

2 November 1944

AIRCRAFT AND MAINTENANCE PARTS

NORTH AMERICAN—REWORK OF COOLANT AND OIL COOLER EXIT FLAP
ACTUATORS, TYPES R-4250 AND R-4310—P-51 SERIES

NOTE As prescribed in T. O. No. 00-20A, appropriate reference to this Technical Order will be entered on AAF Forms 60-A for the aircraft affected. The work directed herein will be accomplished as soon as possible and not later than the next 100-hour inspection period by service activities with the aid of base maintenance facilities, if necessary. Oil and coolant exit flap actuators, Robertshaw types R-4250 and R-4310, in stock, not identified as described in paragraph 2., will be modified prior to issue.

1. To prevent overheating and resultant failure of engines resulting from malfunction of engine oil and coolant exit flap actuators due to leakage of grease from actuator gear box into motor, the actuator units installed on the following airplanes will be modified in accordance with the instructions contained in paragraph 2.

MODEL	AF SERIAL NOS.
P-51B	43-12093 to 43-12492 inclusive
	43-6313 to 43-7202 inclusive
	42-106429 to 42-106978 inclusive
	43-24752 to 43-24901 inclusive
P-51C	42-102979 to 42-103978 inclusive
	43-24902 to 43-25251 inclusive
	44-10753 to 44-11152 inclusive
	44-13253 to 44-14789 inclusive
P-51D	44-11153 to 44-11226 inclusive

P-51D airplanes, AF Nos. 44-14790 and subsequent, and 44-11227 and subsequent, will be reworked at the factory prior to delivery.

2. The instructions for accomplishing this change, as contained in North American Field Service Bulletin P-51-183A, dated 4 October 1944, are as follows:

a. Remove the defective actuators from the airplane. The coolant flap actuator, part No. R-4250, is removed as follows:

(1) Remove the oxygen cylinder access door on the aft left side of the airplane.

(2) Remove the access door on the underside of the airplane, aft of the coolant flap door.

(3) Disconnect the electrical wiring harness from the actuator, and remove the control unit cover.

(4) Mark the edge of the diastat assembly mounting plate in order that it can be reinstalled in its original relative position to the control box, and remove the diastat assembly from its mounting. Coil the capillary line and diastat back up out of the way. The cover remains with the capillary line.

NOTE The capillary line, diastat assembly, and thermal bulb, constitute a hermetically sealed assembly and should be treated with great care. Do not crush, or bend line to a radius of less than 2 inches. The solvent to be used in cleaning various parts of the motor and armature, referred to in the text, may be diluent naphtha or clean unleaded gasoline. Use care when cleaning with these fluids, to keep the fluid from being ignited.

(5) Remove the coolant actuator rod assembly access plate located on the bottom of the coolant flap

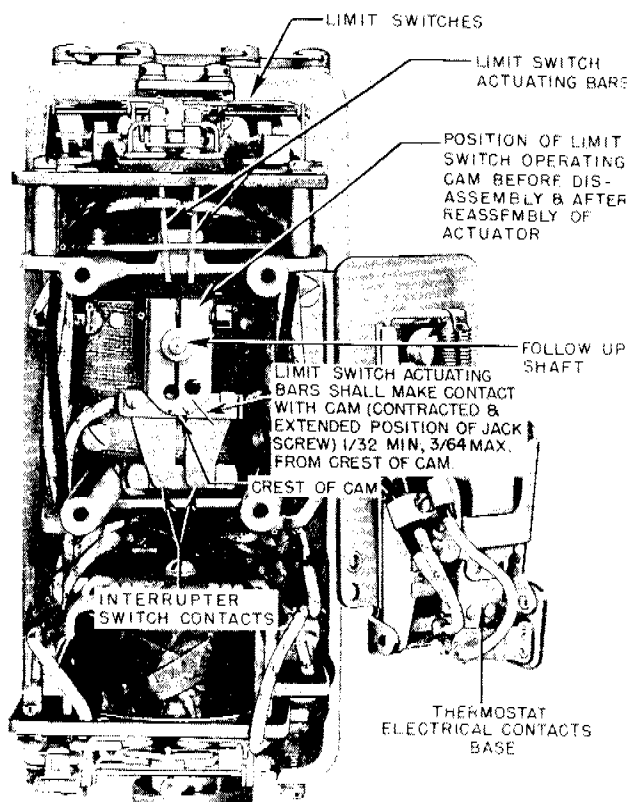


Figure 1 - Actuator Control Unit - Dust Cover

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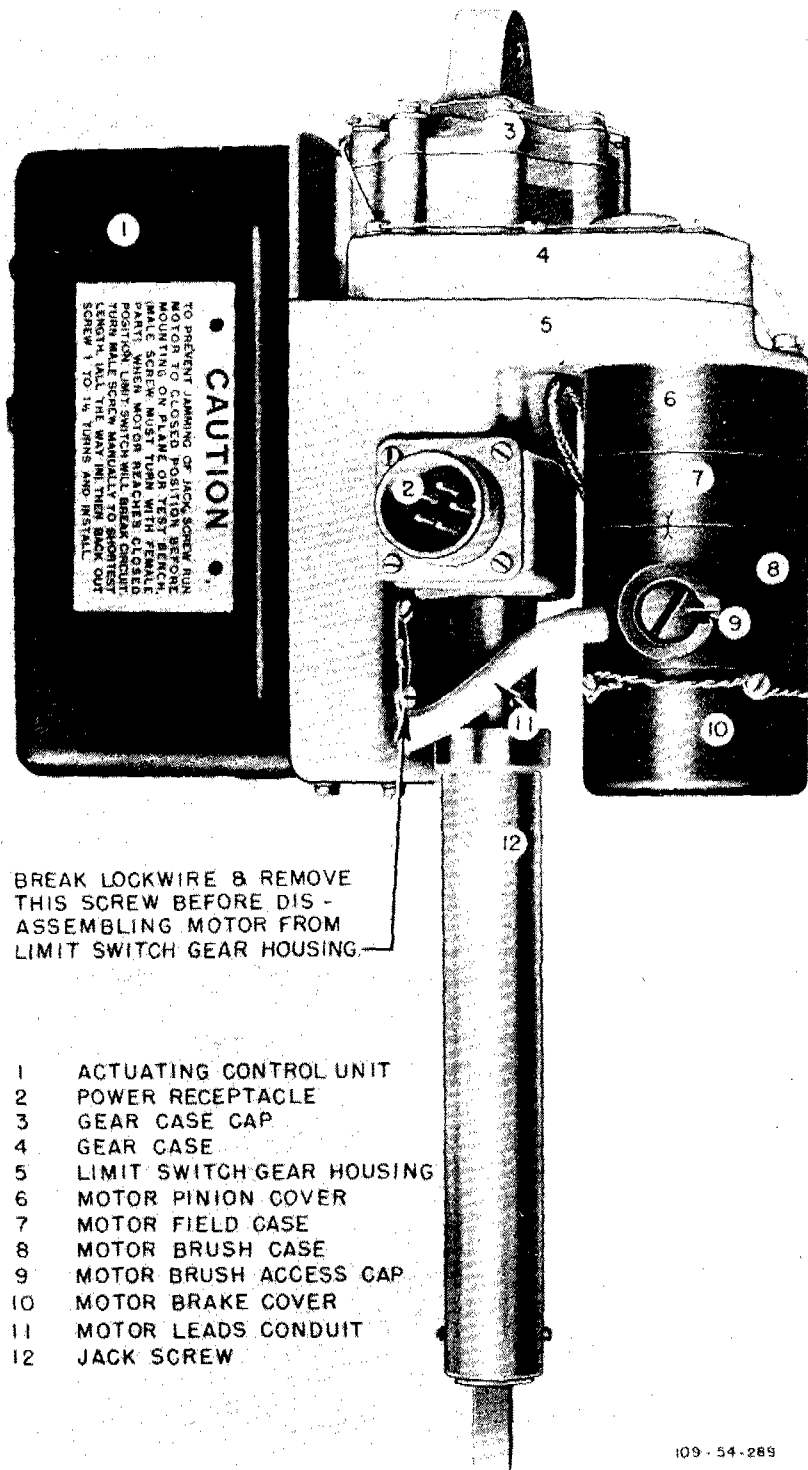


Figure 2
Robertshaw
Actuator -
General View

BREAK LOCKWIRE & REMOVE THIS SCREW BEFORE DIS-ASSEMBLING MOTOR FROM LIMIT SWITCH GEAR HOUSING.

- 1 ACTUATING CONTROL UNIT
- 2 POWER RECEPTACLE
- 3 GEAR CASE CAP
- 4 GEAR CASE
- 5 LIMIT SWITCH GEAR HOUSING
- 6 MOTOR PINION COVER
- 7 MOTOR FIELD CASE
- 8 MOTOR BRUSH CASE
- 9 MOTOR BRUSH ACCESS CAP
- 10 MOTOR BRAKE COVER
- 11 MOTOR LEADS CONDUIT
- 12 JACK SCREW

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door, and detach the lower clevis end of the scoop rod assembly from the flap. Detach the rod fair-leads and remove the rod from the lower clevis on the jack screws.

(6) Detach the coolant actuator from the supporting member and remove the actuator from the air-plane. If at all possible, a spare dust cover should be obtained to protect the control unit. In any case, care

should be exercised to prevent injury to the control unit component parts.

b. To remove the oil cooler exit flap actuator:

(1) Remove the left and right wing fillets, disconnect the electrical connector, and remove the dust cover from the actuator control box. The diastat unit must first be marked to insure proper positioning on

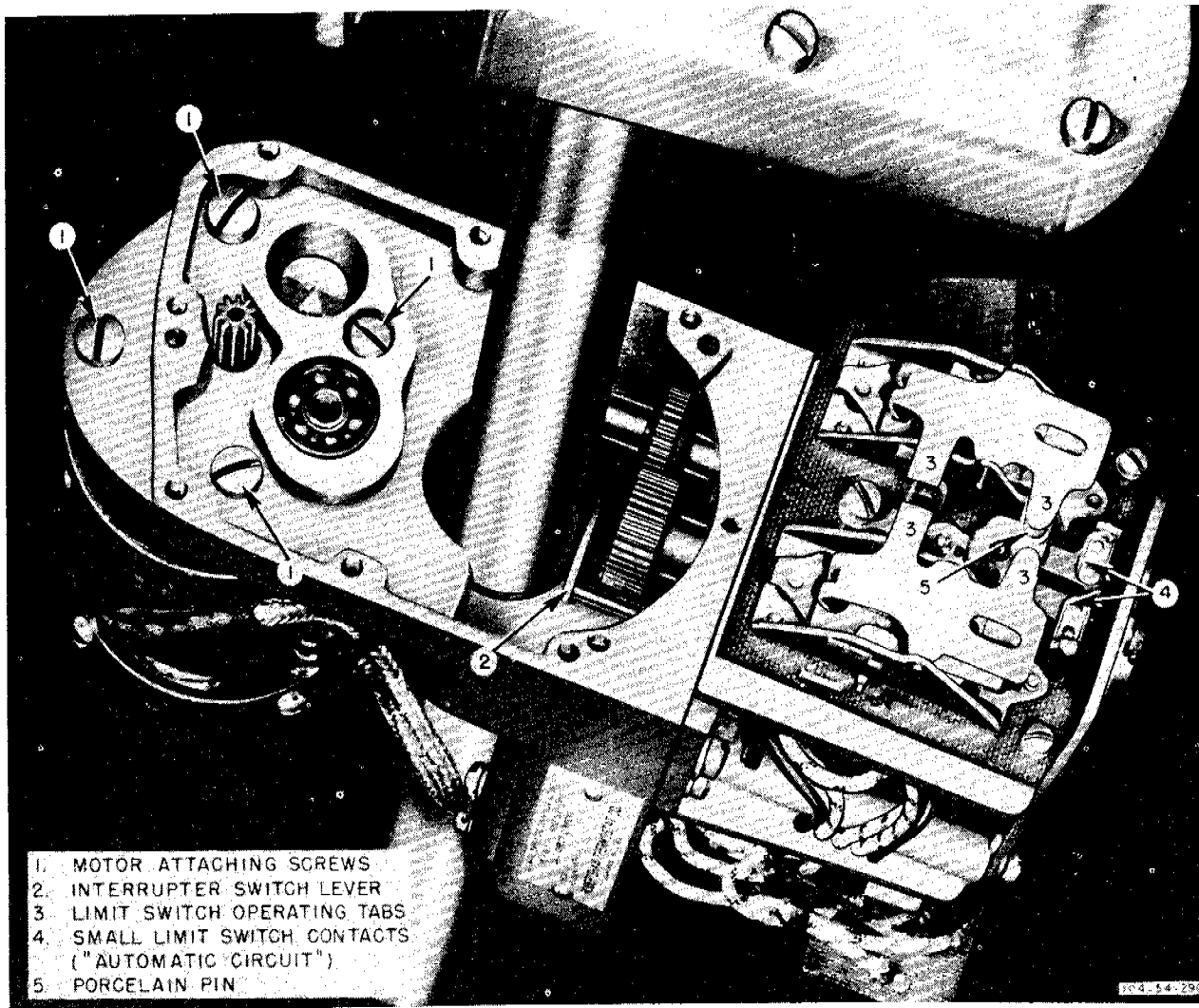


Figure 4 - Top View of Limit Switch Gear Housing

- A - Motor ground or common.
- B - Automatic connection.
- C - Motor lead for "OPEN" rotation.
- D - Motor lead for "CLOSE" rotation.
- E - Not connected internally.

(2) Manually rotate the jackscrew to its greatest length by turning the drive end fitting (12, figure 2), and remove the eight lockwired screws holding the gear case to the limit switch housing (4, figure 2).

(3) Stand the unit upright, gear housing up, and bump the jackscrew gently against the bench top to separate the gear housing. Use a soft wood block or a felt pad to prevent damaging the clevis fitting. Be careful not to damage the gear case gasket while sliding the motor and gear case down the jackscrew. See figure 4 for results obtained by preceding procedure.

(4) Clean all the excess grease from the gear case and limit switch housing. After cleaning the grease from the gears, only a light film of grease should be left on the gear teeth. The grease can be removed

easily by use of a small clean dry paint brush, then blow the grease out of inaccessible places with an air hose. See figure 3 for additional instructions.

(5) See figure 2 for precautionary note, and remove the motor conduit retaining screw. Rotate the gear case and jackscrew to such a position that the motor attaching screws can be reached (1, figure 4), and remove the motor from the gear case.

CAUTION Do not twist or damage motor leads.

(6) Remove one of the motor housing through bolts, the two motor brushes, and inspect for evidence of grease in the motor interior. If any grease is found in the motor, and the motor pinion cover is not provided with vent slots as shown in figure 9, the motor must be disconnected from the control unit and modified in accordance with the following procedure.

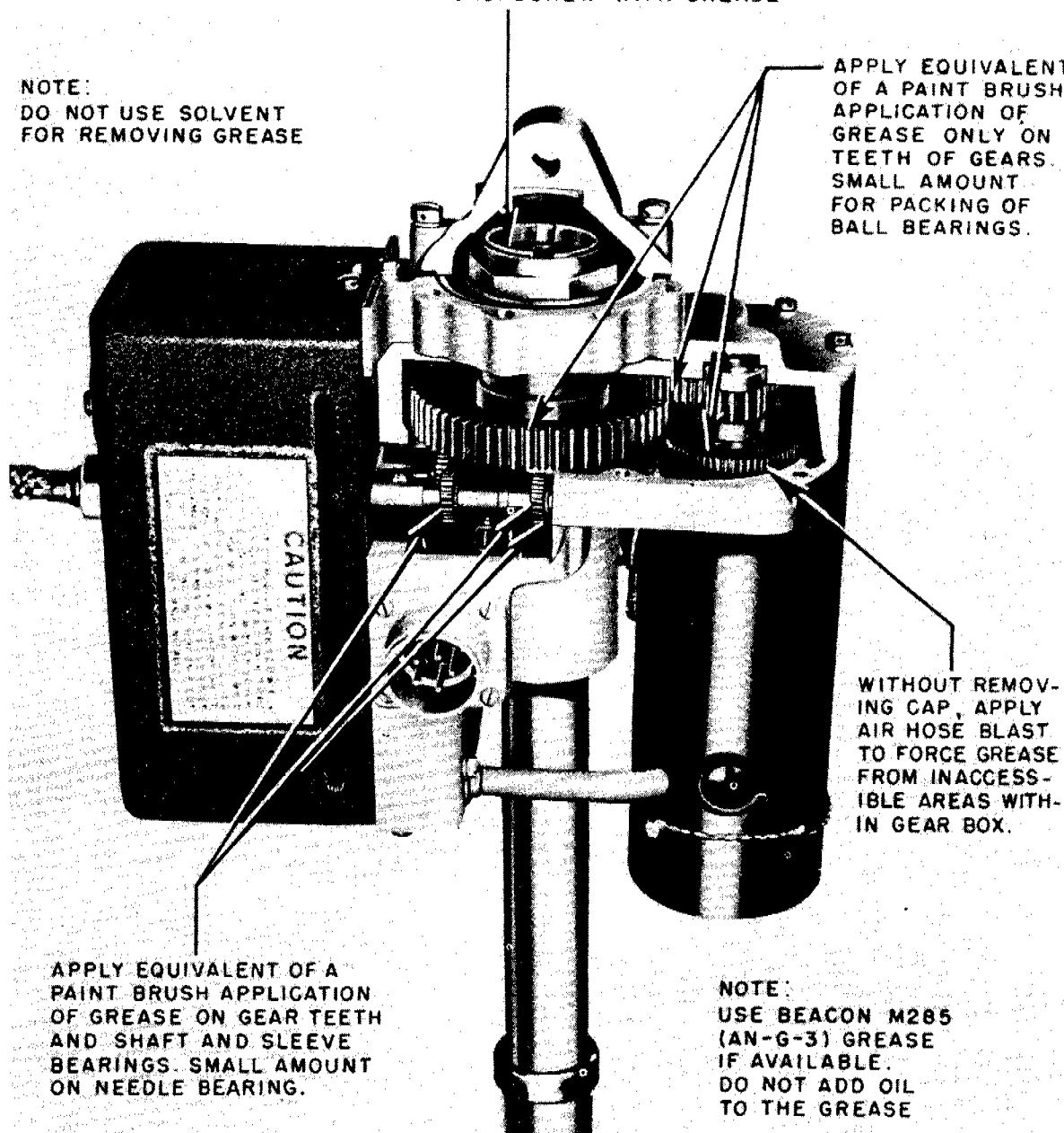
d. Removal of motor.

APPLY EQUIVALENT OF A
PAINT BRUSH APPLICATION
OF GREASE ON JACKSCREW
AND BETWEEN THREAD AND
BAKELITE BUSHING AT END
OF JACKSCREW. DO NOT
CLOSE HOLE IN CENTER OF
JACKSCREW WITH GREASE

NOTE:
DO NOT USE SOLVENT
FOR REMOVING GREASE

APPLY EQUIVALENT
OF A PAINT BRUSH
APPLICATION OF
GREASE ONLY ON
TEETH OF GEARS.
SMALL AMOUNT
FOR PACKING OF
BALL BEARINGS.

Figure 3
Actuator -
View
Showing
Application
of Grease



reassembly, then disconnected and coiled carefully up out of the way.

(2) Disconnect the actuator from the bellcrank and the supporting member, and remove the actuator from the airplane.

(3) If a spare dust cover is available, it should be fastened over the control unit. In any event, great care must be taken to prevent injury to the component parts of the control unit, and to prevent dirt or foreign matter from falling into parts.

c. Inspection and degreasing of the coolant and oil exit flap actuators will be accomplished as follows:

(1) The diastat mounting plate must be disconnected and moved over to one side. (See figure 1.) The limit switch operating cam should be positioned as shown in figure 1, prior to disassembly. This may be accomplished by energizing the motor through the plug connector on the actuator, using a power source of 24 volts. The connector pins are connected as follows:

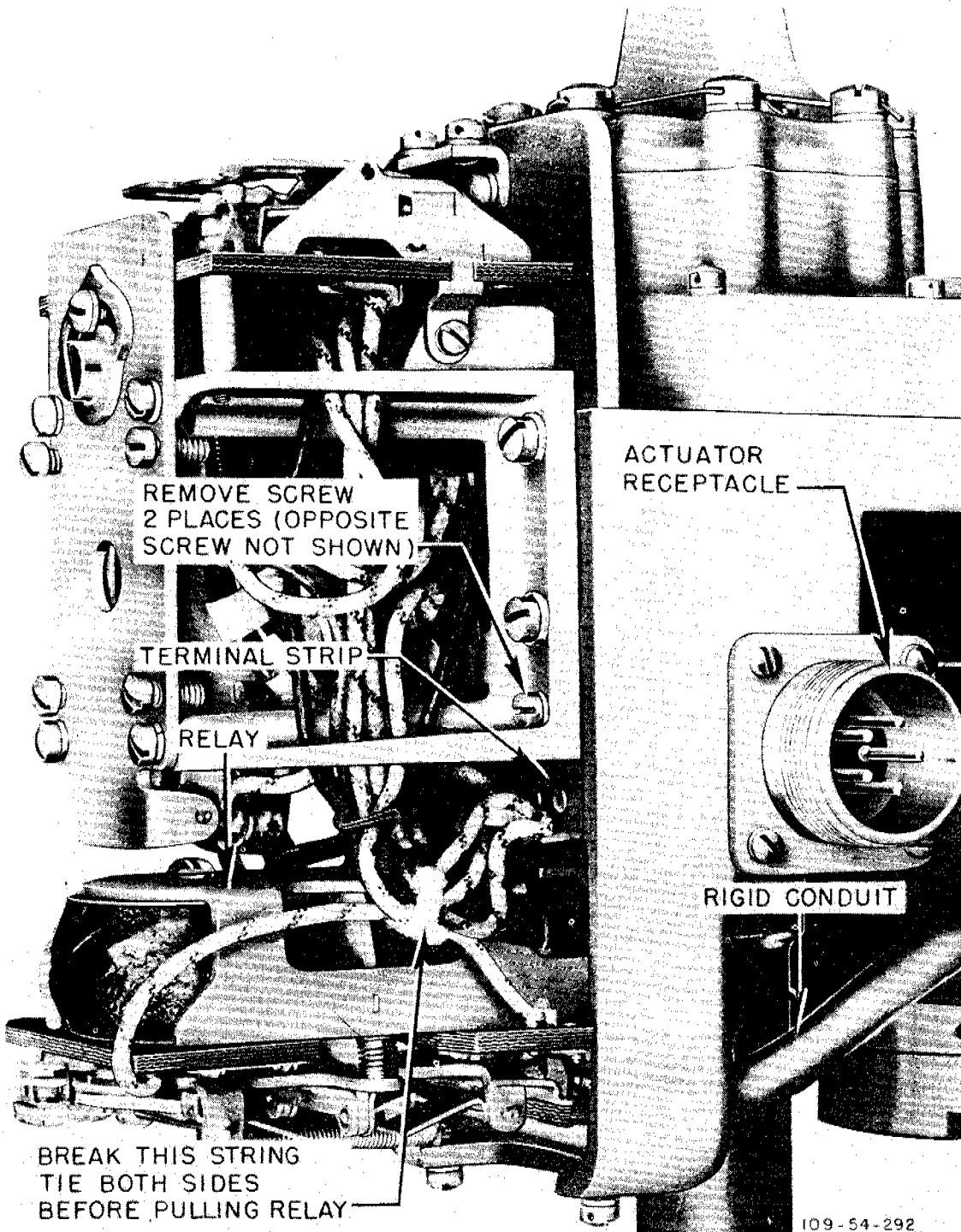


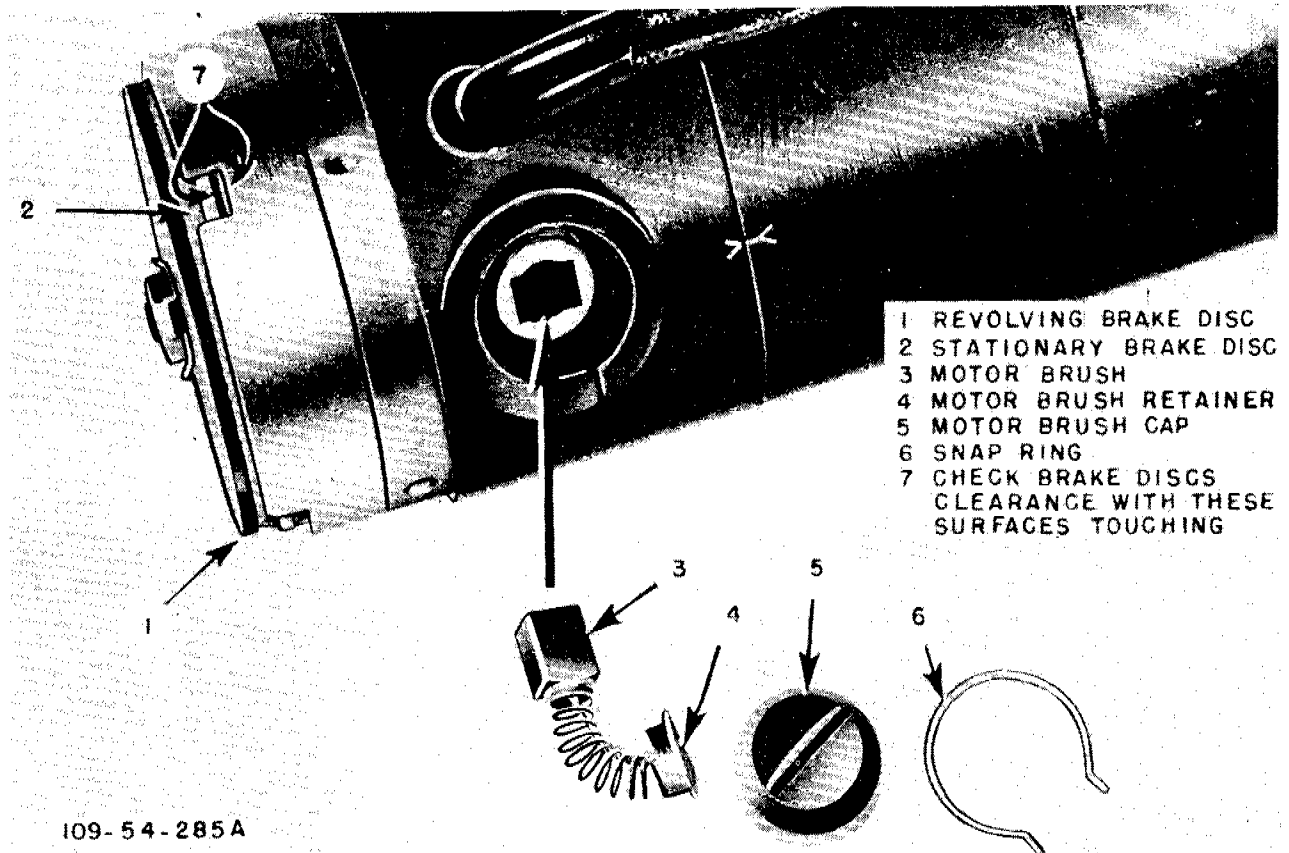
Figure 6
Actuator Control Unit -
Side View

(1) To insure free action of the motor brake, the four projections of the stationary brake disc (5, figure 8), and the four notches in the motor housing (figure 10) will be chamfered .006 to .010 inch as shown on figures 8 and 10.

(2) Before reassembling the motor brake, make certain that the brake spring, when compressed, fits loosely in the recess in the motor end housing. That is, the spring should not wedge or bind in the recess whatsoever.

(3) Thoroughly clean all grease from the brake discs and parts, and reassemble the motor brake in the sequence shown in figure 8.

(4) Check the brake clearance to insure proper and uniform clearance. Push in on each of the stationary disc projections in turn, compressing the brake spring. As each projection is compressed, check the clearance with a feeler gage. Rotate the motor disc 90 degrees and repeat the check. Rotate the disc 180 degrees from the first position and again repeat the



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Figure 5 - Actuator Motor - View With Motor Brushes and Motor Brake Cover Removed

(1) Remove the three remaining screws holding the motor relay to the limit switch housing (figure 2), and lift the relay assembly away from the control unit as shown on figures 6 and 7.

(2) Dismount the fiber motor terminal strip from limit switch housing (figure 7), and make notes to insure proper polarity for reconnection, and unsolder the motor leads from the terminal strip. Pull the motor and motor leads free of the limit switch housing, exercising care not to injure wire insulation.

e. Cleaning of motor.

(1) Mark the housing sections of the motor with alignment marks as shown on figures 2 and 3, and remove brushes if not already removed.

(2) Remove the motor through bolts.

(3) Separate the motor pinion cover from the motor, taking care not to lose the spacer washers inside the cover.

(4) Remove the motor brake cover (10, figure 2), and disassembly the motor brake as shown in figure 8.

(5) Remove the armature from the housing, pull the two bearings, and wipe excess grease from the bearings. Lay the bearings aside for reinstallation.

(6) Wipe all grease from the motor parts, submerge in a suitable solvent and wash thoroughly. Blow the cleaning fluid from the armature and fields, and dry with an air hose.

(7) Be certain to remove any grease or oil that might be in the motor conduit.

(8) Reinstall the two bearings and reassemble the armature in the motor housing. Do not reinstall the pinion cover or the brake assembly.

f. Rework of motor pinion cover.

(1) Pinion covers that have not been slotted for venting as shown in figure 9, will be reworked in accordance with the instructions contained therein. Be careful not to exceed the maximum depth of .062 inch.

(2) Clean the cover of all metal chips and reinstall the pinion cover.

(3) Check motor shaft for end play. Clearances should be .002 inch minimum, .005 inch maximum. End play can be varied by adding or reworking spacer washers.

g. Modification and adjustment of motor brake.

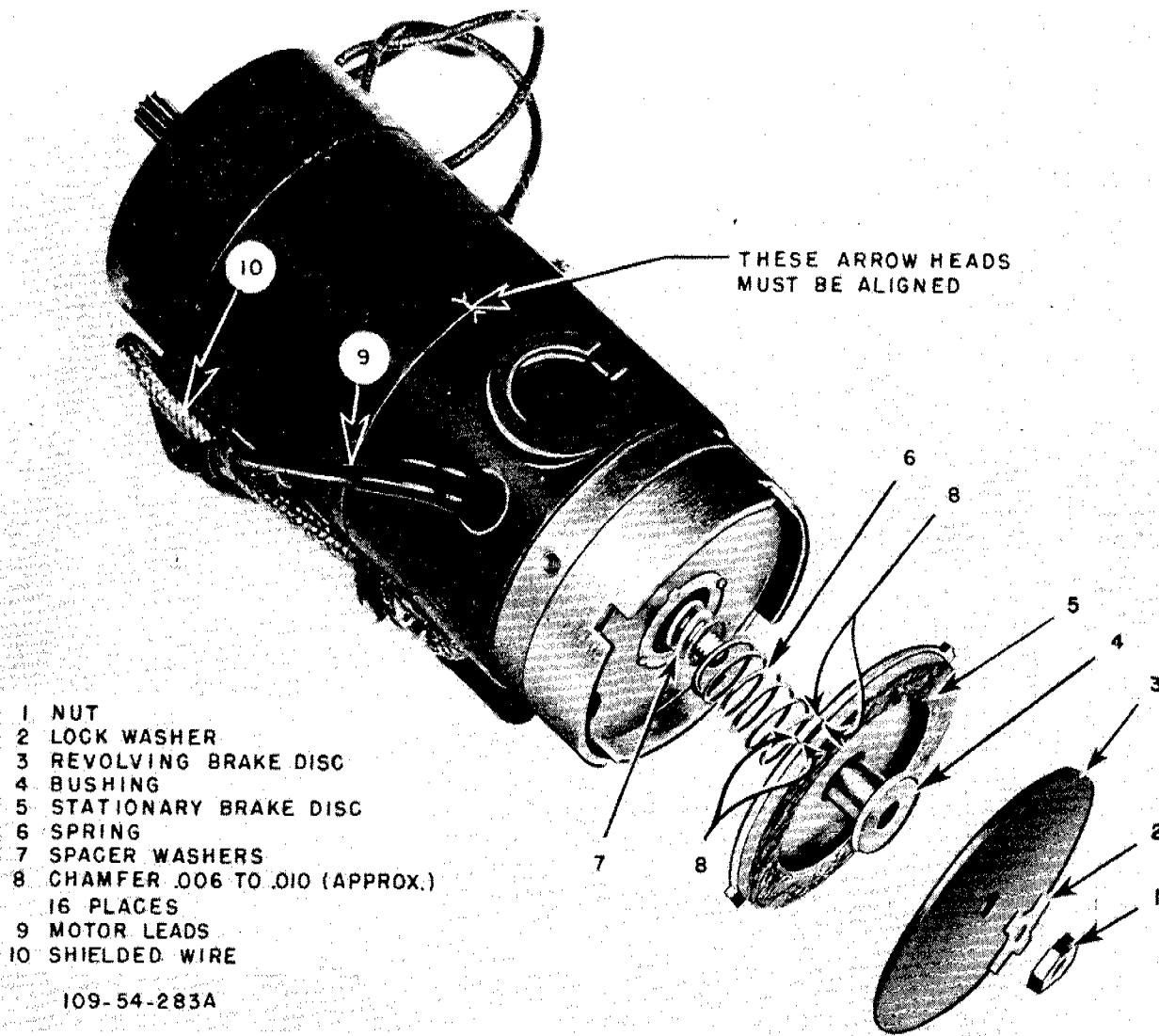


Figure 8 - Motor Brake - Exploded View

(4) It will be noted that the drilled head motor mounting screw is on the outside of the gear housing.

(5) Check the loose end of the shielded wire protruding from motor housing to insure against a short to ground.

(6) Make certain that the limit switch operating cam is still in its original position as shown in figure 1. It is very important that the cam does not move from this position when the gear case is reassembled. In addition, check to make certain that the cam on the jackscrew does not foul the interrupter switch lever (2, figure 4), as the case is closed.

(7) It should be noted that the limit switch cam setscrew must not be loosened at any time during disassembly or reassembly.

(8) Reinstall the housing screws and safety wire the screw heads.

(9) Check the control unit to insure that all parts are free of oil or grease. Special attention should be taken with all contacts.

NOTE Do not use sandpaper, emery or abrasives, on the electrical contacts. If it becomes necessary to dress the contacts, it will be done with a contact burnishing tool. Sharp or jagged points can be removed with a contact file. Rough contacts will be burnished or dressed with a minimum of material being removed.

(10) Check the clearance of the two limit switch actuating bars. There should be a clearance of approximately .002 inch, and they should be free to move in the guides.

(11) Reinstall the diastat mounting plate on the control assembly and check all wiring etc, to insure that the control unit is properly reassembled.

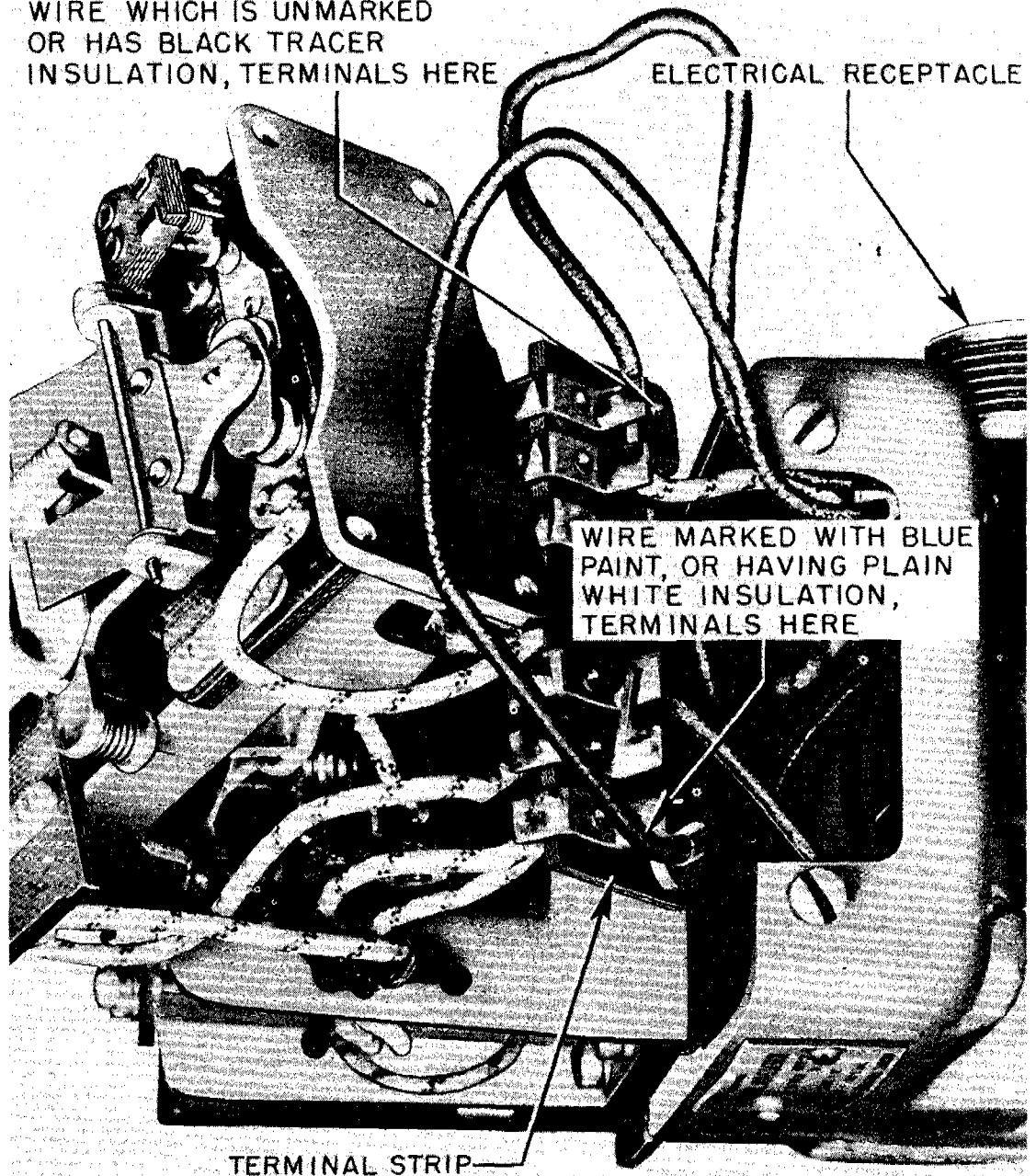
i. Manual operational check.

(1) Use a 24-volt DC power supply, and energize the motor for operation to one end or limit of travel. (See paragraph 2.c.(1).) Observe the rotation of the limit switch operating cam. When the large limit

WIRE WHICH IS UNMARKED
OR HAS BLACK TRACER
INSULATION, TERMINALS HERE

ELECTRICAL RECEPTACLE

Figure 7
Bottom View
of Control
Unit Relay and
Terminal
Shown



check. In the event excessive variations are noted, the cork faced disc should be removed and the thickness equalized by buffing the cork disc with sandpaper. The minimum clearance should not be less than .005 inch, and the maximum clearance should not exceed .010 inch.

(5) Now press the brake end of the motor shaft toward the motor, removing end play. A check of disc clearance in this position should give a minimum clearance of .002 inch. If the clearance between discs is too little or too great, add or remove washers (7, figure 8).

h. Reassembly of actuator.

(1) Reinstall the motor on the actuator, checking for proper connection of motor leads from notation previously made. Pull all excess length of wire out of motor and fold it behind the terminal strip and relay.

(2) Reinstall brushes and motor brake cover.

(3) Make certain that the motor grease seal is properly installed on the underside mounting face for motor of the limit switch gear housing. The felt washer should be held in place by a washer and snap ring.

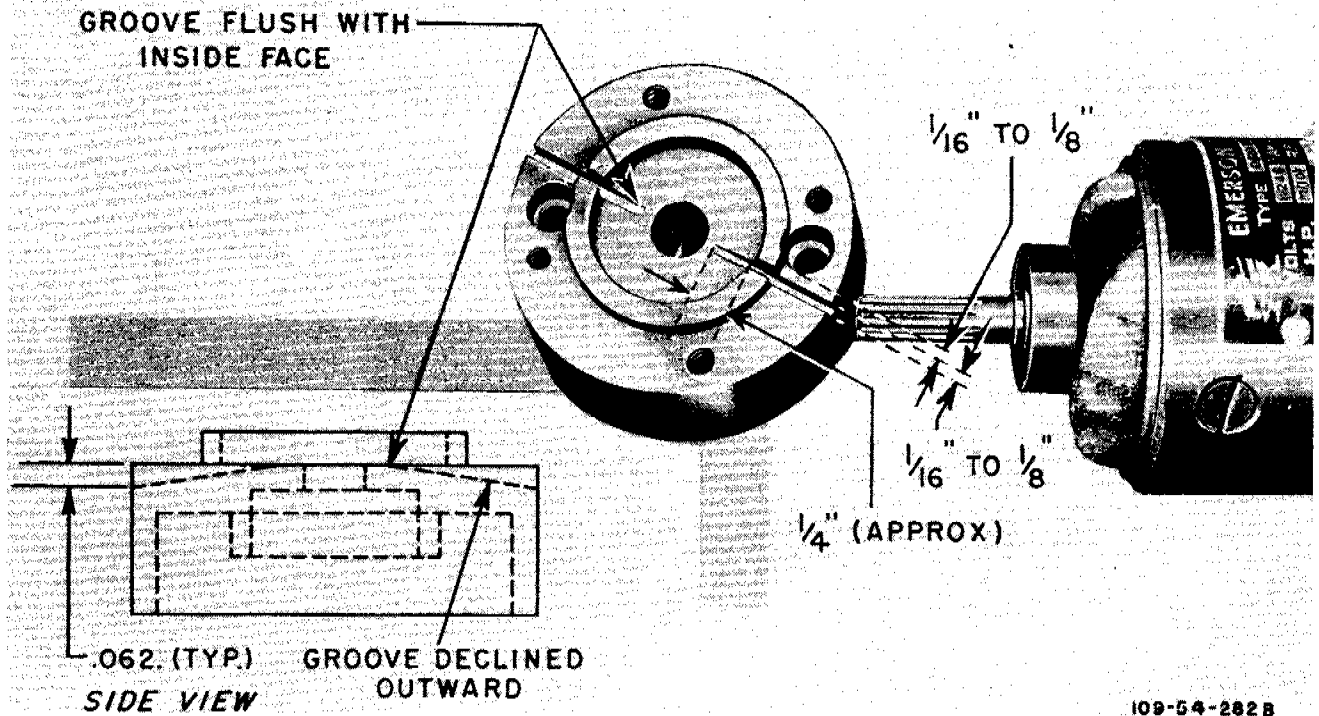


Figure 9 - Rework of Motor Pinion Cover

switch first snaps and power cuts off the motor at the contracted or extended position of the jackscrew, check the point of contact between the limit switch operating bar and the limit switch cam. This point of contact shall not be less than $1/32$ nor more than $3/64$ inch from the crest of the cam, as shown in figure 1 (measurements taken along face of cam). This point of contact can be arrived at by operating the unit very slowly in short pulsations. Make minor adjustments on limit switch lever tab, if necessary. (See figure 1.)

(2) Energize the motor to operate to the opposite limit of travel. When limit switch first snaps and power cuts off the motor, again check point of contact between cam and switch operating bar. Point of contact shall be same as in paragraph 2.i.(1). (See figure 1.) Again make minor adjustments on limit switch lever tabs, if necessary. (See figure 4.)

(3) The points on the small limit switches must always open before those of the corresponding large limit switch. To check this condition, hold unit vertically so that the porcelain pin rests on the small limit switch spring. (See figure 4.) Operate the unit in short pulsations or move the main limit switch bar slowly, using a screw driver as a lever. The travel of the porcelain pin and the opening of the small limit switch points should be .005 to .015 inch before the main limit switch points break contact. Make minor adjustments on the limit switch lever tab, if necessary.

(4) Energize the actuator for automatic operation. Jackscrew should operate to one limit and relay should come to neutral (all points open), indicating

locking relay circuit is open through small limit switch.

(5) As the diastat assembly is not connected to the unit, depress the diaphragm lever with a pencil eraser or wood dowel and operate to other limit; the same relay action should occur in this position (all points are open).

j. Paint the motor brake end of the actuator motor case white, to indicate that the subject rework has been accomplished. Also cement a placard on the unit reading as follows: "CAUTION: BRUSH BEACON M-285 (SPECIFICATION NO. AN-G-3) GREASE ON GEAR TEETH ONLY. PACK BEARINGS. AVOID EXCESS GREASE APPLICATION."

k. Reinstallation of coolant actuator.

(1) Reinstall the diastat (capillary line and temperature bulb) on the actuator control unit with the four screws previously removed.

(2) Hang the unit in the airplane by means of the upper or main fitting at the motor end of the actuator, using original parts removed. Leave the other end free to turn.

(3) After placing the cockpit control switch in the "OFF" position, plug in the electrical connector. Leave the driven end or lower fitting free to turn, and operate the unit by the manual position of the cockpit switch in the "CLOSE" position until the limit switch in the unit stops the motor. Place the cockpit switch in the "OFF" position.

CHAMFER FOUR EDGES OF EACH NOTCH
AS INDICATED BY ARROWS

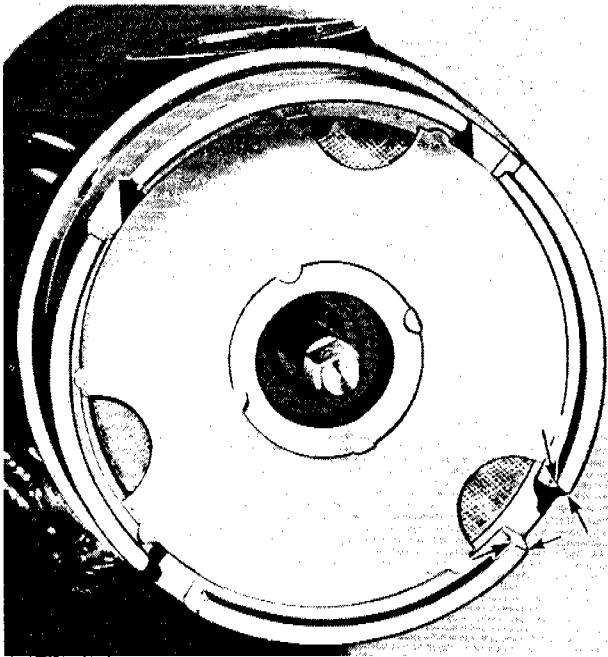


Figure 10 - Rework of Brake End of Motor Case

(4) Grasp the driven-end fitting on the actuator and turn it to the right until the screw retracts to its shortest over-all length. Then back it off approximately $3/4$ turn, plus or minus $1/4$ turn to the left, and maintain this position of the screw jack for all further phases of its adjustment of the scoop flap.

(5) Screw into the actuator's driven-end fitting, the end of the rod assembly that connects the actuator to the scoop flap. This rod should be screwed in until the hole through its threaded part is approximately in the center of the slot in the driven-end fitting.

(6) Locate and mark the position of the scoop flap that will clear the jammed closed position at its point of jamming by $1/4$ inch plus or minus $1/16$ inch.

(7) The final adjustment is that of having the connecting rod assembly screwed into the driven-end of the actuator just enough so that when the lower end of

the connecting rod is attached to the scoop flap and the actuator screw jack is in the predetermined position, the scoop flap matches the clearance mark as located in paragraph 2.k.(6). Use the attaching parts originally removed from the installation.

1. Reinstallation of oil actuator.

(1) Install the diastat (capillary line and temperature bulb) on the actuator control unit with the four screws previously removed.

(2) Hang the unit in the airplane by means of the main fitting at the motor end of the actuator, using the original attaching parts.

(3) After the control switch in the cockpit has been placed in the "OFF" position, plug in the electrical connector.

(4) Hold or support the unit so that the screw jack may turn freely and operate the unit by the manual position of the control switch in the cockpit in the "OPEN" position until the limit switch in the unit stops the motor. Place control switch in the "OFF" position.

(5) Grasp the driven-end fitting on the actuator and turn it to the right until the screw contracts to its minimum length. Then back it off approximately $1-1/4$ turns, plus or minus $1/4$ turn, to the left, and connect it to the bell crank, using the original attaching parts. During other phases of adjustment, this setting of the fitting to the bell crank must not be disturbed.

(6) Operate the unit with the cockpit switch in the "CLOSE" position until the limit switch stops the motor. Check the scoop flap for $3/16$ plus or minus $1/16$ -inch clearance between the duct and the flap. Adjust the fitting on the upper end of the connecting rod to match its corresponding arm of the bell crank if necessary.

3. No special parts will be required to accomplish this work.

4. It will take a crew of 2 men approximately 7 hours to accomplish this work.

5. There will be no change in weight due to this rework.

By Command of General ARNOLD:

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