Chapter 98

ACTUATOR, ENGLISH ELECTRIC, TYPE AE4026 Mk. 1

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LEADING PARTICULARS

Actuator, Type AE4026	*Ref. No. 5W/2710*
Nominal voltage	*28V. d.c.*
Normal load current	*4·2A.*
Normal stroke	*2·75 in.*
Normal working load	*220 lb.*
Maximum working load	*450 lb.*
Time for normal stroke	*6·7 sec.*
Brush grade	*E.G.O. (HAM)*
Minimum brush length	*0·18 in.*
Brush spring pressure	*4 to 5 oz.*
Total weight	*3·75 lb.*
Minimum commutator diameter	*0·595 in.*
Rating	*Intermittent*

Introduction

1. The actuator, Type AE4026 is designed to operate the rudder trim tabs on aircraft. It is capable of operating the tabs in both directions up to an emergency maximum load on the actuator of 600 lb.

2. The actuator consists of a 2 pole, split series field, 24 volt, d.c. motor, driving an actuating nut through the medium of a dog clutch and a three stage reduction gear train. The third reduction gear wheel rotates a steel screw, which in turn drives the actuating nut.

3. Snap action limit switches switch off the motor supply current when the actuating nut reaches its extreme limit of travel. In the event of a failure occurring in a limit switch, the actuating nut is brought to a standstill by coming into contact with a mechanical stop.

4. Incorporated in the motor is a 4 pole, electro-magnetic brake, which stops the motor when the supply is switched off by one of the limit switches or manually at any intermediate point of travel of the actuating nut.

5. The actuator is of off-set construction, i.e. the motor and actuating nut are side by side and parallel to each other. The spur gear train and clutch are situated across the ends of the actuating screw and motor pinion.

DESCRIPTION

Housing

6. The housing is in four main sections, the motor, gearbox, gearbox end cover, and limit switch housing.

Motor

7. The motor is a detachable, self-contained unit, and is housed in four light alloy parts. The armature, field coils, brush gear assembly, commutator end bearing, and motor supply terminal block are housed in the motor frame. The brake assembly, armature drive end bearing, and armature extension shaft are housed in the brake, the bearing for the extension shaft being located half in the drive housing and half in the drive endplate. The drive endplate serves as a location for the motor to gearbox housing.

8. The end cover concealing the brush gear and commutator end bearing is fixed to the motor frame by two small screws. The cover can be withdrawn completely to enable the brushes to be inspected. The motor frame brake housing and drive endplate are provided with wiring ducts and when these components are secured together, a continuous duct is formed, through which the leads pass. The motor frame and brake housing are held together by four studs and nuts. The drive endplate is fastened to the brake housing by four studs and nuts which also secure the whole motor unit to the gearbox housing.

Gearbox

9. The gearbox housing and end cover are both castings of aluminium alloy. They house the dog clutch, the three stage reduc-

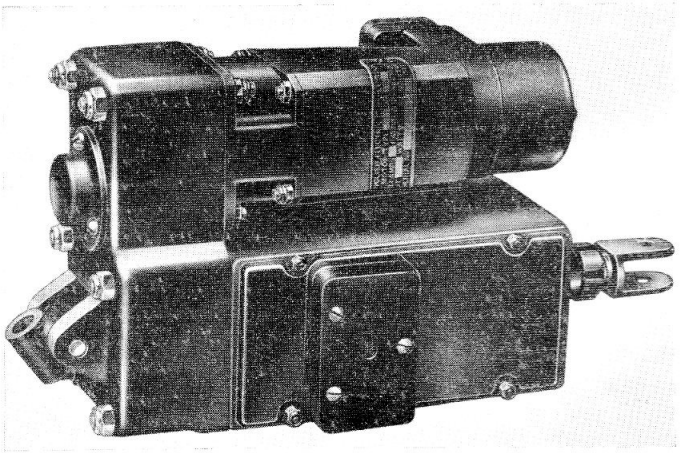

Fig. 1. Actuator, Type AE4026, Mk. 1.

tion gear train and the end of the actuating screw and its bearings. Studs for securing the cover to the housing are screwed into one side of the housing, the studs for securing the motor unit being screwed into the other side. An aluminium alloy bearing cap, housing the bearing for the first reduction shaft and the spring for the dog clutch is secured to the end cover by three screws. Cast on the front end cover, and in line with the actuating screw, is a fork end to which is pinned a trunnion block used for mounting the actuator. A wiring trough is cast in the gearbox housing, so that the leads from the motor may be passed to the limit switches. An L shaped bracket which acts as a cable cleat, is secured to the gearbox end cover.

Limit Switch Housing

10. The limit switch housing is a casting of magnesium alloy, this contains the actuating screw, the actuating nut and limit switch assemblies. A felt seal is fitted in the box to prevent ingress of foreign matter. The compartment is sealed with a cover and secured in position after the switches have been adjusted by the manufacturer.

Motor and brake

11. The motor is a 24 volt, split series field design. Two opposite fields are used to extend the actuating nut and the remaining two to retract it. Connected in series with each pair of fields is a limit switch which is so adjusted that when the nut reaches the end of either its retraction or extension stroke, one of the switches operates and breaks the motor supply circuit

12. The yoke and pole pieces are made of one set of laminations, the poles being integral with the yoke. Two brushes are fitted, mounted in brass brush boxes, which are in turn mounted on a moulded brush rocker. Pressure on each brush is maintained by a flat coiled spring, the pressure of which is transmitted by a brush lever to the top of the brush.

13. The armature is supported at either end by a single row ball bearing incorporating a shield on one side, that at the brake end of the armature being located halfway along the brake housing. The brake coil which is connected in series with the armateure is wound on the brake yoke, this is secured to the endplate by four countersunk screws. Equally spaced around the brake yoke are four brake shoes. Each shoe has a brake lining located by two pins, these allow the shoes to ride up and down freely on the yoke. Pressure between each shoe and the inside periphery of the brake drum is maintained by four helical springs which are located in holes in the brake yoke.

14. A 3 way moulded terminal block is screwed to a machined facing at the end of the motor frame. The leads to the motor pass along the wiring duct in the motor frame and the brake housing, emerging through the drive end-plate.

Gearbox and clutch

15. The gearbox consists of a three stage reduction gear train and is situated across the axes of the motor and the actuating screw. The primary reduction pinion is pinned to the armature extension shaft. The primary and secondary reduction pinions are mounted on a shaft supported at each end by a ball bearing. One of these bearings is located in the gearbox housing, and the other in the bearing cap is screwed to the end cover. Integral with the primary reduction pinion is the female half of the dog clutch, the pinion being a press fit on the shaft. The male half of the dog clutch is integral with the second pinion and is a sliding fit on the shaft.

16. The two halves of the clutch are held in engagement by a spring situated between the bearing in the bearing cap and the end face of the pinion. The second reduction gear wheel and the third reduction pinion are integral and supported by a ball bearing at either end.

17. The actuating screw is supported by two ball bearings, one of which is mounted in the gearbox housing and the other in the gearbox cover. The bearing in the gearbox housing is located between a shoulder on the screw and the third reduction gear. The wheel is pinned in position on the screw so providing a positive drive. It is held axially

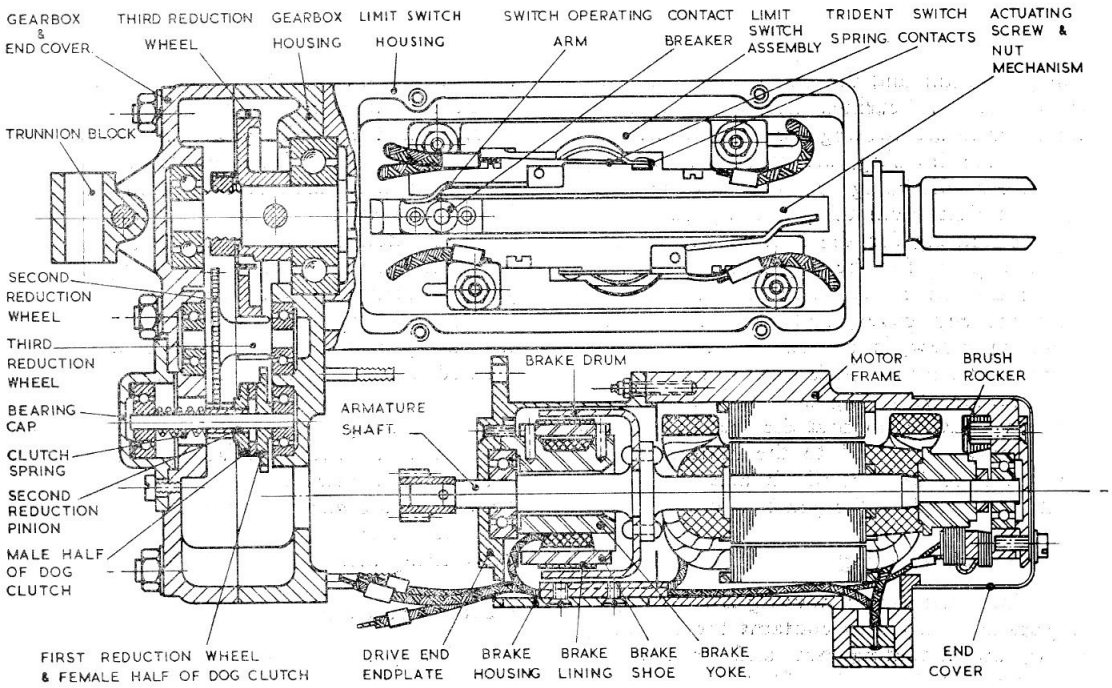

Fig. 2. Sectional view

against the bearing by a nut on the actuating screw. By these means a drive is established between the drive end and the actuating nut, the loading at which the clutch slips being determined by the spring pressure.

Actuating nut and screw

18. The screw drives the actuating nut by means of an acme screw thread, the nut being threaded for approximately one third of its length. At the end of the nut opposite to the acme threaded portion, a short internal thread is cut, into which is threaded a fork end, this provides a mounting for the actuator. The fork end is secured by a slotted lock nut, which also acts as a retraction stop against the end of the limit switch housing. At the opposite end of the actuating nut, a mechanical abutment slides in a slot in the limit switch housing and prevents the nut rotating during its extension or retraction. The end of the slot is machined to fine limits to serve as the extension stop against the end of the abutment. A contact breaker is screwed to the top of the abutment, the contact breaker strikes the switch arm of the limit switches when the actuating nut reaches the end of its travel in either direction, this breaks the motor control circuit.

Limit switches

19. The moulded limit switch assemblies are situated in the limit switch housing one on either side of the machined slot. Each switch assembly is fastened by two bolts to a clamping plate, which is positioned on the underside of the base of the switch compartment. The bolts which secure the switch assemblies are located in slots in the compartment base to provide adjustment for the switches.

20. Terminal connections are provided for the leads to the motor, one contact is integral with one end of the terminal connections the other contact being fitted to the centre of one end of a trident spring. The opposite end of the spring is fastened to the other terminal connection and is arranged so that when unrestrained, the contacts are pressed together. When the switch arm is operated by the contact breaker on the actuating nut, pressure is applied to the central point of the trident spring; this opens the contacts smartly,

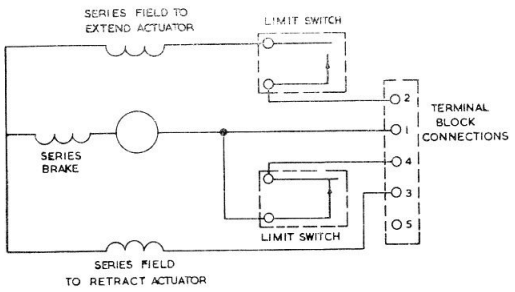

Fig. 3. Internal wiring diagram

thereby breaking the motor circuit. If the actuating nut is now traversed in the reverse direction the pressure is removed from the trident spring and the contacts close again.

INSTALLATION

21. On the outside of the end cover and in line with the actuating screw is a cast fork end to which is pinned a trunnion block used for mounting the actuator in the aircraft. At the opposite end of the actuating screw assembly is a fork end piece which is used to connect the actuator to its load. The internal wiring is shown in fig. 4.

Adjustment of centres

22. During installation it may be necessary to adjust the distance between the centres of the actuator attachment points. To effect this operation the actuating nut should be extended until a 1/16 in. dia. hole is visible. The lock nut securing the fork end should then be slackened by rotating it in a counter-clockwise direction. The nut should then be screwed back until the fork end can be moved freely. The distance between centres may be adjusted by screwing the fork end either inwards or outwards as required. Inward adjustment is limited by the actuator design since it is impossible to turn the fork end beyond a certain point. Care must be taken when adjusting in the outward direction to ensure that the fork end is within safety limits. This can be checked by inserting a length of 1/16 in. dia. wire in the tube in the actuating nut, the wire should enter for a distance of approximately 1/16 in. If it is possible to insert the wire to a depth of approximaely $\frac{1}{2}$ in., then the fork end must be screwed back until it is within safety limits.

23. The distance between the centre of the hole in the trunnion block and that in the fork end, with the actuating screw retracted against the mechanical stop, should be 7·425 in. The distance between these centres, when the actuating screw has been stopped by limit switch action in the retracted position, should be 7·55 in. In this condition there is a working adjustment of $\pm$ 1/8 in. on the dimension quoted.

SERVICING

24. The actuator is to be inspected and serviced in accordance with the instructions contained in the appropriate Servicing Schedule.

Brush Gear

25. The locking wire and the two small screws that secure the motor end cover should be removed and the cover detached to enable the brushgear to be examined. The brushes must be able to move freely in the brush boxes. If a brush is binding, the brush box and brush should be thoroughly cleaned and dust blown out with dry compressed air. Worn brushes should be replaced at the periods prescribed in the Servicing Schedule and whenever examination reveals that they are unlikely to function satisfactorily for the period that must elapse before the next servicing.

26. The bearings are packed with grease during initial assembly, they will not require further lubrication until the actuator is removed from the aircraft for bay servicing. The bearings should then be cleaned, all traces of old lubricant removed and the bearing then repacked with grease XG275 (Ref. No. 34B/9100512). If the bearings are removed from the armature assembly it is essential that when the bearings are replaced, the shield incorporated in the bearing is on the side facing the armature.

Insulation test

27. Measure the insulation resistance between live parts and the frame using a 250 volt insulation resistance tester. A reading of not less than 50,000 ohms should be obtained.

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