Chapter 53

ACTUATORS, ROTAX, A0900 SERIES

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Introduction

1. These units are general purpose 28-volt d.c. linear actuators designed for operation of aircraft ancillary equipment. Two limit switches are incorporated to control the ram stroke. Details of individual types will be found in Appendices to this chapter.

DESCRIPTION

2. The A0900 series actuators, of which a typical machine is shown in fig. 1 and 2, are of in-line construction and in general comprise five main assemblies. They are motor, brake and clutch, gearbox, ram and screwshaft, and limit switches, of these all except the limit switches are disposed on the motor/ram axis. The limit switches are located in a housing parallel with the ram and screwshaft but offset. Except for a trunnion shackle and a 4-pole plug which are mounted externally, the main assemblies are contained by two castings.

Motor

3. The motor is a 2-pole, 2-brush machine with laminated pole shoes and yoke. It is split series wound, one field being used for clockwise and the other for anti-clockwise rotation.

4. The armature is supported at the commutator end by a ball bearing; at the driving end the shaft is located in a plain bearing formed integral with a driving plate which runs in a ball bearing. Relative rotation between the armature and driving plate occurs only during clutch slip.

5. A moulding containing two brushes forms the brushgear. Each brush is retained in contact with the armature commutator by a spring loaded trigger mounted on a post which protrudes from the moulding. A split pin passing through the post retains the trigger in position.

6. Access to the brushgear is made by way of two rectangular inspection plates each secured by four countersunk head screws, located on opposite sides of the actuator at the trunnion or fixed shackle end.

Brake and clutch

7. Between the driving plate and armature (*para.* 4) is an electro-magnetic brake and single plate clutch. The clutch plate is made of phosphor bronze and is interposed between the driving plate and a brake disc. Lateral pressure, exerted by a helical spring in the armature shaft, maintains contact between the clutch and driving plates.

8. The brake consists of a coil, connected in series with the armature, wound on a hub

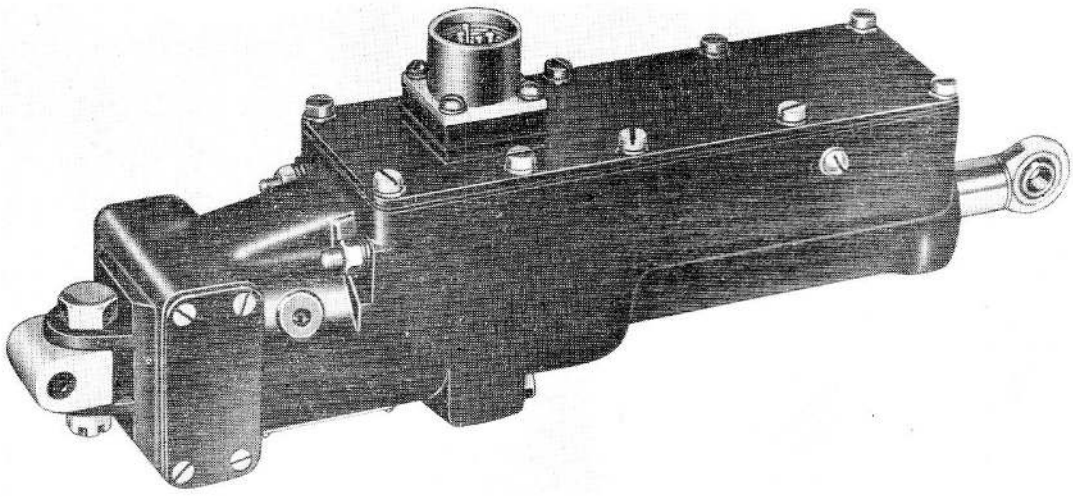

Fig. 1. Typical actuator, A0900 series

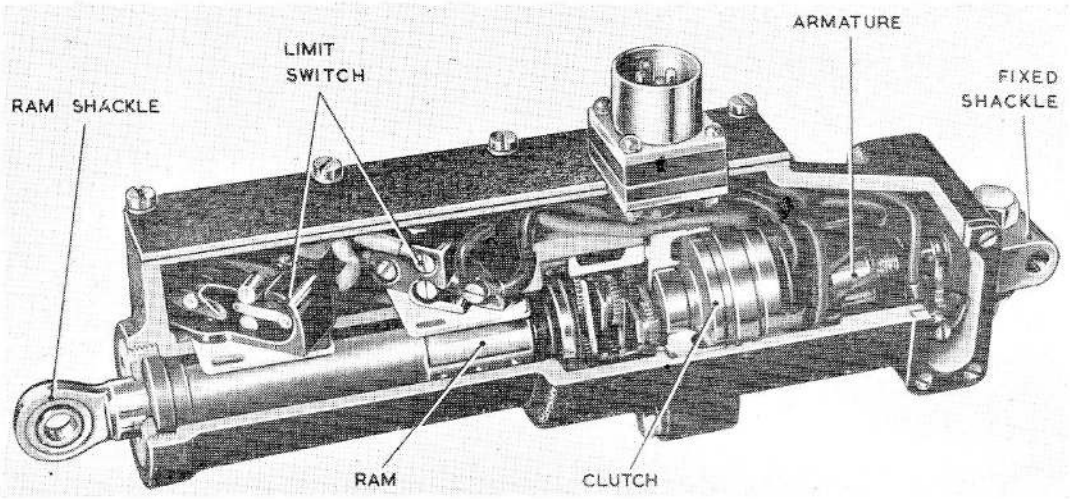

Fig. 2. Sectional view of actuator

and enclosed by a shell so as to form a solenoid arrangement. Around the periphery of the solenoid shell are spaced twelve holes, each of which houses a helical spring. These springs exert lateral pressure on one side of the brake disc. The other side, which is faced with Langite, engages with the driving plate. This condition prevails when the motor is switched off, i.e. the brake coil is not energized. Upon energizing the brake coil, the brake disc is withdrawn from contact with the driving plate and transmission occurs via the clutch plate. Three dowel pins, also located around the periphery of the solenoid shell, prevent the brake disc rotating. The single plate clutch serves to dissipate the stored energy in the armature when the brake is applied, thus assisting the deceleration of the ram.

Gearbox

9. The gearbox contains a multi-stage epicyclic gear train which revolves in a fixed annulus gear. The drive from the armature enters the gearbox via a sungear formed integral with the driving plate and is transmitted to the ram via the screwshaft which has the final gear train secured to it. A reduction ratio is introduced by the gearing to the screwshaft.

Ram and screwshaft

10. The ram, housing a steel nut, is driven by a screwshaft having two tracks of recirculating balls. The screwshaft is borne by a double-row ball bearing, and torque reaction is absorbed by two sets of three balls located in depressions in the ram, and sliding in guides in the ram housing. Positioned in front of the ram housing is a nut through which the ram passes. This nut contains a hard felt ring which serves to prevent the ingress of foreign matter.

Limit switches

11. Two single pole, snap-action limit switches control the ram stroke; they are connected in series with the respective field windings (*fig.* 3). The switches, mounted on separate plates, are located in a housing offset from the ram and screwshaft. They are operated by the ram exerting pressure on a spring loaded plunger which protrudes through the mounting plate of each switch.

12. An opening at one end of the limit switch housing gives access to a passage which by-passes the gearbox and brake, and terminates in the motor compartment. This passage contains the internal wiring of the

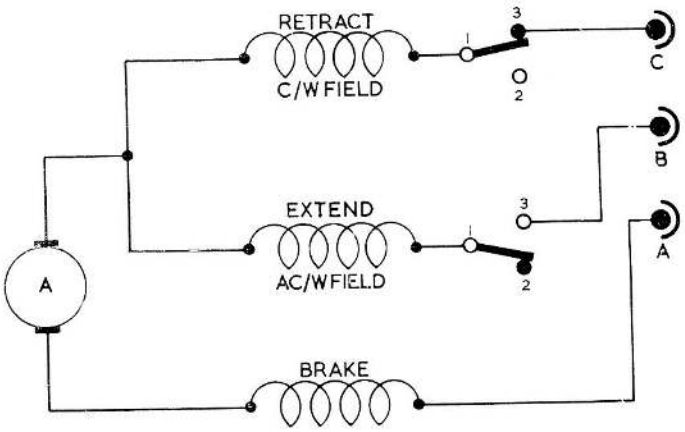

Fig. 3. Diagram of internal connections

actuator. A cover plate, retained by cheese-head screws and extending the length of the limit switch housing and passage, is provided for inspection purposes. To this cover is secured the actuator supply plug.

Electrical connections

13. The actuator is connected to its supply via a 4-pole plug.

INSTALLATION

14. The actuators may be installed in any attitude and are supported between shackles. One shackle being fixed and taking the form of a trunnion block; the other is secured to the ram and contains a self aligning bush. The bore of the bush and that of the hole in the trunnion block is 0·250 in. dia.

SERVICING

15. Normally, servicing of the actuators is confined to a general inspection of the machine with particular attention to the brushgear. Examination of the latter will necessitate the removal of two inspection plates (*para.* 6).

Brushgear

16. To service the brushgear of the units:—

(1) Remove two inspection plates.

(2) Check the length of the brushes to ascertain if they are long enough to perform satisfactorily until the next servicing period.

(3) The minimum permissible length of brush will be found in the relevant chapter of the appendix for the variants of the A0900 series actuators. If new brushes require fitting it will necessitate removal of the unit from the aircraft in order that new brushes can be properly bedded.

(4) The brushgear should be checked to ensure that the boxes are free of carbon dust and that the brushes slide freely in their boxes. If a brush appears to be binding, this may be caused by an accumulation of carbon dust in the boxes. Loose dust may be removed with a jet of dry compressed air.

(5) Badly chipped or cracked brushes must be removed and new brushes fitted, this will necessitate the unit being removed from the aircraft so that the new brushes may be bedded in the appropriate manner.

(6) Check the brush spring pressure by attaching a tension gauge (Ref. No. 1H 59) to the tip of the triggers and raising them $\frac{1}{16}$ in. above the level of the brush boxes.

Note . . .

Reference should be made to the relevant Appendix to the A0900 series for the brush spring pressures of the variants.

Lubrication

17. The ball bearing of the actuators are grease lubricated during manufacture and repair and will not require lubrication during servicing periods.

General

18. Ensure that all external screws and locking devices are secure. Examine the supply plug for security and damage, also the brushgear connections.

19. At the conclusion of servicing operation, ensure that the inspected components are in their correct positions and replace and secure the two inspection covers.

Testing

20. The insulation resistance between all live parts and the frame should be measured, using a 250 volt insulation resistance tester and should not be less than 50,000 ohms.

Note . . .
The value of insulation resistance given in para. 20 *applies to A*0900 *series being tested under normal workshop conditions. Due allowance should be made for the climatic conditions of the locality and those of the aircraft servicing area or dispersal point where the tests are being applied. In particularly damp climates, the readings obtained may be low enough to give apparently sufficient reason for rejection and, in these instances, discretion should be exercised.*

Appendix 1

ACTUATOR, ROTAX, TYPE A0901

LEADING PARTICULARS

Actuator, Type A0901	*Ref. No. 5W/2070*
Voltage	*28V d.c.*
Current	*3·5 amp*
Ram load (normal)	*250 lb*
Ram load (maximum)	*400 lb*
Ram speed	*2 in. in 7 sec*
Maximum static load	*1,000 lb*
Overrun (maximum)	*0·010 in.*
Brush spring pressure	*2½ to 3½ oz (71 to 99 gm.)*
Minimum brush length	*0·200 in.*
Brush grade	*DM 4A*
Operating temperature range	*−70°C. to +90°C.*
Electrical connections	*4-pole plug (Ref. No. 5X/6006)*
Distance between shackle centres—	
Retracted	*8·812 in.*
Extended	*10·812 in.*
Overall dimensions—	
Width	*1·750 in.*
Height	*3·343 in.*
Weight	*2 lb*
Finish	*Fully tropicalized*
Installation—	
Fixed end	*Trunnion block*
Moving end	*Hoffman self-aligning bush C.J.1*

This actuator is identical with that described and illustrated in the main chapter.

Appendix 2

ACTUATOR, ROTAX, TYPE A0903

LEADING PARTICULARS

Actuator, Type A0903	*Ref. No.* 5*W*/439
Voltage	28*V d.c.*
Current	3·5 *amp*
Ram load (normal)	250 *lb*
Ram load (maximum)	400 *lb*
Static load	1,000 *lb*
Ram speed	$1\frac{1}{4}$ *in. in* $3\frac{1}{2}$ *sec*
Overrun	0·010 *in.*
Brush spring pressure	$2\frac{1}{2}$ *to* $3\frac{1}{2}$ *oz* (71 *to* 99 *gm.*)
Minimum brush length	0·200 *in.*
Brush grade	*DM* 4*A*
Operating temperature range	−70°*C. to* +90°*C.*
Electrical connections	4-*pole plug* (*Ref. No.* 5*X*/6006)
Distance between shackle centres—	
Retracted	8·812 *in.*
Extended	10·062 *in.*
Overall dimensions—	
Width	1·750 *in.*
Height	3·455 *in.*
Weight	2 *lb* 4 *oz*
Finish	*Fully tropicalized*
Installation—	
Fixed end	*Trunnion block*
Moving end	*Hoffman self-aligning bush C.J.*1

The A0903 is similar to others in the series except that the plug is turned through 90 degrees and parallel with the axis of the actuator. The pins of the plug are facing the fixed shackle end.

Appendix 3

ACTUATOR, ROTAX, TYPE A0904

LEADING PARTICULARS

Actuator, Type A0904	*Ref. No. 5W/420*
Voltage	*28V d.c.*
Current	*3·5 amp*
Ram load (normal)	*250 lb*
Ram load (maximum)	*400 lb*
Ram speed	*2 in. in 7 sec*
Maximum static load	*1,000 lb*
Overrun (maximum)	*0·010 in.*
Brush spring pressure	*$2\frac{1}{2}$ to $3\frac{1}{2}$ oz (71 to 99 gm.)*
Minimum brush length	*0·200 in.*
Brush grade	*DM 4A*
Operating temperature range	*−70°C. to +90°C.*
Electrical connections	*4-pole plug (Ref. No. 5X/6006)*
Distance between shackle centres—	
Retracted	*9·680 in.*
Extended	*11·680 in.*
Overall dimensions—	
Width	*1·750 in.*
Height	*3·343 in.*
Weight	*2 lb*
Finish	*Fully tropicalized*
Installation—	
Fixed end	*Trunnion block*
Moving end	*Hoffman self-aligning bush C.J.1*

The A0904 is mechanically the same as that described in the main chapter except for the retracted and extended distance between shackle centres.

Appendix 4

ACTUATOR, ROTAX, TYPE A0906

LEADING PARTICULARS

Actuator, Type A0906	*Ref. No. 5W/*
Voltage	28*V d.c.*
Current	3·5 *amp*
Ram load (normal)	250 *lb*
Ram load (maximum)	400 *lb*
Ram speed	1¼ *in. in* 3½ *sec*
Maximum static load	850 *lb*
Overrun (maximum)	0·010 *in.*
Brush spring pressure	2½ *to* 3½ *oz* (71 *to* 99 *gm.*)
Minimum brush length	0·200 *in.*
Brush grade	*KCEG* 14
Operating temperature range	−70°*C. to* +90°*C.*
Electrical connections	4-*pole plug* (*Ref. No. 5X/6006*)
Distance between shackle centres—	
Retracted	8·812 *in.*
Extended	10·062 *in.*
Overall dimensions—	
Width	1·750 *in.*
Height	3·460 *in.*
Weight	2 *lb* 4 *oz*
Finish	*Fully tropicalized*
Installation—	
Fixed end	*Self-aligning ballrace* (0·312 *in. dia bore*)
Moving end	*Hoffman self-aligning bush C.J.1*

The A0906 is similar to others in the series, except that the plug is mounted in a horizontal position, and in place of the trunnion shackle on the fixed end of the unit there is a self-aligning ballrace. A stainless steel ram has also been introduced for primary aircraft structure including flying controls.

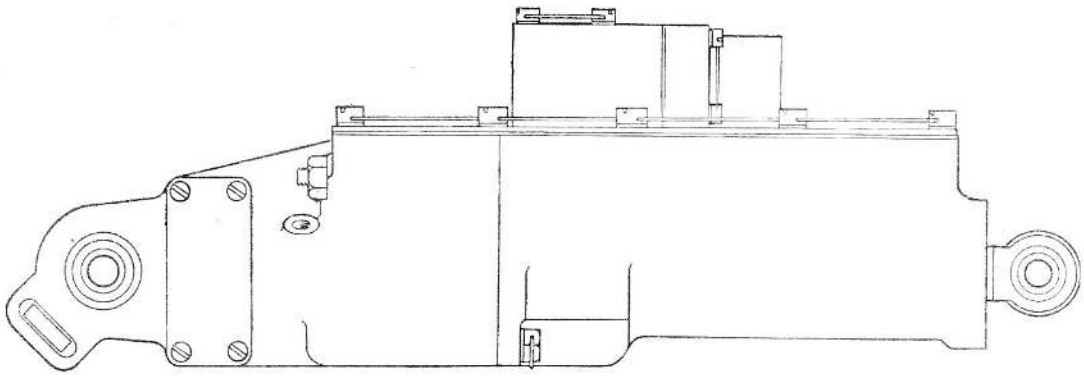

Fig. 1. Actuator, Type A0906

566840/Wt.57135/D.8330 1,875 4/61 E.S.Ltd. Gp.375/7