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SERVO-POTENTIOMETER (SERVO-POT) TYPE S.144 SERIES

GENERAL AND TECHNICAL INFORMATION

BY COMMAND OF THE DEFENCE COUNCIL

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FOR USE IN THE ROYAL NAVY

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LIST OF CHAPTERS

Chapter 1—0

SERVO-POTENTIOMETER (SERVO-POT), TYPE S.144 SERIES

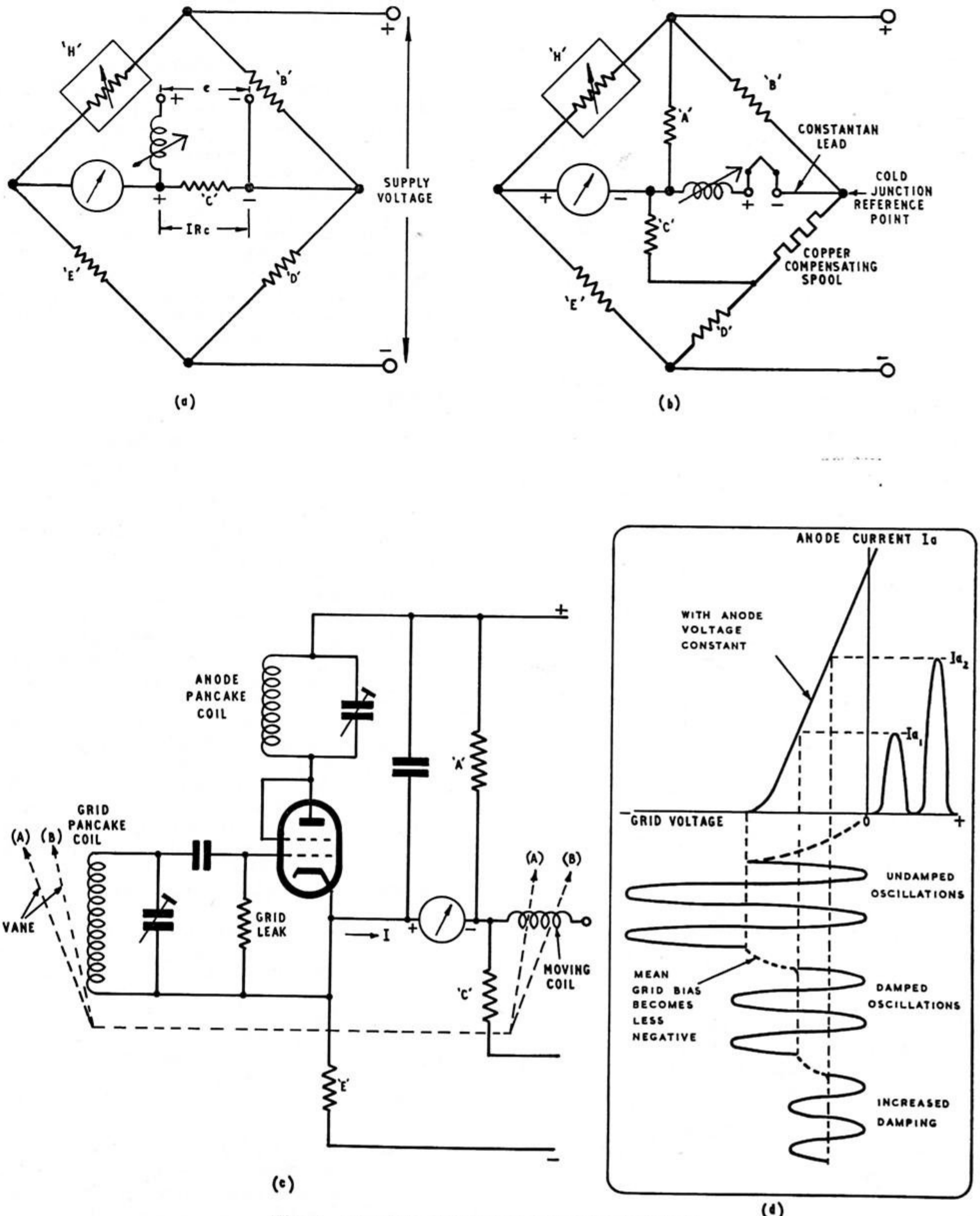

Fig. 1. Principle of bridge and electronic circuit

Introduction

1. This chapter deals with the basic Servopotentiometer, (SERVO-POT S.144, Forms 3 and 4). Each SERVO-POT has a manufacturer's code number which is made up of three parts. A typical code is S.144.4.53 where S.144 is the model number, 4 is the 'form' (i.e. d.c. or a.c. version) and 53, the suffix number, represents the application of the particular variant.

2. Subsequent chapters of this information unit contain information apertaining to calibration, testing, internal circuit diagram and particular information.

3. The complete system consists of a SERVO-POT, standard A.M. thermocouples, and a circular scale indicator. It is used, in aircraft with jet-engine power units, to provide an indication of the temperature of the exhaust gas, in order that the engine may be operated under conditions of maximum efficiency, and to ensure that the safe working temperature under various conditions is not exceeded.

4. Two forms of SERVO-POT (d.c. or a.c.), each with an anti-vibration mounting, are in Service use, The d.c. version, (form 3), installed in earlier systems and used for indication only, is suitable for connecting up to three indicators in series without loss of accuracy; this version is now superseded by an a.c. system (form 4), for use in conjunction with indication and temperature control systems.

5. The essential function of the SERVO-POT is to provide a high output, from a low millivolt input generated by the thermocouples, for the operation of a calibrated indicator. Basically this is a self-balancing potentiometer in the form of an electronically balanced measuring bridge circuit, with a negligible input current.

6. D.C. versions of the SERVO-POT are not suitable for use in conjunction with temperature control systems. With the measuring circuit connected direct to the 28-volt d.c. supply, grounded thermocouples cause circulation currents and a consequent voltage drop; any voltage loss from the thermocouple output will upset the millivolt/degree calibration. The a.c. version measuring circuit is isolated from the 115-volt, 400c/s, a.c. supply by means of a transformer, permitting insulated or grounded thermocouples to be used for temperature control applications.

7. The advantage, with this system, is that with varying output loads up to 1500 ohms permissible, the necessity for long runs of compensating cable is alleviated and since, when balanced, negligible current flows in the bridge circuit, the system is independent of input resistances up to 100 ohms; therefore, heavy compensating leads to the indicator are not required.

8. In normal use the system comprises one indicator per SERVO-POT, with a four-thermocouple assembly when used for indication only, and an eight-thermocouple assembly when used for both indication and temperature control. Training aircraft, however, may have two indicators per SERVO-POT, using the same thermocouple arrangement.

9. The thermocouples used are of the standard A.M. Type B6 (Ref. No. 6A/3578) and a description is given in A.P.112G-0602—1.

10. The indicators are suitably calibrated milliammeters. In earlier systems the Sangamo Weston S.78 indicator was used, but this has been superseded by the S.149 Form 3. The same indicator is used in the d.c. and a.c. systems, and in fig. 4 and fig. 5, the indicators are shown reading the minimum temperature of 40 deg. C. This setting (40 deg. C) represents the cold junction temperature of the thermocouple, and is the normal internal temperature of the SERVO-POT. The increased temperature is caused by the valve and the other components and is the no-input current condition of the SERVO-POT. Details of the indicators are given in A.P.112G-0508—1.

Principle

11. The operation of the SERVO-POT is based on controlling the effective impedance of a valve oscillator by means of a permanent magnet moving coil system in which the pointer has been replaced by a vane which can move towards, or away from, a small pancake coil; this coil is the grid coil in the oscillator circuit.

12. Basically the system consists of a balanced bridge network comprising three resistors B, D and E, and an electronic element designed to operate as a variable d.c. resistance H, fig. 1(a). The vane of the moving coil system controls the effective resistance of H; the position of the vane determining the degree of balance of the bridge. Assume that, until a potential 'e' is applied to the circuit consisting of the moving coil and resistance C, the vane is in such a position that the bridge is balanced. When potential 'e' is applied to the input, a small current flows in the circuit and the vane moves nearer the pancake coil, unbalancing the bridge and causing a current to flow across the centre of the bridge through resistor C and the series indicator. The voltage developed across resistor C is proportional to the current flowing across the centre of the bridge; this current increases until the potential difference across resistor C balances the millivolt input 'e'. Under these conditions no current flows in the loop circuit consisting of the moving coil and resistor C. Consequently, provided resistor C is constant, the current flowing through the indicator is directly proportional to the input millivolts.

13. When the SERVO-POT is used in conjunction with a thermocouple over a wide range of ambient temperatures; it is necessary to provide compensations for variations in the temperature of the reference junction.

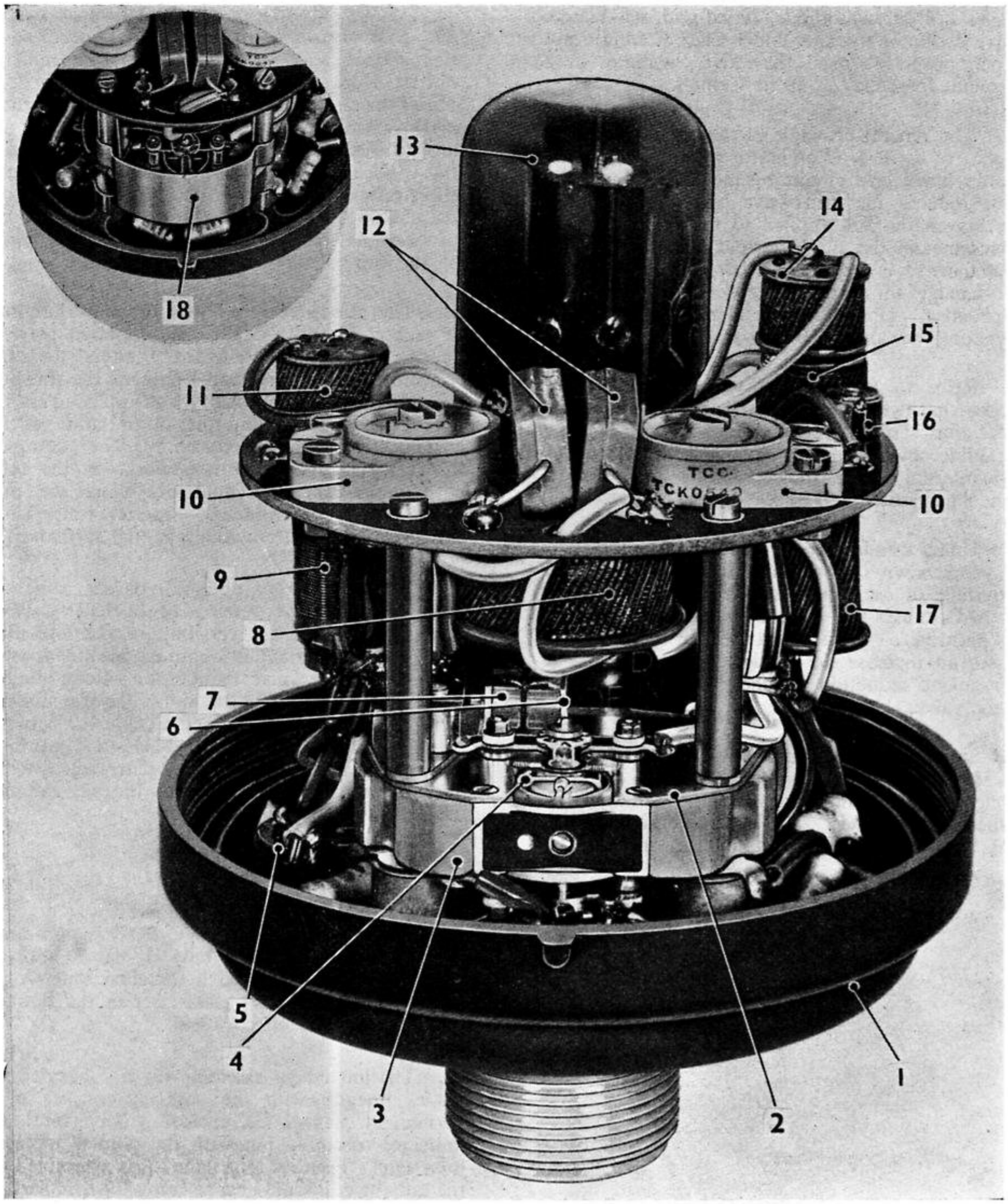

Fig. 2. Servo potentiometer, d.c. version, cover removed

14. This is achieved by means of a built-in temperature sensitive bridge consisting of three resistor elements A, B and C, having negligible temperature coefficients, and a temperature-sensitive compensating element in the form of a copper spool, fig. 1(b). The reference junction of the thermocouple is made at the copper spool, so that any variations in temperature affect the thermocouple and the compensating element equally. Therefore, as the ambient temperature varies, this bridge supplies a small voltage to compensate for the change in the reference junction potential. A constantan cable, between the cold junction and negative of the thermocouple, completes the compensating requirement with the copper spool, for the nickel-chromium/nickel-aluminium junction of the thermocouple.

15. The electronic oscillator element, fig. 1(c), which operates as a variable d.c. resistance consists of a tuned-anode, tuned-grid, self-biased, valve oscillator working under Class C conditions. When properly tuned the valve oscillates at a resonant frequency of 38 to 40 mc/s.

16. The general principle of the circuit, fig. 1(c), is that of a Class C oscillator in which damping of the tuned grid circuit by means of a metallic vane reduces the grid drive and, consequently, the automatic bias applied to the grid. This in turn increases the anode current of the valve and, as the valve is fed from a constant h.t. supply, the change in current represents a change of impedance. Under varying degrees of damping, therefore, the valve behaves as a variable resistance.

17. Refer to fig.1(d); the valve characteristics shows that with the oscillations undamped the valve biases itself almost to cut-off, and passes negligible anode current giving a condition of high internal d.c. resistance. Under these conditions the circuit would be set for zero output.

18. Under conditions of medium damping with the vane shown at position A, fig.1(c), the reduced amplitude of oscillations shown as DAMPED in fig. 1.(d), causes the grid d.c. potential to become less negative. This, due to the valve characteristic causes an increase in anode current I_{a1} and a consequent reduction in the internal resistance of the valve,

19. Similarly, under conditions of INCREASED DAMPING, fig. 1(d), with the vane in position B, fig. 1(c), the amplitude of the oscillations is reduced still further. The d.c. potential on the grid becomes less negative, and an increase in anode current I_{a1} results, causing a further reduction in internal resistance.

20. Summarizing; an increase or decrease of temperature, causes a change in the millivolt output from the thermocouple, which in turn varies the current in a moving coil. A proportionately varying torque rotates the moving coil and an attached vane; the approach of recession of the vane in relation on the grid inductance coil, effectively damps the oscillations. This controls the effective resistance of the valve and a current proportional to the input is fed across the centre of the bridge.

21. The anode current flows for less than half of each cycle and a capacitor, connected between anode and cathode, effectively alters the time constant of the circuit and lengthens the timebase of each wave of the positive half-cycle. This has the effect of improving the mean value of the current waveform produced. The complete SERVO-POT has several networks in the form of a choke and two capacitors which are used to suppress radio frequency interference. These can be seen in the circuit diagram (fig. 9, 10 and 11).

22. The principle of operation is the same for both the d.c. and a.c. versions of the SERVO-POT, except that in the a.c. version, the d.c. potential for the bridge circuit is obtained by means of a half-wave diode valve rectifier or silicon diodes. The circuit diagram, fig. 10, shows the transformer input to the rectifier valve and a capacitor between cathode and the negative rail. This is a precautionary measure and should a fault occur, the capacitor provides a path to negative for the a.c. but not the d.c.

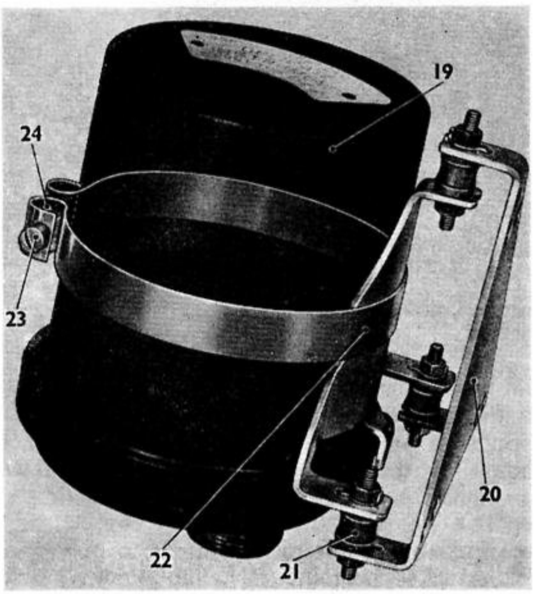

Fig. 3. Anti-vibration mounting, d.c. version

DESCRIPTION

SERVO-POT, d.c. version, Form 3

23. The d.c. version SERVO-POT is contained in a case consisting of a base (1, fig. 2) with an integral Cannon plug and a threaded outer cover (19, fig. 3). A rubber gasket, set in the bottom thread of the base, effects a seal.

24. The movement assembly (2) is supported on bosses integral with the base; it consists of a permanent magnet (3), enclosing a conventional indicator assembly but with the pointer replaced by a vane. The disc type vane (6) is assembled on the moving coil cross-arm to bring the disc surface at right-angles to the axis of the grid pancake coil (7). This coil and a terminal panel are mounted on a plate above the movement assembly (2). A magnetic shield (18), clipped onto two pillars, screens the movement assembly.

25. The fixed and variable components of the bridge circuit are secured to an insulated mounting plate as shown in fig. 2. Resistors A(17), B(8) and compensating spool (9) are mounted on the underside; on the upper surface are resistors C(14), D(11) and E(15), the two variable capacitors (10) of the tuned circuits, pancake coil (16) associ-

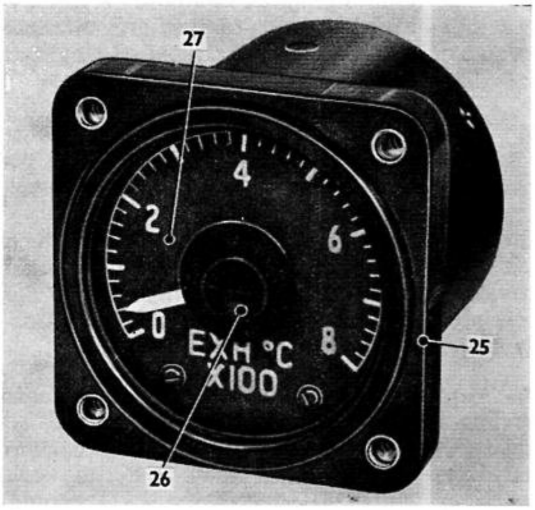

Fig. 4. Indicator, S78

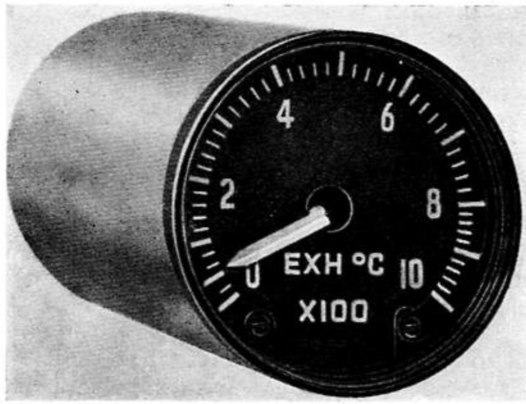

Fig. 5. Indicator, S149

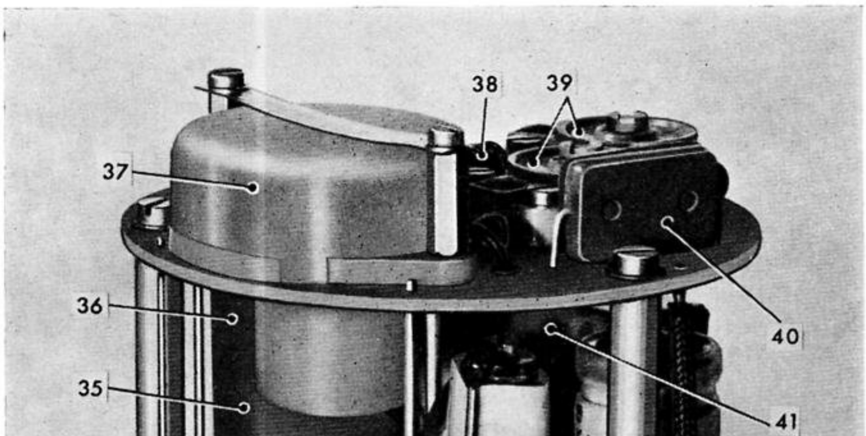

Fig. 6. SERVO-POT, a.c. version valve diode, cover removed

ated with the anode tuned circuit and two fixed capacitors (12); one maintains grid base and the other improves the mean value of the waveform.

26. Valve (13) is a tetrode, with the screen grid strapped to the anode so that valve functions as a triode; the valveholder and valve retainer are secured to the two posts integral with the base.

27. Situated in the well of the base are the grid bias resistor, several radio frequency suppressor networks and a spool type resistor F(5) which limits the valve heater supply voltage.

28. A typical circuit diagram for the d.c. SERVO-POT is shown in fig. 9, the component values given being common to all the range of these SERVO-POTS. Components values for a particular variant (i.e. 0 to 800 deg. C, 0 to 1000 deg. C etc.), are given in the relevant sub-chapter.

Anti-vibration mounting, d.c. version

29. This mounting, fig. 3, comprises a triangular plate (20) with seven holes to facilitate alternative fixing, a clamp-ring which is riveted to a mounting plate (22) and three absorber units (21).

30. The three absorber units (21) each consists of two threaded studs, moulded in resilient polystyrene, and fitted with two nuts and washers.

31. The triangular plate (20), which is intended as a permanent fitting on the aircraft, has a lug providing a locating position for the SERVO-POT; three other lugs, are each drilled to enable one of the absorber units to be assembled to it.

32. Mounting plate (22) also has three corresponding lugs with elongated holes, by means of which the plate is mounted on the absorber units. The clamp-ring is formed at its free end around two circular nuts (24) a special screw (23) providing

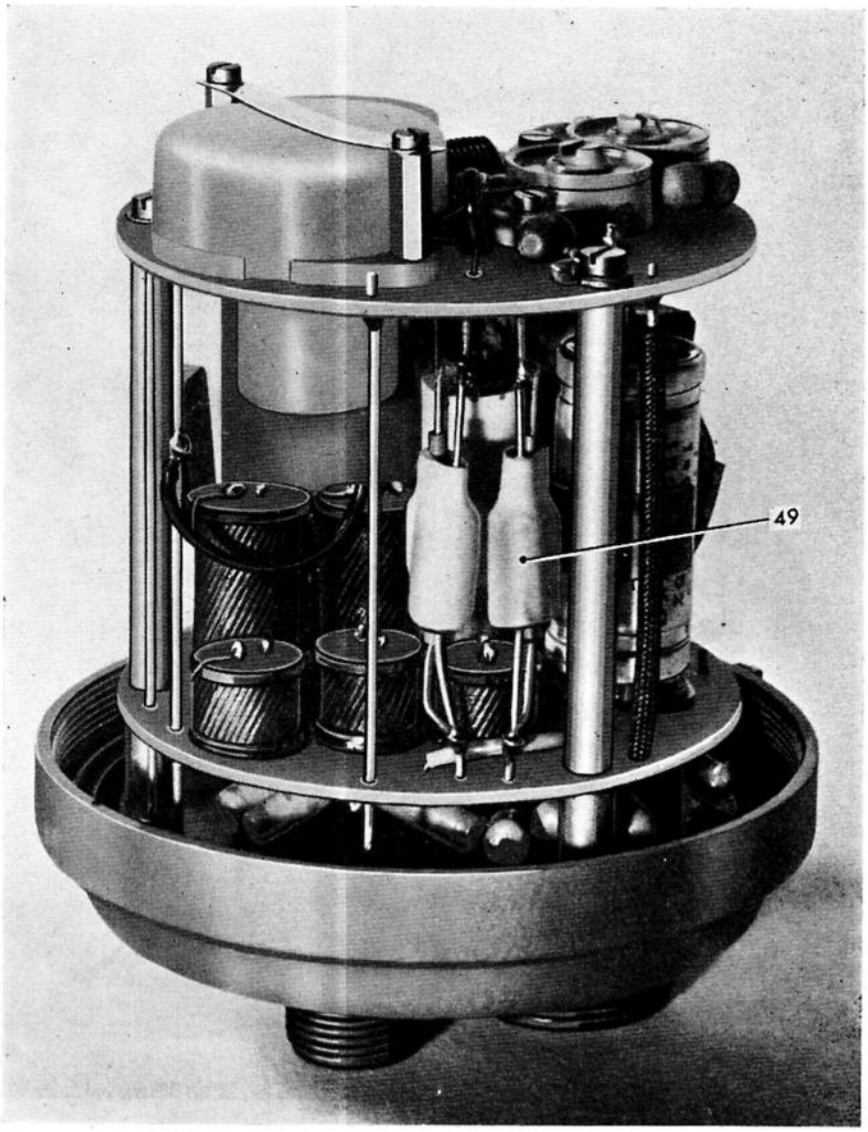

Fig. 7. SERVO-POT, a.c. version, silicon diode, cover removed

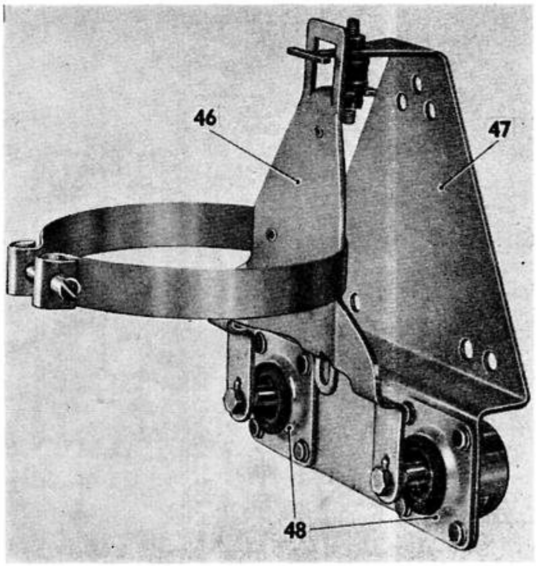

Fig. 8. Anti-vibration mounting, a.c. version

the means of securing the SERVO-POT in the clamp-ring.

SERVO-POT, a.c. version (valve diode) Form 4

33. This SERVO-POT, fig. 6. is contained in a case similar to that of the d.c. version but has a different anti-vibration mounting. In this version the bridge circuit is isolated from the mains supply by a transformer; d.c. is provided by diode rectification.

34. The components are assembled on three printed circuit mounting plate assemblies supported on pillars secured to tapped posts integral with the base (28).

35. The upper assembly plate carries a moulded nylon container (37) enclosing the moving coil and vane assembly, and the inductance pancake coil of the grid parallel tuned circuit; the container is held in position by a retaining spring secured to two support pillars on the assembly plate. Also assembled on the plate are two tuning capacitors

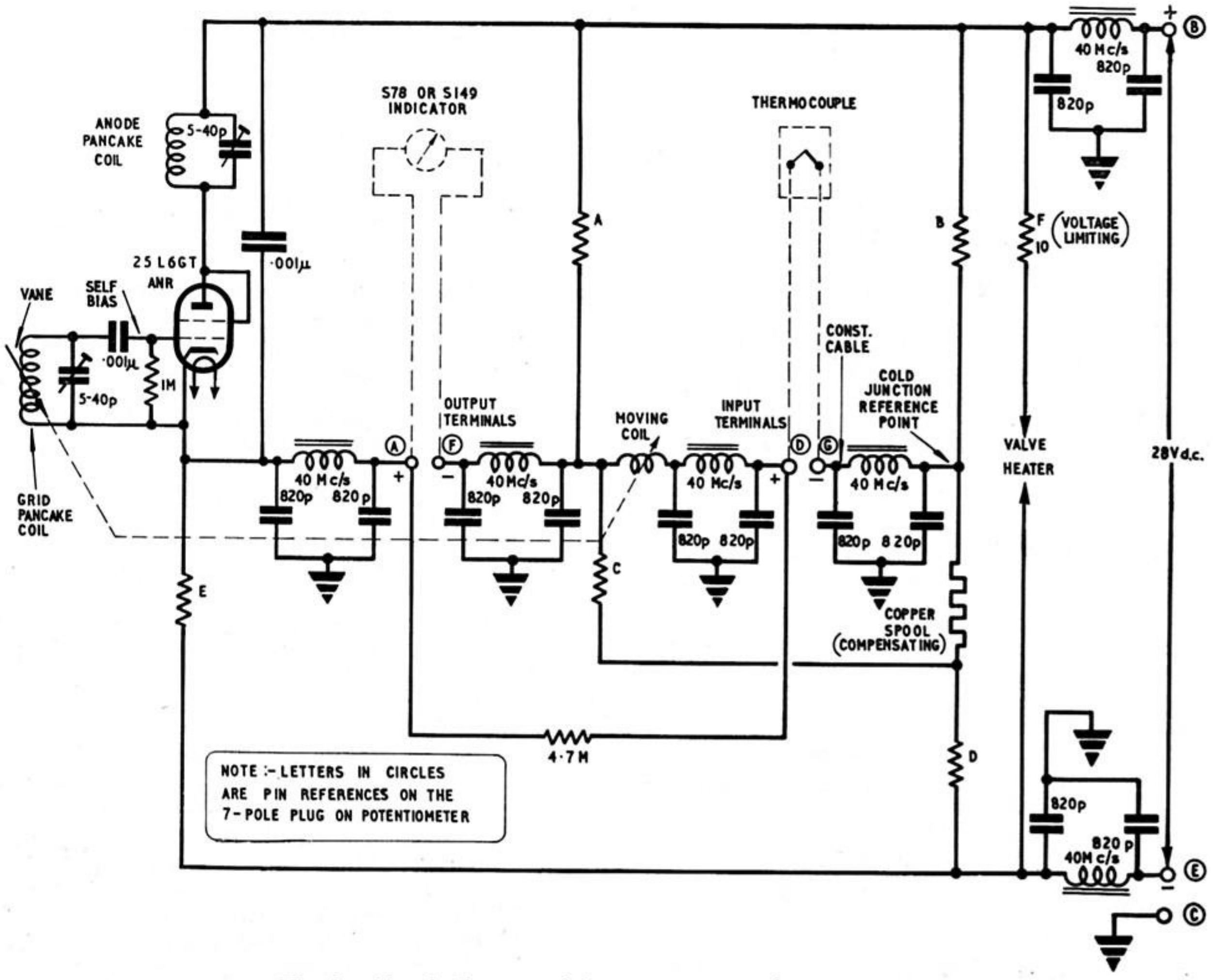

Fig. 9. Circuit diagram of d.c. servo—potentiometer system

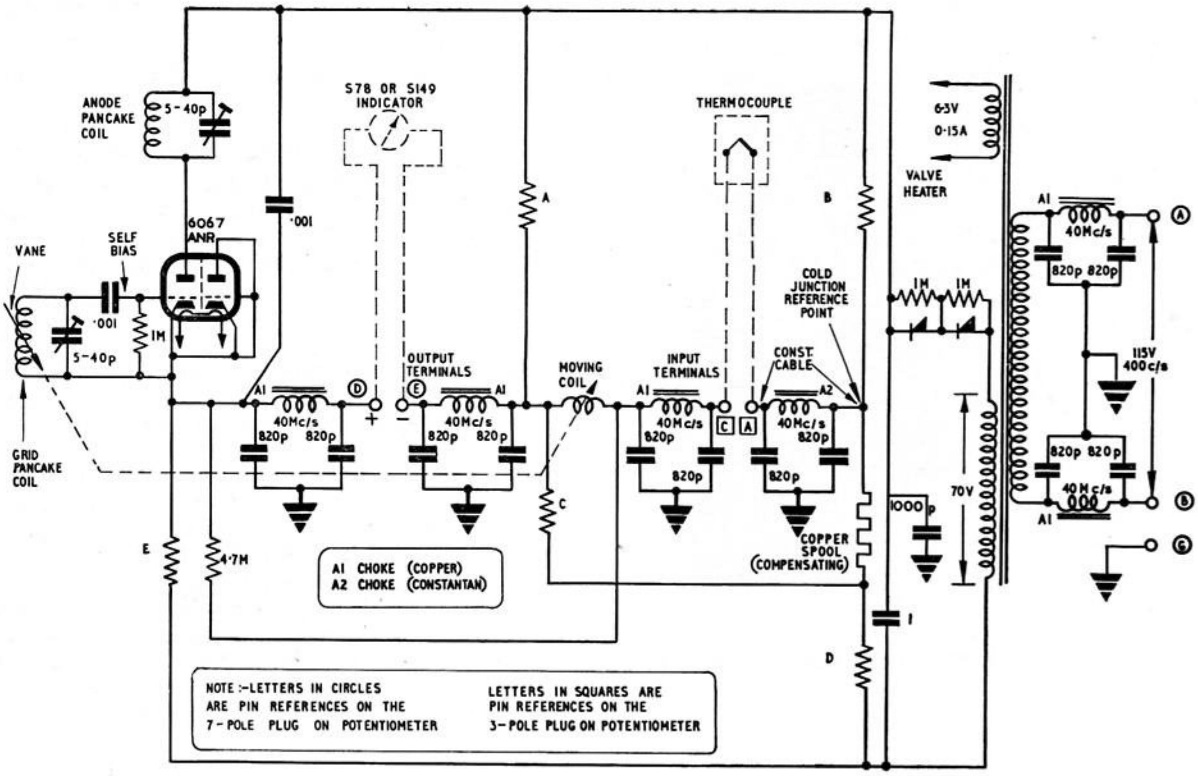

Fig. 10. Circuit diagram of a.c. servo potentiometer system (valve rectifier)

(39), a moulded mica capacitor (40) for improving the mean current value, a silvered mica grid bias capacitor (not shown) and an inductance coil (38) which is in the anode parallel tuned circuit.

36. Mounted on the centre assembly plate are resistors E(29), D(30), C(31), B(33), A(34) and the copper compensating spool (43), comprising the resistance element requirement for the compensating bridge. Also mounted on the centre assembly plate are the double triode valve (35) supported in a valveholder and fitted with a spring bayonet type valve retainer (36), transformer (41), d.c. blocking capacitor (42) held in a clip attached to the transformer, and the grid leak resistor (32).

37. The components of the interference suppressor networks are assembled on the lower assembly plate which is secured in the well of the base. (28).

38. All internal electrical connections between components or assembly plates are by means of cables or printed circuits. External connections to the SERVO-POT are made by means of two Cannon plugs one a 7-pole plug (44) utilizing poles A, B, D, E and G only, the other a 3-pole plug (45) using poles A and C only or connection to the thermocouple. A typical circuit diagram of the a.c. version (valve rectifier) SERVO-POT is given in fig. 10; the values of components given are common to all versions of the SERVO-POT, for circuit details of particular variants a list of component values is given in the relevant sub-chapter.

SERVO-POT, a.c. version (silicon diodes) Form 4

39. The information contained within the preceding para. 32 to 38 applies, in general, to the silicon diode version with the following exception:

(1) Silicon diodes (29) are used instead of the conventional glass envelope rectifying valve.

(2) The secondary voltage of the input transformer is 70 and 6·3 volts.

40. A general circuit for the silicon diode version is given in fig. 11. The value of spools A and C control the temperature range to which the SERVO-POT is applied. For circuit details of a particular variant, a list of components values is given in the relevant sub-chapter.

Anti-vibration mounting, a.c. version

41. This mounting consists of a shaped mounting plate (46, fig. 7) suspended at three points, on a triangular securing plate (47). Riveted to the lower portion of the securing plate are two spring absorbers (48). These absorbers consist of a cylindrical cap and face plate, with a central rod, to which a plate is attached, bearing on a spring inside the cap. A rubber ring, on the outer lip of the face plate, limits the return movement of the spring.

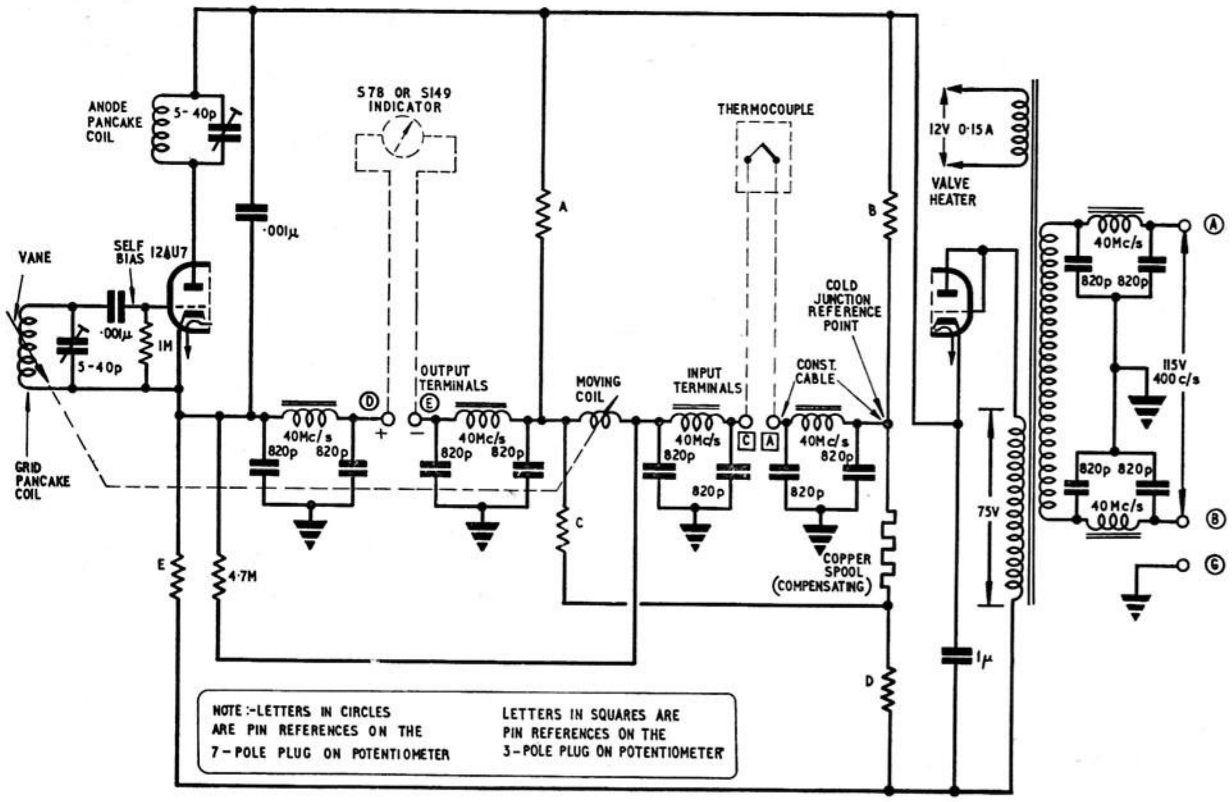

Fig. 11. Circuit diagram of a.c. servo—potentiometer system (silicon diode rectifier)

42. The lower portion of the mounting plate is held by screws to the rods of the absorber units, and the upper portion is secured to a third moulded absorber which is attached to the securing plate. A T-shaped projection of the securing plate protrudes through a slot in the mounting plate, thus limiting the forward and downward movement. Riveted to the mounting plate is a clamp-ring, whose free ends are formed around two circular nuts. A special screw, passing through the formed ends and nuts, clamps the SERVO-POT when it is located in the mounting.

Chapter 1-1

STANDARD SERVICEABILITY TESTS FOR SERVO-POTS, TYPE S.144 SERIES

INTRODUCTION

1. The tests laid down in this Chapter must be applied to the above equipment immediately prior to installation in aircraft and at any time that its serviceability is suspect.

METHOD OF TEST

2. The components should be mounted in the normal position, i.e. the SERVO-POT vertical with the connectors facing downwards.

TEST EQUIPMENT

3. The following test equipment is required:-

Item	Ref. No.
Cambridge Potentiometer, Type 44228	6C/1057081
Test Set, Exhaust Gas Thermometer	◀ 6C/4360563 ▶
Test Set, Multirange, No. 1	5QP/1057049
Thermometer, precision	◀ 6C/9432934 ▶
◀ Tester, insulation, Type C or Comark Mk.2	5G/9156675 5G/1112740 ▶
Themocouple of known accuracy	As in system
Indicator	As in system
Resistor 1,000 ohm, 0·5%, $\frac{1}{2}$W	10W/0222002
Block, terminal, 2-way	◀ 5CZ/1053794 ▶
Block, terminal, 6-way	5CZ/5093
Connector, (7-pole) HAN 3106E-16S-1S(D14)	◀ 5X/4501773 ▶
Connector, (3-pole) HAN 3106-10SL-3S	5X/12864

ELECTRICAL SUPPLIES

4. Dependent upon the type of system used, the following electrical supplies are required:-

(1) 28V d.c.

(2) 115V, 400Hz, 3-phase a.c. with the phase rotation A, B, C with B earthed. Poles A and B or B and C of the inverter are to be used.

BALANCE CHECK OF SERVO-POT MOVING COIL

5. Test the balance of the SERVO-POT moving coil as follows:-

(1) Connect the test circuit shown, either in fig. 1 for d.c. version, or fig. 2 for a.c. version. Ensure that the correct polarity is maintained. The thermocouple conductors are identified by RED, (positive) and BLUE, (negative) sleeves.

(2) Allow a period at least five minutes for the SERVO-POT to reach its working temperature.

(3) Standardize the Cambridge Potentiometer as described in the instructions supplied. Repeat the standardization as necessary to compensate for battery drift.

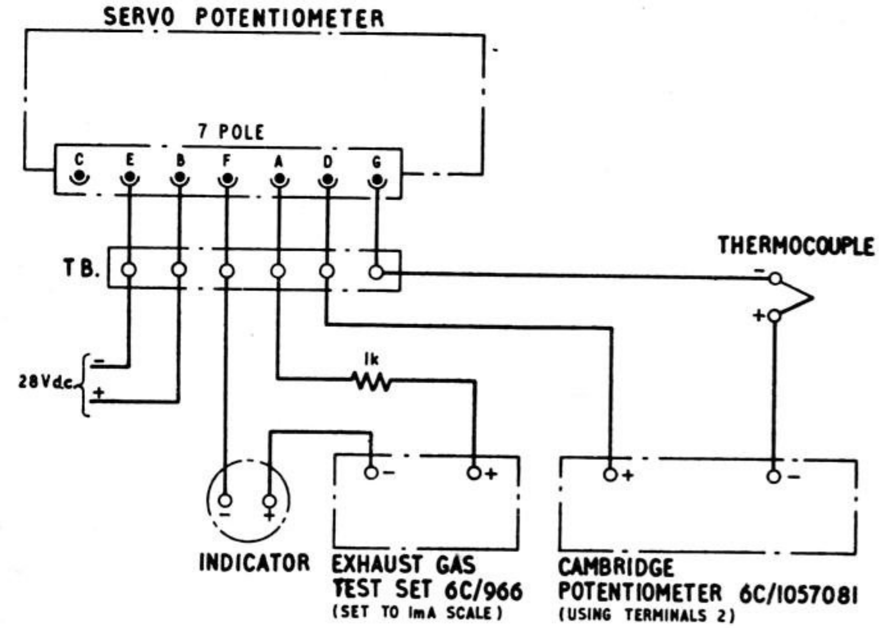

Fig. 1. Bench test circuit d.c. servo-pot

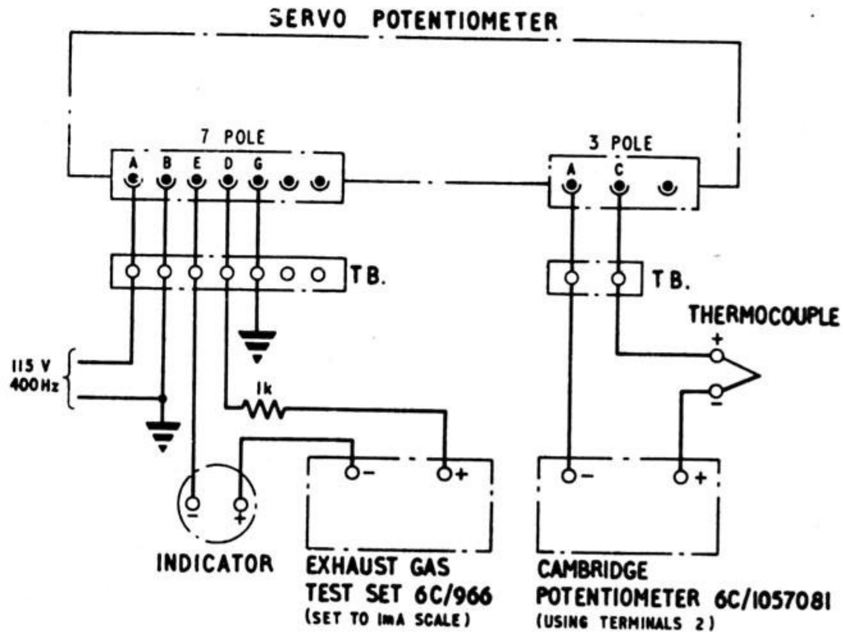

Fig. 2. Bench test circuit a.c. servo-pot

(4) Set the Exhaust Gas Thermometer Test Set Switch A to 1mA, and Switch B to 1mA.

(5) Set Cambridge Potentiometer Switch to Millivolt Supply.

(6) Set the Cambridge Potentiometer so as to give a half-scale reading on the thermometer test set.

(7) Place the SERVO-POT with its major axis horizontal (i.e. connectors towards the operator). Lightly tap the SERVO-POT and note the thermometer test set reading.

(8) Rotate the SERVO-POT 90 deg about its major axis and repeat operation (7). Again repeat operation (7) for each of the remaining 90 deg positions.

(9) Compare the thermometer test set readings obtained in each of the four ◀ operations (7) and (8). The readings must not differ by more than 0·005mA. ▶

(10) Replace SERVO-POT with the major axis vertical, i.e. with the connectors ◀ at the bottom. ▶

OUTPUT TEST OF SERVO-POT

6. Test the output of the SERVO-POT by means of the following operations:-

(1) Ascertain the ambient temperature at the thermocouple, using the precision thermometer.

(2) Subtract the millivolt equivalent of the thermocouple ambient temperature (Table 3) from 1·61mV (40°C).

(3) Set the resultant value of millivolts on the dials of the Cambridge Potentiometer.

(4) Adjust Millivolt Supply until, Galvamometer is nulled with Test Button pressed.

(5) Adjust the indicator pointer to SET ZERO.

(6) Test the SERVO-POT full range value for the particular variant under test, setting the Cambridge Potentiometer to the millivolt input value corrected for ambient temperature. Note the reading on the thermometer test set.

(7) Repeat operation (6) for each of the values shown in Table 1 or Table 2, as appropriate. The thermometer test set readings must be within ±0·008mA of those shown in the appropriate Table.

INSULATION TEST

SERVO-POT d.c. version

7. Test insulation resistance of the SERVO-POT, using the 250V insulation tester, between pins A, B, D, E, F and G and the metal base. The insulation resistance must not be less than 20 megohms.

TABLE 1

0 to 800 deg. C. range

Temperature deg. C.	Input millivolts	Output milliamps
0	0	-0·048
40	1·61	0
100	4·10	0·075
200	8·13	0·196
300	12·21	0·319
400	16·40	0·444
500	20·64	0·572
600	24·91	0·700
700	29·14	0·826
800	33·30	0·952

TABLE 2

0 to 1000 deg. C. range

Temperature deg. C.	Input millivolts	Output milliamps
0	0	-0·039
40	1·61	0
100	4·10	0·060
200	8·13	0·158
300	12·21	0·257
400	16·40	0·358
500	20·64	0·467
600	24·91	0·564
700	29·14	0·666
800	33·30	0·768
900	37·36	0·865
1000	41·31	0·961

SERVO-POT a.c. version

8. Test the insulation resistance of the SERVO-POT, using, the 250V insulation tester, between pins A, B, D and E of the 7 pin plug, and pins A and C of the 3 pin plug and the metal base. The insulation resistance must not be less than 20 megohms.

CONTINUITY CHECK

9. Use the Test Set, Multirange, No. 1, and test for continuity pin C (d.c. version) or pin G (a.c. version) and the metal base. The resistance must be 0 ohms.

TABLE 3

Temperature - millivolt equivalent for ambient temperature compensation

°C.	0	1	2	3	4	5	6	7	8	9	10
					mV						
-40	-1·50	-1·54	-1·57	-1·61	-1·64	-1·68	-1·72	-1·75	-1·79	-1·82	-1·86
-30	-1·14	-1·17	-1·21	-1·25	-1·28	-1·32	-1·36	-1·39	-1·43	-1·47	-1·50
-20	-0·77	-0·80	-0·84	-0·88	-0·92	-0·95	-0·99	-1·03	-1·06	-1·10	-1·14
-10	-0·39	-0·42	-0·46	-0·50	-0·54	-0·58	-0·62	-0·66	-0·69	-0·73	-0·77
- 0	-0·00	-0·04	-0·08	-0·12	-0·16	-0·19	-0·23	-0·27	-0·31	-0·35	-0·39
+ 0	0·00	0·04	0·08	0·12	0·16	0·20	0·24	0·28	0·32	0·36	0·40
10	0·40	0·44	0·48	0·52	0·56	0·60	0·64	0·68	0·72	0·76	0·80
20	0·80	0·84	0·88	0·92	0·96	1·00	1·04	1·08	1·12	1·16	1·20
30	1·20	1·24	1·28	1·32	1·36	1·40	1·44	1·49	1·53	1·57	1·61
40	1·61	1·65	1·69	1·73	1·77	1·81	1·85	1·90	1·94	1·98	2·02
50	2·02	2·06	2·10	2·14	2·18	2·23	2·27	2·31	2·35	2·39	2·43
60	2·43	2·47	2·51	2·56	2·60	2·64	2·68	2·72	2·76	2·80	2·85

Chapter 1—2

SERVO-POT, TYPE S144.3.43

Particular information

1. SERVO-POT Type S.144.3.43 has a range of 0-800 deg. C and is designed for use on a 28V d.c. supply, in conjunction with a nickel-chromium/ nickel-aluminium thermocouple. This variant is fitted with a tetrode valve the screen grid of which is strapped to the anode so that the valve functions as a triode amplifier.

Circuit and connections

2. The circuit diagram is shown in fig. 9 of Chapter 1—0 and connection to the SERVO-POT is by means of a 7-pole Cannon plug integral with the base; connections poles B and E d.c. input, D and G thermocouple input, A and F output to indicator and C earthed.

Component values

3. Resistance of spools

A	687·4 kilohms ± 340 ohms
B	490 ohms to 510 ohms (500 ohms nominal)
C	33·3 ohms ± 0·05 ohm
D	50·0 ohms ± 0·1 ohm
E	1·0 kilohm ± 10 ohms
F	10·0 ohms ± 1·0 ohm

Testing and calibration

4. When testing the SERVO-POT for serviceability proceed as detailed in Chapter 1—1.

Chapter 1—3

SERVO-POT, TYPE S144.4.38

Particular information

1. SERVO-POT Type S.144.4.38 has a range of 0-800 deg. C and is designed for use on a 115V a.c., 400 c/s supply, in conjunction with a nickel-chromium/nickel-aluminium thermocouple. This variant is fitted with silicon-diode rectifiers.

Circuit and connections

2. The circuit diagram is shown in fig. 11 of Chapter 1—0 and connection to the SERVO-POT is by means of a 3-pole and 7-pole Cannon plug integral with the base; connections (3-pole plug) poles A and C thermocouple input and (7-pole plug) poles A and B a.c. input, D and E output indicator, and G earthed.

Component values

3. Resistance of spools

A	234·5 kilohms ± 1·1 kilohms
B	11·172 kilohms to 11·628 kilohms (11·40 kilohms nominal)
C (Ranging spool)	33·3 ohms ± 0·05 ohm
D	300 ohms ± 3 ohm
E	2·0 kilohms ± 20 ohms

Testing and calibration

4. When testing the SERVO-POT for serviceability proceed as detailed in Chapter 1—1.

Chapter 1—4

SERVO-POT, TYPE S144.4.42 and 51

Particular information

1. SERVO-POT Type S.144.4.42 and 51 has a range of 0-1000 deg. C and is designed for use on a 115V a.c., 400c/s supply, in conjunction with a nickel-chromium/nickel-aluminium thermocouple. This variant is fitted with silicon-diode rectifiers.

Circuit and connections

2. The circuit diagram is shown in fig. 11 of Chapter 1—0 and connection to the SERVO-POT is by means of a 3-pole and 7-pole Cannon plug integral with the base; connections (3-pole plug) poles A and C thermocouple input and (7-pole plug) poles A and B a.c. input, D and E output to indicator, and G earthed.

Component values

3. Resistance of spools:

A	291·0 kilohms ± 1·4 kilohms
B	11·172 kilohms to 11·628 kilohms (11·40 kilohms nominal)
C (Ranging spool)	41·31 ohms ± 0·05 ohm
D	300 ohms ± 3 ohm
E	2·0 kilohms ± 20 ohms (4K ± 0·04 S144.4.51)

Testing and calibration

4. When testing the SERVO-POT for serviceability proceed as detailed in Chapter 1—1.

Chapter 1—5

SERVO-POT, TYPE S144.4.49

Particular information

1. SERVO-POT Type S.144.4.49 has a range of 0-800 deg. C and is designed for use on a 115V a.c., 400 c/s supply, in conjunction with a nickel-chromium/nickel-aluminium thermocouple. This variant is fitted with silicon-diode rectifiers.

Circuit and connections

2. The circuit diagram is shown in fig. 11 of Chapter 1—0 and connection to the SERVO-POT is by means of a 3-pole and 7-pole Cannon plug integral with the base; connections (3-pole plug) poles A and C thermocouple input and (7-pole plug) poles A and B a.c. input, D and E output to indicator and G earthed.

Component values

3. Resistance of spools:

A	234·5 kilohms ± 1·1 kilohms
B	11·172 kilohms to 11·628 kilohms (11·40 kilohms nominal)
C (Ranging spool)	33·3 ohms ± 0·05 ohm
D	300 ohms ± 3 ohm
E	2·0 kilohms ± 20 ohms

Testing and calibration

4. When testing the SERVO-POT for serviceability proceed as detailed in Chapter 1—1.

Chapter 1—6

SERVO-POT, TYPE S144.4.53

Particular information

1. SERVO-POT Type S.144.4.53 has a range of 0-800 deg. C and is designed for use on a 115V a.c., 400 c/s supply, in conjunction with a nickel-chromium/nickel-aluminium thermocouple. This variant is fitted with silicon-diode rectifiers.

Circuit and connection

2. The circuit diagram is shown in fig. 11 of Chapter 1—0 and connection to the SERVO-POT is by means of a 3-pole and 7-pole Cannon plug integral with the base; connection (3-pole plug) poles A and C thermocouple input and (7-pole plug) poles A and B a.c. input, D and E output to indicator, and G earthed.

Component values

3. Resistance of spools

A	234·5 kilohms ± 1·1 kilohms
B	11·172 kilohms to 11·628 kilohms (11·40 kilohms nominal)
C (Ranging spool)	33·3 ohms ± 0·05 ohm
D	300 ohms ± 3 ohm
E	1·4 kilohms ± 14 ohms

Testing and calibration

4. When testing the SERVO-POT for serviceability proceed as detailed in Chapter 1—1.

Chapter 1—7

SERVO-POT, TYPE S144.3.37

Particular information

1. SERVO-POT, Type S144.3.37 has a range of 0 to 1000 deg. C and is designed for use on a 28V d.c. supply in conjunction with a nickel-chromium/nickel-aluminium thermocouple. This variant is fitted with a beam tetrode valve (25L6GT) which functions as a triode amplifier.

Circuit and connections

2. The circuit diagram is shown in fig. 9 of Chapter 1—0 and connection to the SERVO-POT is by means of a 7-pole Cannon plug integral with the base. Connection are poles B and E d.c. input (B +ve, E −ve), D and G thermocouple input, A and F output to indicator and C earthed.

Component values

3. Resistance of spools:

A	85·28k ± 425
B	500 to 525
C	41·31 ± 0·05
D	50 ± 0·1
E	1k ± 10
F	10 ± 1

Testing

4. When testing the SERVO-POT for serviceability the SST detailed in Chapter 1—1 must be used.

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