Chapter 3

ACTUATORS, ROTAX, C7200 SERIES

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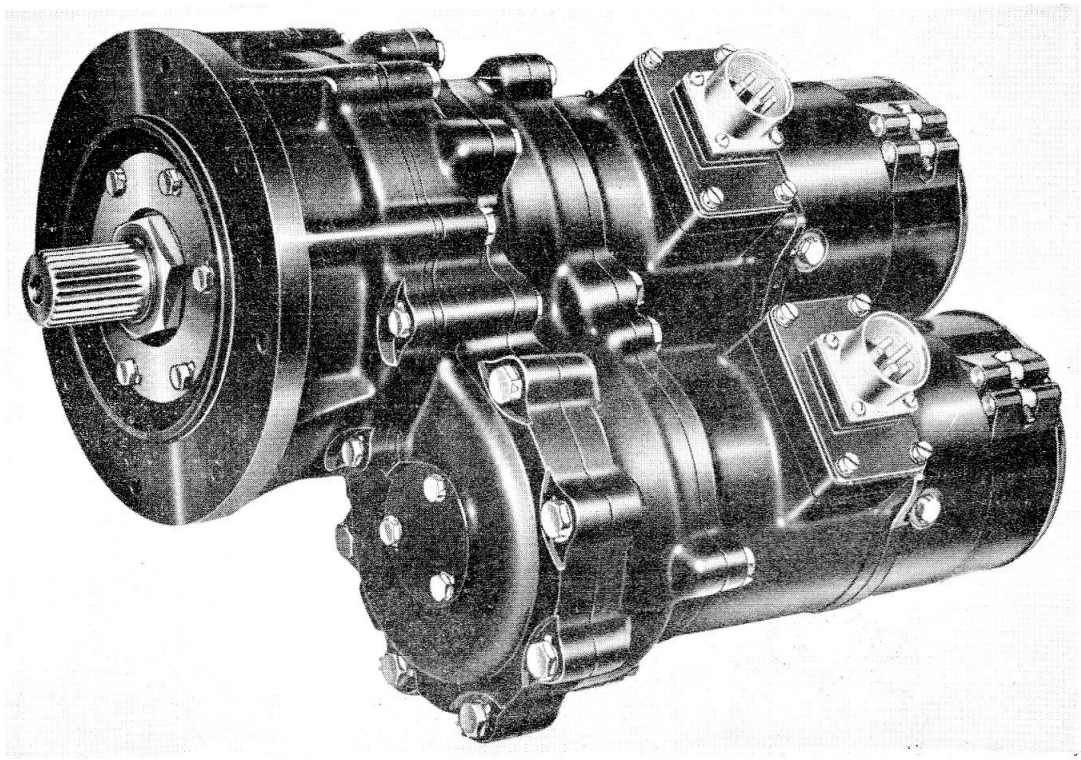

Fig. 1. A typical C7200 series actuator

Introduction

1. Rotary actuators in the C7200 series are basically similar, and incorporate a main and an auxiliary electric motor. The purpose of the auxiliary motor may vary according to the requirements to be met by the various types of actuator within the series, and for details of specific machines reference should be made to the appropriate Appendix to this chapter.

DESCRIPTION

2. A typical machine of the series is illustrated in fig. 1. The unit comprises a main motor and an auxiliary motor driving into a common gearbox which in turn drives a serrated output shaft. The output shaft is on the same axis as the main motor, whilst the auxiliary motor is offset but parallel to it. Each motor is fitted with a brake and clutch and the unit is fully tropicalized.

Motors

3. The motors are 4-pole, 4-brush, short-shunt, compound-wound, and reversal of rotation is effected by changing the polarity of the armature connections.

4. The field windings of each motor have two components: shunt and series, the former being the main component. The series component is used for starting and is a compensation for excessive loads.

5. The armatures are supported at the commutator end by ball bearings housed in the end frames, whilst at the drive end they are borne by plain bearings within the brake drums which, in turn, revolve in ball bearings.

Brake and clutch

6. Interposed between each motor and its

gearing is a drum type electromagnetic brake and, also, a multiplate clutch. The brake consists of a double-flanged core on to which a coil is wound; the magnetic path being completed through shoes arranged around the periphery and connecting the two flanges. When the motor is switched on, the coil is energized and the shoes are drawn, against the force of helical springs, on to the flanges. When the motor is switched off, the coil is de-energized and the shoes engage the drum due to the action of the helical springs; thus the brake is applied automatically. There are four springs per shoe and they are located in holes drilled around the periphery of the flanges. Each brake has six shoes, and locating pins protruding from the flanged core prevent their displacement.

7. Situated between the brake and gearing of each motor is a multiplate clutch assembly which carries the drive and dissipates the kinetic energy in the armature when the brake is applied; in this manner the clutch assists the deceleration of the output shaft and limits the overrun.

Note . . .

The clutch is not a safety device for overloads but is used only for limiting the overrun. The clutch is set during assembly of the motor and must not be slipped deliberately for more than a fraction of a second.

8. Relative rotation between the armature and brake drum occurs only during clutch slip. The clutch plates have alternate faces of sintered bronze and steel, the former being mounted on steel plates and are keyed to the housing in the base of the brake drum. The plain steel plates are keyed to a sleeve which is splined to the clutch spindle.

9. Clutch adjustment is effected by means of a clutch shaft, push rod, and an adjustable screw which carries a locking nut; with the exception of the latter, all are located in a hollow shaft carrying the armature.

10. The clutch shaft, which is splined to the clutch sleeve at one end of the brake and to a sleeve in the hollow armature shaft at the other end, is spring loaded. The loading of the spring can be adjusted by means of the adjusting screw, access to which is from the commutator end of the motors. The push rod is located between the clutch shaft and the adjusting screw.

Gearbox

11. The main motor drives the output shaft at a step down ratio of 94·5 to 1. The auxiliary motor drives the output shaft at a step down ratio of 196 to 1, and the relative gear trains are as follows.

12. The main motor drives the output shaft through three epicyclic gears, each with a fixed annulus. The centre annulus is fixed by reason of its being held by the gearing and brake of the auxiliary motor.

13. The auxiliary motor drives the output shaft through the following gears: —

(1) Two epicyclics, each with a fixed annulus.

(2) One spur train (i.e., the planet carrier of the second stage) is flanged and the teeth of the periphery of the

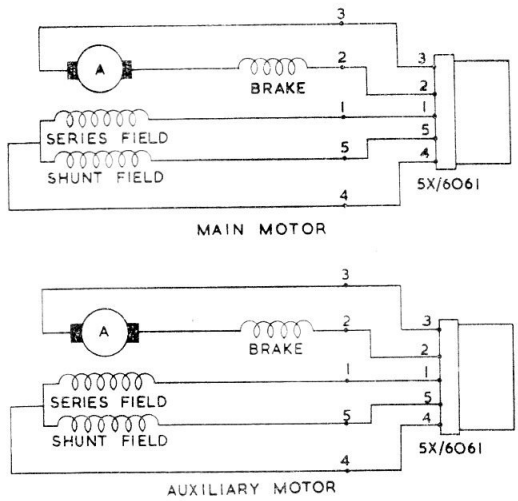

Fig. 2. Wiring diagram

flanged portion mesh with the annulus of the second stage in the main gear train. (The arrangement is such that the annulus rotates, but its sun gear and the first stage of the main gear train are fixed by reason of their being held by the brake of the main motor.)

(3) One epicyclic with a fixed annulus and this forms the final stage of the main gear train.

Output shaft

14. The output shaft is of 1·000 in. nominal diameter having 24 course serrations cut full depth for a length of 1·187 in. The length of shaft protruding from the end of the housing is 1·469 in.

Electrical connections

15. Electrical connections are made via two 5-pole plugs (Ref. No. 5X/6061), one being mounted on the side of each motor, and their appropriate mating sockets (Ref. No. 5X/6064), the latter being included in the aircraft installation.

16. Pin connections for clockwise and anti-clockwise rotation, looking on the output shaft, are as follows: —

(1) Clockwise rotation:

(a) Connect pin 5 (+ve main) and pin 2 together.

(b) Connect pin 3 and pin 4 together.

(c) Pin 1 is negative (—ve main).

(2) Anti-clockwise rotation:

(a) Connect pin 5 (+ve main) and pin 3 together.

(b) Connect pin 2 and pin 4 together.

(c) Pin 1 is negative (—ve main).

Note . . .

The pins referred to above are the pin numbers of the 5-pole plugs (para. 15).

Operation

17. Direction of rotation is determined by the polarity of the armature connections. When the field of the main motor is energized, the electro magnetic brake is released and the drive from the armature shaft is transmitted to the brake drum via the splined clutch shaft and the multiplate clutch. Integral with the brake drum, and extending beyond the brake housing, is the first sun-gear, and the drive from here is transmitted through three epicyclic gears, each with a fixed annulus. The centre annulus is fixed by reason of its being held by the gearing and brake of the auxiliary motor. Thus the output shaft receives the drive from the main motor, giving a step down ratio, armature to output shaft, of 94·5 to 1.

18. When the field of the auxiliary motor is energized, a similar sequence occurs. In this instance, however, the drive from the sun-gear, integral with the brake drum, is transmitted via two epicyclic gears, one spur train and one epicyclic gear with a fixed annulus; the latter being the final stage of the main gear train. In this manner the drive from the armature of the offset auxiliary motor is carried to the output shaft. The step down ratio of the auxiliary gearing, armature to output shaft, is 196 to 1.

Note . . .

The spur train is formed by the planet carrier of the second stage being flanged and the teeth on the periphery of the flanged portion being meshed with the annulus of the second stage of the main train. The annulus rotates, but its sun-gear and the first stage of the main gear train are fixed by reason of their being held by the brake of the main motor.

INSTALLATION

19. Information on the installation of the actuators will be found in the relevant Aircraft Handbook.

20. The actuators will operate satisfactorily in any position. Provision for securing the unit to its associated equipment is made by eight equispaced holes of 0·257 in. dia, being drilled through the mounting flange of the main motor on a P.C.D. of 5·700 in.

SERVICING

21. These actuators should be serviced in accordance with the general chapter in A.P. 4343, Vol. 1, Sect. 17, and the relevant Servicing Schedule.

Brushgear

22. The minimum length beyond which brushes should not be used is 0·437 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.

23. Brush spring pressure should be between 14 and 16 oz. (397 and 453 gm.), when measured by attaching a tension gauge (Ref. No. 1H/86) to the tip of the brush spring and raising it $\frac{1}{16}$ in. above the level of the top of the box.

Lubrication

24 These actuators are lubricated during manufacture, and should not normally require lubrication except when dismantled for repair. Any trace of oil seepage within the motor should be investigated and the point of ingress found. Oil within the motor will seriously impair its performance, and by carrying carbon dust inside the windings will lower the insulation resistance.

General

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

26. At the conclusion of the servicing operations, ensure that all components are in their correct positions, and secure the window straps.

Insulation resistance test

27. The insulation resistance, when measured with a 500-volt insulation resistance tester between all live parts and the frame, should not be less than 0·5 megohm (for R.N.), or 0·05 megohm (for R.A.F.).

Appendix 1

ACTUATOR, ROTAX, TYPE C7201/1

LEADING PARTICULARS

Actuator, Type C7201/1	*Ref. No. 5W/292*
Voltage	112*V d.c.*
Normal current	
Main motor	15 *amp.*
Trimming motor	27 *amp.*
Maximum current—	
Main motor	30 *amp.*
Trimming motor	35 *amp.*
Normal torque at output shaft—	
Main motor	50 *lb. ft.*
Trimming motor	250 *lb. ft.*
Maximum torque at output shaft—	
Main motor	150 *lb. ft.*
Trimming motor—normally	340 *lb. ft.*
in emergency	375 *lb. ft.*
Time for 62·5 rev. at output shaft (normal torque)—	
Main motor	32·5 *sec.*
Trimming motor	75 *sec.*
Clutch setting (checked on motor and brake unit only)—	
Main motor	320 *lb. ft.*
Trimming motor	460 *lb. ft.*
Over-run on no load on 112V d.c. (without relays)—	
Main motor	30 *deg.*
Trimming motor	12 *deg.*
Rotation (both motors)	*Reversible*
Brush springs pressure (both motors)	14 *to* 16 *oz.* (397 *to* 453 *gm.*)
Minimum brush length (both motors)	0·437 *in.*
Brush grade (both motors)	*KCEG.* 12
Weight	43 *lb.*

1. The actuator, Type C7201/1, is similar to that described and illustrated in the main chapter. The unit has been designed particularly for the adjustment of tail plane incidence, but may also be used for the operation of aircraft ancillary equipment. In these instances the motors are identified as the main and trimming motors. The trimming motor, by reason of its higher gear reduction, can also be used for a particular emergency operation.

Appendix 2

ACTUATOR, ROTAX, TYPE C7202

LEADING PARTICULARS

Actuator, Type C7202	
Voltage	112*V d.c.*
Normal current	
Main motor	11 *amp.*
Auxiliary motor	6 *amp.*
Maximum current—	
Main motor	45 *amp.*
Auxiliary motor	20 *amp.*
Mean torque at output shaft (both motors)	28·3 *lb. ft.*
Maximum torque (both motors)	70 *lb. ft.*
Maximum emergency torque at output shaft (both motors)	215 *lb. ft.*
Time for 62·5 rev, at mean torque—	
Main motor	30 *sec.*
Auxiliary motor	66·5 *sec.*
Clutch setting (output shaft, both motors)	300 *lb. ft.*
Over-run on no load on 112V d.c. (without relays)	30 *deg.*
Rotation (both motors)	*Reversible*
Brush springs pressure (both motors)	14 *to* 16 *oz.* (397 *to* 453 *gm.*)
Minimum brush length (both motors)	0·437 *in.*
Brush grade—	
Main motor	*KCEG.* 12
Auxiliary motor	*PM50. HAM*
Weight	42 *lb.*

1. The actuator, Type C7202, is generally similar to that described and illustrated in the main chapter; it may be used to operate aircraft chassis doors, although its application is not necessarily restricted to this function.

2. This actuator follows the same general construction as others in the series, but the armature of the auxiliary motor is slightly shorter than that of the main motor, and consequently the length of the motor housing has been correspondingly reduced.