Chapter 59

ACTUATORS, PLESSEY, JAGUAR (SLOW SPEED) SERIES

LIST OF CONTENTS

LIST OF ILLUSTRATIONS

LIST OF APPENDICES

Introduction

1. The Jaguar series of actuators are designed to provide remotely-controlled linear motion against tensile or compressive loads.

2. Basically, the actuators in the slow speed range consist of a reversible motor which drives a leadscrew, threaded into a plunger, through a multi-stage reduction gear train. The travel of the plunger is controlled by two adjustable limit switches which are operated by the plunger. Electrical connections to the actuator are made through a plug positioned on either the front cover or the spacer case. An end fitting screwed on to the plunger provides one attachment point, the other being an end fitting secured to the rear of the actuator body.

3. Variants in this range differ in their plunger travel, leadscrew thread, type and position of the electrical plug, and end fittings. Details of these variants will be found in the appendix to this chapter.

Note . . .

The servicing details given in this chapter are limited to routine inspections. Detailed servicing on individual actuators will be given in the appropriate appendix to this chapter, and will be issued later.

DESCRIPTION

General

4. A general view of a typical Jaguar actuator is shown in Fig. 1, and a unit in this slow speed range is shown sectioned in Fig. 2.

Motor

5. The motor is series-wound and incorporates duplicate field windings, to permit reversible operation, and an electro-magnetic brake. The armature is supported in two

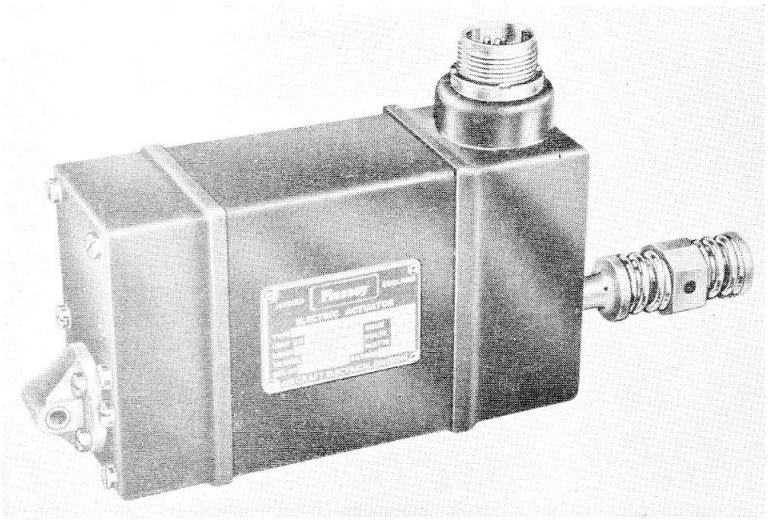


Fig. 1. General view of Jaguar (slow speed) actuator

ball bearings, one located in the drive-end housing and the other in the commutator-end housing. The housings are secured to the yoke by through-studs, screwed into the brake coil casing in the drive-end housing, and the assembly is secured by two nuts at the commutator end. The brushgear is secured to the commutator-end housing and, for the purpose of adjustment, the brushgear can be moved radially within the limits of the two slots through which the studs pass.

6. The brake coil is enclosed within the drive-end housing and, when energized, attracts the lined brake disc away from the rear face of the brake plate. The motor pinion forms an integral part of the brake plate which is secured to the drive end of the armature. The brake disc is prevented from rotating by two lugs on its periphery and is loaded by the brake spring.

Reduction gear train

7. The drive from the motor pinion to the leadscrew is through a reduction gear train of four compound gears and a final gear.

8. The gear shafts are supported in ball bearings in the front and rear housings, the third compound gear being mounted on, but independent of, an extension of the first compound gear shaft.

Leadscrew and plunger

9. The final gear is secured to the rear end of the leadscrew. An Acme or Whitworth thread machined on the outside of the leadscrew and in the bore of the plunger serves to convert the rotary action of the leadscrew into linear movement of the plunger, causing the plunger to extend or retract. The plunger is prevented from rotating by integral torque-reaction ears which locate in slots in the plunger housing.

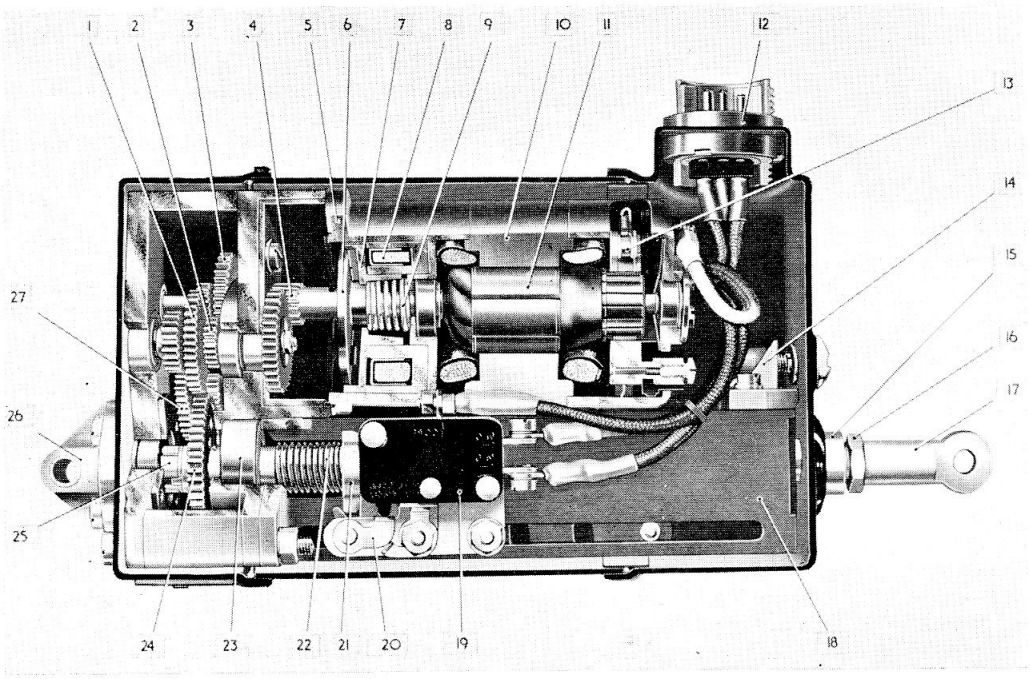
10. A large ball bearing supports the rear end of the leadscrew and plunger assembly while the front end of the assembly is supported in a plain bush. The outer end of the plunger is threaded to carry the front end fitting for attachment to the component being driven.

Limit switches and operating mechanism

11. Plunger travel is controlled by two limit switches, mounted one on each side of the plunger housing. The switches are operated by a mechanism (fig. 3) which is tripped by one of the torque-reaction ears on the plunger.

12. At the pre-set limit of plunger travel, the lower torque-reaction ear comes into contact with the operating arm of the switch mechanism. Movement of this arm is transmitted through a transverse spindle to an operating arm on the outside which moves upwards to depress the limit switch plunger and so cut off the power supply to the motor.

13. Adjustment of plunger travel is made by altering the position of the limit switch assemblies along the slots in the sides of the plunger housing, so that the torque-reaction ear on the plunger contacts the operating arm earlier or later.



1. 3RD STAGE COMPOUND GEAR
2. 1ST STAGE COMPOUND GEAR
3. 2ND STAGE COMPOUND GEAR
4. MOTOR PINION
5. MOTOR DRIVE-END HOUSING
6. BRAKE PLATE
7. BRAKE DISC
8. BRAKE COIL
9. BRAKE SPRING
10. YOKE
11. ARMATURE
12. PLESSEY PLUG
13. BRUSHGEAR
14. FRONT COVER FIXING BRACKET
15. PLUNGER
16. LOCKNUT
17. FRONT END FITTING
18. PLUNGER HOUSING
19. LIMIT SWITCH
20. SWITCH OPERATING ARM
21. PLUNGER TORQUE-REACTION EAR
22. LEADSCREW
23. LEADSCREW BALL BEARING
24. FINAL GEAR
25. FINAL GEAR RING NUT
26. REAR END FITTING
27. 4TH STAGE COMPOUND GEAR

Fig. 2. *Sectional view of Jaguar (slow speed) actuator*

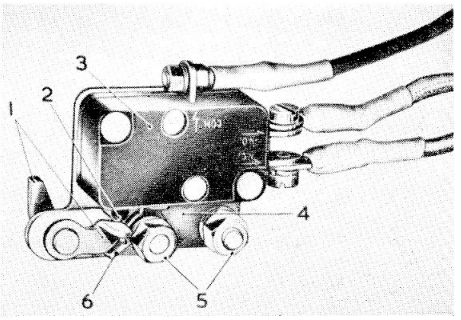
Electrical connections

14. The electrical connections to the actuator are made through a Bendix, Cannon or Plessey plug which is positioned on the top or front of the front cover or on the top of the spacer case, according to the variant.

15. The internal connections and a typical external circuit are shown in Fig. 4.

End fittings

16. The rear end fitting is spigotted into the rear housing and is secured with screws. The front end fitting is screwed on to the front of the plunger and locked by a locknut. The type of end fitting used varies with the actuator type.



1. OPERATING ARMS
2. SWITCH PLUNGER
3. LIMIT SWITCH
4. MOUNTING PLATE
5. SECURING NUTS
6. SPECIAL WASHER AND STOP

Fig. 3. *Limit switch assembly*

OPERATION

17. The motor rotates the leadscrew through the reduction gear train and the final gear. The plunger, being threaded on to the leadscrew, extends or retracts according to the direction of rotation of the leadscrew and is itself prevented from rotating by two integral torque-reaction ears which locate in slots in the plunger housing.

18. At the extremes of plunger travel, the contacts in one of the limit switches are opened by the switch operating mechanism, thereby cutting off the power supply to the motor; the brake incorporated in the motor prevents excessive overrun of the plunger. The reverse rotation is achieved by selecting the alternative position of the external control switch.

INSTALLATION

19. For details of an actuator installation in a particular aircraft, reference should be made to the appropriate Aircraft Handbook.

20. When fitting a new or overhauled unit, first check that the actuator is of the correct type for the installation; no adjustment of the plunger travel is possible in service since a special test rig is used to obtain the required accuracy. Check that the actuator has not been damaged in transit, that all external screws, nuts and bolts are fully tightened, and that the necessary fittings are available for securing the actuator to its associated component. Ensure that the plunger of the

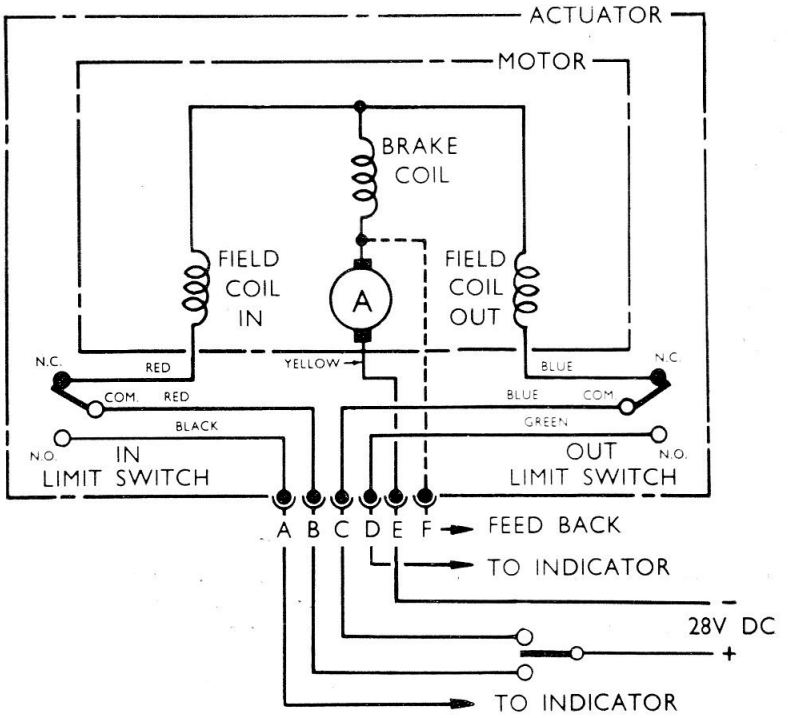


Fig. 4. *Typical circuit diagram*

actuator and the drive shaft of the associated component are correctly positioned before coupling them together.

21. After the actuator has been installed, check the security of the installation and operate the actuator to ensure that it functions correctly.

SERVICING

22. During routine inspection, carried out in accordance with the appropriate aircraft servicing schedule, the actuator should be examined for signs of damage, and checked for security of mounting. The actuator should then be operated over its full range in both directions to ensure that it functions correctly. Any external fittings should be kept well lubricated with low temperature grease.

23. Using a 250 V insulation resistance tester, measure the insulation between the pins of the plug and frame, the minimum reading obtained should not be less than 50,000 ohms.

Appendix C

STANDARD SERVICEABILITY TEST

ACTUATORS, JAGUAR (SLOW SPEED), PLESSEY, TYPE 1CZ135770/2—VARIANTS

Introduction

1. The tests detailed in this appendix may be applied to the actuators in the above mentioned series, immediately prior to installation in an aircraft, or whenever their serviceability is suspect.

Test equipment

2. The following test equipment is required:—

(1) Linear actuator test rig (Ref. No. 4G/5420)

(2) 250V d.c. insulation resistance tester, Type C (Ref. No. 5G/152)

(3) A d.c. supply variable, between 18 and 29 volts.

TEST PROCEDURE

Insulation resistance test

3. Using a 250V d.c. insulation resistance tester, measure the insulation resistance between each plug pin and the actuator frame. The values in each instance must not be less than 50,000 ohms.

Brushgear

4. At the periods prescribed in the relevant Servicing Schedule, the actuator should be dismantled sufficiently for examination of the brushgear. The brushes should be replaced by new, in accordance with the instructions contained in the relevant Servicing Schedule, or whenever this examination reveals that the brushes may reach their minimum length before the next routine servicing.

5. To gain access to the brushes, refer to fig. 2 in the main chapter which illustrates a similar actuator, then proceed as follows:—

(1) Slacken the locknut (16) and remove front end fitting (17).

(2) Take out the four screws securing plug receptacle and push receptacle down into the front cover.

(3) Unscrew the captive screw, located just above the plunger.

(4) Withdraw the front cover and spacer case.

6. To re-assemble, replace spacer case, secure plug receptacle in front cover with four screws and refit to actuator. Assemble the locknut and front end fitting to the dimensions quoted in Table 1, para. 2 of Appendix 3. Instructions on how to apply these dimensions are contained in Appendix 1, figure 1 to the main chapter. The end fitting should be lined up so that the axis of the hole in the eye-end is parallel to the horizontal axis of the actuator and the locknut tightened against it.

Functional test

7. The linear actuator test rig is described and illustrated in A.P.4343S, Vol. 1, Book 2, Sect. 8. With the variable d.c. supply set to 25 volts, mount the actuator to be tested on the test rig, using the correct end fittings, and adjust the stroke on no-load to 2·0 inches. Operate the actuator and check that the stroke times and current values conform to the condition detailed in Table 1.

TABLE 1

Applied Voltage	Load (lb.)	Condition of load	Time in seconds for full stroke Min.	Max.	Maximum current (Amperes)	Stroke variation limits (in.)
29	30	C.L.O.	15	23	1·4	
29	30	C.L.A.	14	22	1·3	−0·030
29	30	T.L.O.	15	23	1·4	
29	30	T.L.A.	14	22	1·3	+0·030
29	0	Extend	13	21	1·3	
29	0	Retract	13	21	1·3	
18	0	Extend	21	36	1·2	
18	0	Retract	21	36	1·2	

T.L.O.—Tensile load opposing
T.L.A.—Tensile load assisting
C.L.O.—Compressive load opposing
C.L.A.—Compressive load assisting

8. If a test rig is not available, connect the actuator to a d.c. supply variable from 18 to 29 volts, through an ammeter and a three-way switch with a central 'OFF,' and to two external indicators, as shown in the typical circuit diagram in the main chapter. Perform the no-load tests detailed in Table 1, timing the stroke with a stopwatch and noting the ammeter readings.

9. Check that the indicators function, and that no excessive vibration is felt.

10. Make several inching strokes in each direction, to check for satisfactory operation.

APPENDIX 1

ACTUATORS, PLESSEY, TYPE CZ 77917/- VARIANTS

LEADING PARTICULARS

Actuator, Plessey, Type	*CZ* 77917	*Ref. No.* 5*W*/3850
	CZ 77917/*A*	*Ref. No.*
	CZ 77917/*B*	*Ref. No.*
	CZ 77917/*C*	*Ref. No.*
	CZ 77917/*D*	*Ref. No.*
	CZ 77917/*E*	*Ref. No.*
	CZ 77917/*F*	*Ref. No.*
	CZ 77917/*G*	*Ref. No.*
Operating voltage range		22 *to* 29 *V d.c.*
Normal voltage		28 *V d.c.*
Working load—normal		125 *lb.*
maximum		175 *lb.*
Maximum static load		800 *lb.*
Current consumption (normal load)		2·0 *amp.*
Rating (normal load)		1½ *minutes*
Ambient temperature range		−45°*C to* +90°*C*
Electrical plug		*Plessey MK.*4, 6 *way*
Installation details		*Refer to Table* 1
Motor, Type C 1606*B*/24		*Ref. No.* 5*W*/1065
Output		0·0155 *h.p. at* 15,500 *r.p.m.*
Commutator dia, new		0·490 in. / 0·495 in.
*worn**		0·450 in.
Undercut micas, depth		0·020 in. / 0·025 in.
width		0·018 in. / 0·026 in.
Maximum eccentricity		0·0003 *in. T.I.R.*
Bearing, Type—drive end		*Hoffman No.* 4666
comm. end		*Hoffman No.* 463
Brushes, Type		*High-altitude; carbon grade CM5H (Morgan Crucible Co. Ltd.)*
Length, new		0·355 in. / 0·385 in.
worn		0·250 in.

**After skimming to* 0·470 *in.*

TABLE 1

(Installation details)

Type	Centres (in.)		Plunger Travel (in.)	End Fittings	
	Retracted	Extended		Front	Rear
CZ 77917	7·42	10·42	3·0	CZ 55336	1CZ 135266
CZ 77917/A	7·47	10·47	3·0	Z 63582	1Z 135267
CZ 77917/B	7·97	10·97	3·0	CZ 55524	1Z 135267
CZ 77917/C	8·19	11·19	3·0	CZ 63289	1Z 135267
CZ 77917/D	7·42	10·42	3·0	Z 53332	1CZ 135266
CZ 77917/E	6·95	9·95	3·0	Z 64376	1CZ 135266
CZ 77917/F	8·90	10·67	1·77	CZ 63289	1Z 135267
CZ 77917/G	7·57	10·57	3·0	Z 60332	1Z 135267

1. The actuators Type CZ 77917/- variants are included in the Jaguar (slow speed) series of linear actuators, the basic construction of which are described and illustrated in the main chapter.

2. These particular variants have a one-piece front cover and spacer case, also a 3/8 in. diameter Amco thread is machined on the outside of the leadscrew and in the bore of the plunger. The electrical connections are made through a Plessey plug positioned on the top of the front cover. The differences in the variants are in the plunger travel settings and the end fittings.

3. Front and rear end fittings of various types are fitted to these actuators and details of these will be found in Table 1.

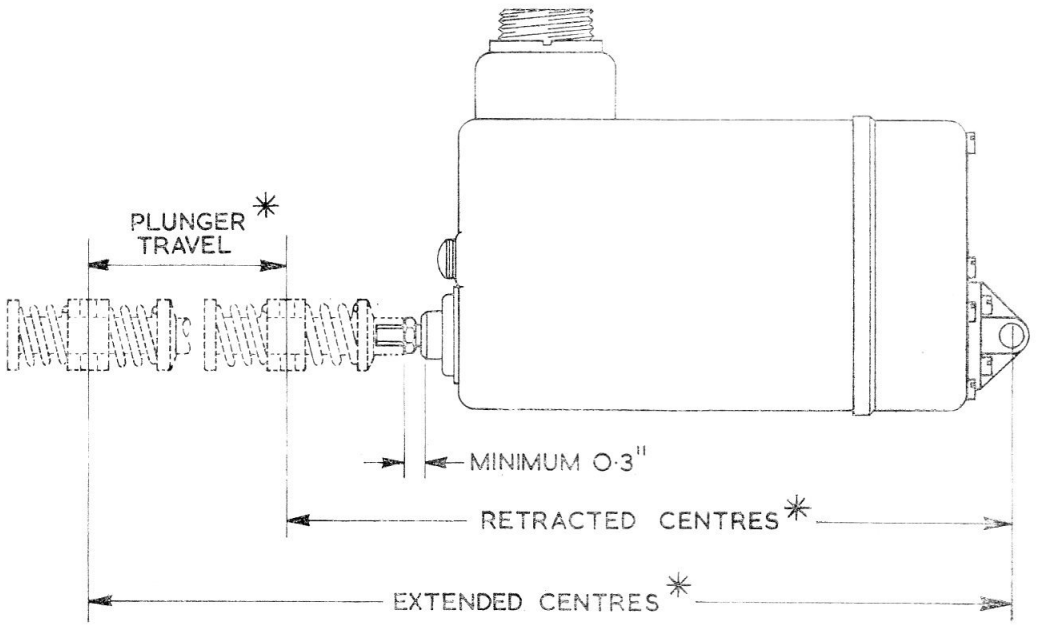


Fig. 1. *Installation details*

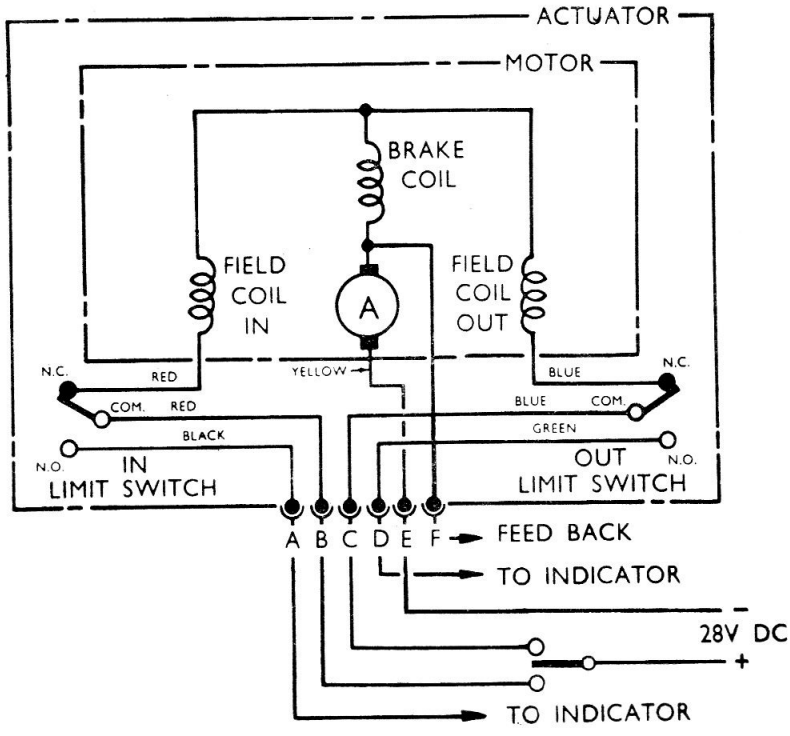


Fig. 2. *Circuit diagram*

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Appendix 2

ACTUATORS, PLESSEY, TYPE CZ64337/1/- VARIANTS

LEADING PARTICULARS

Voltage range	22-29*V d.c.* 28*V d.c. (normal)*
Normal working load	125 *lb.*
Maximum working load	175 *lb.*
Maximum static load	800 *lb.*
Current consumption at normal load	3 *amp.*
Rating (normal load)	1·5 *min.*
Ambient temperature range	—45 *to* +90 *deg. C*
Motor, Type C1606 B/24 (4CZ92025)	*Ref. No. 5W/1065*
Output	0·0155 *h.p. at* 15,500 *r.p.m.*
Commutator dia., new	0·490 *to* 0·495 *in.*
worn (min.)*	0·450 *in.*
Undercut micas, depth	0·020 *to* 0·025 *in.*
width	0·016 *to* 0·026 *in.*
Maximum eccentricity	0·0003 *in. T.I.R.*
Bearing, type — drive end	*Hoffman No.* 4666
comm. end	*Hoffman No.* 463
Brushes, Type	*High altitude; carbon grade CM5H (Morgan Crucible Co. Ltd.)*
Length, new	0·355 *to* 0·385 *in.*
worn	0·250 *in.*

* After skimming to 0·470 in.

INSTALLATION DETAILS

Type	*Ref. No.*	*Retracted centres (in.)*	*Extended centres (in.)*	*Stroke (in.)*	*End Fittings Front*	*Rear*	*Position of rear fitting (refer to fig. 1)*
CZ64337/1/A	5W/2405	7·120	9·812	2·69	Z67056	CZ54077	A
CZ64337/1/B		6·87	7·87	1	Z61476	Z58424	A
CZ64337/1/C	5W/414	7·875	10·875	3	CZ55524	CZ54077	B
CZ64337/1/D		6·875	9·425	2·55	Z64364	CZ54077	A
CZ64337/1/E	5W/1124	8·875	11·875	3	CZ60333	CZ54077	A
CZ64337/1/F		7·00	10·00	3	Z64376	Z58424	A
CZ64337/1/G		9·10	12·10	3	CZ55524	CZ59826	B
CZ64337/1/J		7·12	9·85	2·73	1Z80695	Z58424	A
CZ64337/1/K		7·50	10·50	3	Z60332	CZ54077	A
CZ64337/1/L		8·20	10·80	2·6	CZ55524	Z58424	A
CZ64337/1/M	5W/3849	7·462	10·164	2·702	Z63582	Z58424	A
CZ64337/1/N		9·07	12·07	3	CZ55524	CZ59826	A
CZ64337/1/0		7·5	10·5	3	CZ55336	Z58424	A

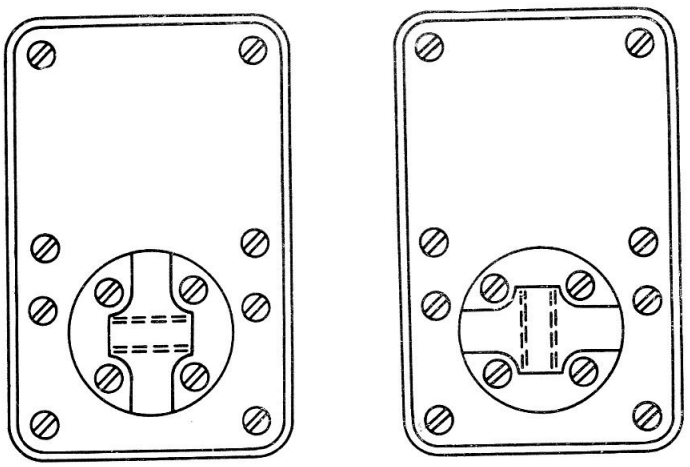

Fig. 1. Alternative positions of rear end fitting

The basic construction of the actuators, Type CZ64337/1/-, is as described and illustrated in the main chapter. These particular variants have a $\frac{3}{8}$ in. dia. Acme thread machined on the outside of the leadscrew and in the bore of the plunger. Electrical connections are made through a 6-pole plug positioned on the front of the front cover.

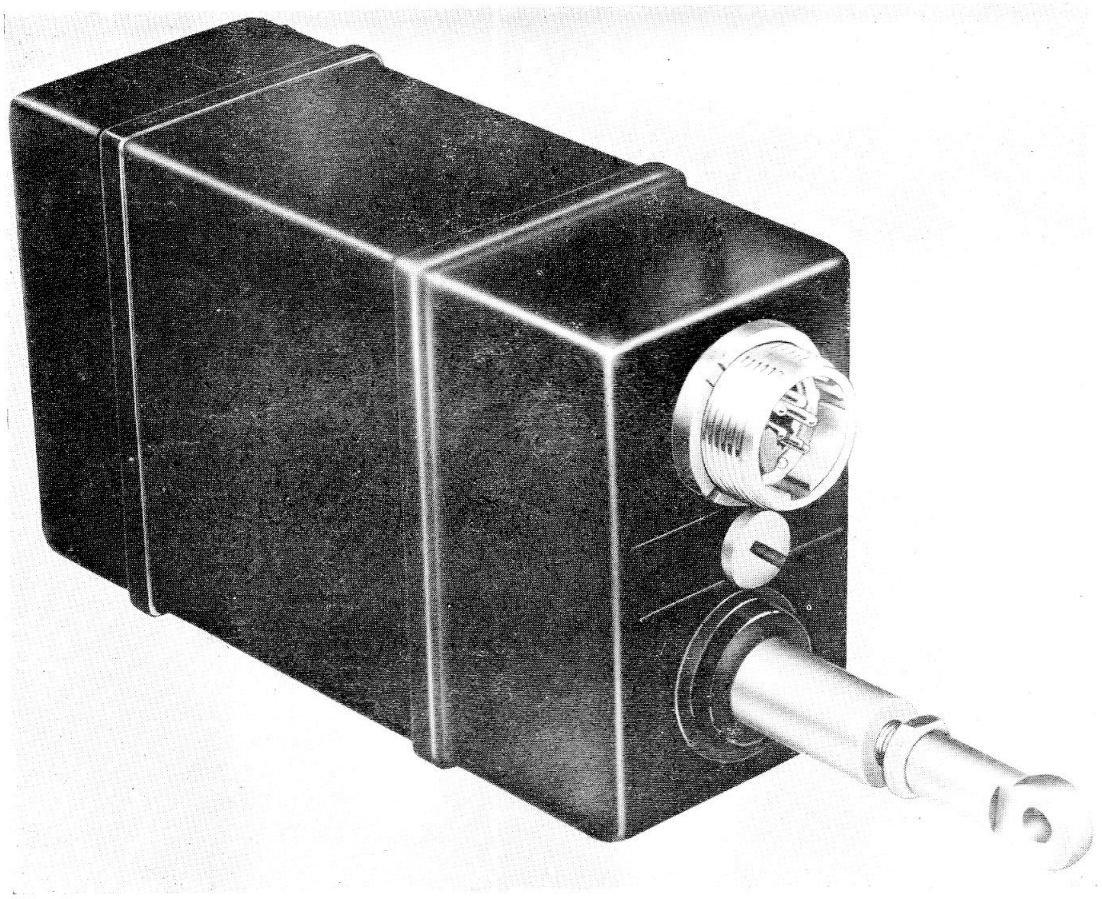

Fig. 2. General view of actuator, Type CZ64337/1

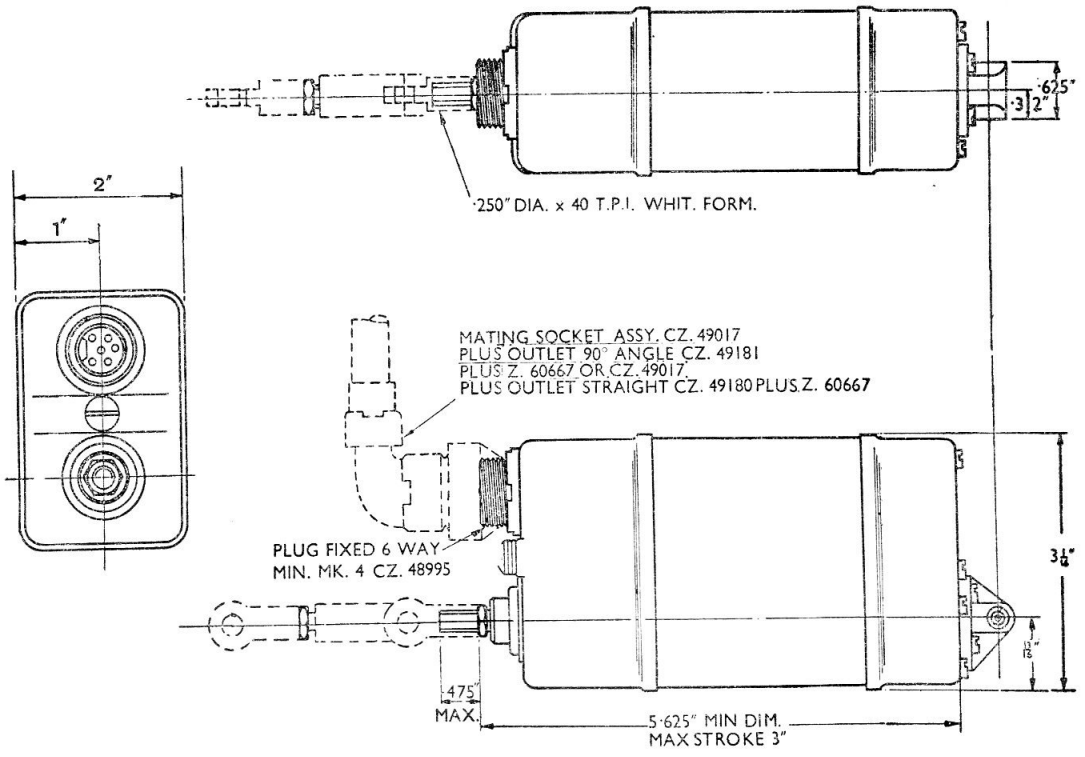

Fig. 3. Installation drawing

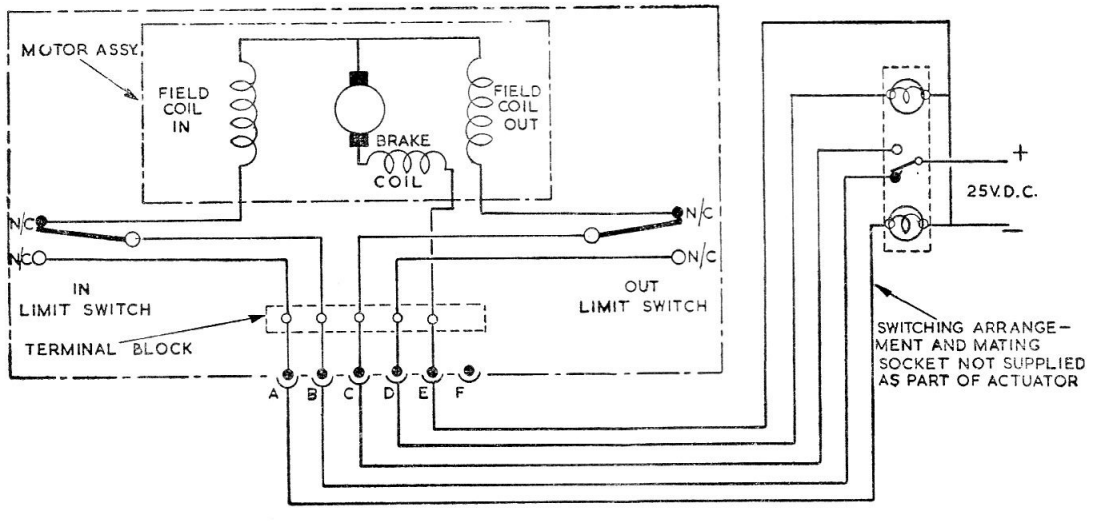

Fig. 4. Circuit diagram

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Appendix 3

ACTUATORS, JAGUAR, (SLOW SPEED), PLESSEY, TYPE 1CZ135770/2—VARIANTS

LEADING PARTICULARS

Actuator, Type 1CZ135770/2	*Ref. No. 5W/-*
Operating voltage range	*18 to 29V d.c.*
Normal voltage	*28V d.c.*
Normal working load	30 *lb.*
Maximum working load	50 *lb.*
Maximum static load	300 *lb.*
Rating at normal load	1½ *min.*
Ambient temperature range	−60 *to* +90 *deg. C*
Weight	2 *lb.* 6 *oz.*
Overall dimensions: height (to top of plug)	4·26 *in.*
width	2·05 *in.*
length (less end fittings)	5·67 *in.*
Motor, Type C1606B/24	*Part No. 4CZ92025, Ref. No. 5W/1065*
Output	0·015 *h.p. at 15,500 rev/min.*
Commutator dia., new	0·490 *to* 0·495 *in.*
worn (min.)	0·450 *in.*
after skimming (min.)	0·470 *in.*
Undercut mica inter-segments, depth	0·020 *to* 0·025 *in.*
width	0·018 *to* 0·022 *in.*
Maximum eccentricity of commutator to shaft journal	0·0003 *in. T.I.R.*
Bearing, drive end	*Hoffman No. 4666, Ref. No. 2A/9501383*
commutator end	*Hoffman No. N463, Ref. No. 2A/9501186*
Brushes	*Type H.A.M. E.G.14, Ref. No. 5W/1041*
length, new	0·355 *to* 0·385 *in.*
worn (min.)	0·250 *in.*

1. These actuators, Plessey Part No. 1CZ135770/2, are variants in the Jaguar (Slow Speed) Series described in the main chapter. A 5-pole Cannon type plug, is located in the top section of the front cover, for connection to the external electrical circuit. Hence, with the exception of the 'feedback' line from the brake coil to F on the plug assembly, the typical circuit diagram, Fig. 4 in the main chapter, is applicable to actuators covered in this appendix. All other information detailed in the main chapter is applicable to the type covered in this appendix, in addition, a Standard Serviceability Test on these actuators is contained in Appendix C.

2. The differences between the 1CZ135770/2 variants relate to length of stroke, centres dimensions, end fittings and the position of the rear end fitting. These features are detailed, for each actuator, in Table 1.

TABLE 1

Stroke setting and installation details for 1CZ135770/2 actuators

Variant 1CZ135770/2	Ref. No.	Centres (in.) Retracted	Extended	Stroke (in.)	End Fitting Front	Rear	Position of Rear End Fitting (Refer to Fig. 1)
/A/2	—	15·28 +0·010 −0	12·31 +0 −0·010	2·97	1Z82938	CZ59826	A

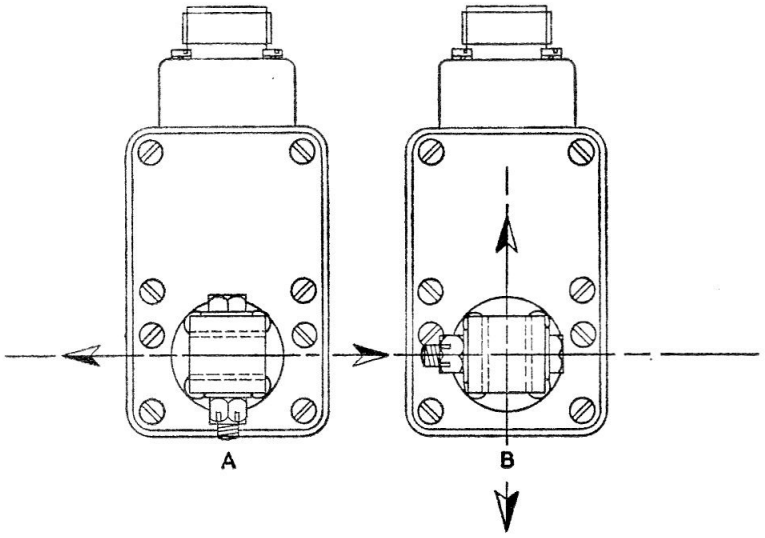

Fig. 1. Alternative positions of rear end fitting

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370989/Wt.43002/D.1813 1,500 3/64 Gp.375/7