Appendix 11

PLESSEY, SQUIRREL SERIES

LIST OF CONTENTS

LIST OF ILLUSTRATIONS

Introduction

1. Plessey rotary actuators of the Squirrel series follow the general design described in this Appendix; the actuator illustrated, the Type CZ75792, is typical of the series and the specific details of individual actuators will be found in A.P.4343D, Vol. 1, Book 3, Sect. 16. They vary in such details as the working load and the distance and time of angular travel.

2. The Squirrel rotary actuator is a light-weight, compact unit, which provides a

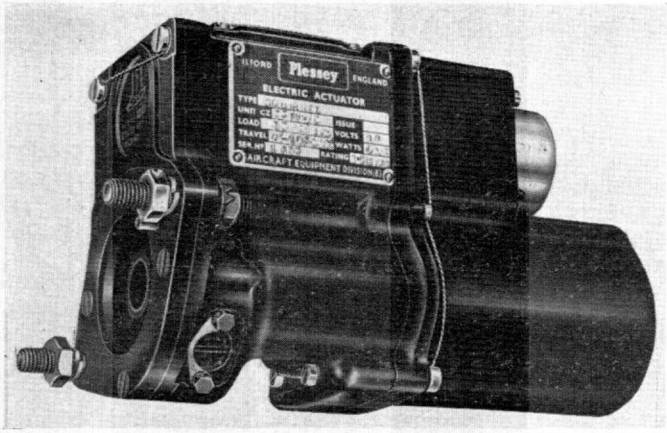

Fig. 1. General view of actuator

relatively high torque and is designed for the remote control of aircraft fuel cocks, air valves or similar devices requiring operating torques up to a maximum of 75 lb. in.

3. Motive power in the actuator is provided by a small electric motor, the drive shaft pinion of which engages with a train of gears. Limit switches are fitted to switch off the motor supply automatically when the actuator reaches the end of its rotary arc of travel.

Limit switches

6. The purpose of the four limit switches is to break the motor supply when the actuator drive shaft has rotated the required amount in either direction. The actual tripping of the switches is performed by two cams which are rotated by the final gear of the gear train.

7. These micro switches are of the snap action, single-pole, changeover type and are secured to a mounting bracket. The mounting bracket is secured to the actuator body

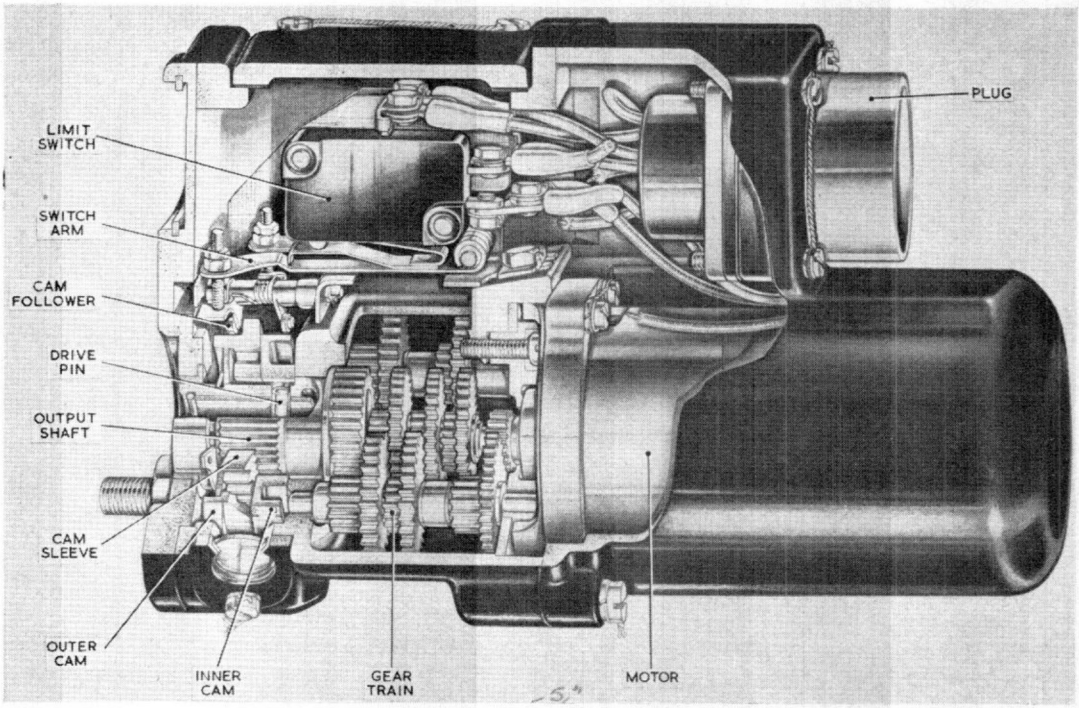

Fig. 2. Sectional view of actuator

DESCRIPTION

Motor

4. The motor, which is of conventional design for actuator operation is a split-field, series wound, reversible machine, incorporating an electro-magnetic brake, which rapidly stops the actuator movement with a minimum of over-run when the supply is switched off. It is attached to the actuator body by means of two 6 B.A. (drilled head) screws and spring washers.

Actuator housing assembly

5. The actuator housing contains the gear train, the limit switch operating cams, the four limit switches and visual indicator. Half of the electrical plug, together with its associated wiring protrudes into the housing. by two screws and spring washers. The switch terminals are accessible from the top of the mounting bracket.

Switch operating mechanism

8. The switch operating mechanism varies with different types of actuators in the series; for details see the relevant chapter in A.P.4343D, Vol. 1, Book 3, Sect. 16.

Switch cams

9. The two cams, which control the positions at which the limit switches operate, are driven from the final gear of the gear train.

10. The 0° and 180° positions are controlled by the inner cam, which has engraved on its periphery the principal angles of rotation; the engraving can be seen through the

window in the actuator body. This cam has a single track and is mounted directly on the serrated portion of the output shaft. The number of serrations on the shaft is 36, thus permitting angular adjustment between cam and shaft in 10° steps. This adjustment is used to vary the datum position.

11. The intermediate position, e.g. 90°, is controlled by the outer cam, which has two tracks, one for the clockwise approach to the intermediate position and one for the counter-clockwise approach. This cam is internally serrated with 24 serrations and is mounted on a sleeve (externally serrated with 24 serrations and internally with 36 serrations) which, in turn, is mounted on the serrated output shaft. The combination of the 24 and 36 serrations permits the cam to be adjusted with respect to the output shaft in 5° steps.

12. The cams and the cam sleeve are retained on the output shaft by a washer and a circlip. Both cams and the sleeve are engraved with index marks, which are used in conjunction with marks on the output shaft and the actuator body to set the required travel (*fig.* 3).

Electrical connections

13. Connections from the external circuit are made by means of a Plessey 9-way socket CZ56101 (Ref. No. 5X/6379), which mates with a 9-way plug mounted on the actuator motor cover. The internal connections to the actuator plug pins are given in the relevant chapter in A.P.4343D, Vol. 1, Book 3, Sect. 16.

14. The actuator is wired with Lewcos 360 14/36 s.w.g. double glassbraid covered, flexible conductors, sleeved with $1\frac{1}{2}$ mm Vidaflex in the appropriate colours.

Actuator variants

15. The basic Squirrel is a universal rotary unit which can provide, without any mechanical adjustment, either 3-position working (0° to 90° to 180°), 2-position working (0° to 90°) or continuous rotation, depending solely on the plug pins selected for energization. Variants of the Squirrel actuator can easily be produced by altering the position of the limit switch operating cams. By this means, angular travels of between 10° and 175° (in steps of 5°) may be obtained. These

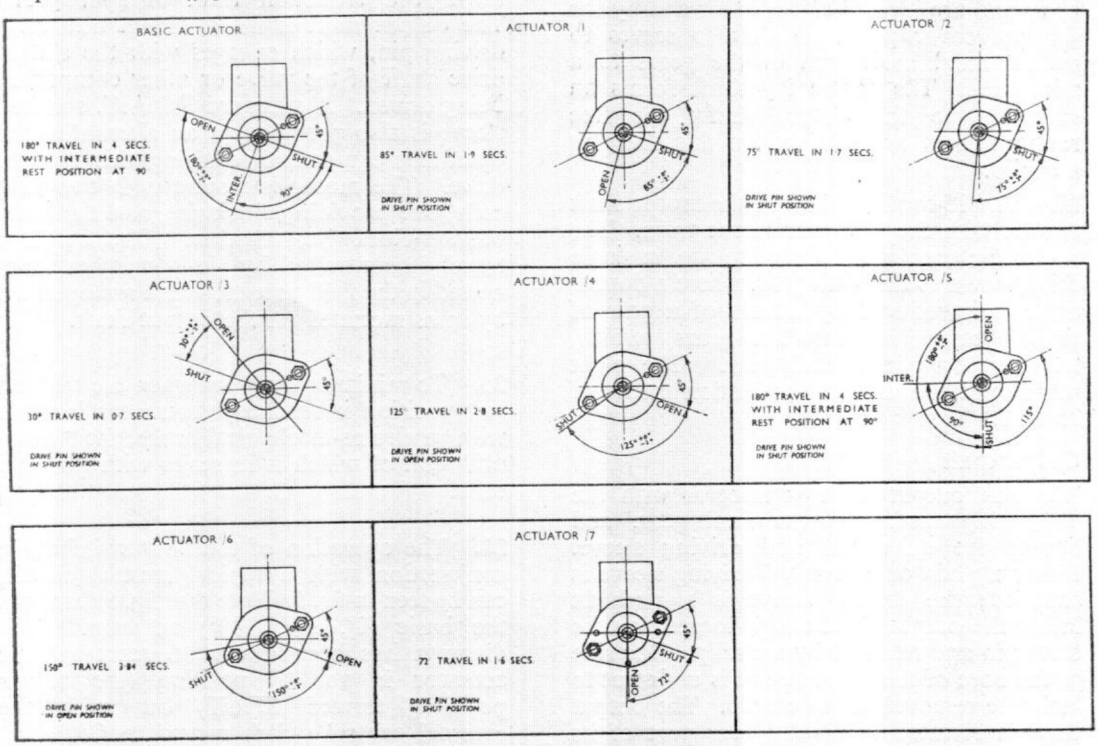

Fig. 3. Actuator variants, allocation of stroke numbers

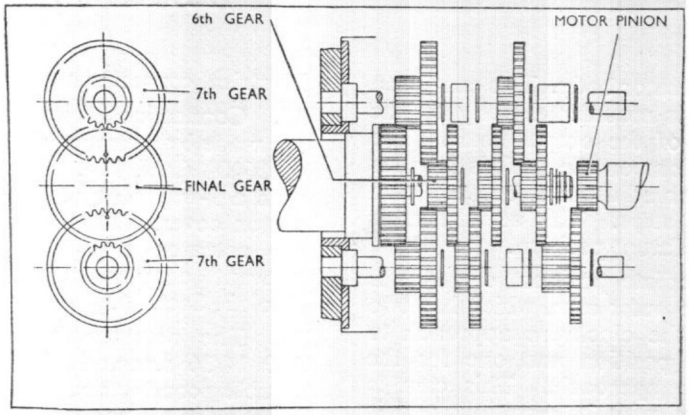

Fig. 4. Gear train

variants are identified by suffix numbers, viz., /1 for 0° to 85° travel, /2 for 0° to 75° travel, etc. (*see fig.* 3).

Gear train

16. The gear train consists of eight 40T × 15T double spur wheels running on three shafts as shown in fig. 4. The outer gear shafts are mounted at one end in the actuator body and are located at the other end by the gearbox cover plate, which also serves to restrict axial movement of the gears to a minimum. The centre lay shaft forms an extension to the output shaft; the free running gears are retained on this shaft by a circlip.

17. The 15-tooth pinion on the motor shaft meshes with the first gear in the train. The rest of the gears are arranged to run, in single drive, down to the sixth gear, where a double drive is introduced by means of a pair of timed gears (i.e., the 7th gears) which, together, drive the final gear. The eight stages provide a total reduction ratio of 2562: 1.

Output shaft

18. The output shaft is integral with the centre lay shaft and the final gear, and houses the drive pin and driving sleeve. Either a plain or a serrated driving sleeve is supplied; the driving sleeve is a push fit inside the output shaft and is located by the drive pin and retained by a circlip. One side of the bore of the output shaft is undercut to facilitate removal of the circlip. The output shaft is serrated externally over part of its length to locate the switch operating cams.

PRINCIPLE OF OPERATION

19. The principal components of the actuator can be seen in the sectioned illustration (*fig.* 2). The actuator circuit and the connections in a typical control circuit are shown in fig. 5. The actuator incorporates a fractional horse-power, split-field, series wound motor, which drives the output shaft through a reduction train of spur gears. The output shaft is fitted with a transverse driving pin, which engages with the slotted drive shaft of the valve or other component being driven. A standard S.B.A.C. serrated sleeve is also provided as an alternative for operating equipment requiring this type of drive. The motor is wound with two field coils, one providing clockwise, and the other counter-clockwise, rotation. The actuator travel is controlled by limit switches, connected in the field circuits, which are operated by cams mounted on the output shaft.

20. To minimize over-run when the selected rest position is reached, the motor is fitted with an electro-mechanical brake, the " hold-off " coil of which is in series with the field coils.

21. The operation of the limit switches, in conjunction with a typical control circuit, can be seen in fig. 5. Note that fig. 5 describes the basic (0°, 90°, 180°) actuator. The diagram has been drawn to represent the actuator in the 0° position (the datum position, termed SHUT) but with the external control switch moved to OPEN as shown. When the switch in the external

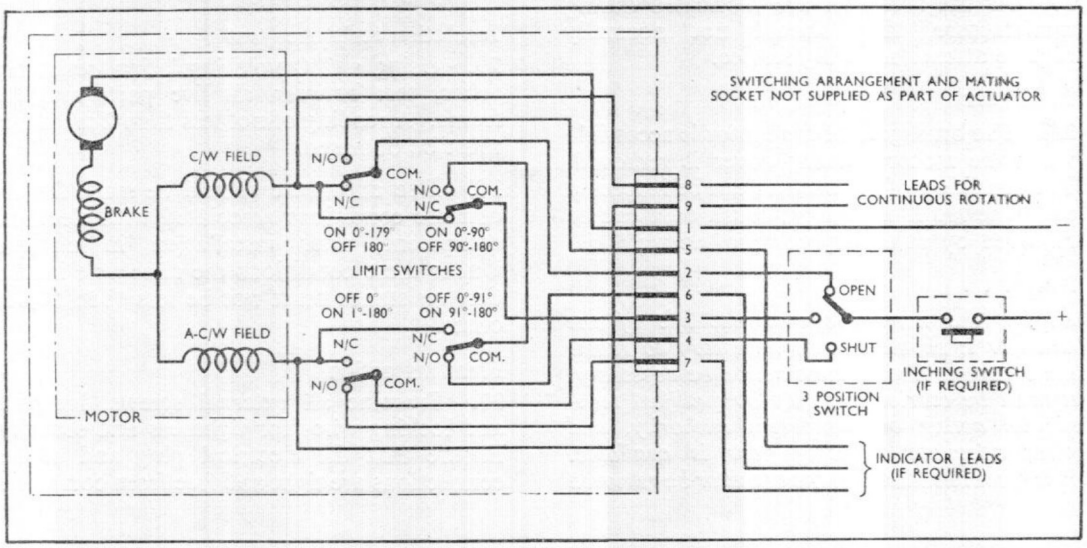

Fig. 5. Actuator circuit diagram and external connections

circuit is operated the following sequence of operations takes place:

(1) Selector switch moved to the intermediate or mid-position. The positive of the 28V supply is connected, via the external control circuit, pin 3 on the actuator connector and the GREEN (0°– 90°) limit switch, to the clockwise field coil and the brake "hold-off" coil. The brake is held off and the actuator output shaft commences to rotate clockwise. At 90° the GREEN limit switch is operated by the outer cam: this interrupts the circuit through the field coil, brake coil and armature, causing the motor to stop. The normally-open contacts now connect the supply to the indicator in the external circuit via the normally-open contacts on the BROWN limit switch and pin 6 on the connector.

(2) Selector switch moved to OPEN, or 180° position. The supply is now connected to the clockwise field coil, via pin 2 and the normally-closed contacts on the BLUE (180°) limit switch. The output shaft again rotates clockwise. At 180° the BLUE limit switch is operated by the inner cam breaking the motor circuit and feeding the supply to the indicator via pin 5.

22. A similar sequence of operations takes place when the selector switch is moved to the intermediate or the fully SHUT position, the rotation being controlled by the BROWN (91°– 180°) and RED (1°– 180°) limit switches.

INSTALLATION

23. Ensure that the actuator has the necessary fittings and is set to the appropriate angles of travel for the particular installation for which it is to be used. It is important to observe that the attachments are able to move freely and to ensure that the actuator and its associated load are both at the correct end of their travel before coupling them together.

24. Remove the protective cap from the electrical plug on the actuator and mate the plug and socket. Ensure that the mounting studs on the actuator, or the mounting holes fitted on other types of the same fundamental design, are in alignment with the holes in the mounting plate on the driven component.

25. The actuator is mounted in position by means of two $\frac{1}{4}$-in. B.S.F. studs which pass through holes in the mounting flange of the actuator body and protrude from the flange plate assembly, fitted at the drive end of the actuator, and held by nuts and spring washers.

26. After installation the actuator should be given a test to ensure that it functions correctly.

SERVICING

Lubrication

27. As the actuators are lubricated during manufacture, they should not normally require attention during service.

Brushgear

28. The brushgear of the motor is accessible when the motor housing cover is removed. The condition of the brushes can be inspected and renewed if necessary; brush dust can be removed by using dry compressed air.

Note . . .

During the normal operational life of the actuator it should not be necessary to renew the brushes. Should such action be necessary, it must be carried out only by qualified technicians acting on competent authority, and when adequate servicing gear is available. It is recommended that the actuator be removed for bay servicing in accordance with the instructions contained in the relevant Aircraft Servicing Schedule.

Insulation resistance test

29. Using a 250 volt insulation resistance tester, test between all live parts and the frame. A reading of not less than 2 megohms must be obtained.

30. Due allowance should be made for the climatic conditions associated with electrical equipment, after installation in aircraft. Under these conditions the allowable insulation resistance must not be less than 50,000 ohms.

Final inspection

31. Examine all external screws, locknuts and locking wires for tightness and security. Ensure that the electrical plug and socket connections are tight and free from corrosion.

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