Cancelled now AP 11BF-0503-1

THROTTLE MOTOR, ULTRA, TYPE M174/1

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LEADING PARTICULARS

Throttle motor unit, Ultra, Type M174/1	*Ref. No.* 5UD/6680
Overall dimensions	$8\frac{7}{8}$ *in.* × $4\frac{5}{8}$ *in.* × $6\frac{1}{4}$ *in.*
Weight	12 *lb.*
Power supplies—normal system	150*V*, 400 *c/s, single phase (from amplifier, Type* A401/3)
Power supplies—override system	28*V d.c.*
Power consumption—normal system	100 *VA at* 0·6 *p.f.*
Power consumption—override system	60*W*

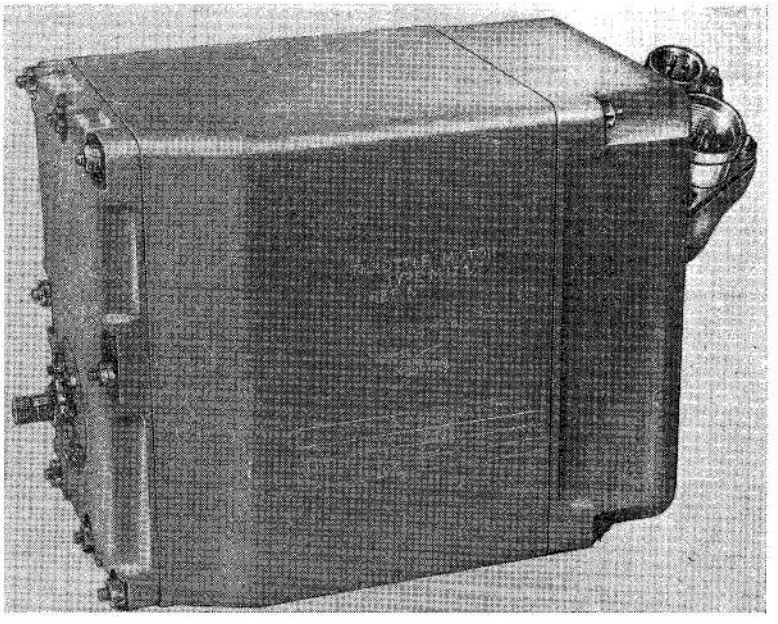


Fig. 1. Throttle motor, Ultra, Type M174/1

Introduction

1. The throttle motor unit, Ultra, Type M174/1 (fig. 1), forms part of the Ultra Engine Control System B.A.P. 3, described in A.P.4343K, Vol. 1, Sect. 1, Chap. 1. The unit houses the following parts of the system:—

(1) Normal motor.
(2) Override motor.
(3) Feedback generator.
(4) Reset synchro.

2. The unit receives throttle demand signals from either of two sources. In the normal mode, signals are received via the amplifier, Type A401/3, from the transmitter, Type 401/1 which is mechanically coupled to the pilot's throttle lever. In the override mode, throttle demand signals are fed directly to the unit from an inching switch controlled by the pilot. Operation of either of these two forms of control results in a rotary movement of the throttle motor output shaft which is connected, via a mechanical linkage, to the engine throttle valve.

3. During normal operation the output of the amplifier, Type A401/3, is modified by engine speed and jet-pipe temperature; in addition, various safety systems are incorporated in the amplifier and transmitter. The modifying signals and the operation of the safety systems are fully described in A.P.4343K, Vol. 1, Sect. 4, Chap. 1.

DESCRIPTION

4. The throttle motor unit consists of a main case having two end covers. The internal assembly comprises two sections, housing the mechanical and electrical components respectively.

5. The mechanical components are located in the gear frame assembly (fig. 2). This assembly consists of two gear trains, one for the normal system, the other for the override system. The two gear trains drive into a common, differential gear assembly, the output of which is coupled, via a torque limiting clutch, to the output shaft of the unit. The output shaft is splined, a blind spline being provided to facilitate alignment with the throttle valve linkage.

Normal system

7. The normal motor consists of a three-phase hysteresis motor driving into one side of the differential gear assembly via gear shafts 1 and 2 (fig. 2). The feedback generator is driven by the normal motor via gear shaft 5. The output of the differential gear assembly is fed to one side of the torque limiting clutch. This clutch prevents damage to the gears in the event of a sudden throttle closing action which can result from certain conditions in the temperature channel. The driven side of the clutch is coupled to the output shaft. Anti-backlash gears on the output shaft drive the reset synchro shaft.

Override system

8. When the pilot's master control switch is set to OVERRIDE, the d.c. motor in the

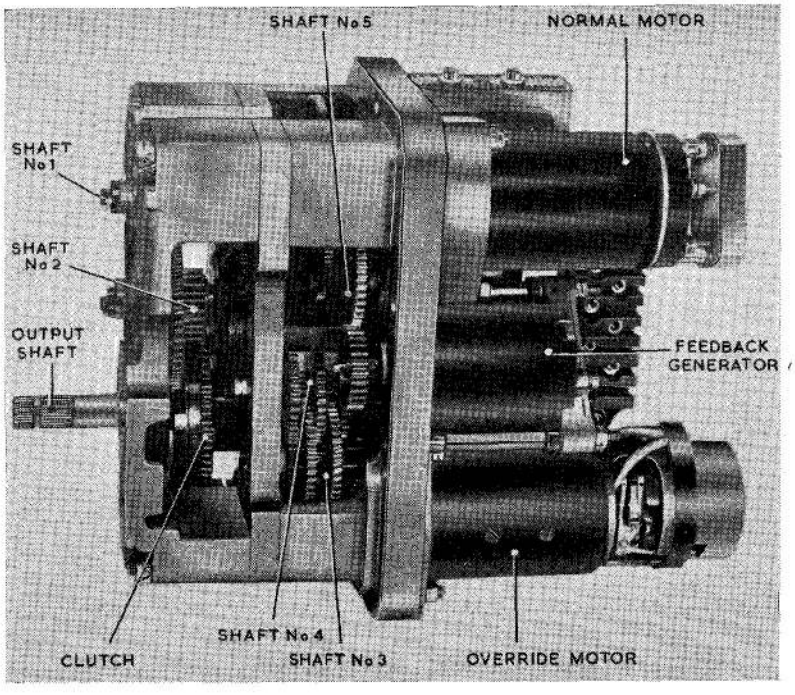


Fig. 2. Gear frame assembly

6. The electrical compartment of the unit is sealed to prevent the ingress of oil. Housed in this compartment are the normal motor, the override motor and limiting microswitches, the feedback generator, the reset synchro, a terminal block and a resistance assembly. The arrangement of these components is illustrated in fig. 3.

throttle motor unit is connected to the override control switch on the pilot's console. The d.c. motor drives into one side of the differential gear assembly via gear shafts 3 and 4 (*fig.* 2). The output of the differential gear assembly is as described in para. 7. A cam on the reset synchro shaft actuates two microswitches which disconnect the override

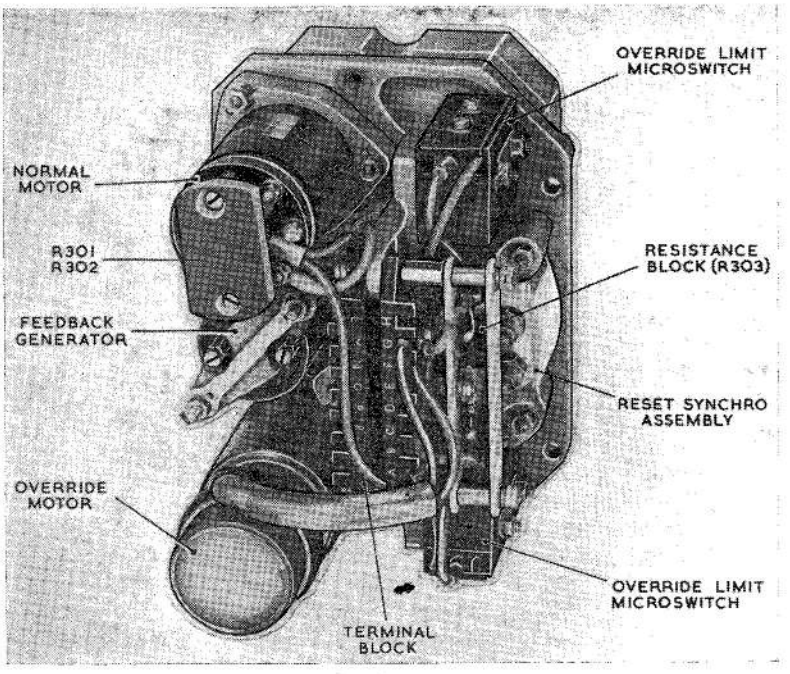


Fig. 3. Electrical components

motor supply at the limits of override travel. No such limiting is required for the normal system since a closed loop servo system is employed. The d.c. motor is Rotax, Type C6703/4 and further information will be found in A.P. 4343D. Book 4, Sect. 20.

OPERATION

9. The principles of operation of the B.A.P. 3 system are described in A.P. 4343K, Vol. 1, Sect. 1, Chap. 1.

CIRCUIT DESCRIPTION

10. Fig. 4 illustrates the circuit of the throttle motor. External connections to the unit are made via two plugs, one 4-pole, the other 9-pole. A 16-way terminal block forms the distribution point, inside the unit, for the external connections. Plug M.1 (9-pole) is connected to plug A.3 on the amplifier, Type A401/3 ; plug M.2 (4-pole) is connected to the override switch and to the 28V d.c. negative pole (earth).

11. The 3-phase stator windings of the reset synchro are connected via poles 5, 6 and 7 of plug M.1, to the amplifier unit and thence to the stator windings of the transmit synchro in the transmitter unit. The magnetic field set up in the reset synchro is thus a replica of that existing in the transmitter synchro and the phase and magnitude of the voltage induced in the reset synchro rotor is dependent on the direction and magnitude of the angular difference between the reset and transmit rotor positions, i.e., on the difference between the pilot's throttle lever angle and the throttle motor angle. The voltage at the reset synchro rotor is one of the main inputs to the amplifier unit and is fed to the amplifier via poles 8 and 9 of plug M.1.

12. The positioner output from the amplifier unit is applied, via poles 1, 2 and 3 of plug M.1, to the 3-phase, hysteresis motor. The motor, and hence the output shaft, is thus driven in such a direction as to reduce the angular difference between the transmitter and throttle motor shafts to zero. At the same time, the reset synchro is being driven so as to reduce the error signal from the reset synchro rotor.

13. The armature of the feedback generator is connected to poles 3 and 4 of plug M.1. The output at these points is a d.c. voltage, the magnitude of which is proportional to the speed of rotation of the normal motor. This voltage is fed to the amplifier as a negative, rate feedback signal and is used to

modify the positioner amplifier input so as to prevent overshoot of the throttle motor shaft.

14. The d.c. override supply from the override control switch is fed either to pole A or pole C of plug M.2, depending on the direction of rotation selected by the switch. The field windings are connected to plug M.2 via the microswitches S301 and S302. The microswitches are actuated by a cam on the reset synchro shaft and break the d.c. supply when the limits of override travel are reached, in either direction. Pole B of plug M.2 carries the common return for the override motor supply.

15. Both the override and normal motors are fitted with braking devices to ensure that one side of the differential gear is locked whilst the other side is being driven. The normal motor brake is in form of a d.c. winding inside the motor. This winding is connected to the 28V d.c. supply to the override motor. Thus, when the override system is in operation, the brake winding is energised and the magnetic field set up opposes movement of the normal motor. The override motor brake is a solenoid operated mechanical brake. The brake is arranged so that when the 28V d.c. supply is fed to the override motor, the solenoid is energised thus releasing the brake. Under normal control, however, the solenoid is not energised and the brake is applied.

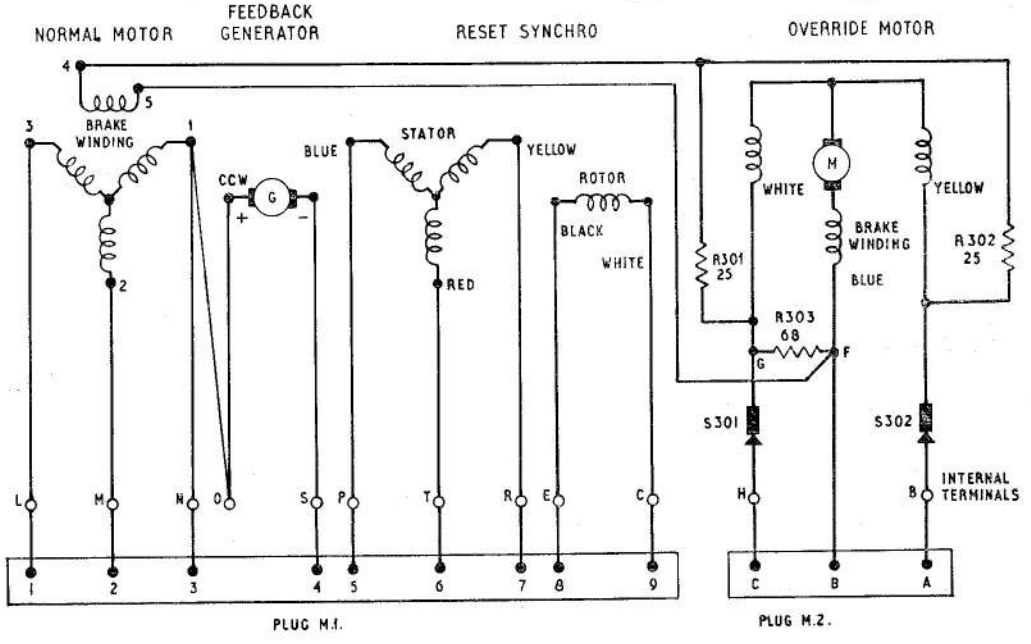


Fig. 4. Circuit diagram

SERVICING

16. The procedure for bench testing the throttle motor, using test equipment. Type QT4066, is given in Appendix A.

Aircraft tests

17. Since it is not possible to make accurate shaft angle and output torque measurements on an installed unit, comprehensive performance tests can be done only with the unit in the bench test rig (see Appendix A).

18. Aircraft tests are performed with the test equipment, Ultra, Type QE406. A description of this equipment, together with detailed test instructions, will be found in A.P. 4343K, Vol. 1, Sect. 10, Chap. 3.

Fault finding

19. Should the standard serviceability tests, or the aircraft tests, indicate unserviceability of the throttle motor, it may be possible to

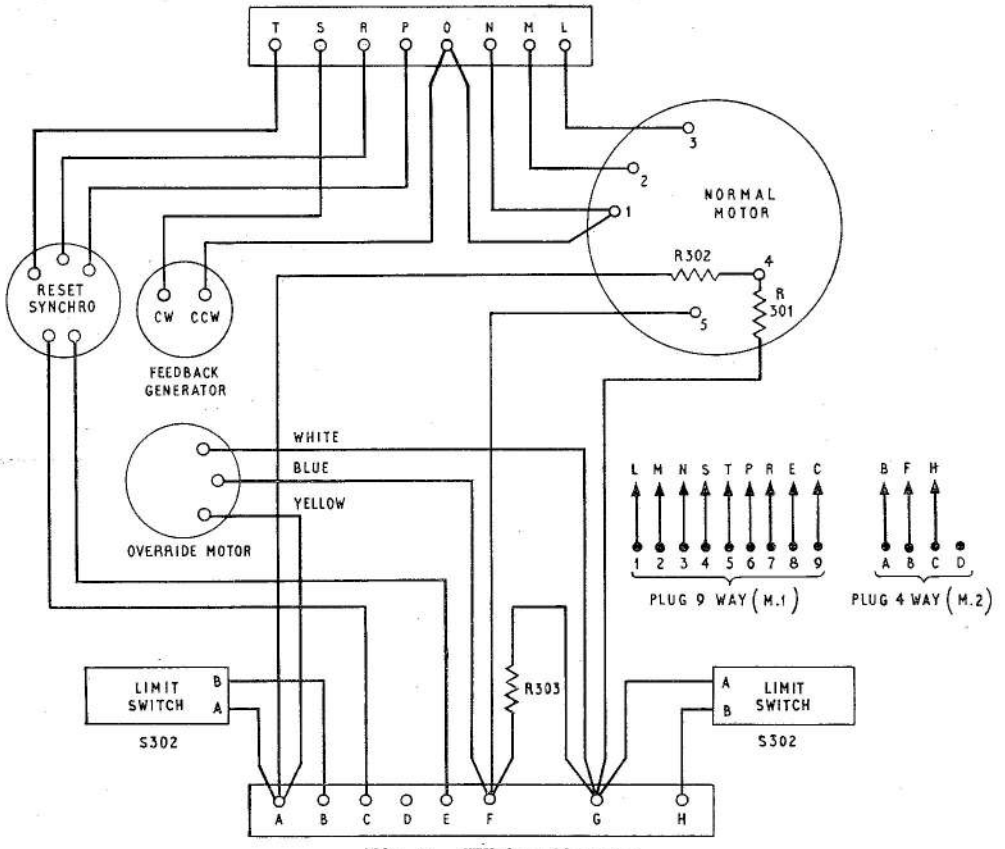


Fig. 5. Wiring diagram

locate the fault by measuring the resistance between certain plug holes.

20. Table 1 gives the resistance values which should be obtained when measuring across these poles, using a Multimeter, Type 12889. It should be remembered that these tests do not prove all electrical functions of the throttle motor, neither do they provide any indication of the serviceability of the mechanical components within the throttle motor.

TABLE 1

Resistance values

Throttle motor plug poles	Function	Multimeter range	Resistance Ω
M.1.3 to M.1.4	Feedback generator	Ω ÷ 100	18 to 80
M.1.1 to M.1.2	Normal motor	Ω ÷ 100	30 to 36
M.1.2 to M.1.3	Normal motor	Ω ÷ 100	30 to 36
M.1.5 to M.1.6	Reset synchro stator	Ω ÷ 100	43 to 57
M.1.5 to M.1.7	Reset synchro stator	Ω ÷ 100	43 to 57
M.1.8 to M.1.9	Reset synchro rotor	Ω	400 to 600

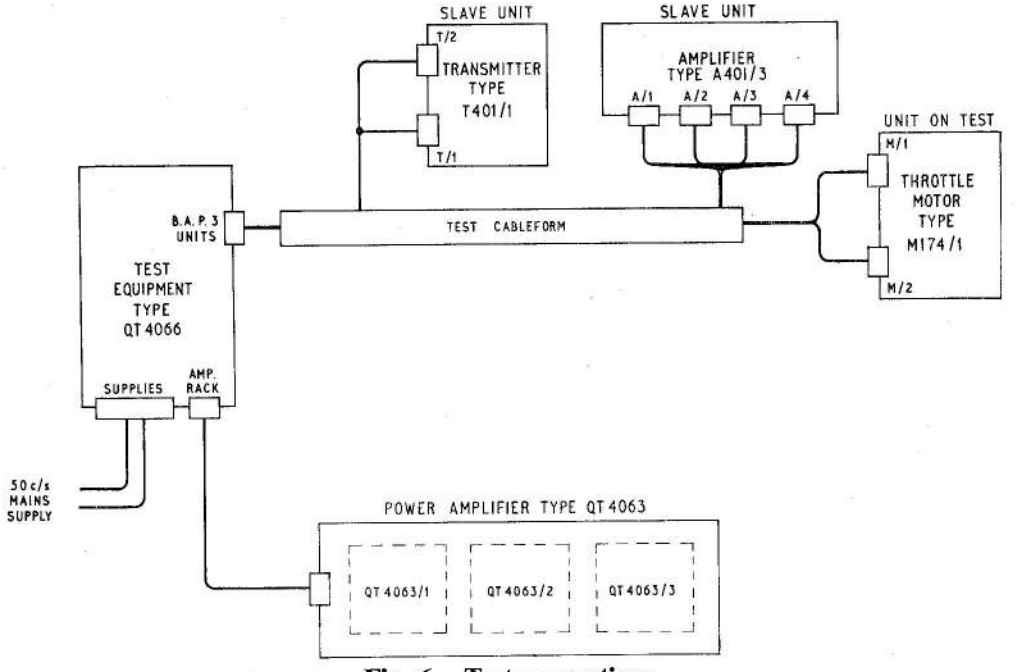


Fig. 6. Test connections

Insulation tests

21. Measure the insulation resistance between the following points and the throttle motor case.

M. 1. 1 Normal motor and feedback generator M. 1. 6 Reset synchro stator M. 1. 8 Reset synchro rotor	Not less than 5 MΩ at 500V d.c.
M. 2. B Override motor and brake solenoids	Not less than 0·5MΩ at 250V d.c.

Renewal of sub-assemblies

22. Certain sub-assemblies of the throttle motor may, if found to be unserviceable, be renewed. Instructions are given in the following paragraphs for removing and reassembling the items listed in table 2.

TABLE 2

Renewal sub-assemblies

Sub-assembly	Ultra Part No.	Ref. No.
Gear frame assembly	Y361—2004	5UD/6847
Override motor and gear	X430—38 (Rotax Type C6703/4)	5UD/6842
Feedback generator and gear	Y430—39	5UD/6841
Normal motor and gear	Y431—2037	5UD/6843
Output shaft oil seal	B698—28	5UD/6844
Output shaft oil seal housing	Y379—53	5UD/6845
Pointer	X488—2003	5UD/7124

23. During re-assembly of the above sub-assemblies certain additional items will be required. These are listed in table 3.

TABLE 3

Items required during assembly

Item	Ultra Part No.	Ref. No.
Plain washers (4BA)	SP10B	
Tab washers (4BA)	Y883—84	5UD/6846
Tab washers (2BA)	SP24C	28W/12248
Wellseal (or equivalent sealing compound)	H499—00	
Aeroshell grease 11		XG275
Locking wire (23 SWG)	B914—05	
Rubber sleeves ($\frac{1}{2}$mm. I/D × $1\frac{1}{8}$ in. long)	B718—20	

Gear frame assembly and electrical components

24. Renewal of these items will require use of the following special equipment.

(1) Output shaft shroud, to prevent the splines damaging the oil seal.

(2) Test equipment as specified in para. 2 of Appendix A (less items (6), (8) and (9)).

(3) Power supplies as specified in para. 3 of Appendix A.

(4) Throttle motor test rig as described below.

Throttle motor test rig

25. Means must be provided for rigidly securing the throttle motor. In addition, provision must be made for measuring the output shaft angle to an accuracy of $\pm$ 0·1°. The protractor and vernier must be secured to the output shaft and the test rig respectively. A suitable rig is illustrated in fig. 7 and engraving details of the protractor, together with details of the collet hole, are given in fig. 8. To facilitate torque loading of the throttle motor output shaft, provision must be made for suspending weights, on a cord, from the protractor. This is most conveniently achieved by a pulley groove in the protractor, round which the cord can be wrapped. The weights used must be capable of providing torque loads up to 75 lb. in.

Removal

26. Refer to fig. 9.

(1) Remove the four 2BA nuts (18) and tabwashers (19) securing the plug end cover (17) to the main case (8).

(2) Remove the two 4BA nuts (33), spring washers (34) and plain washers (35) securing the resistance assembly (36) to the terminal block (31) to allow access to the terminal screws on the block.

(3) Remove the connections to the terminal block (31), noting the special arrangement of the washers on terminals F, G and O. Mark the disconnected leads to facilitate reconnection.

(4) Remove the three locking wires (22) sealing the six pillar nuts (9) and remove the pillar nuts. Discard the rubber sleeves (28).

(5) Remove the pointer from the output shaft.

(6) Carefully withdraw the main case (8) and end cover (32) over the output shaft.

Note . . .

The end cover (32) *should not be removed from the main case* (8) *unless a faulty oil seal or oil seal housing is suspected* (*see para.* 34).

(7) Remove the three 4BA tab washers (6), nuts (5) and clamping plate (27) securing the normal motor (15) to the gear frame (11).

(8) Remove the two 4BA tab washers (6), nuts (5) and clamping plate (14) securing the feedback generator (12) to the gear frame (11). Note the arrangement of the shim washers under the clamping plate (14).

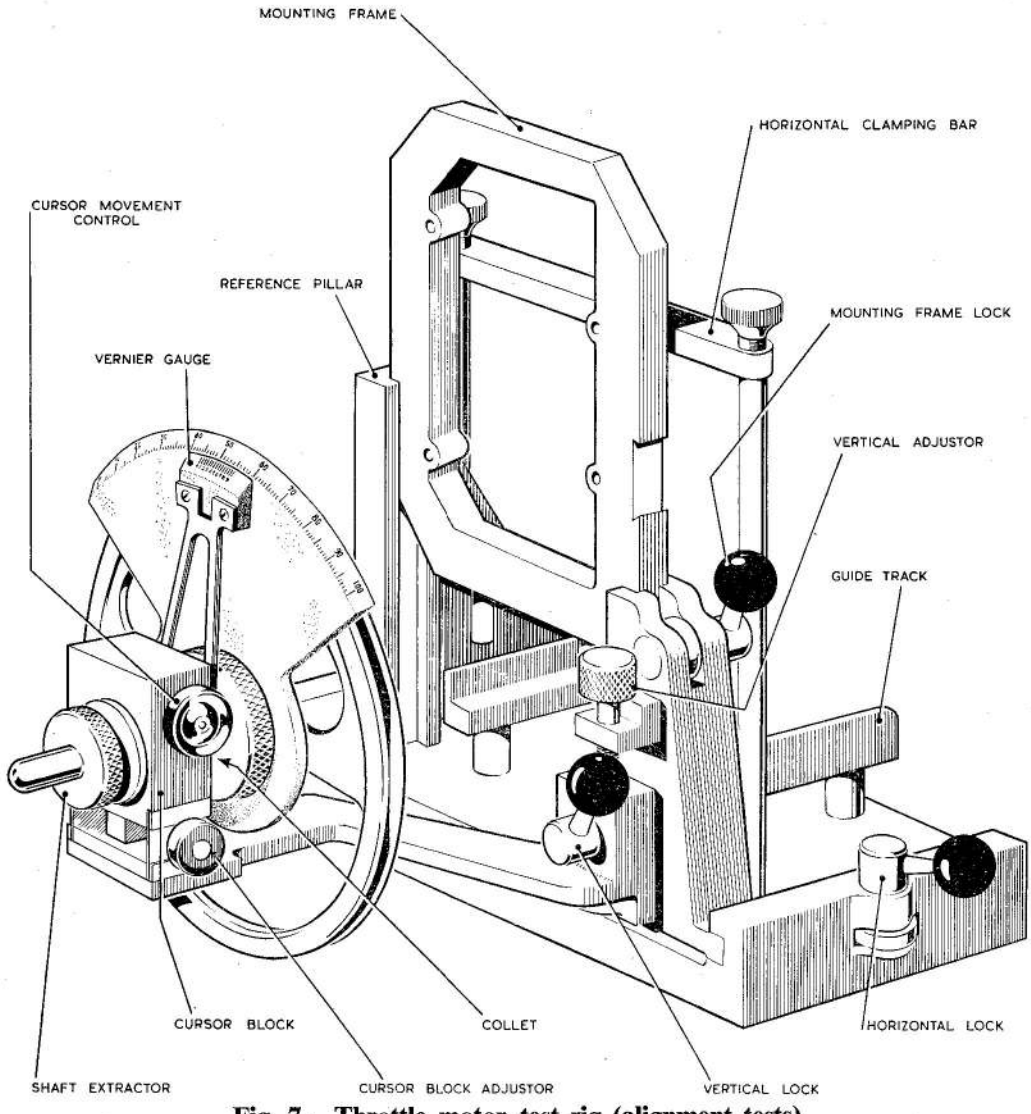


Fig. 7. Throttle motor test rig (alignment tests)

(9) Remove the three 4BA tab washers (6) nuts (5) and the clamping plate (30) securing the override motor (1) to the gear frame (11).

Note . . .

If the override motor is to be renewed, remove the clamp ring (25) *and the sealing ring* (26).

(10) Remove the four 4BA nuts (5) and their associated plain and spring washers (7) (16) securing the reset synchro assembly (10) to the gear frame (11).

(11) The remaining items, gear frame sub-assembly, studs, gears and shafts, comprise the gear frame assembly 5UD/6847.

Assembly

27. Before re-assembly is commenced, remove all traces of old sealing compound from the mating surfaces of the normal motor, override motor, reset synchro assembly, feedback generator, gear frame, plug end cover and main case. Check that all gears and rotors are free to rotate and

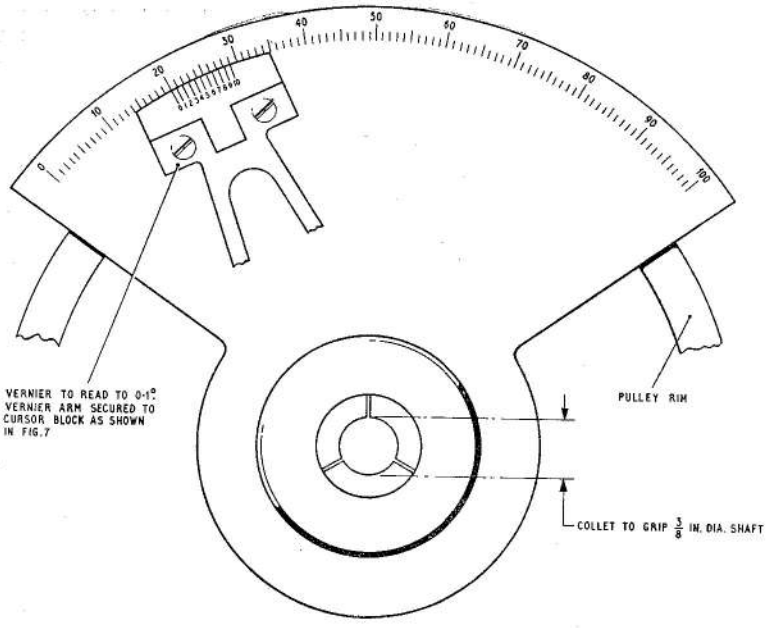


Fig. 8. Details of protractor engraving and collet hole

apply a light coating of grease XG275 to the gear teeth.

28. As shown in fig. 9, the mating surfaces of the motors, reset synchro, feedback generator and gear frame assembly are sealed with Wellseal compound. This compound, or an equivalent, should be applied to the surfaces at least five minutes before commencing the assembly intructions detailed in para. 29.

29. (1) Secure the normal motor (15) to the gear frame (11) using the clamping plate (27), three 4BA nuts (5) and a new tab washers (6). Do not lock the tab washers. Ensure that the clamping plate is square to the axis of the normal motor.

(2) Secure the override motor (1) to the gear frame (11) using the clamping plate (30), three 4BA nuts (5) and new tab washers (6). Do not lock the tab washers. If the override motor is a replacement, assemble the clamp ring (25) loosely and place the sealing ring (26) in position.

(3) Place the reset synchro assembly (10) in position on the four mounting studs but do not push it right home.

(4) Rotate the clutch gear on the gear frame (11) until the gear train is against the 'throttle open' stop.

(5) Rotate the reset synchro spur gear so that the microswitch actuating cam is holding the 'open limit' microswitch tappet in the fully open position.

Note . . .

The 'open limit' microswitch is the upper one in fig. 9.

(6) Take up the tension on the anti-blacklash gear, ensuring that the two halves of this gear are moved, relative to each other, by more than one tooth but not more than two teeth.

(7) Hold the two halves of the anti-backlash gear in the position arrived at in (6) above and push the reset synchro fully home ensuring that neither the synchro rotor nor the clutch gear rotates.

(8) Secure the reset synchro assembly to the gear frame using four 4BA nuts (5), spring washers (7) and plain washers (16).

(9) Secure the feedback generator (12) to the gear frame (11) using the clamping plate (14), two 4BA nuts (5) and new tab washers (6). Do not lock the tab washers. Ensure that the shim washers under the clamping plate (14) are replaced in the correct positions. If a

new feedback generator is being fitted, the shim washers should be added so as to give a clearance of 0·010 in. between the clamping plate and the pillars before the nuts are tightened.

(10) Check that the spur gears on the normal and override motors, the feedback generator and the reset synchro are fully engaged with their mating gears. Check that the reset synchro gear does not foul the casting.

(11) Referring to the wiring diagram (*fig.* 5), re-make the electrical connections to the terminal block (31), noting the special arrangement of the washers on terminals F, G and O (*fig.* 9).

(12) Secure the resistance assembly (36) to the terminal block (31) using the two 4BA nuts (33), spring washers (34) and plain washers (35).

(13) Using a Multimeter, on the Ω ÷ 100 range, check the continuity of the wiring between the poles of plugs M.1 and M.2 and the electrical components

Alignment tests

30. At this stage of re-assembly, the following alignment tests should be carried out.

Caution . . .
Do not operate the motor on OVERRIDE control when the output shaft angle is less than 18°.

(1) Lower the assembly onto the guide tracks of the test rig (fig. 7) so that the output shaft of the assembly is aligned with the protractor collet.

(2) Adjust the mounting frame lock lever to ensure that the mounting frame is correctly positioned against the reference pillar.

(3) Fit the motor assembly onto the dowels in the mounting frame, ensuring that the output shaft enters the protractor collet.

(4) Secure the gear frame to the mounting frame using four 2BA screws passing through the gear frame into the tapped holes on the mounting frame

(5) Tighten the collet nut temporarily.

(6) Screw out the actuating tappets of the two override limit microswitches on the reset synchro assembly (10) so that the switches are made.

(7) Rotate the output shaft, by hand, in a clockwise direction until the gear train just touches the stop pin at the closed end of travel. Note the vernier reading.

(8) Set the output shaft 1° counter-clockwise from the position noted in sub-para. (7).

Note . . .

In order to eliminate the effects of backlash, it is necessary to rotate the output shaft, past the position required so as to approach the 1° *point from an angle of, say,* 5°.

(9) Connect the test equipment and power supplies as shown in fig. 6

(10) Set the slave transmitter to 0° and hang a weight on the transmitter shaft to obtain a torque of 6 lb. in against the transmitter closed stop

(11) Set the SELECT LOAD switch to DUMMY.

(12) Set the AMPLIFIER RACK switch to STANDBY and, two minutes later, set the H.T. switch to ON.

(13) When the 400 c/s lamp lights adjust the voltage and frequency of the supply to 115V, 400 c/s.

(14) Set the OVERRIDE-OFF-NORMAL switch to NORMAL.

(15) Check that the throttle motor angle is still as set in sub-para. (8)

(16) Slacken the four nuts and two screws clamping the two halves of the reset synchro stator housing.

(17) Connect a Multimeter, on the 25V a.c. range, between monitor points M.1.6. and M.1.7 on test set Type QT4066.

(18) Rotate the stator to obtain a minimum reading on the Multimeter, re-setting the meter range to 2·5V a.c. to increase the accuracy of adjustment.

Note . . .

◀*The stator protrudes through an aperture in the outer half of its housing and is rotated by tapping its periphery lightly, using a flat nosed punch or drift and a small hammer.*▶

(19) When a minimum reading has been obtained, tighten the stator hous-

ing screws and nuts evenly. Check that the setting of the stator has not been disturbed.

(20) Slacken the protractor collet and, without moving the output shaft, set the protractor and vernier to read 0° at the point of minimum reading of the Multimeter. Tighten the collet and disconnect the Multimeter.

(21) Set the SELECT LOAD switch to THROTTLE MOTOR and set the transmitter angle to 29°.

(22) Short circuit monitor points M.1.5 and M.1.6 and depress the shorting switch between lines T.1.3 and T.1.4.

(23) The throttle motor angle should be 37° ± 0·5°.

(24) If necessary, re-adjust the reset synchro stator position, as described in sub-para (16) to (19), to obtain this 37° angle. Remove the short circuits between M.1.5—M.1.6 and T.1.3—T.1 4

(25) Set the OVERRIDE-OFF-NORMAL switch to OVERRIDE and, using the OVERRIDE control switch, set the throttle motor angle to approximately 40°.

(26) Adjust the closing limit switch tappet so that, when the OVERRIDE control switch is set to CLOSE, the final throttle motor angle is 18.75° + 0·25°.

(27) Set the throttle motor angle to approximately 70°.

(28) Adjust the opening limit switch so that, when the OVERRIDE control swich is set to OPEN, the final throttle motor angle is 90° ± 0·25°.

Clutch tests

31. Carry out the following tests on the torque limiting clutch.

(1) Set the OVERRIDE-OFF-NORMAL switch to NORMAL.

(2) Set the transmitter to give a throttle motor angle of approximately 45°.

(3) Using the pulley, weights and cord forming part of the throttle motor test rig, measure the torque which causes the clutch to slip in either direction. This torque must not exceed 75 lb. in.

Caution . . .

Care must be taken to ensure that the throttle motor is not driven against its limit stops during these tests.

(4) Apply a torque load of 45 lb. in., introduce slip by momentarily increasing the torque. Ensure that the clutch stops slipping immediately the torque is returned to 45 lb. in. Check in both directions.

Note . . .

Throttle motors which have completed more than 1500 *operating hours should be tested using a* 40 *lb. in. torque in sub-para.* (4).

(5) Disconnect the test equipment and power supplies.

(6) Remove the torque load weights and slacken the collet nut.

(7) Remove the four 2BA screws securing the gear frame to the mounting frame.

(8) Using the shaft extractor, force the output shaft out of the collet.

Assembling the main case

32. (1) Lock all tab washers.

(2) Apply a coat of Wellseal compound to the mating surfaces of the gear frame (11) and the main case (8).

(3) Assemble the gear frame (11) to the main case (8) using a tapered shroud over the output shaft splines to avoid damaging the oil seal (20).

(4) Assemble and tighten the six pillar nuts (9) securing the gear frame (11) to the main case (8).

(5) Wire-lock the pillar nuts, assembling new rubber sleeves (28) to the locking wires as shown in fig. 9.

(6) Secure the pointer (4) to the output shaft as shown in fig. 9.

Bench tests

33. At this stage of re-assembly, carry out the bench tests detailed in Appendix A of this A.P. When the bench tests have been completed, proceed as follows :—

(1) Check that the clamp ring (25) is a sliding fit on the override motor frame and ensure that the seal (26) is in position.

(2) Place four 0·025 in. thick shims on the main case joint face, one at each corner.

(3) Slide the plug end cover (17) over the four studs in the main case (8) and push the cover onto the studs until it is fully home against the shims.

(4) Remove the cover and the shims and tighten the clamp ring (25).

(5) Apply a coat of Wellseal compound to the mating surfaces of the main case (8) and the plug end cover (17) and allow five minutes to elapse, before proceeding further.

(6) Fit the plug end cover to the main case and secure it with four 2BA nuts (18) and new tab washers (19).

(7) Lock the tab washers.

Output shaft oil seal and oil seal housing

34. Renewal of these parts requires the following special equipment :—

(1) Output shaft shroud, to prevent the splines damaging the oil seal.

(2) 28V d.c. supply capable of supplying a current of up to 3A. (As specified in Appendix A, para. 3).

Removal

35. (1) Remove the eight, 2BA nuts (2) and tab washers (3) securing the end cover (32) to the main case (8).

(2) Remove the pointer (4) from the output shaft.

(3) Withdraw the end cover (32) from the main case (8).

(4) Remove the three 4BA nuts (5) and tab washers (6) securing the oil seal housing (21) to the end cover (32) and withdraw the housing from the end cover.

(5) Extract the oil seal (20) from the oil seal housing (21).

Asembly

36. (1) Remove all traces of old sealing compound from the oil seal housing (21), the end cover (32) and the main case (8).

(2) Insert the new oil seal (20) into the housing (21).

(3) Coat the mating surfaces of the oil seal housing and the end cover with Wellseal. Allow the Wellseal to dry for at least five minutes before proceeding further.

(4) Secure the oil seal housing (21) to the end cover (32) with three 4BA nuts (5) and new tab washers (6). Lock the tab washers.

(5) Coat the mating surfaces of the end cover (32) and the main case (8) with Wellseal. Allow the Wellseal to dry for at least five minutes before proceeding further.

(6) Assemble the end cover (32) to the main case (8) using a tapered shroud over the output shaft to avoid damaging the oil seal (20).

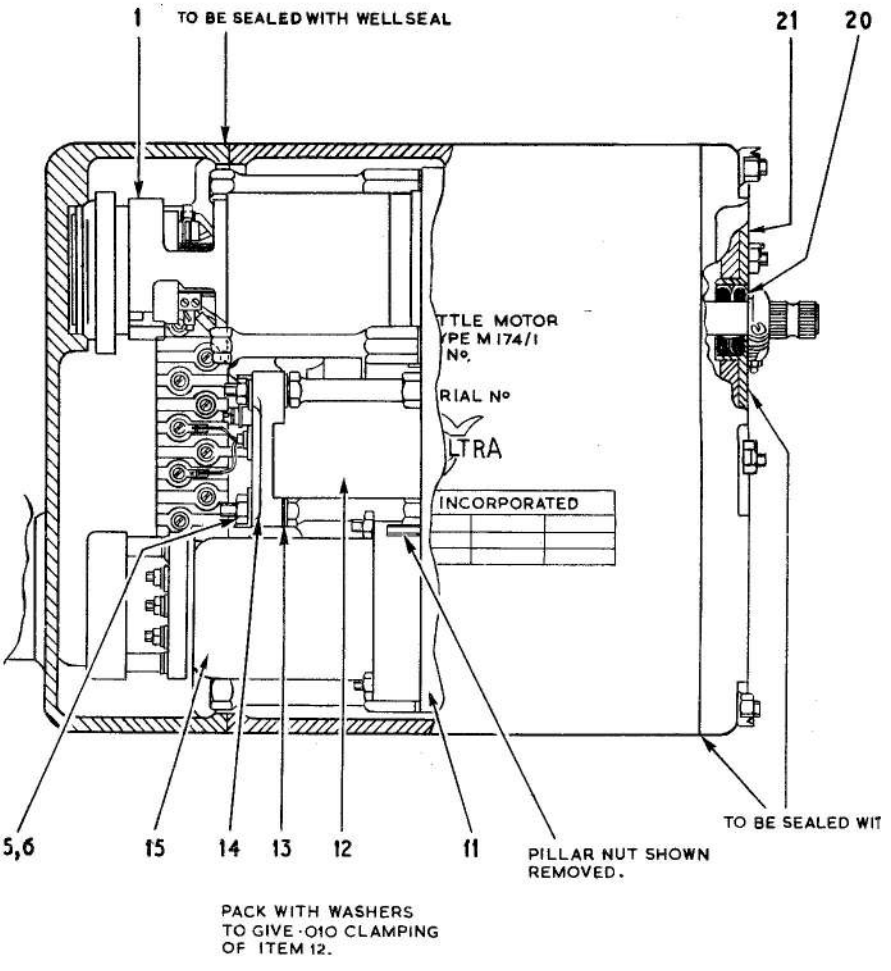
(7) Secure the end cover (32) to the main case (8) with eight 2BA nuts (2) and new tab washers (3). Do not lock the tab washers.

(8) Connect the 28V d.c. supply to poles A (+ ve) and B of plug M.2 and check that the throttle motor runs smoothly to the end of its override travel.

(9) Connect the 28V d.c. supply to poles C (+ ve) and B of plug M.2 and check that the throttle motor runs smoothly to the opposite end of its override travel.

(10) Lock the eight 2BA tabwashers (3).

(11) Secure the pointer (4) to the output shaft as shown in fig. 9.



NOTES :-

1. PILLAR NUTS, ITEM No.9, TO BE LOCKED WITH WIRE
2. FOR SEALING, USE WELLSEAL COMPOUND No H49900.
3. ALL NUTS AND SCREWS TO BE LOCKED WITH TABS PROVIDED.
4. CARE TO BE TAKEN WHEN ASSEMBLING OILSEALS OVER SHAFT; SPLINED END TO BE SHROUDED WITH TAPERED GUIDE TO PREVENT DAMAGE. EXCESSIVE BILATERAL MOVEMENT ON ASSEMBLY WILL DAMAGE SEAL AND RENDER INOPERATIVE.

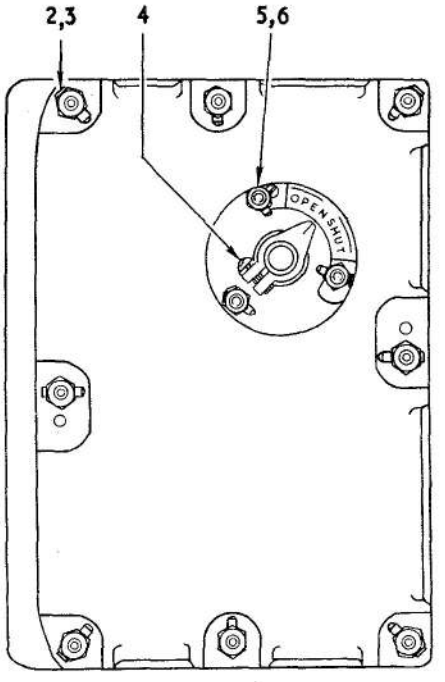
Important

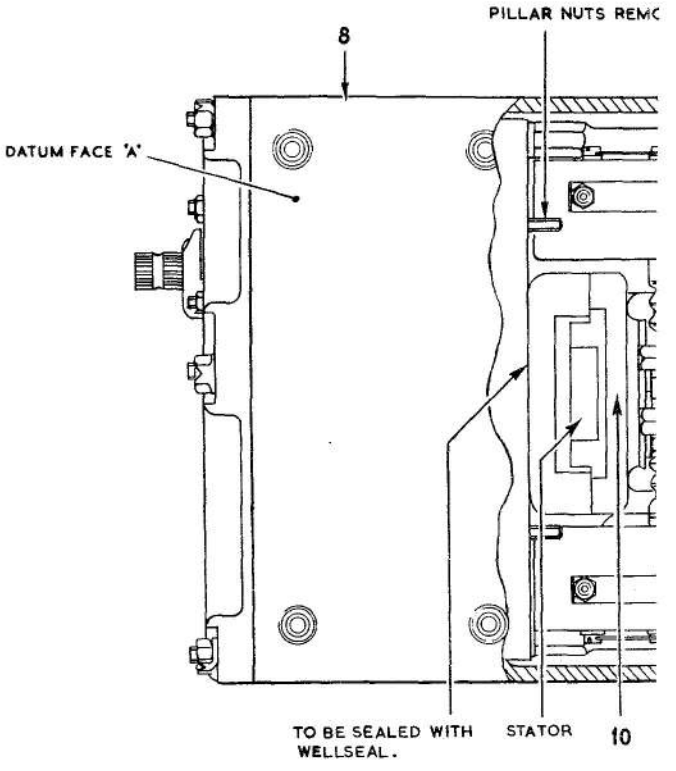
WHEN COATING FACES WITH WELLSEAL COMPOUND IT IS IMPORTANT THAT AT LEAST FIVE ELAPSE BEFORE BRINGING SURFACES TOGETHER.

Fig.9

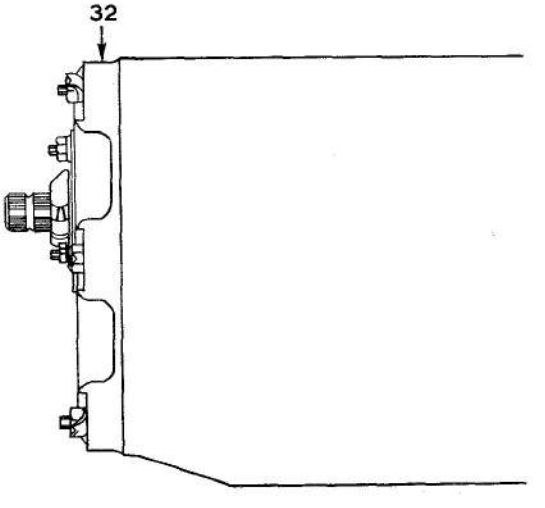
NOTE: MASTER SPLINE ON OUTPUT SHAFT TO BE PARALLEL TO DATUM FACE 'A' WITHIN ±3° WHEN MOTOR IS ELECTRICALLY DRIVEN TO THE OPEN POSITION ON OVERRIDE OPERATION (i.e. WITH LIMIT SWITCHES CONTROLLING TRAVEL) SHAFT MUST NOT BE MOVED BY HAND.

NO





H WELLSEAL.

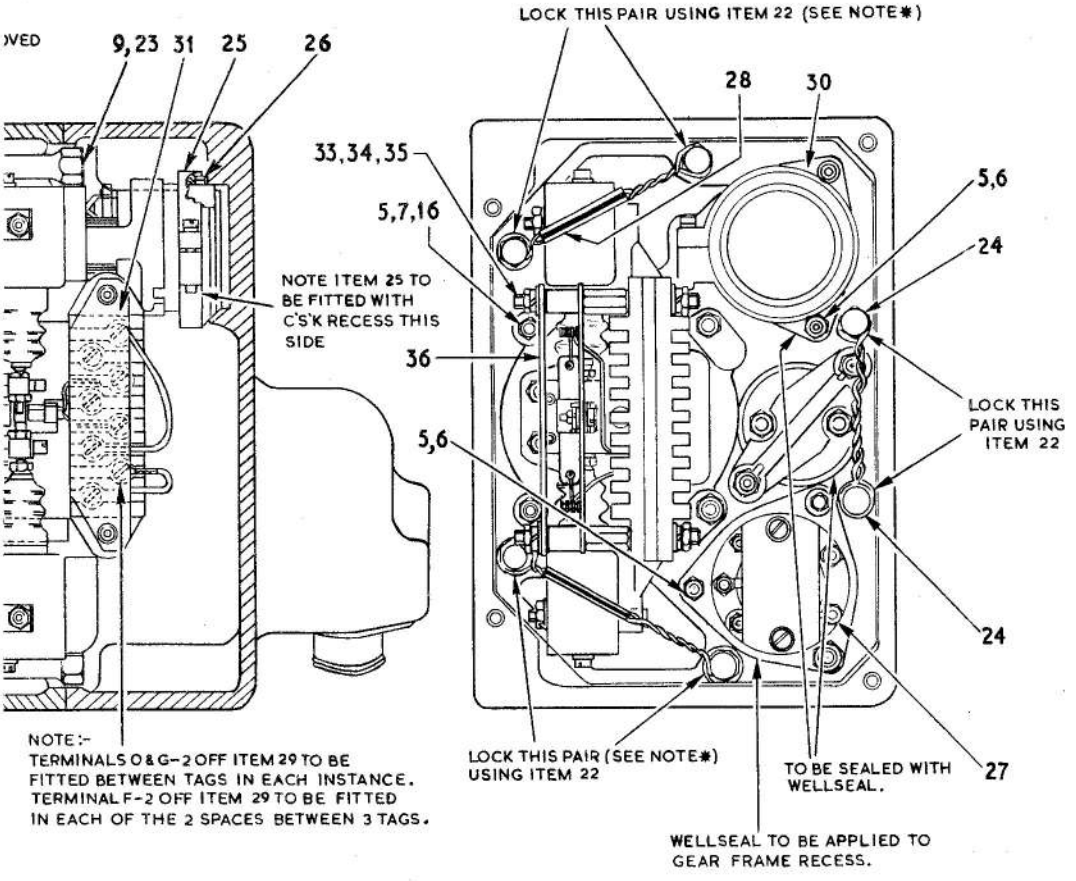


MINUTES

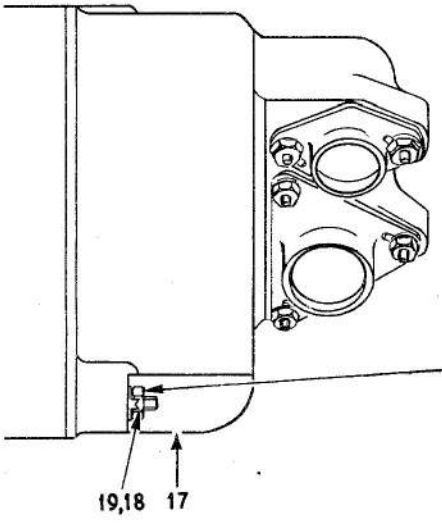
Throttle motor, Ultra, Type M174/1—general assem

RESTRICTED

TE: ADJUST HEIGHT OF CLAMP RING SO THAT WHEN COVER (ITEM 17) IS PLACED IN POSITION, A GAP OF ·025 TO ·030 IS OBTAINED AT THE JOINT FACE BEFORE CLAMPING DOWN COVER.



VIEW WITH PLUG END COVER REMOVED.



* NOTE:- SLEEVE (ITEM 28) TO BE FITTED TO LOCKING WIRE (ITEM 22) WHEN PASSING OVER MICRO-SWITCHES, EACH WIRE TO BE FITTED WITH A SLEEVE AND LOCKING WIRE TWISTED EACH END OF SLEEVES TO RETAIN IN CORRECT POSITION.

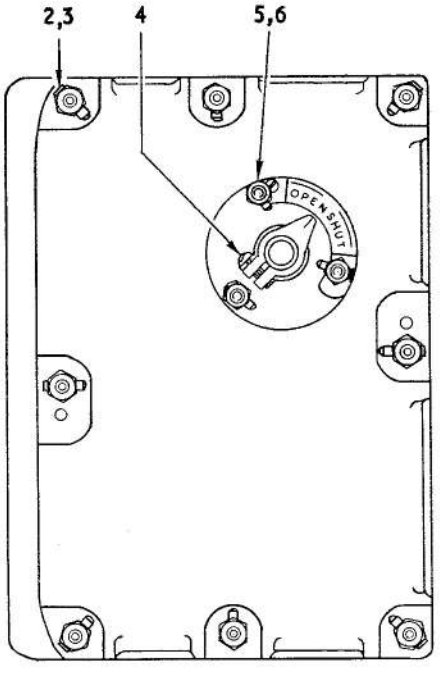
THIS NUT TO BE SEALED ON LOCKED FLAT WITH 60/40 SOLDER AFTER FINAL TEST.

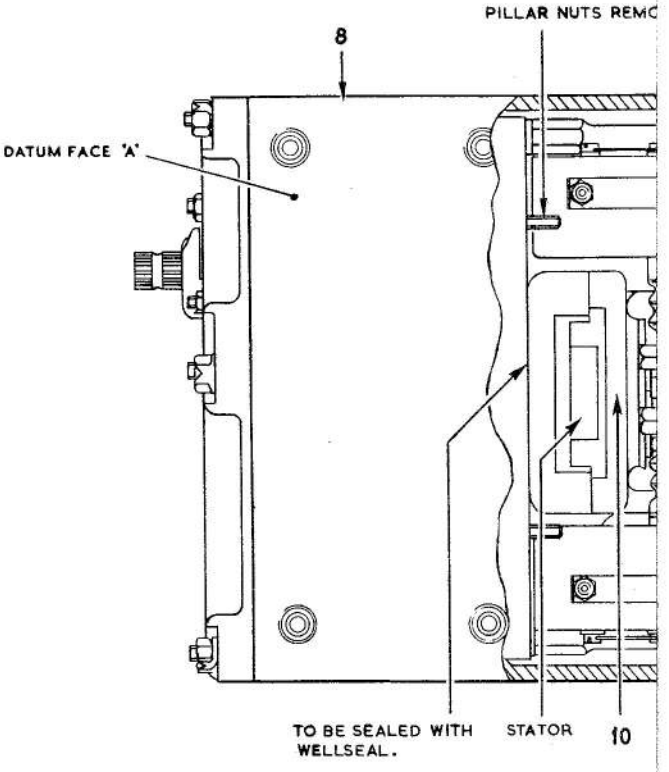
bly

Fig. 9

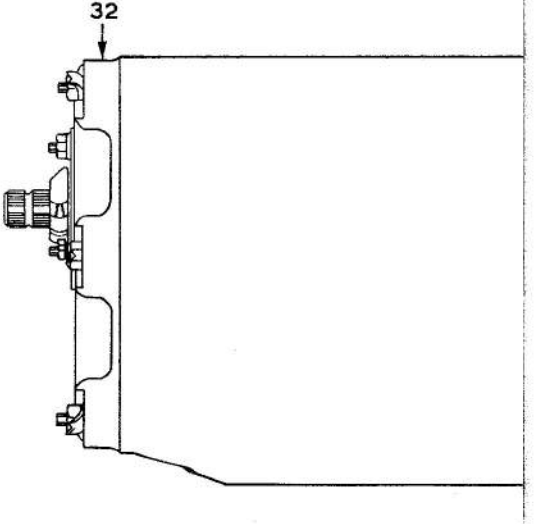
NOTE: MASTER SPLINE ON OUTPUT SHAFT TO BE PARALLEL TO DATUM FACE 'A' WITHIN ±3° WHEN MOTOR IS ELECTRICALLY DRIVEN TO THE OPEN POSITION ON OVERRIDE OPERATION (i.e. WITH LIMIT SWITCHES CONTROLLING TRAVEL) SHAFT MUST NOT BE MOVED BY HAND.

NO





H WELLSEAL.



MINUTES

Throttle motor, Ultra, Type M174/1—general assem

RESTRICTED

Appendix A

STANDARD SERVICEABILITY TEST

FOR

THROTTLE MOTOR, ULTRA, TYPE M174/1

LST OF CONTENTS

LIST OF ILLUSTRATIONS

Introduction

1. The tests detailed in this Appendix may be applied to the unit before it is put into service, or at any time to determine its serviceability.

TEST EQUIPMENT

2. The following test equipment is required:—

(1) Test equipment, Ultra, Type QT4066

(2) Power amplifier, Ultra, Type QT4063

(3) Slave transmitter, Ultra, Type T401/1

(4) Slave amplifier, Ultra, Type A401/3

(5) Multimeter, Type 12889 (5QP/17447)

(6) 250V and 500V insulation resistance testers

(7) Protractor and mounting rig for slave transmitter

(8) Protractor and mounting rig for throttle motor

(9) Stopwatch

POWER SUPPLIES

3. The following power supplies are required :—

(1) 250V, 50 c/s capable of supplying a current of up to 5A.

(2) 28V d.c. capable of supplying a current of up to 3A.

TEST PROCEDURE

Insulation resistance

4. Using the 250V and 500V insulation resistance testers, check that the insulation resistance at the following points is as stated.

(1) Between each pole of the 9-way plug and the throttle motor case, at 500V d.c.—not less than 5MΩ.

(2) Between each pole of the 4-way plug and the throttle motor case, at 250V d.c.—not less than 0·5MΩ.

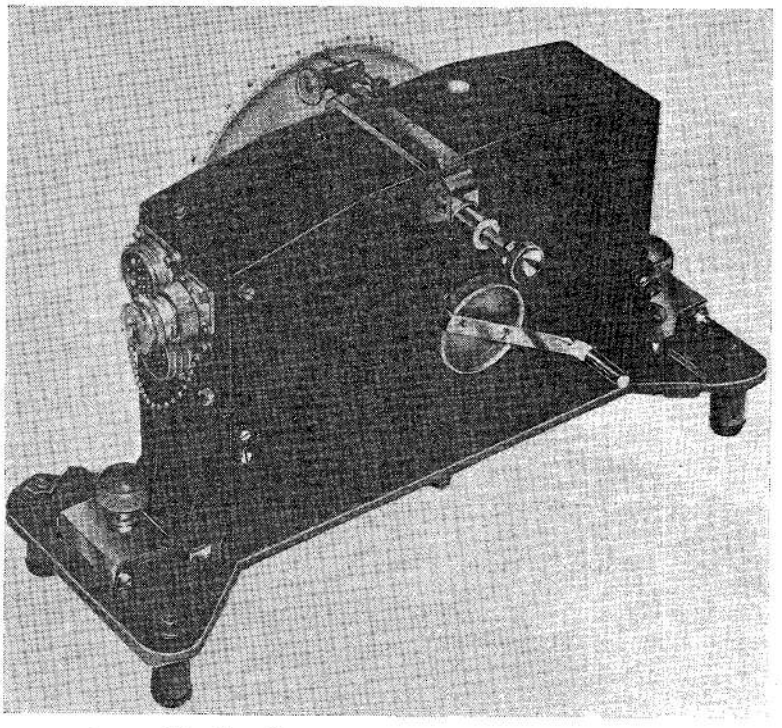


Fig. 1. Slave transmitter in test rig

Test connections

5. Secure the slave transmitter and the throttle motor into their mounting rigs and attach the protractors as shown in figs. 1 and 2. Connect the throttle motor, slave units, test gear and power supplies as shown in fig. 3.

(1) Set the AMPLIFIER RACK switch to STANDBY and, two minutes later, set the H.T. switch to ON.

(2) Adjust the voltage and frequency of the supply to 115V, 400 c/s.

(3) Ensure that the reading on meter 5 does not exceed 0·85A, that the warning lamp is not lit and that the trim indicator reads zero.

(4) Allow a 15 min. warm up period.

Caution . . .

Do not operate the motor on OVERRIDE control when the output shaft angle is less than 18°.

Normal positioning

6. (1) Set the transmitter angle to 28° and depress the shorting switch between lines T.1.1 and T.1.4. Link poles 3 and 4 of the transmitter test plug. Set the SELECT LOAD switch to THROTTLE MOTOR.

(2) Using OVERRIDE control, increase the throttle motor angle by 15°, then revert to NORMAL control.

(3) The final angle reached by the throttle motor is the reference angle and

should be 37°. Repeat the procedure in sub-para (2) three times and check that the 37° angle is obtained each time.

(4) Remove the short circuit between T.1.1 and T.1.4.

(5) Set the transmitter angle to 56° and depress the shorting switch between lines T.1.1 and T.1.2.

(6) The throttle motor angle should be 74° ± 1°.

(7) Remove the link between poles 3 and 4 of the transmitter test plug and remove the short circuit between lines T.1.1 and T.1.2.

(8) Set the transmitter angle to 0°.

(9) Set the SELECT LOAD switch to DUMMY.

(10) Connect the Multimeter, on the 100mA a.c. range, to the DISCRIMINATOR I/P CURRENT sockets in place of the link.

(11) Increase the transmitter angle until the reading on the Multimeter is a maximum. This reading should be not less than 14mA.

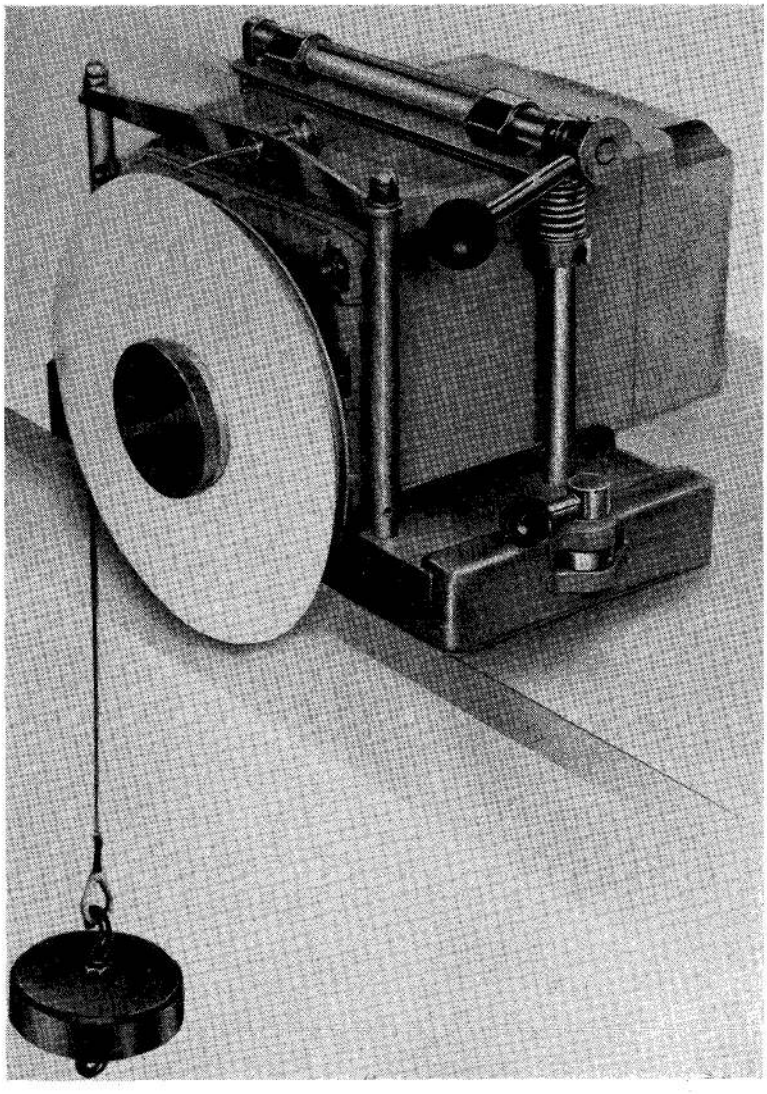


Fig. 2. Throttle motor in test rig

(12) Set the SELECT LOAD switch to THROTTLE MOTOR, remove the Multimeter and replace the DISCRIMINATOR I/P CURRENT link.

(13) Check that the system is smooth in operation, stable and free from overshot, although an overshoot of up to 3° is permissible after a rapid shutdown. Observe the stability of the positioning system over a period of at least 30 sec.

Sensitivity

7. (1) Set the transmitter to 28°.

(2) Using OVERRIDE control, reduce the throttle motor angle by approximately 15°.

(3) Revert to NORMAL control and note the final throttle motor angle.

(4) Using OVERRIDE control, increase the throttle motor angle by approximately 15°.

(5) Revert to NORMAL control and note the final throttle motor angle.

(6) The angle noted in sub-para (5) should be not less than that noted in sub-para. (3) and not more than 0·5° greater.

(7) Set the transmitter to 56°.

(8) Repeat the tests detailed in sub-paras. (2) to (5) and check that the limits laid down in sub-para. (6) are not exceeded.

Normal opening rate

8. (1) Move the transmitter shaft from 0° to 70° in less than 1 sec.

(2) The throttle motor opening rate, between 10° and 70°, should be 16 to 22°/sec., i.e., a time of 2·75 to 3·75 sec.

(3) Hold the transmitter shaft against the open stop.

(4) The throttle motor angle should be 90° ± 0·75°.

Normal operating torque

9. (1) Hang a weight from the throttle motor protractor pulley to give an opposing torque of 15 lb. in.

(2) Move the transmitter shaft from 0° to 70° in less than 1 sec.

(3) The time taken for throttle motor travel over the range 10° to 70° should be 2·75 to 4·0 sec.

(4) Increase the opposing torque to 30 lb. in. and check that the throttle motor operates in each direction. The rate of travel is immaterial.

Override positioning

10. (1) Check the reference angle as described in para. 6(1), (2) and (3). Remove the short circuit between lines T.1.1 and T.1.4 and remove the link between poles 3 and 4 of the transmitter test socket.

(2) Using OVERRIDE control, decrease the throttle motor angle until the closing limit switch operates. The throttle motor angle at this point should be 18·75° ± 0·5°.

(3) Increase the throttle motor angle until the opening limit switch operates. The throttle angle at this point should be 90° ± 0·25°.

Override torque

11. (1) Hang a weight from the throttle motor protractor pulley to give an opposing torque of 15 lb in.

(2) Run the throttle motor between the limit switch operating points in each direction, using OVERRIDE control.

(3) The times for full travel should be:—

Opening	8 to 12 sec.
Closing	6·5 to 10 sec.

(4) Whilst the throttle motor is running in each direction, check that the reading on meter 1 does not exceed 2·5A. Disregard the initial surge.

(5) Check, by "inching" the throttle motor in at least ten steps in each direction, that the override brake operates.

(6) Hang a weight from the throttle motor protractor pulley to give an opposing torque of 20 lb. in.

(7) Run the throttle motor between the limit switch operating points in each direction, using OVERRIDE control.

(8) The times for full travel should be:—

Opening	8 to 11 sec.
Closing	6·5 to 10 sec.

Clutch operation

12.

Caution . . .

Care must be taken to ensure that the throttle motor is not driven against its limit stops during these tests.

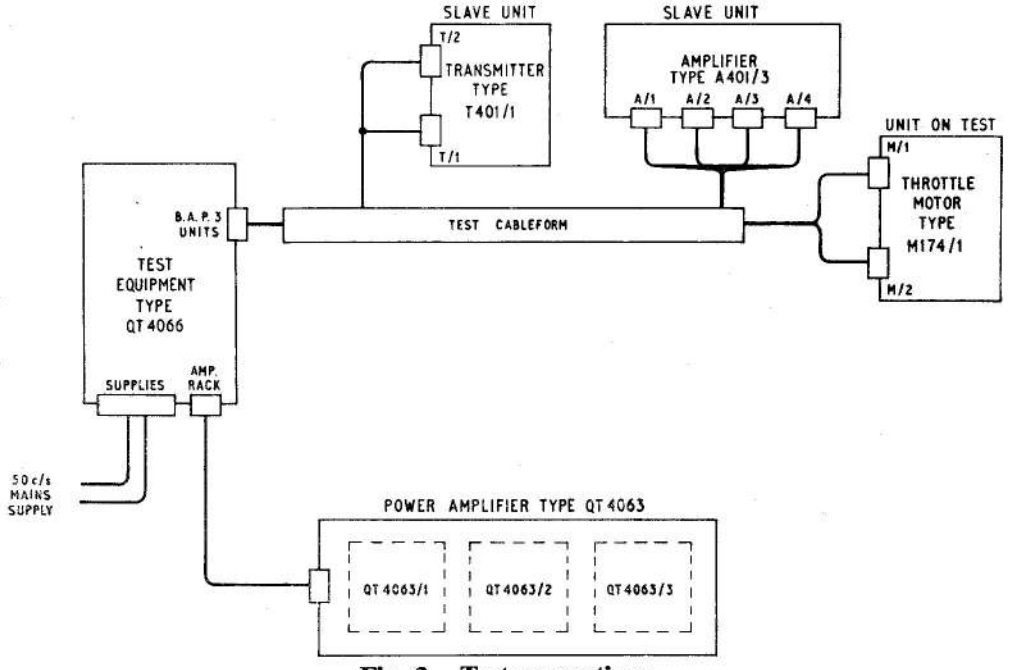


Fig. 3. Test connections

(1) Set the OVERRIDE-OFF-NORMAL switch to NORMAL.

(2) Set the transmitter to give a throttle motor angle of approximately 45°.

(3) Using a selection of pulley weights, measure the torque which causes the clutch to slip in each direcion. This torque must not exceed 75 lb. in.

(4) Apply a torque load of 45 lb. in. Induce slip by momentarily increasing the torque load.

(5) Ensure that the clutch stops slipping immediately the torque is returned to 45 lb. in. Check in both directions.

Note . . .

Throttle motors which have completed more than 1500 *operating hours should be tested using a* 40 *lb. in. torque for the test in sub-para.* (4).

Final check

13. (1) Check that there is nothing loose inside the unit.

(2) Repeat the insulation resistance check described in para. 4.

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