Chapter 13

ACTUATOR, ENGLISH ELECTRIC, TYPE 203

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LIST OF ILLUSTRATIONS

LEADING PARTICULARS

Actuator, Type 203	*Stores Ref. 5W/52*
Rated voltage	*24 d.c.*
Current consumption (approx.)	*3·5 amp.*
Speed of motor	*11,000 r.p.m.*
Speed of rotation	*60 deg. in 3·07 sec.*
Minimum brush length	*0·175 in.*
Brush spring pressure	*4 to 5 oz.*
Length of actuator	*8·03 in.*

Introduction

1. The rotary actuator, Type 203 (*fig.* 1) operates an air mixing valve in both directions of rotation up to an emergency torque at the valve of 110 lb. in.

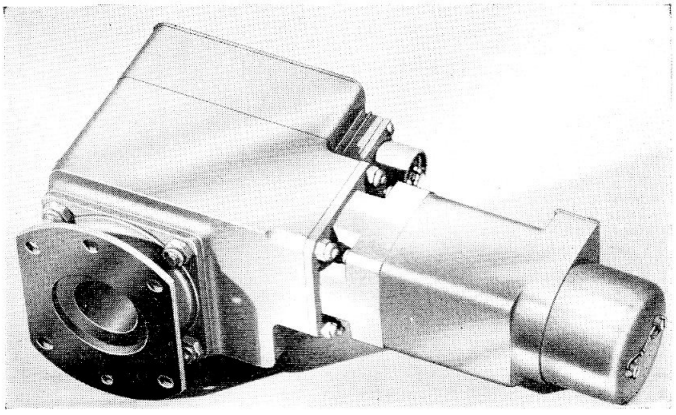

Fig. 1. Actuator, Type 203

DESCRIPTION

2. The actuator consists of a 2-pole, split-series field 24-volt d.c. motor that drives the valves through the medium of a double plate friction clutch, a three-stage epicyclic gear trail and a worm and wheel.

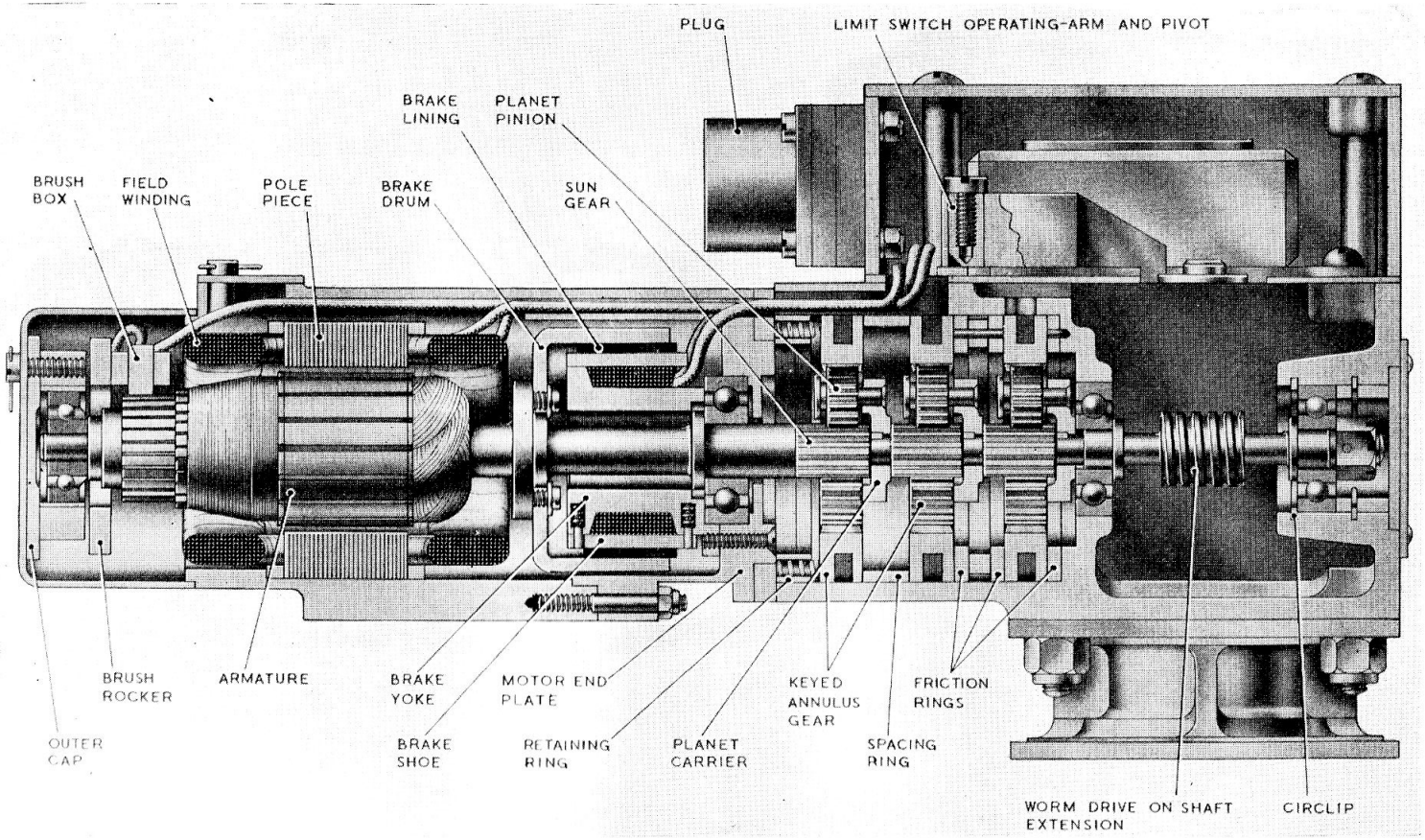

Fig. 2. Sectional view of actuator

3. Snap-action limit switches switch off the supply to the motor at the end of the travel in each direction of rotation of the valve. Mechanical stops are fitted to prevent overrun of the actuator output shaft which would cause damage to the limit switches in the event of their failure.

4. The clutch prevents damage to the motor and gears if an overload is accidently applied or in the event of limit switch failure when the output shaft runs on to the mechanical stops.

5. Housed within the motor is a four-shoe, electro-magnetic brake that stops the motor when the current is switched off. The actuator is of right-angle construction, the motor, clutch, epicyclic gear train and worm being on the same axis of rotation, while the output shaft, which carries the worm wheel, is at right angles to the motor axis.

Housing and covers (*fig. 1 and 2*)

6. The actuator comprises four main sections: motor, gearbox, limit switches, and mixing valve adapter.

7. The motor is housed in three light alloy parts and is a detachable, self-contained unit. The armature, field coils, brush gear assembly and commutator end bearing are housed in the motor frame; the brake assembly and driving end bearing are fitted in the brake housing, the end of which serves to locate the motor to the gearbox housing.

8. The end cover, which conceals the brush gear and commutator end bearing, is secured to the motor frame by two small screws which can be withdrawn completely for inspection of the brush gear. The motor frame and brake housing are held together by four studs and nuts; the whole motor unit is fixed to the gearbox housing by four studs and nuts.

9. The gearbox housing is an alloy casting which contains the epicylic gear train, clutch, planet carrier extension shaft and its bearings and the mechanical stops.

10. The limit switch housing contains, in addition to the limit switches, the limit switch operating arm and the 4-pole plug for electrical connection. Between the limit switch housing and the gearbox housing is fitted a diaphragm that prevents grease from the gears entering the limit switch housing. Four screws secure the housing, the diaphragm, and the aluminium alloy lid to the gearbox housing, the parts being sealed by the manufacturers after final adjustment of the limit switches.

11. A magnesium alloy adapter, containing the end of the actuator output shaft, is fixed by four studs and nuts to the gearbox housing at the opposite end to the limit switches. Six holes are drilled in the adapter, three of which are used for mounting the mixing valve.

Motor and brake (*fig. 2*)

12. The motor is a 24-volt, 2-pole, split-field series type. The yoke and pole pieces are manufactured from one set of laminations, the poles this being integral with the yoke. Two brushes are fitted; each is mounted on a brass brush box, which is in turn secured to a moulded brush rocker. Brush pressure is maintained by a flat coiled spring which reacts on a brush lever that bears on the top of the brush.

13. The armature, to which is fastened the brake drum, is supported at the commutator end by a ball bearing, the other end of the armature being supported by a ball bearing in the end of the brake housing. A single coil, connected in series with the armature, is wound around the brake yoke, the yoke being secured to the end of the housing by four screws.

14. Equally spaced around the brake yoke are four brake shoes. Each shoe is fitted with a brake lining and located by two pins which allow the shoe to ride up and down freely on the yoke. Pressure is maintained betqeen each shoe and the inside periphery of the brake drum by four small helical springs fitted in holes in the brake yoke.

Gearbox and clutch (*fig. 2*)

15. The gearbox is of three-stage epicyclic and right-angled worm drive construction, with the sun gear of the first planet carrier assembly being integral with the motor armature shaft. The third annular gear works against the friction rings of the clutch; these rings are held against the annulus by springs, and are designed to slip should the load become excessive. Adjustment of the load to give the correct torque at which the annulus slips is made, if necessary, by

varying the number of springs in the spring retaining ring.

16. The final drive is then taken by a worm, and transmitter at right angles through the worm wheel pinned to the output shaft. A cam (*fig.* 3) is fitted on the output shaft for limit switch operation.

Limit switches (*fig.* 3)

17. The moulded limit switches are fitted on clamp, ing plates with slotted holes thus providing means of adjustment. The switches are operated by a pivoted switch operating arm. In one direction of rotation, the gearbox cam pivots this arm one way to operate the plunger of the relevant limit switch; in the other direction of rotation, the arms is pivoted the other way, and the second switch operates.

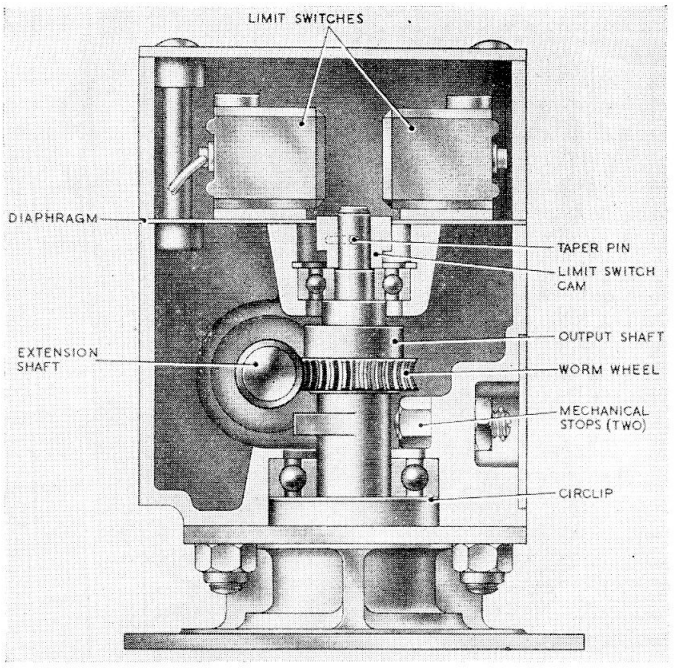

Fig. 3. Part section view on worm drive end

INSTALLATION

18. The mixing valve with which this actuator is associated, has three 2 B.A. mounting studs. On installation, the actuator mounting face, in which six holes are drilled, should be fitted over the studs and secured in position with fixing nuts.

19. In normal circumstances, there is no need to make any internal adjustment to the actuator during its installation. The limit switches are pre-set by the manufacturers, and their setting must not be altered.

20. Fit the electrical supply socket to the 4-pole plug in the actuator; it should be noted that pin D on this plug is not used.

OPERATION

21. Assuming that the actuator outfit has operated in the direction of rotation required to shut the mixing valve, the "shut" limit switch is open and the "open" limit switch is closed. When the supply to the motor is switched on through the "open" limit switch (*fig.* 4), the two relevant field coils and the brake coil, which is in series with the motor armature, are energized. The brake shoes are pulled on to the brake yoke, this releasing the pressure on the brake drum. The armature now rotates, thus opening the mixing valve; as soon as the mixing valve begins to open, the "shut" limit switch will close.

22. When the motor supply is switched off by some external means, between the two extremes of travel permitted by the limit switches, or when the switch cam is allowed to operate the "open" switch, the relevant field coils and the brake coil are de-energized. The four springs, under each of the brake shoes, force the shoes outwards against the inside periphery of the brake drum when the pressure between the shoes and the brake drum brings the motor and output shaft to rest.

23. The mixing valve may now be closed if the supply to the motor is completed through the "shut" limit switch. The actuator will operate in a manner similar to that already described but in the opposite direction of rotation. The nominal inclusive angular travel of the actuator output shaft is 60 deg. The limit switches, however, are set to switch off after a travel of 58 deg., thus allowing for some overrun.

SERVICING

Brush gear

24. Remove the locking wire and the two

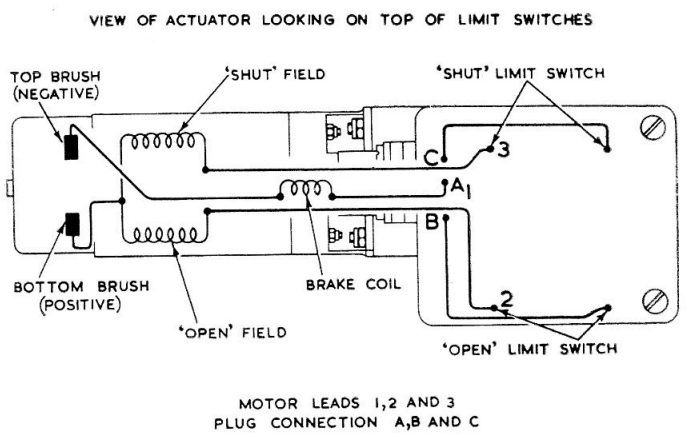

Fig. 4. Layout of internal wiring

small screws that secure the motor end cover. Detach the cover. Inspect the brushes to ensure that they are a free fit in the brush boxes. Where binding brushes are encountered, the brush and brush box should be thoroughly cleaned, and any accumulation of carbon dust blown out with dry, compressed air.

25. Worn brushes should be renewed before they reach the minimum permissible length of 0·175 in. If brush renewal is necessary, only brushes of grade E.G.O. (HAM) should be used.

26. The brush spring tension should be checked using a spring balance (Stores Ref. 1H/86) and must be between 4 and 5 oz.

Lubrication

27. The actuator is lubricated during manufacture and should require no attention at routine servicing periods.

Limit switches

28. During routine inspections the limit switch cover must not be removed. If the limit switch settings are disturbed it is not possible to re-adjust them whilst the actuator is installed in the aircraft.

Final check

29. Ensure that all nuts, screws and locking devices are secure and that the electrical connections to the actuator are tight and free from corrosion.