Chapter 8

DOUBLE ROTARY ACTUATOR, ROTAX, TYPE C 8103/1 (INCORPORATING MOTOR C 9901/1)

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LIST OF ILLUSTRATIONS

LEADING PARTICULARS

Actuator, Type C8103/1	*Ref. No. 5W/3498*
Operating voltage—	
Normal	*112-V. d.c.*
Minimum	*100-V. d.c.*
Maximum	*116-V. d.c.*
Current at rated torque	*42 amp. (per motor)*
Current at starting	*120 amp. (per motor)*
Total rated torque	*105 lb. ft. (52·5 lb. ft. from each output drive)*
Speed at rated torque	*320 r.p.m.*
Clutch torque setting	*490±50 lb. ft.*
Rating	*Two minutes*
Rotation	*Reversible*
Brush spring pressure	*13 to 15 oz.*
Minimum brush length	*0·562 in.*
Brush grade	*E.G.O. HAM.*
Operating temperature range	*—70 deg. C. to +50 deg. C.*
Weight	*100 lb.*
Overall dimensions—	
Height	*9·531 in.*
Length	*29·218 in.*
Width	*11·949 in.*

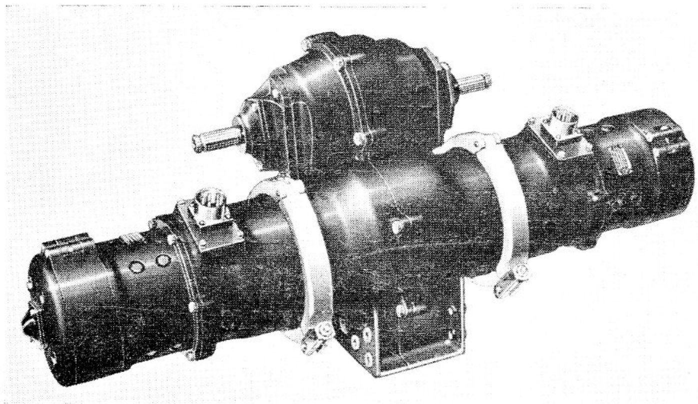

Fig. 1. Type C 8103/1 actuator

Introduction

1. These actuators have been designed to operate aircraft ancillary controls e.g., landing flaps from a 112 volt d.c. supply. They incorporate two identical reversible motors (Type C 9901) driving an offset parallel common shaft with two output drives. Limit switches are not incorporated.

DESCRIPTION

2. The Type C 8103/1 (*fig.* 1) actuator, has been designed so that, in the event of a difference of speed occurring between the two motors, differential gearing will vary the overall gear ratio. Also, if either motor becomes inoperative, the remaining motor will operate the actuator at half normal speed, the torque output remaining constant.

3. The actuator comprises two identical motor units mounted either side of a central casting which houses gearing, overload clutch and output shaft.

The overload clutch and output shaft are offset from the axis of the motor units and gearing but they are housed within a common casting (*fig.* 2).

4. Each motor unit consists of motor, brake (with over-run clutch) and two stages of epicyclic gearing. The drive from each motor is transmitted via these epicyclic trains to a common differential epicyclic gear, which in turn drives the common output shaft via a spur gear machined on the outside of the overload clutch barrel. Because the motor units are identical (*para.* 1), it is only necessary to describe the components and working of one.

Motor

5. The motor is a 4-pole, 4-brush machine with a short shunt, compound wound field. Reversal of rotation is effected by changing the polarity of the armature connections. The armature is wave bound and borne by two ball bearings; one bearing is fitted in a liner pressed into the commutator end frame and the other is located in a housing machined in the motor end of the brake spider. The armature shaft is hollow and accommodates a steel push rod which is used in connection with the clutch loading adjustment (*para.* 9) of the overrun clutch.

Brake and overrun clutch

6. Between the motor and its gearing is a drum type, electromagnetic brake, and multi-plate clutch.

The purpose of the clutch is to limit overrun and absorb part of the inertia of the armature on stopping.

7. The brake consists of a double flanged steel core on which a coil is wound, the magnetic path being completed through shoes placed around the periphery and connecting the two flanges. When the motor is switched on, the brake coil is also energized and attracts the shoes against the influence

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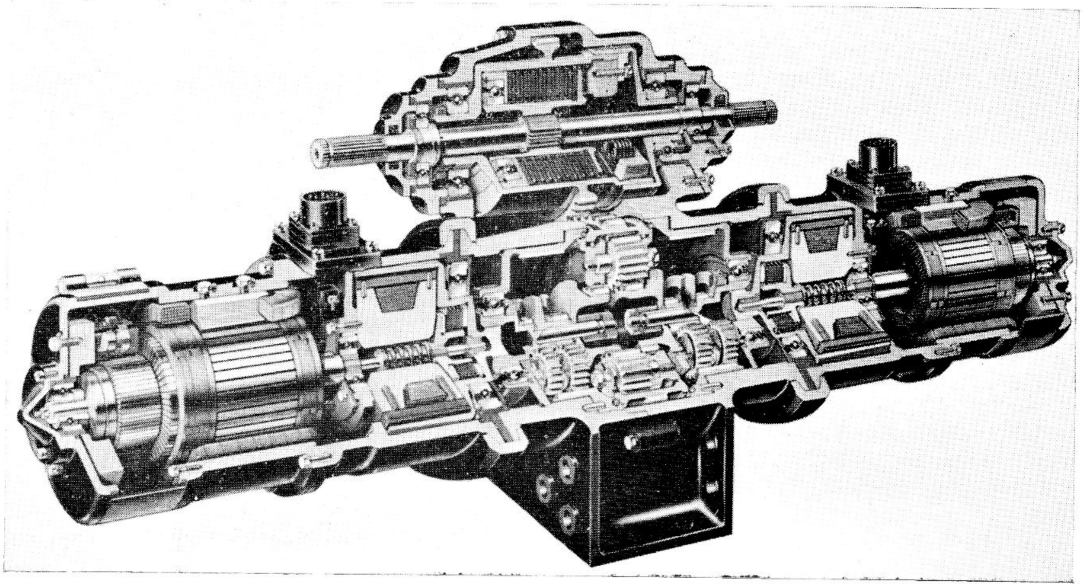

Fig. 2. Sectional view C 8103/1 actuator

of helical springs, on to the flanges. When the motor is switched off, the coil is de-energized and the shoes are forced against the brakedrum by the springs. In this manner the brake is automatically applied. There are four springs per shoe and they are located in holes drilled around the periphery of the flanges. The brake has six shoes, and, locating pins protruding from the flanged core, prevent their displacement.

8. Interposed between the brake and gearing is a multi-plate clutch which dissipates the kinetic energy in the armature when the brake is applied. Relative rotation between the armature and brake drum occurs only during clutch slip. The clutch plates have alternative faces of sintered bronze and steel, the former being keyed to the clutch well inside the brake drum housing and the latter to the clutch shaft.

9. The clutch shaft is spring loaded by a single helical spring to which varied loads may be applied by means of an adjuster screw, located under the end cap of the commutator end frame assembly, and transmitted via the push rod (*para.* 5) in the armature shaft.

10. Formed integral with the brake drum is an external sun gear which engages with the plant pinions of the first epicyclic train. The motor output is thus transmitted to its gearing (two epicyclic trains) and in turn fed into the common differential epicyclic gear. The planet carriers of the first ("fast') and second ("slow") trains revolve in a fixed annulus gear whose internal teeth engage both trains of gears.

Gearbox

11. The sun gear of the second epicyclic gear train protrudes through an aperture in the differential planet carriers and engages with three planet gears mounted on the carrier. This arrangement being common to both drives, produces three planet gears on each of the right hand and left hand differential planet carriers. These six gears are meshed to form three pairs and each pair has a gear associated with each drive. Consequently the driving sun gears of both differential gear assemblies can only turn their respective planet gears as a locked assembly. Rotation of this locked assembly of planet gears will then cause both differential planet carriers to rotate.

12. Teeth are machined on the periphery of both differential planet carriers and they engage with a similar number of teeth machined on the inside of the revolving differential gear casing. These teeth act as splines preventing any relative movement between the planet carriers and the gear casing. Rotation of the differential planet carriers will cause the gear casing and its integral spur gear to rotate.

13. The differential external spur gear engages with a similar number of teeth machined on the outside of the overload clutch barrel causing it to rotate and, through the incorporated clutch plates, to transmit the drive to the common output shaft.

14. In the event of one motor failing to operate, its differential sun gear will become locked, due to the brake. The operative motors differential sun gear will drive all the differential planet gears around the stationary sun gear, but in this instance half the normal speed.

Overload clutch and output shaft

15. The overload clutch is fitted to prevent damage to the motors and gearing. It consists of a number of steel plates of which alternative plates have a sintered bronze treatment. The sintered plates are keyed to the clutch barrel and the plain steel plates to the clutch shaft. The open end of the clutch barrel fits into a clutch carrier or "Cup" and the complete assembly rotates between ball bearings located in liners pressed into the gear housing assembly. In addition, the clutch barrel houses a bearing spacer assembly which serves to maintain the concentricity of the plates during times of clutch slip. The clutch is loaded by thirteen equally spaced helical springs located in the recesses in the adjusting nut which is screwed into the clutch barrel. The loading is set on a special rig before the clutch is assembled to the actuator. (*Para.* 3)

16. The output shaft is borne between ball bearings. They are located in steel liners which are pressed into bearing housings, the latter being bolted either side of the gear housing assembly. Two end caps, each fitted with a felt oil seal through which the output shaft passes, are bolted to the bearing housings.

Note . . .
The right hand and left hand outputs of the shaft are integral. Thus, when each output drive is viewed from its driving end the shaft will have opposite directions of rotation.

Electrical connections

17. Each motor derives its supply via a 5-pole plug (Ref. No. 5X/6061). The plug is located on a raised mounting cast integral with the intermediate housing of the motor. Connections for each motor individually (*fig.* 3) and for the two motors when assembled to the actuator, with respect to direction of output rotation, are as given in paras. 18 and 19.

Connections for individual motors

18. (1) Clockwise rotation

+VE to 2 and 5

3 to 4

—VE to 1.

(2) Anti-clockwise rotation

+VE to 3 and 5

2 to 4

—VE to 1

Connections to coupled motors

19. For the given rotation of output shaft connect as follows :—

(1) For clockwise rotation of right-hand output shaft.

+VE to { 3 and 5, 2 connected to 4 left hand motor; 2 and 5, 3 connected to 4 right hand motor. }

—VE to 1 on both motors.

(2) For anti-clockwise rotation of right-hand output shaft.

+VE to { 2 and 5, 3 connected to 4 left hand motor. 3 and 5, 2 connected to 4 right hand motor. }

—VE to 1 on both motors.

Note . . .
The RIGHT-HAND OUTPUT is taken as that part of the shaft appearing on the right hand side of the output unit (fig. 2).

INSTALLATION

20. The actuator may be mounted in any attitude. It is secured by means of ten 0·3125 in. dia. holes for mounting purposes. The holes are drilled through the flanges of the central gearbox housing (five per flange) parallel with the axis of the unit. Each hole is steel bushed and five $\frac{5}{16}$ in. dia. bolts are used to secure the unit when offered up in position. (*fig.* 2).

21. The motor unit is secured to the gear housing by a manacle ring clamp which embraces two mating flanges. A dowel pin arrangement on the faces of the mating flanges serves to align the radial position of the plug connections.

SERVICING

22. Normally servicing of this actuator will not necessitate any dismantling, other than removing the straps which enclose the brush-gear.

Brush-gear

23. Service the brush-gear in the following manner :—

(1) Remove the window strap surrounding each brush-gear by withdrawing the securing screws, 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 permissible length is 0·562 in. If new brushes require fitting, it is only necessary to remove the motor unit concerned in order that new brushes can be properly fitted and bedded.

(3) Check that the brush-gear is free from carbon deposits and that the brushes side freely in their boxes without any tendency to bind. If a brush appears to be binding this may be due to an accumulation of carbon dust in the box and should be removed. Loose dust may be removed with a jet of dry compressed air.

(4) Badly chipped or cracked brushes should be removed and new ones fitted.

(5) Check the brush spring pressures by attaching a tension gauge (Stores Ref. 1H/86) to the tip of the spring and raising it $\frac{1}{8}$ in. above the top of the brush box. The correct pressure should be between 13 and 15 oz. (369 and 426 grm.)

Lubrication

24. The bearings of the actuator are grease lubricated during manufacture and repair, and normally should not require lubrication during servicing periods.

General

25. Ensure that all external screw and locking devices are secure. Examine the motor supply plugs for security and damage, also the brush-gear connections.

26. At the conclusion of the servicing operations, ensure that the inspected components are in their correct positions.

Note . . .
The C 9901/1 motor unit (para. 1) are replaceable items.

Insulation resistance tests

27. The insulation resistance between all live parts and the frame should be measured, using a 500 volt insulation resistance tester, and should not be less than 50,000 ohms.

Note . . .

The value of insulation resistance given in para. 27 applies to C 8103/3 actuators 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.

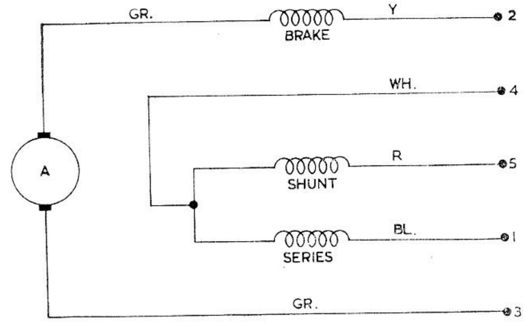

Fig. 3. Diagram of internal connections

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