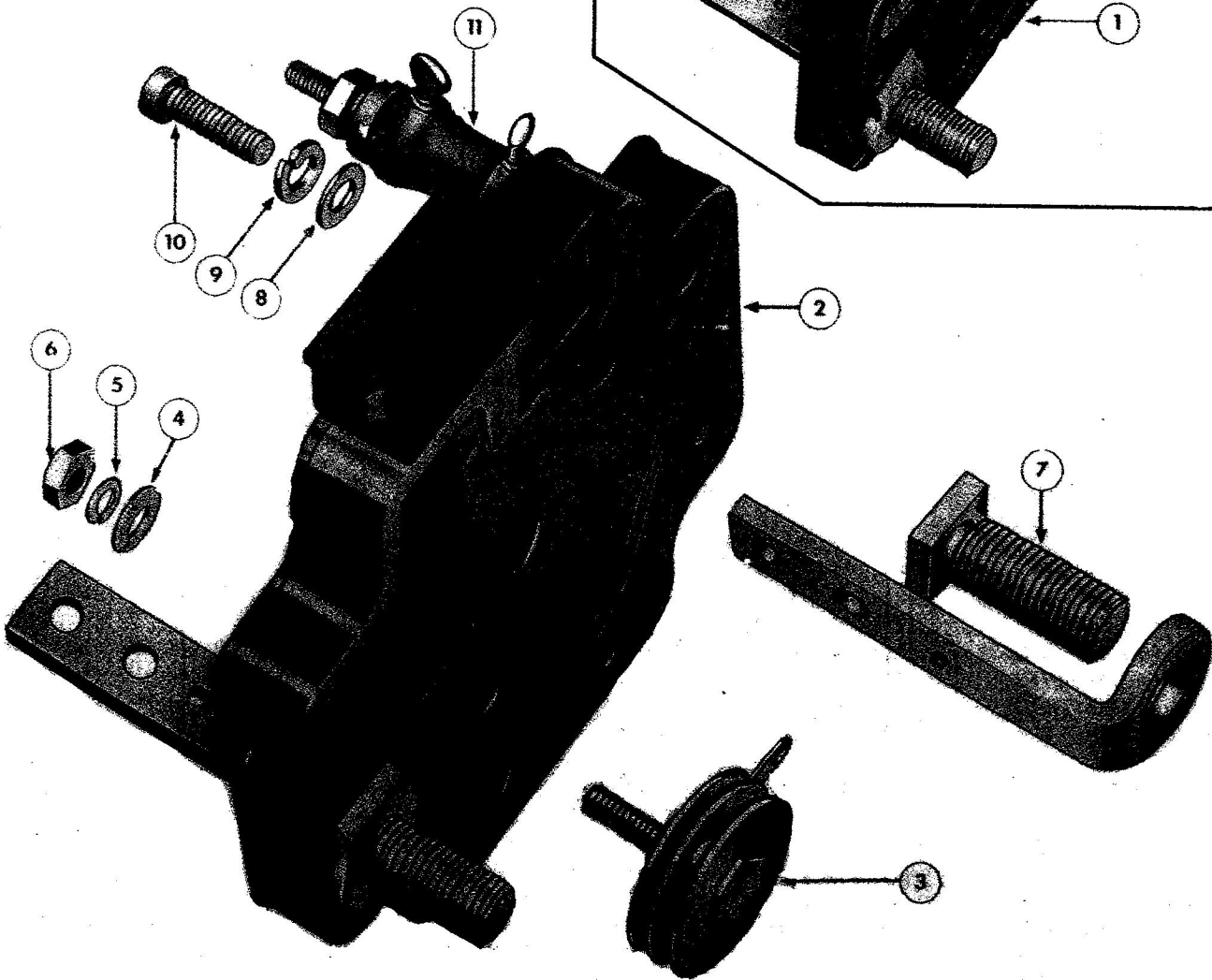
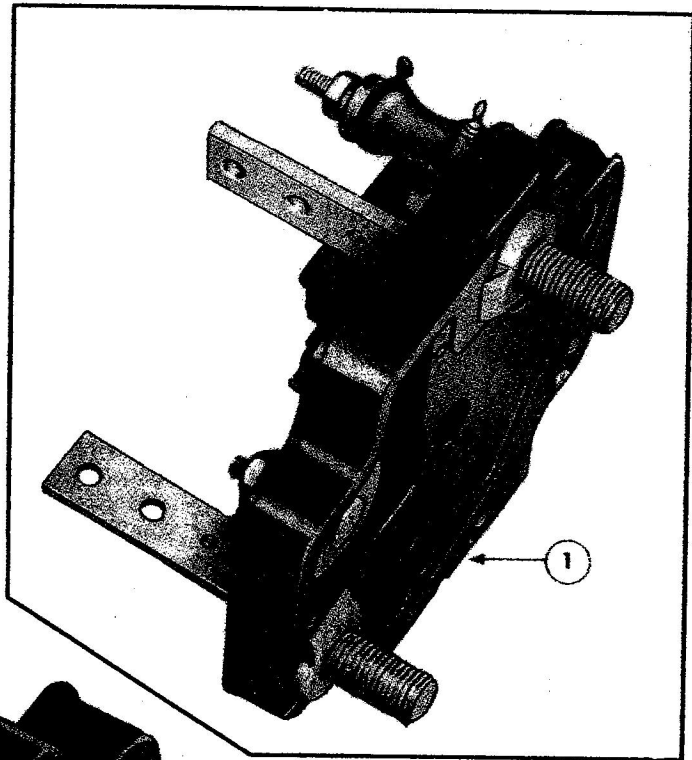


Figure 21—Generator Control Relay (Differential) Switch

Figure and Index Number	Part Number	NOMENCLATURE							U. S. Army	British Army	Units Per Assy
		1	2	3	4	5	6	7			
21 1	7A5930G1	Generator Control Relay Assembly—Differential							4246	105U	1
21 2	12B3286P6	Cover—Top, generator control relay							4246	105U	1
21 3	AN502-10-5	Screw—Generator control relay cover attaching							6500	128	1
21 4	12B3301P1	Cover—Bottom, generator control relay							4246	105U	1
21 5	11D5832P2	Screw—Self-tapping, No. 4-40 x 3/16 in. bottom cover attaching							4246	105U	5
21 6	AN960-616	Washer—Plain, steel, 3/8 in., battery and generator terminal stud							6500	128	2
21 7	AN935-616	Washer—Lock, steel, cadmium plate, 3/8 in., for battery and generator terminal stud							6700	128	2
21 8	AN316-6R	Nut—Hexagon, aircraft check, steel, 3/4-24, for battery and generator terminal stud							6500	128	2
21 9	AN960-10L	Washer—Plain, steel, cadmium plate, No. 10, for armature and switch terminal stud							6500	128	4
21 10	AN935-10	Washer—Lock, steel, cadmium plate, No. 10, for armature and switch terminal stud							6700	128	4
21 11	AN345-10	Nut—Hexagon, steel, cadmium plate, No. 10-32, for armature and switch terminal stud							6700	128	4
21 12	4C4873P1	Gasket—Cover									1
22 1	12B3296G1	Base Assembly—Relay, generator control							4246	105U	1
22 2	7A5926P2	Base—Relay, generator control							4246	105U	1
22 3	11D5754G1	Rectifier—Relay, generator control							4246	105U	1
22 4	AN960-8	Washer—Plain, steel, cadmium plate, No. 8, rectifier mounting screw							6500	128	1
22 5	AN935-8	Washer—Lock, steel, cadmium plate, No. 8, rectifier mounting screw							6700	128	1
22 6	AN340-8	Nut—Hexagon, steel, cadmium plate, rectifier mounting screw							6700	128	1
22 7	11D5747P1	Stud—Terminal connection, for battery and generator terminals							4246	105U	2
22 8	AN960-10L	Washer—Plain, steel, cadmium plate, No. 10, connection stud attaching screw							6500	128	2
22 9	AN935-10	Washer—Lock, steel, cadmium plate, No. 10, connection stud attaching screw							6700	128	2
22 10	AN501-10-10	Screw—Fillister drilled head, steel, cadmium plate, No. 10 32 x 3/8 in., connection stud attaching							6700	128	2
22 11	9D5810P1	Resistor—82 ohm							4246	105U	1
23 1	12B3260G1	Relay Assembly—Polarized							4246	105U	1
23 2	4C4865P1	Frame—Magnet left							4246	105U	1
23 3	4C4865P2	Frame—Magnet right							4246	105U	1
23 4	11D5722P1	Spacer—Magnet and coil (brass)							4246	105U	1
23 5	11D5847P1	Magnet—Permanent							4246	105U	1
23 6	11D5782P1	Spring—Tension							4246	105U	1
23 7	AN960-4	Washer—Plain, steel, cadmium plate, No. 4, magnet and spacer to magnet frame screw							6500	128	2
23 8	AN935-4	Washer—Lock, steel, cadmium plate, No. 4, magnet and spacer to magnet frame screw							6700	128	2
23 9	AN500-B4-9	Screw—Fillister head, machine, brass, No. 4-40 x 9/16 in., magnet and spacer to magnet frame							6700	128	2
23 10	12B3285G1	Coil and Spool Assembly—Polarized relay							4246	105U	1
23 11	4C4858P1	Bracket—Mounting, armature							4246	105U	1
23 12	13D1747G1	Armature Assembly—Polarized relay, with shunt							4246	105U	1
23 13	12B3260P19	Shunt—Armature grounding wire							4246	105U	1
23 14	9D8468G1	Screw—Bearing							4246	105U	2
23 15	S60929	Screw—Set, bearing screw							4246	105U	2
23 16	7D8527P1	Screw—Adjusting, armature contact							4246	105U	1

\* 1 2 3 4 5 6 7



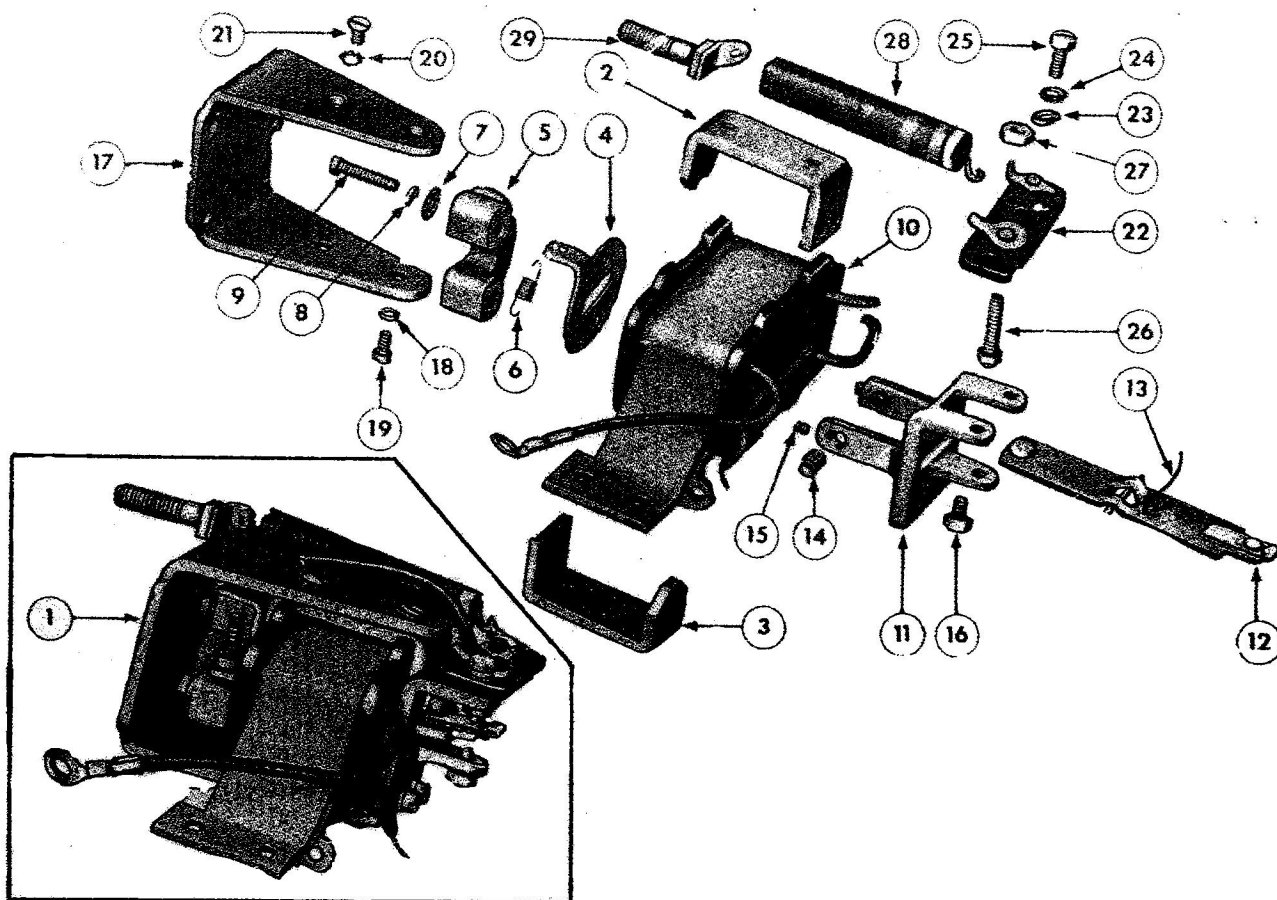


Figure 23—Polarized Relay Assembly

Figure and Index Number	Part Number	NOMENCLATURE							U. S. Army	British Army	Units Per Assy	
		1	2	3	4	5	6	7				
23 17	4C4859P1								Bracket—Mounting, polarized relay	4246	105U	1
23 18	AN936-A4								Washer—Lock, steel, cadmium plate, No. 4, mounting frame right to relay mounting bracket screw	6700	128	2
23 19	AN500-4-4								Screw—Flat head, steel, cadmium plate, No. 4-40 x 1/4 in., magnet frame right to relay mounting bracket	6700	128	2
23 20	11D5862P1								Washer—Lock, countersunk tooth, No. 4, magnet frame left to relay mounting bracket screw	4246	105U	2
23 21	AN505-4-3								Screw—Flat head, steel, cadmium plate, No. 4-40 x 3/16 in., magnet frame left to relay mounting bracket	6700	128	2
23 22	11D5710G1								Plate Assembly—Insulation	4246	105U	1
23 23	11D5845P1								Washer—Special insulation plate attaching screw	4246	105U	2
23 24	AN935-4								Washer—Lock, steel, cadmium plate, No. 4, insulation plate attaching screw	6700	128	2
23 25	AN500-4-4								Screw—Flat head, steel, cadmium plate, No. 4-40 x 1/4 in., insulation plate attaching	6700	128	2
23 26	11D5726P1								Screw—Contact	4246	105U	1
23 27	AN-340-4								Nut—Hexagon, steel, cadmium plate, No. 4-40, contact screw	6700	128	1
		1	2	3	4	5	6	7				



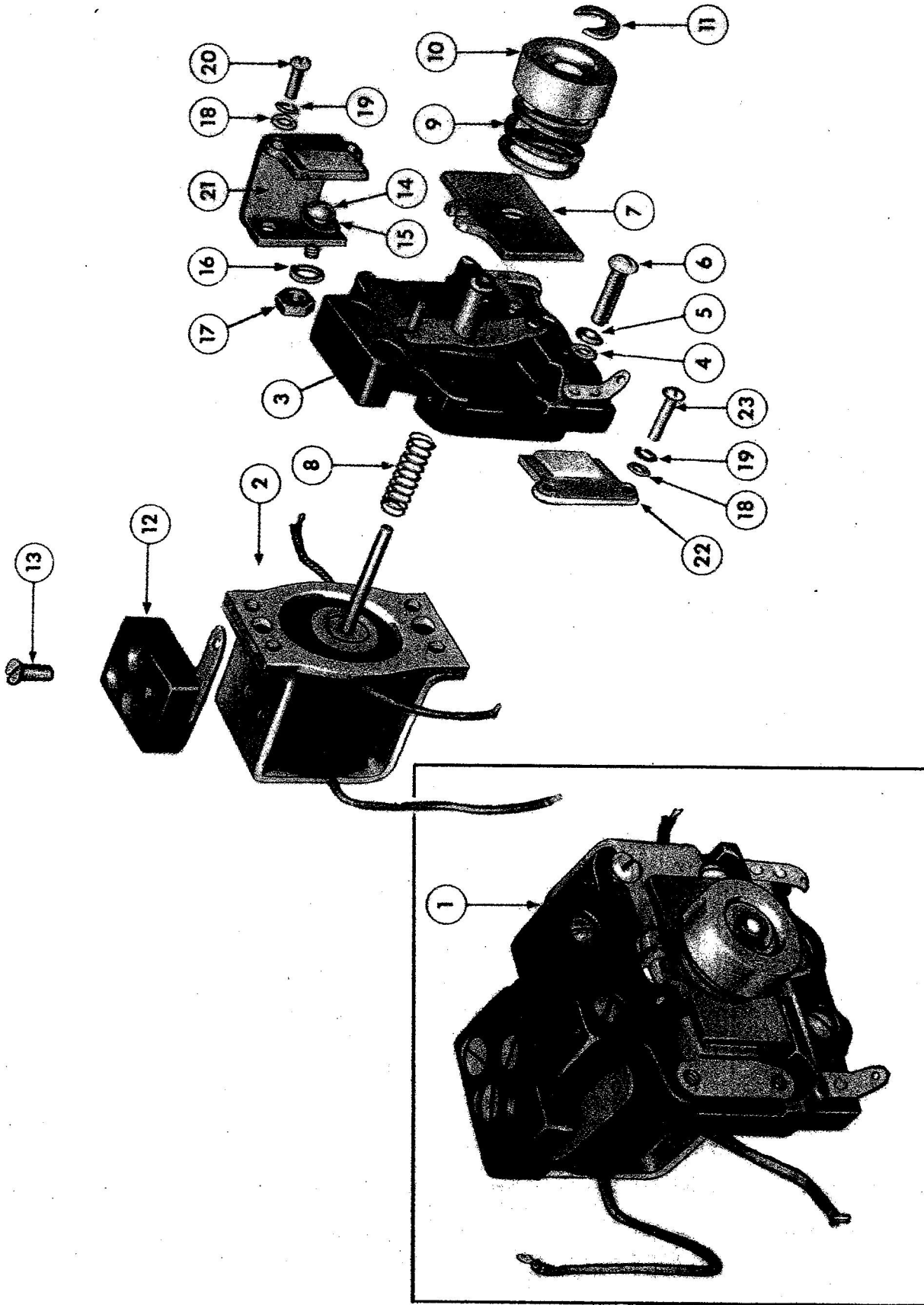


Figure 24—Contactor Assembly



Figure and Index Number	Part Number	NOMENCLATURE							U. S. Army	British Army	Units Per Assy	
		1	2	3	4	5	6	7				
23 28	9D5751P1								Resistor—Polarized relay assembly (470 ohm)	4246	105U	1
23 29	11D5799G1								Screw—Terminal for armature and switch terminal			1
24 1	12B3287G1								Contact Assembly—Relay, generator control	4246	105U	1
24 2	4C4890G1								Frame, Coil and Face Plate Assembly—Contactor	4246	105U	1
24 3	4C4898G1								Base Assembly—Sub, contactor	4246	105U	1
24 4	11D5878P1								Washer—Special, base assembly attaching screw	4246	105U	4
24 5	AN935-6								Washer—Lock, steel, cadmium plate, No. 6, base assembly attaching screw	6700	128	4
24 6	AN515-6-9								Screw—Round head, steel, cadmium plate, No. 6-32 x 7/16 in., base assembly attaching	6700	128	4
24 7	11D5736G1								Bar Assembly—Contact, moving	4246	105U	1
24 8	11D5802P1								Spring—Pick-up	4246	105U	1
24 9	11D5807P1								Spring—Contact	4246	105U	1
24 10	13D1822P1								Retainer—Contact spring	4246	105U	1
24 11	11D5815P								Washer—Locking, spring retainer	4246	105U	1
24 12	4C4889G1								Block Assembly—Mounting	4246	105U	1
24 13	AN505-6-7								Screw—Flat head, steel, cadmium plate, No. 6-32 x 7/16 in., mounting block to contactor attaching	6700	128	3
24 14	AN515-8-8								Screw—Round head, steel, cadmium plate, No. 8-32 x 1/2 in., stationary contact to terminal strap	6700	128	2
24 15	AN960-8								Washer—Plain, steel, cadmium plate, No. 8, stationary contact to terminal strap	6500	128	2
24 16	AN935-8								Washer—Lock, steel, cadmium plate, No. 8, stationary contact to terminal strap	6700	128	2

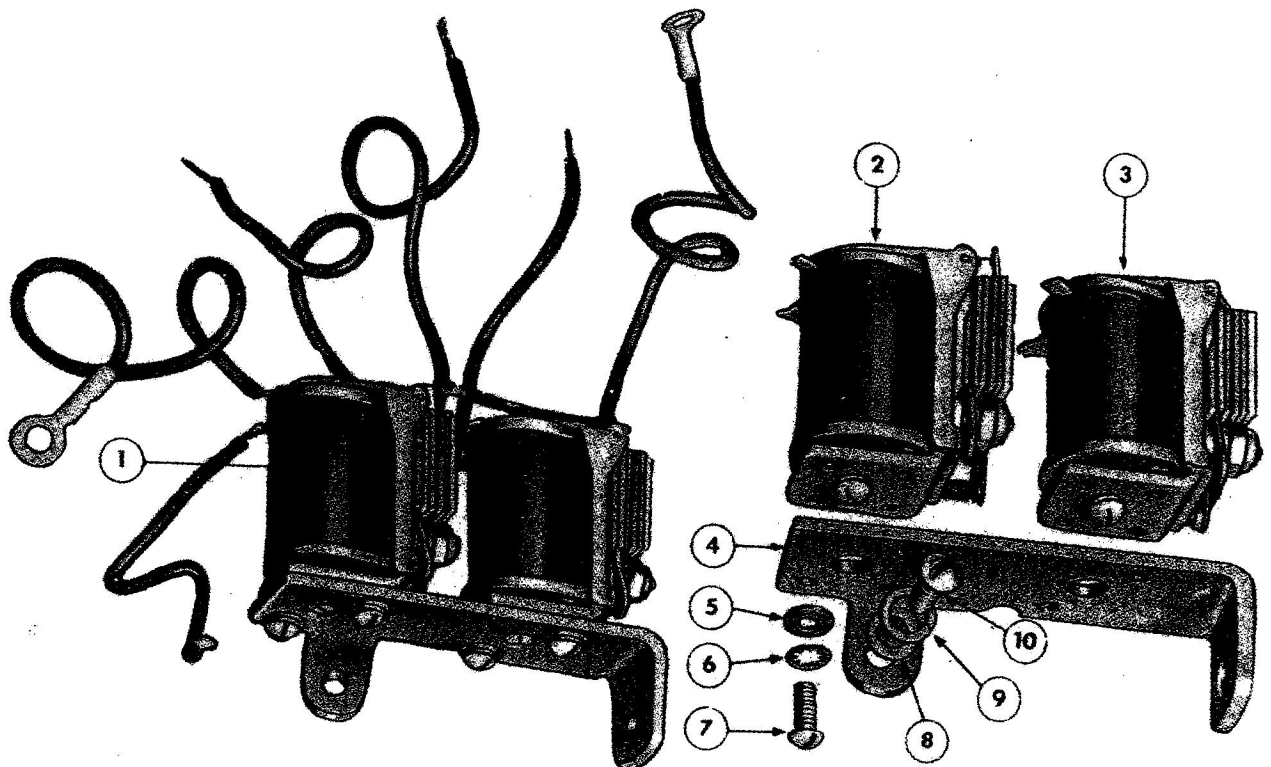


Figure 25—Auxiliary (Telephone-Type) Relay

Figure and Index Number	Part Number								NOMENCLATURE	U. S. Army	British Army	Units Per Assy
		1	2	3	4	5	6	7				
24 17	AN340-8								Nut—Hexagon, steel, cadmium plate, No. 8-32, stationary contact to terminal strap screw	6700	128	2
24 18	13D1708P1								Washer—Plain, steel, cadmium plate, No. 4, stationary right and left contact mounting screw	6500	128	4
24 19	AN935-4								Washer—Lock, steel, cadmium plate, No. 4, stationary right and left contact mounting screw	6700	128	4
24 20	AN515-4-6								Screw—Round head, machine, steel, cadmium plate, No. 4-40 x 3/8 in., stationary contact right mounting	6700	128	2
24 21	11D5770G1								Contact Assembly—Stationary right			1
24 22	11D5813G1								Contact Assembly—Stationary left			1
24 23	AN515-4-7								Screw—Mounting, stationary contact left			2
25 1	4C4893G1								Relay Assembly—Auxiliary	4246	105U	1
25 2	9D5823P1								Relay—Top, telephone type	4246	105U	1
25 3	9D5823P2								Relay—Bottom, telephone type	4246	105U	1
25 4	4C4880P1								Bracket—Mounting, relay	4246	105U	1
25 5	AN960-4								Washer—Plain, steel, cadmium plate, No. 4, relay attaching screw	6500	128	4
25 6	AN935-4								Washer—Lock, steel, cadmium plate, No. 4, relay attaching screw	6700	128	4
25 7	AN500-4-4								Screw—Flat head, steel, cadmium plate, No. 4-40 x 1/4 in., relay attaching	6700	128	4
25 8	AN960-6								Washer—Plain, steel, cadmium plate, No. 6, bracket to contactor screw	6500	128	1
25 9	AN935-6								Washer—Lock, steel, cadmium plate, No. 6, bracket to contactor screw	6700	128	1
25 10	AN515-6-4								Screw—Round head, steel, cadmium plate, No. 6-32 x 1/4 in., bracket to contactor attaching	6700	128	1