SECTION 16
ELECTRICAL SYSTEMS

TABLE OF CONTENTS

16-1. ELECTRICAL SYSTEMS.

16-2. GENERAL. This section contains service information necessary to maintain the Aircraft Electrical Power Supply System, Battery and External Power Supply System, Alternator Power System, Aircraft Lighting System, Pitot Heater, Stall Warning, Cigar Lighter and Electrical Load Analysis.

16-3. ELECTRICAL POWER SUPPLY SYSTEM.

16-4. DESCRIPTION. Electrical energy for the aircraft is supplied by a 14-volt, direct-current, single-wire, negative ground electrical system. A 12-volt battery supplies power for starting and furnishes a reserve source of power in the event of alternator failure. An engine-driven alternator is the normal source of power during flight and maintains a battery charge controlled by a voltage regulator. An external power source receptacle is offered as optional equipment to supplement the battery alternator system for starting and ground operation.

16-5. BUS BAR.

16-6. DESCRIPTION. Electrical power for electrical equipment and electronic installations is supplied through the split bus bar. The bus bar is interconnected by a jumper wire and attached to the circuit breakers on the lower, center of the instrument panel.

16-7. REMOVAL AND INSTALLATION. (Refer to figure 16-1).

16-8. MASTER SWITCH.

16-9. DESCRIPTION. The master switch controls the operation of the battery and alternator systems. The switch is a interlocking split rocker with the battery mode on the right hand side and the alternator mode on the left hand side. This arrangement allows the battery to be on the line without the alternator, however, operation of the alternator without the battery on the line is not possible. The switch is labeled "BAT" and "ALT" on the side of the switch and is located on the left hand side of the switch panel.

16-10. AMMETER.

16-11. DESCRIPTION. The ammeter is connected between the battery contactor and the bus bar. The meter indicates the amount of current flowing either to or from the battery. With a low battery and the engine operating at cruise speed the ammeter will show the fuel alternator output when all electrical equipment is off. When the battery is fully charged and cruise RPM is maintained with all electrical equipment off, the ammeter will show a minimum charging rate. The ammeter is located on the right hand side of the instrument panel.

16-12. BATTERY POWER SYSTEM.

16-13. TROUBLE SHOOTING THE BATTERY POWER SYSTEM.

TROUBLE	PROBABLE CAUSE	REMEDY
BATTERY WILL NOT SUPPLY POWER TO BUS OR IS INCAPABLE OF CRANKING ENGINE.	Battery discharged.	1. Measure voltage at "BAT" terminal of battery contactor with master switch and a suitable load such as a taxi light turned on. Normal battery will indicate 11.5 volts or more. If voltage is low, proceed to step 2. If voltage is normal, proceed to step 3.
	Battery faulty.	2. Check fluid level in cells and charge battery at 20 amps for approximately 30 minutes or until the battery voltage rises to 15 volts. Check battery with a load type tester. If tester indicates a good battery, the malfunction may be assumed to be a discharged battery. If the tester indicates a faulty battery, replace the battery.

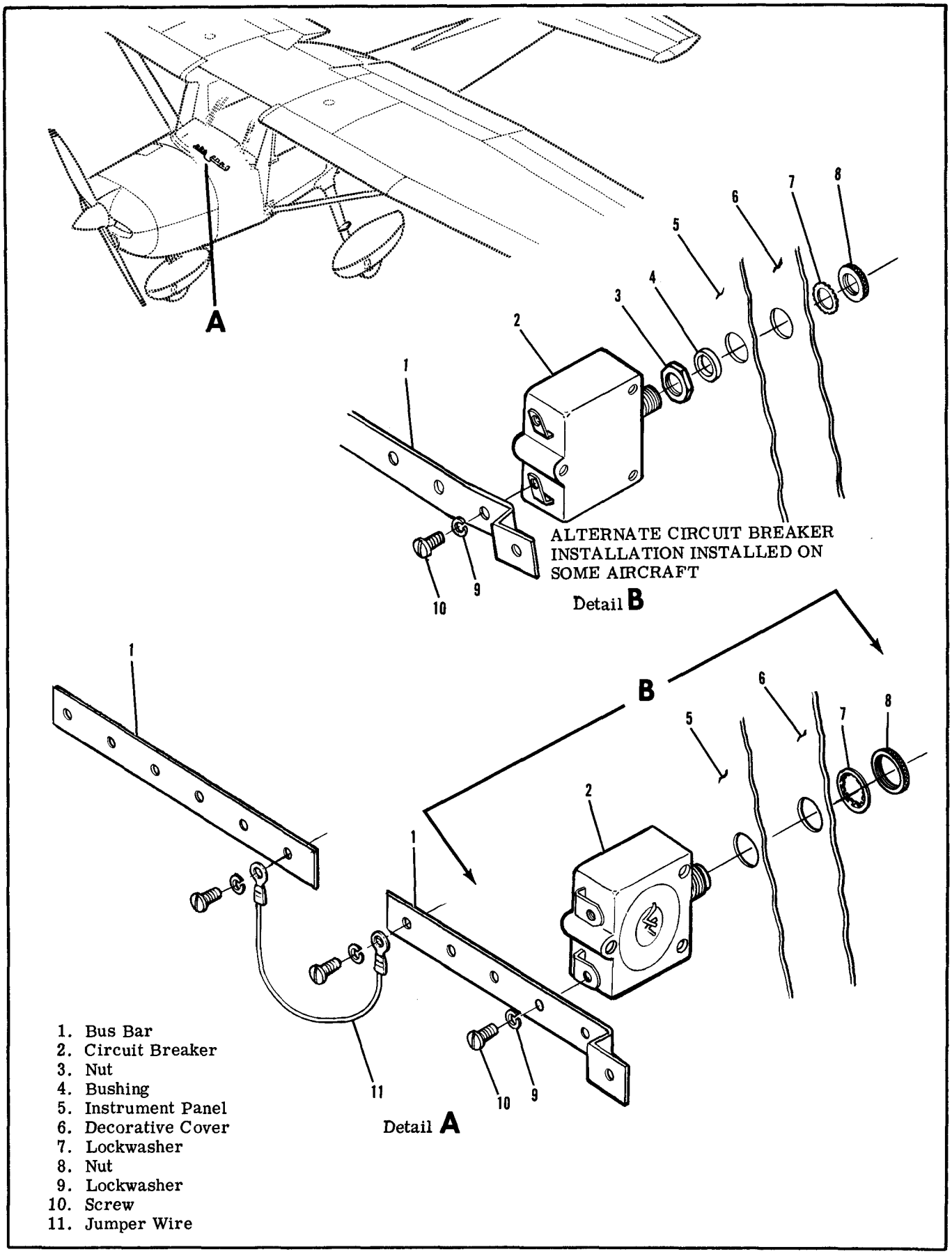


Figure 16-1. Bus Bar Installation

16-13. TROUBLE SHOOTING THE BATTERY POWER SYSTEM. (CONT.)

TROUBLE	PROBABLE CAUSE	REMEDY
BATTERY WILL NOT SUPPLY POWER TO BUS OR IS INCAPABLE OF CRANKING ENGINE. (CONT.)	Faulty contactor or wiring between contactor or master switch.	3. Measure voltage at master switch terminal (smallest) on contactor with master switch closed. Normal indication is zero volts. If voltage reads zero, proceed to step 4. If a voltage reading is obtained check wiring between contactor and master switch. Also check master switch.
	Open coil on contactor.	4. Check continuity between "BAT" terminal and master switch terminal of contactor. Normal indication is 16 to 24 ohms (Master switch open). If ohmmeter indicates an open coil, replace contactor. If ohmmeter indicates a good coil, proceed to step 5.
	Faulty contactor contacts.	5. Check voltage on "BUS" side of contactor with master switch closed. Meter normally indicates battery voltage. If voltage is zero or intermittant, replace contactor. If voltage is normal, proceed to step 6.
	Faulty wiring between contactor and bus.	6. Inspect wiring between contactor and bus. Repair or replace wiring.

16-14. BATTERY.

16-15. DESCRIPTION. The battery is 12 volts and is approximately 25 ampere-hour capacity. The battery is mounted on the forward side of the firewall and is equipped with non-spill filler caps.

16-16. REMOVAL AND INSTALLATION (Refer to figure 16-2.)

a. Remove top half of cowl.
b. Remove the battery box cover.
c. Disconnect the ground cable from the negative battery terminal.

CAUTION

- When installing or removing battery always observe the proper polarity with the aircraft electrical system (negative to ground). Reversing the polarity, even momentarily, may result in failure of semiconductor devices (alternator diodes, radio protection diodes and radio transistors).

- Always remove the battery ground cable first and replace it last to prevent accidental short circuits.

d. Discount the cable from the positive terminal of the battery.
e. Lift the battery out of the battery box.
f. To replace the battery, reverse this procedure.

16-17. CLEANING THE BATTERY. For maximum efficiency the battery and connections should be kept clean at all times.

a. Remove the battery and connections in accordance with the preceding paragraph.
b. Tighten battery cell filler caps to prevent the cleaning solution from entering the cells.
c. Wipe the battery cable ends, battery terminals and the entire surface of the battery with a clean cloth moistened with a solution of bicarbonate of soda (baking soda) and water.
d. Rinse with clear water, wipe off excess water and allow battery to dry.
e. Brighten up cable ends and battery terminals with emery cloth or a wire brush.
f. Install the battery according to the preceding paragraphs.
g. Coat the battery terminals with petroleum jelly or an ignition spray product to reduce corrosion.

16-18. ADDING ELECTROLYTE OR WATER TO THE BATTERY. A battery being charged and discharged

with use will decompose the water from the electrolyte by electrolysis. When the water is decomposed hydrogen and oxygen gases are formed which escape into the atmosphere through the battery vent system. The acid in the solution chemically combines with the plates of the battery during discharge or is suspended in the electrolyte solution during charge. Unless the electrolyte has been spilled from a battery, acid should not be added to the solution. The water, however will decompose into gases and should be replaced regularly. Add distilled water as necessary to maintain the electrolyte level with the horizontal baffle plate or the split ring on the filler neck inside the battery. When "dry charged" batteries are put into service fill as directed with electrolyte. When the electrolyte level falls below normal with use, add only distilled water to maintain the proper level. The battery electrolyte contains approximately 25% sulphuric acid by volume. Any change in this volume will hamper the proper operation of the battery.

CAUTION

Do not add any type of "battery rejuvenator" to the electrolyte. When acid has been spilled from a battery, the acid balance may be adjusted by following instructions published by the Association of American Battery Manufacturers.

16-19. TESTING THE BATTERY. The specific gravity of the battery may be measured with a hydrometer to determine the state of battery charge. If the hydrometer reading is low, slow-charge the battery and retest. Hydrometer readings of the electrolyte must be compensated for the temperature of the electrolyte. Some hydrometers have a built-in thermometer and conversion chart. The following chart shows the battery condition for various hydrometer readings with an electrolyte temperature of 80° Fahrenheit.

BATTERY HYDROMETER READINGS

READINGS	BATTERY CONDITION
1.280 Specific Gravity	100% Charged
1.250 Specific Gravity	75% Charged
1.220 Specific Gravity	50% Charged
1.190 Specific Gravity	25% Charged
1.160 Specific Gravity	Practically Dead

NOTE

All readings shown are for an electrolyte temperature of 80° Fahrenheit. For higher temperatures the readings will be slightly lower. For cooler temperatures the readings will be slightly higher. Some hydrometers will have a built-in temperature compensation chart and a thermometer. If this type tester is used, disregard this chart.

If a specific gravity reading indicates that the battery is not fully charged, the battery should be charged at approximately 20 amperes for 30 minutes, or until the battery voltage rises to 15 volts. After charging, a load type tester will give more meaningful results. A specific gravity check can be used after charging but the check cannot spot cells which short under load, broken connectors between plates of a cell, etc.

16-20. CHARGING THE BATTERY. When the battery is to be charged, the level of the electrolyte should be checked and adjusted by adding distilled water to cover the tops of the internal battery plates. Remove the battery from the aircraft and place in a well ventilated area for charging.

SHOP NOTES:

WARNING

When a battery is being charged, hydrogen and oxygen gases are generated. Accumulation of these gases can create a hazardous explosive condition. Always keep sparks and open flame away from the battery. Allow unrestricted ventilation of the battery area during charging.

The main points of consideration during a battery charge are excessive battery temperature and violent gassing. Under a reasonable rate of charge (20 amperes or less) the battery temperature should not rise over 125°F, nor should gassing be so violent that acid is blown from the vents.

16-21. BATTERY BOX.

16-22. DESCRIPTION. The battery box is constructed of metal and painted inside and out with acid-proof paint. The box is attached to the right hand side of the firewall. A vent tube is attached to the bottom of the box and extends below the firewall to allow gases and spilled acid to be vented overboard.

16-23. REMOVAL AND INSTALLATION. (Refer to figure 16-2.) The battery box is not considered as a removable item except for replacement purposes. The box is riveted to mounting brackets on the firewall. Should the battery box be removed, on installation of the box or a new box, all rivets and scratches should be painted with acid-proof lacquer, Part No. CES1054-381, available from the Cessna Service Parts Center.

16-24. MAINTENANCE. The battery box should be inspected and cleaned periodically. The box and cover should be cleaned with a strong solution of bicarbonate of soda (baking soda) and water. Hard deposits may be removed with a wire brush. When all corrosive deposits have been removed from the box, flush it thoroughly with clean water.

SHOP NOTES:

WARNING

Do not allow acid deposits to come in contact with skin or clothing. Serious acid burns may result unless the affected area is washed immediately with soap and water. Clothing will be ruined upon contact with battery acid.

Inspect the cleaned box and cover for physical damage and for areas lacking proper acid proofing. A badly damaged or corroded box should be replaced. If the box or lid require acid proofing, paint the area with acid proof lacquer, Part No. CES1054-381, available from the Cessna Service Parts Center.

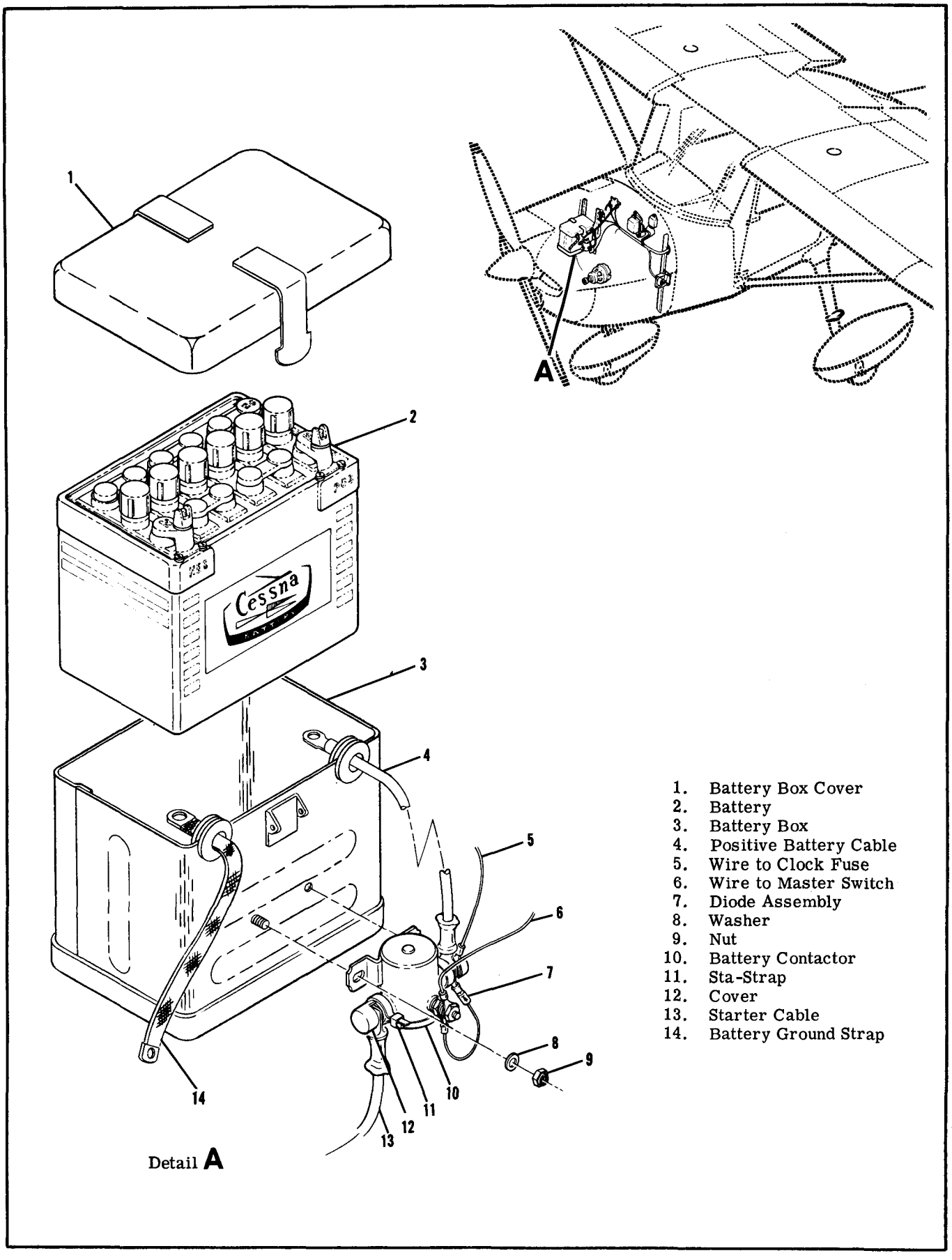
16-25. BATTERY CONTACTOR.

16-26. DESCRIPTION. The battery contactor is a plunger type and is actuated by turning on the master switch. The contactor is bolted to the inboard side of the battery box. A silicon diode is installed to eliminate spiking of transistorized radio equipment when the contactor is closed. Nylon covers are installed on the terminals to prevent accidental short circuits.

16-27. REMOVAL AND INSTALLATION. (Refer to figure 16-2.)

a. Place master switch in the OFF position.
b. Open battery box and disconnect ground cable from negative battery terminal. Pull cable clear of battery box.
c. Cut sta-straps and remove nylon covers from terminals on contactor.
d. Remove nuts, lockwashers and plain washers securing the battery cables to the contactor.
e. Remove nut, lockwasher and plain washers securing master switch wire to contactor.
f. Remove nuts, washers, and bolts securing the contactor to the battery box and remove contactor.
g. To install battery contactor reverse the preceding steps.

16-28. BATTERY CONTACTOR CLOSING CIRCUIT. The battery contactor closing circuit consists of a 5 amp fuse, a resistor and a diode installed across the battery contactor. This serves to shunt a small charge around the battery contactor when the battery is too dead to energize the contactor by itself.



1. Battery Box Cover
2. Battery
3. Battery Box
4. Positive Battery Cable
5. Wire to Clock Fuse
6. Wire to Master Switch
7. Diode Assembly
8. Washer
9. Nut
10. Battery Contactor
11. Sta-Strap
12. Cover
13. Starter Cable
14. Battery Ground Strap

Figure 16-2. Battery, Battery Box and Battery Contactor Installation

16-29. GROUND SERVICE RECEPTACLE.

16-30. DESCRIPTION. A ground service receptacle may be installed to permit the use of external power for cold weather starting or when performing lengthy electrical maintenance. The receptacle is mounted on the left hand side of the firewall with an access door in the engine cowl.

NOTE

Before connecting an external power source, it is important that the master switch be turned "ON". This will close the battery contactor and enable the battery to absorb transient voltages which otherwise might damage the electronic equipment. It will also provide excitation of the alternator field in the event that the battery is completely dead.

16-31. REMOVAL AND INSTALLATION. (Refer to figure 16-3.)

a. Remove engine cowl in accordance with Section 11.

b. Open battery box and disconnect the ground cable from the negative terminal of the battery and pull cable from the battery box.

c. Remove the nuts, washers and ground strap from the terminals of the receptacle and remove the battery cable.

d. Remove the screws and nuts securing the receptacle to the mounting bracket. Remove receptacle.

e. To install ground service receptacle, reverse the preceding steps. Be sure to place the ground strap on the negative stud of the receptacle.

16-32. ALTERNATOR POWER SYSTEM.

16-33. DESCRIPTION. The alternator system consists of an engine driven alternator, a voltage regulator mounted on the left hand side of the firewall and a circuit breaker located on the instrument panel. The system is controlled by the left hand portion of the split rocker, master switch labeled "ALT." A over-voltage sensor switch and red warning light labeled "HIGH VOLTAGE" are incorporated to protect the system, (refer to paragraph 16-40). The aircraft battery supplies the source of power for excitation of the alternator.

16-34. ALTERNATOR.

16-35. DESCRIPTION. The alternator is three phase, delta connected with integral silicon diode rectifiers. The alternator is rated at 14 volts at 60 amperes continuous output. The moving center part of the alternator (rotor) consists of an axial winding with radial interlocking poles which surround the winding. With excitation applied to the winding through slip rings the pole pieces assume magnetic polarity. The rotor is mounted in bearings and rotates inside the stator which contains the windings in which ac is generated. The stator windings are three-phase, delta connected and are attached to two diode plates, each of which contains three silicon diodes. The diode plates are connected to accomplish full-wave, rectification of ac. The resulting dc output is applied ot the aircraft bus and sensed by the voltage regulator. The regulator controls the excitation applied to the alternator field thus controlling the output of the alternator.

16-36. REMOVAL AND INSTALLATION. (Refer to figure 16-4.)

a. Ensure that master switch is off and the negative lead is disconnected from the battery.

b. Remove wiring from the alternator and label.

c. Remove screw and nut holding blast tube to support strap clamp, blast tube will then be free for removal.

d. Remove nuts and washers from alternator mounting bolts.

e. Remove alternator.

f. To replace alternator, reverse this procedure.

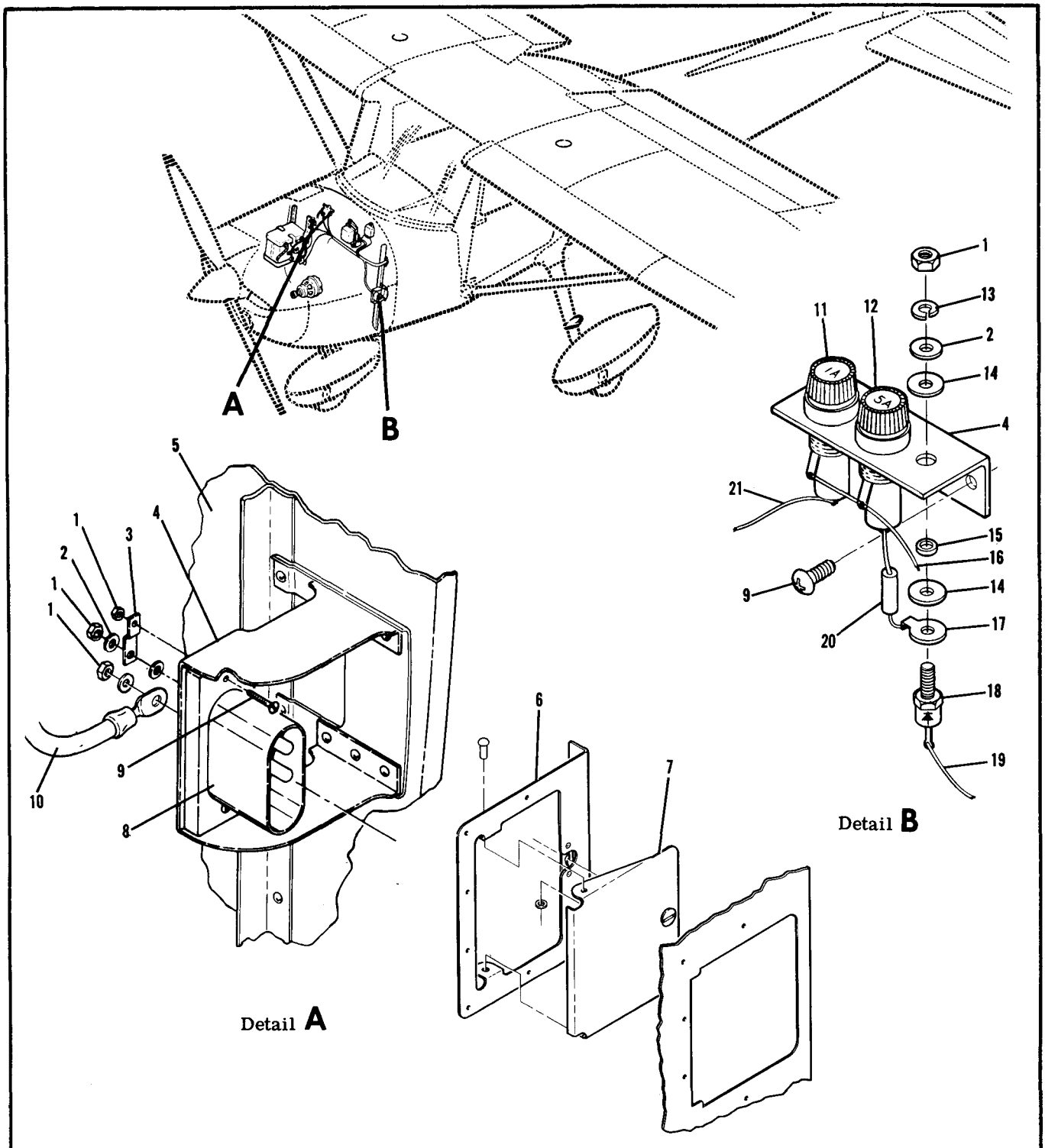
16-37. ALTERNATOR FIELD PROTECTION.

16-38. DESCRIPTION. A 2-amp automatic resetting circuit breaker located on the left hand, stationary instrument panel stiffner, is provided to protect the alternator field circuit.

16-39. ALTERNATOR REVERSE VOLTAGE DAMAGE. The alternator is ver susceptible to reverse polarity current because of the silicon diodes. The diodes, having a very high resistance to reverse current flow, are used without any cutout relay such as used on a generator system. The alternator diodes are arranged with their cathodes connected to the aircraft bus bar which is positive and no back current will flow. If the polarity of the battery is reversed, the diodes will offer no resistance to the current flow. The current rating of the diodes is exceeded and diode failure may result.

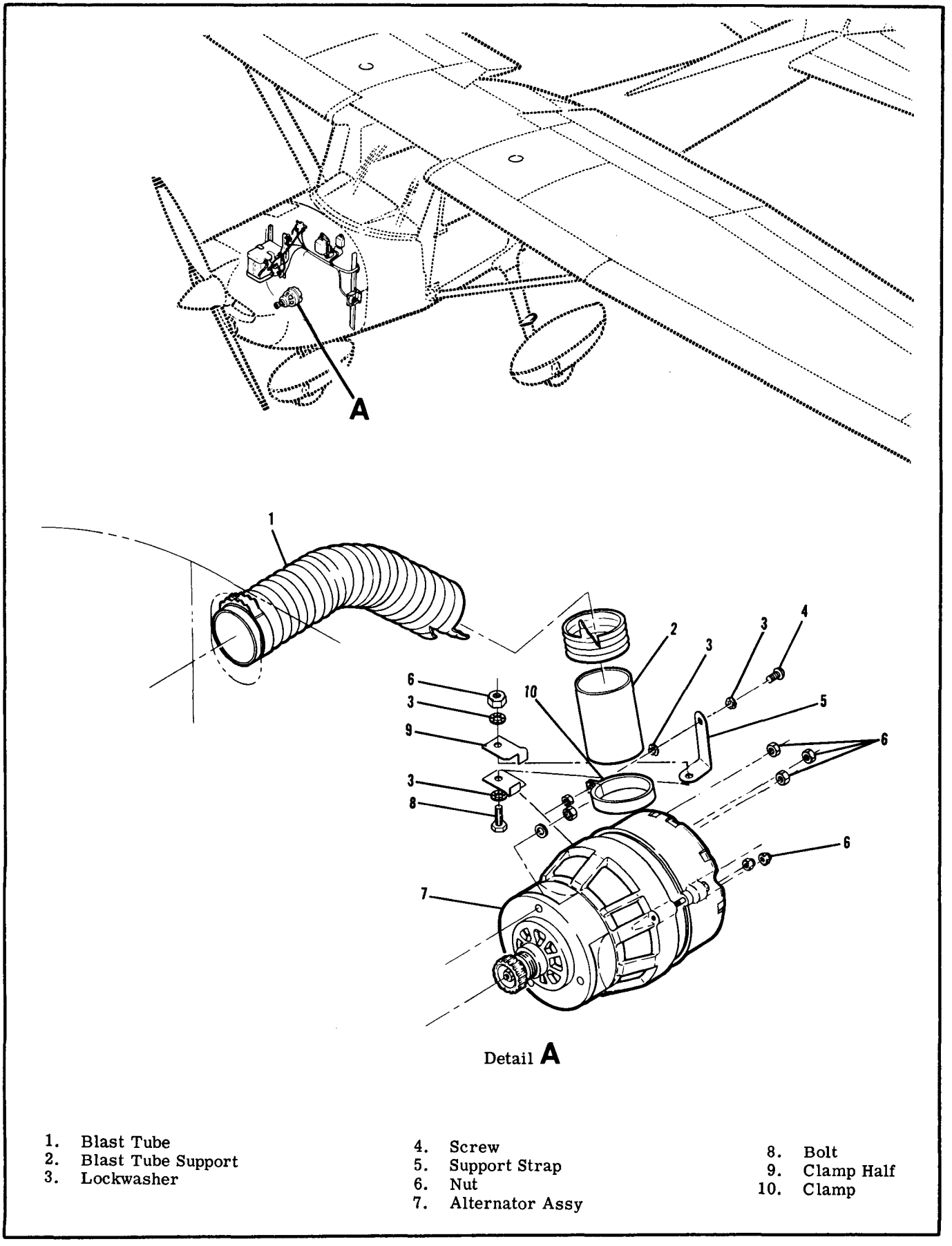
16-40. OVER-VOLTAGE WARNING SYSTEM

16-41. DESCRIPTION. The over-voltage system consists of an over-voltage sensor switch and a red warning light labeled "HIGH VOLTAGE". The over-voltage sensor is attached to the wire bundle behind the instrument panel and the light is located on the right hand side of the instrument panel. When an over-voltage tripoff occurs the over-voltage sensor turns off the alternator system and the red warning light comes on. The ammeter will show a discharge. Turn off both sections of the master switch to recycle the over-voltage sensor. If the over-voltage condition was transient, the normal alternator charging will resume and no further action is necessary. If the over-voltage tripoff recurs, then a generating system malfunction has occurred such that the electrical accessories must be operated from the aircraft battery only. Conservation of electrical energy must be practiced until the flight can be terminated. The over-voltage light filament may be tested at any time by turning off the "Alternator" portion of the master switch and leaving the battery portion on. This test does not induce an over-voltage condition on the electrical system.



1. Nut
2. Washer
3. Ground Strap
4. Bracket
5. Firewall
6. Doubler
7. Access Door
8. Receptacle
9. Screw
10. Power Cable
11. Fuse-Clock
12. Fuse-Battery Contactor Closing Circuit
13. Lockwasher
14. Insulating Washer
15. Spacer
16. Wire to Battery Contactor (Bat. Side)
17. Solder Terminal
18. Diode
19. Wire to Battery Contactor
20. Resistor
21. Wire to Clock

Figure 16-3. Ground Service Receptacle and Battery Contactor Closing Circuit Installation



1. Blast Tube
2. Blast Tube Support
3. Lockwasher
4. Screw
5. Support Strap
6. Nut
7. Alternator Assy
8. Bolt
9. Clamp Half
10. Clamp

Figure 16-4. Alternator Installation

NOTE

The over-voltage sensor switch contains solid state devices. Observe proper polarity before supplying power. Grounding the orange lead or interconnecting orange and black leads will destroy the device. When removal is required for replacement, identify (tag) wiring and follow the wiring diagram in Section 20 for rewiring.

16-42. TROUBLE SHOOTING THE ALTERNATOR SYSTEM.

TROUBLE	PROBABLE CAUSE	REMEDY
AMMETER INDICATES HEAVY DISCHARGE WITH ENGINE NOT RUNNING OR ALTERNATOR CIRCUIT BREAKER OPENS WHEN MASTER SWITCH IS TURNED ON.	Shorted radio noise filter or shorted wire.	1. Remove cable from output terminal of alternator. Check resistance from end of cable to ground (MASTER SWITCH MUST BE OFF). If resistance does not indicate a direct short, proceed to step 4. If resistance indicates a direct short, proceed to step 2.
		2. Remove cable connections from radio noise filter. Check resistance from the filter input terminal to ground. Normal indication is infinite resistance. If reading indicates a direct short, replace filter. If no short is evident, proceed to step 3.
		3. Check resistance from ground to the free ends of the wires which were connected to the radio noise filter (or alternator if no noise filter is installed). Normal indication does not show a direct short. If a short exists in wires, repair or replace wiring.
	Shorted diodes in alternator.	4. Check resistance from output terminal of alternator to alternator case. Reverse leads and check again. Resistance reading may show continuity in one direction but should show an infinite reading in the other direction. If an infinite reading is not obtained in at least one direction, repair or replace alternator.

16-42. TROUBLE SHOOTING THE ALTERNATOR SYSTEM (Cont).

TROUBLE	PROBABLE CAUSE	REMEDY
ALTERNATOR SYSTEM WILL NOT KEEP BATTERY CHARGED.	Regulator faulty or improperly adjusted.	1. Start engine and adjust for 1500 RPM. Ammeter should indicate a heavy charge rate with all electrical equipment turned off. Rate should taper off in 1-3 minutes. A voltage check at the bus should indicate a reading consistant with the voltage vs temperature chart in the Cessna Alternator Charging Systems Service/Parts Manual. If charge rate tapers off very quickly and voltage is normal, check battery for malfunction. If ammeter shows a low charge rate or any discharge rate, and voltage is low, proceed to step 2.
		2. Stop engine, remove cowl, and remove cover from voltage regulator. Turn master switch ON/OFF several times and observe field relay in regulator. Relay should open and close with master switch and small arc should be seen as contacts open. If relay is inoperative, proceed to step 3. If relay operates, proceed to step 4.
		3. Check voltage at "S" terminal of regulator with master switch closed. Meter should indicate bus voltage. If voltage is present, replace regulator. If voltage is not present check wiring between regulator and bus.
		4. Remove plug from regulator and start engine. Momentarily jumper the "A+" and "F" terminals together on the plug. Ship's ammeter should show heavy rate of charge. If heavy charge rate is observed, replace regulator. If heavy charge rate is not observed, proceed to step 5.
	Faulty wiring between alternator and regulator, or faulty alternator.	5. Check resistance from "F" terminal of regulator to "F" terminal of alternator. Normal indication is a very low resistance. If reading indicates no, or poor continuity, repair or replace wiring from regulator to alternator.

16-42. TROUBLE SHOOTING THE ALTERNATOR SYSTEM (Cont).

TROUBLE	PROBABLE CAUSE	REMEDY
ALTERNATOR SYSTEM WILL NOT KEEP BATTERY CHARGED (Cont).	Faulty wiring between alter-	6. Check resistance from "F" terminal of alternator to alternator case. Normal indication is 6-7 ohms. If resistance is high or low, repair or replace alternator.
		7. Check resistance from case of alternator to airframe ground. Normal indication is very low resistance. If reading indicates no, or poor continuity, repair or replace alternator ground wiring.
ALTERNATOR OVERCHARGES BATTERY - BATTERY USES EXCESSIVE WATER.	Regulator faulty or improperly adjusted.	Check bus voltage with engine running. Normal indication agrees with voltage vs temperature chart in the Cessna Alternator Charging Systems Service/Parts Manual. Observe ships ammeter, ammeter should indicate near zero after a few minutes of engine operation. Replace regulator.
OVER-VOLTAGE WARNING LIGHT ON.	Regulator faulty or improperly adjusted. Faulty sensor switch.	1. With engine running turn off and on battery portion of the master switch. If the light stays on shut down engine then turn on the "BAT" and "ALT" portions of the master switch. Check for voltage at the "S" terminal of the voltage regulator. If voltage is present adjust or replace regulator. If voltage is not present check master switch and wiring for short or open condition. If wiring and switch are normal replace sensor.

16-43. VOLTAGE REGULATOR.

16-44. DESCRIPTION. The voltage regulator is a semi-solid state regulator. The field relay in the regulator is a mechanical type and the voltage limiter portion of the regulator is solid state. The regulator is a remove and replace item and not repairable.

16-45. REMOVAL AND INSTALLATION. (Refer to figure 16-5).

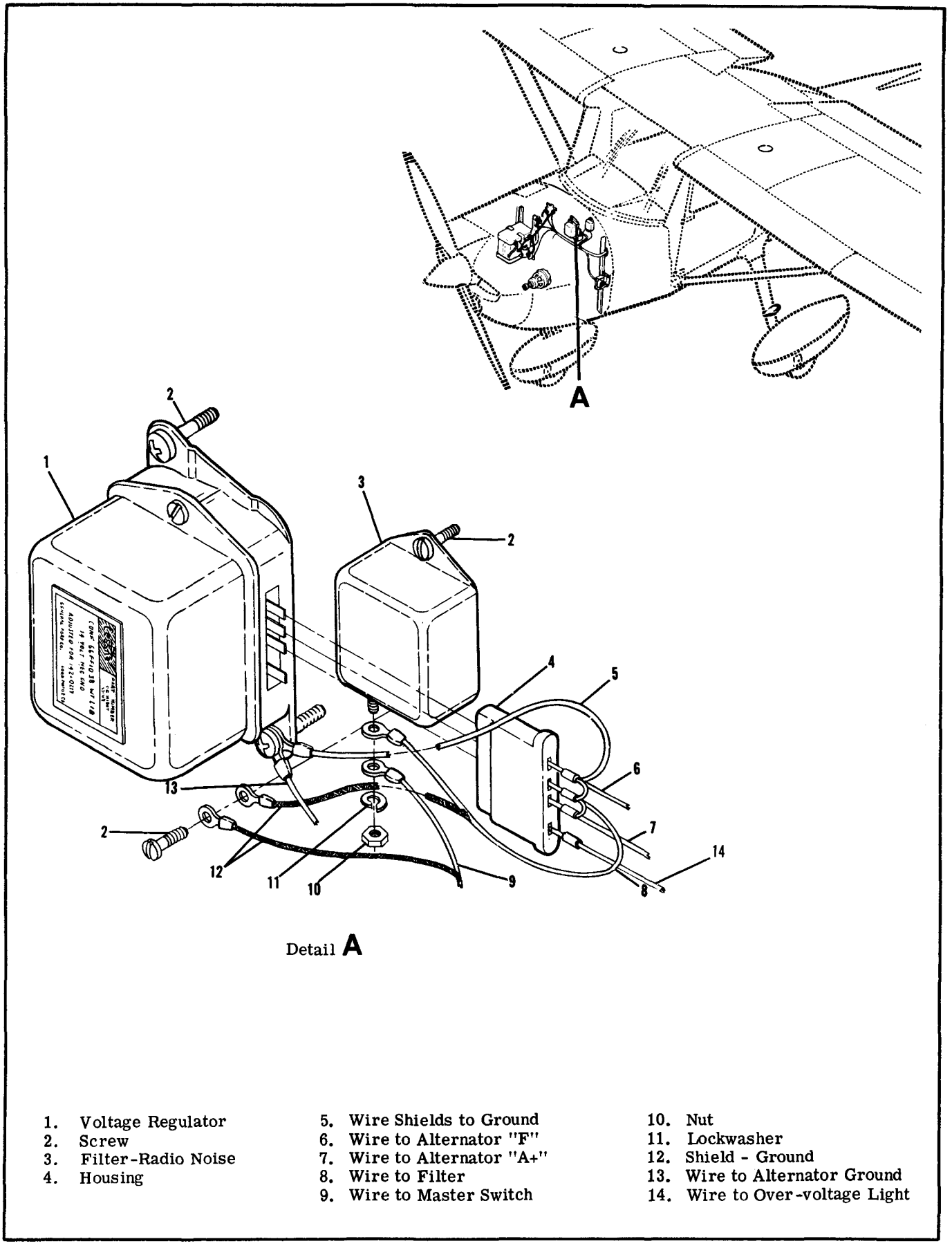
a. Make sure the master switch is in the OFF position.

b. Disconnect the negative lead from the battery and pull lead free of the battery box.

c. Remove the connector plug from the regulator.

d. Remove two screws securing the regulator to the firewall.

e. To install the regulator, reverse the preceding steps. Be sure the connections for grounding the alternator, wiring shields and the base of the regulator are clean and bright before assembly. Otherwise, faulty voltage regulation and/or excessive radio noise may result.



Detail **A**

1. Voltage Regulator
2. Screw
3. Filter-Radio Noise
4. Housing
5. Wire Shields to Ground
6. Wire to Alternator "F"
7. Wire to Alternator "A+"
8. Wire to Filter
9. Wire to Master Switch
10. Nut
11. Lockwasher
12. Shield - Ground
13. Wire to Alternator Ground
14. Wire to Over-voltage Light

Figure 16-5. Voltage Regulator Installation

16-46. AIRCRAFT LIGHTING SYSTEM.

16-47. DESCRIPTION. The aircraft lighting systems consists of landing and taxi lights, navigation lights, anti-collision strobe lights, flashing beacon light, dome and instrument flood lights, control wheel map light, compass and radio dial lights.

16-48. TROUBLE SHOOTING.

TROUBLE	PROBABLE CAUSE	REMEDY
LANDING AND TAXI LIGHT(s) OUT.	Short circuit in wiring.	1. Inspect circuit breaker. If open, proceed to step 2. If OK, proceed to step 3.
	Defective wiring.	2. Test each circuit separately until short is located. Repair or replace wiring.
	Defective switch.	3. Check voltage at lights with master and landing and taxi light switches ON. Should read battery voltage. Replace switch.
LANDING AND/OR TAXI LIGHT OUT.	Lamp burned out.	1. Test lamp with ohmeter or new lamp. Replace lamp.
	Open circuit in wiring.	2. Test wiring for continuity. Repair or replace wiring.
FLASHING BEACON DOES NOT LIGHT.	Short circuit in wiring.	1. Inspect circuit breaker. If open, proceed to step 2. If OK, proceed to step 3.
	Defective wiring.	2. Test circuit until short is located. Repair or replace wiring.
	Lamp burned out.	3. Test lamp with ohmmeter or a new lamp. Replace lamp. If lamp is good, proceed to step 4.
	Open circuit in wiring.	4. Test circuit from lamp to flasher for continuity. If no continuity is present, repair or replace wiring. If continuity is present, proceed to step 5.
	Defective switch.	5. Check voltage at flasher with master and beacon switch on. Should read battery voltage. Replace switch. If voltage is present, proceed to step 6.
	Defective flasher.	6. Install new flasher.

16-48. TROUBLE SHOOTING (Cont.)

TROUBLE	PROBABLE CAUSE	REMEDY
FLASHING BEACON CONSTANTLY LIT.	Defective flasher.	1. Install new flasher.
ALL NAV LIGHTS OUT.	Short circuit in wiring.	1. Inspect circuit breaker. If open, proceed to step 2. If OK, proceed to step 3.
	Defective wiring.	2. Isolate and test each nav light circuit until short is located. Repair or replace wiring.
	Defective switch.	3. Check voltage at nav light with master and nav light switches on. Should read battery voltage. Replace switch.
ONE NAV LIGHT OUT.	Lamp burned out.	1. Inspect lamp. Replace lamp.
	Open circuit in wiring.	2. Test wiring for continuity. Repair or replace wiring.
WARNING The anti-collision system is a high voltage device. Do not remove or touch tube assembly while in operation. Wait at least 5 minutes after turning off power before starting work.		
BOTH ANTI-COLLISION STROBE LIGHTS WILL NOT LIGHT.	Open circuit breaker.	1. Check, if open reset. If circuit breaker continues to open proceed to step 2.
		2. Disconnect red wire between aircraft power supply (battery/external power) and strobe power supplies, one at a time. If circuit breaker opens on one strobe power supply. If circuit breaker opens on both strobe power supplies proceed to step 3. If circuit breaker does not open proceed to step 4.
		3. Check aircraft wiring. Repair or replace as necessary.
		4. Inspect strobe power supply ground wire for contact with wing structure.

16-48. TROUBLE SHOOTING (Cont).

TROUBLE	PROBABLE CAUSE	REMEDY
	CAUTION Extreme care should be taken when exchanging flash tube. The tube is fragile and can easily be cracked in a place where it will not be obvious visually. Make sure the tube is seated properly on the base of the nav light assembly and is centered in the dome. NOTE When checking defective power supply and flash tube, units from opposite wing may be used. Be sure power leads are protected properly when unit is removed to prevent short circuit.	
ONE ANTI-COLLISION STROBE LIGHT WILL NOT LIGHT.	Defective Strobe Power Supply, or flash tube.	1. Connect voltmeter to red lead between aircraft power supply (battery/external power) and strobe power supply, connecting negative lead to wing structure. Check for 12 volts. If OK proceed to step 2. If not, check aircraft power supply (battery/external power).
		2. Replace flash tube with known good flash tube. If system still does not work, replace strobe power supply.
DOME LIGHT TROUBLE.	Short circuit in wiring.	1. Inspect circuit breaker. If circuit breaker is open, proceed to step 2. If circuit breaker is OK, proceed to step 3.
	Defective wiring.	2. Test circuit until short is located. Repair or replace wiring.
		3. Test for open circuit. Repair or replace wiring. If no short or open circuit is found, proceed to step 4.
	Lamp burned out.	4. Test lamp with ohmeter or new lamp. Replace lamp.
	Defective switch.	5. Check for voltage at dome light with master and dome light switch on. Should read battery voltage. Replace switch.

16-48. TROUBLE SHOOTING (Cont).

TROUBLE	PROBABLE CAUSE	REMEDY
INSTRUMENT LIGHTS WILL NOT LIGHT.	Short circuit in wiring.	1. Inspect circuit breaker. If open, proceed to step 2. If OK, proceed to step 3.
	Defective wiring.	2. Test circuit until short is located. Repair or replace wiring.
		3. Test for open circuit. Repair or replace wiring. If no short or open circuit is found, proceed to step 4.
	Defective rheostat.	4. Check voltage at instrument light with master switch on. Should read battery voltage with rheostat turned full clockwise and voltage should decrease as rheostat is turned counterclockwise. If no voltage is present or voltage has a sudden drop before rheostat has been turned full counterclockwise, replace rheostat.
	Lamp burned out.	5. Test lamp with ohmmeter or new lamp. Replace lamp.
CONTROL WHEEL MAP LIGHT WILL NOT LIGHT	Nav light switch turned off.	1. Nav light switch has to be ON before map light will light.
	Short circuit in wiring.	2. Check lamp fuse on terminal board located on back of stationary panel with ohmmeter. If fuse is open, proceed to step 3. If fuse is OK, proceed to step 4.
	Defective wiring.	3. Test circuit until short is located. Repair or replace wiring.
		4. Test for open circuit. Repair or replace wiring. If a short or open circuit is not found, proceed to step 5.
	Defective map light assembly.	5. Check voltage at map light assembly with master and nav switches on. If battery voltage is present, replace map light assembly.

16-49. LANDING AND TAXI LIGHT.

16-50. DESCRIPTION. The landing and taxi light is mounted in the nose cap of the lower half of the engine cowl. This position facilitates the use of one lamp or both a landing and taxi light. A light cover provides weather protection for the lamp. The landing and taxi light is controlled by a rocker type switch located on the instrument panel. A circuit breaker is used to protect the landing and taxi light circuit.

16-51. REMOVAL AND INSTALLATION. (Refer to figure 16-6).

a. Remove screws (1) and washers (2) securing cover (3) to nose cap (9) and remove cover.
b. Remove screws (4) through bracket (5) and remove light assembly from support bracket (8). Note position and number of washer between plate (7) and support bracket (8).
c. Disconnect electrical leads from lamp (6) and remove lamp assembly.
d. Remove screws (13) from bracket (5) and remove lamp.
e. To install landing and taxi light, install new lamp (6) between bracket(s) and plate (7). A minimum of one gasket (12) and a maximum of two may be used to secure lamp.
f. Connect electrical leads to lamp.
g. Secure lamp assembly to bracket (8) with screws (4). Be sure washers (10) are installed in the same position as prior to removal.
h. Secure cover (3) to nose cap (9) with screws (1) and washers (2).

16-52. DUAL LANDING AND TAXI LIGHTS.

16-53. DESCRIPTION. The landing and taxi lights are mounted in the nose cap of the lower half of the engine cowl. The left lamp is used for taxiing and the right for landing. The lamps are controlled by a dual switch assembly with individual operating rocker type switches located on the instrument panel.

16-54. REMOVAL AND INSTALLATION. (Refer to figure 16-6).

a. Remove screws (11) securing bracket assembly (1) to nose cap (8).
b. Pull bracket assembly (1) forward from nose cap (8) and disconnect electrical leads from lamps.
c. Remove screws (7) securing lamp assembly being removed to bracket assembly (1) and remove lamp assembly. Be sure to note position of washers and spacer on taxi light if taxi light is being removed.
d. Remove screws (2) securing bracket (3) to plate (6) and remove lamp (4).
e. To install landing or taxi light, install new lamp (4) between bracket (3) and plate (6). A minimum of one gasket (5) and a maximum of two may be used to secure lamp.
f. Connect electrical leads to lamps.
g. Secure lamp assembly or assemblies removed to bracket assembly (1) with screws (7). Be sure washers (9) and spacer (10) are installed in the same position as prior to removal if the taxi light is being installed.
h. Connect electrical leads to lamps.
i. Secure bracket assembly (1) to nose cap (8) with screws (11).

16-55. NAVIGATION LIGHTS.

16-56. DESCRIPTION. The navigation lights are attached to the wing tips and the aft end of the vertical fin tip. The lamps are controlled by a rocker type switch located on the instrument panel. A circuit breaker is installed to protect the circuit.

16-57. REMOVAL AND INSTALLATION. For removal and installation of navigation lights refer to figure 16-7.

16-58. ANTI-COLLISION STROBE LIGHTS.

16-59. DESCRIPTION. A white strobe light may be installed on each wing tip with the navigation lights. Strobe lights are vibration resistant and operate on the principle of a capacitor discharge into a xenon tube, producing an extremely high intensity flash. Energy is supplied to the lights from individual power supplies mounted on each wing tip rib.

16-60. REMOVAL AND INSTALLATION. For removal and installation of strobe light and power supply refer to figure 16-7.

WARNING

The anti-collision system is a high voltage device. Do not remove or touch tube assembly while in operation. Wait at least 5 minutes after turning off power before starting work.

16-61. OPERATIONAL REQUIREMENTS.

CAUTION

The capacitors in the strobe light power supplies must be reformed if not used for a period of (6) months. The following procedure must be used.

Connect the power supply, red wire to plus, black to ground to 6 volt DC source. Do Not connect strobe tube. Turn on 6 volt supply. Note current draw after one minute. If less than 1 ampere, continue opera-

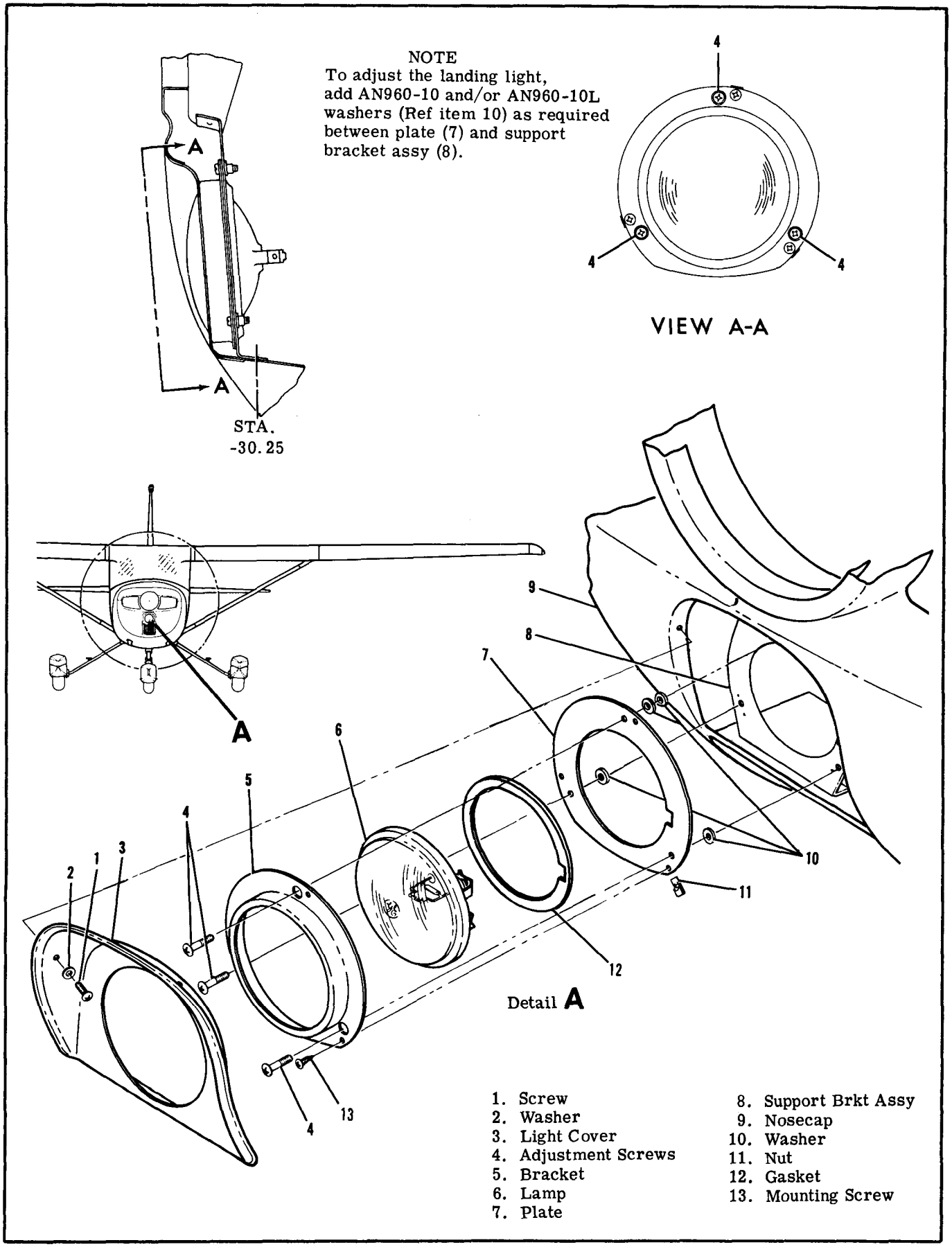


Figure 16-6. Landing and Taxi Light Installation (Sheet 1 of 2)

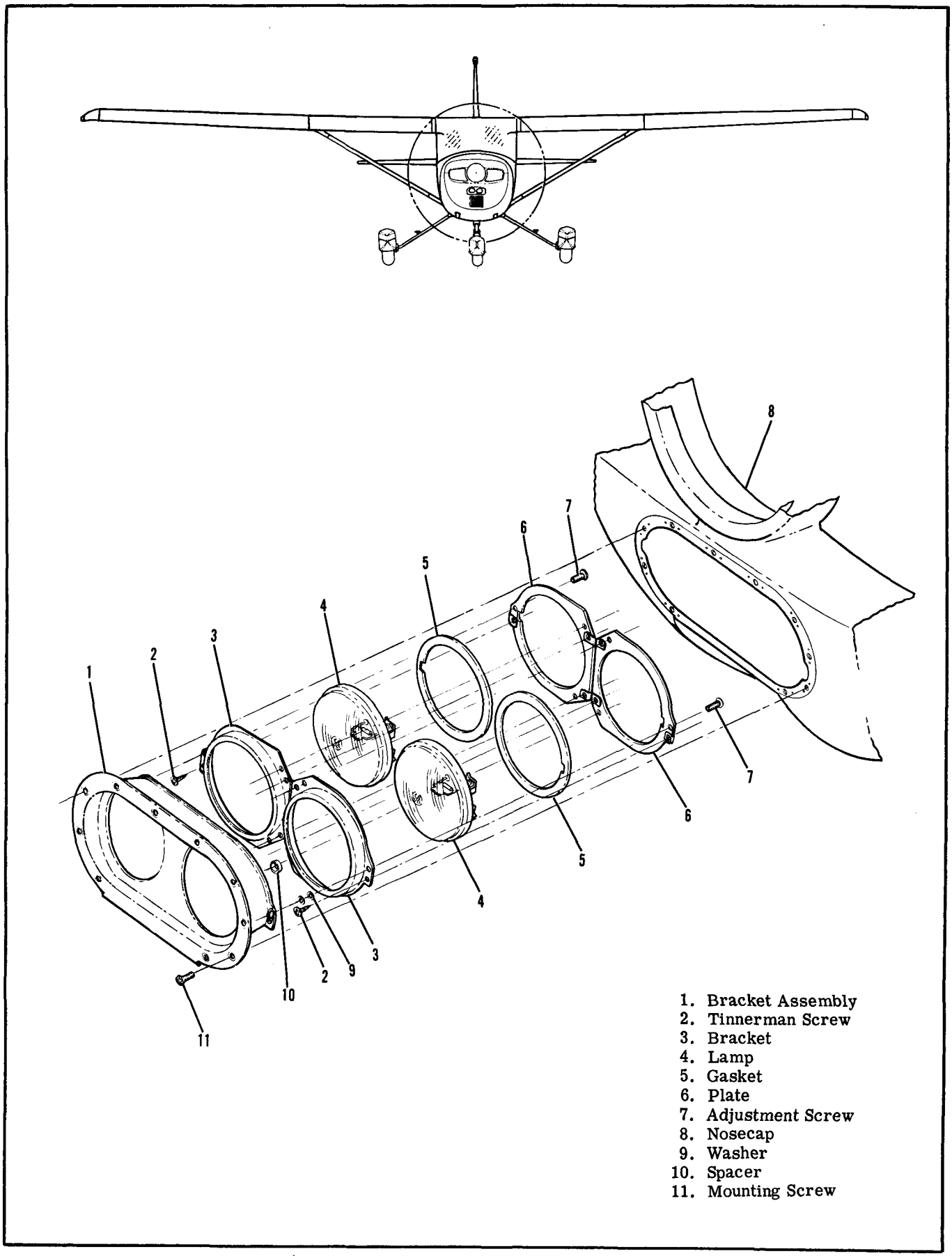
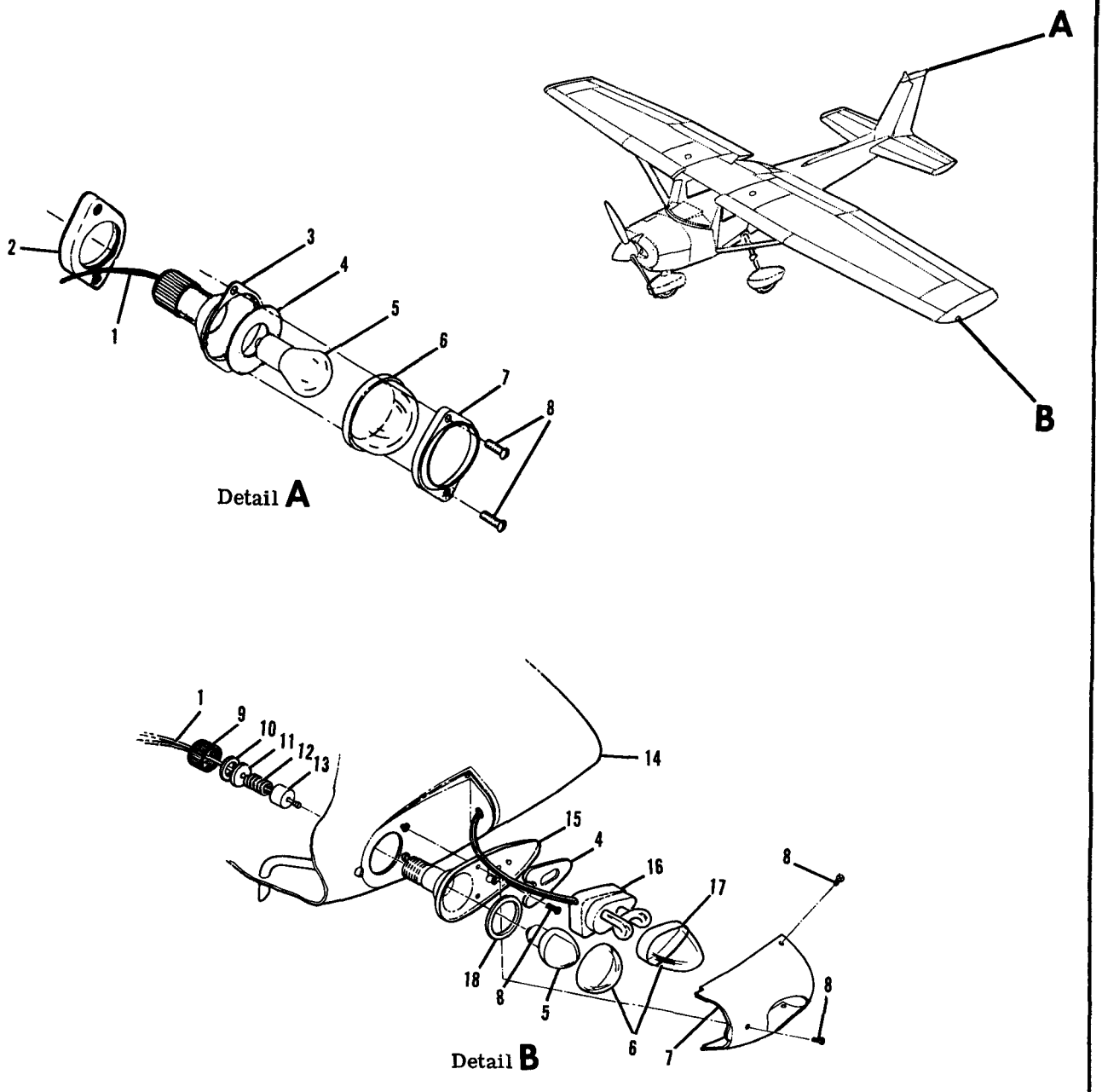
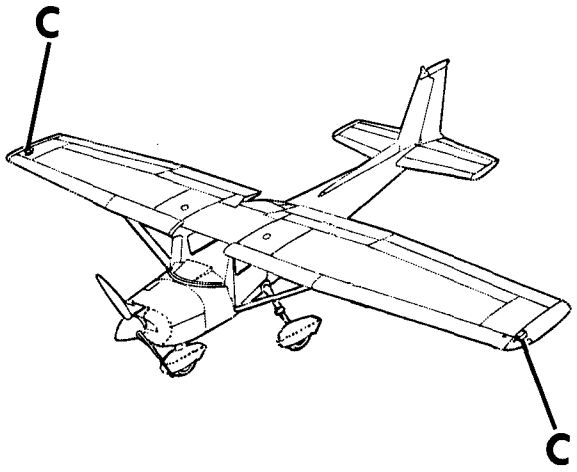


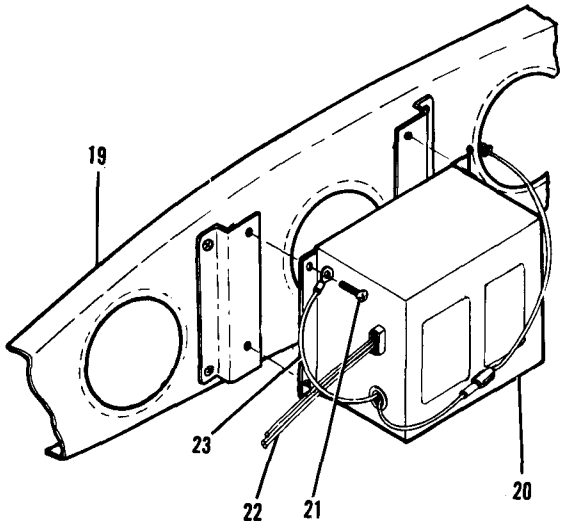
Figure 16-6. Landing and Taxi Light Installation (Sheet 2 of 2)



1. Electrical Leads
2. Mount Bracket
3. Socket
4. Gasket
5. Lamp
6. Lens
7. Lens Retainer
8. Screw
9. Cap
10. Washer
11. Insulated Washer
12. Spring
13. Insulator
14. Wing Tip
15. Socket
16. Flash Tube Assembly
17. Gasket
18. Seal

Figure 16-7. Navigation and Anti-Collision Strobe Lights Installation (Sheet 1 of 2)





Detail C

19. Wing Tip Rib
20. Power Supply
21. Screw
22. Electrical Leads
23. Ground Wire

Figure 16-7. Navigation and Anti-Collision Strobe Lights Installation (Sheet 2 of 2)

tion for 24 hours. Turn off DC power source. Then connect to the proper voltage, 12 volt. Connect tube to output of strobe power supply and allow to operate, flashing, for 15 minutes. Remove strobe tube. Operating power supply at 12 volts, note the current drain after one minute. If less than 0.5 amperes, operate for 6 hours. If current draw is greater than 0.5 amperes, reject the unit.

16-62. FLASHING BEACON.

16-63. DESCRIPTION. The flashing beacon light is attached to the vertical fin tip. The lamp is iodine-vapor, electrically switched by a solid-state flasher assembly. The flasher assembly is mounted in the aft section of the tailcone. The switching frequency of the flasher assembly operates the beacon at approximately 45 flasher per minute. A 1.5 ohm, 75 watt resistor is installed to eliminate a pulsing effect on the cabin lighting and ammeter.

16-64. REMOVAL AND INSTALLATION. For removal and installation of flashing beacon refer to figure 16-8.

16-65. INSTRUMENT AND DOME LIGHTS.

16-66. DESCRIPTION. The instrument flood light and dome light are installed in the overhead console. The dome light consists of a frosted lens and a single bulb controlled by a rocker switch on the instrument panel. The instrument flood light consists of a red lens and a single bulb controlled by a rheostat switch located on the instrument panel below the pilots control wheel.

16-67. REMOVAL AND INSTALLATION. For removal and installation of instrument and dome lights refer to figure 16-9.

16-68. TRANSISTORIZED LIGHT DIMMING.

16-69. DESCRIPTION. A remotely located, two-circuit transistorized dimming assembly is installed to control instrument lighting. One circuit controls the compass light, map light and instrument flood lights. The other circuit controls radio lighting. A concentric knob arrangement on a dual rheostat assembly mounted on the instrument panel.

16-70. REMOVAL AND INSTALLATION. For removal and installation of transistorized dimming assembly, refer to figure 16-10.

16-71. COMPASS AND RADIO DIAL LIGHTING.

16-72. DESCRIPTION. The compass and radio dial lighting are contained within the individual units. The lighting is controlled by a concentric knob arrangement on a dual rheostat assembly mounted on the instrument panel.

16-73. CONTROL WHEEL MAP LIGHT.

16-74. DESCRIPTION. The control wheel map light is mounted on the lower side of the control wheel. Light intensity is controlled by a thumb operated rheostat. For dimming the rheostat should be turned clockwise.

16-75. REMOVAL AND INSTALLATION. (Refer to figure 16-11).

a. For easy access to the map light assembly, rotate the control wheel 90°.
b. Remove screws (9), spacers (8) and shield (10).
c. Remove screws (7), inserts (11) and shield (12).
d. Label the map light wires at the terminal block, then remove screws securing wires to terminal block.
e. For reassembly reverse the preceding steps.

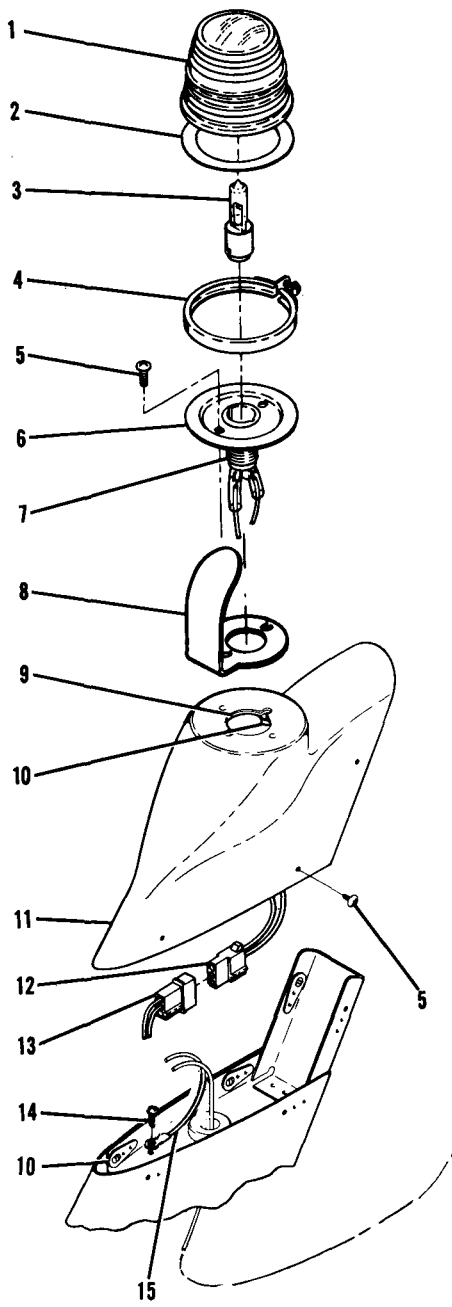
16-76. PITOT HEATER.

16-77. DESCRIPTION. An electrical heater unit may be installed in the pitot tube. The heater offsets the possibility of ice formation on the pitot tube. The heater is integrally mounted in the pitot tube.and is operated by a rocker switch on the instrument panel.

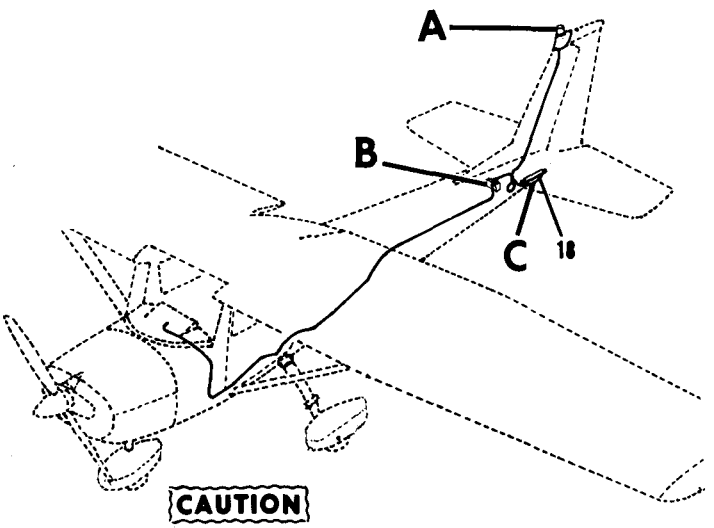
16-78. REMOVAL AND INSTALLATION. For removal and installation of pitot heater refer to figure 16-12.

16-79. CIGAR LIGHTER.

16-80. DESCRIPTION. The cigar lighter is mounted on the instrument panel below the pilots control wheel. A 9 amp inline fuse is installed to protect the wire from the cigar lighter to the ammeter.



Detail **A**

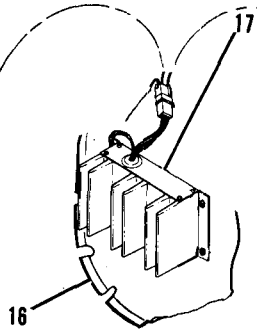


CAUTION

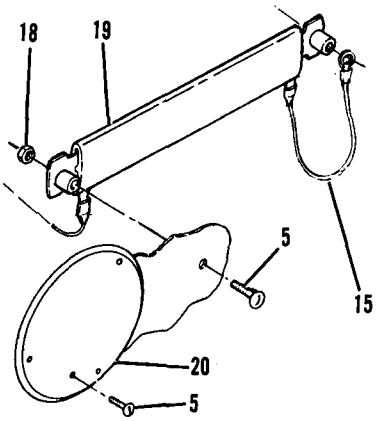
When inserting lamp into socket always use a handkerchief or a tissue to prevent getting fingerprints on the lamp.

NOTE

Fingerprints on lamp may shorten the life of the lamp.



Detail **B**



Detail **C**

1. Dome
2. Gasket
3. Lamp
4. Clamp Assembly
5. Screw
6. Plate - Mounting
7. Socket Assembly
8. Shield
9. Plate Assy - Mounting
10. Nutplate
11. Tip Assembly - Fin
12. Housing - Plug
13. Housing - Cap
14. Grommet
15. Ground Wire
16. Bulkhead - Tailcone
17. Flasher Assembly
18. Nut
19. Resistor
20. Inspection Plate

Figure 16-8. Flashing Beacon Light Installation

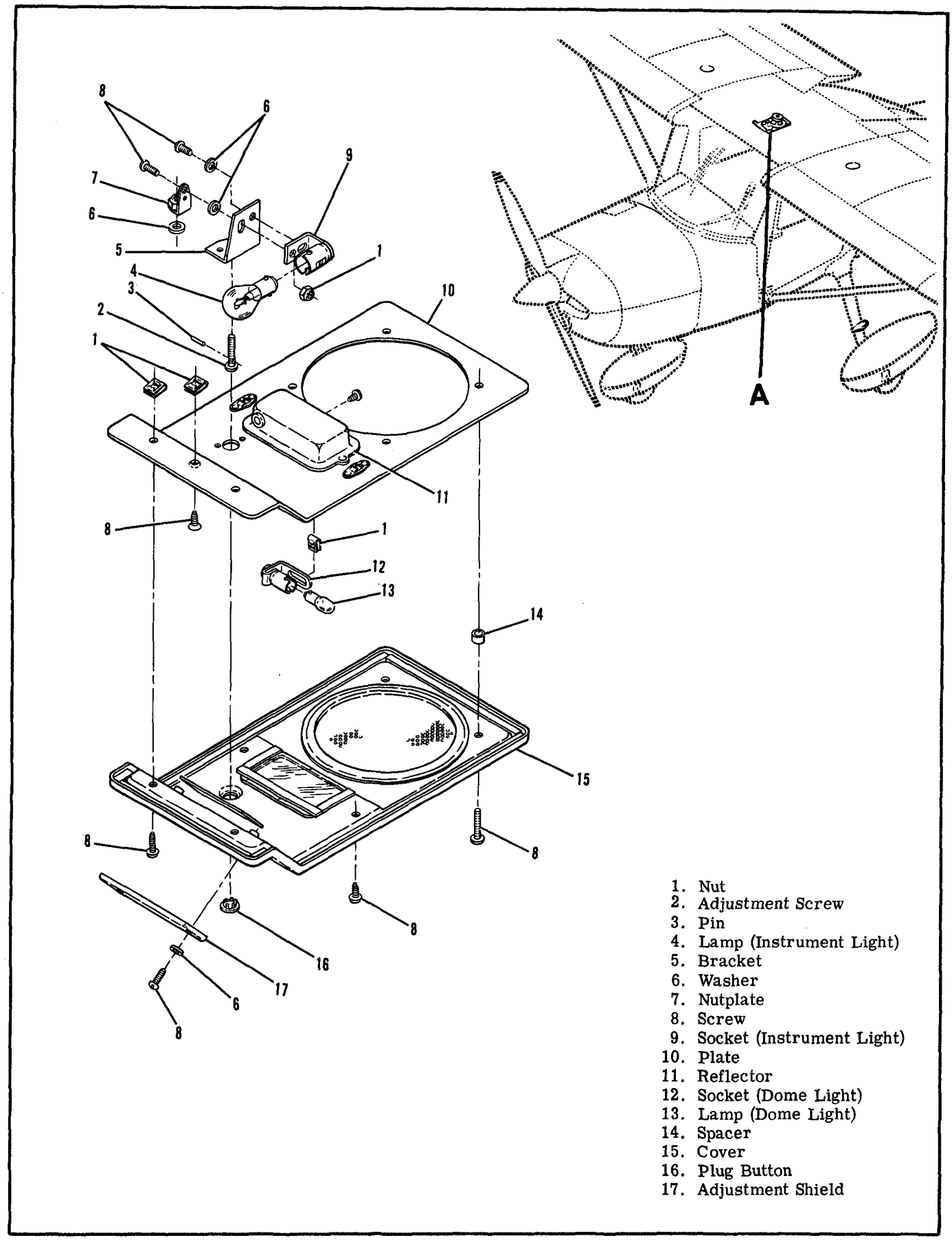
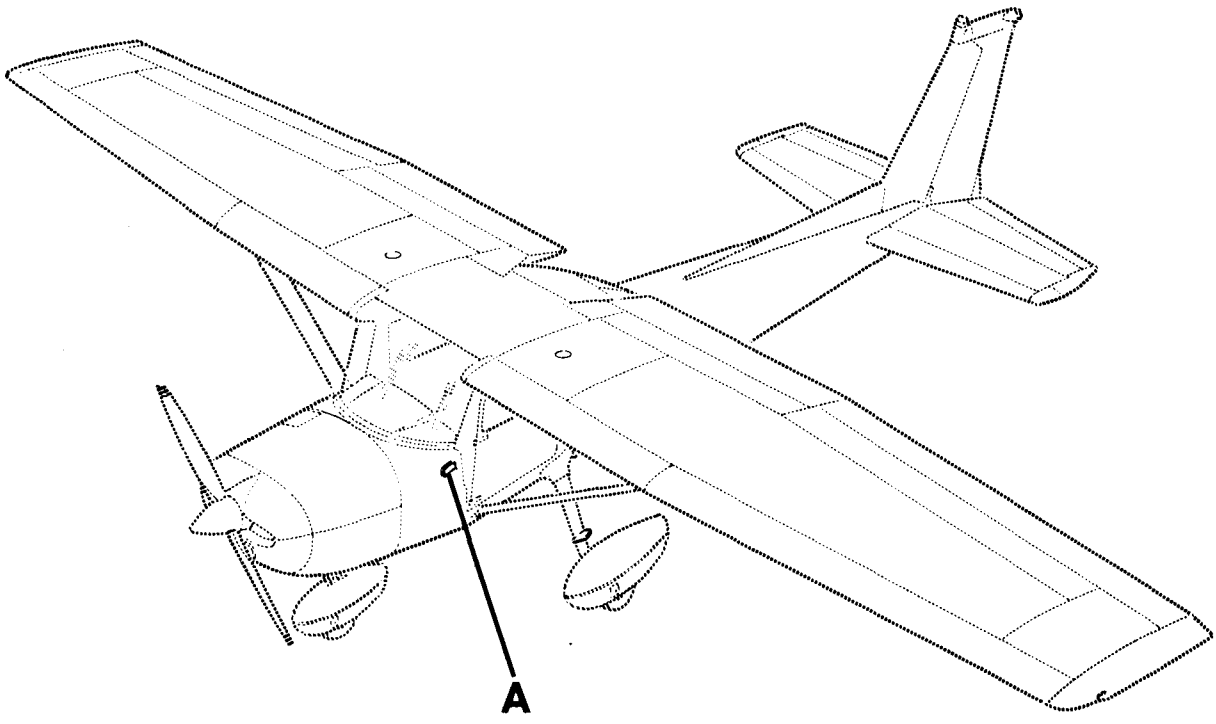
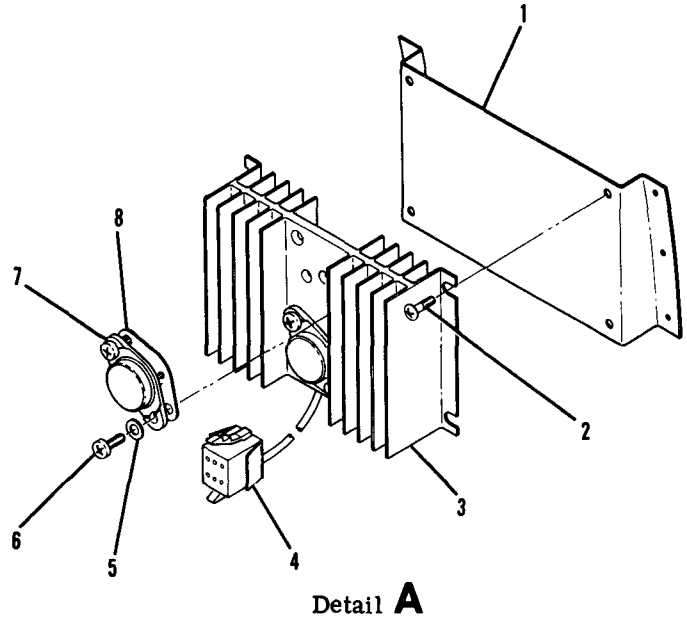


Figure 16-9. Instrument and Dome Light Console Installation





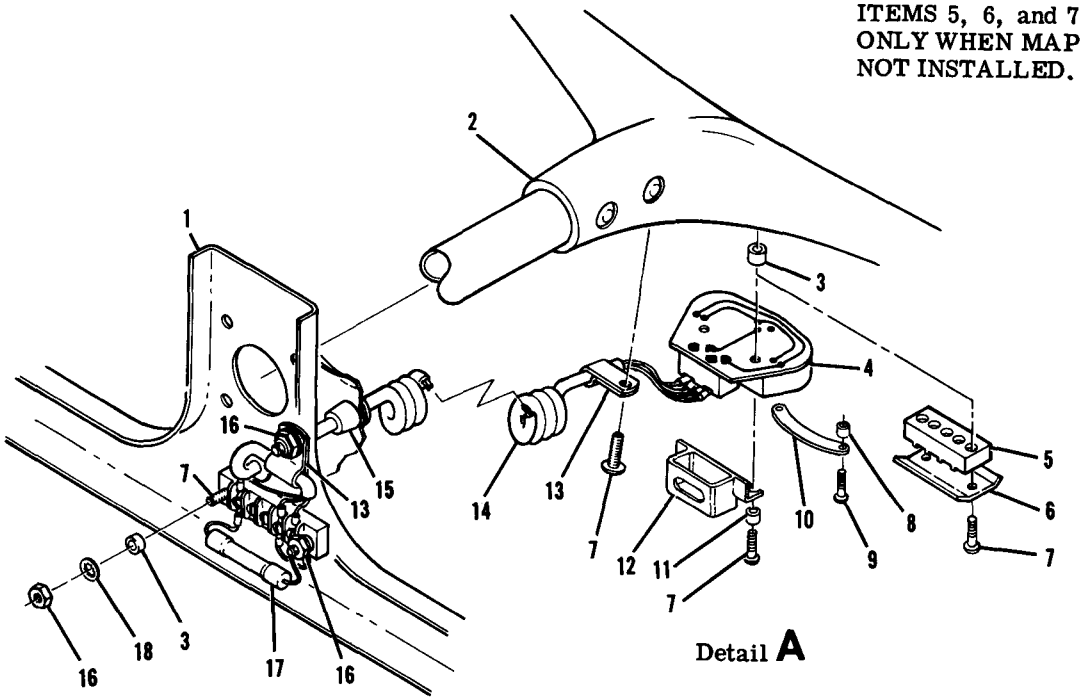
Detail **A**

1. Mounting Bracket
2. Mounting Screw
3. Heat Sink
4. Connector
5. Washer
6. Screw
7. Transistor
8. Insulator

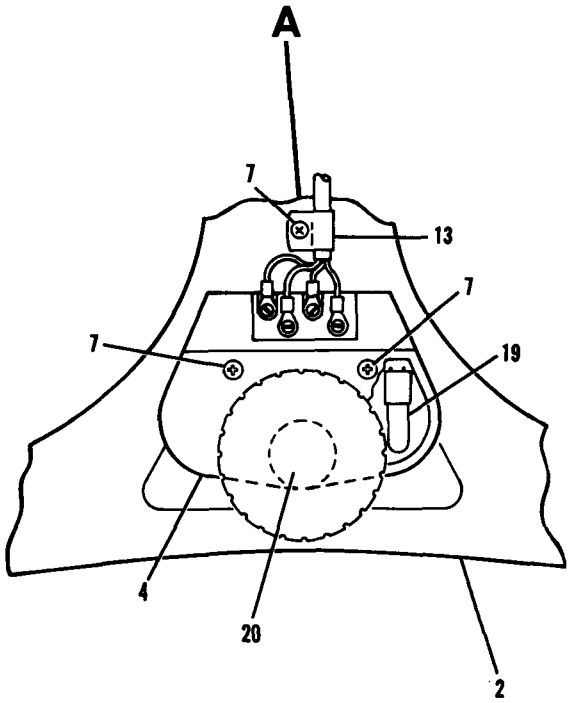
Figure 16-10. Transistorized Light Dimming Installation

NOTE

ITEMS 5, 6, and 7 ARE USED ONLY WHEN MAP LIGHT IS NOT INSTALLED.

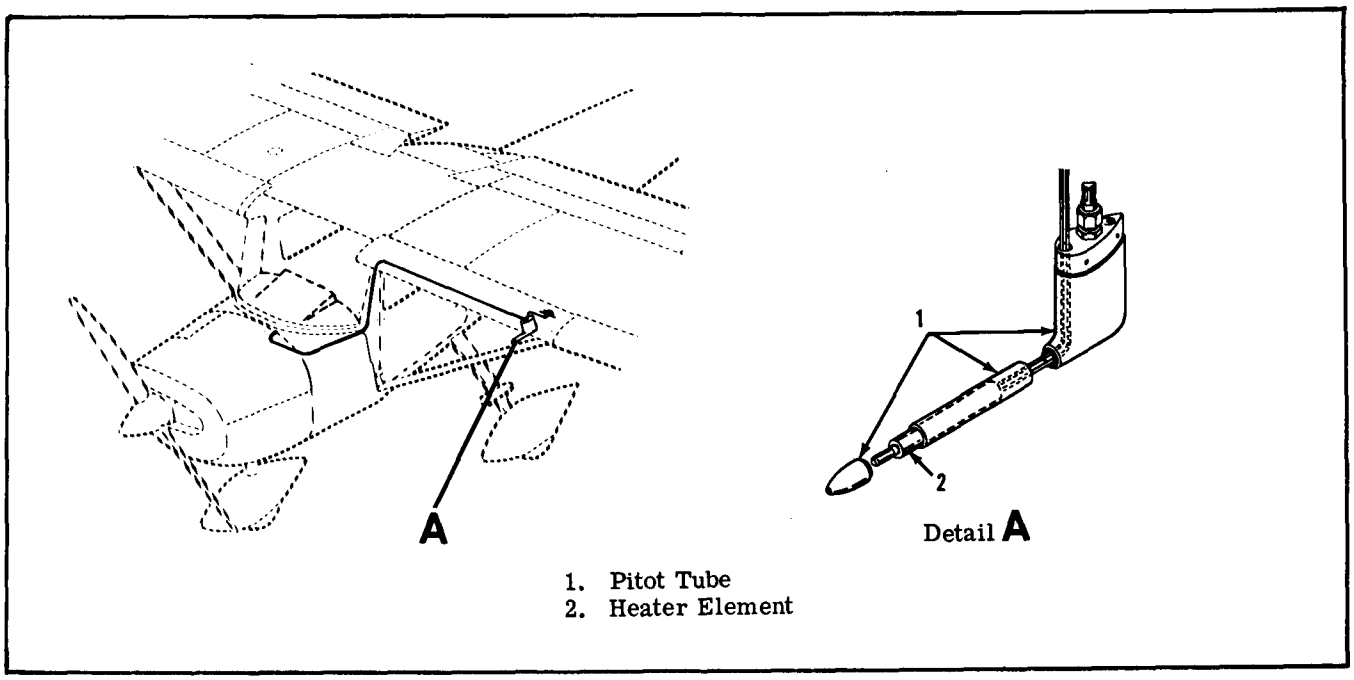


Detail **A**



1. Stationary Panel Assembly
2. Control Wheel Assembly
3. Spacer
4. Map Light Assembly
5. Terminal Block
6. Cover
7. Screw
8. Spacer
9. Screw
10. Shield
11. Insert
12. Cover
13. Clamp
14. Cable Assembly
15. Grommet
16. Nut
17. Fuse
18. Lock Washer
19. Lamp
20. Rheostat

Figure 16-11. Control Wheel Map Light Installation



1. Pitot Tube
2. Heater Element

Figure 16-12. Pitot Heater System

SHOP NOTES:

16-81. EMERGENCY LOCATOR TRANSMITTER.

16-82. DESCRIPTION. The ELT is a self-contained, solid state unit, having its own power supply, with an externally mounted antenna. The C589510-0209 transmitter is designed to transmit simultaneously on dual emergency frequencies of 121.5 and 243.0 Megahertz. The C589510-0211 transmitter used for Canadian registry, operates on 121.5 only. The unit is mounted in the tailcone, aft of the baggage curtain on the right hand side. The transmitters are designed to provide a broadcast tone that is audio modulated in a swept manner over the range of 1600 to 300 Hz in a distinct, easily recognizable distress signal for reception by search and rescue personnel and others monitoring the emergency frequencies. Power is supplied to the transmitter by a battery-pack which has the service life of the batteries placarded on the batteries and also on the outside end of the transmitter. ELT's are equipped with a battery-pack containing four lithium "D" size batteries which are stacked in two's (See figure 16-13). The ELT exhibits line of sight transmission characteristics which correspond approximately to 100 miles at a search altitude of 10,000 feet. When battery inspection and replacement schedules are adhered to, the transmitter will broadcast an emergency signal at rated power (75 MW-minimum), for a continuous period of time as listed in the following table.

TRANSMITTER LIFE
TO 75 MILLIWATTS OUTPUT

Temperature	4 Cell Lithium Battery Pack
+130°F	115 hrs
+ 70°F	115 hrs
- 4°F	95 hrs
- 40°F	23 hrs

Battery-packs have a normal shelf life of five to ten (5-10) years and must be replaced at 1/2 f normal shelf life in accordance with TSO-C91. Cessna specifies 5 years replacement of lithium (4-cell) battery packs.

16-83. OPERATION. A three position switch on the forward end of the unit controls operation. Placing the switch in the ONposition will energize the unit to start transmitting emergency signals. In the OFF position, the unit is inoperative. Placing the switch in the ARM position will set the unit to start transmitting emergency signals only after the unit has received a 5g (tolerances are +2g and -0g) impact force, for a duration of 11-16 milliseconds.

CAUTION

Do not leave the emergency locator transmitter in the ON position longer than 5 seconds or you may activate downed aircraft procedures by C.A.P., D.O.T. or F.A.A. personnel.

16-84. CHECKOUT INTERVAL:

100 HOURS.

a. Turn aircraft master switch ON.
b. Turn aircraft transceiver ON and set frequency on receiver to 121.5 MHz.
c. Remove the ELT's antenna cable from the ELT unit.
d. Place the ELT's function selector switch in the ON position for 5 seconds or less. Immediately replace the ELT function selector switch in the ARM position after testing ELT.
e. Test should be conducted only within the time period made up of the first five minutes after any hour.

CAUTION

Tests with the antenna connected should be approved and confirmed by the nearest control tower.

NOTE

Without its antenna connected, the ELT will produce sufficient signal to reach your receiver, yet it will not disturb other communications or damage output circuitry.

NOTE

After accumulated test or operation time equals 1 hour, battery-pack replacement is required.

f. Check calendar date for replacement of battery-pack. This date is supplied on a sticker attached to the outside of the ELT case and to each battery.

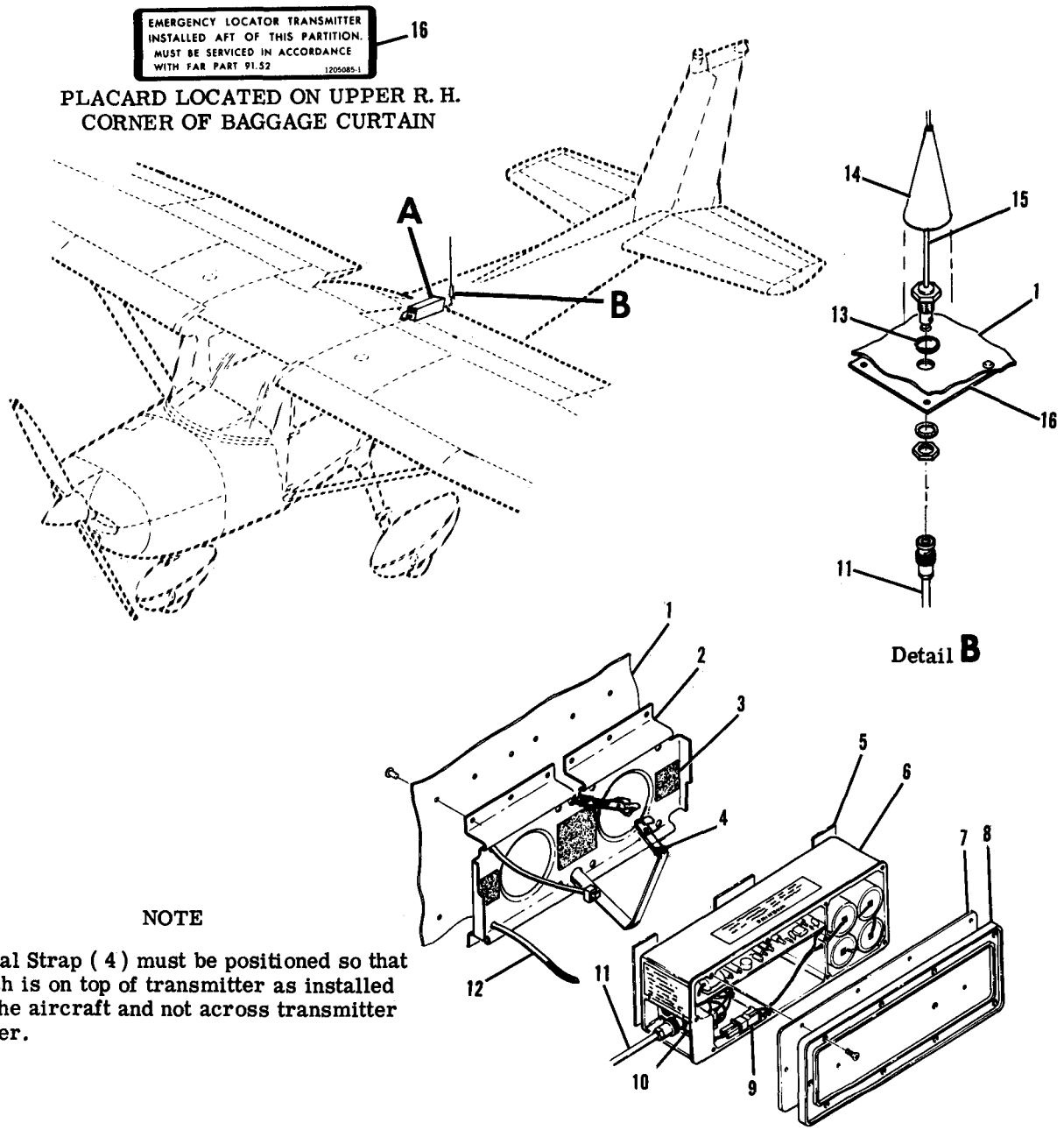
16-85. REMOVAL AND INSTALLATION OF TRANSMITTER. (Refer to figure 16-13.)
a. Remove baggage curtain to gain access to the transmitter and antenna.
b. Disconnect co-axial cable from end of transmitter.
c. Cut sta-strap securing antenna cable and unlatch metal strap to remove transmitter.

NOTE

Transmitter is also attached to the mounting bracket by velcro strips; pull transmitter to free from mounting bracket and velcro.

NOTE

To replace velcro strips, clean surface thoroughly with clean cloth saturated in one of the following solvents: Trichloric thylene, Aliphatic Napthas, Methyl Ethyl Ketone or Enmar 6094 Lacquer Thinner. Cloth should be folded each time the surface is wiped to present a clean area and avoid redepositing of grease. Wipe surface immediately with clean dry cloth, do not allow solvent to dry on surface. Apply Velcro #40 adhesive to



NOTE

Metal Strap (4) must be positioned so that latch is on top of transmitter as installed in the aircraft and not across transmitter cover.

1. Tailcone Skin
2. Bracket
3. Fabric Fastener - Hook
4. Metal Strap
5. Fabric Fastener - Pile
6. Transmitter
7. Seal
8. Cover
9. Connector
10. Arm Switch
11. Co-axial Cable
12. Sta-strap
13. Rubber Washer
14. Rubber Boot
15. Antenna
16. Doubler

Figure 16-13. Emergency Loactor Transmitter Installation

each surface in a thin even coat and allow to dry until quite tacky, but no longer transfers to the finger when touched (usually between 5 and 30 minutes). Porous surfaces may require two coats. Place the two surfaces in contact and press firmly together to insure intimate contact. Allow 24 hours for complete cure.

d. To reinstall transmitter, reverse preceding steps.

NOTE

An installation tool is required to properly secure sta-strap. This tool may be purchased locally or ordered from the Pandiut Corporation, Tinley Park, Ill., part number GS-2B (Conforms to MS90387-1).

CAUTION

Ensure that the direction of flight arrows (placarded on the transmitter) are pointing towards the nose of the aircraft.

16-86. REMOVAL AND INSTALLATION OF ANTENNA. (Refer to figure 16-13.)

a. Disconnect co-axial cable from base of antenna.

b. Remove the nut and lockwasher attaching the antenna base to the fuselage and the antenna will be free for removal.

c. To reinstall the antenna, reverse the preceding steps.

NOTE

Upon reinstallation of antenna, cement rubber boot (14) using RTV102, General Electric Co. or equivalent, to antenna whip only; do not apply adhesive to fuselage skin or damage to paint may result.

16-87. REMOVAL AND INSTALLATION OF LITHIUM FOUR (4) CELL BATTERY-PACK. (Refer to figure 16-14.)

NOTE

Transmitters equipped with the 4 cell battery-pack can only be replaced with another 4 cell battery-pack.

a. After the transmitter has been removed from aircraft in accordance with para. 16-85, place the transmitter switch in the OFF position.

b. Remove the nine screws attaching the cover to the case and then remove the cover to gain access to the battery-pack.

NOTE

Retain the rubber gasket and screws for reinstallation.

c. Disconnect the battery-pack electrical connector and remove battery-pack.

d. Place new battery-pack in the transmitter with four batteries as shown in the case in figure 16-14.

e. Connect the electrical connector as shown in figure 16-14.

NOTE

Before installing the new 4 cell battery-pack, check to ensure that its voltage is 11.2 volts or greater.

CAUTION

It is desireable to replace adhesive material on the 4 cell battery-pack, use only 3M Jet Melt Adhesive #3738. Do not use other adhesive materials since other materials may corrode the printed circuit board assembly.

f. Replace the transmitter cover and gasket.

g. Remove the old battery-pack placard from the end of transmitter and replace with new battery-pack placard supplied with the new battery-pack.

CAUTION

Be sure to enter the new battery-pack expiration date in the aircraft records. It is also recommended this date be placed in your ELT Owner's Manual for quick reference.

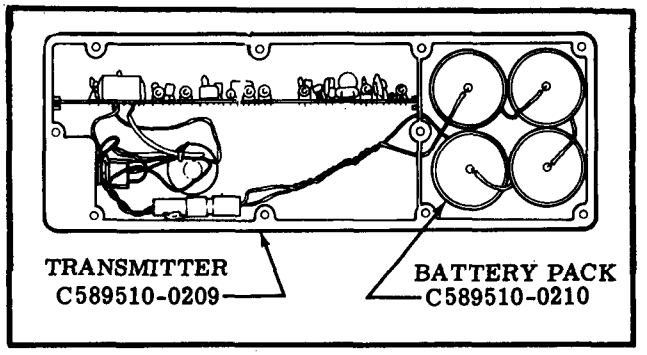


Figure 16-14. Lithium 4 Cell Battery Pack Installations

16-88. TROUBLE SHOOTING. Should your Emergency Locating Transmitter fail the 100 Hours performance checks, it is possible to a limited degree to isolate the fault to a particular area of the equipment. In performing the following trouble shooting procedures to test peak effective radiated power, you will be able to determine if battery replacement is necessary or if your unit should be returned to your dealer for repair.

16-88. TROUBLE SHOOTING (Cont.)

TROUBLE	PROBABLE CAUSE	REMEDY
*POWER LOW	Low battery voltage.	1. Set toggle switch to off. 2. Remove plastic plug from the remote jack and by means of a Switchcraft #750 jackplug, connect a Simpson 260 model voltmeter and measure voltage. If the battery pack transmitters is 11.2 volts or less, the battery pack is below specification.
	Faulty transmitter.	3. If the battery-pack voltage meets the specifications in step 2, the battery-pack is O. K. If the battery is O. K., check the transmitter as follows: a. Remove the voltmeter. b. By means of a switchcraft 750 jackplug and 3 inch maximum long leads, connect a Simpson Model 1223 ammeter to the jack. c. Set the toggle switch to ON and observe the ammeter current drain. If the current-drain is in the 85-100 ma range, the transmitter or the co-axial cable is faulty.
	Faulty co-axial antenna cable.	4. Check co-axial antenna cable for high resistance joints. If this is found to be the case, the cable should be replaced.

*This test should be carried out with the co-axial cable provided with your unit.

ELECTRICAL LOAD ANALYSIS CHART

ALL MODELS

STANDARD EQUIPMENT (RUNNING LOAD)	AMPS REQD 1977
Battery Contactor	0.6
Fuel Indicators	0.4
Flashing Beacon Light **	7.0
Instrument Lights	1.1
Position Lights	5.6
Turn Coordinator *	0.8
OPTIONAL EQUIPMENT (RUNNING LOAD)	
Strobe Lights	3.0
Cessna 300 ADF (Type R-546E)	1.0
Cessna 300 Nav/Com (RT-308C)	1.5
Cessna 300 Transceiver (Type RT-524A)	3.2
Cessna 300 Transponder (RT-359A)	1.0
Cessna 300 N/C (ARC Type RT-328T)	1.5
Cessna 300 Glideslope (R-443B) (40 Channel)	0.5
Cessna 400 Marker Beacon (Type R-402A)	0.1
Cessna 400 Encoding Altimeter (Type EA-401A)	0.2
400 XPDR (ARC Type RT-459A) (Export Only)	1.0
Marker Beacon (Bendix GM-247A) (Export Only)	0.10
ITEMS NOT CONSIDERED AS PART OF RUNNING LOAD	
Cigar Lighter	10.0
Clock	†
Dome Light	0.3
Flap Motor	15.0
Landing Light (Cowl Mounted)	20.0
Landing and Taxi Lights (Dual Cowl Mounted)	15.6

† Negligible
* Optional on the Standard Model 150
** Optional on the Standard, Trainer and F150