Cancelled, now AP 113E-0502-1

Chapter 2

THROTTLE ACTUATOR AMPLIFIER, Ref. No. 6TE/4449 AND MOUNTING TRAY, Ref. No. 6TD/603

LIST OF CONTENTS

ILLUSTRATIONS

LIST OF APPENDICES

LEADING PARTICULARS

Throttle actuator amplifier	*Ref. No. 6TE/4449*
Overall dimensions	8·17 *in.* × 5·86 *in.* × 4·38 *in.*
Weight	5 *lb.* 10 *oz.*
Mounting tray	*Ref. No 6TD/603*
Overall dimensions	7·58 *in.* × 6·2 *in.* × 2·4 *in.*
Weight	0·5 *lb.*
Power supplies	115*V* 400 *c/s single phase* 28*V d.c.*

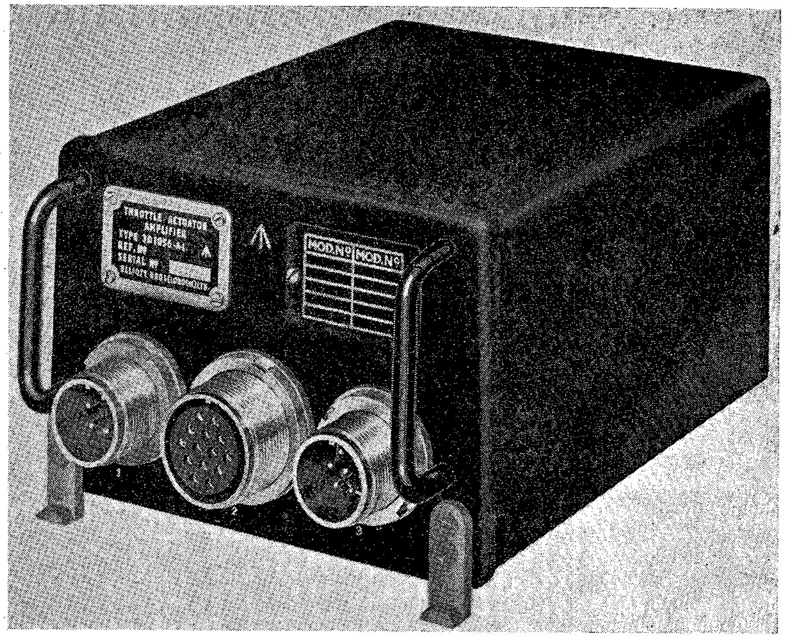

Fig. 1. Throttle actuator amplifier

Introduction (fig. 1 and 2)

1. The main requirements for the Sea Vixen auto-throttle system is to regulate the speed of the aircraft to a constant landing datum speed during the final approach. Full details of the servo system will be found in A.P.4343K, Vol. 1, Sect. 1, Chap. 2, but basically the fundamental requirement is achieved by a throttle servo loop, consisting of a throttle actuator, and throttle actuator amplifier, which controls the thrust of the aircraft's port engine through the pilot's throttle linkage.

2. The throttle actuator amplifier receives two controlling input signals. The first regulates the speed of the aircraft by a comparison with a fixed air speed datum, and the second produces changes of thrust to compensate for changes in elevation angle. These signals are amplified within the unit by three magnetic amplifiers. The output from the third magnetic amplifier is applied directly to the control winding of the throttle actuator control motor.

THROTTLE ACTUATOR AMPLIFIER

General

3. The unit (fig. 1) consists of a single chassis enclosed by a removable cover

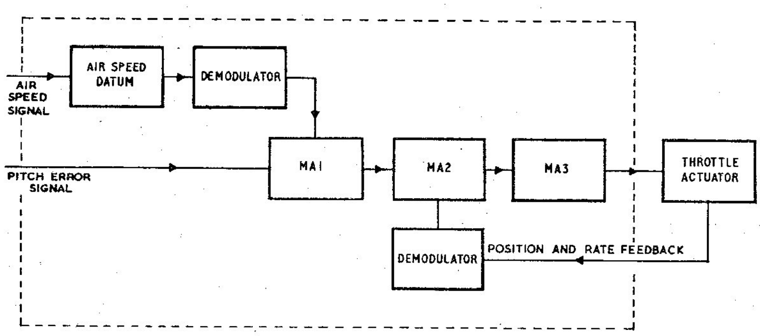

Fig. 2. Block diagram

which slides over the chassis from the rear and is fastened at the back by two captive slot-nuts. Two handles on the front panel facilitate withdrawal of the amplifier from its mounting tray, and also serve as carrying handles. The amplifier is held in the mounting tray by two knurled screw clamps which engage on two lugs at the front of the unit.

4. The amplifier is connected to other units in the system through two UK-AN plugs, and one socket, mounted on the front panel. A 7-way plug connects the air speed datum, and relay box via a test point in the cockpit (navigators side); a 5-way plug connects direct to the air speed datum, and relay box, and a 14-way socket connects to the throttle actuator via a bulkhead plug, and socket.

5. Mounted upon the amplifier chassis (fig. 3 and 4) are three magnetic amplifiers MA1, MA2 and MA3, four transformers T1, T2, T3 and T4, an a.c. pick-off with a fixed armature, and three preset variable resistors. The magnetic amplifier MA3 is mounted upside down and is recessed below the level of the main chassis. Various circuit components are mounted beneath the chassis, these include eight silicon diodes which are fixed to the side of the recess containing the magnetic amplifier MA3. Four silicon diodes, three resistors, and a capacitor are mounted on a component panel above the magnetic amplifier MA3.

Preset controls (fig. 3)

6. Three preset controls are mounted on the chassis adjacent to MA1, and are marked SPEED GEARING, GLIDE DECREASE, and FEEDBACK respectively. The GLIDE DECREASE preset control is

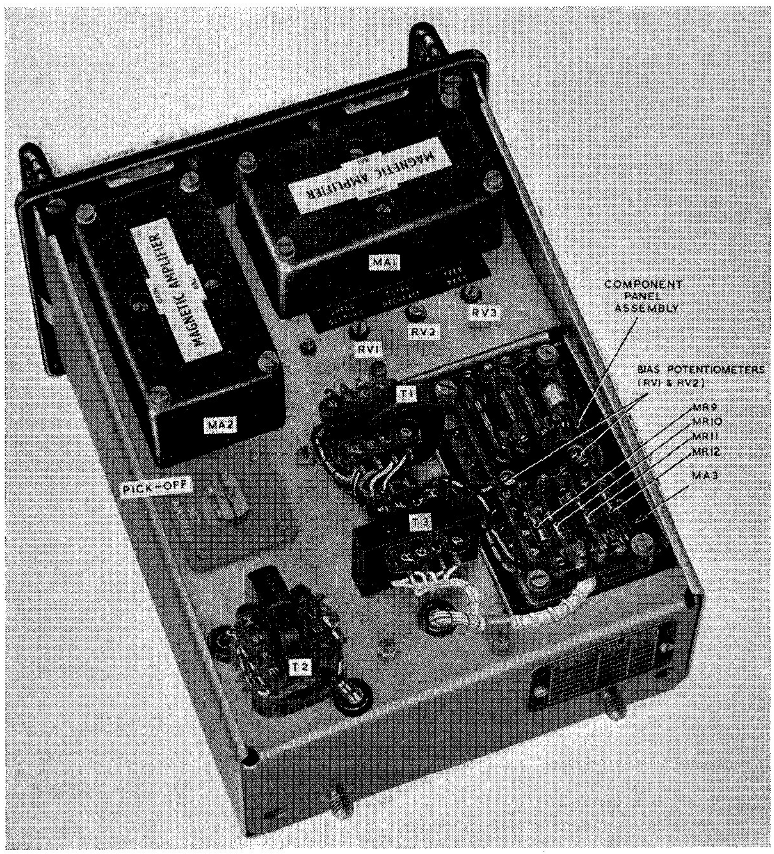

Fig. 3. Amplifier chassis

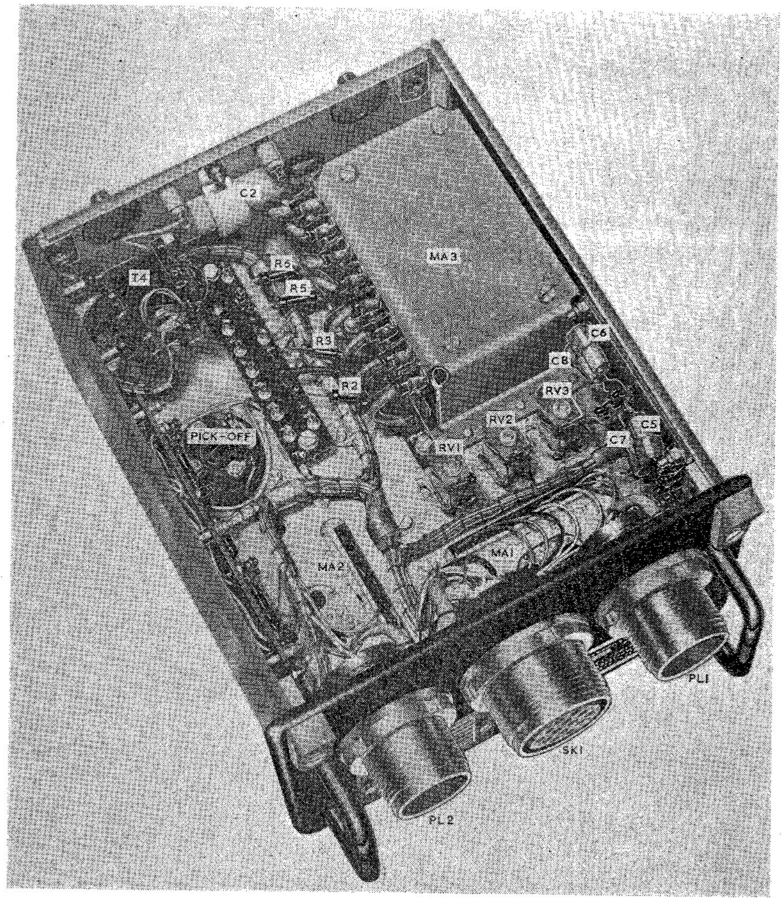

Fig. 4. Amplifier chassis from below

not used in this system. The Magnetic amplifiers MA1 and MA2 each have two preset controls marked GAIN, and BALANCE, accessible through holes in the magnetic amplifier covers while the magnetic amplifier MA3 has two preset controls controlling the bias circuit. The spindle of the a.c. pick-off is slotted to permit adjustment and is locked by a clamp. This preset pick-off forms the air speed datum.

Power supplies (fig. 11)

7. There are four power supply transformers T1, T2, T3 and T4 which are connected to phase A-B of the 115V 400 c/s supply via pin A, and B of PL1. Transformer T1 has three secondary windings lettered EFG, LM and CD. Winding EFG supplies 85V-0-85V to MA3, the return line of the control winding from the actuator motor goes to the centre point F via pin K of SK1; winding LM provides the 8V supply for the tachogenerator in the throttle actuator, via pins L and M of SK1; and winding CD supplies 25V to the full-wave rectifier, composed of silicon diodes MR9-10-11-12 (fig. 3), which provides a d.c. current to bias MA3.

8. Transformer T2 has six secondary windings lettered HGFE, NOPR, ML and KJ. Windings HGFE supply the air speed datum pick-off within the unit with 11V; winding NOPR provides the 11V excitation supply for the rate feedback pick-off in the throttle actuator via pins E and F of SK1. Windings KJ and ML provide the 7V reference supplies required by two half-wave demodulators composed of silicon diodes MR1-2-3-4 and MR5-6-7-8 (fig. 4).

9. Centre-tapped windings DJBL and AMNH on transformer T3 deliver 16·5-

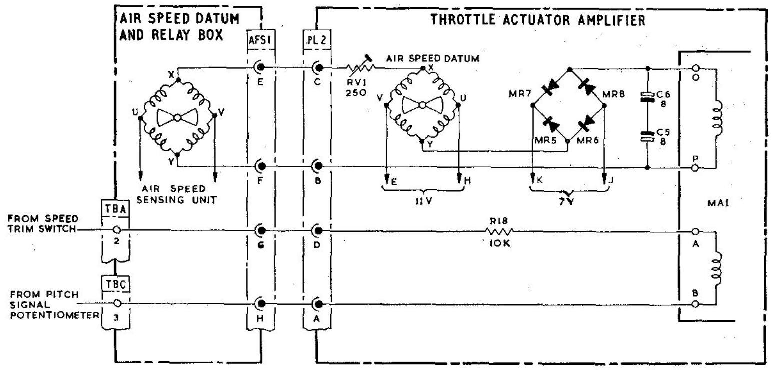

Fig. 5. Input circuit

0-16·5V to terminals EKD of MA1 and MA2 respectively.

10. Transformer T4 has one secondary winding lettered CD, which supplies 86V to the power winding of the servomotor of the throttle actuator, via a phase-shifting capacitor C2 and pins G and H of SK1.

Input circuit (fig. 5)

11. The first controlling input to the throttle actuator amplifier is an error signal developed between two electrically identical a.c. pick-offs, and is applied to winding OP of MA1. These a.c. pick-offs modulate the 400 c/s aircraft supply in proportion to the deflection of their armatures, and in a sense corresponding to the direction of deflection. The first a.c. pick-off is part of the air speed sensing unit in the air speed datum and relay box, and the position of its armature is proportional to indicated air speed. The second a.c. pick-off is the air speed datum and its armature is locked in a position corresponding to a speed of 130 knots. The a.c. error signal is demodulated by the silicon diodes MR5-6-7-8, smoothed by the capacitors C5 and C6 and applied to the control winding OP of magnetic amplifier MA1. Changes of air speed away from the speed at engagement are sensed by the air speed sensing unit, in the air speed datum and relay box, and compared to the air speed datum pick-off to provide error signals to the servo system, which maintains the aircrafts approach speed constant.

12. For complete control of the approach speed any change in elevation angle must be accompanied by a corresponding change in thrust. Consequently the second controlling input applied to the throttle actuator amplifier is a pitch angle error signal. The ends of control winding AB of MA1 are connected to a speed trim switch and to a varying pitch angle potentiometer in the artificial horizon. Hence, a d.c. error current which represents deviations from the pitch datum, is applied to MA1, resulting in changes of thrust to compensate for changes of aircraft attitude. The magnetic amplifier MA2 receives input signals from magnetic amplifier MA1 and a demodulated signal from the throttle actuator position feedback.

MAGNETIC AMPLIFIER, TYPE 3C516

Mechanical construction (fig. 6)

13. Each of the two magnetic amplifiers Type 3C516 (MA1, MA2) have a cover retained by four screws which removes to expose two transductors mounted upon a common baseplate. Each transductor has two cores composed of E-shaped laminations with overlapping joints to reduce magnetic losses. The two load windings of each transductor are wound separately on each of these cores, while each overwound control winding encircles both cores.

Description

14. The magnetic amplifier sums the

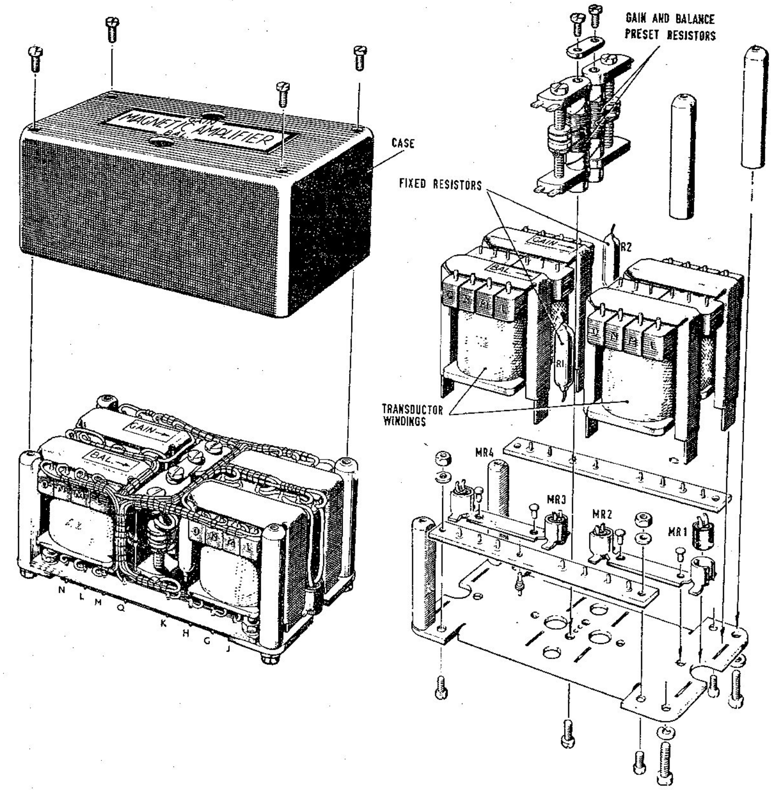

Fig. 6. Magnetic amplifier, Type 3C516

various input signals of different magnitudes and polarities, and provides an output which is proportional to the algebraic sum of the input signals. It contains two transductors connected in Class A push-pull and delivers a full-wave rectified d.c. output for a d.c. input into any of its five control windings. Each control winding consists of two series coils, one wound on each transductor. The air speed signals, and pitch angle signals are applied separately to two of these control windings, the third control winding is not used, while the fourth winding provides amplifier bias. Negative feedback is applied to the fifth winding in order to control the gain of the amplifier.

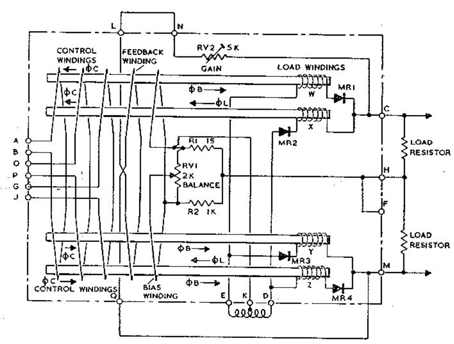

Fig. 7. Magnetic amplifier, Type 3C516 circuit diagram

Operation

15. The magnetic amplifier Type 3C516, has a series parallel arrangement of the load windings (fig. 7) which provides both auto-excitation and a d.c. output with the use of only four rectifiers. The operation of the amplifier can be most easily appreciated by considering first the action of the load circuit without bias, then the effect of the bias circuit, and finally the influence of an input signal.

16. The silicon diode rectifiers MR1-2-3-4 are so arranged that uni-directional currents flow through the high impedence load windings W, X, Y and Z, in alternate pairs for each half-cycle of the supply voltage. Thus when terminal D of the supply voltage is positive with respect to E, current passes through windings X and Z, and when terminal E is positive with respect to D, current flows through W and Y. In both cases, these currents flow through terminals C and M into the load resistors to combine in the centre-tap connection, and return to the transformer centre-tap via bias resistors R1 and R2. As the load windings are both wound and connected in the same direction the load fluxes $\varnothing_L$ always flow in the same direction. This direction is from right to left with respect to fig. 7, the fluxes being marked in to correspond with the presence of current in load winding X and Z. The magnitude of the supply voltage is such that, with no bias, both cores would be saturated for a considerable part of each half-cycle. Hence the load winding impedences would collapse, and large equal, and opposite standing currents would flow through the load resistors.

17. A constant direct current, however, flows through bias windings, to induce bias fluxes $\varnothing_B$ which oppose the load fluxes. Since each bias winding encircles both transductors element cores, the bias fluxes flow in all four cores of the magnetic amplifier, as marked on fig. 7. Consequently, when current passes through the load windings W and Y, the load fluxes are still opposed by the bias fluxes.

18. The two amplifiers characteristics enable the constant direct current necessary for the bias windings to be derived internally. First, as already described, the current flowing from output terminal H to transformer terminal K is unidirectional. Secondly for normal inputs this current is substantially constant in magnitude as well as direction; even when signals are applied to the amplifier control windings. A constant bias voltage is therefore developed across the bias resistors R1 and R2 in series with the transformer centre-tap connection, and applied to the bias windings via the balancing resistor RV1. The bias is adjusted to alter the condition of the transductor cores from complete saturation (when there is no bias), to that of being just at the point of saturation. This is the normal condition of the magnetic amplifier before input signals are applied. Standing currents flow through the load resistors, but as they are equal and opposite there is no voltage across the output terminals.

19. The control windings of the two transductors are connected in series so that the fluxes induced by a d.c. input signal flow in opposite directions in the two pairs of transductor cores. For example, when a d.c. input signal is applied to control AB such that terminal A is positive with respect to B, the control fluxes $\varnothing_C$ flow from right to left in the top two cores, and from the left to right in the bottom two. Consequently, the control fluxes alternately oppose and reinforce the resultant of the bias and load fluxes, so that one load winding is saturated and the other brought out of saturation for each half cycle of the supply voltage. Thus a large pulse of current flows through one load resistor while a small one flows through the other, and the large and small pulses of current combine in the centre-tap connection to give the constant current referred to in para. 17. Moreover, when the polarity of the input signal is reversed, the large and small pulses of current flow in opposite load resistors, so that the output voltage is reversed, and the sense of the d.c. input signal is preserved. It can now be seen that, in addition to ensuring a d.c. output, the configuration of the rectifiers provides a measure of auto-excitation since the uni-directional load fluxes assist the control fluxes in the conducting half of the amplifier.

Negative feedback

20. The gain of each magnetic amplifier is controlled by the application of negative feedback to control winding LQ. Output terminal C is connected through resistor RV2 (fig. 7), and terminal N, to terminal L, and terminal Q is connected to output terminal M. Thus the output of the amplifier from terminals M and C is applied to winding LQ via resistor RV2 in the correct sense to achieve negative feedback. The amplifiers MA1 and MA2 are generally similar but gain resistor RV2 and MA1 is shunted by resistor R17 (fig. 11) to displace the operating position of the resistor wiper to the centre of its travel.

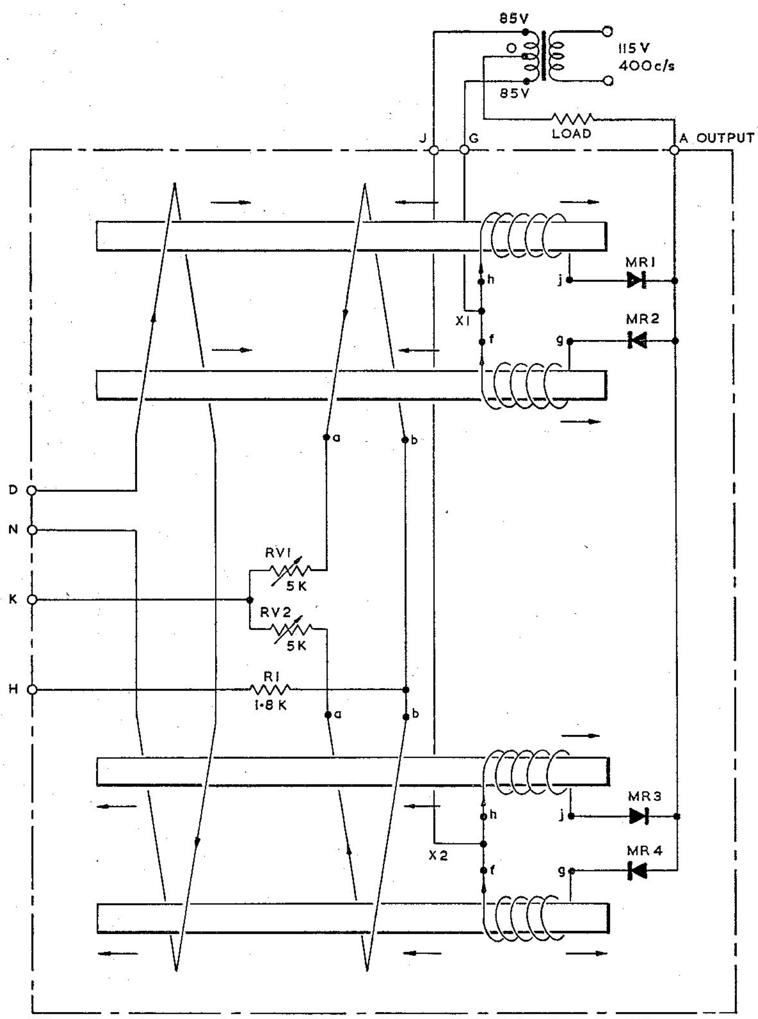

Fig. 8. Magnetic amplifier, Type 3C635 circuit diagram

Such a correction is unnecessary with MA2.

Load circuits

21. In both cases, the output loads of each magnetic amplifier, the control winding AB of MA2 for MA1, and DN of MA3 for MA2, are single-sided. Artificial centre-tapped loads are therefore provided to complete the bias circuits and to achieve the effect of zero load current for zero control current. These loads are the two resistors (R11 and R12 of MA1, R13 and R14 for MA2, fig. 11) mentioned in para. 18.

MAGNETIC AMPLIFIER, TYPE 3C635

Mechanical construction (fig. 3)

22. The magnetic amplifier, Type 3C635 is mounted upside down and is secured by four screws to the recessed section of the main chassis. It supports a component panel comprising a four diode demodulator MR9, MR10, MR11, and MR12, a capacitor C9 and three resistors R19, R20 and R21. The magnetic amplifier (fig. 8) consists of two matched transductors, each with two silicon diode rectifiers MR1-4, with R1, and two preset resistors RV1 and RV2 controlling the bias circuit.

23. The magnetic amplifier, Type 3C635 is a class B, push-pull amplifier connected to the output of MA2. The construction and principle of operations are similar to the magnetic amplifiers MA1 and MA2 (Type 3C516) described in para. 13 to 20. All differences are described in the following paragraphs.

Description (fig. 8)

24. The magnetic amplifier has only one control winding, supplied from the output of MA2, and no feedback winding. The bias current is supplied externally from the secondary CD of transformer T1, and is rectified by the rectifier bridge MR9, MR10, MR11 and MR12 and smoothed by the RC network R21, C9 (fig. 11).

25. The output of the load windings are rectified by diodes MR1, MR2, MR3, and MR4. The output from terminal A is the difference between the a.c. currents flowing in the load windings and is applied to the control coil of the servomotor in the throttle actuator via SK1/J. The return from the servomotor control coil is to the centre-tap of secondary EFG of transformer T1 via SK1/K (fig. 11). As the load windings are supplied from the opposite ends of EFG the phase of the output is reversed when the direction of the input signals from MA2 is reversed, thus controlling the direction of movement of the throttle servomotor.

26. Since there are no gain or balance adjustment potentiometers, adjustment of the two bias potentiometers RV1 and RV2 also controls the amplifier balance. Potentiometers RV1 and RV2 are accessible from the underside of the amplifier (fig. 3).

Position feedback (fig. 11)

27. The movement of the throttle actuator shaft must be subjected to a further kind of control to make it proportional to the applied input signal. This control is a position feedback. An a.c. pick-off in the throttle actuator is operated from winding NOPR of T2 and has an armature linked to the throttle actuator shaft. The a.c. pick-off modulates a 400 c/s supply in proportion to the deflection of the armature, and in a sense corresponding to the direction of deflection. The a.c. signal is fed back into the control

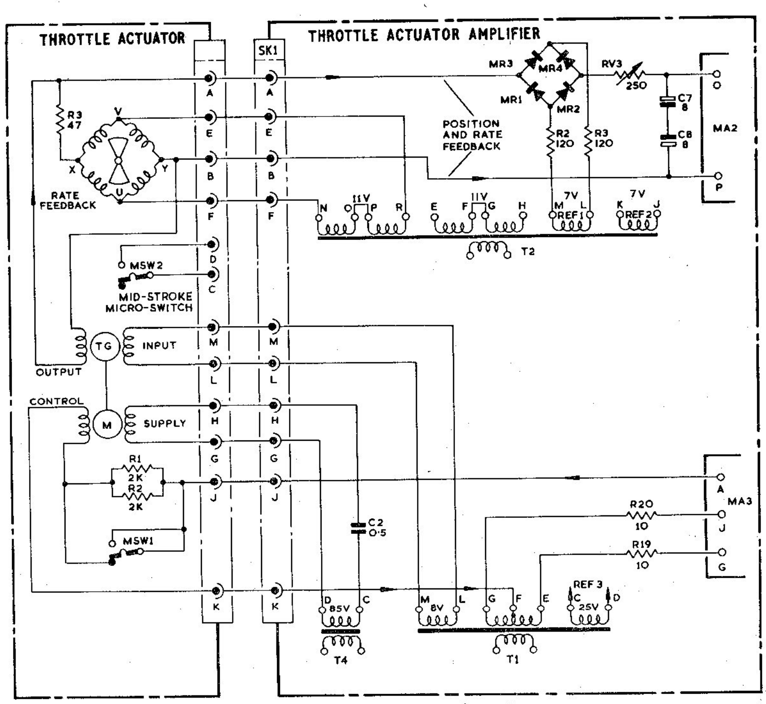

Fig. 9. Output circuit

winding OP of MA2 via a half-wave phase-sensitive demodulator composed of silicon diodes MR1, MR2, MR3 and MR4, and opposes the input signal applied to winding AB. Resistor RV3 enables the amount of feedback to be controlled.

Rate feedback (fig. 11)

28. A tachogenerator is constructed upon the shaft of the servomotor in the throttle actuator. The a.c. output of this tachogenerator is proportional to the speed of the servomotor and it is applied to MA2, in combination with the position feedback signals to give a rate feedback to damp the motion of the servomotor armature.

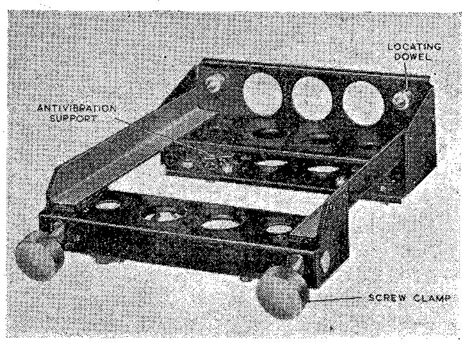

Fig. 10. Mounting tray

AMPLIFIER MOUNTING TRAY

Description

29. The mounting tray (fig. 10) is a rectangular light alloy frame supporting the throttle actuator amplifier. Two perforated box-section cross-members are riveted to two L-section longitudinal members which act as slides for the amplifier unit and locate it laterally. At the front of the mounting tray are two pivoted knurled screw clamps which engage on two lugs at the front of the amplifier. These clamps hold the amplifier in position by pressing it against the vertical rear cross-member of the mounting tray. Bolted to this vertical rear cross-member are two dowels which pass through clearance holes in the amplifier cover into locating holes in the amplifier chassis.

30. The mounting tray is attached to the aircraft by four spring anti-vibration mountings which are bolted to the underside of the main cross-members. An earthing braid connects the mounting tray to the aircraft earth.

SERVICING

General

31. The test procedures normally carried out at specified periods, or at any time when the correct functioning of the throttle actuator amplifier is suspect, are described in Appendix A of this chapter.

Preliminary examination

32. Remove the cover by slackening off the two captive nuts at the rear of the amplifier. Slide the amplifier slowly forward out of the cover, using the handles on the front panel. The components of the amplifier are now accessible for servicing.

33. A brief visual examination of the unit should be made for :—

(a) Faulty insulation
(b) Broken wiring
(c) Wiring not placed in position
(d) Cleanliness

and signs of :—

(e) Overheating
(f) Corrosion
(g) Cracking

34. Subject the unit to the standard serviceability tests Appendix A.

Transformers T1, T2, T3 and T4

35. Each transformer is secured to the chassis by means of two 6 B.A. $\frac{3}{16}$ in. cheesehead screws with the exception of T4, which is secured by means of two 6 B.A. $\frac{9}{16}$ in. countersunk screws and two $\frac{1}{4}$ in. spacers. To renew any of the transformers proceed as follows :—

(1) Cut and remove the terylene binding cord from around the faulty transformer.

(2) Unsolder the cableform connections from the terminal pins of the transformer, noting the terminal pins and lead colours.

(3) Remove the two 6 B.A. securing screws, (and spacers where applicable), and lift the transformer from the chassis.

(4) Position the new transformer (with spacers where applicable), and replace the two 6 B.A. securing screws.

(5) Resolder the cableform wires to the appropriate terminal pins of the new transformer.

(6) Secure the cableform to the body of the new transformer by four turns of terylene binding cord.

Replacement of magnetic amplifiers MA1 and MA2

36. The following procedure describes the method of removing, and replacing magnetic amplifiers MA1 and MA2.

(1) Unsolder the cableform wires from the faulty magnetic amplifier, noting the lead colours and terminal connections. Note also the position of any shorting links.

(2) Remove the four 6 B.A. $\frac{1}{4}$ in. cheesehead securing screws (and cableform cleats, earthing tags etc. where applicable).

(3) Fit a new magnetic amplifier, the correct way round, and tighten the four 6 B.A. $\frac{1}{4}$ in. cheesehead screws (and cleats, tags, etc., where applicable).

(4) Resolder the appropriate cableform connections and replace shorting links.

Replacement of magnetic amplifier MA3

37. The following procedure describes the method of removing and replacing magnetic amplifier MA3.

(1) Remove the four 6 B.A. $\frac{9}{16}$ in. cheesehead screws, washers, and spacers from the component panel mounted on MA3.

(2) Draw back the component panel as far as the length of free cableform will allow.

(3) Unsolder the cableform wires from the magnetic amplifier noting lead colours and terminal connections. Note the position of any shorting links.

(4) Remove the four 6 B.A. $\frac{1}{4}$ in. cheesehead screws, and washers, from below the recessed chassis and lift out the faulty components.

(5) Remove the 6 B.A. cheesehead cover screws, and washers from the cover of the new magnetic amplifier, and place the component, with its cover in position, on the recessed chassis. Ensure that it is the correct way round, and that the potentiometer adjusting screws are upwards.

(6) Replace the 6 B.A. cheesehead cover screws, and washers beneath the recessed chassis, to secure the component in position.

(7) Resolder the appropriate cableform wires, and replace shorting links.

(8) Place the four spacers in position on MA3, and align the component panel over them. Insert, and tighten the four 6 B.A. cheesehead screws which secure the panel to the magnetic amplifiers.

Final checking procedure

38. A final mechanical inspection should be made on the amplifier to ensure :—

(a) All screws, nuts, and washers are in position, and correctly locked.

(b) All unlocked screws are coated with Loctite sealant grade " E."

(c) All lead wires are freed from soldering-iron burns.

(d) All soldered joints are sound, and secure.

(e) Excess solder has been removed.

(f) Rubber sleeves are in position.

39. Slide the cover over the amplifier and tighten the two captive nuts at the rear of the cover.

40. Subject the instrument to the Standard Serviceability Tests (Appendix A of this chapter).

PACKAGING

41. The following description, and instructions on the method employed to pack the auto-throttle amplifier, and mounting tray are extracted from Issue 1 of the Services Packaging Instruction Sheet to comply with Defence Specification DEF-1234, and to the latest issues of all other relevant specifications.

Amplifier package

42. The amplifier package is a restricted standard container made up as follows :—

(1) Primary container which is a rigid, fibreboard box, Type C to Specification DEF-1319. The internal dimensions of the box are 9 in. × 7 in. × 5 in.

(2) Outer container which is a rigid, fibreboard box, Type C to Specification DEF-1319. The internal dimensions of the container are 15 in. × 13 in. × 11 in., and the inside faces are lined with rubberised hair blocks. The gross package weight is 9 lb. Warning labels F. PKG 59, F. PKG 192, and F. PKG 193 are attached giving details as follows :—

Label F. PKG 59

DESICCATED PACK

NOT TO BE OPENED UNTIL REQUIRED FOR USE EXCEPT FOR THE RENEWAL OF DESICCANT

DESICCANT CHANGE

CLIMATIC PORTION .... **6 oz**

DUNNAGE PORTION .... **Nil**

TOTAL QUANTITY OF CHARGE ...... **6 oz**

DATE OF LAST CHARGE ....

Label F. PKG 192

PRIMARY STANDARD PACKAGE

Label F. PKG 193

RESTRICTED STANDARD PACKAGE

43. Special packaging instructions are as follows :—

(1) Ensure that the amplifier is clean, dry and free from dust, and corrosion.

(2) Mask all electrical connections with tissue paper (DEF-1251), and secure with tape (DTF-1314).

(3) Mask all sharp edges liable to puncture barrier with tape (DEF-1314).

(4) Secure the desiccant to the amplifier with tape (DEF-1314).

(5) Place the amplifier in a polythene envelope (DEF-1317) 14 in × 11 in × 0·020 in. thick. Extract all excess air, and heat seal in accordance with DEF-1234 Part 2, Sect. 4, Appendix B.

(6) Place the amplifier in the primary container, and tightly pack with cellulose wadding (DEF-1248). Secure the lid of the container with gummed strip paper (DEF-1299).

(7) Place the primary container into the outer container, securing the lid using gummed strip paper (DEF-1299).

(8) Identify throughout in accordance with DEF-1234.

Amplifier mounting tray package

44. The mounting tray package consists of a rigid, fibreboard, Type C to Specification DEF-1319. The internal dimensions of the box are 9 in. × 7 in. × 3 in. The gross package weight is $2\frac{1}{2}$ lb. Warning label F. PKG 193 is attached giving details as follows :—

RESTRICTED STANDARD PACKAGE

45. Special packaging instructions are as follows :—

(1) Ensure that the mounting tray is clean, dry, and free from dust, and corrosion.

(2) Secure all loose parts using tape (DEF-1314).

(3) Wrap the mounting tray in grease resisting wrapping paper (DEF-1316).

(4) Place the mounting tray in a polythene bag (DEF-1317) 12 in. × 10 in. × 0·005 in. thick. Extract excess air, and heat seal in accordance with DEF-1234, Part 2, Sect. 4, Appendix B.

(5) Place the mounting tray in the container, and cushion by filling all excess space with corrugated paper (DEF-1253 S/F), and secure with tape (DEF-1299).

(6) Label and identify in accordance with DEF-1234.

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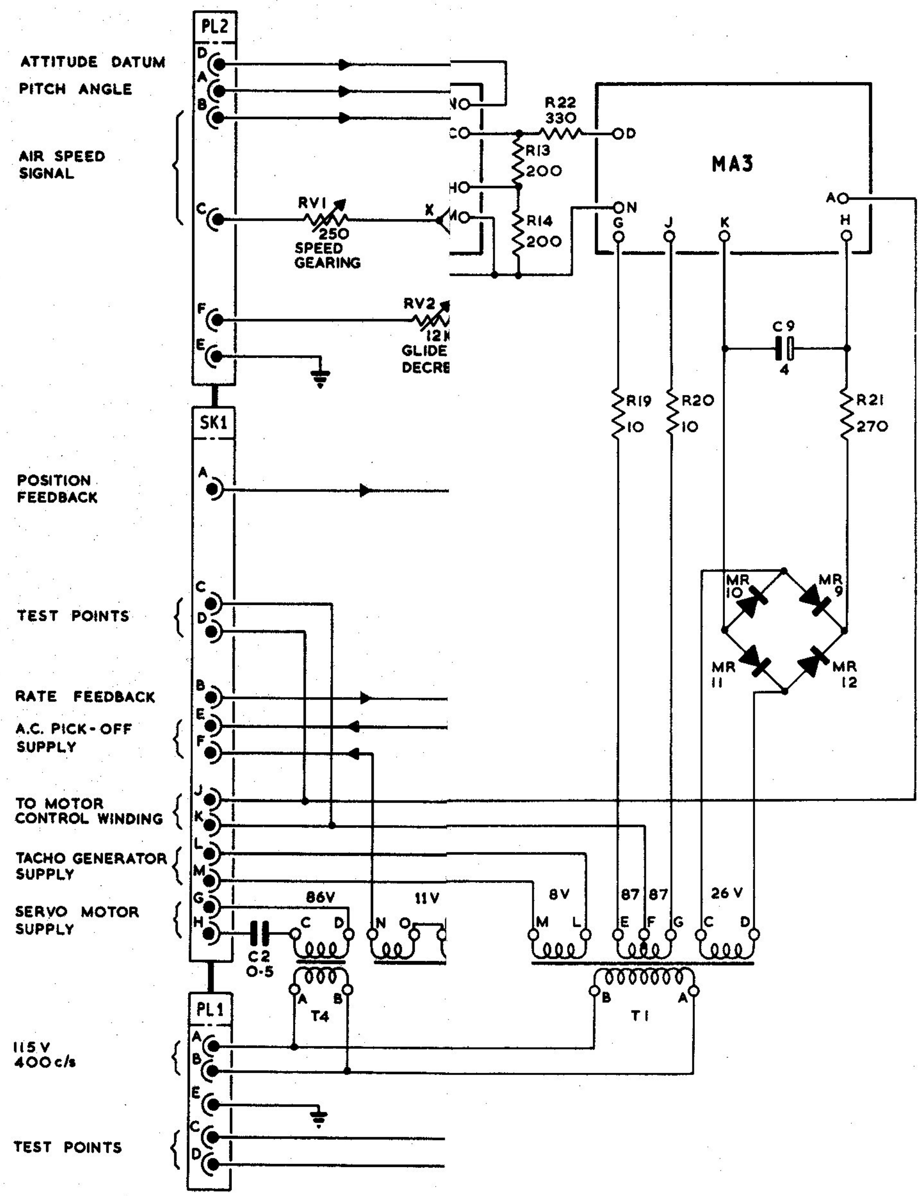

Fig. 11

Fig. 11

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Appendix A

STANDARD SERVICEABILITY TEST FOR THROTTLE ACTUATOR AMPLIFIER Ref. No. 6TE/4449

LIST OF CONTENTS

Introduction

1. These tests should be applied to the autothrottle amplifier before it is fitted to an aircraft, or at any time when its serviceability is suspect.

TEST EQUIPMENT

2. The following test equipment is required :—

(1) 2nd line test set Type 3D2262-A-1.

(2) Valve voltmeter C.T.471, Ref. No. 0557/6625-99-972-0247.

(3) 500V Insulation Tester Type A Ref. No. 5G/1621.

POWER SUPPLIES

3. The following power supplies are required :—

(1) 115V $\pm$0·5 400 c/s single phase.

(2) 28V $\pm$0·5V d.c.

PRELIMINARY PROCEDURE

Preparation

4. Remove the covers and examine the interior of the unit for signs of moisture ingress corrosion, damage to components and electrical connections.

5. Ensure that all test set switches are to the off position. Connect 115V a.c. and 28V d.c. to PL1 of test set.

6. Switch on external power supplies and check supplies on the test set as follows:—

(1) S16 to A.C.
S18 to ON.
The a.c. supply indicated on meter M1 shall be 115V $\pm$0·5V.

(2) S16 to D.C.
S17 to ON.
The d.c. supply indicated on meter M1 shall be 28V $\pm$0·5V d.c.

(3) Set S17 and S18 to OFF.

TEST PROCEDURE

Insulation resistance

7. Measure the insulation resistance between the following isolated circuits and between each circuit and chassis, in each case the insulation resistance should be greater than 5 megohms.

Plug 1 (marked 1) Pins A and C.
Plug 2 (marked 3) Pins A and B.
Socket 1 (marked 2) Pins E, G, I, K and L.

8. Connect the autothrottle amplifier to the test set socket SK1 using cable harness No. 3C2864.

Balance of magnetic amplifier

9. Set switches S1 and S4 to TEST switch S14 to position 3 (200 mA MA3 O/P) and switch S18 to ON. The reading on meter M3 should be less than 10mA.

10. Set switch S14 to position 4 (10mA MA3 O/P). The reading on meter M3 should be less than 3mA.

11. Set switch S14 to position 3 and set Switch S18 to OFF.

Magnetic amplifier MA2 gain

12. Set switch S3 to MA2, S13 to position 5 (500μA MA2), S14 to position 3 (200mA MA3 O/P), S15 to position 2 (Tacho 1/P). Set potentiometer RV1 to zero. Set switches S17 and S18 to ON.

13. Rotate RV1 clockwise until meter M2 indicates 5 on upper scale. The current indicated on meter M3 shall be 110± 5mA. Reset RV1 to zero and set switches S17 and S18 to OFF.

Stalled motor and tacho currents

14. Set switch S3 to MA2, S13 to position 3 (10mA MA2), S14 to position 1 (200 mA REF), S15 to position 1 (MOTOR REF.) and set switches S17 and S18 to ON.

15. Rotate RV1 clockwise until meter M2 indicates 10 on the lower scale (right hand scale). The reading on meter M3 should be 110±20mA. The pointer of meter M4 should move into the green sector.

16. Set switch S14 to position 2 (200mA TACHO) and switch S15 to position 2 (TACHO 1/P). The reading on meter M3 should be 50±10mA. The pointer of meter M4 should move into the green sector.

17. Set switch S14 to position 3 (200mA MA3 O/P). The reading on meter M3 should be 120±20mA.

18. Set switches S15 to position 3 (MA3 O/P). The pointer of meter M4 should move into the red sector.

19. Set RV1 to zero and set switches S17 and S18 to OFF.

Pitch channel gearing

20. Connect valve voltmeter (5V a.c. range) via cable harness No. 4 Type 3C/3022) to SK4 on the test set.

21. Set the following switches and controls to the positions listed below :—

S1 to TEST
S2 to OFF
S3 to MA1
RV1 to zero
L2 to zero
S12 to position 2 (L2)
S13 to position 6 (500μA MA1)
S14 to position 3 (200mA MA3 O/P)
S15 to position 3 (MA3 O/P)
S17 to ON
S18 to ON

22. Rotate L2 control clockwise until valve voltmeter indicates 4·3 volts r.m.s.

23. Set switch S1 to AMPLIFIER and set S2 to MA1.

24. Rotate RV1 clockwise until the current indicated by meter M3 is less than 3mA (set switch S14 to 10mA position as required). Meter M2 should then indicate 4·2±0·4 on the upper scale.

25. Set switch S14 to position 3 (200mA MA3 O/P) and set switch S1 to TEST. The pointer of M4 should move into the green sector.

26. Rotate L2 through zero in a counter-clockwise direction until valve voltmeter indicates 4·3V r.m.s.

27. Switch S1 to AMPLIFIER and rotate RV1 counter-clockwise through zero until the current indicated by meter M3 is less than 3mA (set switch S14 to 10mA position as required). Meter M2 should indicate 4·2±0·4 on the upper scale.

28. Set switch 14 to position 3 and switches S17 and S18 to OFF.

Airspeed datum

29. Set switch S1 to TEST, S2 to OFF, S3 to MA1 and S4 to AMPLIFIER. Set L1 to zero, S12 to position 1 (L1), S14 to position 3 (200mA MA3 O/P). Set valve voltmeter to indicate 30mV.

30. Set switch S17 and S18 to ON.

31. Adjust L1 about the zero until the current indicated on M3 is less than 3mA (set switch S14 to 10 mA position as required).

32. Set switch S4 to TEST and valve voltmeter should indicate less than 30mV.

33. Set switch S14 to position 3 and switches S17 and S18 to OFF.

Airspeed channel gearing

34. Set switch S1 to TEST, S2 to OFF, S3 to MA1, S4 to AMPLIFIER, L1 and L2 to zero, S12 to position 2 (L2), S14 to position 3 (200mA MA3 O/P), S15 to position 3 (MA3 O/P). Set valve voltmeter to indicate 4·5V r.m.s. Set switches S17 and S18 to ON.

35. Rotate L2 counter-clockwise until valve voltmeter indicates 4·5V r.m.s. and set S1 to AMPLIFIER.

36. Rotate L1 counter-clockwise until current indicated on meter M3 is less than 3 mA (set switch S14 to 10mA position as required).

37. Set switch S14 to position 3 (200mA MA3 O/P). Set switch S4 to TEST and S12 to position 1 (L1). The valve voltmeter should indicate $0{\cdot}38 \pm 0{\cdot}04$V r.m.s.

38. Set switches S17 and S18 to off. Remove amplifier, disconnect valve voltmeter and cable harnesses.

Final check

39. Repeat the insulation check detailed in para. 7.

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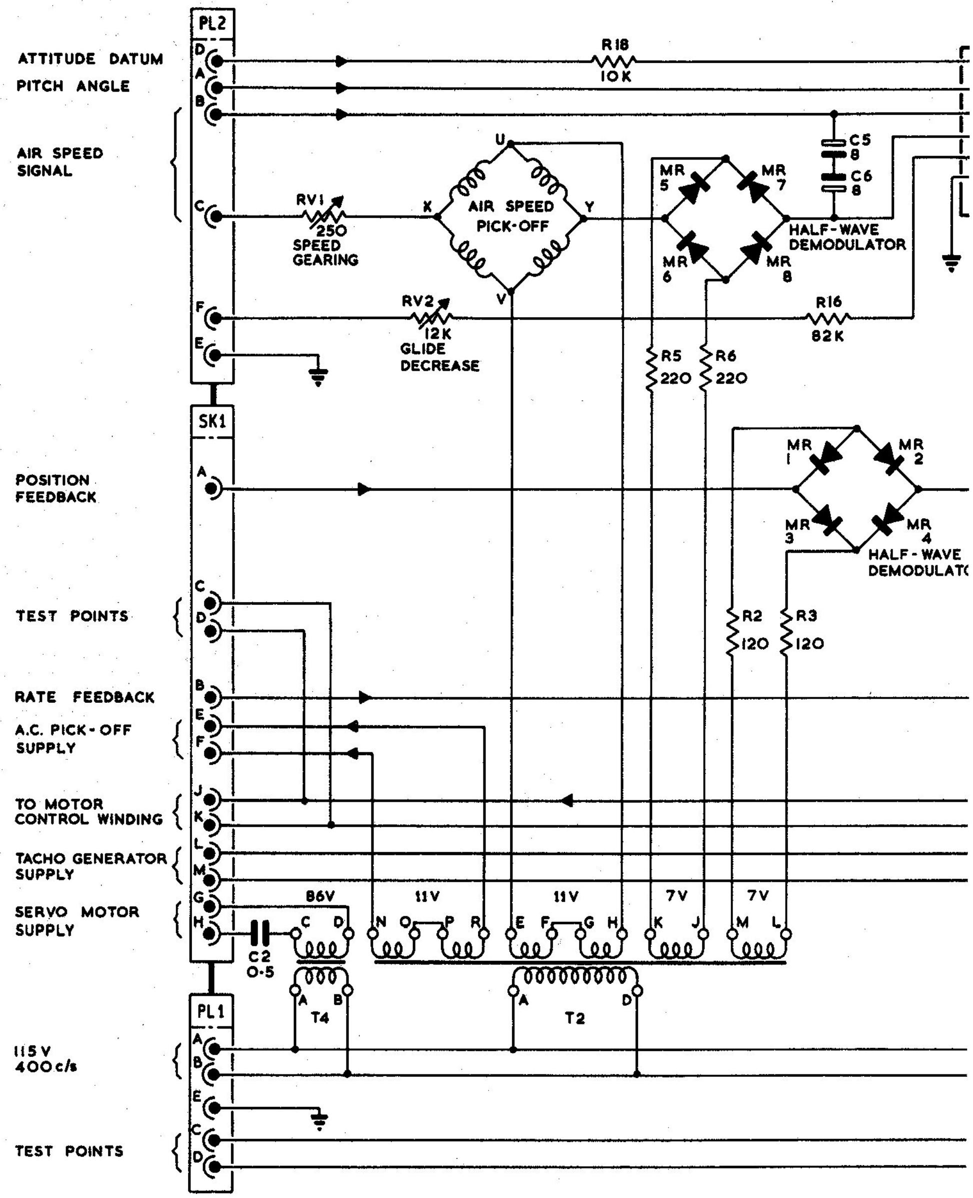
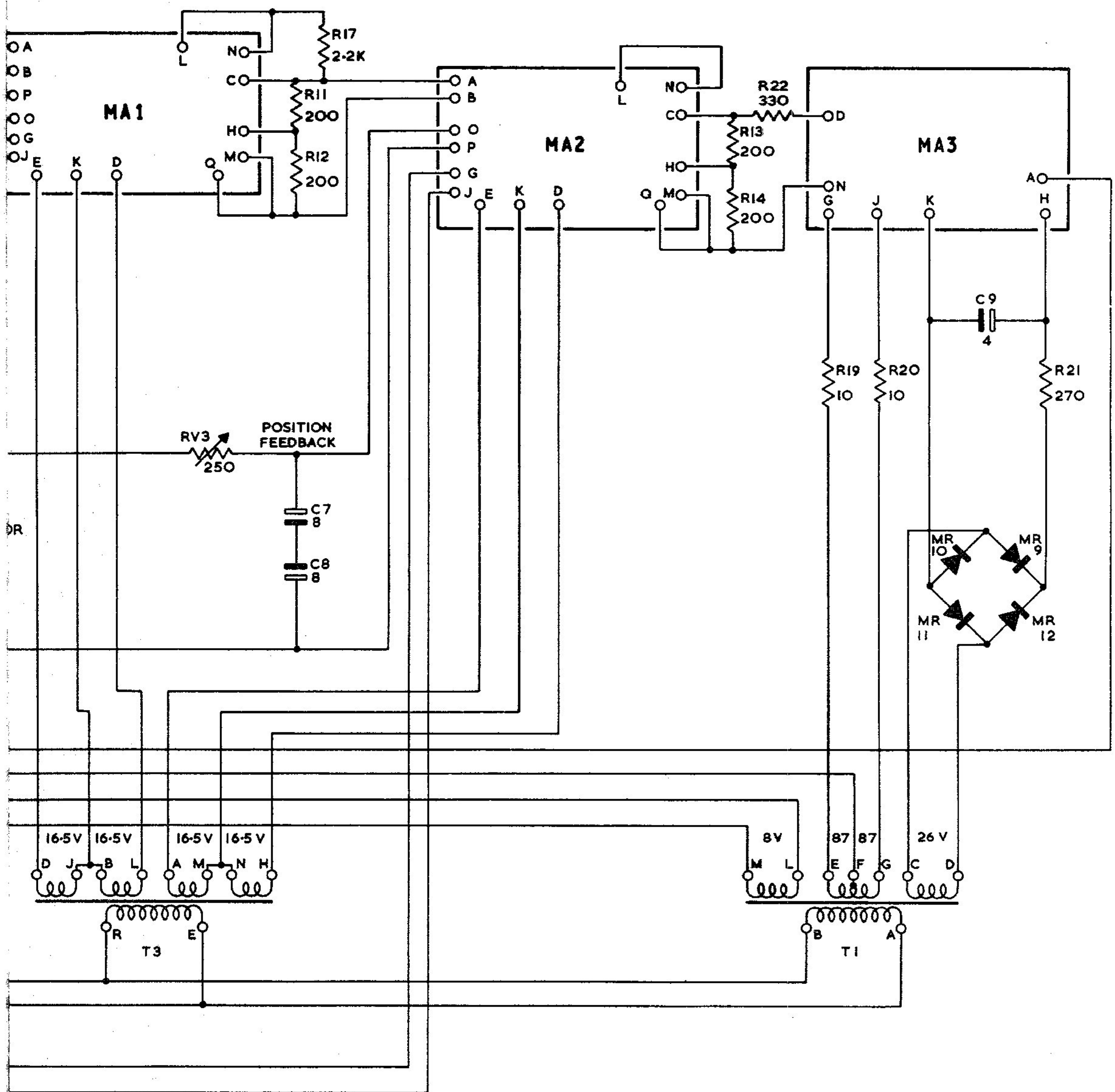


Fig.11 Throttle actuatc

R



r amplifier–circuit diagram

Fig. 11

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