# Appendix 3

# PITOT-STATIC TRANSDUCER, TYPE A, Ref. No. 6A/5550

## SERVICING

## TEST AND ADJUSTMENTS

### LIST OF CONTENTS



### LIST OF TABLES



### LIST OF ILLUSTRATIONS



**General**

**1.** The tests detailed in this appendix are additional to the standard serviceability test (App. 1) and are to be applied during fault diagnosis (App. 2). Unless otherwise stated, tests must be carried out with the test layout shown in App. 1, fig. 1 (if test set, Type 9 is used) or fig. 2 (if test set, Type 9A is used). The transducer cover must be removed and the transistor amplifier placed in the servicing position.

**2.** Views and circuit diagrams of the transducer are contained in Chap. 2.

**3.** After a sub-unit or component has been adjusted, carry out the standard serviceability test to ensure that the fault has been cleared and that the transducer is serviceable.

**4.** Servicing must be carried out in dust-free, temperature controlled conditions.

**Test equipment**

**5.** Either the test set, Type 9 (Ref. No. 6C/2199) or the test set, Type 9A (Ref. No. 6C/3156) may be used for the tests detailed in the following paragraphs. Reference to test set components and control positions is made with the test set, Type 9A, reference contained in parentheses and following that for the test set, Type 9, e.g. S1(S12). Where a test set component or control position designation is the same for both test sets, only one reference is given. For convenience the engraved ON position of switch S7 (test set, Type 9) and the engraved SUPPLY ON position of S1 (test set, Type 9A) are referred to in the following text as the ON position.

**6.** Test set, Type 9 component abbreviations are as follows:—

PCU = Power control unit.
SDR = Servo data receiver.
S1 = RECEIVER switch.
S7 = MAINS switch.

**7.** Test set, Type 9A component abbreviations are as follows:—

PCU = Power control unit.
SDR = Servo data receiver.
S1 = Ø ROTATION / OFF / SUPPLY ON switch.
S12 = TEST switch.

**8.** Other items of test equipment required are as follows:—

(1) Pitot-static test set, Mk. 3 (Ref. No. 6C/2106) (abbreviated, Mk. 3 P.S.).

(2) Multimeter, Type 12889 (Ref. No. 5QP/17447).

(3) Valve voltmeter, Type V200A (Ref. No. 10S/17730).

(4) Insulation resistance tester, Type C (Ref. No. 5G/1621).

(5) Stop watch, G.S. $\frac{1}{5}$ sec. (Ref. No. 6B/9101001).

**Note . . .**

*Instruments of similar range and accuracy to those in sub-para.* (2) *to* (5) *will be acceptable.*

**9.** The following pneumatic supplies are required:—

(1) A vacuum supply capable of simulating 75 000 ft (1·030 in. Hg), Standard Conditions. This is obtainable from pressure-vacuum test unit (Ref. No. 6C/3154) or aneroid testing vacuum pump (Ref. No. 6C/1522).

(2) A pressure supply not exceeding 20 lb/in.$^2$, obtainable from pressure-vacuum test unit (Ref. No. 6C/3154).

**Wiring tests**

**10.** Carry out continuity tests as detailed in App. 1. Using the insulation resistance tester, check that the insulation resistance between each pin of socket PT.1 and plug PT.2 and the base plate is not less than 10 megohms. In addition, use the multimeter to make continuity checks throughout the complete circuit, paying due regard to the effect of any component in the line being tested. Line resistance should not exceed 0·2 ohm.

**Capsule unit wiring tests**

**11.** Remove the cable-form connections to the base plate of the capsule unit. Carry out continuity tests between the base plate terminals as follows:—

| Terminals | Resistance |
|---|---|
| 5 and 6 | 40 ± 10 ohms |
| 2 and 8 | 125 ± 15 ohms |
| 3 and 8 | 125 ± 15 ohms |

**Synchro wiring tests**

**12.** Check that the resistance between pairs of stator terminals S1 and S2, S2 and S3, and S3 does not exceed 300 ohms ± 10%. Check that the resistance between terminals R1 and R2 does not exceed 465 ohms ± 10%.

**Setting of RV5**

**13.** (1) Set the PCU switch to the off position and switch S7(S1) to OFF.

(2) Set the pitot-static pressure to a value greater than 66·44 mb (200 kt), to prevent hunting.

(3) Set the valve voltmeter to the 300mV range and connect across capacitor C2, with the earth terminal of the meter connected to the earth terminal of C2 (fig. 1).

(4) Set the PCU switch to ON and switch S7(S1) to ON.

(5) Check that the valve voltmeter indicates a null not greater than 2mV r.m.s., reducing the range of the meter as necessary.

(6) If the null indication is greater than 2mV r.m.s., adjust RV5 (Chap. 1, fig. 2) to obtain an indication of not greater than 2mV r.m.s.

(7) If the smallest null obtained is greater than 2mV r.m.s. carry out the voltage checks detailed in App. 2. If the checks are correct, declare the transducer unserviceable.

**Note . . .**

*If the servo runs away and does not tend to null, carry out the servo amplifier checks of para.* 24 *to* 30.

**14.** Wind the 200T gear of axis 2 (fig. 1) five revolutions in a clockwise direction away from the null and note the valve voltmeter reading at each revolution. Check that the meter readings are as shown in Table 1, Col. (b) and (c). If any reading is incorrect and cannot be corrected by adjustment of RV5, declare the transducer unserviceable.

**TABLE 1**

**Pick-off sensitivity**

| 200T gear (revolutions) (a) | Output (mV) (b) | Tolerance (±mV) (c) |
|---|---|---|
| 1 | 24·4 | 5·5 |
| 2 | 48·6 | 5·5 |
| 3 | 73·2 | 5·5 |
| 4 | 97·7 | 5·5 |
| 5 | 122·0 | 5·5 |

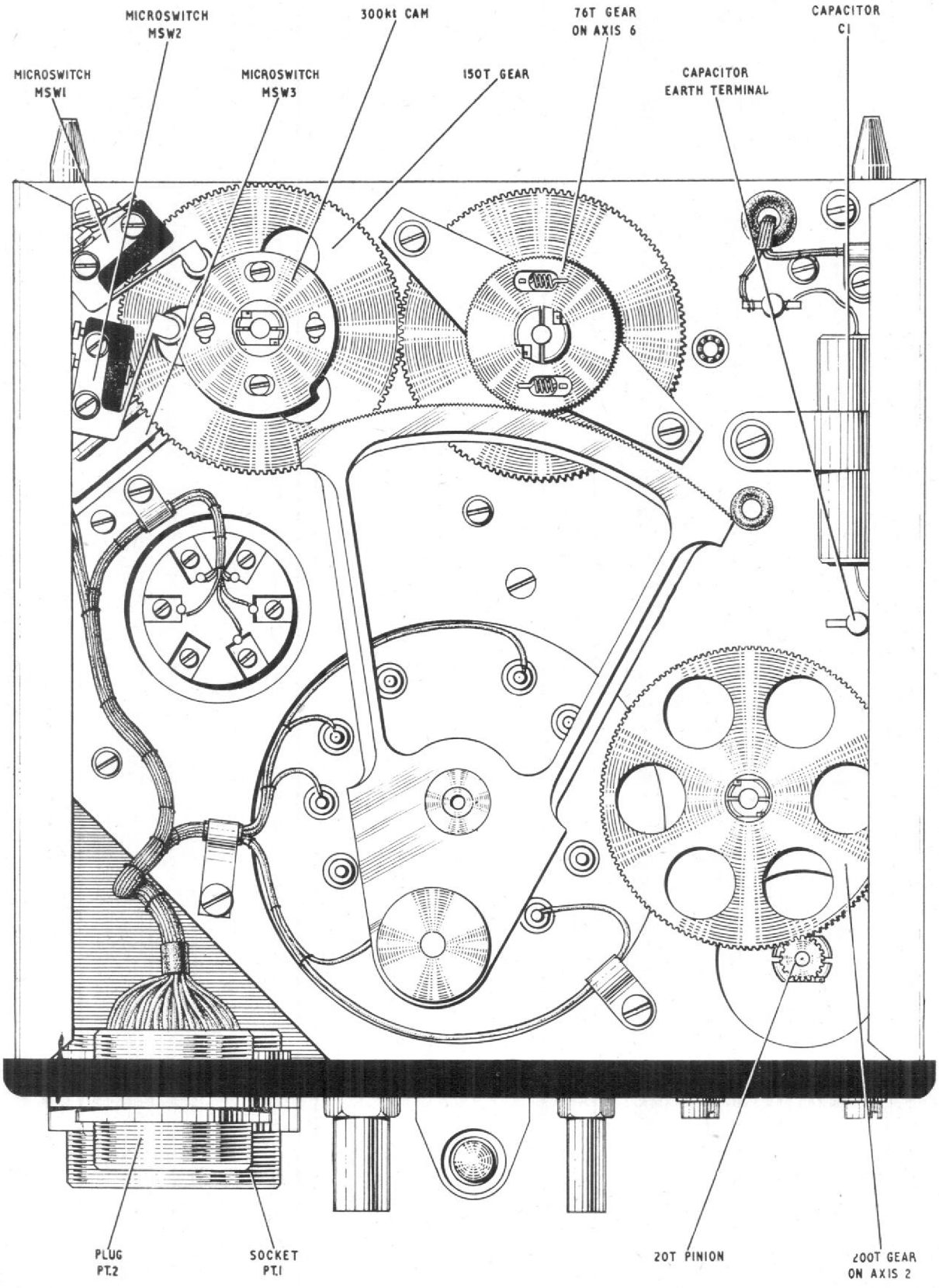


**Fig. 1. Pitot-static transducer, Type A—underside view**

**Setting of RV1**

**15.** (1) Set the pitot-static pressure to a value greater than 66·44 mb (200 kt), to prevent hunting.

(2) With test set switches set as in para. 13, sub-para. (4), wind the 200T gear of axis 2 (fig. 1) one turn against the servo action and then release it.

(3) Check that the gear makes one overshoot and one undershoot only, before coming to rest.

(4) Wind the 200T gear of axis 2 one turn in the direction of the servo action and then release it.

(5) Check that the gear makes one overshoot and one undershoot only before coming to rest.

(6) If necessary, adjust RV1 (Chap. 2, fig. 8) to obtain the conditions in sub-para. (3) and (5).

**16.** If the conditions in para. 15 are not obtained by adjustment of RV1, check the values of RV1 or R6 (Chap. 2, fig. 8 and fig. 5 respectively). Check the potentiometer for smooth wiper action. If the correct condition is still not obtained, check the motor-tachogenerator. If the fault persists, carry out the servo amplifier checks of para. 24 to 30.

**Servo system stiffness check**

**17.** (1) Set the PCU switch to the off position and switch S7(S1) to OFF.

(2) Connect the valve voltmeter, set to the 10V range, across capacitor C1, with the meter earth terminal connected to the capacitor earth terminal (fig. 1).

(3) Set the PCU switch to ON and switch S7(S1) to ON.

(4) Check that the valve voltmeter reading does not exceed 5V r.m.s.

(5) Turn the 200T gear on axis 2 (fig. 1) three revolutions in a clockwise direction, against the servo action. Release the gear and mark the position at which it comes to rest. Turn the gear in a counter-clockwise direction three revolutions, then release and mark the position at which it comes to rest.

**Note . . .**

*Mark the gear positions with a soft lead pencil. Do not use a ball point pen, since the ink may cause a chemical interaction with the surface of the metal.*

(6) Check that the difference between the two marked positions in sub-para. (5) is not greater than 5° (about 3 teeth).

(7) If the difference is greater than 5°, check capacitor C1 and the motor-tachogenerator. If the fault persists, carry out the servo amplifier checks detailed in para. 24 to 30.

**Calibration of RV3 (log (P-S) potentiometer)**

**18.** (1) Set the PCU switch to ON and switch S7(S1) to ON.

(2) Set the test set switches as for the log (P-S) output voltage test in App. 1.

(3) Set the wipers of RV2 and RV4 to a point mid-way along their respective tracks. Ensure that the terminals of RV3 are in the position shown in Chap. 2, fig. 8.

(4) Apply a pitot-static pressure of 66·44 mb (200 kt) to the transducer.

(5) Check that the position of the compensating drive unit cam follower is as shown in fig. 2. If necessary, obtain this condition by slackening the screws on the split clamp securing RV3 spindle, and rotating the compensating drive unit. Tighten the split clamp screws, using a torque screwdriver set to the correct loading (see Table 2).

**Note . . .**

*The cam follower must be towards the rear of the transducer during this operation.*

(6) Reduce the P-S pressure to 36·98 mb (150 kt). Check that the SDR reading is within ±70 divisions of the figure quoted against 150 kt log (P-S) (Mk. 1A, log (P-S)) of the test set calibration chart. If the SDR reading is incorrect, adjust RV3 (by means of the screwdriver slot on the top of the potentiometer body) until the figure quoted against 150 kt log (P-S) (Mk. 1A, log (P-S)) in the calibration chart is obtained.

(7) Increase the static pressure to 1240·33 mb (750 kt). Check that SDR reading is within ±70 divisions of the figure quoted against 750 kt log (P-S) (Mk. 1A, log (P-S) of the test set calibration chart. If necessary, adjust RV2 to bring the SDR reading within this tolerance.

(8) Reduce the static pressure to 36·98 mb. Repeat sub-para. (6) and (7). It may be necessary to repeat these operations several times before the SDR readings are brought into tolerance.

(9) Carry out the log (P-S) output voltage test (App. 1).

(10) If some of the SDR readings are incorrect, proceed as follows:—

(a) Set the static pressure to the value which gives the greatest error,

(b) Adjust RV3 to correct the SDR reading.

(c) Carry out the log (P-S) output voltage test (App. 1).

(d) Repeat sub-sub-para. (a) to (c) until all SDR readings are within tolerance.

(12) If correct calibration cannot be achieved, and the I.A.S. synchro test is correct, carry out the gear train checks of App. 2. Repeat the log (P-S) output voltage test: if the SDR readings are still incorrect, declare the transducer unserviceable.

**Calibration of CX1 (I.A.S. synchro)**

**19.** (1) Release the transistor amplifier and plinth, but without unsoldering any connections. Lift clear and locate conveniently.

(2) Set the PCU switch to ON and switch S1(S12) to TEST 2 (SELF TEST 2). Check that the SDR reading is 00000 ± 1 division.

(3) Set S1(S12) to I.A.S. and allow a warm-up time of 15 min. to elapse.

(4) Set the pitot-static pressure to 50·6 mb (175 kt). Check that the SDR reading is 00000 ± 31 divisions.

(5) If the SDR reading is incorrect, check that the cam follower of the compensating drive unit is in the correct position (App. 2). A method of checking this position is shown in fig. 2. The template shown in this figure may be constructed from any thin rigid material.

(6) If the cam follower is incorrectly positioned, release the clamp locking the cam unit (Chap. 2, fig. 8). Set the cam follower to the correct position without disturbing the gear train. Tighten the clamp to the correct torque loading (Table 2) and check the SDR reading.

(7) Set the pitot-static pressure to 16·33 mb (100 kt). Check that the SDR reading is 00350 ± 2 divisions.

(8) If the SDR reading is incorrect, release the three 6 B.A. screws clamping synchro CX1 (Chap. 2, fig. 2). Without disturbing the gear train, rotate the body of CX1 to obtain the correct reading. Exercise care when making this adjustment, since space is limited.

(9) Tighten the three 6 B.A. clamp screws, ensuring that the SDR reading does not change.

(10) If the SDR readings are incorrect, repeat the procedure of sub-para. (4) to (6), retarding the cam slightly if the errors are positive and advancing the cam if the errors are negative (fig. 2).

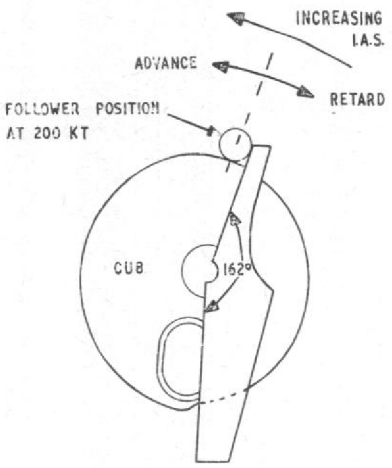


**Fig. 2. Adjustment of compensating drive unit**

(11) If the correct SDR readings cannot be obtained, and the log (P-S) test is correct, carry out the gear train checks of App. 2 and repeat the procedure of sub-para. (7) to (10). If the test readings are still incorrect, declare the transducer unserviceable.

**Setting of MSW1 and MSW2 (300 kt and 400 kt microswitches)**

**20.** These microswitches are shown in fig. 1. Microswitch MSW1 operates at 300 kt and MSW2 operates at 400 kt. The cam which operates MSW1 is mounted above that which operates MSW2 (when viewed with the transducer inverted) and so must be removed when the latter cam is adjusted. When both microswitches are to be adjusted, MSW2 must be adjusted first.

**Setting of MSW1**

**21.** (1) Set the PCU switch to on and switch S7(S1) to OFF.

(2) Set the pitot-static pressure to 153·77 mb (300 kt).

(3) Loosen the two 10 B.A. ch.hd. screws securing the MSW1 cam to the (lower) MSW2 cam and loosen the two 8 B.A. ch.hd. screws securing MSW1 to the motor plate pillars.

(4) Connect the multimeter, set to the ohms ÷100 range, between the red/black and white/brown lead connections to MSW1.

(5) Adjust the position of MSW1 and its actuator, such that the microswitch is open (as indicated on the multimeter) when the actuator follower is resting on the smaller diameter of the cam adjacent to the dip in

the cam profile. It may be necessary to adjust slightly the position of MSW1 cam to achieve this condition.

(6) Tighten the two 8 B.A. ch.hd. screws securing MSW1.

(7) Rotate the cam in a counter-clockwise direction until the miscroswitch is closed. Tighten the two 10 B.A. ch.hd. screws securing the cam.

(8) Set the pitot-static pressure to 105·13 mb (250 kt).

(9) When the servo has stabilized, slowly increase the pitot-static pressure to 213·17 mb (350 kt) and check that MSW1 is open at 143·21 mb (290 kt) and closed at 164·74 mb (310 kt).

(10) If the test of sub-para. (9) fails, check MSW1 for continuity. If the microswitch is correct carry out the servo amplifier checks of para. 24 to 30.

**Setting of MSW2**

**22.** (1) Remove the two 10 B.A. ch.hd. screws securing MSW1 cam to the cam which operates MSW2.

(2) Remove MSW1 cam, noting its approximate position relative to the MSW2 cam.

(3) Set the PCU switch to on and switch S7(S1) to OFF.

(4) Set the pitot-static pressure to 284·37 mb (400 kt).

(5) Loosen the two 10 B.A. ch.hd. screws securing the MSW2 cam to the 150T gear on axis 7 and loosen the two 8 B.A. ch.hd. screws securing MSW2 to the motor plate pillars.

(6) Connect the multimeter, set to the ohms ÷100 range, between the black/orange and white/brown lead connections to MSW2.

(7) Adjust the position of MSW2 and its actuator, such that the microswitch is open (as indicated on the multimeter) when the actuator follower is resting on the smaller diameter of the cam and adjacent to the dip in the cam profile. It may be necessary to adjust slightly the position of the cam to obtain this condition.

(8) Tighten the two 8 B.A. ch.hd. screws securing MSW2.

(9) Rotate the cam in a counter-clockwise direction until the microswitch is closed. Tighten the two 10 B.A. ch.hd. screws securing the cam.

(10) Set the pitot-static pressure to 213·17 mb (350 kt).

(11) When the servo has stabilized, slowly increase the pitot-static pressure to 368·57 mb (450 kt) and check that MSW2 is open at 269·12 mb (390 kt) and closed at 300·14 mb (410 kt).

(12) If the test of sub-para. (11) fails, check MSW2 for continuity. If the microswitch is correct, carry out the servo amplifier checks of para. 24 to 30.

(13) When MSW2 is correctly set-up, replace the cam of MSW1 (as noted in sub-para. (2)). Set-up MSW1 as described in para. 21.

**Setting of MSW3 (low speed microswitch)**

**23.** This microswitch is shown in fig. 1. It is operated by a stop mounted on the 150T gear of axis 7, the stop being mounted on the underside of this gear. The microswitch is set-up as follows:—

(1) Set the PCU switch to on and switch S7(S1) to OFF.

(2) At the Mk. 3 P.S., set the pitot-static pressure to 8·44 mb (72 kt). Check that the stop on the 150T gear of axis 7 is almost operating MSW3.

(3) Increase the pitot-static pressure to 36·99 mb (150 kt) and allow the servo system to stabilize.

(4) Slowly decrease the pitot-static pressure to 6·87 mb (65 kt) and check that MSW3 is operated (opened) at between 8·44 mb (72 kt) and 6·87 mb (65 kt). When the microswitch is operated, the gear train is driven in the opposite direction to close the switch.

(5) If the microswitch operation is incorrect, carry out the following procedure:—

(a) Set the pitot-static pressure to 8·44 mb and note the position of the microswitch actuator relative to that of the operating stop.

(b) Remove the microswitch, but without disconnecting the leads. Loosen the two 8 B.A. ch.hd. screws securing the microswitch to its support.

(c) Adjust the microswitch actuator such that the switch is almost operated at the applied pitot-static pressure of 8·44 mb. Tighten the two 8 B.A. ch.hd. screws and replace the microswitch.

**Note . . .**

*This is a somewhat delicate operation; it may require several adjustments before the correct condition is obtained.*

(d) Increase the pressure to 36·99 mb (150 kt) and allow the servo system to stabilize. Repeat sub-para. (4).

(6) If correct microswitch operation cannot be obtained, check MSW3 for continuity. If the microswitch is correct, carry out the servo amplifier checks of para. 24 to 30.

**Servo amplifier checks**

**24.** (1) Set switch S7(S1) to OFF.

(2) Disconnect the lead on terminal N on the magnetic amplifier (Chap. 2, fig. 2).

(3) Connect the multimeter, set to the 10mA d.c. range, between terminal N and the lead disconnected in sub-para. (2).

(4) Set switch S7(S1) to ON.

(5) Note the position of the 200T gear on axis 2 (fig. 1) and then rotate the gear against the action of the servo until the multimeter indicates 4mA. Check that the gear has turned through not more than one-third of a revolution.

(6) Return the 200T gear to the position noted in sub-para. (5) and repeat the action in this sub-para., but turning the gear in the opposite direction.

**25.** If the test in para. 24 fails, use the multimeter to check the power supplies to transistor amplifier TA1 and magnetic amplifier MA1 as follows:—

| Between terminals | Multimeter range | Voltage |
|---|---|---|
| TA1 terminals j and c | 10V d.c. | –5·0V to –9·0V d.c. |
| h and c | 10V d.c. | –5·0V to –9·0V d.c. |
| d and c | 25V d.c. | +8·0V to +11·0V d.c. |
| (connect terminal c to signal earth) | | |
| MA1 terminals H and N | 50V a.c. | 25V ± 1V a.c. |
| (connect MA1 terminal H to bias earth) | | |

**26.** If the power supplies are correct, set switch S7(S1) to OFF and check that the 25V REF. supply to the junction of MR1 and MR2 (Chap. 2, fig. 5) via R14 is present. If the supply is correct, measure the open circuit resistance of MR1 and MR2. Using the multimeter, check that the forward resistance is of the order of ohms and that the reverse resistance is of the order of megohms. If this test is satisfactory, declare the transducer unserviceable.

**27.** (1) With the multimeter connected as in para. 24, sub-para. (3), connect the valve voltmeter, set to the 10V range, across C1 with the earth terminal of the meter connected to the earth terminal of the capacitor (fig. 1).

(2) With the servo in the null position, check that the valve voltmeter reading does not exceed 5V.

(3) If the multimeter indicates a current flow, disconnect the meter from terminal N and check that the motor does not run. If the motor runs, disconnect the lead from terminal J. Connect the multimeter between this lead and terminal J. Check that the line current is 8mA. Disconnect the lead from terminal G and connect the multimeter between this lead and terminal G. Check that the line current is 8mA. If necessary, adjust the bias potentiometer until the line currents to terminals J and G are each 8mA. Disconnect the multimeter and reconnect the leads to terminals J and G. Connect the multimeter to terminal N. If the motor still runs, declare the transducer unserviceable.

(4) Set the valve voltmeter to the 100V range.

(5) Repeat the test of para. 24, and check that when the multimeter reads 4mA, the valve voltmeter reading is greater than 30V in each direction of revolution of the 200T gear. Check that the difference between the two readings is not greater than 5V.

**28.** If the test of para. 27 fails, use the multimeter to check the power supplies to MA1 as follows:—

| Between pins | Multimeter range | Voltage |
|---|---|---|
| J and H | 100V a.c. | 80V to 90V a.c. |
| G and H | 100V a.c. | 80V to 90V a.c. |
| K and H | 100V d.c. | –32V to –25V d.c. |
| (connect pin H to bias earth) | | |

**29.** If the power supplies to MA1 are correct, and the fault persists, declare the transducer unserviceable.

**30.** Disconnect the meters and re-connect the lead to pin N of MA1.

**Servo follow-up check**

**31.** (1) Set switch S7(S1) to ON.

(2) Set the pitot-static pressure to 153·78 mb (300 kt).

(3) When the SDR reading is steady, set switch S7(S1) to OFF.

(4) Set the pitot-static pressure to 66·44 mb (200 kt).

(5) Set switch S7(S1) to ON and start the stop watch.

(6) Check that the servo system becomes stationary within 6 seconds of switching on.

(7) If the time taken is greater than 6 seconds, refer to App. 2.

(8) If the time taken is correct, carry out the standard serviceability test of App. 1.

**TABLE 2**

**Split clamp loading torques**

| Size of clamp screw (a) | Torque mild steel (b) | Torque high tensile stainless steel (c) |
|---|---|---|
| 12 B.A. | 0·645 kg.cm. | 0·85 kg.cm. |
| 10 B.A. | 1·230 kg.cm. | 1·90 kg.cm. |
| 8 B.A. | 3·125 kg.cm. | 6·00 kg.cm. |
| 6 B.A. | 3·750 kg.cm. | 8·50 kg.cm. |

**Note . . .**

*Stainless steel screws can be distinguished by their bright state.*



Printed for Her Majesty's Stationery Office, by Herald Printers, York
(63532) Demand 87147 600 11/65 Gp. 483/7 (24/9/65 571630)