Appendix 4

AIR DATA COMPUTER, TYPE B, Ref. No. 6A/5404 and TYPE C, Ref. No. 6A/8743

SERVICING

TESTS AND ADJUSTMENTS

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General

1. The tests detailed in this appendix are additional to the standard serviceability tests (App. 2) and are necessary either when certain components are replaced (App. 5) or during fault-diagnosis (App. 3). Unless instructed to the contrary these tests are to be performed with the computer connected to the test set, Type 9B, Ref. No. 6C/2868, as shown in App. 2, fig. 1, and the dust cover removed; the procedures detailed in App. 2, up to and including self tests on test set, Type 9B, must all have been carried out. The tests are applicable to units modified up to and including mod. ADS/143.

2. Illustrations of the computer and circuit diagrams of individual gearboxes and the complete computer are contained in Chap. 7.

3. Should a fault develop in any sub-unit or component for which spares are not held the computer will be declared unserviceable and returned for repair in accordance with current service instructions.

4. On adjustment or replacement of a faulty sub-unit or component or adjustment of the gear train, the computer should be subjected to the relevant standard serviceability test to ensure that only this sub-unit/component (or gear train) is at fault.

5. The conditions under which servicing is to be carried out must be closely controlled regarding freedom from dust and dirt, and temperature environment. On completion of the tests all switches and simulators on the test set, Type 9B, should be set to the off, normal or zero position, the computer disconnected from the test set and all plugs and sockets lightly smeared with silicone compound MS4.

6. App. 2, Table 1 gives a list of abbreviations used for test equipment components. Test equipment additional to that of App. 2, is required as below:—

(1) Insulation resistance tester, Type C, Ref. No. 5G/152.

(2) Voltage divider box, 4 dial to an accuracy of 0·1 per cent, Ref. No. 6C/2352 (or equivalent).

(3) Single pole, four-position switch.

(4) Universal bridge, CT492, NATO Ref. No. 6625–99–972–4702.

(5) Transistor amplifier test equipment as detailed in fig. 17.

Preliminary checks

7. Continuity tests are given in App. 2. Should these fail the computer should be disconnected from all test equipment and the following checks made:—

(1) That each pin on plugs AD2 and AD7 and sockets AD1, AD3, AD4, AD5, AD6, AD8 and AD9 is connected to the relevant point(s) as shown on the circuit diagram. Use the multimeter set to the ÷100 range for this test.

(2) That all soldered connections are mechanically sound and adequate clearance exists between adjacent terminals.

(3) That the insulation resistance between each pin of plugs AD2 and AD7 and sockets AD1, AD3, AD4, AD5, AD6, AD8 and AD9 in turn and the computer chassis is greater than 10M ohms.

(4) That all internal connections comply with the circuit diagram.

Note . . .

Individual channel circuits need not be checked unless a fault cannot be located to a particular sub-unit or component.

8. It is assumed that all supplies are correct at plug AD7 as these are supplied by the test set, Type 9B. However, should a sub-unit or output component be suspect then, where possible, the voltage supplies at the sub-unit or output component should be checked before deciding on a replacement. Tolerances are given in App. 2, Table 2.

Balance of 20V supplies

9. The method of balancing the 20V supplies as described in the standard serviceability test App. 2, does not cater for any adjustment of the balance potentiometers RV1 and RV2 within the computer.

10. Modification INST/T85 to the test set, Type 9B overcomes this difficulty and the procedure for balancing 20V supplies detailed as follows is based on this modification having been incorporated in the test set.

11. Before any tests are carried out on the computer, the 20V supplies must be balanced as follows:—

(1) Ensure that the self tests on test set, Type 9B of App. 2 have been carried out.

(2) Set test set, Type 9B S14 to 20V BALANCE (ADC TEST) and S15 to X 100.

(3) Set S15 to the lowest position at which a null is registered on meter M3.

(4) If this null is outside a value of ±10mV then RV1 and/or RV2 (Chap. 7, fig. 2) should be adjusted to bring this figure within tolerance.

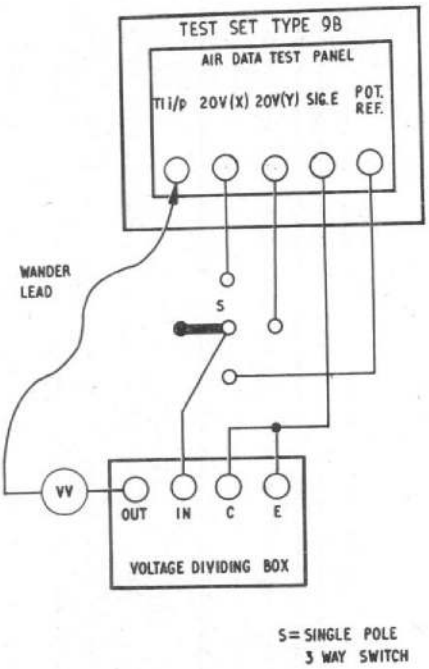


Fig. 1. Connections for subsidiary test equipment

GEAR TRAIN CHECKS

12. Examine the gear train of a suspect gearbox in order to determine:—

(1) Whether any gear is damaged—broken teeth, distorted gear, etc., and if so declare the gearbox unserviceable.

(2) That all split clamps are tight at the correct torque loading (Table 6), with the two halves of the clamp symmetrically placed on the collar. Before tightening split clamps associated with synchros or servo driven potentiometers, carry out the appropriate setting up tests.

13. Check the slip clutch. If the split clamp is loose it should be tightened to the correct torque loading (Table 6), in such a position that when a gramme gauge is inserted in one of the holes of the gear on axis 2 of the gearbox in question then:—

(1) The force required to turn the gear train does not exceed 4 gm except in the case of the height gearbox (G3) (pre-mod. ADS/134) when the force should not exceed 3 gm.

(2) If the gear on axis 4 (G1, G3 or G5), axis 5 (G4) or axis 6 (G6 or G7) is held to prevent it moving, the force required to slip the clutch does not exceed 7 gm.

14. Before proceeding to the testing of individual gearboxes connect the computer to the test set, Type 9B as shown in App. 2, fig. 1, set S1 to OFF, S5 to OFF and T4 to 4450 (200 kt).

LOG MACH NO. GEARBOX (G1)

15. Remove the gearbox from the computer without disturbing cable connections. Switch S1 to ON. The gearbox should servo to a null.

16. If the gears run continuously or do not run at all, carry out the following:—

(1) Check that the connections to RV9 (Chap. 7, fig. 8) comply with the circuit diagram (Chap. 7, fig. 32).

(2) Connect the valve voltmeter between T1 INPUT on the test set, Type 9B and pin b on TA2. Switch S4 to LOG (P-S). The valve voltmeter shoud read approximately 8·9V.

(3) Connect the valve voltmeter between pin 11 of the gearbox tagboard and pin b on TA2. The valve voltmeter reading should vary between zero and approximately 20V as the servo runs. If it does not, measure the voltage between terminals 1 and 3 of RV9; this should be 20V approximately.

(4) Measure the voltage between the wiper of RV9 (pin W) and pin 3 on the tagboard; this should vary between zero and approximately 20V as the servo runs.

17. If the tests of para. 16 are all satisfactory proceed to the servo amplifier checks.

18. Check that RV5 (Chap. 7, fig. 8) is so adjusted that when the 200T gear of axis 2 (fig. 2) is displaced one turn against the servo action and released it makes only one overshoot in each direction before becoming stationary.

19. Connect the valve voltmeter across capacitor C1 (ensuring that the earth terminal of the meter is connected to the end of the capacitor which lies between RV6 and RV7/RV8 as shown in Chap. 7, fig. 8). Switch the meter to the 10V range and read the meter; the voltage indicated should not exceed 5V.

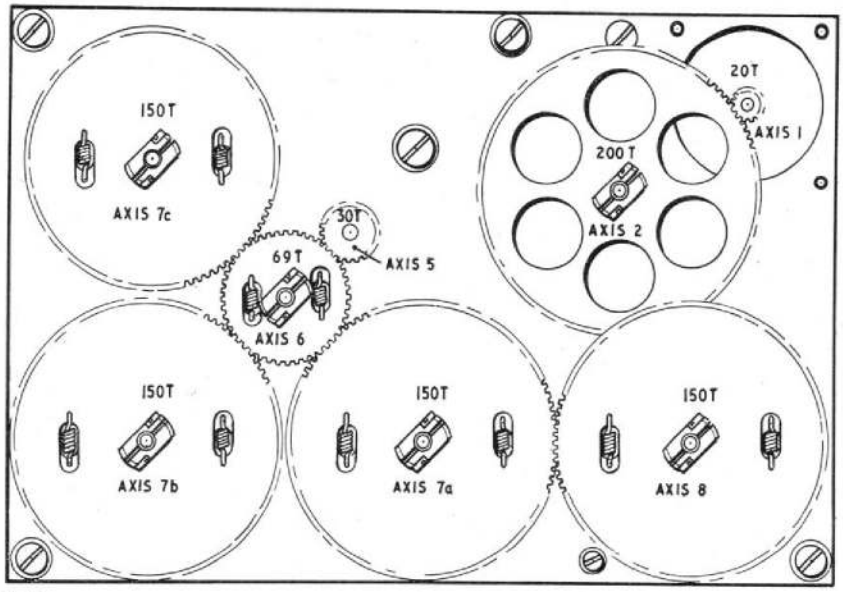
Note . . .

Owing to the possibility of oscillation produced by wire stepping in RV9 it may be necessary to hold the servo at the null for this check.

20. Switch the meter to the 100V range and rotate the 200T gear of axis 2 clockwise by hand to increase the meter reading to 40V. To achieve this it should not be necessary for the 20T pinion of axis 1 meshing with the 200T gear of axis 2 to rotate more than 4 revolutions. Mark with a soft pencil the position of the 200T gear when returned to the null.

Note . . .

Do not use a ball pen for marking the gear position.



Note . . .
Axis 7c removed by Mod. ADS/104.

Fig. 2. Log Mach gearbox (G1)—underside

21. Repeat the procedure of para. 20, turning the 200T gear of axis 2 counter-clockwise. The result should be the same within half a revolution of the pinion and the 200T gear when returned to the null should come to rest within 5° of the clockwise reading.

22. If any of the checks of para. 18 to 21 cannot be satisfied proceed to the servo-amplifier checks.

23. Set T4 on the test set, Type 9B to 4935 (250 kt). This should cause the 200T gear of axis 2 to rotate counter-clockwise.

24. Set all test set, Type 9B switches, except S1, to the off zero or normal position.

Check of log S_0 voltage

25. Ensure that the power has been switched on to the equipment for at least 15 min. then check the 20V balance. Remove the link between pin 25 of the gearbox tagboard and pin 25 of the gearbox interconnection tagboard and connect up subsidiary test equipment as shown in fig. 1. Connect the wander lead to pin 25 of the gearbox tagboard and switch the dividing box to 20V (X). Set the voltage dividing box to 7450 and check that the valve voltmeter registers a null. RV1 (Chap. 7, fig. 8) should be adjusted if necessary to achieve this condition.

26. Switch off the voltage dividing box and disconnect the wander lead. Switch S1 of test set, Type 9B to OFF and reconnect pins 25 on the two tagboards. Set T4 to 4430. Switch S1 to ON and check the 20V balance.

Check of log M

27. Using a template constructed of some appropriate thin rigid material, check that the cam follower of CU6 on axis 8 is positioned as shown in fig. 3. If necessary release the clamp locking CU6, position the follower correctly and refasten the clamp.

28. Connect the wander lead to pin 15 of the gearbox tagboard, set the dividing box to 3230 and switch to 20V (X). The valve voltmeter should register a null. If this is not the case, release the clamps on RV10 and turn the potentiometer until a null is registered. Refasten the clamping screws ensuring that the meter remains at the null whilst doing so.

29. (1) Adjust T4 to the settings detailed below, checking that the cam follower of CU6 bears against the cam throughout the complete movement of the gear train. The valve voltmeter should register a null at each setting of T4 with the dividing box set to the value shown within ±10 divisions.

T4	Dividing box
5060	4055
5555	4710
5972	5240
6332	5965
6654	6085
6947	6430
7218	6740
7470	7020

(2) If the results obtained are not within the permitted tolerance set T4 and the dividing box to the figure which produces the greatest error and null the value voltmeter by the adjustment of RV10 as in para. 28.

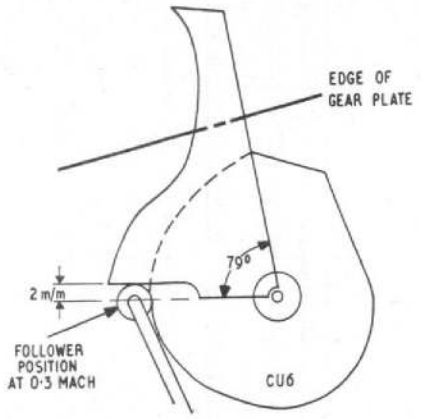


Fig. 3. Adjustment of log Mach cam CU6 by means of 79° template from underside

(3) Repeat sub-para. (1) and (2) until all readings are within tolerance.

(4) Disconnect the wander lead and switch off the dividing box.

Check of 1/2 log (1 + 0·2KM²) (RV11)

30. Check the 20V balance. Connect the wander lead to terminal 3 of RV11. Set the dividing box to 1790 and switch to 20V(Y). Check that the valve voltmeter registers a null. If necessary adjust RV4 to obtain this null.

31. Set T4 on test set, Type 9B to 2080 (66·1 kt) and check that the gearbox comes to rest with the cam follower of CU5 in the position shown in fig. 4. If necessary release the clamp locking CU5 and adjust the follower to this position.

32. Connect the wander lead to pin 27 of the gearbox tagboard, set T4 on test set, Type 9B to 4430, set the dividing box to 0025 and check that the valve voltmeter registers a null. If necessary release the screws clamping RV11 (Chap. 7, fig. 8) and rotate RV11 to obtain this null. Reclamp RV11, ensuring that the meter remains at the null whilst doing so.

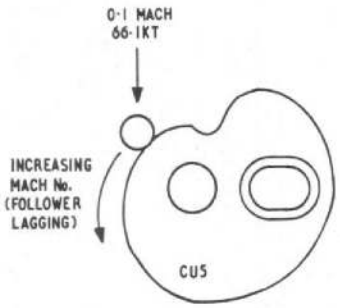


Fig. 4. Adjustment of 1/2 log (1 + 0·2KM²) cam CU5

33. Set T4 to each of the readings shown in col. (b) of Table 1 and at each setting null the meter by means of the dividing box. The dividing box should read as shown in col. (d) of Table 1 against the appropriate T4 setting, to a tolerance of ±20 divisions.

34. If the tolerances recorded in the test of para. 33 deviate from the permissible limits repeat para. 31, 32 and 33, rotating RV11 and the cam follower of CU5 clockwise or counter-clockwise a few degrees until a satisfactory set of readings is obtained.

35. Switch S1, test set, Type 9B to the off position; disconnect subsidiary test equipment and replace the log Mach No. gearbox.

MACH NO. OUTPUT GEARBOX (G5)

(Chap. 7, fig. 10, 11 and 12)

36. Remove the gearbox from the computer without disturbing the cable connections. Set test set, Type 9B T4 to 4430 and S1 to ON. The gearbox should servo to a null.

37. If the gears run continuously or do not run at all, carry out the following:—

(1) Check that the connections to potentiometer RV3 comply with the circuit diagram.

(2) Connect a valve voltmeter between pin 15 of the log Mach No. gearbox tagboard and pin b on TA5; the valve voltmeter should indicate approximately 6·25V.

(3) Connect the valve voltmeter between pin 13 of the gearbox tagboard and pin b on TA5; the valve voltmeter should vary between an indication of zero and approximately 20V as the servo runs.

(4) If the check of sub-para. (3) fails then measure the voltage between pins 2 and 3 of RV3. This should be approximately 20V. Also measure the voltage between pin 1 (wiper) of RV3 and pin 3 of the gearbox tagboard. This should vary between zero and 20V as the servo runs.

38. If all the checks of para. 37 are satisfactory and the gears still run continuously or do not move at all proceed to the servo amplifier checks.

39. Check that RV1 (Chap. 7, fig. 10) is so adjusted that when the 200T gear of axis 2 (fig. 5) is displaced one turn against the servo action it makes only one overshoot in each direction before becoming stationary.

40. Connect the valve voltmeter across C1, ensuring that the earth terminal of the meter is connected to the end of the capacitor further away from the motor-tachogenerator (Chap. 7, fig. 10).

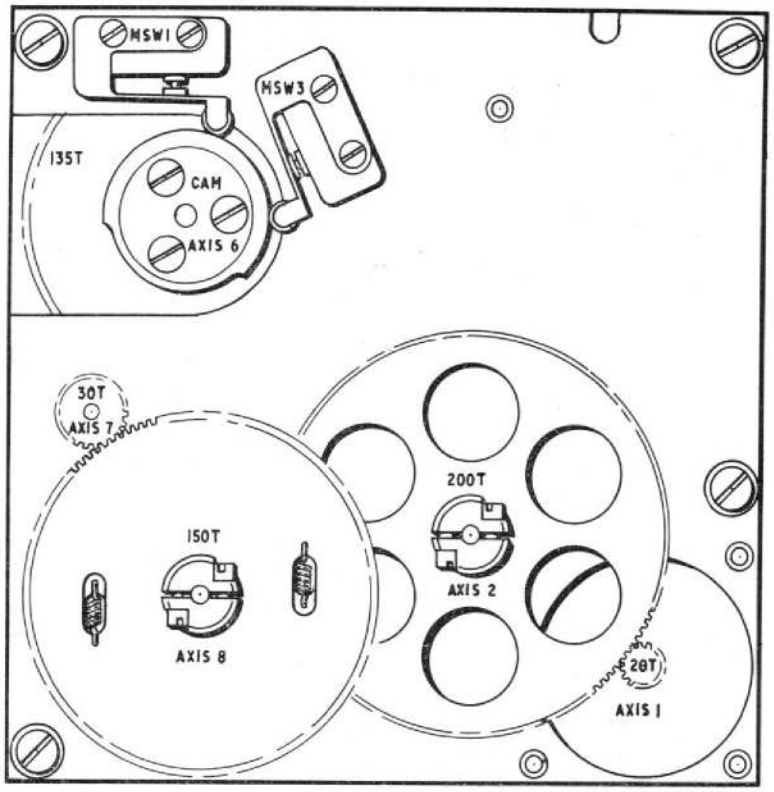


Fig. 5. Mach No. output gearbox (G5)—underside

Switch the meter to the 10V range and read the meter; the voltage should not exceed 5V.

Note . . .

Owing to the possibility of oscillation produced by wire stepping in RV3 it may be necessary to hold the servo at the null for this check.

41. Switch the meter to the 100V range and rotate the 200T gear of axis 2 clockwise by hand to increase the meter reading to 40V. To achieve this it should not be necessary for the 20T pinion of axis 1 meshing with the 200T gear of axis 2 to rotate more than 5 revolutions. Release the 200T gear and with a soft pencil mark its position when returned to rest.

Note . . .

Do not use a ball pen for marking the gear position.

42. Repeat the procedure of para. 41 turning the 200T gear of axis 2 counter-clockwise. The result should be the same within half a revolution of the pinion and the 200T gear when released should come to rest within 5° of the clockwise reading.

43. If any of the checks of para. 39 to 42 cannot be satisfied proceed to the servo amplifier checks.

44. Set T4 on the test set, Type 9B to 4935 (250 kt); this should cause the 200T gear of axis 2 to rotate clockwise. Reset T4 to 4430.

Mach No. synchro output

45. Check that the cam follower of cam CU9 is positioned approximately as shown in fig. 6. If positioned incorrectly release the clamping screws on RV3 (Chap. 7, fig. 10) and rotate RV3 until the follower takes up the correct position. Reclamp the potentiometer and check the 20V balance.

46. Set S4, test set, Type 9B, to MACH NO. and check that the test set, Type 9B SERVO INDICATOR G1 reads 00000 ± 2 divisions; if G1 is out of tolerance release the clamping screws of CX1 (Chap. 7, fig. 10) and rotate the synchro until the G1 reading is within tolerance. Reclamp the synchro.

47. Carry out the computer serviceability test of App. 2 in respect of Mach channel and return T4 to 4430.

48. There are four general types of error which may occur if the results of the test of para. 47 are out of tolerance. These, together with the adjustment procedure to be adopted in each case, are outlined below:—

(1) Positive or negative errors increasing with Mach No. in a linear manner. Set T4 to 7218 (1·0 Mach) and adjust RV3 if necessary until the SERVO INDICATOR G1 reads 01634. Set T4 to 4430 and adjust the follower of cam CU9 as in para. 45 until G1 indicates 00000. Carry out the relevant ranging test of App. 2. Repeat until all readings are within tolerance.

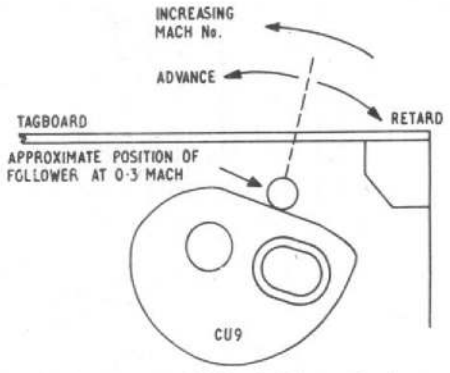


Fig. 6. Adjustment of Mach No. output cam CU9

(2) Positive errors increasing with Mach No. in a non-linear manner or negative errors in the initial range changing to positive errors at higher Mach No. Repeat the procedure of para. 27, 28, 29, 46 and 47, setting the log Mach cam CU6 (fig. 3) to about 77°. (See Note.)

(3) Negative errors increasing with Mach No. in a non-linear manner or positive errors in the initial range changing to negative errors at higher Mach No. Repeat para. 27, 28, 29, 46 and 47, setting the log Mach cam CU6 (fig. 3) to about 81°. (See Note.)

Note . . .

(1) *In all cases adjustment should be primarily on the lines detailed in sub-para.* (1).

(2) *The procedure outlined in sub-para.* (2) *or* (3) *should only be adopted if continued application of that of sub-para.* (1) *fails to clear the fault.*

(3) *Where errors are as outlined in sub-para.* (2) *or* (3) *adjustment of CU6 and RV10 should result in errors of the type of sub-para.* (1). *In such cases further adjustment should be on the lines detailed in sub-para.* (1).

Mach lock potentiometer

49. Set test set, Type 9B S1 to ON, S4 to MACH LOCK, S5 to 0 FT and T4 to 4430.

50. Carry out the computer serviceability test of App. 2 in respect of Mach lock potentiometer. If the results obtained are out of tolerance, set T4 test set, Type 9B to the position producing the greatest error, unclamp RV4 and rotate the potentiometer until the reading is within tolerance and reclamp the potentiometer. Repeat the relevant serviceability test of App. 2.

51. Repeat para. 50 until all readings are within tolerance. Switch off S1 and S4 and set T4 to the zero position.

1/M potentiometer

52. Carry out the standard serviceability test of App. 2 in respect of 1/M potentiometer. If the readings are out of tolerance the only adjustment it is possible to make is by loosening the three screws on the side of RV4/RV5 which gives a limited amount of movement to RV5 without disturbing the setting of RV4.

53. Set T4 to the position producing the greatest error, loosen the screws on the side of RV4/RV5 and adjust RV5 until the G1 reading is within tolerance. Repeat the serviceability test of App. 2 in respect of 1/M potentiometer.

54. Repeat para. 53 until all readings are within tolerance. Switch off S1 and S4 and set T4 to the zero position.

Note . . .

If a result cannot be obtained in which all readings are within tolerance change RV4/RV5 and repeat all checks from para. 49.

Mach No. switch (MSW1)

55. Connect the multimeter set to the ohms range between pins 5 and 16 of the gearbox tagboard. Set T4 test set, Type 9B to 3557 (0·2M) and check that the servo comes to rest with the actuator of MSW1 about to run up to the high part of the cam (fig. 7), and that the multimeter indicates an open circuit.

56. If the actuator is not positioned as in para. 55 release the cam locking clamp and rotate the cam to the correct position. Refasten the clamp.

57. Increase the setting of T4 until the multimeter registers a short circuit, i.e. MSW1 is closed, and note the relative positions of the cam and actuator which should be as shown in the sketch in fig. 7. If incorrect loosen the two 8 B.A. screws fixing the microswitch to the motor plate and move switch away from or towards the cam as required. If sufficient movement cannot be obtained on the switch, the actuator can also be moved. Tighten the switch fixing screws.

58. Recheck the relative positions of cam and actuator at the point where the multimeter indicates a short circuit by altering the setting of T4. Readjust as detailed in para. 57 until a satisfactory position has been obtained.

59. Set T4 to the position where the switch just closes (i.e. the multimeter indicates a short circuit). The setting of T4 should not be greater than 3779. Decrease the setting of T4 until the switch just opens (i.e. the multimeter indicates an open circuit). The setting of T4 should not be less than 3321.

60. Set T4 to 7470 (1·1M) and when the servo has come to rest check that the multimeter

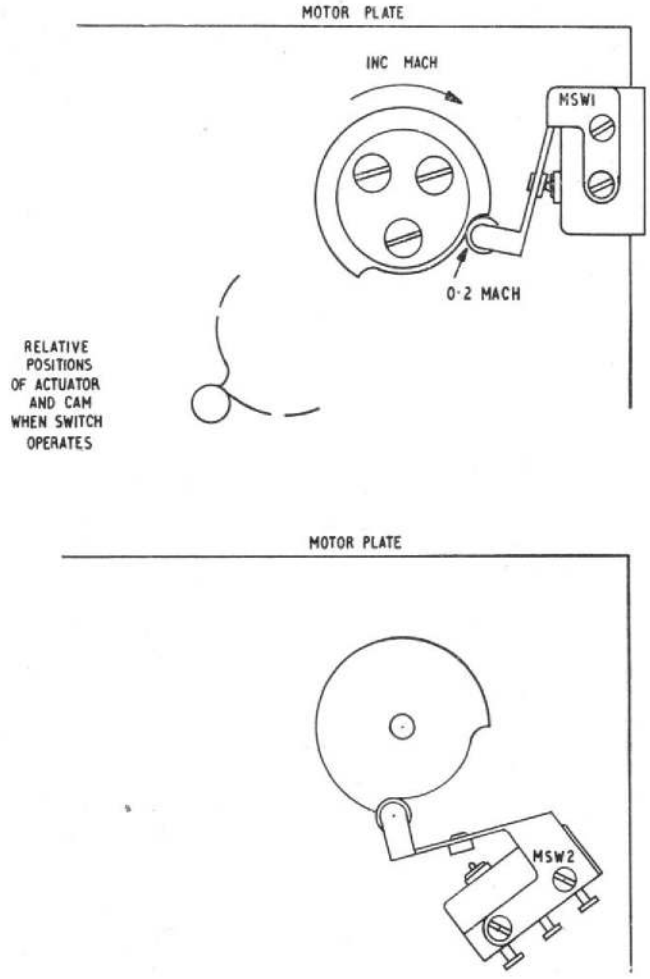


Fig. 7. Adjustment of Mach No. output gearbox microswitches MSW1 and MSW2 from underside

indicates a short circuit (i.e. the microswitch is closed).

61. Remove the multimeter.

Alighting gear warning light switch (MSW2)

62. Set test set, Type 9B T4 to 4036; G1 should come to rest at a reading of 99883. Check that the relative positions of the cam and microswitch actuator of MSW2 are as shown in fig. 7. If necessary release the cam clamp and set the cam and actuator to this position.

63. Decrease the setting of T4 until the U/C SWITCH L.P.1 on the ADTP of test set 9B is extinguished. The G1 reading should not be less than 99853.

64. Increase the setting of T4 until the U/C SWITCH L.P.1 lights. The G1 reading should not be greater than 99913.

65. If necessary repeat from para. 62 until a satisfactory condition is obtained, i.e. the microswitch closing and opening within a G1 reading of 99883 $\pm$ 30 divisions.

66. Switch S1 test set, Type 9B to OFF and replace the Mach No. output gearbox.

RATE OF CLIMB (R/C) GEARBOX (G2)

67. Remove the R/C gearbox from the computer without disturbing the cable-form. Switch S1 test set, Type 9B to ON. The gearbox should servo to a null.

68. If the gears run continuously or do not run at all, proceed to the servo amplifier checks.

69. Connect the valve voltmeter across capacitor C1 (Chap. 7, fig. 21) ensuring that the earth terminal of the meter is connected to the upper terminal of C1. Switch the meter to the 10V range and read the meter; this should not exceed 5V.

70. Switch the meter to the 100V range and rotate the 200T gear of axis 2a (fig. 8) clockwise by hand to increase the meter reading to 40V. To achieve this it should not be necessary for the 60T pinion of axis 1 meshing with the 200T gear of axis 2a to rotate more than 2 revolutions. Allow the servo unit to return to the null and with a soft pencil mark the position of the 200T gear of axis 2a.

Note . . .

Do not use a ball pen to mark the position of the gear.

71. Repeat the procedure of para. 70 turning the 200T gear of axis 2a counter-clockwise. The meter reading should be the same within three quarters of a revolution of the pinion and the 200T gear when returned to the null should be within 5° of the clockwise position.

72. If any of the checks of para. 69 to 71 fail, proceed to the servo amplifier checks.

73. Set S5 test set, Type 9B to 1000 UP; this should cause the 200T gear of axis 2a to rotate clockwise.

74. Set test set, Type 9B S5 and S1 to OFF, and replace the R/C gearbox.

VERTICAL SPEED (V/S) OUTPUT GEARBOX (G4)

75. Remove the vertical speed gearbox from the computer without disturbing the cable-form. Switch S1 test set, Type 9B to ON. The gearbox should servo to a null.

76. Check that when the 150T gear of axis 2 (fig. 9) is displaced one turn against the servo action and released it makes one overshoot in each direction only before becoming stationary. If necessary RV1 (Chap. 7, fig. 23) should be adjusted to achieve this condition.

77. Connect a valve voltmeter across capacitor C1 (Chap. 7, fig. 23) ensuring that the earth terminal of the meter is connected to the end of

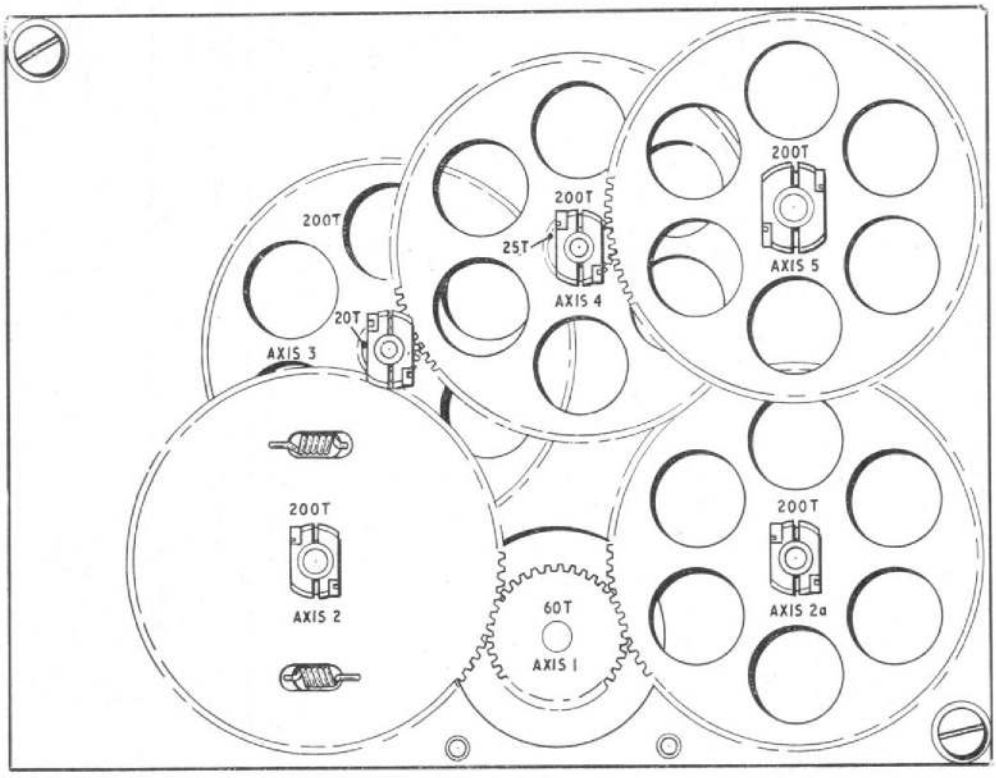


Fig. 8. Rate of climb gearbox (G2)—underside (pre-mod. ADS/80)

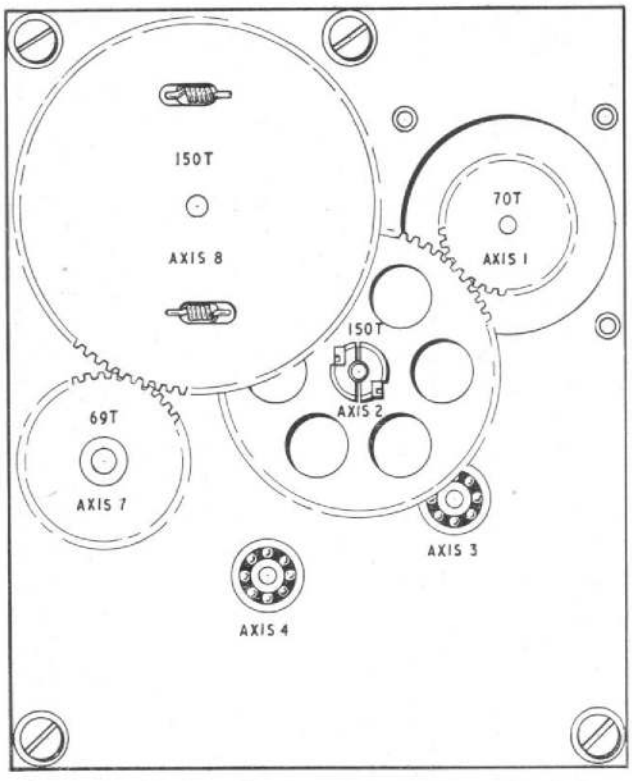


Fig. 9. Vertical speed gearbox (G4)—underside

the capacitor beneath the preset potentiometer bracket. Switch the meter to the 10V range and read the meter; this should not exceed 5V.

78. Switch the meter to the 100V range and rotate the 150T gear of axis 2 clockwise by hand to increase the meter reading to 40V. To achieve this, it should not be necessary for the 70T pinion of axis 1 meshing with the 150T gear of axis 2, to rotate more than 5 revolutions. Allow the servo to return to the null, and with a soft pencil mark the position of the 150T gear of axis 2.

Note . . .

Do not use a ball pen to mark the position of the gear.

79. Repeat the procedure of para. 78 turning the 150T gear of axis 2 counter-clockwise. The meter reading should be the same within half a revolution of the pinion and the 150T gear when returned to the null should be within 5° of the clockwise position.

80. If any of the checks of para. 75 to 79 fail, proceed to the servo amplifier checks.

81. Rotate the 200T gear of axis 2a of the R/C gearbox (G2) about 5 turns clockwise; this should cause the 150T gear of axis 2 of the V/S gearbox to rotate clockwise.

Balance of position feedback potential (RV4)

82. In computers of serial number 132/63 and below the potential for RV4 is derived from the 9·5V (X) and (Y) supplies; the circuit for this is shown in Chap. 7, fig. 34.

83. In computers of serial numbers 133/63 and above the rate of climb (UP) potential of +9V d.c. is obtained from TA6 pin d and the rate of dive (DOWN) potential of –6V d.c. is obtained from TA6 pin j (fig. 10).

84. In order to compensate for these differences in potentials the value of RV2 and RV3 for units of serial number 133/63 and above has been increased to 2·5K: a 1K resistor (R84) has been incorporated in the +9V line and a 470 ohm resistor (R85) in the –6V line. Two voltage stabilizing Zener diodes are connected between pins 16 and 17 of the gearbox interconnection tag-board. The output from RV4 is taken from pin 15 of the gearbox interconnection tag-board to pin 20 of the R/C gearbox interconnection tag-board and thence via a resistance chain R10 and R11, decoupled by C9, to the emitter of VT1 in the rate of climb shaping unit.

Serial 132/63 and below

85. Connect a multimeter set to the 10V range, between pins 11 and 12 of RV4/RV5, switch S1 test set, Type 9B to ON and adjust RV2 to give a meter reading of between 7·5 and 8·5V. Switch S1 to OFF.

86. Connect the multimeter set to the 10V range, between pins 13 and 12 of RV4/RV5, switch S1 test set, Type 9B to ON and adjust RV3 to give a meter reading of the same value as that attained in para. 85 within ±0·1V.

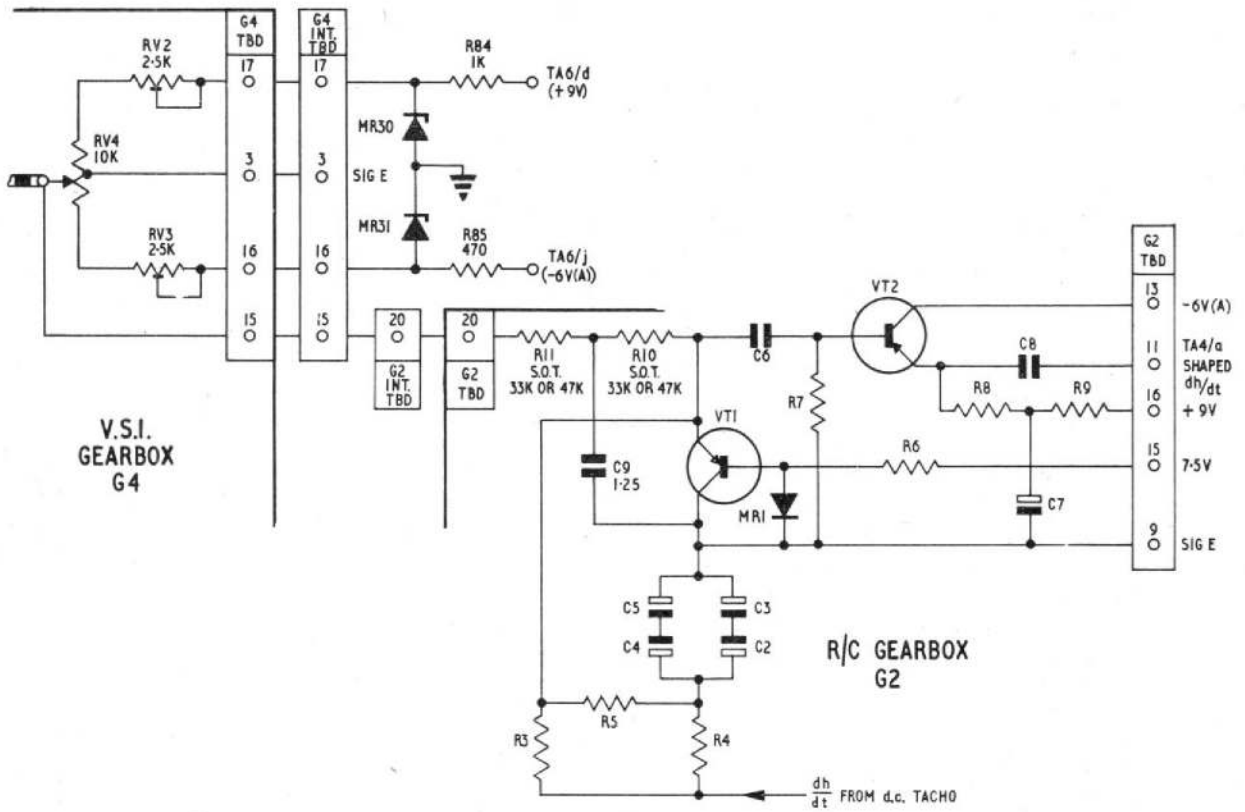


Fig. 10. Vertical speed position feedback circuit—post serial number 132/63

Serial 133/63 *and above*

87. Connect a multimeter set to the 10V d.c. range, between pins 11 and 12 of RV4/RV5, switch S1 test set, Type 9B to ON and adjust RV2 to give a meter reading of 2·4 ± 0·05V. Switch S1 to OFF.

88. Connect the multimeter set to the 10V d.c. range, between pins 13 and 12 of RV4/RV5; switch S1 test set, Type 9B to ON and adjust RV3 to give a meter reading of 2·4 ± 0·05V.

Limit stops

89. Check that the mechanical stop on the lower 150T gear of axis 6 (Chap. 7, fig. 25) is approximately 180° away from the stop on the motor plate; if it is not, proceed as follows:—

(1) Release the three screws clamping potentiometer RV4/RV5 to the component plate.

(2) Rotate the ganged potentiometer until the stop on the gear plate and the motor plate are correctly positioned.

(3) Refasten the clamping screws.

90. Rotate the R/C gearbox (G2) by hand to drive the V/S gearbox (G4) against the stop; release the rate of climb gearbox and the V/S gearbox should return to the position where the gear stop and motor plate stop are approximately 180° apart. Repeat this test driving the V/S gearbox in the opposite direction.

91. If the gearbox remains against the stop with the motor running and the clutch slipping, further adjustment as in para. 89 is required to alter the position of the gear stop relative to the motor plate stop.

Synchro torque transmitter (TX1)

92. Check that cam CU10 and follower are positioned as shown in fig. 11. If they are not proceed as follows:—

(1) On units pre-mod. ADS/97 release the clamp locking the cam and rotate the cam to the correct follower position. Reclamp the cam.

(2) On units post-mod. ADS/97 release the three clamping screws on RV4/RV5 and rotate the potentiometer until the follower takes up the correct position in relation to the cam. Reclamp the potentiometer and repeat from para. 89 until a satisfactory set of adjustments has been made.

93. Set S4 test set, Type 9B to VS and check that G1 reads 00000 ± 35 divisions; if the G1 reading is out of tolerance release the three screws clamping the synchro (Chap. 7, fig. 23) and rotate TX1 until the G1 reading is within tolerance. Refasten the clamps.

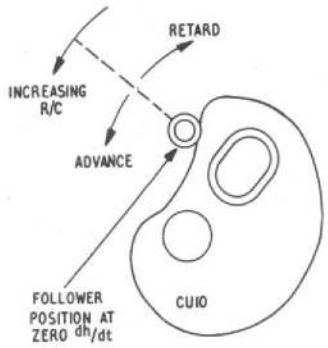


Fig. 11. Adjustment of vertical speed cam CU10

94. Set S5 test set, Type 9B to 3000 UP and note the G1 reading when the gearbox comes to rest. Repeat with S5 set to 3000 DOWN.

95. If the two readings are within 20 divisions of each other the position of the cam is satisfactory; if the difference is more than 20 divisions proceed as follows:—

(1) 3000 UP the greater, advance the cam follower of CU10 as shown in fig. 11.

(2) 3000 DOWN the greater, retard the cam follower of CU10 as shown in fig. 11.

(3) Repeat from para. 93 until a satisfactory result is obtained.

96. Carry out the computer serviceability tests of App. 2 in relation to vertical speed synchro outputs.

97. If the results obtained are out of tolerance set S5 to the position which gives the greatest error on G1 and then adjust as follows:—

(1) On units of serial number 132/63 and below adjust RV1 of the R/C gearbox to bring the G1 reading within tolerance.

(2) On units of serial number 133/63 and above check the values of R10 and R11 in the R/C gearbox and if correct adjust TX1 as detailed in para. 92 and 93 to bring the G1 reading within tolerance.

98. Repeat para. 96 and 97 until a satisfactory set of readings has been obtained.

Vertical speed for SS (RV5)

99. If alterations have been made to the setting of RV4/RV5 as in para. 89 the output from RV5 may well have been affected.

100. Carry out the standard serviceability test of App. 2, in relation to vertical speed for SS. If the results obtained are outside the permitted

tolerances, set S5 (test set, Type 9B) to the position producing the greatest error, unscrew the three screws on the side of RV4/RV5 and turn the RV5 portion, without disturbing the setting of RV4, until the G1 reading is within tolerance. Tighten the potentiometer screws.

101. Repeat the procedure of para. 100 until all G1 readings are within tolerance.

Note . . .

If the conditions of para. 101 *cannot be satisfied then RV*4/*RV*5 *must be changed and the procedure from para.* 82 *repeated.*

102. Switch off, disconnect any subsidiary test equipment and replace the gearbox.

TEMPERATURE GEARBOX (G6)

103. Remove the temperature gearbox from the computer without disturbing the cable-form.

104. Disconnect pins 2, 3, 4, 9 and 14 from the gearbox tagboard. Connect the universal bridge across each trimmer potentiometer RV5, RV6 and RV7 in turn and set them up as follows:—

(1) RV5—150 ohms.

(2) RV6—510 ohms.

(3) RV7—150 ohms.

Reconnect pins 2, 3, 4, 9 and 14 of the gearbox tagboard.

105. Set test set, Type 9B S1 to ON and S6 to 0·4. The gearbox should servo to a null.

106. Check that when the 200T gear of axis 2 (fig. 12) is displaced one turn against the servo action and released it makes only one overshoot in each direction before coming to rest. RV1 (Chap. 7, fig. 15) should be adjusted if necessary to achieve this.

107. Connect the valve voltmeter set to the 10V range across capacitor C1 (Chap. 7, fig. 15) ensuring that the earth terminal of the meter is connected to the end of the capacitor nearer the motor tachogenerator. The voltage should not exceed 5V.

108. Switch the meter to the 100V range and rotate the 200T gear of axis 2 clockwise by hand to increase the meter reading to 40V. To achieve this, it should not be necessary for the 20T pinion of axis 1 meshing with the 200T gear of axis 2, to make more than 5 revolutions. Release the 200T gear and with a soft pencil mark its position when returned to rest.

Note . . .

Do not use a ball pen to mark the position of the gear.

109. Repeat the procedure of para. 108 turning the 200T gear of axis 2 counter-cockwise. The result should be the same within half a revolution of the pinion, and the 200T gear when released should come to rest within 5° of the clockwise reading.

110. If any of the checks of para. 105 to 109 cannot be satisfied proceed to the servo amplifier checks.

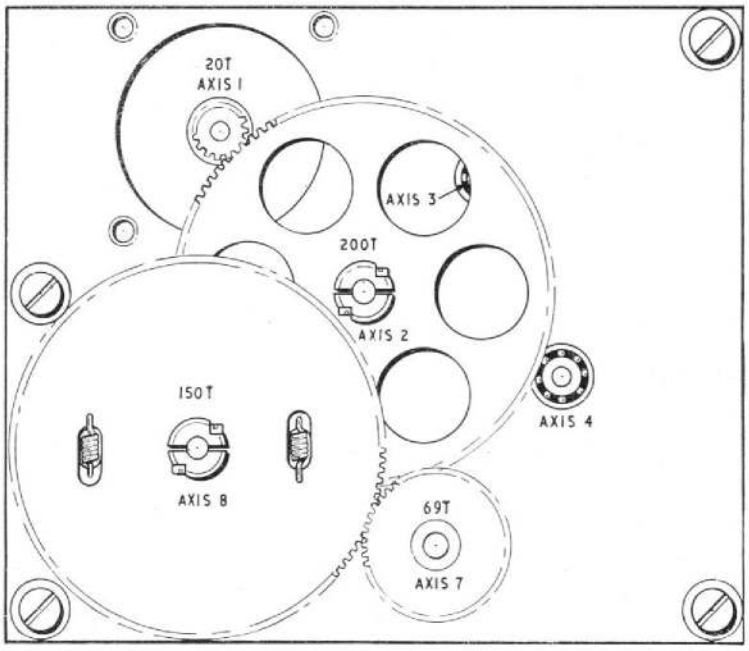


Fig. 12. Temperature gearbox (G6)—underside

Cam CU7 follower (1/2 log Ti)

111. Increase the setting of S6 test set, Type 9B from 0·4 to 0·5 and 0·6; the follower of CU7 should move in a counter-clockwise direction round the cam.

112. Set S6 to 0·4 and check that the follower of CU7 comes to rest in a position approximating to that shown in fig. 13. If it does not, release the three 6 B.A. screws clamping RV3 (Chap 7, fig. 15) and turn the potentiometer until cam CU7 and follower are positioned correctly. Reclamp the potentiometer.

113. Check the 20V balance.

Check of output from RV4

114. Connect up subsidiary test equipment as shown in fig. 1 with the wander lead connected to pin 3 of RV4. Set S6 test set, Type 9B to 0·4, the dividing box to 9840 and switch the dividing box to 20V (X). The valve voltmeter should register a null; RV2 (Chap. 7, fig. 15) should be adjusted if necessary to obtain this null.

115. Connect the wander lead to pin 12 of the gearbox tagboard and S6 to –60°. The valve voltmeter should register a null with the dividing box set to 7882. If it does not, release the three 6 B.A. screws clamping RV4 and turn RV4 until the meter registers a null. Reclamp the potentiometer.

116. Set S6 to each of the positions shown in col. (b) of Table 2. The valve voltmeter should register a null with the dividing box set to the appropriate value shown in col. (c) of Table 2 within ±10 divisions.

117. If the readings obtained are out of tolerance, switch off the dividing box and repeat from para. 112 moving the cam follower a few degrees clockwise or counter-clockwise until a satisfactory set of readings is obtained.

118. Switch S1 test set, Type 9B to OFF, disconnect all subsidiary test equipment and replace the gearbox.

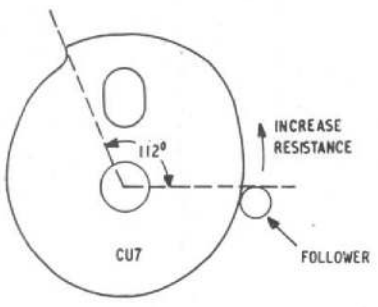


Fig. 13. Adjustment of 1/2 log Ti cam CU7 from underside

TRUE AIR SPEED OUTPUT GEARBOX (G7)

119. Remove the T.A.S. gearbox from the computer without disturbing the cable-form.

120. Switch S1 test set, Type 9B to ON; the gearbox should servo to a null.

121. Check that when the 200T gear of axis 2 (fig. 14) is displaced one turn against the servo action and released it makes only one overshoot in each direction before coming to rest.

122. Connect the valve voltmeter set to the 10V range across capacitor C1 (Chap. 7, fig. 17), ensuring that the earth terminal of the meter is connected to the end of the capacitor nearer the motor-tachogenerator and read the meter. The voltage should not exceed 5V.

123. Switch the meter to the 100V range and rotate the 200T gear axis 2 clockwise by hand to increase the meter reading to 40V. To achieve this it should not be necessary for the 20T pinion of axis 1 meshing with the 200T gear of axis 2 to rotate more than 5 revolutions. Release the 200T gear and with a soft pencil mark its position when returned to rest.

Note . . .

Do not use a ball pen to mark the position of the gear.

124. Repeat the procedure of para. 123, turning the 200T gear of axis 2 counter-clockwise. The result should be the same to within half a revolution of the pinion, and the 200T gear when released should come to rest within 5° of the clockwise reading.

125. If any of the checks of para. 119 to 124 fail, proceed to the servo amplifier checks.

T.A.S. synchro output

126. Connect up subsidiary test equipment as shown in fig. 1 and connect the wander lead to pin 15 of the gearbox tagboad. Set the dividing box to 8325 and switch the dividing box to 20V (Y). RV2 (Chap. 7, fig. 18) should be adjusted if necessary until the valve voltmeter registers a null. Switch off the dividing box and disconnect the wander lead.

127. Set test set, Type 9B T4 to 5060, S5 to OFF and S6 to 0·4; check that the follower of CU11 is approximately in the position shown in fig. 15. If necessary release the three 6 B.A. screws clamping RV4 (Chap. 7, fig. 17) and turn the potentiometer until the follower is in the correct position. Reclamp the potentiometer.

128. Set S4 test set, Type 9B to TAS, and check that G1 registers 00232 ± 16 divisions. If necessary release the three 6 B.A. screws clamping CX1 (Chap. 7, fig. 17) and turn the synchro until G1 registers correctly.

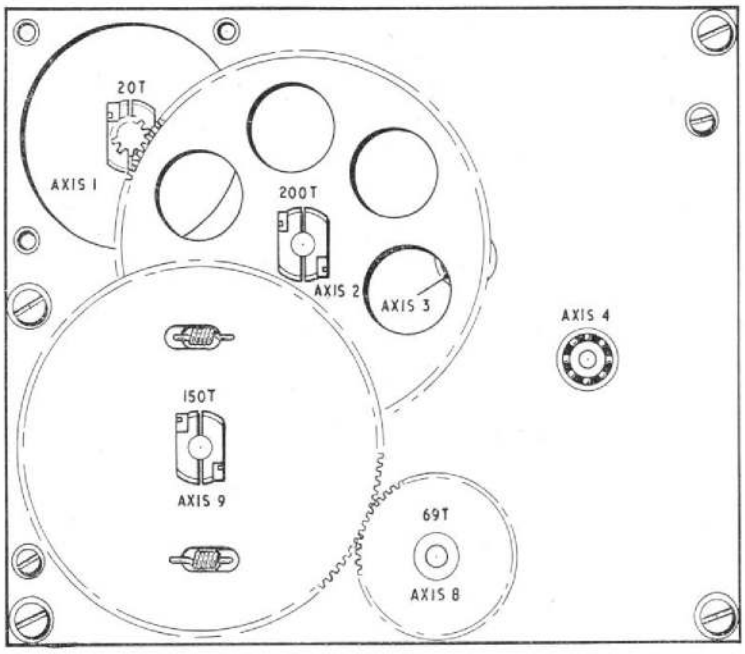


Fig. 14. True air speed gearbox (G7)—underside

129. Carry out the standard serviceability test of App. 2, in relation to TAS synchro outputs.

130. If the readings obtained are out of tolerance proceed as follows:—

(1) Set S6 to 1·0 and T4 to 7218.

(2) Adjust RV4 if necessary until G1 indicates 01660.

(3) Set S6 to 0·4 and T4 to 5060.

(4) Hold the gear train with one hand and rotate the cam follower of CU10 with the other until G1 registers 00232 ± 2 divisions.

(5) Repeat from sub-para. (1).

(6) When the G1 readings at both 0·4M and 1·0M are correct, repetition of the standard serviceability test should show all readings to be in tolerance.

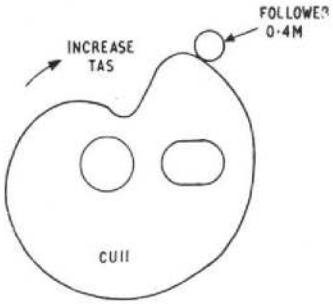


Fig. 15. Adjustment of T.A.S. cam CU11 from underside

131. If incorrect readings still occur repeat from para. 126. If results are still faulty then the Mach No. channel should be checked before changing the synchro or testing the servo amplifier.

T.A.S. for B.J. (RV5)

132. Carry out the standard serviceability test of App. 2 in respect of TAS for BJ.

133. If the readings obtained are out of tolerance set test set, Type 9B, T4 to 6654 and S6 to 0·8. Release the three 6 B.A. screws clamping RV5/RV6 (Chap. 7, fig. 17) and turn the complete potentiometer until the G1 reading is within the tolerance of the figures specified in the test set, Type 9B, calibration chart, Table 1 for that test point. Reclamp the potentiometer.

134. Repeat the procedure of para. 132. If the readings obtained are still out of tolerance repeat para. 133 adding in a portion of the tolerance error at the 0·8 position.

135. Repeat para. 134 until a satisfactory set of readings is obtained.

T.A.S. for S.S. (RV6)

136. Carry out the standard serviceability test of App. 2 in respect of TAS for SS.

137. If the readings obtained are out of tolerance then the position of RV6 relative to that of RV5 must be altered. Set test set, Type 9B T4 and S6 to the positions which give the greatest error, unscrew the three screws on the side of the potentiometer and turn RV6, without disturbing RV5, until the G1 reading is within tolerance. Tighten the potentiometer screws.

138. Repeat the procedure of para. 136 and 137 until a satisfactory set of readings is obtained.

139. In order to check that RV5 has not been moved repeat the procedure of para. 132 to 135.

Note . . .

If the conditions of para. 138 *cannot be satisfied then RV5/RV6 must be changed and the procedure from para.* 132 *repeated.*

140. Remove any subsidiary test equipment. Switch off test set 9B S1 and replace the true air speed gearbox.

SERVO AMPLIFIER CHECKS

General

141. Switch S1 test set, Type 9B to OFF, disconnect pin N of the magnetic amplifier of the servo amplifier under test and connect the multimeter set to the 10mA d.c. range between pin N and the loose wire. Switch S1 to ON.

142. Rotate the appropriate gear (Table 3) against the servo action in both directions. Rotation of the pinion meshing with the gear through not more than the number of revolutions in col. (e) of Table 3 in either direction should produce an indicated current of 4mA on the multimeter.

Transistor amplifier power supplies

143. If the tests of para. 141 and 142 fail, check the power supplies at the transistor amplifier. Values are as follows:—

(1) Between pins j and c, from $-5\frac{1}{2}$V to -9V d.c.

(2) Between pins h and c, from $-5\frac{1}{2}$V to -9V d.c.

(3) Between pins d and c, from +8V to +11V d.c.

Note . . .

Pin c should connect to signal earth.

Ring bridge demodulators

144. Check the reference supply to the ring bridge demodulator of the servo amplifier under test (Table 4). In each instance the voltage should be 15 ± 0.9V.

145. If the checks of para. 143 and 144 are within tolerance, switch off the power supplies and measure the resistance of each of the demodulator diodes, using the multimeter set to the ohms ÷100 range. The resistance should be 15 to 25 ohms in one direction and 40 to 50 ohms in the other.

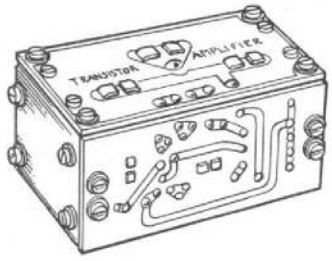
146. If the test of para. 145 is satisfactory then the transistor amplifier must be checked in detail.

Transistor amplifier—detailed checks

147. The transistor amplifier (Chap. 7, fig. 1 and 2) must first be removed from the computer. Access to components is gained by removing the 6 B.A. and/or 8 B.A. ch. hd. screws retaining the printed circuits to the main mechanism assembly. The printed circuits can now be folded back (fig. 16).

148. The complete circuit should be checked to ensure that it conforms to the relevant portion of Chap. 7, fig. 5 and the printed circuits should be examined to check that no part of the copper strip has lifted from the glass-fibre board.

149. Using the multimeter set to the ohms × 100 range measure the insulation between the chassis (main mechanical assembly) and pins a, d, e, h and j, and also between pins a and e. In each case the insulation resistance should be greater than 20 megohm. Should this test fail a wiring fault exists, the transistor amplifier should be changed and a repeat made from para. 141.



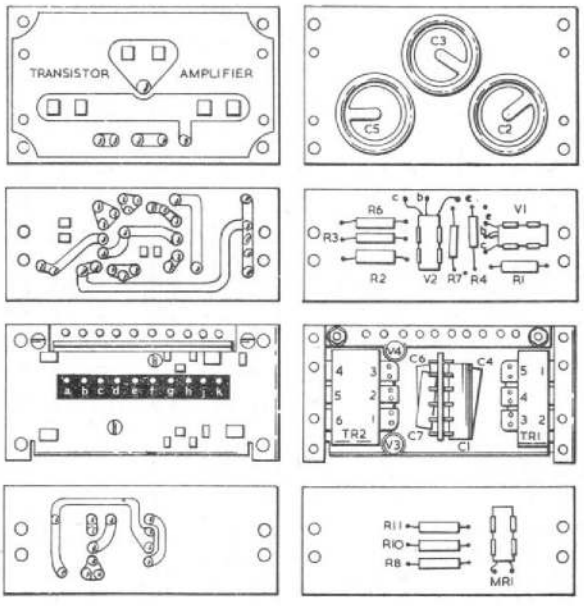


Fig. 16. Transistor amplifier stripped for testing

150. Connect SK1 of transistor amplifier (TA) test equipment (fig. 17) to PL4 of test set, Type 9B SDP and connect the transistor amplifier to the terminal board of TA test equipment. Switch test set, Type 9B S1 and TA test equipment S1 to ON and TA test equipment S2 and S3 to OFF. The TA test equipment meter indications should be as follows:—

Meter	Reading (mA)
M1	3·325 to 5·625
M2	5·2 to 7·8
M3	5·6 to 10·4

151. Switch TA test equipment S3 to 1·5V. M3 should indicate not greater than 45mA.

152. Switch TA test equipments S3 to 0·2V and note the reading of M4. Switch TA test equipment S2 to 1·2K. The reading of M4 should be 0·375 to 0·625 of the original reading.

153. Switch TA test equipment S2 to OFF and note the reading of M4. Switch TA test equipment S3 to 0·4V and 1·5V and note the reading of M4 at each position. Readings should be as shown in Table 5.

154. (1) Should any of the tests of para. 150 to 153 fail then the values of individual components should be tested in the normal manner.

(2) If any component other than those listed in sub-para. (3) is found to be faulty, that component should be changed and the procedure from para. 150 repeated.

(3) If any of the following components are found to be faulty the transistor amplifier is to be changed and the procedure from para. 141 repeated:—

(a) C2, C3 and C5.

(b) T1 or T2

(c) VT3 or VT4.

Magnetic amplifier

155. Connect a valve voltmeter set to the 100V range across C1 of the gearbox associated with the servo amplifier under test and repeat the procedure of para. 141 and 142. When the multimeter indicates 4mA the valve voltmeter should indicate more than 30V in either direction.

156. If the check of para. 155 fails then check the power supplies at the magnetic amplifier, which should be as follows:—

(1) Between pins J and H from 80V to 90V a.c.

(2) Between pins G and H from 80V to 90V a.c.

(3) Between pins K and H from –28V to –35V d.c.

Note . . .

Pin H should connect to bias earth.

157. If the test of para. 156 is satisfactory then the magnetic amplifier should be changed and the procedure from para. 155 repeated.

158. On completion of the servo amplifier checks return to the appropriate gearbox tests.

TABLE 1

Log Mach No. gearbox (G1) RV11 output—1/2 log (1+0·2KM²)

Item (a)	T4 setting (b)	Mach No. (c)	Dividing box (d)	Tolerance (e)
1	4430	0·3	0025	
2	5060	0·4	0046	
3	5555	0·5	0075	
4	5972	0·6	0112	
5	6330	0·7	0144	±20 divisions
6	6654	0·8	0176	
7	6947	0·9	0219	
8	7218	1·0	0267	
9	7470	1·1	0315	

TABLE 2

Temperature gearbox (G6) RV4 output

Item (a)	S6 setting (b)	Dividing box (c)	Tolerance (d)
1	0·4	8380	±10 divisions
2	0·5	8400	
3	0·6	8429	
4	0·7	8466	
5	0·8	8503	
6	0·9	8556	
7	1·0	8599	
8	1·1	8649	
9	–60°	7882	
10	+80°	8624	

TABLE 3

Servo amplifier checks—gear rotation for 4mA transistor amplifier gain

Item (a)	Servo amp. (b)	Gearbox (c)	Gear (d)	No. of revolutions of meshing pinion (e)
1	SA2	Log Mach (G1)	200T Axis 2	4
2	SA5	Mach No. o/p (G5)	200T Axis 2	5
3	SA1	Rate of climb (G2)	200T Axis 2a	5
4	SA4	V/S o/p (G4)	150T Axis 2	5
5	SA6	Temperature (G6)	200T Axis 2	5
6	SA7	True air speed (G7)	200T Axis 2	5

TABLE 4

Servo amplifier checks—ring demodulator reference supply (15V) test points

Item (a)	Servo amplifier (b)	Transformer (c)	Pins (d)
1	SA2	T2	C and E
2	SA5	T1	C and E
3	SA1	T2	F and H
4	SA4	T1	F and H
5	SA6	T3	C and E
6	SA7	T3	F and H

TABLE 5

Transistor amplifier gain checks

Item (a)	TA test equipment S3 (b)	M4 reading (mA) (c)
1	0·2V	3·5 to 10mA
2	0·4V	7·0 to 20mA
3	1·5V	17·5 to 28mA

TABLE 6

Split clamp loading torques

Item (a)	Size of clamp screw (b)	Mild steel torque (c)	High tensile stainless steel torque (d)
1	12B.A.	0·645 kg.cm.	0·850 kg.cm.
2	10B.A.	1·230 kg.cm.	1·900 kg.cm.
3	8B.A.	3·125 kg.cm.	6·000 kg.cm.
4	6B.A.	3·750 kg.cm.	—

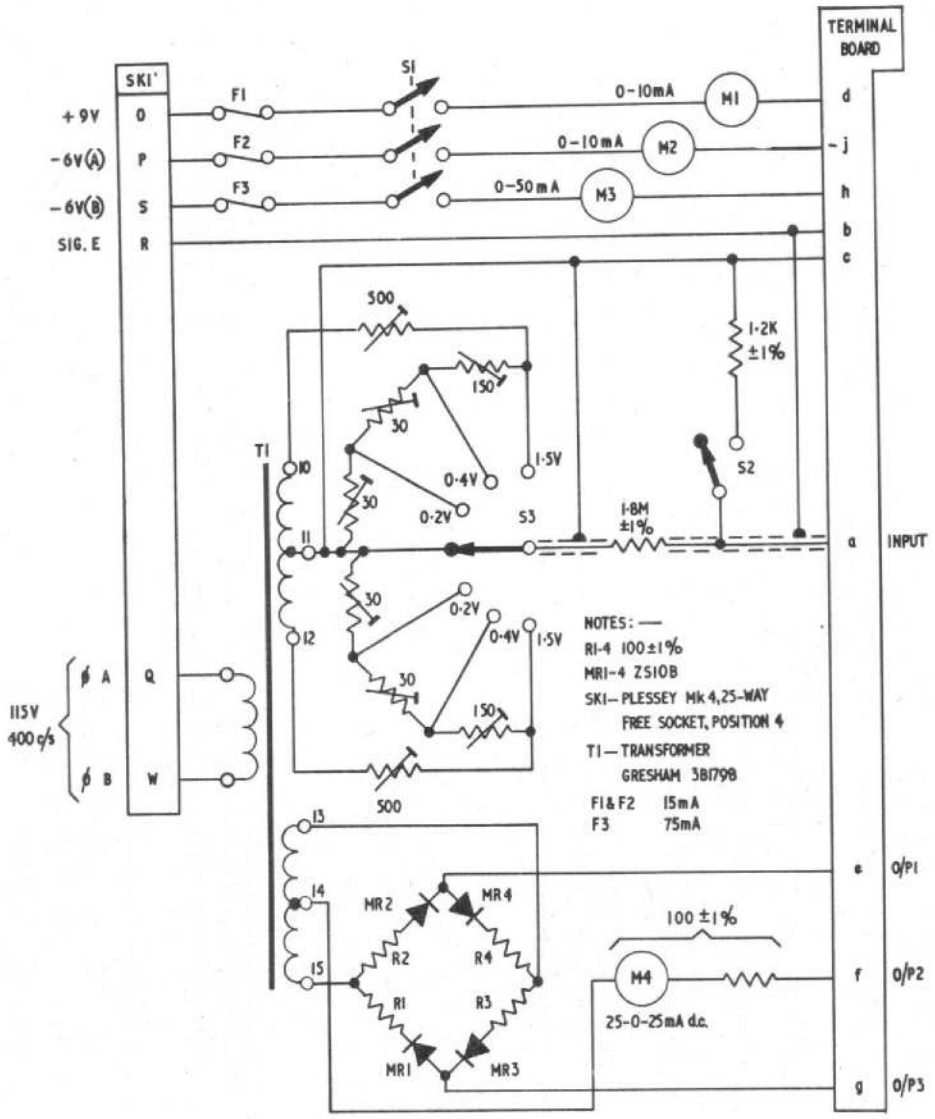


Fig. 17. Transistor amplifier test equipment—circuit diagram

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