# Chapter 65

# ACTUATORS, ROTAX, A1500 SERIES

## LIST OF CONTENTS



## LIST OF ILLUSTRATIONS



## LIST OF APPENDICES

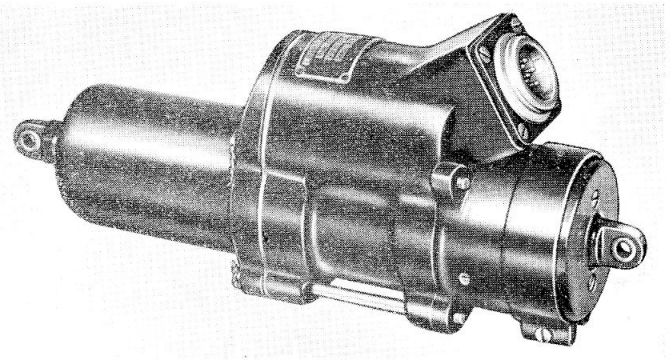

**Fig. 1. General view of typical actuator**

### Introduction

**1.** The Rotax A1500 series actuators are designed for general application in aircraft. Specific details of individual actuators will be found in Appendices to this chapter.

## DESCRIPTION

### General

**2.** The unit is of the linear type and consists of a reversible motor driving the ram through a single plate clutch and epicyclic gearbox. Snap action limit switches are incorporated and a release mechanism operates on the revolving annulus. A brake, normally "on", is electromagnetically released when the actuator is switched "on."

**3.** The construction of the unit is such that it falls broadly into three principal assemblies, each in its respective housing. These are the motor housing, with window strap, containing the motor, the gear housing containing brake, clutch, gearbox, and release mechanism, and the ram housing containing the ram, screwshaft and limit switches.

### Motor

**4.** This is a 24V d.c. split series type, one field being used to retract the ram and the other to extend it. The yoke and poles are manufactured from one set of laminations so that the poles are integral with the yoke. The two brushes are spring loaded on the commutator and are mounted in a moulded brushgear assembly, bolted to the motor housing.

**5.** The lap wound armature is carried in a ball bearing pressed into the motor housing at the commutator end, and at the other end the shaft is extended through the brake solenoid and clutch into a plain bearing in the driving plate which, in turn, is carried in a ball bearing fitted in the annulus.

### Brake and clutch

**6.** The brake assembly is a solenoid and disc about the armature shaft, the Langite lined brake disc being spring loaded against the drive plate by 16 helical springs. Energizing the brake solenoid (which is automatic on switching the actuator "on") attracts the brake disc, overcoming spring pressure and freeing the driveplate.

7. The drive between the motor and gearbox is carried by a spring loaded clutch plate bearing against the driveplate, the clutchplate being a sliding fit on the armature shaft. Relative rotation between the armature shaft and clutch plate is prevented by a pin through the armature shaft, registering in two diametrically opposite slots in the clutchplate.

### Gearbox

**8.** This is of three stage epicyclic construction, the first sun gear being integral with the drive plate. The first two planet carriers

also pass on the drive through integral sun gears, but the third carrier is spigoted into the end of the screwshaft. The annulus is split; the portion in which the first two planets revolve being fixed, and that in which the third gear turns being a rotating annulus controlled by the release mechanism. This annulus rotates in two rows of balls set in a recess in the gearbox wall.

**Release mechanism**

**9.** This consists of a solenoid and spring loaded plunger located in a bore of the gear housing, above the gearbox, the solenoid axis being parallel to that of the drive. The plunger has at its outer end a circular steel plate with three teeth on its periphery. Two of these teeth locate one each side of a pin guide on the housing, preventing rotation of the plunger. When the solenoid is energized the plunger is attracted into line with the annulus, against the pressure of its spring, and the third tooth then engages with teeth on the annulus circumference. This locks the rotating annulus.

**10.** This arrangement of the release mechanism ensures that when the solenoid is not energized, the third stage annulus is free to rotate, and that the ram will therefore extend or retract to its normal position as a result of air pressure being applied to the surface being controlled by the actuator.

**Ram and screwshaft**

**11.** The screwshaft has a flange at its driven end into which the last planet carrier is spigoted. Relative rotation between these two assemblies is prevented by three driving pins on the planet carrier face locating in holes in the shaft flange. The screwshaft flange is chamfered at both sides and carried in two thrust bearings set in a liner in the bearing plate, which is here clamped between the gear and ram housings. The screwshaft has a semi-circular helical groove along its entire length.

**12.** The ram, which is hollow and fits over the screwshaft, has a corresponding helical groove internally, extending in this instance for only four turns. Balls, located in these grooves, recirculate when the actuator is operating, thus providing a frictionless bearing for the linear extension and retraction of the ram.

**Limit switches**

**13.** These are located in the ram housing immediately above the ram. One of the snap action limit switches is operated at the fully extended position, the other at the fully retracted position by cams located on the ram.

**Note . . .**

*No attempt should be made to interfere with the limit switches. These are set to give the correct ram travel within the predetermined limits, and if the settings are altered they cannot be restored without removing the actuator to a workshop.*

## INSTALLATION

**14.** For details of installation of these actuators, reference should be made to the appropriate aircraft handbook.

## SERVICING

**15.** These actuators should be serviced in accordance with the general information in A.P.4343, Vol. 1, Sect. 17, Chap. 2, and the instructions contained in the relevant Servising Schedule.

**Brushgear**

**16.** The minimum length beyond which brushes should not be used is 0·200 in. Brushes should be renewed at periods prescribed in the relevant Servicing Schedule, and whenever examination reveals that they will not remain serviceable for the period that must elapse before the next servicing.

**17.** Brush spring pressure should be measured with a tension gauge (Ref. No. 1H/59), the reading being taken from the point where the arm bears on the brush, taking care not to damage the spring by lifting the arm too high. The correct pressure is between $2\frac{1}{2}$ and $3\frac{1}{2}$ oz. (71 and 99 gm.).

## Testing

**18.** If the serviceability of the machine is suspect, it may be tested as laid down in Appendix A.

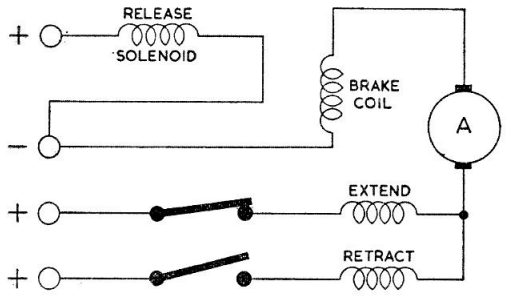


**Fig. 2. Circuit diagram**

# Appendix A

# STANDARD SERVICEABILITY TEST FOR ACTUATORS, ROTAX, A1500 SERIES

## Introduction

**1.** The following tests may be applied to the machine before it is put into service, or at any time when its serviceability is suspect.

## Test equipment

**2.** The following test equipment is required :—

(1) Tension gauge (Ref. No. 1H/59).

(2) Linear actuator test rig (Ref. No. 4G/5420).

(3) Insulation resistance tester, Type 0557/A.P.5047.

## Testing

*Brushgear*

**3.** Check the brush length and brush spring pressure; the brush length should be not less than 0·200 in., and the spring pressure should lie between $2\frac{1}{2}$ and $3\frac{1}{2}$ oz. (71 and 99 gm.) when the spring is 0·062 in. above the top of the brush box.

*Performance test*

**4.** Set the actuator on the rig, and ensure that it operates within the following limits.

| Applied voltage (volts) | Load (lb.) | Time for stroke of 1·5 in. (sec.) | Current (amp.) (max.) |
|---|---|---|---|
| 28 | 0 | 6·3 (max.) | 2·9 |
| 28 | 75 | 6·6 (max.) | 3·05 |
| 28 | 150 | 7·0 (max.) | 3·3 |

*Insulation resistance test*

**5.** The insulation resistance, when measured with a 250 volt insulation resistance tester between all live parts and the frame, should not be less than 0·05 megohm.

# Appendix 1

## ACTUATOR, ROTAX, TYPE A1501

### LEADING PARTICULARS

| | |
|---|---|
| **Actuator, Type A1501** | *Ref. No. 5W/349* |
| *Voltage* | *28V d.c.* |
| *Normal load* | *75 lb.* |
| *Static load* | *300 lb.* |
| *Stall load at 24V* | *270 lb.* |
| *Stroke* | *1·500 in.* |
| *Max. overrun* | *0·010 in.* |
| *Time of stroke* | *4 to 7 sec.* |
| *Distance between centres (retracted)* | *7·562 in.* |
| *Rating at 20 deg. C.* | *6 cycles* |
| *at 90 deg. C.* | *2 cycles* |
| *Operating temperature range* | *—75 deg. C. to +90 deg. C.* |
| *Brush length—* | |
| *New* | *0·358 in.* |
| *Minimum permissible* | *0·200 in.* |
| *Brush grade* | *DM.4* |
| *Brush spring pressure* | *$2\frac{1}{2}$ to $3\frac{1}{2}$ oz. (71 to 99 gm.)* |
| *Commutator diameter—* | |
| *New* | *0·571 in.* |
| *Minimum permissible* | *0·535 in.* |
| *Overall dimensions—* | |
| *Height* | *3·405 in.* |
| *Width* | *2·218 in.* |
| *Length* | *8·062 in.* |
| *Weight* | *1 lb. 14 oz.* |

1. The A1501 is identical with that described and illustrated in the main chapter.

# Appendix 2

## ACTUATOR, ROTAX, TYPE A1502

### LEADING PARTICULARS

| | |
|---|---|
| **Actuator, Type A1502** | *Ref. No. 5W/3557* |
| *Voltage* | 28*V d.c.* |
| *Normal load* | 75 *lb.* |
| *Static load* | 300 *lb.* |
| *Stall load at* 24*V* | 270 *lb.* |
| *Stroke* | 1·500 *in.* |
| *Max. overrun* | 0·010 *in.* |
| *Time of stroke* | 4 *to* 7 *sec.* |
| *Distance between centres (retracted)* | 7·562 *in.* |
| *Rating at* 20 *deg. C.* | 6 *cycles* |
| *at* 90 *deg. C.* | 2 *cycles* |
| *Operating temperature range* | —75 *deg. C. to* +90 *deg. C.* |
| *Brush length—* | |
| *New* | 0·358 *in.* |
| *Minimum permissible* | 0·200 *in.* |
| *Brush grade* | *DM*.4 |
| *Brush spring pressure* | $2\frac{1}{2}$ *to* $3\frac{1}{2}$ *oz.* (71 *to* 99 *gm.*) |
| *Commutator diameter—* | |
| *New* | 0·571 *in.* |
| *Minimum permissible* | 0·535 *in.* |
| *Overall dimensions—* | |
| *Height* | 3·609 *in.* |
| *Width* | 2·218 *in.* |
| *Length* | 8·062 *in.* |
| *Weight* | 1 *lb.* 14 *oz.* |

**1.** The A1502 is identical with that described in the main chapter, except for the introduction of a new gearbox housing, to accommodate a special 4-pole "Breeze" plug CZ28091. (Ref. No. 5X/6006).

# Appendix 3

# ACTUATOR, ROTAX, TYPE A1504

## LEADING PARTICULARS

| | |
|---|---|
| **Actuator, Rotax, Type A1504** | *Ref. No. 5W/* |
| *Voltage* | 28*V d.c.* |
| *Nominal load* | 75 *lb.* |
| *Static load* | 300 *lb.* |
| *Stall load at 24V.* | 270 *lb.* |
| *Stroke* | 1·500 *in.* |
| *Time of stroke* | 4 *to* 7 *sec.* |
| *Max. overrun* | 0·010 *in.* |
| *Distance between centres (retracted)* | 8·250 *in.* |
| *Distance between centres (extended)* | 9·750 *in* |
| *Rating at 20 deg. C.* | 6 *cycles* |
| *at 90 deg. C.* | 2 *cycles* |
| *Operating temperature range* | —75 *deg. C. to* +90 *deg. C.* |
| *Brush length—* | |
| *New* | 0·358 *in.* |
| *Minimum permissible* | 0·200 *in.* |
| *Brush grade* | *DM.4* |
| *Brush spring pressure* | $2\frac{1}{2}$ *to* $3\frac{1}{2}$ *oz.* (71 *to* 99 *gm.*) |
| *Commutator diameter—* | |
| *New* | 0·571 *in.* |
| *Minimum permissible* | 0·535 *in.* |
| *Overall dimensions—* | |
| *Height* | 3·609 *in.* |
| *Width* | 2·218 *in.* |
| *Length* | 8·875 *in.* |
| *Weight* | 2 *lb.* 3 *oz.* |

**1.** The A1504 actuator is used for oil cooling purposes on the Gannet aircraft Double Mamba engines, and is a strengthened version of the A1502 unit.

**2.** The strengthened A1504 unit has been introduced to obviate certain vibration difficulties experienced with the A1502.

**3.** The overall length of the A1504 has been increased, with a corresponding increase in the weight due to the redesigned and strengthened component parts.

**4.** The component parts affected, with the alterations incorporated in the A1504 actuator, are given as follows: —

| | |
|---|---|
| (1) Motor housing assembly | Housing section strengthened and shackle dimensions increased. |
| (2) Brush box assembly | High temperature moulding introduced with new trigger assembly incorporated. |
| (3) Electrical connection plug | High temperature 150 deg. C., Part No 2CZ84870 (Ref. No. 5X/7030). |
| (4) Ram housing assembly | A steel liner has been introduced to strengthen the housing, and provide a linear ball track for the ram guide ball travel. In addition a phosphor bronze end cap, screwed into the ram housing, provides an improved and increased bearing for ram support at the shackle end of the ram. |
| (5) Screwshaft and nut assembly | A strengthened screwshaft and associated ball nut has been introduced, with the nut fitted and secured in the ram |
| (6) Ram assembly | A redesigned ram has been introduced with key ball seats machined on the outside diameter for locating the ram guide balls. A fine limit counterbore has been provided at the same end for fitting the screwshaft ball nut. |
| (7) Limit switch assembly | The actuating spring has been reformed to suit the new cam profile on the redesigned ram assembly. |
| (8) Ram cover assembly | Revised to suit the new ram housing assembly. |
| (9) Ram shackle assembly | The shackle has been increased in width and section to suit the new ram design. |
| (10) Terminal moulding | The wiring configuration has been revised from the terminal moulding to the limit switches. The leads are now secured to the moulding by P clips to provide uniform wiring. |



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