ENGLISH ELECTRIC, TYPE AE 4010 SERIES

Appendix 13

LIST OF CONTENTS

LIST OF ILLUSTRATIONS

LEADING PARTICULARS

Actuator, Type AE4010, Mk. 3	**Ref. No. 5W/2629**
Rated voltage	28*V d.c.*
Maximum working load	150 *lb.*
Normal working load	100 *lb*
Clutch slip load	170—340 *lb*
Static load (as an aircraft strut)	750 *lb*
Normal working stroke	0·8 *in*
Time of stroke (on normal load at 28V d.c.)	8 *sec*
Distance between centres (on " retract " limit switch setting) ...	10·10 *in*
Minimum brush length	0·225 *in*
Brush spring pressure	4–5 *oz*
Brush grade	*C.M.6 (H.A.M.)*
Weight	2 *lb* 13 *oz*

Introduction

1. The English Electric actuators of the AE4010 series follow the general design described in this Appendix. The actuator described here is the AE4010, Mk. 3 and is typical of the series. For specific details of actuators in this series, reference should be made to A.P.4343D, Vol. 1, Book 3, Sect. 14. The linear actuator, Type AE4010, Mk. 3, has been designed to provide remotely controlled linear motion against tensile and compressive loads up to a maximum of 150 lb.

DESCRIPTION

2. The actuator consists of a split field, series wound, 28V d.c. motor. It is fitted with an electro-magnetic brake to prevent excessive overrun after the limit switches have broken the motor circuit (*para.* 30). The drive from the motor to the ram is provided by an arrangement of spur gearing which incorporates a slipping clutch (*para.* 14). The final spur gear is secured by a tapered pin to an acme screw, which, through its mating thread on the ram, provides linear movement.

Housing

3. The actuator housing, comprises a series of covers (together with the gearbox). The main cover is of rectangular cross section reinforced at both ends by strips of alloy sheet. It is made of light alloy, and care should be taken whilst servicing this actuator, to stow this cover away from any potential source of damage.

4. The main cover houses the motor and brake assembly, the ram mechanism, the potentiometer assembly and the limit switches. It is enclosed at one end by the gearbox and at the other by an end cover through which the ram passes.

5. A 2 B.A. screw secures the end cover. This is tightened to a torque of 5 lb. in. to avoid distortion and mis-alignment.

6. The gearbox also has an end cover to which is attached the trunnion block mounting lug.

Motor and brake assembly

7. The motor is a two pole, split field, series wound 28V d.c. machine. The output is 3·7 watts at 14,000 r.p.m. The change of rotation is effected by external switchgear.

8. The two alloy brush boxes are mounted on a moulded rocker, which is adjustable to set the brushes on the correct neutral axis.

9. The brushes are C.M.6 (H.A.M.) type and are held against the commutator by coiled springs bearing on brush fingers. The brush spring pressure should be 4–5 oz.

10. An electro-magnetic brake, connected electrically in series with the armature, and mechanically to the motor frame at the commutator end, is a single plate disc type.

11. The external supply is connected via a six-way terminal block situated on the main cover. This includes connections to the potentiometer (*fig.* 4).

Limit switches

12. The limit switches are of the single pole, change-over type, and are secured on a bracket mounted on the bottom bracket assembly, which incorporates the potentiometer assembly and the switch striker mechanism (*fig.* 2).

Gearbox, drive and ram

13. The gearbox and gearbox cover form the housing for the gear drive from the motor to the ram. Both gearbox and gearbox cover are alloy die castings with ball races inset in them. On these ball races are mounted the spur gears forming the gear drive to the ram.

14. The first pinion of the gear drive is integral with the armature shaft. This drives direct on to the slipping clutch input gear, and, if no slip occurs, the output pinion of the clutch drives a compound gear which in turn meshes with the final spur gear of the train. This final gear is secured to the acme screw by a tapered pin and, through its mating thread on the ram, provides linear movement.

15. Screwed in the end of the ram is the plug end assembly. This is used primarily as one of the mounting points (the other being the trunnion block mentioned in *para.* 6), and secondarily as a means of adjusting the retracted centre distance (*para.* 21).

16. Mechanical stops are fitted in this actuator for safety precautions in the event of limit switch failure. If a limit switch fails, the ram forces its way against a mechanical stop and the clutch slips. The actuator is designed to absorb any torque reaction set up when this occurs.

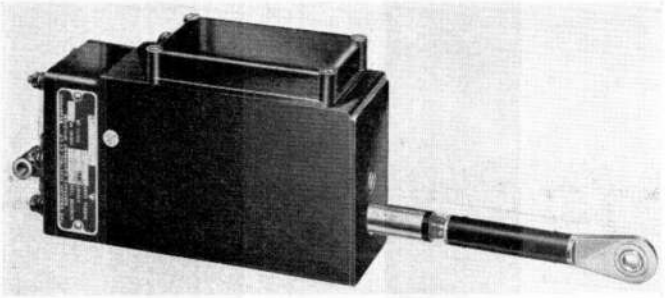

Fig. 1. General view of actuator, Type AE4010, Mk. 3

Potentiometer

17. The potentiometer is used as a position transmitter, fitted for use with a remote ratiometer type indicator.

18. Between the train coils of the potentiometer moves a sliding contact. Small springs hold the contact against the coils, thus providing constant pressure and good electrical contact. The sliding contact is moved along the coils by a carrier attached to the ram.

Switch striker mechanism

19. The switch striker mechanism is incorporated in the bottom bracket assembly (*fig.* 2); it comprises two slider bars on which the striker barrels move. Screwed and locked into a flange on each of these striker barrels is an adjusting screw with which the stroke is set correctly (*para.* 23).

20. The striker barrels are moved along the slider bars by means of pins set in the ram. The pins are permanently set a fixed distance apart so as to give the correct stroke.

INSTALLATION

21. The actuator is secured to the aircraft structure at two mounting points (the plug end and the trunnion block, as mentioned in *para.* 15). The plug end assembly is adjustable; it is fitted with a lock-nut and screws into the internal thread cut on the ram. By slackening the lock-nut, adjustment may be made to the retract centre distance (between the mounting points), by screwing the plug end assembly in, or out, as required.

Note . . .

It is possible to screw out the plug end assembly to a point at which there is insufficient effective thread length on the plug end to carry the loads imposed upon it during normal operation. Accordingly, should any adjustment be required, the following procedure must be adopted. On the ram is a safety hole (*fig.* 2). *Always ensure that the screwed portion of the plug end assembly is screwed sufficiently in the ram to cover this hole. To check this, a piece of* $\frac{1}{16}$ *in. dia. wire should be pushed through the safety hole. If it penetrates to a depth greater than* $\frac{1}{8}$*in., the plug end assembly is not screwed far enough in the ram.*

22. The alignment of the mounting lugs should be checked before the actuator is installed in an aircraft.

23. The distance between the retracted centres of the mounting points should be $10{\cdot}10 \pm 0{\cdot}010$ in. when the actuator is halted by the " retract " limit switch; the stroke being $0{\cdot}80 \pm 0{\cdot}005$ in.

24. After installation the actuator should be given a functional check.

OPERATION

25. With the actuator installed in the aircraft, and the external wiring connected up, the operation is as follows with the ram initially in the fully retracted position.

26. In the fully retracted position the " retract " limit switch will be open and the " extend " limit switch will be closed.

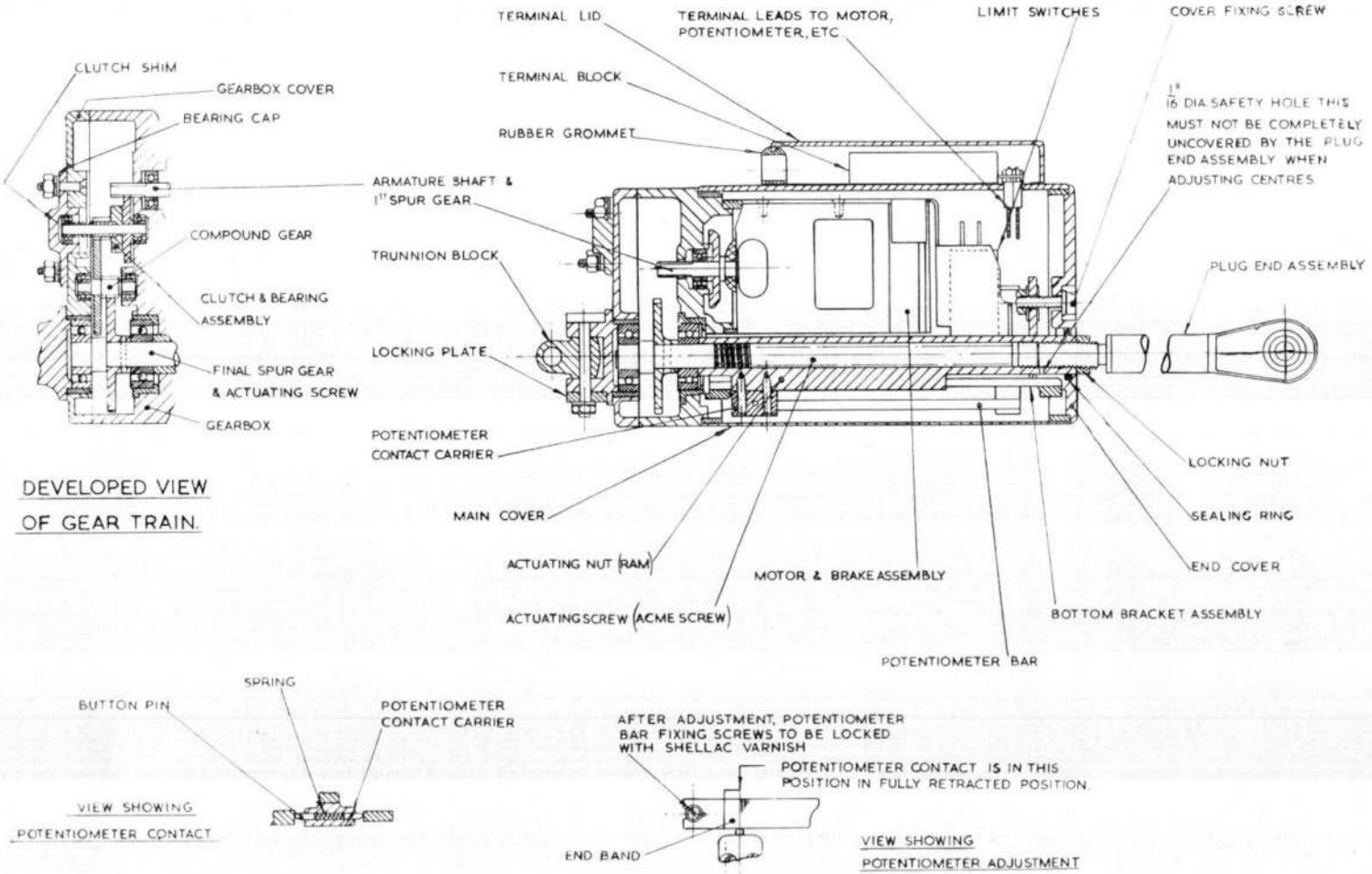

Fig. 2. Sectional view of actuator

27. When the supply is switched on, the brake coil will become energized and will pull the brake shoe away from the brake disc; also the appropriate motor field will become energized and the armature will rotate, thereby setting in operation the gear drive to the ram, and extending the ram.

28. As soon as the ram leaves the fully retracted position, the switch striker barrel will move along the slider bar away from the " retract " limit switch, thus allowing it to close.

29. Now both limit switches are in the closed position, and the actuator may be reversed by altering the position of the remote circuit selector switch.

30. When the actuator reaches the fully extended position, the other switch striker barrel causes the " extend " limit switch to open, and the supply to the motor and brake will be broken. The brake shoe will be forced against the brake disc under the action of a helical spring and the motor will come to an almost instantaneous stop.

31. Should an overload occur at any point during the stroke, the clutch will slip and the ram will come to rest. If this should happen, the high current sustained will blow an external fuse and the supply to the motor will be disconnected.

SERVICING

32. The actuator should be inspected and serviced in accordance with, and at the periods specified in, the appropriate Servicing Schedule.

33. For routine inspections, the external nuts, bolts, screws, etc., should be checked for security. The wiring should be checked for fraying leads, corrosion at the terminals, and security of the terminal screws and lead ends.

34. Worn bushes should be renewed before the minimum brush length limit is reached (0·225 in.). When this is necessary, only brushes of the C.M.6 (H.A.M.) type should be fitted; they should be bedded down to the contour of the commutator over at least 80 per cent. of their contact area.

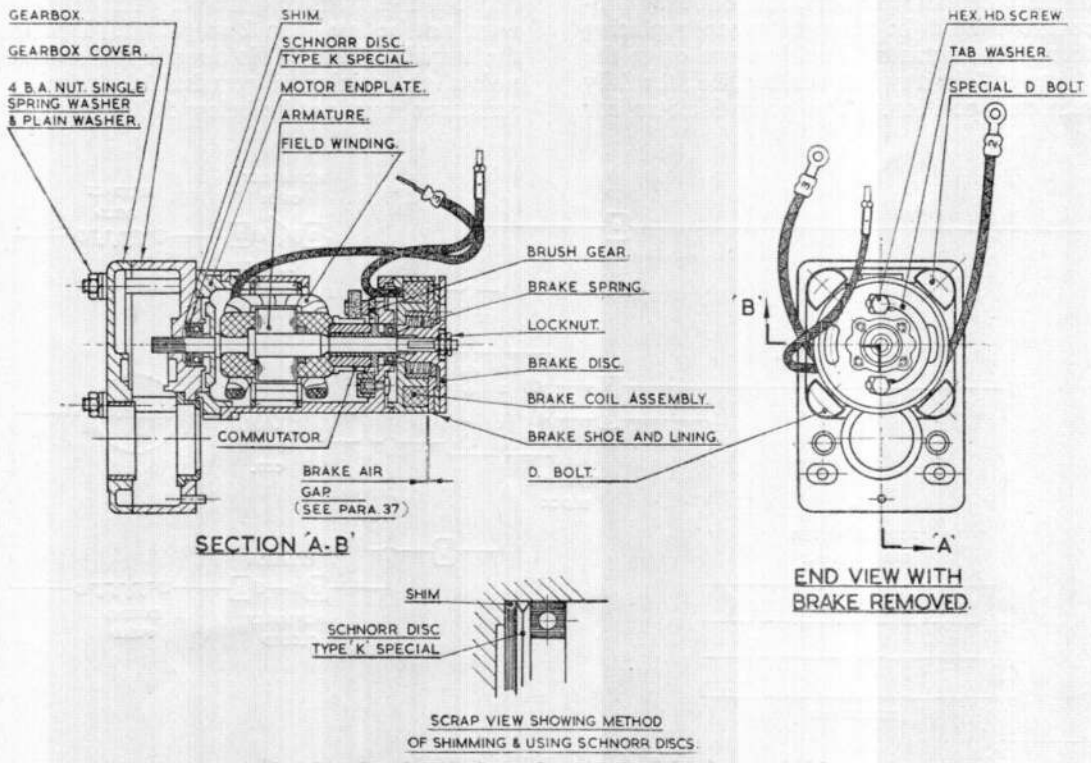

Fig. 3. Sectional view of motor and brake assembly

35. The brush spring tension should be checked with a suitable spring balance (Ref. No. 1H/97), and the values obtained should be between 4 and 5 oz.

36. Should the armature require " drop testing," it will be necessary to remove it from the motor frame. When replacing the armature, the " Schnorr Discs " and shims, fitted between the gearbox housing and drive end bearing, are to be fitted in a " back to back " sequence as shown in fig. 3.

37. The brake lining wear should be checked by feeler gauges between the brake shoe and brake yoke. This gap should be within 0·004–0·015 in.

38. The potentiometer contact surfaces should be inspected for freedom from dirt, grease, and oxides forming on the coils; should there be any evidence of these, the surfaces should be cleaned using only wood backed crocus paper, as the coils are only about 0·006 in. diameter. After cleaning with crocus paper, any accumulation of small grit, dust, etc. should be carefully blown away with dry compressed air.

39. Should the servicing require the removal of the potentiometer bars, the following procedure should be adopted when replacing them. The actuator should be run on to the " retract " limit switch position, i.e., the fully retracted position. The potentiometer bar should be adjusted so that the potentiometer contact is positioned at the junction of the end band and windings (*fig.* 2). With the actuator fully assembled, the resistance between terminals 5 and 6 should be zero (still in fully retracted position), and between terminals 4 and 6 the resistance should be 500 ohms$\pm 7\frac{1}{2}$ per cent. With the actuator on the " extend " limit switch, the resistance between terminals 5 and 6 should be 133 ohms$\pm 7\frac{1}{2}$ per cent. After adjustment the potentiometer bar fixing screws should be locked with shellac varnish.

40. The actuator is lubricated during manufacture and should require no further attention except at the periods laid down in the appropriate Servicing Schedule.

41. A final security check should be made on all external nuts and bolts, screws, etc., after servicing.

Note . . .

It should be noted that this actuator contains mated assemblies.

Insulation resistance test

42. Using a 250 volt insulation resistance tester, measure the insulation resistance between live parts and frame. The reading must not be less than 2 megohms. Due to the humidity prevalent in aircraft at dispersal points, the minimum permissible insulation resistance must not be below 50000 ohms.

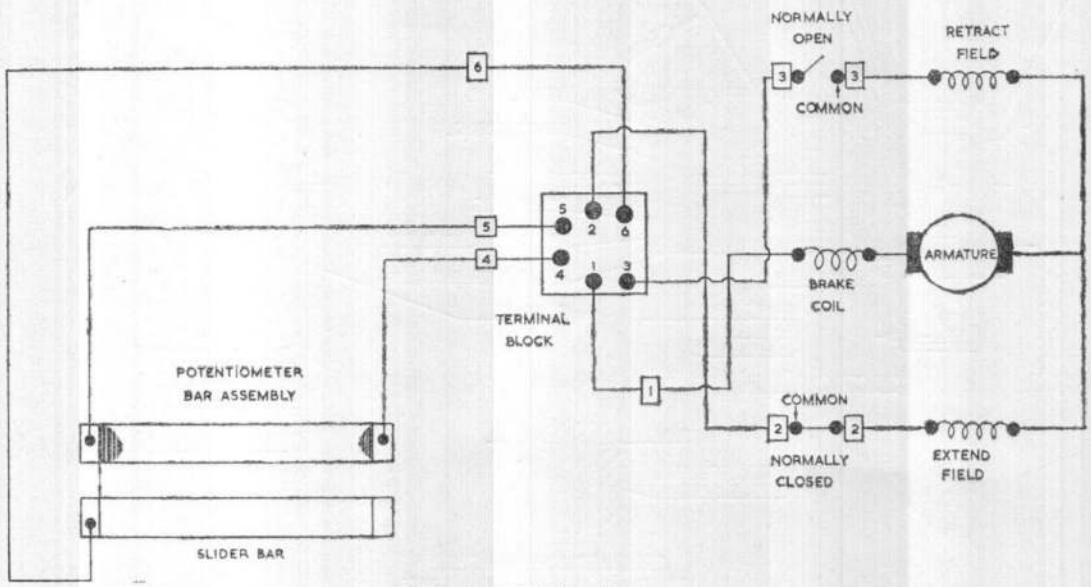

Fig. 4. Wiring diagram

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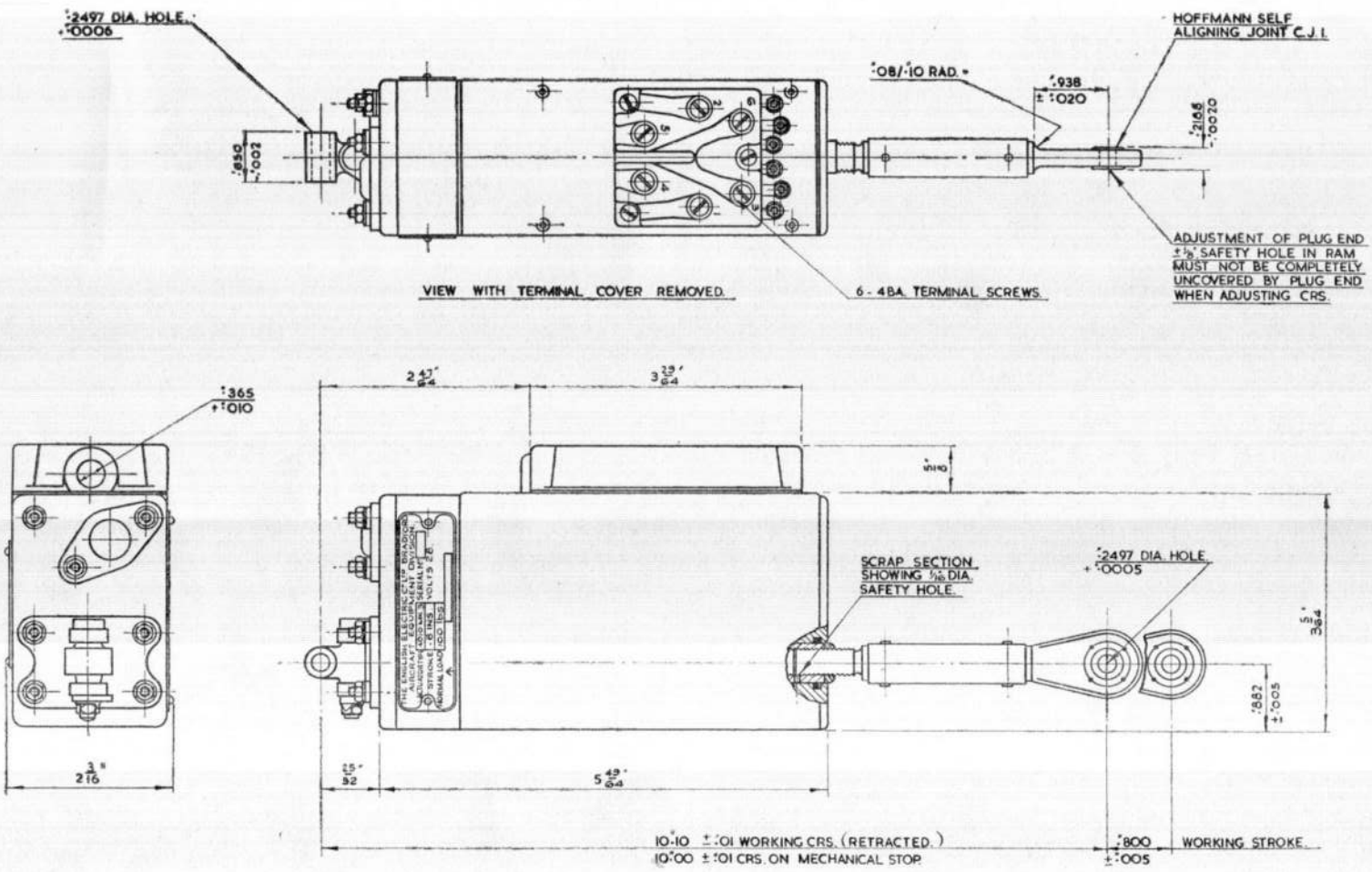

Fig. 5. Installation drawing