

Chapter 2

ACTUATOR, MILES ENG., TYPE MAL. 6

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LEADING PARTICULARS

Actuator, Miles Eng., Type MAL.6	Ref. No. 11A/6009
Operating voltage range	18 to 29V d.c.
Stalled current at max. voltage	
With clutch slipping (actuator stalled)	6 amp.
With motors stalled	9 amp.
Normal working load	10 lb.
Max. working load at -65 deg. C	
at 28V d.c.	25 lb.
at 18V d.c.	10 lb.
Clutch setting load	45 + 5 lb. - 0
Max. static load	500 lb.
Stroke	1.25 \pm 0.01 in.
Time of stroke at 29V d.c.	
With 10 lb. load opposing	5 seconds
With 25 lb. load opposing	8 seconds
Screw thread	10 t.p.i. single start acme
Gear ratio	17.8: 1 spur gear differential
Ambient temperature range	-65 to $+90$ deg. C.
Time rating	1.5 minutes
Max. frequency of operation	2 cycles per minute
Electrical connections	2 Cannon plugs
Overall dimensions	7 \times 6.1 \times 5.4 in.
Weight	10.5 lb.

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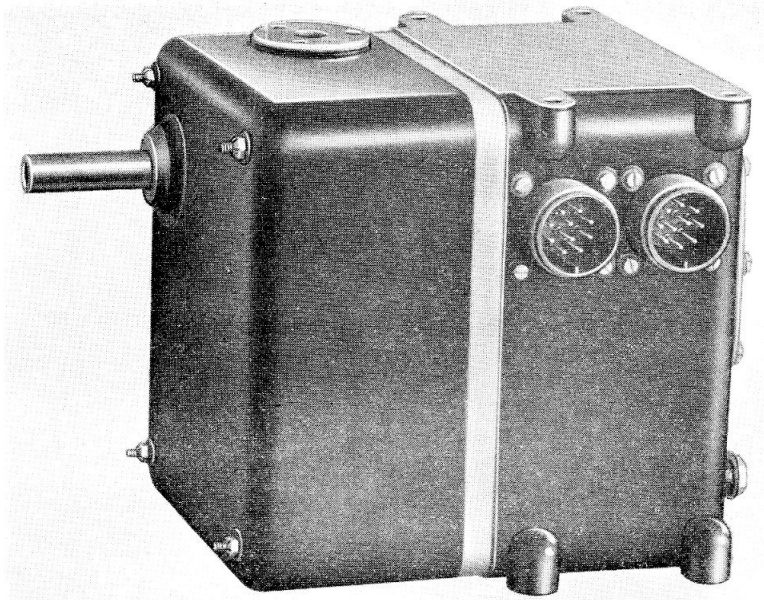


Fig. 1. Actuator, Type MAL.6

Introduction

1. The actuator, Type MAL.6, is designed to provide a fully duplicated electro-mechanical remote controlled system for inserting the 'in flight' safety lock pin in bomb release units. It is intended that a single failure will not cause a complete failure of the actuator.

DESCRIPTION

General

2. The actuator is driven by two d.c. motors, linked mechanically by a spur differential which drives an acme thread ram and nut through a reduction gear and clutch. A positive stop mechanism is fitted in the gear train on the output side of the clutch to ensure accurate positioning of the ram.

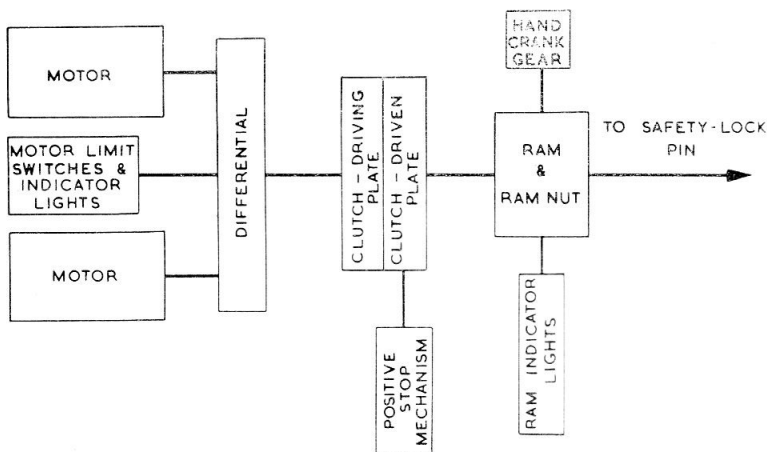


Fig. 2. Block diagram of bomb release safety lock actuator

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3. The motors, which have their length of run controlled by pre-set limit switches are allowed to overrun the positive stop mechanism by slipping the clutch for a pre-determined number of revolutions to ensure that the ram is positioned accurately at the stop.

4. For setting up purposes, the ram may be extended by a hand cranking mechanism operated by a detachable key on the side of the actuator.

Motors

5. The motors used in this actuator are 28-volts d.c. split-field series type. Each motor is fitted with a solenoid operated brake. The brake solenoid is connected in series with the motor field and when the motor is energized, the solenoid disengages the brake against the spring allowing the armature to rotate. When the circuit is broken, either by the limit switch or through failure, the solenoid is de-energized and the spring applies the brake friction lining to the brake disc, thereby locking the armature and its attendant gear train and so locking one side of the differential.

Reduction gear

6. The reduction gear consists of a train

of spur gears giving an overall reduction of 17:8:1 between the differential and the clutch.

7. Each motor drives one side of a spur gear differential. The power take-off gear of the differential drives the clutch, the screw ram and ram nut which operates the motor limit switches. The output side of the clutch drives the ram nut and the positive stop system. A separate pair of bevel gears run in mesh adjacent to the ram nut for the hand cranking mechanism.

8. All the gears and shafts in the gear train are of non-corrodible material such as aluminum bronze and stainless steel. Each shaft is mounted on a pair of sealed ball races, which are housed in light alloy mounting plates, separated by stainless steel pillars.

9. The ram nut is carried between two deep groove ball races, which take the radial load of its gear plus the axial reaction of the ram thrust.

Differential

10. The differential is of the spur gear type with two sets of three planet gears rotating around a centrally placed sun wheel. The

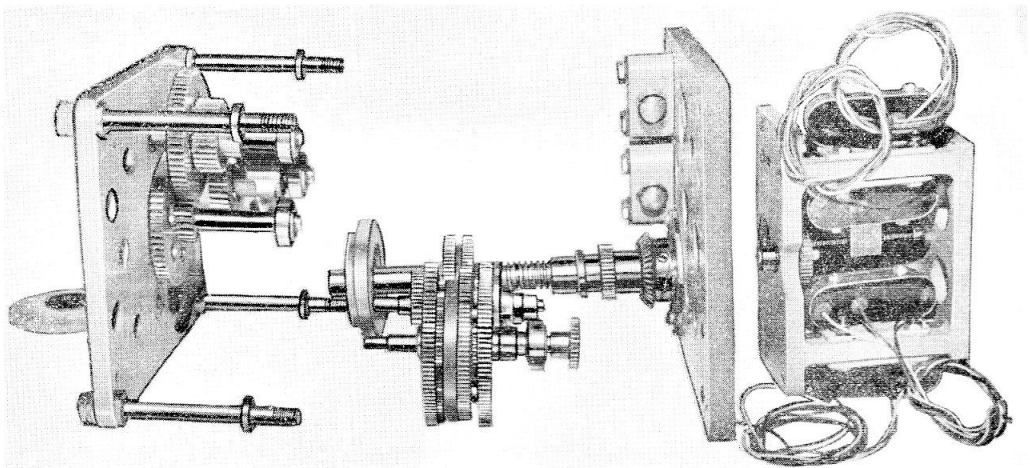


Fig. 3. Dismantled actuator

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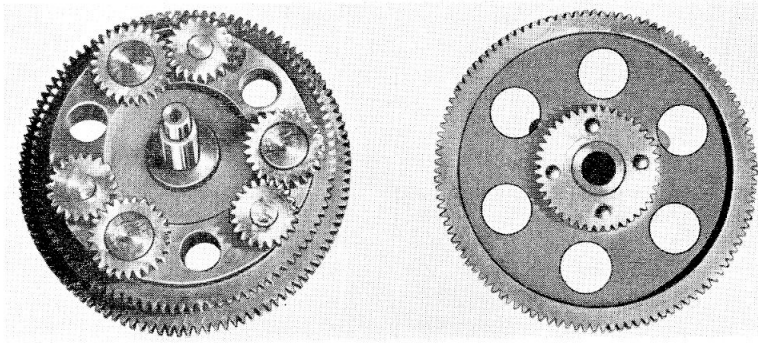


Fig. 4. Differential

planet wheels are mounted on a spur gear, each driven independently by the motors. The whole is mounted co-axially on a common shaft. In the event of one motor failing, one side of the differential is locked and the other motor is able to drive the actuator at the same torque but at half speed.

Positive stop mechanism

11. To control the movement of the ram within ± 0.010 in., a positive stop is provided by having an arm which rotates through 180 degrees between two stops. This arm is rotated through suitable gearing by a drive taken off the output side of the clutch.

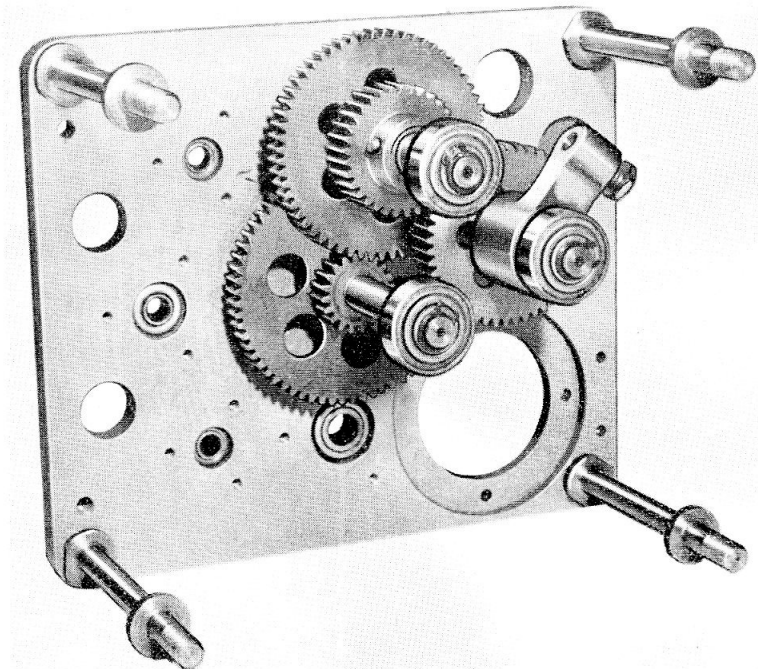


Fig. 5. Reduction gear and positive stop mechanism

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12. The positive stop also prevents the ram nut jamming on the ram due to the over-running of the nut on the end of the thread.

Indicator switch mechanism

13. Indicator switches are operated by an arm at the end of the ram. These give direct and positive indication of the ram position. The switches are hermetically sealed type and both extended and retracted switches are duplicated.

Hand cranking

14. A hand cranking socket is provided to enable the ram to be moved when an electric supply is not available. The hand cranking socket is connected directly to the ram nut by a pair of bevel gears.

15. Operating the ram by hand cranking necessitates slipping the clutch and may cause the limit switch gear to come out of phase with the ram due to the limit switch gear being operated from the driven side of the clutch. Selection and operation of the actuator electrically will rephase the switch gear automatically. The hand cranking gear should only be operated by the special torque screwdriver.

Clutch

16. The clutch is of the single plate friction type where the clutch plate is gripped between the chrome surfaces of the driving and driven plates. Pressure is maintained by a coil spring set to give a force at the ram of 45 ± 5 lb. at normal temperatures.

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Limit switches

17. The operation of the motors is controlled by a set of four micro-switches which control the energizing of the motor field coils. The switches are operated by a screwed ram driven through gearing from the driving side of the clutch.

Screw ram

18. The ram is made of stainless steel and has an acme thread. It is supported by a phosphor bronze nut which is integral with a spur gear. The spur gear connects with the driven side of the clutch and also carries a bevel gear which meshes with a bevel gear on the hand cranking socket at the side of the actuator. The ram passes through a hole in the outer casing of the actuator which is sealed by an 'O' ring seal.

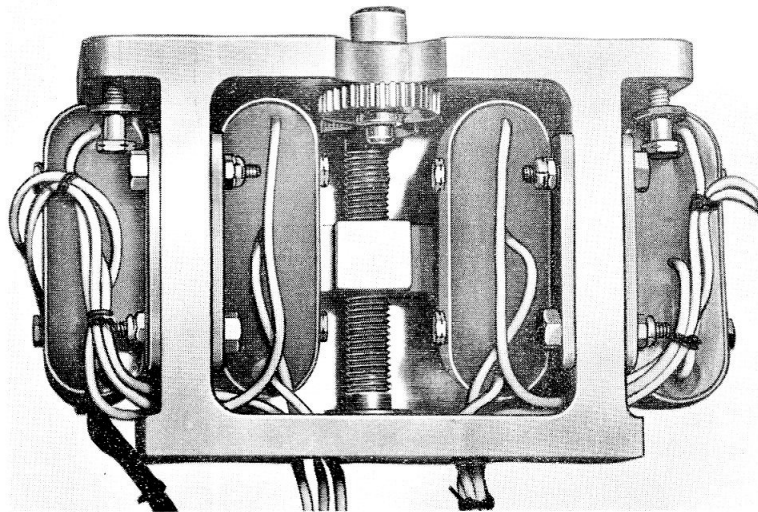


Fig. 6. Switch gear

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Wiring

19. The wire used in the actuator is single core 19/006 P.T.F.E. insulated equipment wire Type A. Each wire is identified with a code numbered cable marker and is soldered at its termination. The wire terminations at the micro-switches are hermetically sealed and two insulated tag boards are mounted inside the actuator to enable connections between the motors and switches to be made. The actuator wiring is terminated at two 'Cannon' plugs, Types MS-3102R-18-IP and MS-3102R-18-IPW. The difference between these plugs is that the keyway is at a different position (70 degrees) to prevent interchanging of the mating sockets.

SERVICING

20. The actuator should be kept clean. The

ram should be lightly covered with grease XG-295. If this grease is not available, the ram should be left clean and dry as this actuator is intended for use at very low temperatures.

21. The performance of the actuator can be checked with the clutch setting gauge to ensure that the power at the ram is between 45 and 50 lb. at normal temperature. The time for the ram to move through its full length of travel should not exceed 3.5 seconds on either motor at 29-volts with both load opposing and load assisting.

22. The insulation resistance, when measured with a 250-volt insulation resistance tester between all plug pins and the frame, should not be less than 50,000 ohms.

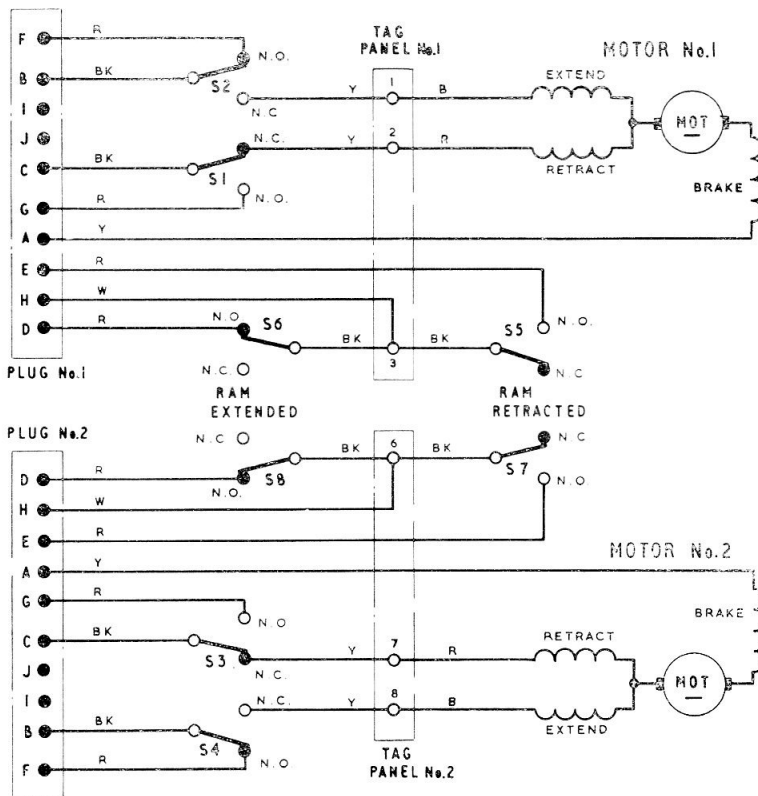


Fig. 7. Circuit diagram

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