Chapter 17

ACTUATOR, ENGLISH ELECTRIC, TYPE AE4540

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LIST OF ILLUSTRATIONS

LEADING PARTICULARS

Voltage	19-29 volts d.c. (normally 28V)
Normal working load	50 lb. in.
Maximum working load	75 lb. in.
Current at normal load	1·8 amperes
Stalled current	3·3 amperes
Velocity of output shaft	6 rev./min.
Angular travel	Continuous, reversible
Maximum operating frequency	2 sec. on, 5 sec. off, continuously
Gears and ratio	Spur 3100: 1
Altitude range	0—45,00 ft.
Temperature range for normal duty	−55°C to + 150°C.
Brush spring pressure	4—5 oz.
Brush grade	C M 6 (HAM)
Minimum brush length	0·225 in.
Overall dimensions	5⅝ in. × 2¾ in. × 3½ in.
Weight	2 lb. 2 oz.

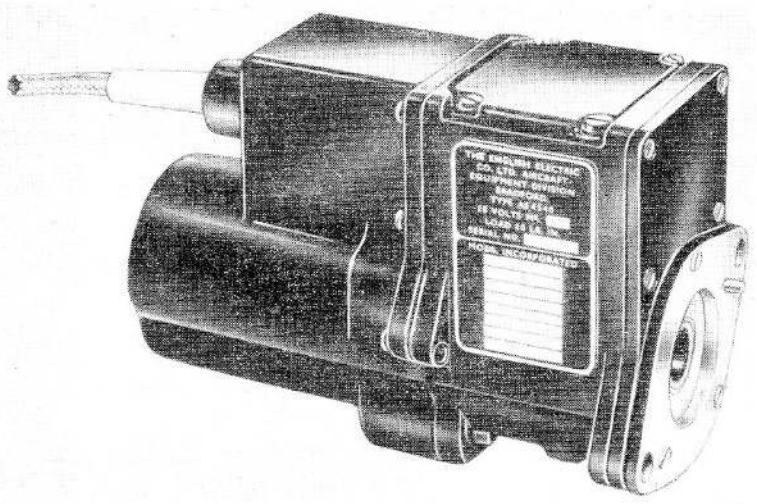

Fig. 1. General view of actuator

Introduction

1. The actuator, English Electric, Type AE4540 is a universal rotary motion d.c. actuator. It is designed to operate equipment such as valves or fuel cocks. Supply to the unit is 19 to 29 volts d.c. Normal work load of the actuator is 50 lb. in. It is capable of handling a maximum load of 75 lb. in. Operation of the unit, either clockwise or counter-clockwise, is continuous at 2 seconds on 5 seconds off. Starting, stopping or reversing the motion of the actuator is effected by external switchgear. The unit does not have limit switches incorporated.

DESCRIPTION

General

2. The actuator comprises a motor, magnetic brake, a set of spur gears and an output shaft assembly. These components are contained with a motor cover, gearcase, drive-end cover and a drive-end endplate.

3. The motor is a split field, series wound d.c. motor. Fields are wound in opposition to give alternate rotary motion.

4. A magnetic brake prevents over-run of the armature when power is cut off. It is mechanically connected between the frame of the motor and the armature shaft at the commutator end, and is connected electrically in series with the armature. The brake disc plate is secured to the armature shaft. A helical spring holds the brake against the disc plate. When power is applied to the motor the brake is pulled off the disc permitting the armature to rotate.

5. Five compound gears, mounted between the motor and gearbox plate assemblies, comprise the gear train. Armature motion is transmitted to the output shaft assembly by the gear train.

6 The output shaft assembly drives the associated equipment of the actuator. It is made up of a shaft, fitted with a needle bearing, and an annulus gear connected to the shaft by a drive pin. The assembly is mounted between the drive-end endplate and the gearbox plate. The output of the gear train motion is fed to the shaft assembly through the annulus gear. Ratio of reduction is 3100 to 1.

7. Electrical connections of the unit are made at a terminal lock mounted on a bracket in the gearcase. Screened flying leads provide the external connections.

Motor and Brake assembly

8. The motor frame and motor plate assembly contain the field and armature.

The field assembly is shrink fitted into the frame. The armature revolves in flanged bearings between the plate and the frame. Two spring discs are positioned between the flanged bearing at the driving end and the motor plate assembly. The discs fit in the housing provided in the plate for the bearing. The splined end of the armature shaft protrudes through the plate into the gearbox and the commutator end of the shaft protrudes through the frame into the magnetic brake compartment.

9. Two aluminium alloy brush box assemblies, mounted on a moulded rocker, holds two brushes, Type CM6 (HAM) against the face of the commutator. The brushes are set 180° apart in the neutral axis. Brush pressure is 4 to 5 oz. Pressure is maintained on the brushes by a combination of the spring, spring spindle and brush finger of the brush box assemblies, the brush finger bearing directly on the brush. Adjustment of the brush pressure can be accomplished through the spring spindle. The moulded rocker is secured to the motor frame. Its position can be adjusted to enable the brushes to be set in the neutral axis.

10. The magnetic brake is fitted between the motor frame and the end of the armature shaft. It comprises a yoke assembly, which houses the coil, a brake shoe assembly a beryllium copper spring, and a single steel brake disc. Four 6 B.A. countersunk screws secure the yoke assembly to the motor frame. The brake disc is fitted to the machined flats of the shaft and is secured on the shaft, and against the flanged bearing, by two 4 B.A. locknuts. Brake shoe assembly and the helical spring are positioned between the yoke assembly and brake disc. The brass sleeve of the brake shoe assembly acts as a guide for the spring which holds the brake shoe assembly against the disc. The brake lining is bonded to the brake shoe assembly. Leads from the coil pass through the motor frame.

11. Machined lugs of the yoke mate with slots machined in the brake shoe when a load is applied and prevent the brake shoe assembly from revolving.

Gearbox

12. Five compound gears contained between the motor plate assembly and the gearbox plate assembly form the gearbox. The plate assemblies are spaced from each other by three pillars and are secured together by three 4 B.A. screws, that pass through pillars, and 4 B.A. stiffnuts. The gears are mounted in ball bearings or bushes set in the plate assemblies. The splined end of the armature shaft engages the 1st compound gear and the motion is transmitted through the train to the 5th compound gear which passes through the gearbox plate and engages the annulus gear of the output shaft. Gears are positionally non-interchangeable.

Output shaft assembly

13. An aluminium bronze shaft fitted with a needle bearing at one end and connected to an annulus gear by a drive pin comprises the output shaft assembly. It is installed between the gearbox plate assembly, the needle bearing end of the shaft assembly being mounted on the bearing pin of the plate assembly, and the self lubricating P.T.F.E. bush of the drive end endplate. The bush and pin are the bearing surfaces on which the shaft assembly rotates. The drive pin, connecting the shaft to the annulus gear, passes through the bore of the shaft.

14. A serrated adaptor fitted to the shaft of the output shaft assembly is the final connection between the actuator and its load i.e., the equipment the actuator is driving. Serrations are cut on the inside of the adaptor. The adaptor is mounted on the output shaft assembly in such a manner that the uncut serration aligns with the centre line of the two $\frac{3}{32}$ in. dia. mounting holes in the drive end endplate and is at 45° to the drive pin.

Housings and drive-end endplate

15. A motor cover, gearcase, drive end cover and drive end endplate house the components of the actuator and are bolted to each other to complete the unit.

16. The motor cover is an aluminium

die casting and contains the motor and magnetic brake.

17. The section of the actuator formed by the gearcase, drive-end cover and drive-end endplate house the gearbox and the output shaft assembly.

18. The gearcase is an aluminium die casting and the drive-end cover is of aluminium alloy. Two dowel pins help to locate the cover on the gearcase.

19. The aluminium alloy drive-end endplate is positioned on the drive end cover and is secured to the cover and gearcase by 6 B.A. countersunk screws. A self lubricating P.T.F.E. bush is press fitted to the endplate and locates the output shaft assembly at the drive end. The endplate is drilled and counterbored to accept a dowel pin which protrudes 0·149 in. beyond the face of the endplate. Purpose of the dowel pin is to ensure correct installation of the actuator by mating with a hole in the mounting face of the associated equipment.

Electrical connections

20. Electrical connections of the unit are made at a terminal block mounted on a bracket in the gearcase. Three $23\frac{1}{2}$ in. uniefglasmet 22. screened flying leads are brought out through a rubber seal mounted in an aluminium alloy adaptor in the motor cover. The seal is secured to the adaptor by a housing nut and washer. The flying leads are identified by three Helsyn sleeves marked, A, B, and C. The screening of the flying leads is connected internally to a motor stud by means of an A.M.P. terminal tag.

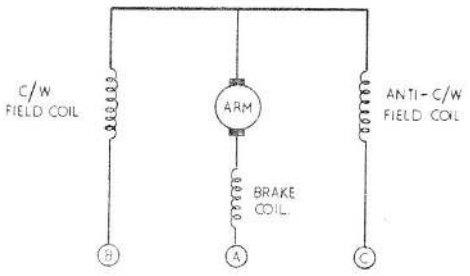

Fig. 2. Wiring diagram

INSTALLATION

21. Prior to installation the serrated adaptor should be fitted to the output shaft assembly as described in paragraph 14.

22 The actuator is mounted on its associated equipment by two $\frac{1}{4}$ in. B.S.F. fixing studs and two plain $\frac{1}{4}$ in. B.S.F. nuts and washers. The dowel pin of the endplate mates with a hole in the mounting face of the equipment.

23. Flying lead identified as A is the common lead to the actuator and the leads identified as B and C are the connections to the clockwise and counter-clockwise fields, respectively, of the actuator. Direction of rotation is taken looking on the output shaft. For clockwise rotation connect leads A and B. For counter-clockwise rotation connect leads A and C.

OPERATION

24. The actuator operates on 19 to 29 volts d.c. When a voltage supply is fed to either field coil the magnetic brake is pulled off the armature and the acuator rotates. Selecting direction of rotation and starting, stopping or reversing must be done by external switchgear. The actuator can operate continuosly on a maximum of 2 seconds on and 5 seconds off.

SERVICING

25. The unit should be serviced in accordance with instructions detailed in the relevant Servicing Schedule. The housings and covers should be inspected for signs of corrosion and cracking and the screening of the flying leads inspected for fraying or damage. Check all external nuts and bolts for security.

26. The wear on the brake lining can be ascertained by checking the gap between the brake yoke and shoe assemblies with a feeler gauge; the gap should be within 0·004 in. to 0·013 in.

27. Check the brushes and spring pressure at the periods specified in the appropriate Servicing Schedules. The minimum brush length allowed is 0·225 in. and the brush spring pressure should be 4 to 5 oz.

TESTING

Performance test

28. Test actuator to voltage and loads given in the following table, load opposing and load assisting, and check that the current draw and time of 180° rotation do not exceed table values.

Operational test

29. At ambient temperature 20°C, apply 50 lb. in. load to actuator and check that actuator performs 50 cycles of operations satisfactorily at normal votage supply (28 volts d.c.). Time the run to ensure that the maximum operating frequency of the machine is not exceeded.

Note . . .

A cycle, in this instance, is defined as one operation against the load plus one operation in the reverse direction with same load.

Insulation test

30. With the motor of the unit hot check that the insulation resistance measured at 500 volts d.c., is greater than 50,000 ohms.

Volts d.c.	Load in lb. in.	Maximum current in amperes	Maximum time for 180° rotation in seconds
18	0	1·4	6·7
18	50	1·6	10·0
18	75	1·8	13·5
28	0	1·35	4·2
28	50	1·6	5·0
28	75	1·75	5·75
29	0	1·3	4·1
29	50	1·55	4·9
29	75	1·80	5·5