

Appendix 1

ROTAX, TYPE C5000 SERIES

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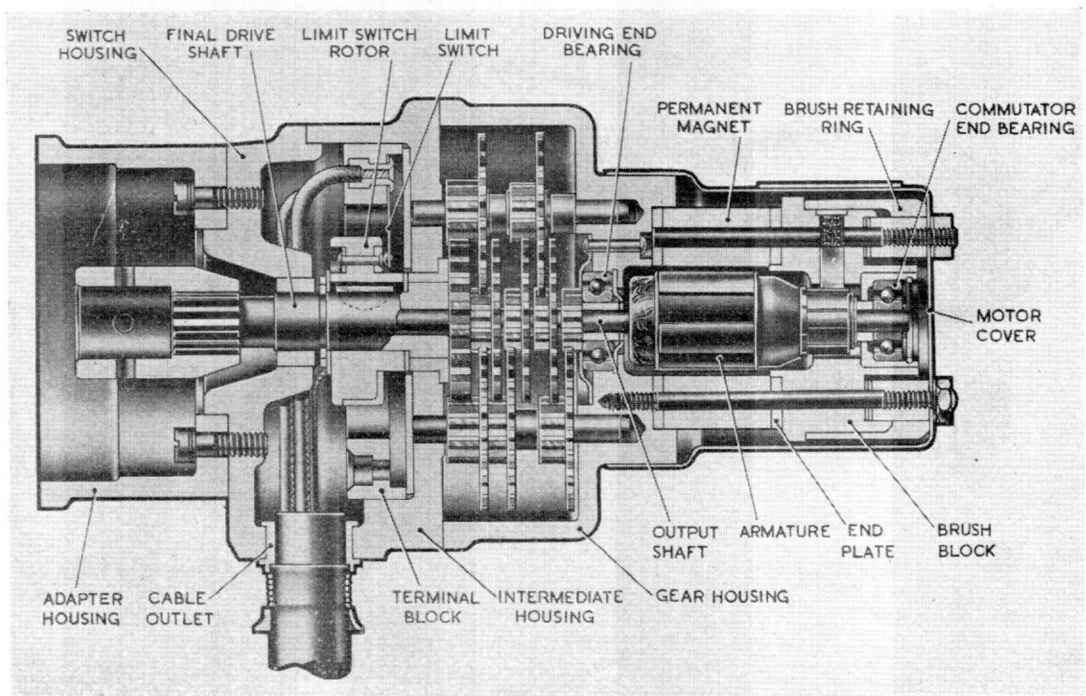


Fig. 1. Actuator, Type C5001, shown in section

Introduction

1. The Type C5000 series of rotary actuators has been developed for use on equipment where reversible rotary movement is required. The range covers a number of variations in mounting, type of connection, speed and torque output. Information which applies to specific types will be found in A.P.4343D, Vol. 1, Book 3, Sect. 16, and is additional to the information contained in the following paragraphs.

DESCRIPTION

2. The construction of the C5000 series of rotary actuators is illustrated in fig. 1. This shows a Type C5001 actuator which is typical of the series, except that some do not embody the adapter housing and coupling piece.

Motor

3. The motor operates on 28 volts and is a 2-pole permanent magnet machine. The armature shaft is supported in two ball bearings—one at the commutator end is housed in the brush block, and one at the driving end is housed in the gear housing. A pinion on the driving end of the armature shaft transmits the drive to the gear train.

4. Electrical connection to the motor is made by two wires leading from the terminal block, situated inside the intermediate casing, to clips which fit over the top of each brush box. These clips also compress the brush springs to the necessary length for producing the correct brush pressure.

Gear train

5. An 8-stage train of reduction gears reduces the speed of the final drive shaft to very much less than the speed of the motor and the reduction ratio varies for the specific types. The gears are carried on three layshafts, two of which locate in the gear housing and intermediate housing, and the third between the armature pinion and the final drive shaft.

Intermediate housing

6. The intermediate housing provides location for two of the layshafts. Two semi-circular terminal blocks provide the connecting points for external and internal electrical leads. The external electrical cable passes into the actuator through a cable outlet fitted in the circumference of the intermediate and switch housings.

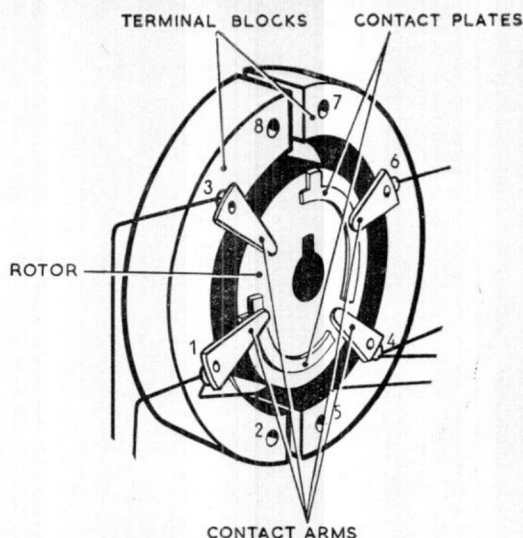


Fig. 2. Arrangement of limit switch

Limit switch (fig. 2)

7. The limit switch, where fitted, consists of contact arms fastened to the four terminals on the terminal blocks, and a rotor secured to the final drive shaft. Two contact plates are inserted in the rotor, and the ends of the contact arms bear on the plates. The positions of the contact arms and plates, relative to one another, govern the amount and direction of rotation of the final drive shaft.

8. The switch housing fits in the end of the intermediate housing, completely enclosing the limit switch.

Adapter housing

9. The adapter housing is fitted on some types and not on others. It is secured to the end face of the switch housing and protects the drive coupling. The housings are fitted to accommodate special installation requirements and vary in shape and the position of the securing holes.

OPERATION

10. The actuator may be operated in a clockwise or anti-clockwise direction by reversing the flow of current in the armature of the motor. When current is fed through the brushes to the armature, the actuator operates in the direction of rotation selected by the appropriate switch, until it reaches a position where contact between the contact arm on the terminal block and the contact

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plate on the rotor is broken. At this point, the limit switch makes connection with the other circuit which allows the actuator to rotate in the opposite direction upon operation of the switch.

11. The maximum amount of rotary movement is 90 degrees with a variation up to 1.5 degrees above 90. The machine may be stopped at any intermediate position and may be made to rotate in either direction.

INSTALLATION

12. Information on the installation of the actuators will be found in the relevant Air Publications for specific aircraft. It is important that care be exercised when making the electrical connections, as a reversal of leads will reverse the direction of rotation indicated in the relevant circuit diagram.

13. The actuators will operate satisfactorily in any position, but to obtain maximum operating efficiency they should be mounted vertically.

SERVICING

14. Normal servicing of an actuator will not necessitate any dismantling other than removing the motor cover to obtain access to the brushgear.

Brushgear

15. Service the brushgear as follows:—

- (1) Remove the motor cover together with the brush retaining ring and remove the brushes from their holders.
- (2) Check the length of the brushes to ascertain if they are long enough to perform satisfactorily until the next servicing period. The minimum length is $\frac{3}{32}$ in., and if new brushes are to be fitted they should be bedded to the contour of the commutator.
- (3) Badly chipped or cracked brushes should be removed and new ones fitted.
- (4) Ensure that the brushes are a free fit in the holders.
- (5) Place the brush and spring assembly on a scale and compress the spring to 0.172 in.; the reading on the scale should be 1.25 oz.

Lubrication

16. The actuators are lubricated during manufacture and repair and should not need further lubrication during servicing periods.

General

17. Check the security of all soldered leads. Ensure that all external nuts, screws and locking devices are secure. Examine the electrical connections for security and damage, and the cable for frayed or damaged insulation.

18. At the end of the servicing operations, ensure that all the components are in their correct positions, and replace and secure the motor cover.

TESTING

19. All the C5000 group of actuators should be tested for satisfactory operation by connecting them to a suitable 28-volt circuit.

20. Since these actuators have permanent magnet field motors, it is preferable to use a pure d.c. supply when testing. If a d.c. supply is not available, however, it is permissible for functional tests only, to use an a.c. supply which has been rectified by a suitable rectifier unit, e.g., R.A.F. Type 37 (Ref. No. 5P/2908) or Admiralty Types "Westruk 609" and "Westruk 829."

Note . . .

When "testing to specification," pure d.c. only must be used.

21. It is important to ensure that the supply polarity is correct, since with a reversal of polarity it is possible for the switch cam to overrun the switch contacts in the opposite direction to that required to operate the unit correctly, thus leaving the electrical system in an open-circuited condition.

22. Test the insulation of all the live parts to the frame by a 250-volt insulation resistance tester. A reading of not less than 50,000 ohms should be obtained.

Note . . .

This value of resistance applies to units being tested under normal workshop conditions. Due allowance should be made for the climatic conditions of the locality where the tests are being applied. In particularly damp climates the readings may be low enough to give apparently sufficient reason for rejection; in these instances discretion should be exercised.

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DESCRIPTION AND OPERATION**Motor**

2. The motor is a 2-pole series wound type incorporating a split field, and electrical connections are made from both sections of the field to a switch mechanism located at the end of the epicyclic reduction gears. Change-over from one section of the field to the other, causing a reversal of rotation of the motor, is accomplished by means of the switch which is semi-automatic in action.

3. The field coils and laminated core assembly is a press fit in the motor housing and is secured by two bolts.

4. The armature and commutator are assembled on a hollow shaft which is carried in two ball bearings, one each end of the shaft.

5. The brush boxes are attached to an insulated brush ring which is secured to the commutator end frame by screws.

Clutch

6. The drive from the motor to the epicyclic reduction gearing passes through a clutch which consists of a single plate interposed between the motor and the gearbox. The clutch plate is lined and keyed to the armature shaft and rotates at the same speed as the motor. A rod for adjusting the clutch pressure passes through the hollow armature shaft, and adjustment is effected by screwing the nut which varies the tension of the clutch spring controlling the pressure on the clutch plate. Access to the adjusting nut can only be obtained after the solenoid brake assembly has been removed.

Gearbox

7. The drive from the motor passes through a 4-stage epicyclic gear train which gives a reduction in speed of 625 to 1 from the motor to the driving spindle. Each stage consists of three planet pinions which mesh with an annular gear.

8. On those actuators where an auto-switch is incorporated, a further epicyclic gear train, giving an additional 4 to 1 reduction, is fitted to rotate the auto-switch operating cam. When there is no auto-switch incorporated, this additional gear train is not fitted.

Auto-switch

9. The auto-switch operates when the driving spindle has reached the end of its allotted

angular movement, and stops the motor by automatically cutting off the electrical supply. A switch on the pilot's instrument panel controls the direction of rotation of the driving spindle at any position in its angular travel except at the limit of its travel, when further movement can be only in the reverse direction.

10. Operation of the switch is brought about by the lobes on the operating cam which is driven by the epicyclic gear train. The auto-switch mechanism consists of small spring-loaded levers carrying silver contacts. The outer contacts are stationary and the inner contacts are moved to make connection with them at the correct periods determined by the positions of the lobes on the operating cam. The cam operates plungers which transmit the motion to the inner contacts.

Solenoid brake

11. The solenoid operated brake is designed to prevent creepage of the motor after it has been switched off.

12. The solenoid is connected in series with the armature, and the brake remains on until current is passed through the solenoid; this happens immediately the actuator is switched on.

13. The brake disc is keyed to the armature shaft, and adjacent to the disc is the brake spindle, the face of which is lined and makes pressure contact on the face of the brake disc when the motor is switched off. When the brake solenoid is energized, the brake spindle is drawn away from the disc and the motor is free to rotate. A coil spring, located between the end of the brake spindle and the solenoid cover, provides the pressure on the brake spindle to produce the braking effect.

INSTALLATION

14. Installation of these actuators should present few difficulties if a suitable mounting and adequate clearance space is provided. Care should be taken to ensure that the fixing strap is between the ribs on the motor housing. It is important to ascertain the angular position of the driving spindle before connecting an actuator to the equipment it is to operate; this is to ensure the correct angular and directional position of the actuator spindle relative to the equipment. For information on the installation of actuators in specific aircraft, reference should be made to the relevant Aircraft Handbook.

SERVICING

15. Normal servicing of these actuators will necessitate the removal of the cover band to obtain access to the brushgear, and the removal of the terminal cover to obtain access to the terminals.

16. The actuators are lubricated during manufacture and major servicing, and should not need further lubrication.

Brushgear

17. Service the brushgear as follows:—

- (1) Check that the pressure of the brush springs is within the stated limits.
- (2) Remove the brushes from their boxes and check their lengths to ascertain if they are long enough to perform satisfactorily until the next servicing period. They should be renewed when the top of the brush is flush with the brush box, and new ones should be bedded to the contour of the commutator.
- (3) Severely chipped or cracked brushes should be removed and new ones fitted.
- (4) Ensure that the brushes move freely in their boxes without excessive play.

General

18. Check the security of all the electrical leads and examine the insulation for fraying and damage.

19. Examine the terminals for security and tighten them up as necessary. Check all nuts, screws and locking devices for security.

20. Examine the motor for traces of oil and, if any is evident, investigate the source and rectify the fault, as oil will cause rapid deterioration of insulation.

21. Test the insulation between all the live parts and the frame by a 250-volt insulation resistance tester. If a reading of less than 1 megohm is obtained, the actuator will be unserviceable.

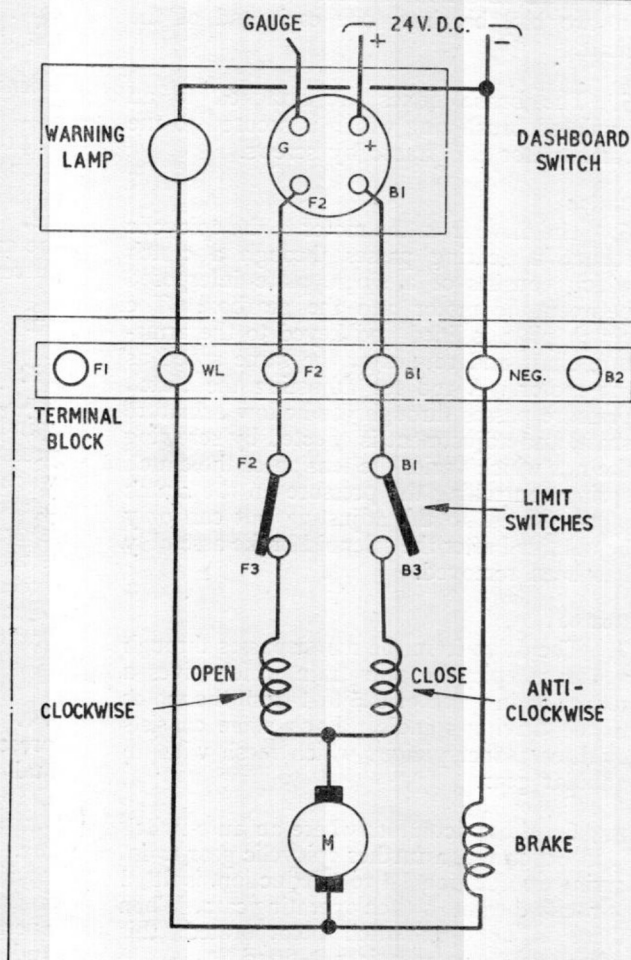
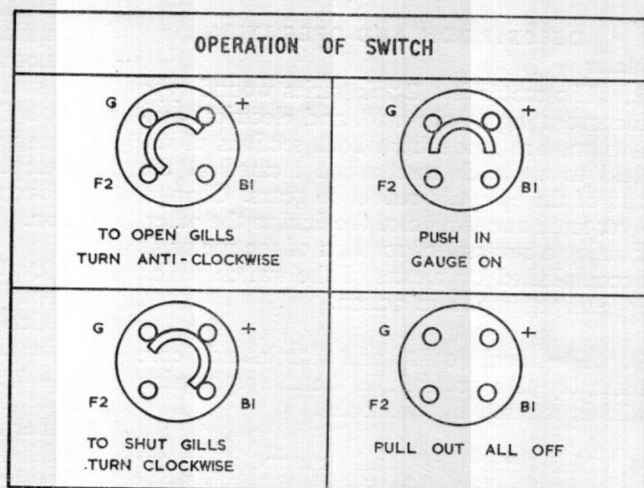


Fig. 3. Switch operation and wiring diagram

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