Chapter 6

CONTROL UNIT, B.300 SERIES

LIST OF CONTENTS

LIST OF ILLUSTRATIONS

LEADING PARTICULARS

Control unit, B.300-2	*Ref. No. 5UC/6636*
Control unit, B.300-3	*Ref. No. 5UC/6113*
Output voltage	115-118*V., a.c. (r.m.s.)*
Output voltage variations (750*W. to max. output*)	±1%
Output voltage variations (375*W.* 750*W.*)	±2%
Output frequency	2400 *c/s*
Output frequency variations	± 1%—750*W. to max. output* ± 2%—375*W. to* 750*W.*
Recovery time after load change (frequency)	0·5 *sec.*
Overall length	10¼ *in.*
Overall width	8⅛ *in.*
Overall height	9 *in.*
Oil capacity	5 *pints*
Oil specification	*OM*.16 (*Gulfsil B*30)
Weight B.300-2	21 *lb.*
B.300-3	22 *lb.*

Introduction

1. The control units of the B300 series are used in conjunction with the B503 and B504 series of motor-generators described in AP.4343A, Vol. 1, Sect. 2, to maintain the motor-generator output voltage at a nominal 117V. a.c The figure of 117V allows for voltage drop in the leads to the load circuits. These control units also provide the means for governing the motor speed, thus keeping the generator speed and frequency constant within limits, and protect the generator and its loads from damage due to fault conditions causing an excessive frequency variation (high or low) or a drop in output voltage.

2. Each control unit (fig. 1) contains three circuits which are known respectively as the voltage control circuit, frequency control circuit and the starting and protective circuits. The components of each circuit being virtually independant, are mounted on separate chassis within the control unit housing.

3. The control units type B300-2 and B300-3 differ only in the location of the potentiometers for the voltage and frequency control circuits. The type B300-2 has the potentiometers mounted on its front bulkhead while the type B300-3 accommodates the potentiometers within its housing.

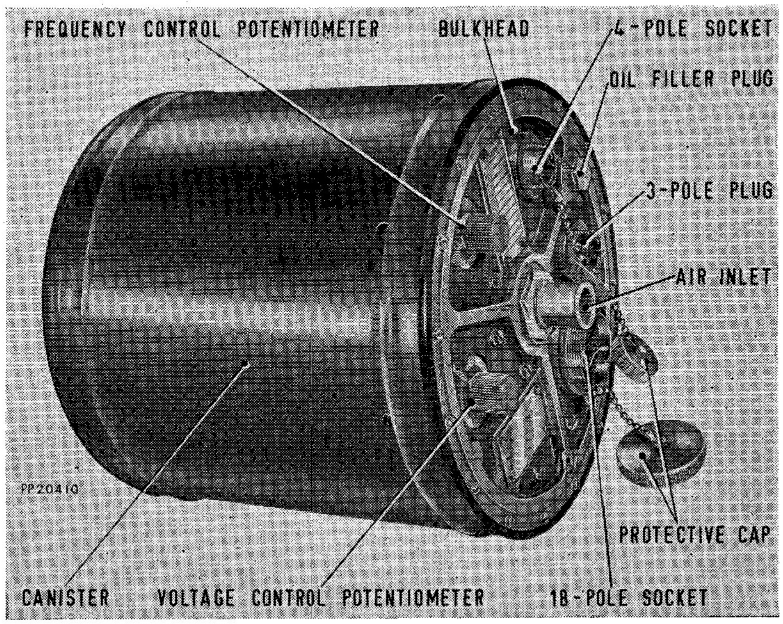


Fig. 1. General view of Control Unit B300–2

DESCRIPTION

Construction

4. The three separate chassis are each in the form of a sector of a cylinder. They are fitted together around a central tube, and are screwed to the front circular aluminium-alloy bulkhead of the control unit. Surrounding the three chassis is a cylindrical aluminium-alloy housing which is screwed to the bulkhead, the control tube passing from the front bulkhead to the rear of the housing. The outside of this housing has a channel in the form of a helix formed on it for cooling purposes and is filled to about 85 per cent full with transformer oil. Oil seals are fitted at each end to prevent leakage. Surrounding this housing is a canister made of a synthetic resin bonded material. Cooling air is fed in via the central tube through the centre of the control unit to the rear of the housing where it disperses radially inside the canister and flows through the channelling to exhaust near the front of the outer canister. The oil ensures a satisfactory heat transfer from the electrical components to the housing and thence to the cooling air. It is important that the control unit is mounted with the word TOP on the front bulkhead at the top, thus ensuring that all the hot components are completely immersed in the oil, i.e. the starting and protective circuits chassis should be at the top.

5. The front bulkhead carries an 18-pole socket, a 4-pole socket and a 3-pole plug. The cooling air entry pipe passes through this bulkhead and the oil filler opening is sealed with a wire-locked hexagon-headed plug. A small cover plate on the bulkhead of the type B300–3 control unit provides access to the voltage control potentiometer (RV1) so that adjustments to the generator output voltage can be made.

6. The potentiometers for the voltage and frequency control circuits of the type B300–2 control unit are located on the bulkhead for external adjustment.

7. All the connections between the control unit and the motor-generator are made via the capacitor and junction box described in Chap. 7.

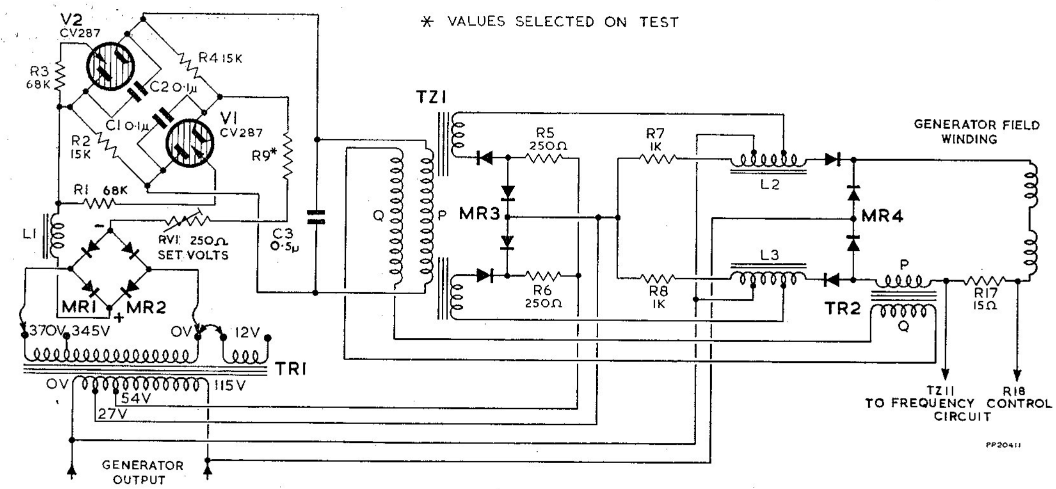


Fig. 2. Voltage control circuit

OPERATION

Voltage control circuit (*fig.* 2)

8. The generator output is fed into the primary of the input transformer TR1 and the output of its secondary is rectified and fed via choke L1 to a neon bridge circuit incorporating two gas-filled stabilizing valves V1 and V2 (CV287). During normal operation, the potential drop across each of these valves is 150V., and 150V. is also dropped across each of their series resistors R2 and R4. Thus, when the bridge is supplied with 300V. d.c. there is no potential difference between the cathode of V2 and the anode of V1. If the d.c. input to the bridge is varied, a potential difference is developed, however, and this produces an error, or out-of-balance, current through the control winding P of the transductor TZ1; the direction of this current depends upon whether the input to the bridge is above the nominal figure of 300V. and the amplitude of the current depends on the amount of the input variation. The choke input to the bridge ensures that the bridge input voltage is proportional to the average generator output voltage. The variable resistor RV1 determines the nominal voltage applied across the neon bridge, and thus determines the datum point (117V. at about half load) of the voltage control circuit, and the capacitors C1, C2 and C3 stabilize the neon bridge circuit and reduce the ripple fed into the transductor. The principal secondary of TR1 is tapped, and a small extra secondary is provided so that the input voltage to MR1 and MR2 can be varied if necessary should the range of RV1 be found to be insufficient during factory test or servicing. These adjustments cannot be made after the control unit is finally assembled into its housing.

9. TZ1 is a simple auto-excited transductor, and it forms the first stage of a two stage magnetic amplifier that supplies the field current for the generator during normal running. The second stage is a modified form of Ramey magnetic amplifier (half-cycle type). Briefly, the transductor TZ1 determines the "reset" current for the Ramey saturable reactors L2 and L3, thus varying the mean value of the a.c. input to MR4 which supplies the generator field (L1 and L2 by definition are also transductors, but they are termed saturable reactors in this description to distinguish them from the conventional transductors in the control unit).

10. The complete operation of the transductors and saturable reactors is rather complex, but in principle they operate by virtue of their high initial reactance which is caused to vary (by the application of a control current) so that the current in the a.c. circuit in which they are connected is varied. The control current is made to vary the working point on the flux/e.m.f. characteristic curve for the core material so that the a.c. current through the main output winding and load circuit causes the core to saturate for a longer or shorter period per cycle of the supply potential. When the core is saturated, the reactance of the output winding becomes virtually zero, so that the whole of the supply voltage is applied to the

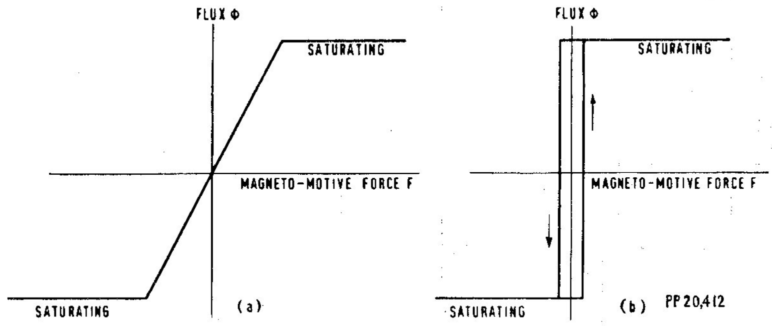


Fig. 3. Ideal flux/M.M.F. characteristics for Transductor TZ1

load circuit; thus the duration per cycle that the core is saturated determines the mean or average load current. This current only flows into the load during the "saturating" or "conducting" half cycles when the associated rectifiers conduct.

11. With the transductor TZ1, the control current is the d.c. error current from the neon bridge which is so arranged that, if the generator output voltage is high, the core of TZ1 is saturated for a longer period per cycle than if the output voltage is correct. In this event, the resulting "resetting" current for the saturable reactors L2, L3 is also high and this reduces the saturation periods of the reactors and thus reduces the field current supplied to the generator. With a low generator output voltage, the converse applies.

12. The main difference between the transductor TZ1 and the saturable reactors L2 and L3 is in the type of core material used. The ideal form of the flux/e.m.f. characteristics of the core material for TZ1 is a straight line, as shown at (a) (*fig.* 3) while that for the reactors is a narrow rectangular loop as shown at (b) (*fig.* 3). The result is that when, during each cycle, the current through the output windings of TZ1 falls below that necessary to maintain saturation, the flux level of the core drops to zero or to a level determined by the control current, if present. For reactors such as L2 and L3 however, after initial saturation the core remains saturated when the current through the winding falls to zero. Thus, during subsequent half-cycles of the same sense, the core remains saturated and the load current remains at its maximum value, unless the flux level is "reset" during each normally non-conducting half-cycle i.e. when the load circuit rectifiers prevent load current from flowing. There are some other differences of a minor nature. The transductor has two separate cores for the main output windings and one or more control windings, each of which is common to both cores; the transductors of this basic type can supply full-wave rectifiers and load circuits (e.g. transductors TZ11, TZ12 and TZ21 in the control unit). Each of the reactors L2, L3, however, has a single core and a single winding, part of which is used as a control winding for resetting purposes; the reactors are essentially half-wave devices and two of them are used for full-wave operation.

13. Referring to the simplified diagram of the magnetic amplifier (*fig.* 4) and assuming that during a particular half-cycle of the supply the polarities are as shown; L3 is delivering power ("conducting") into the load RL (i.e. the generator field) and L2 is being "reset" according to the output of the

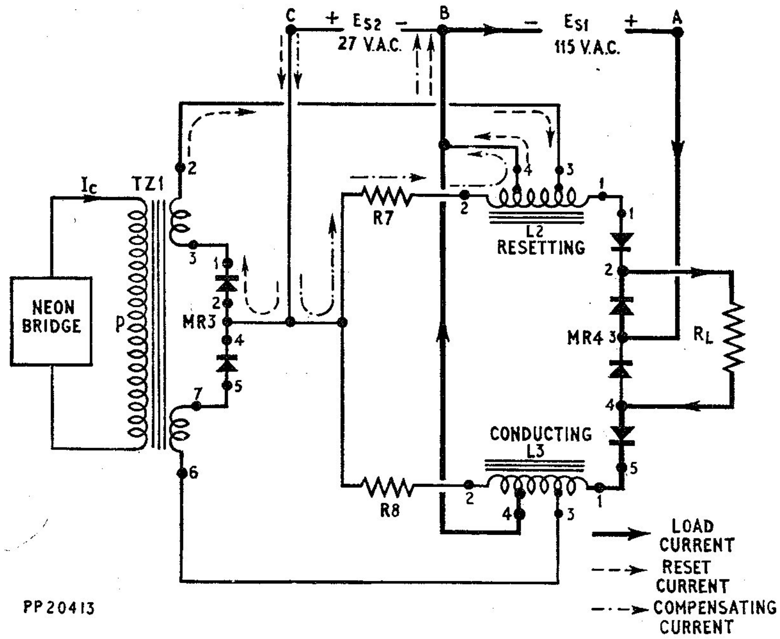


Fig. 4. Simplified circuit of Magnetic Amplifier

transductor TZ1, whose output in turn is dependent on the mean level of its cores as determined by the control or error current Ic from the neon bridge.

14. There are four main circuits to be considered:

(1) Load circuit from Es1 via L3 and RL.

(2) Compensation circuit from Es2 to balance out leakage currents through MR4 in the reverse direction.

(3) Reset circuit to reset reactor L2 according to the output of TZ1.

(4) The circuit described in para. 18 and 19 which is included to enable the reset circuit to operate correctly.

15. Load current from terminal A of the 115V. supply Es1 (*fig.* 4) flows through MR4 (3–2), the load RL (generator field), rectifier MR4 (4–5), reactor L3 (1–4) and back to terminal B of the supply Es1. The mean value of this current depends on how much L3 has been reset during the previous half cycle, zero resetting producing maximum output.

16. Since the performance of the rectifiers is not ideal, some current flows through MR4 in the reverse direction and through L2 (1–4), when L3 is delivering its output. This small current flows in the same direction as the normal reset current, thus tending to reset the core, and therefore limiting the maximum output current through the load. To offset this leakage current, part of the reactor winding (2–4) is fed with a predetermined a.c. current via resistors R7 and R8 from the 27V. supply Es2. No rectifiers are required in this circuit, the current flowing through this part (2–4) of the conducting output reactor winding having no effect on its output.

17. While L3 is "conducting", the core of L2 is reset by the current from the low voltage (27V.) a.c. supply Es2. Reset current from terminal C of Es2 flows through MR3 (2–1), winding (3–2) of TZ1, part of reactor L2 returning to terminal B of Es2. A relatively small number of turns (taps 3–4) and a low voltage supply only are required to reset the reactors, thus reducing the overall power losses, increasing the efficiency of the circuit, and enabling miniature low voltage rectifiers to be used thus saving space.

18. The circuit shown in fig. 4 requires certain additional components and another supply source, however, as shown in fig. 5,

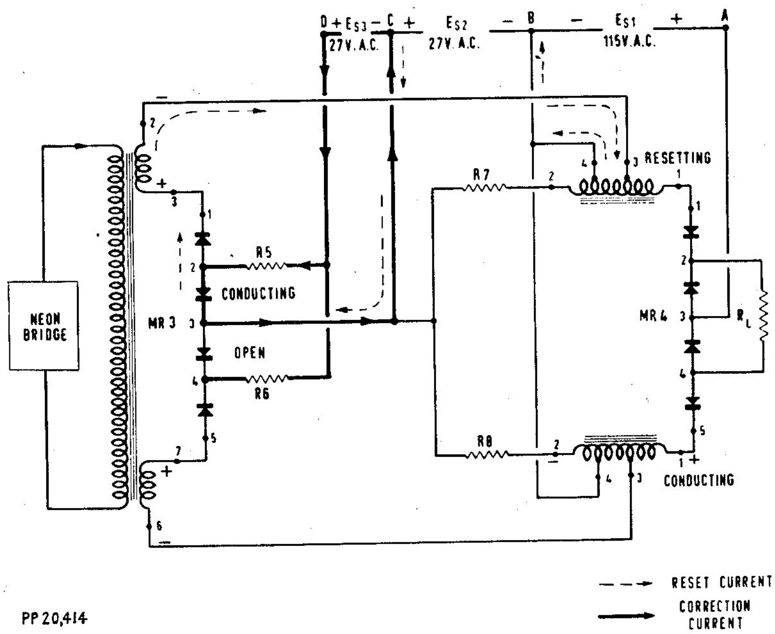


Fig. 5. Simplified circuit of Magnetic Amplifier with additional components to overcome coupling effects

to overcome the deleterious effect on the circuit of the coupling between the cores of the transductor TZ1 by its control winding, which is common to them both. This is serious during the pre-saturation period of each half cycle, although after saturation no coupling takes place. To follow the behaviour of the circuit under pre-saturation conditions, refer to fig. 4 and again assume that the polarities are as shown in the diagram (for clarity, the r.m.s. values of the supplies are given in the following description.)

19. While TZ1 is unsaturated, virtually the whole of Es2 (27V.) is applied across TZ1 winding (3–2) via the resetting turns (3–4) of L2, and, due to the coupling of the two output windings of TZ1 by the common control windings via the impedance of the neon bridge, an e.m.f. of approximately 27V. (or less) is induced in winding (6–7) of TZ1. At the same time, since virtually the whole of Es1 (115V.) is applied across (1–4) of the output reactor L3, a further 27V. (approx.) is produced by auto-transformer action between taps (3–4) of L3. These two e.m.f.'s are in the same sense and being additive, exceed that of Es2 (27V.) and cause rectifier MR3 (5–4) to conduct. The resulting current through TZ1 (6–7) causes undesirable effects in both cores of the transductor due to the coupling via the control windings, resulting in abnormal control characteristics, and loss of efficiency.

20. These effects are removed by preventing rectifier MR3 (5–4) from conducting by increasing the potential at tag 4 of MR3 to a higher voltage than the combined induced and developed e.m.f. produced in windings (7–6) of TZ1 and (4–3) of L3, thus blocking the rectifier. This is done by connecting the a.c. supply Es3 (27V.) in series with Es2 (27V.) and including the resistors R5, R6 and rectifiers MR3 (3–4) and MR3 (2–3) as shown in fig. 5.

21. The operation of the circuit in fig. 5 is as follows. During the half cycles when the polarities are as shown (assuming pre-saturation conditions) the additional supply voltage of Es3 appears across the rectifier MR3 (4–3) which does not conduct, so that terminal 4 of MR3 is at potential D relative to B (i.e. 54V.) and this will always be higher than the combined induced and developed e.m.f.'s that appear at terminal 5 of MR3. Thus no current can flow through MR3 (5–4) and winding (6–7) of TZ1, and the transductor can operate in its normal manner. The additional rectifiers are thus connected so as to oppose the normal resetting currents, but these resetting currents are able to flow for the following reasons. Consider the resetting circuit of L2 during a half cycle when the polarities are as shown in fig. 5. The resetting current can pass through the rectifier MR3 (3–2) in its reverse direction because a slightly larger current, provided by the additional supply Es3 through resistor R5, flows in the forward direction of MR3 (2–3) with the result that the impedance of the rectifier is quite low. Providing that the difference between the amplitudes of the two currents (resetting and circulating) is sufficient to enable the rectifier to conduct and operate above the lower bend of its characteristic, this low impedance operates in both directions but if the resetting current equals or exceeds that through R5, the potential across the rectifier is reversed, the rectifier blocks, and no current will flow in either direction. When reactor L2 is delivering its output (i.e. conducting), and L3 is being reset, rectifier MR3 (3–4) operates in the same manner and rectifier MR3 (2–3) blocks any current flowing through TZ1 (2–3) resulting from the induced and developed e.m.f.

22. The supply Es1 referred to in the preceding paragraphs is the main 115V., 2400 c/s supply from the generator that is fed into the primary of TR1, and also to the primaries of the other main input transformers in the control unit. Supply Es2 is obtained from transformer tappings (0–27V.) on the primary of TR1, and supply Es3 is obtained between the 27V. and 54V. tappings on TR1 primary (*fig.* 2).

23. The generator field current also passes through the primary of the rate feedback current transformer TR2, the secondary output of which is fed back in a negative sense across the whole amplifier to the control winding Q of TZ1. Transformer TR2 is designed to be sensitive to changes in field current and its output thus introduces a stabilizing effect to reduce "hunting" and "overshoot" following a change of load. Ripple is also fed back from the output of the amplifier, but this has a negligible effect on the overall performance, considerable smoothing being provided by the generator field.

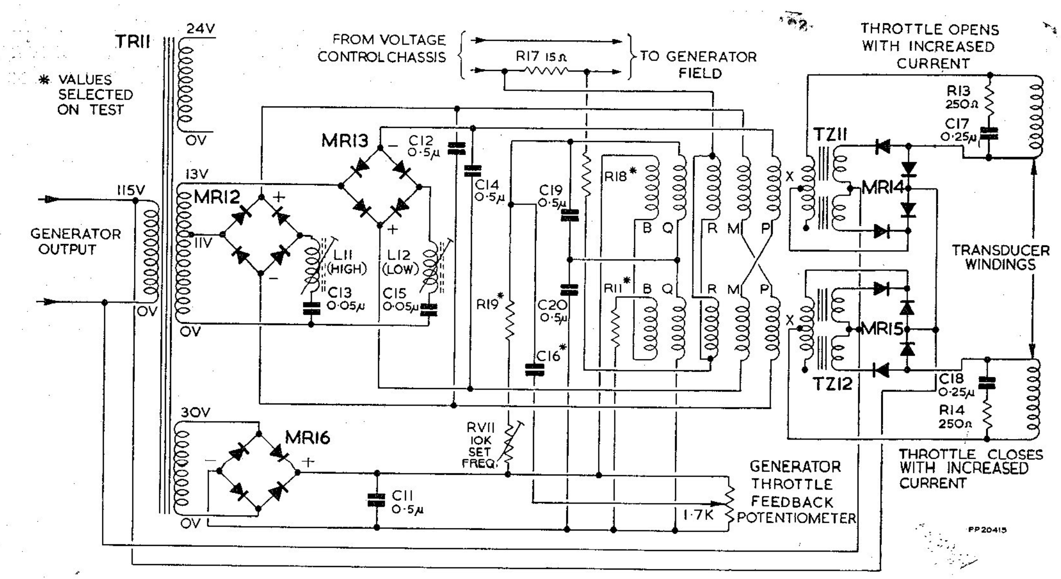


Fig. 6. Frequency control circuit

Frequency control circuit (*fig.* 6)

24. The generator output is fed to the primary of TR11, to one secondary of which two series resonant tuned circuits (L11, C13, and L12, C15) are connected, each in series with a bridge rectifier (MR12 and MR13 respectively). These circuits resonate at approximately 2700 c/s and 2100 c/s respectively, i.e. 300 c/s above and below the nominal 2400 c/s output of the generator, and are so arranged that when the generator frequency is correct, the output from both of the rectifiers is the same; to compensate for the lower Q of the low frequency circuit, it is fed with a slightly higher a.c. voltage. The rectified outputs are fed into a push-pull magnetic amplifier incorporating the transductors TZ11 and TZ12 which are of the same basic type used for TZ1 (*para.* 9).

25. Each transductor feeds one of the windings of the throttle transducer of the hydraulic motor, the operation being arranged as follows:

(1) Low frequency (e.g. during starting; or because of an increased load); the output of MR13 increases (MR12 output decreases), the output of TZ11 increases TZ12 output decreases), the transducer armature rotates, operating the servo selector valve thus causing the servo piston to open the throttle. The throttle spring then opposes the transducer torque with increasing force until the transducer torque is neutralized, returning the selector valve to its central position, the final position of the throttle being such that the frequency increases to the nominal value.

(2) High frequency (e.g. decreasing load etc.); the output of MR12 increases (MR13 output decreases), the output of TZ12 increases (TZ11 output decreases), the transducer rotates, operating the selector valve so causing the servo piston to close the throttle, and conversely to (1), the frequency decreases to the nominal value.

(3) Nominal frequency; the outputs of both MR12 and MR13 are equal, and if there were no load feedback signal (*para.* 26 (4)) the output of both transductors TZ11 and TZ12 would also be equal, so that equal currents would flow into the two windings of the transducer which consequently would remain in its central position; in this position the servo selector valve is closed and the servo piston, and thus the throttle, is held in whatever position it happens to be. In practice, the nominal frequency conditions apply at a particular load only, because the throttle and the transducer (and thus the selector valve) are coupled by a spring, and different load conditions require different throttle openings. The outputs of MR12 and MR13 are insufficient to return the frequency to the nominal range and an additional signal is therefore obtained from the load feedback signal (*para.* 26 (4)).

26. Each transductor has six control windings which serve the following purposes:

(1) Control winding TZ11–M and TZ12–P are connected in series, across the output of the high—frequency resonant circuit rectifier MR12.

(2) Control windings TZ11-P and TZ12–M are similarly connected in series across the low-frequency circuit rectifier MR13.

(3) A small amount of negative current feedback is provided for each transductor by passing its output current through its control winding X.

(4) A load feedback signal is produced by the field current passing through R17 and the voltage thus developed is applied to both transductors by the parallel-connected control windings R. The purpose of this feedback signal is to reduce the frequency change that normally occurs with a change in load, the generator output frequency tending to increase with a reduced load and vice-versa. A reduced load, however, also causes the generator output voltage to increase, in turn producing a drop in field current from the voltage control circuit and a consequent fall in the voltage drop across R17; the reduced load feedback signal causes the throttle to be slightly closed.

(5) To compensate for the fact that the load feedback current is present under all load conditions, a backing-off current obtained from the rectifier MR16 via the variable resistor RV11 and resistor R19, is fed into the series-connected control

winding Q. RV11 thus determines the frequency datum point, which is nominally 2400 c/s at approximately half-power output.

(6) The normal working points of the two transductors are determined by the bias current, obtained from MR16, which is fed through the windings B. These are connected so that a change in the bias current moves the characteristics of both transductors up and down together (not in push-pull).

27. The output of rectifier MR16 is also applied across the throttle-operated potentiometer in the motor. The voltage tapped from the wiper of this potentiometer is fed back through the CR circuit C16, R12 and thence across the backing-off winding Q (*para.* 26 (5)) to provide a stabilizing signal to reduce hunting and overshoot, etc.

28. Auto-excitation of the transductors is provided by the rectifiers MR14 and MR15. C17, R13 and C18, R14 are filter circuits to improve the linearity of the amplifier frequency/output characteristics.

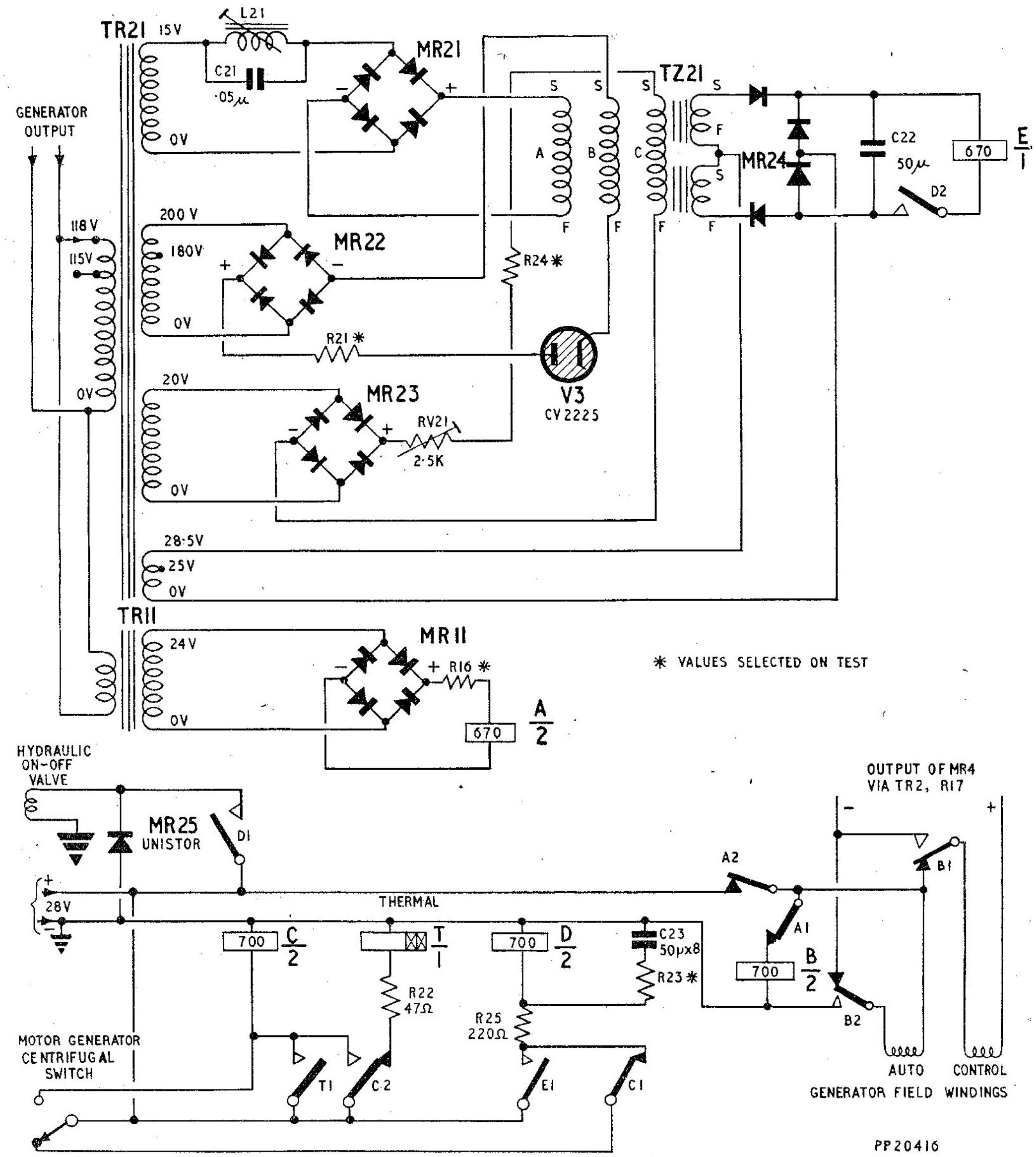


Fig. 7. Starting and protective circuits

Starting and protective circuits (*fig.* 7)

Starting circuit

29. There are no permanent magnets in the generator field, and so an external source of excitation is necessary until the generator output is sufficient to produce its own field current from the voltage control circuit. This external excitation is provided by the 28V. d.c. supply that is also used to energize the solenoid on-off valve in the hydraulic system of the motor-generator. This supply is used to excite part of the field winding (the "auto" field) on the generator, the other part (the "control" field) being excited by the voltage control circuit; both parts of the field are series-connected to the voltage control circuit for normal operation.

30. When the generator output is required, 28V. d.c. is applied via relay contacts A1 and A2 to energize relay B. Contact B2 connects the generator auto field winding to the 28V. d.c. supply, and contact B1 connects the generator control field winding across the voltage control circuit output. The 28V. d.c. is also applied through the centrifugal switch contacts in the generator, which are closed until the switch operates at 23,000 rev/min. and the normally closed relay contact C1 to energize relay D. Contact D1 connects the 28V. d.c. line to the hydraulic on-off solenoid valve, the other connection of which is earthed, and contact D2 completes the circuit between transductor TZ21 (via MR24) and the protective circuit relay E (*para* 35). The thermal relay T is energized from the 28V. d.c. supply via relay contact C2 and resistor R22 (*para.* 43).

31. As the generator speed increases, the generator output voltage increases (the field current initially being provided by the 28V. d.c. supply) and thus the "control" field current also increases. When the generator output is about 90–100V. r.m.s. the output of the rectifier MR11, which is supplied from the 24V. r.m.s. (nominal) secondary of TR11, causes relay A to operate. When this occurs, contact A1 de-energizes relay B and contact A2 disconnects the "auto" field from the +28V. line. Relay B being de-energized, the contacts B1 and B2 connect the two parts of the generator field in series across the voltage control circuit, the output of which is at its maximum for the input supply. Then, as soon as the neons in the neon-bridge circuit strike, the normal voltage regulation commences.

32. When the generator speed reaches 23,000 rev/min. the centrifugally operated switch in the generator changes over and disconnects the 28V. d.c. line from relay D. Relay D, however, though disconnected from the 28V. d.c. line, will remain in its energized state for between 0·75 and 1·5 seconds due to the delay circuit, consisting of C23, R23, thus ensuring that the generator output has enabled the protective circuit relay E to become energized (*para.* 35), and re-connect relay D to its energizing supply. This delay circuit for relay D also prevents the machine from being shut down due to transient conditions. If relay E is not energized at the expiry of the delay period, relay D de-energizes, contact D1 opens, and the hydraulic on-off solenoid valve is closed, thus shutting down the machine (*para.* 35).

33. The load feedback signal produced by the field current flowing through R17 is present when the field is energized from the 28V. d.c. supply during starting, and when normally operating (*para.* 26 (4)).

Protective circuit

34. If the generator output frequency and voltage are incorrect for any reason, the protective circuit causes relay D to be de-energized, thus disconnecting the 28V. d.c. supply to the hydraulic on-off solenoid valve, and shutting down the machine; shut down occurs only for frequency and/or under voltage errors in excess of 5 per cent.

35. Relay D is de-energized if, after the starting sequence has been completed, the protective circuit relay E becomes de-energized. The energizing supply for relay E is provided by the output of the transductor TZ21, but if fault conditions develop, the output of TZ21 falls and relay E de-energizes; the system is thus said to "fail to safe" Contact D2 prevents relay E from re-energizing when, for instance, the generator is running down from an overspeed fault condition

36. The reduction in the output of transductor TZ21 when fault conditions are present is produced by causing a drop in either or both of the control currents that are fed through the transductor control windings A and B

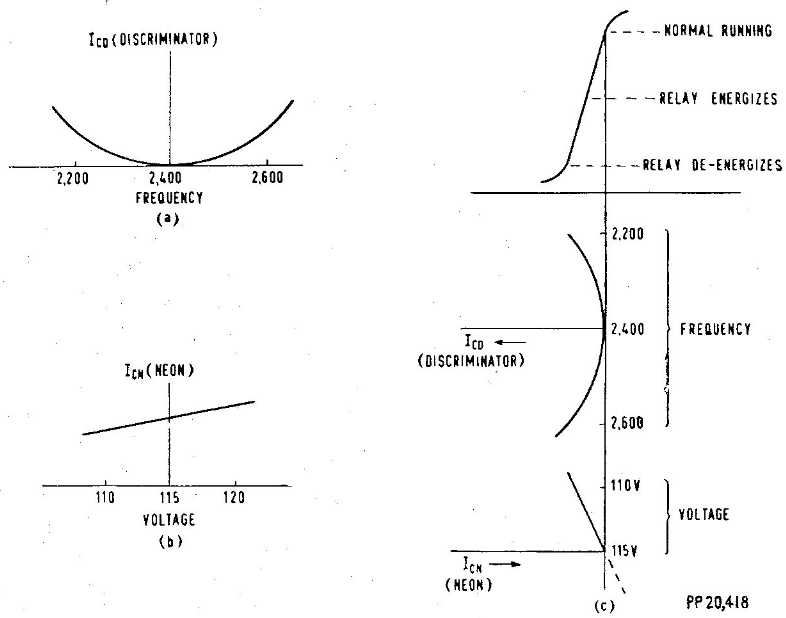


Fig. 8. Circuit characteristics

37. Control winding A of TZ21 (*fig* 7) is fed with d.c. (Icd) from the rectifier MR21 which is supplied with 15V. r.m.s. from a secondary winding on the input transformer TR21 via the parallel-tuned circuit L21; C21 that has a resonance characteristic of the approximate form shown at (a) (*fig* 8).

38. Control winding B of TZ21 is fed with d.c. (Icn) from MR22 via the resistor R21 and the neon stabilizing valve V3. MR22 is supplied by a 200V. secondary on transformer TR21. The approximate characteristics of the circuit TR21, MR21, R21, V3 are shown at (b) (*fig*. 8). (Icn is the control current from the neon circuit).

39. The magnetic amplifier, consisting of the transductor TZ21 and rectifier MR24 etc., accepts these two signals, together with a bias signal current (Icb) from MR23 the overall transductor characteristics having the form shown diagrammatically at (c) of fig. 8 (Icb is the control current from the bias circuit). The bias current off-sets the standing e.m.f. derived from the two control windings A and B such that under normal running conditions relay E is fully energized. A frequency error and/or under-voltage error in excess of 5 per cent will cause the transductor output to drop, as can be seen from (c) of fig. 8, so that relay E de-energizes. This is also the case if a short-circuit on the 115V. line occurs, since the transductor output will fall to zero.

40. When the generator starts and accelerates to its normal operating speed, starting conditions are the same as fault conditions (i.e. low frequency and voltage). To distinguish between the apparent fault condition on starting, and the true fault conditions occuring after a normal starting sequence, a centrifugally operated switch is fitted in the generator. This circuit operates in the following manner.

41. Relay D is energized when the generator output is required and the relay contacts complete the circuits of relay E, rectifier MR24, transductor TZ21, and the hydraulic on-off solenoid valve. When the centrifugal switch operates, the 28V. d.c. supply to relay D is interrupted until it is completed again via contact E1 of the protective circuit relay E; this relay is energized when the generator attains its normal output frequency and voltage. The centrifugal switch also causes relay C to operate; contact C2 then completes a "holding" circuit so that relay

C remains energized and ensures that relay D is only energized via contact E1.

42. When a fault prevents the generator from reaching its correct speed, the centrifugal switch may not operate and the protective circuit would then remain inoperative because relay D is energized via contact C1. To counteract this, the thermal delay relay T is energized when the 28V. d.c. supply is switched to the control unit; the relay operates after approximately 40 sec. and its contact T1 then energizes relay C. Contact C1 breaks the circuit through relay D and the machine is shut down.

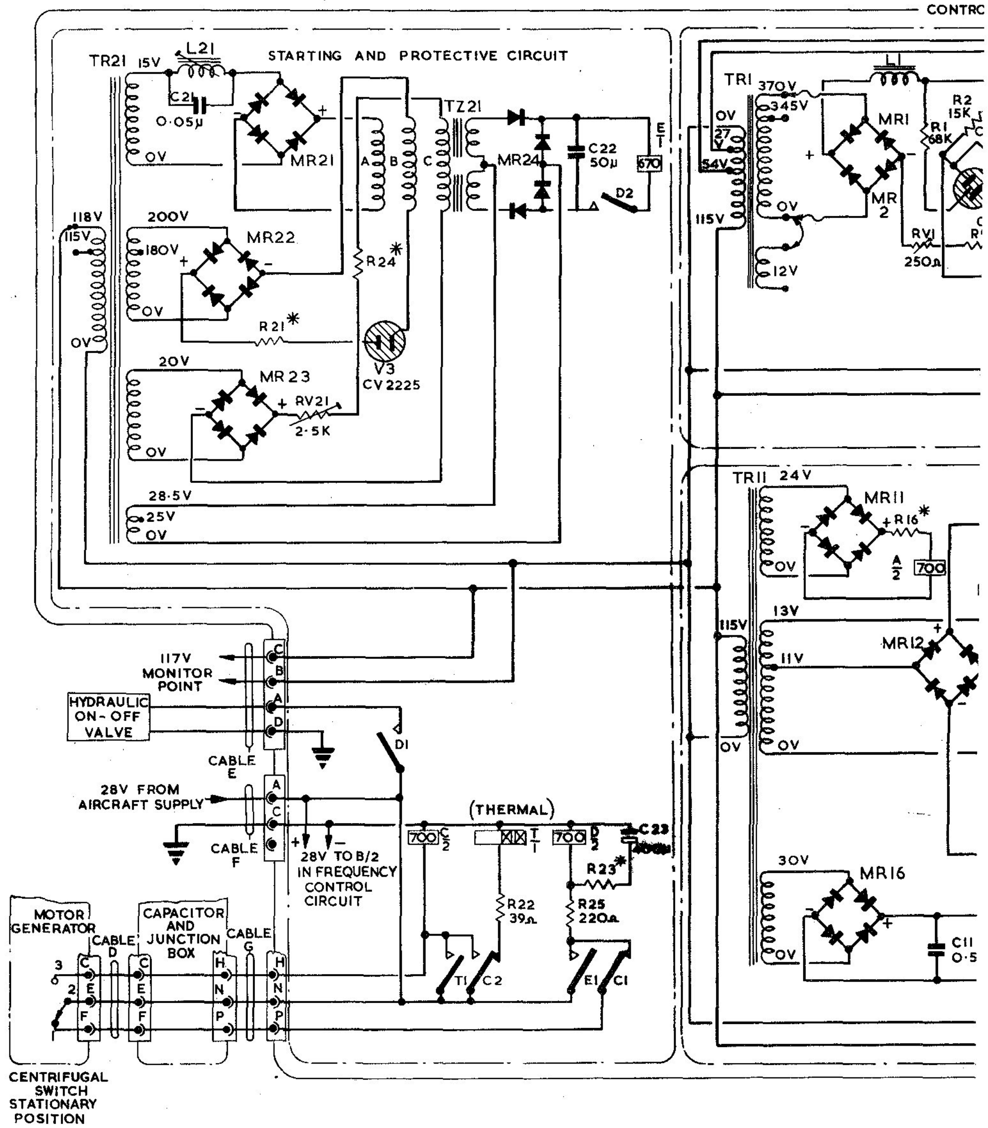
Installation

43. It is most important that the word TOP shown on the front bulkhead is always at the top when the control unit is mounted in an aircraft. Care must be taken to see that sufficient clearance is left for all cables and cooling pipes, that the potentiometers RV1 and RV11 on the front bulkhead of the B300–2 control unit are accessible for adjustment and that the cover plate for RV1 on the front bulkhead of the type B300–3 control unit is always in such a position that it can be removed easily for adjustment to the potentiometer.

NOTE :-
VALUES SELECTED ON TEST SHOWN THUS — ✳
LIMITS AS SHOWN.

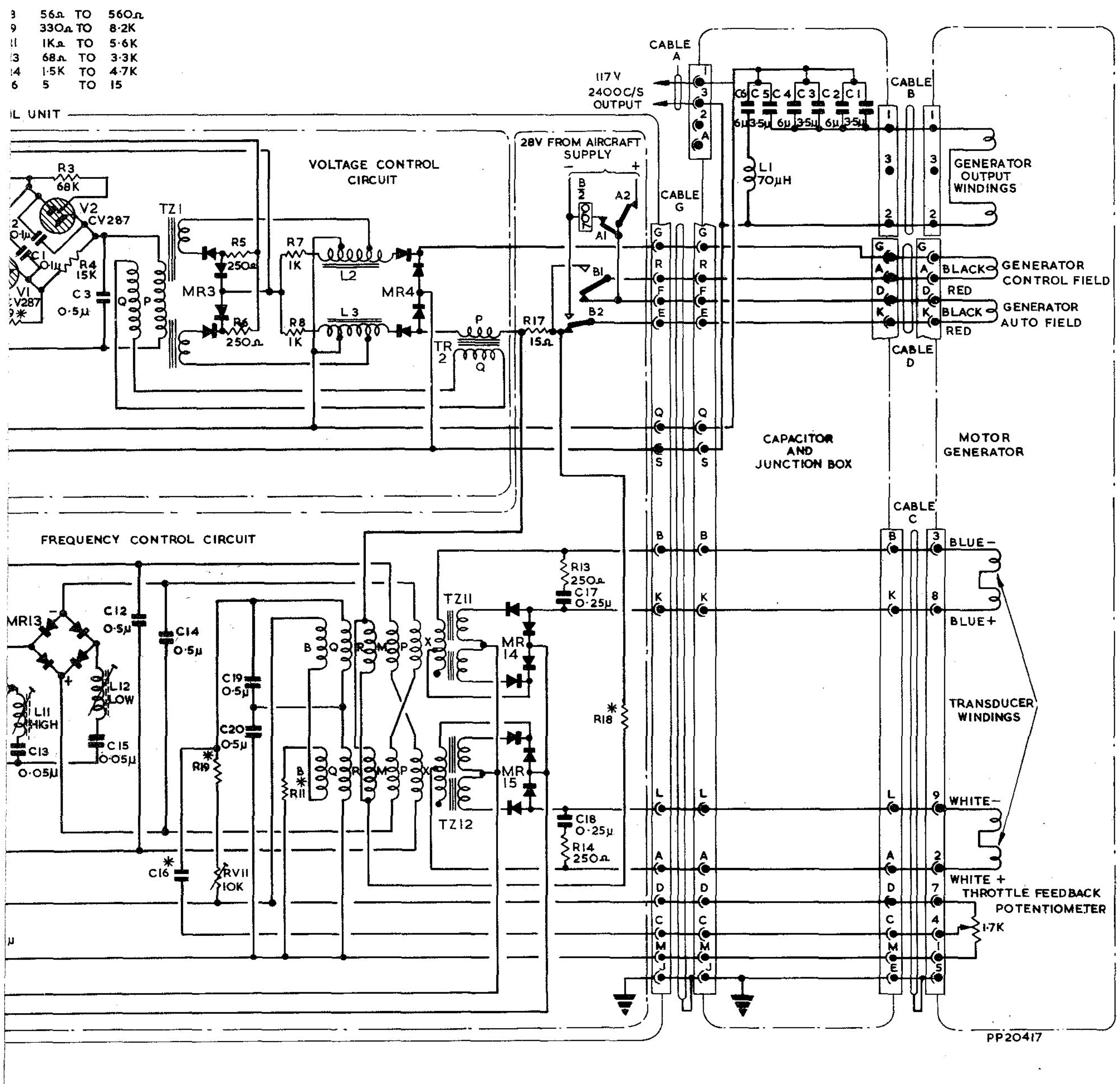
R 9	100Ω	TO	680Ω
R 11	4·7K	TO	33K
R 12	100Ω	TO	10K
R 16	100Ω	TO	10K

RI
RI
R2
R2
R2
CI



F.S./8

Fig.9



Generator control circuit

SERVICING

General

44. The following paragraphs contain details off the procedures for the dismantling, servicing and assembly of the variants of the B300 series of control units. Attention is drawn to the differences in wiring, control and component location which exist between the two types of control units of the B300 series. Routine servicing must be effected in accordance with the relevant servicing schedule and the instructions given in this chapter.

Routine servicing

45. The routine servicing detailed below should be completed with the control unit installed in the aircraft:

(1) Ensure that the control unit is securely attached to its mounting fixture and that all metal bonding strips are intact and firm.

(2) Examine all electrical connectors for cleanliness and security.

(3) Ensure that the cooling air pipe attachment is secure.

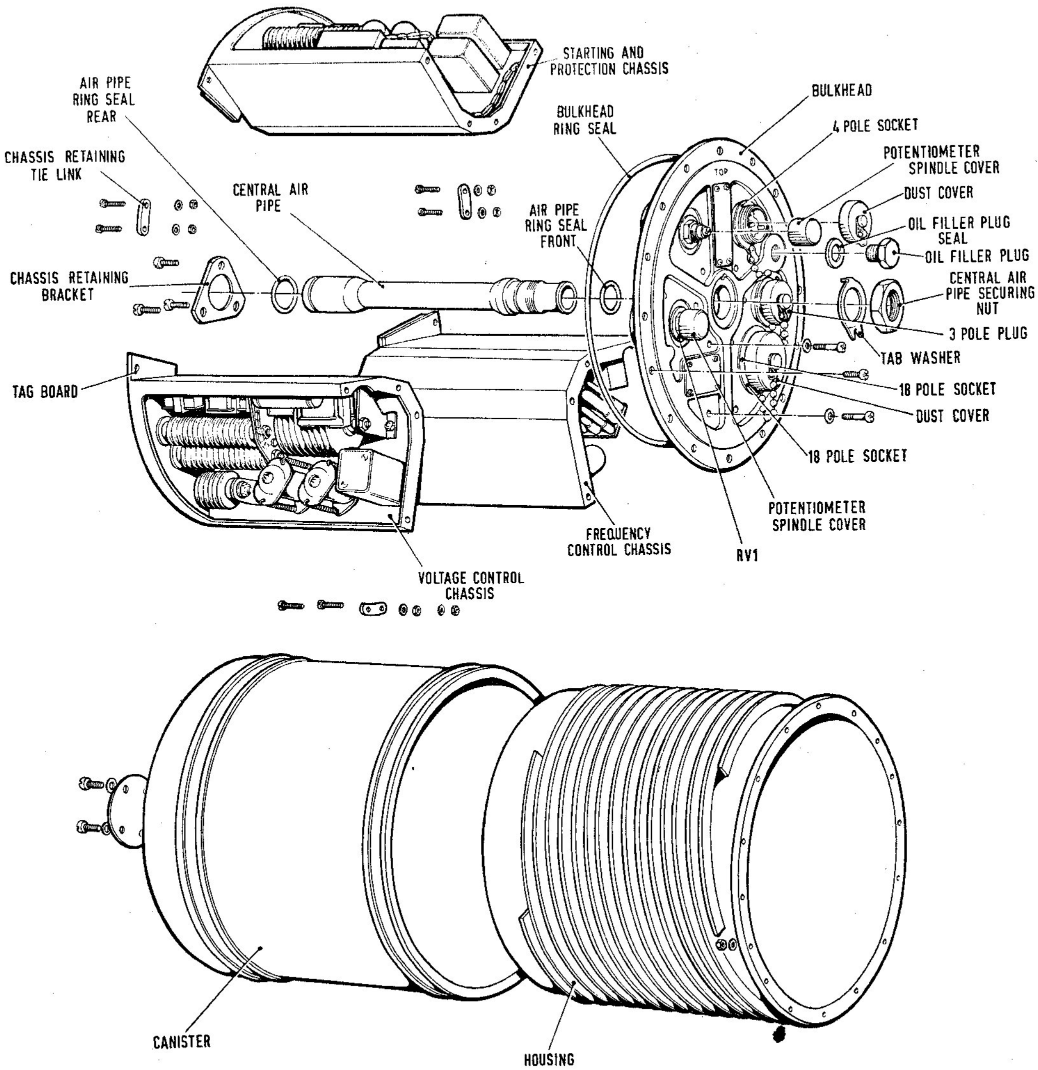


Fig. 10. Control unit—Exploded view

(4) Ensure that all securing screws are tight and wire locking intact.

(5) Inspect the control unit for oil leakage.

Note . . .

If an oil leak is found it will be necessary to remove the control unit from the aircraft. Detailed instructions for the removal of the unit will be found in the relevant aircraft handbook.

46. The permissible electrical adjustments to the B300 series controller when installed in the aircraft differ according to the controller in use. With the B300-3 controller installed the only adjustment is to the output voltage. This is accomplished by removing the small cover plate on the front of the bulkhead and adjusting the potentiometer RV1 thus exposed. When the B300-2 controller is installed, adjustment of both output voltage and frequency is possible. Access to RV1 and RV11 is by cutting the locking wire and removing the potentiometer spindle covers (*fig.* 10). Detailed procedure for making these adjustments is given in Chap. 7.

REFER TO STN/ELECT/98

Matching the B.300-2 control unit to B.503 or B.504 a.c. generators

47. The B300-2 control unit can be matched with any B503 or B504 a.c. generator using the 1st or 2nd line test sets in accordance with the following instructions.

(1) Connect the a.c. generator, to which the control unit is to be matched, to the test set, type BT.139 or BT.950 as for a routine test (*A.P.*4343*A*, *Vol.* 1, *Sect.* 2, *Chap.* 2 *and* 15 *refer*).

(2) Remove the protecting covers from the voltage control potentiometer, RV1 (*fig.* 1 *and* 2) and from the frequency control potentiometer, RV11 (*fig.* 1 *and* 6).

(3) Set both potentiometer spindles to their mid positions.

(4) Set the Load Unit to full load. (1750 watts for the B503 and 3000 watts for the B504 series a.c. generators.)

(5) Run up the a.c. generator.

Note . . .

With the BT.950 test set the inlet pressure should be 2650 lb/in², with a back pressure of 100 lb/in². With the BT.139 test set the inlet pressure should be 2650 to 2950 lb/in².

(6) Check the generator output voltage, adjusting RV1 as necessary to obtain a value of 117±1%.

(7) Check the frequency of the generator output, adjusting RV11 as necessary to obtain a frequency of 2400 c/s±1%.

(8) Shut the machine down, replace the covers on the potentiometers and wire lock them.

(9) Make a normal 1st and 2nd line test.

Dismantling

48. When dismantling the unit reference should be made to fig. 10.

Canister

49. Remove the canister as follows :—

(1) Cut the locking wire and remove and retain the four 4BA screws and the plate at the domed end of the canister.

(2) Withdraw the bulkhead and its housing from the canister.

Housing

50. Remove the housing as follows :—

(1) Cut the locking wire on the oil filler plug.

(2) Remove the oil filler plug and discard the sealing washer.

(3) Drain out all the oil (approx. 5 pints).

(4) Remove and retain the sixteen 6BA screws, washers and nuts from the periphery of the housing.

(5) Withdraw the housing from the bulkhead. The bulkhead can be supported by the cooling air tube during this operation.

Note . . .

Aluminium castings are used for both housing and bulkhead and irreparable damage will result if undue force is used; the ring seal of the bulkhead may also be damaged unless care is taken during the removal of the housing.

Chassis

51. To remove any one of the three chassis proceed as follows: —

(1) Disconnect the wiring linking the two small tag panels on the chassis to the panels attached to the adjacent chassis. When disconnecting the voltage control chassis unsolder the two fly leads to resistor R9

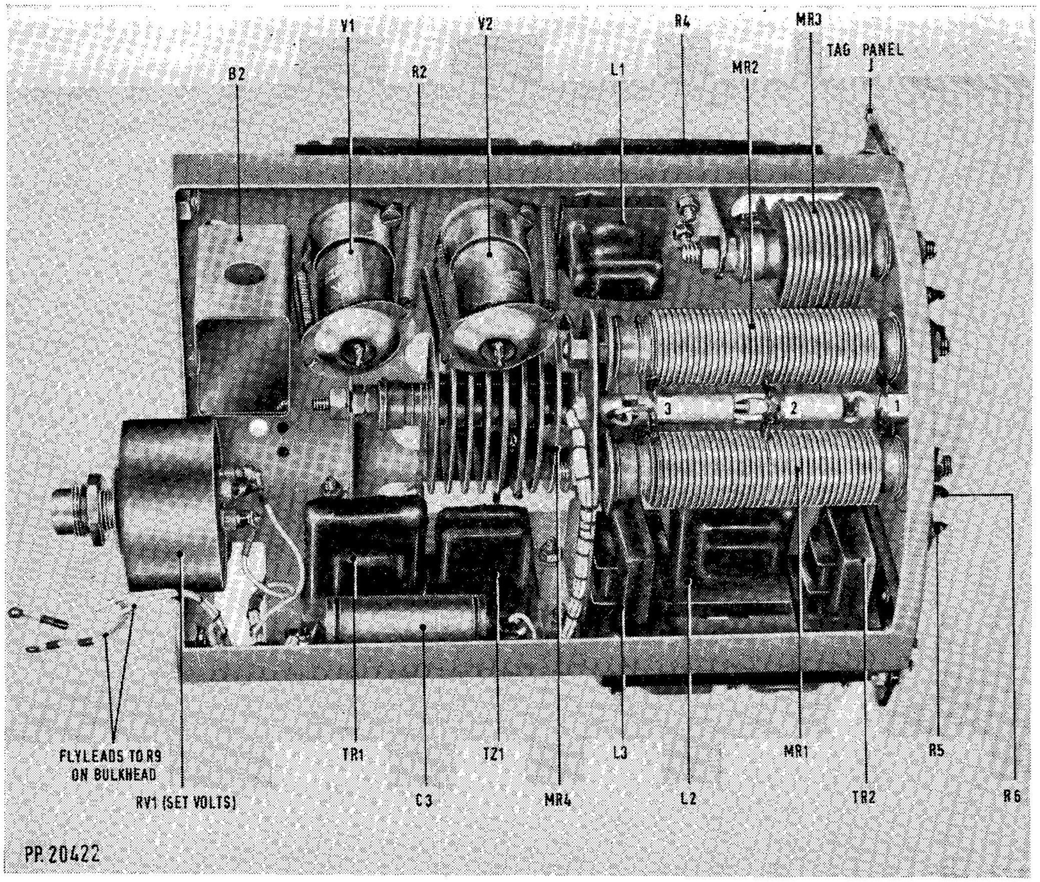


Fig. 11. Voltage control chassis—Upper surface

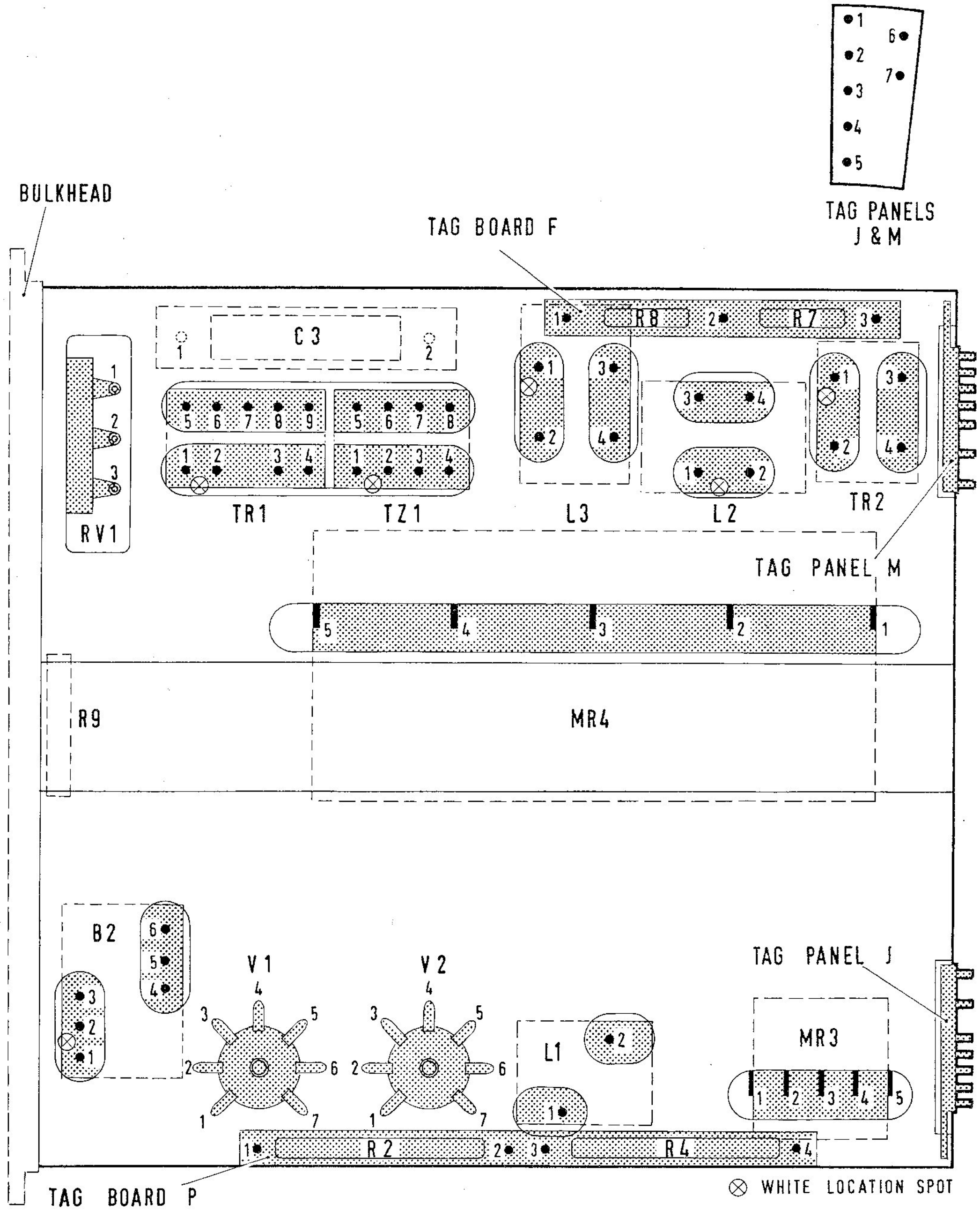
and ensure that all wiring removed can be identified so as to enable it to be connected correctly when re-fitting the chassis.

(2) Remove the protective cap on the appropriate Mk. 4 connector and slacken the locking ring on the rear of the bulkhead; remove and retain the ring from the front of the connector. Discard the sealing washer.

(3) Cut the locking wire and remove and retain the appropriate potentiometer spindle covers on RV1 and RV11, and the respective locking nuts and sealing washers. Discard the sealing washers. In the case of control unit B300-3 it will not be necessary to disturb RV11.

52. Remove and retain the 6BA screws on the appropriate chassis securing the chassis to the retaining bracket on the central air pipe. Detach and retain the tie links attaching the outer edges of the chassis to the two adjacent chassis. Retain the two 8BA screws, washers and nuts in each.

53. Remove the four 4BA screws and sealing washers securing the chassis to the bulkhead. Retain the four screws and discard the four sealing washers. Note the positions of screws with drilled heads.



(d) SIMPLIFIED VIEW OF LOWER SURFACE OF CHASSIS TO SHOW TAG NUMBERING ETC. (BLOCK B2 CONTAINS C1, C2, C3, R1, R3.)

PP. 20423

Fig. 12. Voltage control chassis—Lower surface

54. Carefully withdraw the chassis from the bulkhead, with the associated connector(s) and/or potentiometer(s).

55. Removal of small components i.e. resistors, capacitors, etc., can now be accomplished by unsoldering the connecting leads from the tag boards.

56. To remove any one of the larger components, transformers, relays etc., proceed as follows:

(1) Unsolder the connecting leads at the component. (Avoid the application of excessive heat as this will damage the component and/or adjacent components).

(2) Remove and retain the component securing screws and/or nuts and washers.

(3) Remove the component from the chassis.

57. After re-fitting any component, lock all screws, and/or nuts and washers which have been disturbed with varnish V130/1, (spec. TS188).

Renewing ring seals

Ring seal—bulkhead

58. The ring seal on the bulkhead can be renewed when the canister and housing are removed. Remove the canister and housing

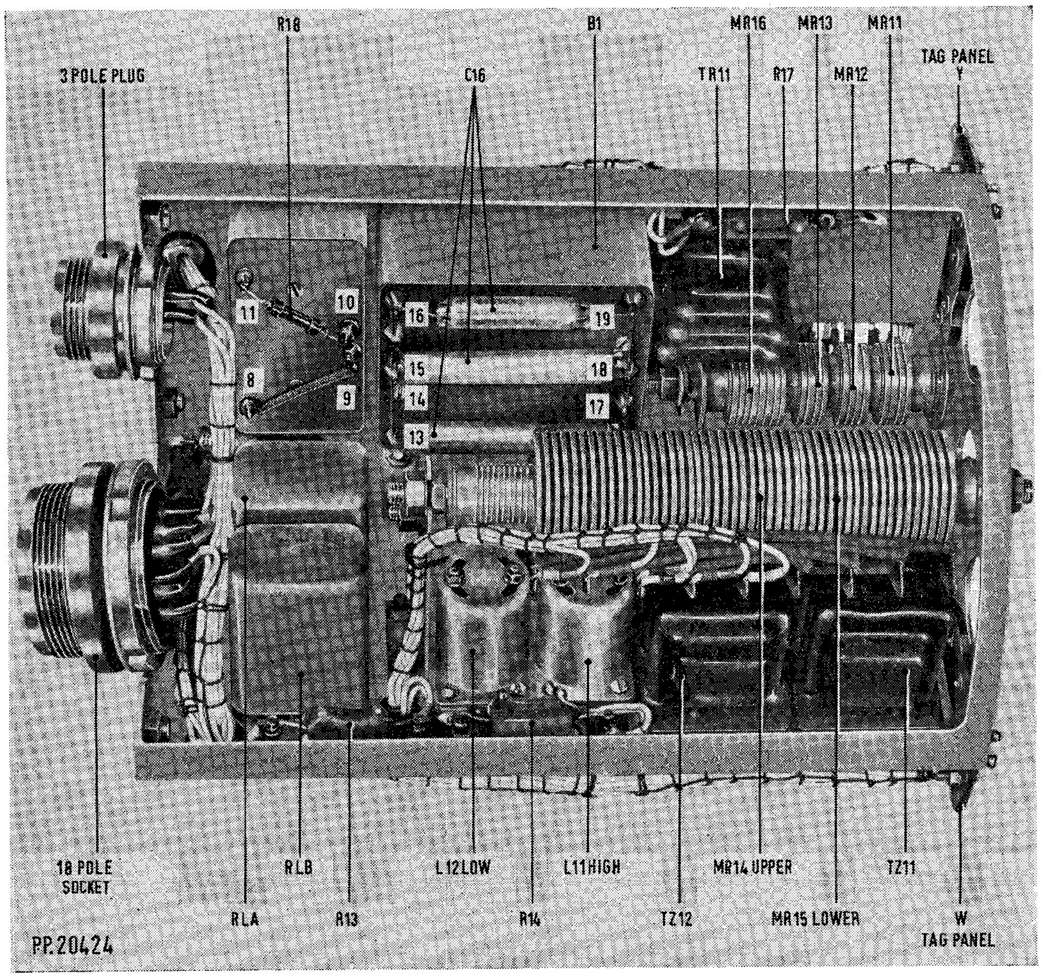
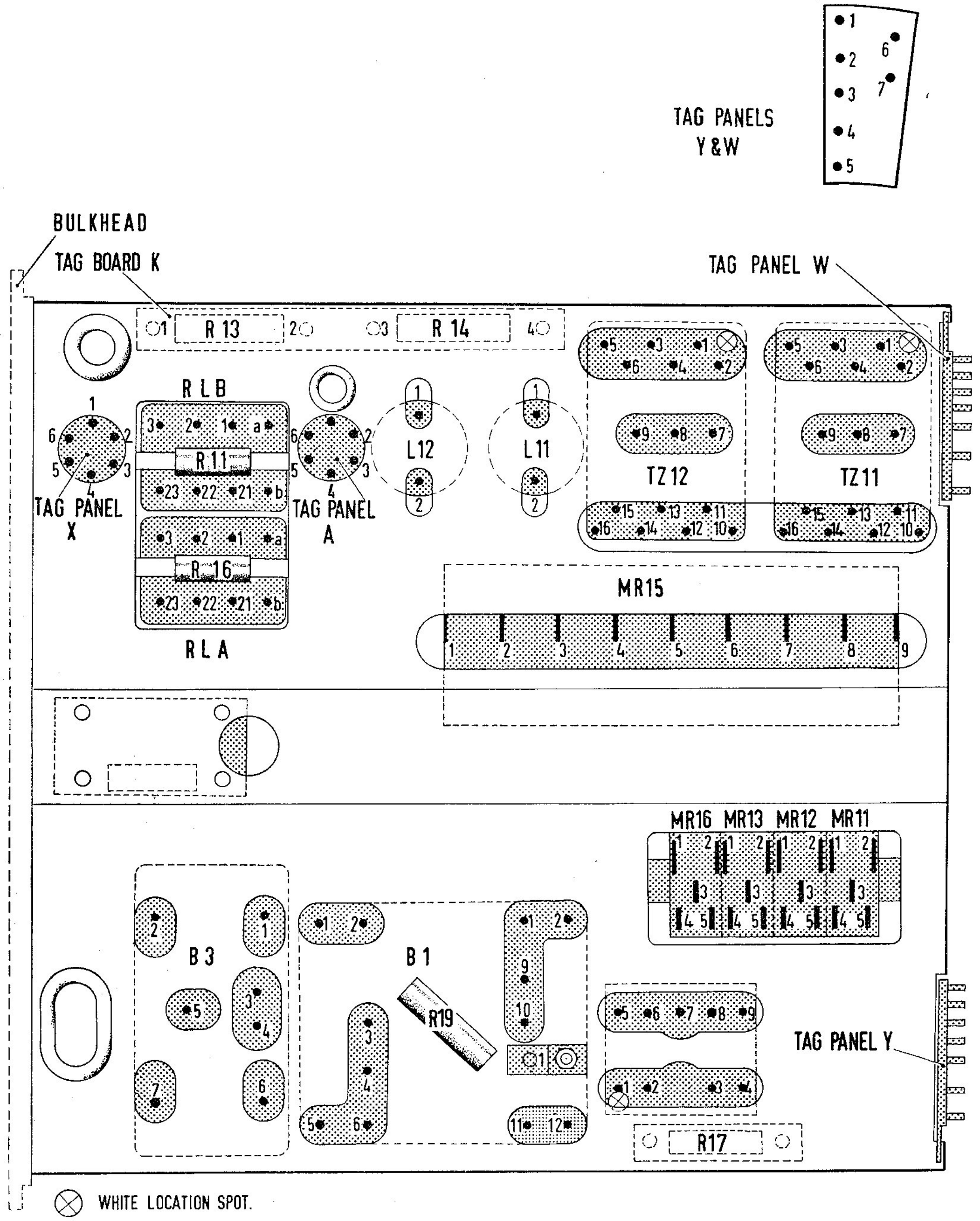


Fig. 13. Frequency control chassis—Upper surface



(a) SIMPLIFIED VIEW OF LOWER SURFACE OF CHASSIS TO SHOW TAG NUMBERING ETC.

PP.20425 BLOCK B1 CONTAINS C11, C12, C14, C16, C17, C18. BLOCK B 3 CONTAINS C13, C15.

Fig. 14. Frequency control chassis —Lower surface

as described in paras. 48 and 49 of this chapter. Renew the seal as follows:

(1) Disengage the ring seal from its groove on the periphery of the bulkhead lip.

(2) Remove the ring seal from the control unit by sliding it away from the bulkhead, over the chassis, until it is clear of the control unit.

(3) Ensure that the groove for the ring seal in the bulkhead is clean and free from any foreign matter.

(4) Place the new ring seal over the chassis and move it towards the bulkhead. Take care to avoid damage to the ring seal when passing over the chassis.

(5) Engage the ring seal in the seating and ensure that it is correctly seated over the entire circumference.

Ring seal—air pipe—rear

59. The ring seal can be renewed when the canister and housing are removed. Remove the canister and housing as described in paras. 48 and 49 of this chapter. Renew the ring seal as follows:

(1) Remove the ring seal from its groove near the end of the central air pipe.

(2) Ensure that the groove for the ring seal is clean and free from foreign matter.

(3) Slide the new ring seal over the end of the central air pipe and locate it in the groove. Ensure that the ring seal is securely located in the groove.

Ring seal—air pipe—front

60. Renew the ring seal between the central air pipe and the bulkhead as follows:

(1) Remove the canister and housing as described in para. 48 and 49 of this chapter.

(2) Remove any two chassis, following the procedure detailed in para. 50 of this chapter.

(3) Remove and retain the 6BA screw securing the remaining chassis to the chassis retaining bracket and remove and retain the bracket.

(4) Bend back the tab washer which locks the nut on the bulkhead end of the central air pipe and remove and retain this nut. Discard the tab washer.

(5) Withdraw the central air pipe from the bulkhead until it is clear of the chassis.

(6) Remove and discard the ring seal thus exposed.

(7) Ensure that the groove for the ring seal is clean and free from dirt or foreign matter.

(8) Fit the new ring seal on the central air pipe, ensuring that it is firmly located in its groove.

(9) Smear the ring seal with transformer oil, OM.16 (Gulfsil type B30, to British spec. 148. Low temperature requirement –45°C. pour point) to facilitate insertion.

(10) Insert the central air pipe through the bulkhead and, using a new tab washer, secure in place with the nut removed in (4).

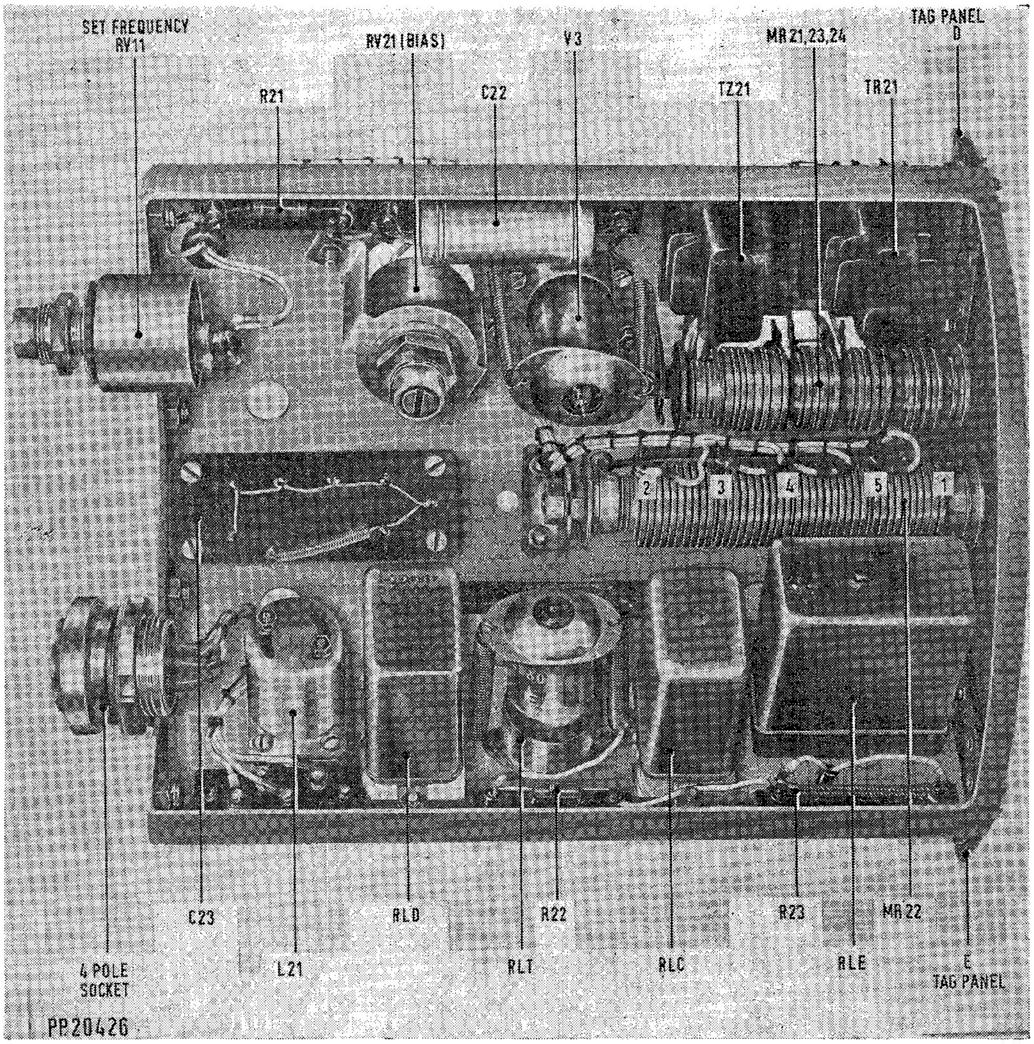


Fig. 15. Starting and protective chassis—Upper surface

Re-assembly

61. To re-assemble the unit proceed as follows:

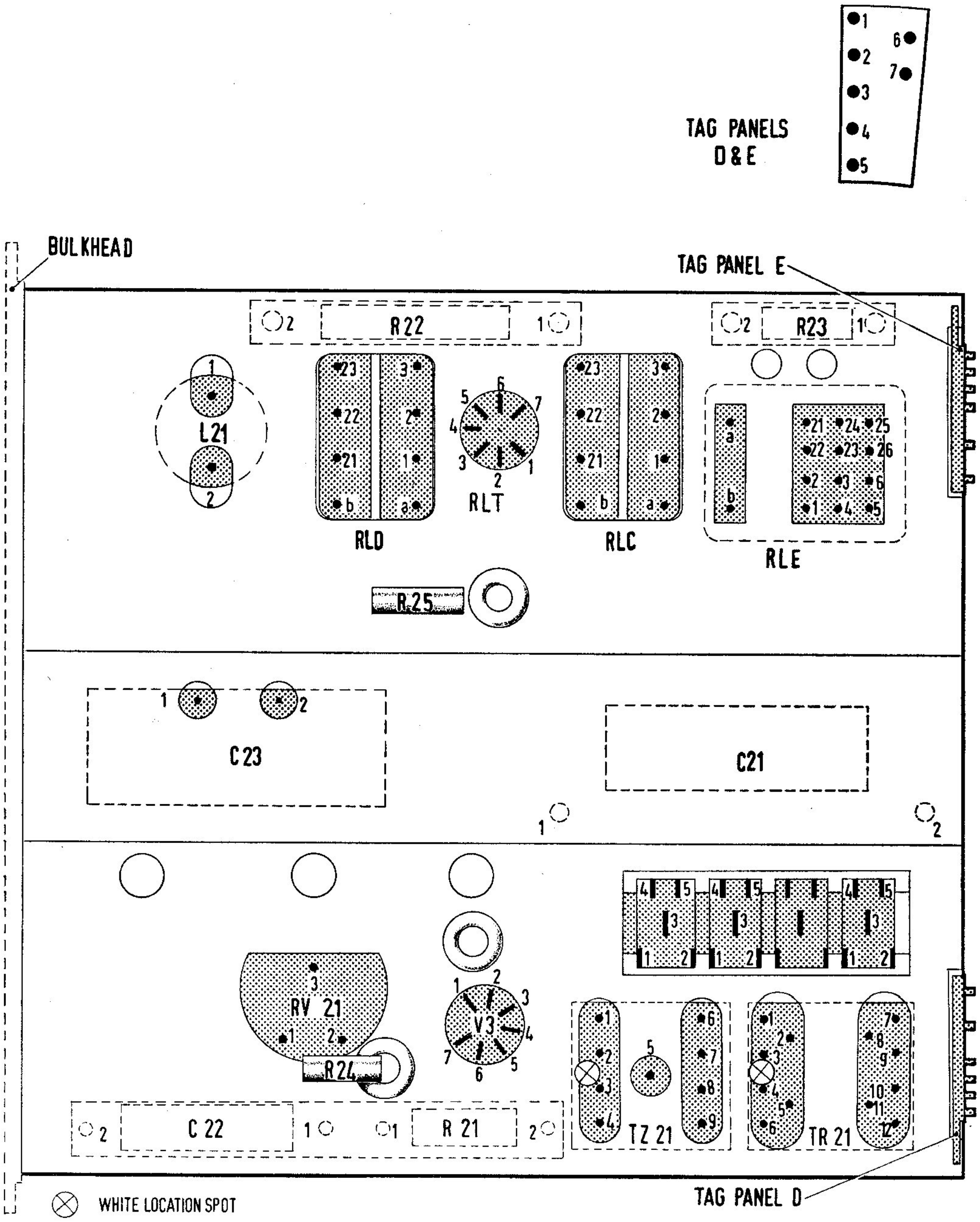
62. Before re-assembling the control unit lock all screws and nuts, which are not locked mechanically, with varnish V130/1 (spec. TS.188). Also, ensure that new sealing washers are incorporated on all chassis/bulkhead securing screws, Mk. 4 connectors and potentiometers.

Chassis

63. To re-assemble any one of the three chassis to the central air pipe/bulkhead assembly proceed as follows:

(1) Position the chassis against the bulkhead, inserting the Mk. 4 connectors and potentiometers through their respective holes in the bulkhead.

(2) Insert the four 4BA screws complete with new sealing washers through their respective holes in the bulkhead and secure. Ensure that the special screws with drilled heads are inserted in the holes from which they were removed.



(C) SIMPLIFIED VIEW OF LOWER SURFACE OF CHASSIS TO SHOW TAG NUMBERING ETC.

Fig. 16. Starting and protective chassis—Lower surface

(3) Place new sealing washers on the Mk. 4 connectors and on the potentiometers. Screw on the threaded rings and locknuts removed from the Mk. 4 connectors and potentiometers respectively.

(4) Secure the Mk. 4 connectors by tightening their locking rings on the rear of the bulkhead.

(5) Secure the potentiometers by tightening their locknuts on the front of the bulkhead.

(6) Screw on the potentiometer spindle cover but do not wire-lock until final testing is completed.

(7) Fit the tie links to secure the outer edges of the chassis to the two adjacent chassis and insert and tighten the four 8BA screws, washers and nuts (two in each tie link).

(8) Insert the 6BA screws to secure the chassis to the chassis retaining bracket.

(9) Re-connect the wiring linking the two small tag panels on the chassis to the panels attached to the adjacent chassis (*fig.* 17).

Note . . .
When connecting the voltage control chassis, it will be necessary to connect the two fly leads to R9 (fig. 10).

Housing

64. Re-assemble the housing as follows:

(1) Smear the ring seal with transformer oil, OM.16 to facilitate insertion.

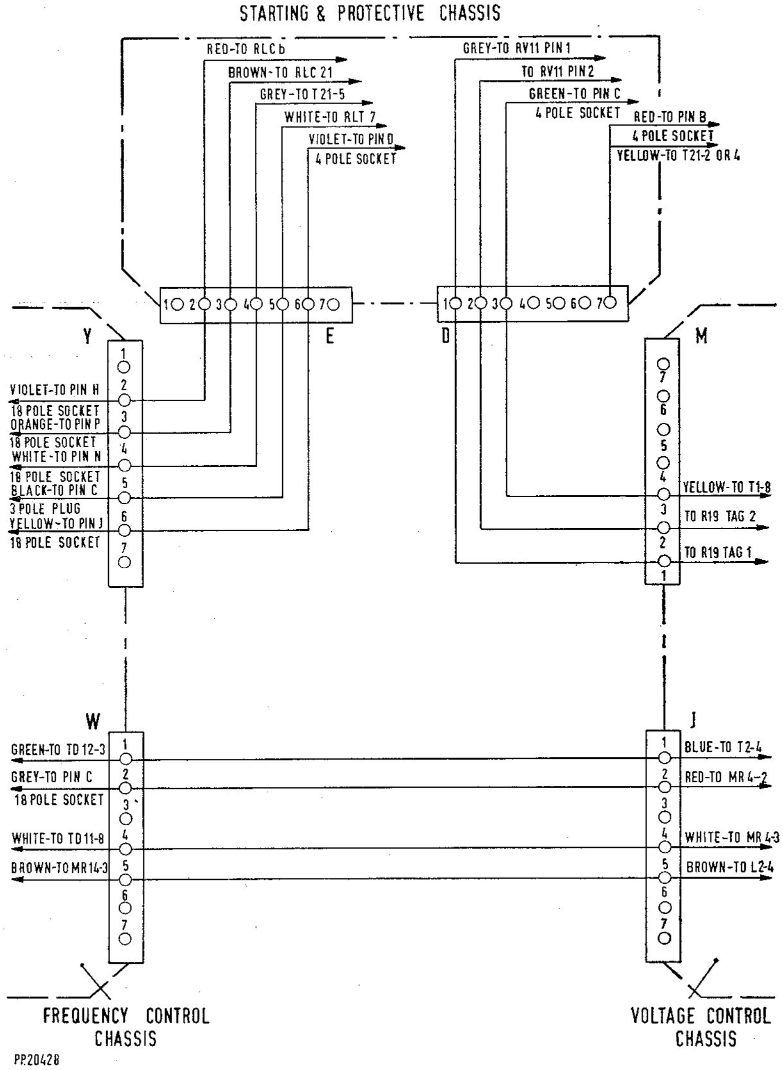


Fig. 17. Chassis interconnection diagram

(2) Slide the bulkhead/chassis assembly into the housing.

(3) Secure the housing to the bulkhead with the sixteen 6 BA screws, washers and nuts.

Canister

65. Re-assemble the canister to the housing as follows:—

(1) Slide the housing/bulkhead assembly into the canister, ensuring that the four holes in the domed end of the canister are aligned with the four screw holes in the raised boss of the housing.

(2) Secure the canister to the housing with the four 4 BA screws.

(3) Secure the four 4 BA screws with 22 s.w.g. locking wire.

(4) Fill the assembly with approximately 5 pints of transformer oil OM.16, through the filler hole in the front of the bulkhead.

(5) Using a new sealing washer, refit the oil filler plug and secure it with locking wire to the adjacent voltage control chassis securing screw.

TESTING

General

66. Control units of the B300 series are tested by means of a serviceable B504 series slave a.c. generator, its complementary capacitor and junction box and either the B.T.950 or the B.T.2780, electronic test console and associated slave control unit. Hydraulic supplies for running the slave a.c. generator are obtained from an H.M.L. test rig.

67. The slave a.c. generator and slave control unit are used, for providing a 117V supply at a frequency of 2·4kc/s which is routed to the control unit under test via the test console. This supply may be varied in both voltage and frequency by use of controls mounted on the test console: i.e. voltage is varied by means of the VARIAC control and frequency by the SET FREQUENCY control. Information on running up the B504 a.c. generating system is contained in A.P.4343A, Vol. 1, Sect 2, Chap 15.

Test equipment required

68. The following items of test equipment are required:

(1) Electronic test console type B.T.950 (Ref. No. 5G/3187) or test console B.T.2780 (Ref. No. 5G/4191) incorporating a slave control unit

(2) Slave B504 ac. generator together with capacitor and junction box.

(3) Voltmeter, 0-150V a.c. (Ref. No. 5QP/25256).

(4) Test meter, type F (Ref. No. 5QP/1).

(5) Stop watch.

(6) Resistance bridge, Marconi type or equivalent.

(7) H.M.L. hydraulic test rig.

(8) 110-125V or 200-255V 50/60 c/s electrical supply.

(9) Load unit (water cooled, Ref. No. 5G/3202) or (air-cooled Ref. No. 5G/3201).

Setting up procedures

69. Set up the test equipment as follows:

(1) Set up and calibrate the B.T.950 test console as detailed in A.P.4343S, Vol. 1, Book 2, Sect 9, Chap. 6. Set up the console type BT.2780 as detailed in A.P.4343S, Vol 1, Book 2, Sect. 9, Chap. 11.

(2) Connect the slave a.c generator to the hydraulic test rig

(3) Connect the load unit to the test console.

(4) Mount the control unit under test in the clamps provided on the test console.

(5) Make the electrical connections shown on fig. 18.

(6) Connect the a.c. voltmeter across poles J and K of SKT23 (C.R.O.) on the test console.

70. Make the following switch and/or control settings on the test console load control and controller test panel:

(1) Set the CONT TEST INPUT switch to VARIAC.

(2) Set the VOLTMETER switch to CONTROLLER INPUT.

(3) Set the RUN/START switch to START.

(4) Set the FINE LOAD CONTROL/CONTROLLER TEST INPUT switch to CONTROLLER TEST INPUT.

(5) Set the relevant ALTERNATOR LOAD switch to 1000W ON DIRECT.

(6) Set the VARIAC control fully counter clockwise.

(7) Set the CONTROLLER switch to TEST.

(8) Set the C.R.O. switch to CONT. TEST.

(9) Set the SET VOLTS control to approximately mid position.

(10) Set the SET FREQUENCY control to approximately mid position.

(11) Connect the resistance bridge

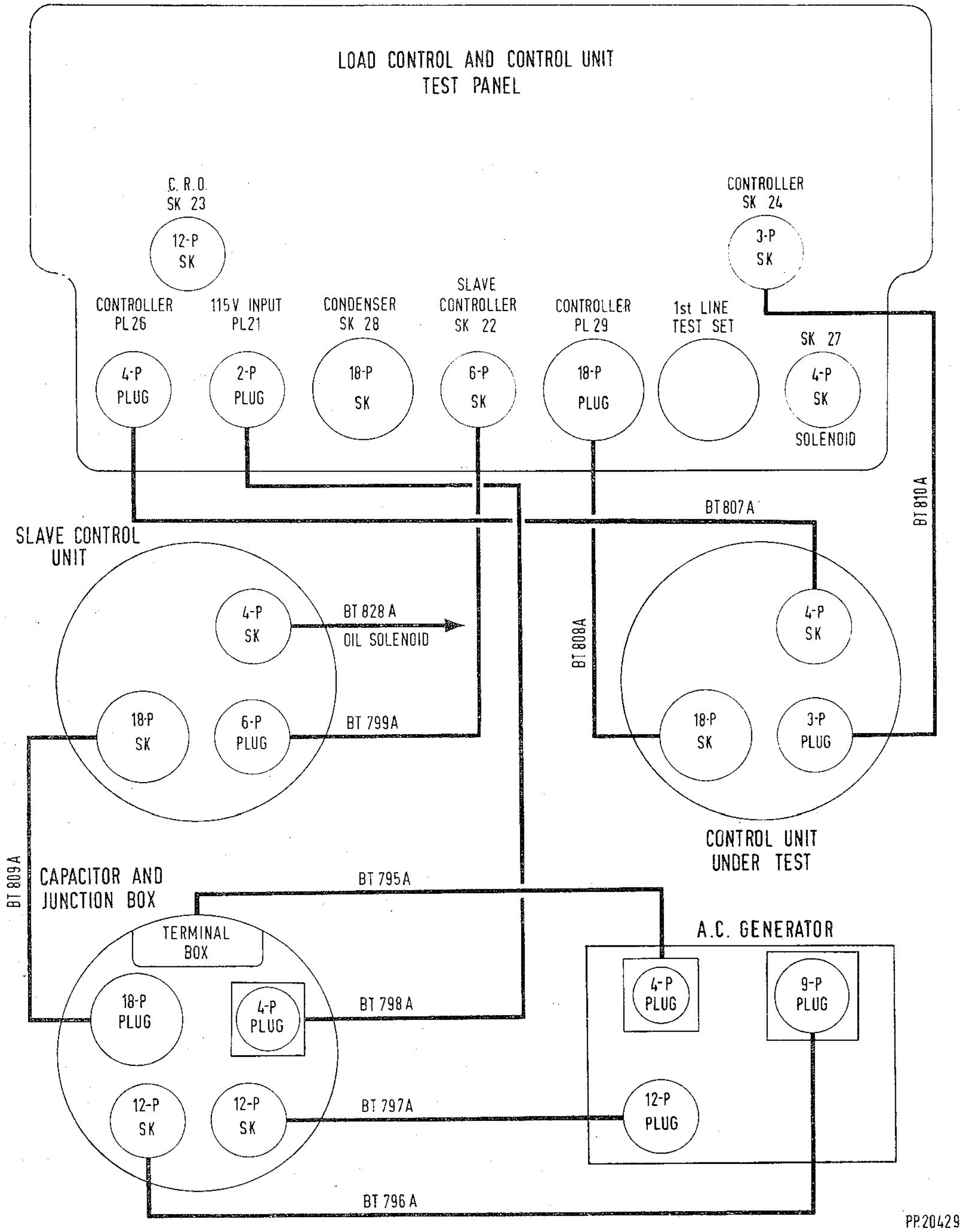


Fig. 18. Control unit interconnection diagram

across poles E and G of PL29 (CONTROLLER) of the test console: adjust the SET FIELD current control to give a value of 130Ω on the resistance bridge. Remove the resistance bridge and reconnect the cable loom.

(12) If the test console type B.T.2780 is used, set the POWER UNIT SELECTOR switch to position 1.

71. Make the following switch settings on the test console meter panel:

(1) Set RANGE A MILLIAMPS to 300.
(2) Set SELECTOR A to TRANSDUCER 1.
(3) Set RANGE B MILLIAMPS to 300.
(4) Set SELECTOR B to TRANSDUCER 2.
(5) Set RANGE C MILLIAMPS to 1000.
(6) Set SELECTOR C to AUTO FIELD.
(7) Set RANGE D VOLTS to 30.
(8) Set SELECTOR D to D.C. SUPPLY.

72. By means of the SET DC VOLTS control obtain a reading of 27 ± 1V on METER-D.

Testing procedures

73. Testing procedures are divided into two parts:

(1) Testing of the complete control unit
(2) Testing of individual chassis of the control unit.

74. Testing of the complete control unit is performed by making the connections shown on fig. 18 and applying varying voltages and frequencies produced by the slave a.c. generating system to the control unit in order to determine the overall performance. Failure to meet the test requirements by one or more chassis should be followed by individual testing of the chassis involved.

Note . . .

A voltage of 117V is quoted as the datum output of the slave a.c. generating system for testing purposes. This voltage is used for all R.N. applications of the B300 control unit. For R.A.F. purposes a voltage of 115V datum should be used.

75. Testing of the individual chassis is performed by dismantling the control unit (para. 48 to para. 57) and isolating the chassis required to be tested. The electrical connections shown on fig. 18 should remain as for overall testing except that the cable looms B.T.807A, B.T.808A and B.T.810A connecting the control unit under test to the console should be removed In place of the cable looms, flyleads are used to make the necessary connections. Chassis failing to conform to the requirements of individual testing should be replaced by serviceable chassis.

Overall testing of the control unit

Protective circuit run-up delay test

76. This test is intended to establish the upper and lower limits of the time constant of the control unit thermal relay RLT/1 governing the run up delay period when a voltage of 27 ± 2V d.c. is applied to it. The test is performed as follows:

(1) Test the continuity of the delay circuit by setting the ALTERNATOR START switch to ON and observing that the DC ON CONTROLLER and SIMULATE SOLENOID lamps are lit.

(2) Adjust the SET D.C. VOLTS control to obtain a reading of 29V on METER-D.

(3) Switch off the ALTERNATOR START switch.

(4) Wait 2 min to allow RLT/1 to cool.

(5) Switch ON the ALTERNATOR START switch and simultaneously start the stop watch

(6) Observe that the SIMULATE SOLENOID lamp does not become extinguished in less than 25s.

(7) Switch off the ALTERNATOR START switch and reset the stop watch.

(8) Adjust the SET DC VOLTS control to obtain a reading of 25V on METER-D.

(9) Repeat (4).

(10) Switch on the ALTERNATOR START switch and simultaneously start the stop watch.

(11) Observe that the SIMULATE SOLENOID lamp does not become extinguished in less than 90s.

(12) Adjust the SET DC VOLTS control to obtain a reading of 27V on METER-D.

(13) Set RANGE C MILLIAMPS to 1000.

(14) Set SELECTOR C to CONT FIELD.

(15) Set the SLAVE ALT START switch to ON.

(16) Run up the slave a.c. generating system steadily to governing speed adjusting the SET VOLTS and SET FREQUENCY controls to obtain an output of 117V at a frequency of 2·4kc/s.

(17) Connect the a.c. voltmeter across poles J and K of SKT23 (C.R.O.) of the test console.

(18) Increase the gain of the VARIAC control slowly.

(19) Observe that the current indication on METER-C rises smoothly as the a.c. voltage, as indicated on the voltmeter, increases. When the idication on METER-C reaches 50mA the voltage should not exceed 55V.

Run-up field changeover test

77. Proceed as follows:

(1) Increase the gain of the VARIAC control to 100 ± 7V, as indicated on the a.c. voltmeter, at which value the field changeover relay should operate. This is indicated by a sudden decrease in the current registered by METER-C to approximately 50% of that quoted in para. 76 (19).

(2) Increase the gain of the VARIAC control to 125V as indicated on the a.c. voltmeter before which value the neon valves of the voltage regulator should strike as indicated by a further decrease in the value of the current shown on METER-C.

(3) If the neons do not strike at a voltage of not greater than 125V adjust RV1 on the control unit under test and repeat (1) and (2) until this result is obtained.

Voltage regulator input/output test

78. Proceed as follows:

(1) Increase the gain of the VARIAC control to give an indication of 125V on the a.c. voltmeter.

(2) Reduce the indicated voltage slowly until the current reading shown on METER-C stands at 140mA at which point the voltage should be 117 ± 1·0V.

(3) Set SELECTOR A to 100 and SELECTOR B to 100.

(4) Observe the indications on both METER-A and METER-B: they should each be 62·5 ± 2·5mA.

Frequency governor input/output test

79. Proceed as follows:

(1) Adjust the SET FREQUENCY control until the indications on both METER-A and METER-B are 62·5 ± 2·5mA.

(2) Adjust the SET FIELD CURRENT control until the difference between the indicated currents on METERS A and B is 60 ± 2·5mA. The indication on METER-B should decrease as that on METER-A increases.

(3) When the condition set within sub-para. (2) is achieved the current reading on METER-C should be 100 ± 15mA.

(4) Adjust the SET FIELD CURRENT control until the difference between the indicated currents on METERS A and B is 60 ± 2·5mA. The indication on METER-B should increase as that on METER-A decreases.

(5) When the condition set out in sub-para. (4) is achieved the current reading on METER-C should be 180 ± 15mA.

(6) Adjust the SET FIELD CURRENT control to give an indication on METER-C of 140mA.

(7) Adjust the SET FREQUENCY control to give 2·4kc/s.

(8) Adjust the gain of the VARIAC control to give an indication of 117V on the a.c. voltmeter.

(9) Adjust the SET FIELD CURRENT control until both METER-A and METER-B indicate 62·5 ± 2·5mA

(10) Decrease the gain of the SET FREQUENCY control until the difference between the indicated currents on METERS A and B is 60 ± 4mA. The indication on METER-B should increase as that on METER-A decreases

(11) When the condition set out in sub-para. (10) is achieved the output frequency should be 2350 ± 10c/s.

(12) Re-adjust the SET FREQUENCY control to obtain an ouput frequency of 2·4kc/s.

(13) Adjust the SET FIELD CURRENT control until both METER-A and METER-B indicate 62·5 ± 2·5mA.

(14) Increase the gain of the SET FREQUENCY control until the difference between the indicated currents on METER A and B is 60 ± 4mA. The

indication on METER-B should decrease as that on METER-A increases.

(15) When the indication set out in sub-para. (14) is achieved the output frequency should be 2450 ± 10c/s.

(16) Set the SLAVE ALT START switch to OFF.

Starting circuits test

80. Proceed as follows:

(1) Ensure that the RUN/START switch is set to START.

(2) Set the SLAVE ALT START to ON.

(3) Allow the slave a.c. generating system to run up to governing speed.

(4) Set the RUN/START switch to RUN.

(5) Observe that the SIMULATE SOLENOID lamp remains lit.

Protective circuits cut-out limits test

81. For low voltage cut-out limit measurement proceed as follows:

(1) Decrease the gain of the VARIAC control to give an indication of 105 ± 3·5V on the a.c. voltmeter.

(2) Observe that at this indication the SIMULATE SOLENOID lamp becomes extinguished.

82. For low frequency cut out limit measurement proceed as follows:

(1) Increase the gain of the VARIAC control to give an indication of 117V on the a.c. voltmeter.

(2) Set the SLAVE ALT START switch to OFF.

(3) Set the RUN/START switch to START.

(4) Set the SLAVE ALT START switch to ON.

(5) Allow the slave a.c. generating system to run up to governing speed (117V at 2·4kc/s).

(6) Immediately set the RUN/START switch to RUN.

(7) Maintain the output voltage at 117V by means of the VARIAC control.

(8) Simultaneously reduce the output frequency until the SIMULATE SOLENOID lamp becomes extinguished.

(9) When the effect in sub-para. (8) is achieved observe the output frequency: it should be between 2150 and 2250c/s.

Testing individual chassis

83. Before making any of the tests detailed for individual chassis ensure that the operations enumerated in para. 70 and 71 have been performed.

84. In order to gain access to individual chassis dismantle the control unit in accordance with the instructions in para. 48 to para. 57.

Voltage regulator chassis

85. Ensure that the following leads are connected:

	From	To	At
White 1	MR4/3	TR1/8	TR1/8
Red 5	MR3/3	TR1/2	TR1/2
Green 2	M4	TR1/7	TR1/7
Brown	MR1/2	TR1/5	
Orange 1	MR2/2	TR1/1	
Link	TR1/4	TR1/9	

86. Disconnect all three cable looms between the control unit under test and the test console.

87. Refer to the test certificate supplied with each control unit and ascertain the value of the 'select on test' resistor, R9. Check the resistance value of R9.

88. Make the following connections and adjustments:

(1) Simulate RV1 of the control unit under test by connecting RV5 (poles A and B of SKT23, C.R.O.) of the test console across pole 1 of the full-wave rectifier MR1/MR2 and pole 6 of VT1 of the control unit.

(2) Adjust RV5 of the console by means of the relevant EXTERNAL RESISTANCE control to a value of 120 ± 20Ω as measured on the test meter type F.

(3) Connect a resistor of the preferred value of R9 in series with RV5.

(4) Repeat the instructions contained in para. 70 sub-para. (11).

89. Proceed as follows:

(1) Connect poles 3 and 8 of T1 to poles Q and S of the 18 pole plug (PL29 CONTROLLER) of the test console.

(2) Connect poles J1 and J2 of the

control unit to poles E and G respectively of PL29 (CONTROLLER) of the test console: Insert a link between poles R and F of PL29.

90. Adjust the SET DC VOLTS control to obtain a reading of 27V on METER-D.

91. Set the SLAVE ALT START switch to ON and run up the slave a.c. generating system steadily to governing speed, adjusting the SET VOLTS and SET FREQUENCY controls to obtain an output of 117V at a frequency of 2·4kc/s.

92. Increase the gain of the VARIAC control slowly and observe that the current indication on METER-C rises smoothly as the a.c. voltage indicated on the voltmeter increases. When the indication on METER-C reaches 50mA the voltage should not exceed 55V.

93. Increase the gain of the VARIAC control to 125V as shown on the a.c. voltmeter before which value the neon valves of the voltage regulator should strike as indicated by a sudden fall in the value of the current shown on METER-C. If necessary adjust RV5 on the test console.

94. Increase the gain of the VARIAC control to give an indication of 125V on the a.c. voltmeter; reduce the indicated voltage slowly until the current reading shown on METER-C stands at 140mA at which point the voltage should be 117 ± 1·0V.

95. Reduce the gain of the VARIAC control to zero; set the SLAVE ALT START switch to OFF: disconnect all test leads.

Frequency governor chassis

96. Reconnect cable loom BT808A between the 18 pole socket on the control unit under test and the 18 pole plug (PL29, CONTROLLER) on the test console.

97. Refer to the test certificate supplied with each control unit and ascertain the values of each of the three 'select on test' resistors (R16, R18 and R19). Check the resistance value of each resistor.

98. If the potentiometer RV11 is connected to the frequency governor chassis, set it to the mid-position of its travel: if RV11 is not connected, connect RV6 of the test console (poles C and D of SKT23 (C.R.O.)) to simulate RV11. By means of the test meter set RV6 to 5K, using the relevant EXTERNAL RESISTANCE control.

99. On the relevant control unit tagboard disconnect poles W1 and W2. Connect poles W1 and W2 to poles A and C of the 3 pole SKT24 (CONTROLLER) on the test console by means of flyleads.

100. Set the SLAVE ALT START switch to ON and run up the slave a.c. generating system steadily to governing speed, adjusting the SET VOLTS and SET FREQUENCY controls to obtain an output of 117V at a frequency of 2·4kc/s.

101. Adjust the SET DC VOLTS control to obtain an indication of 27V on METER-D: set SELECTOR C to AUTO FIELD.

102. Adjust the SET FIELD CURRENT control to obtain a reading of 140 ± 10mA; the current indications on both METERS-A and -B should be 62·5 ± 2·5mA.

103. Adjust the SET FIELD CURRENT control until the difference between the indicated currents on METERS A and B is 60 ± 2·5mA, the indication on METER-A increasing as that on METER-B decreases. At this point the reading on METER-C should be 100 ± 15mA. Readjust the SET FIELD CURRENT control to give a reading of 140 mA on METER-C.

104. Adjust the SET FIELD CURRENT control until the difference between the indicated currents on METERS A and B is 60 ± 2·5mA, the indication on METER-A decreasing as that on METER-B increases. At this point the reading on METER-C should be 180 ± 15mA, Readjust the SET FIELD CURRENT control to give a reading of 140mA on METER-C.

105. Decrease the gain of the SET FREQUENCY control until the difference between the indicated current on METERS A and B is 60 ± 4mA, the indication on METER-A decreasing as that on METER-B increases. At this point the output frequency should be 2350 ± 10c/s. Readjust the SET FREQUENCY control to obtain an output frequency of 2·4kc/s.

106. Increase the gain of the SET FREQUENCY control unit the difference between the indicated currents on METERS A and B is 60 ± 4mA, the indication on METER-A increasing as that on METER-B decreases. At this point the output frequency should be 2450 ± 10c/s. Readjust the SET FREQUENCY control to obtain an output frequency of 2·4kc/s.

107. Perform the following operations:

(1) Set the SLAVE ALT START switch to OFF.

(2) Reduce the gain of the SET DC VOLTS control to zero as registered on METER-D.

(3) Remove the flyleads connected between poles W1 and W2 on the control unit tagboard and poles A and C of the 3 pole SKT24 (CONTROLLER) on the test console.

(4) Re-connect cable loom B.T.810A between the 3 pole plug on the control unit and the 3 pole SKT24 (CONTROLLER) on the test console.

(5) Connect pole B of RLB to pole W1 of the control unit tagboard.

(6) Connect pole 22 of RLB to pole W2 of the control unit tagboard.

(7) Adjust the SET DC VOLTS control to give an indication of 27V on METER-D.

(8) Note the indication on METER-C with SELECTOR C set to AUTO FIELD.

(9) Note the indication on METER-C with SELECTOR C set to CONT FIELD: leave SELECTOR C in this position.

108. Set the SLAVE ALT START to ON and run up the slave a.c. generating system steadily. Increase the gain of the VARIAC control to 100 $\pm$ 7V as indicated on the a.c. voltmeter at which value the changeover from 'auto field' to 'controller field' should take place. This changeover is indicated by a sudden decrease in the current indication on METER-C.

109. Set SELECTOR C to AUTO FIELD: the indication on METER-C should be zero.

110. Set the SLAVE ALT START switch to OFF: remove cable loom B.T.808A from the 18 pole control unit socket and from the 18 pole PL29 (CONTROLLER) of the test console.

Starting and protective chassis

111. Refer to the test certificate supplied with each control unit and ascertain the values of each of the three 'select on test' resistors (R21, R23 and R24). Check the resistance value of each resistor. Check that the correct tappings of T21 are selected.

112. Perform the following operations:

(1) Connect poles Q and S of the 18 pole plug (PL29, CONTROLLER) of the test console to piles 5 and 2 of T21.

(2) Connect the 3 pole plug of the control unit to the 3 pole socket (SKT 24, CONTROLLER) of the test console by means of cable loom BT810A.

(3) Connect the 4 pole socket of the control unit to the 4 pole socket (SKT27, SOLENOID) of the test console by means of cable loom BT807A..

(4) Connect pins E2, E4 and E3 of the control unit protective bay to poles H, N and P respectively of the 18 pole plug (PL29, CONTROLLER) of the test console.

(5) Set the RUN/START switch to START.

113. Remove hydraulic pressure from the H.M.L. test rig: set the ALTERNATOR START switch to ON.

114. Observe that the DC ON CONTROLLER and SIMULATE SOLENOID lamps are lit: adjust the SET DC VOLTS control to obtain an indication of 29V on METER-D.

115. Set the ALTERNATOR START switch to OFF: wait for two minutes: set the ALTERNATOR START switch to ON and simultaneously start the stop watch.

116. When the SIMULATE SOLENOID lamp becomes extinguished stop the stop watch. Observe that the time interval is not less than 25s.

117. Switch OFF the ALTERNATOR START switch and wait for two minutes: switch on the ALTERNATOR START switch. Observe that the DC ON CONTROLLER and SIMULATE SOLENOID lamps are lit.

118. Adjust the SET DC VOLTS control to obtain an indication of 25V on METER-D: set the ALTERNATOR START switch to OFF and wait for two minutes. Set the ALTERNATOR START switch to ON and simultaneously start the stop watch.

119. When the SIMULATE SOLENOID lamp becomes extinguished stop the stop watch. Observe that the time interval is not less than 90s. Readjust the SET DC VOLTS control to obtain an indication of 27V on METER-D.

120 Make the following switch settings:

(1) Set the CONT TEST INPUT switch to POWER AMPLIFIER.

(2) Set the OSCILLATOR RANGE C/S switch to 2100-2700.

(3) Set the OSCILLATOR FREQUENCY dial inner scale to 2·4kc/s.

(4) Adjust the SET P.A. REGULATOR and set P.A. DRIVE controls to give an indication of 117V on the a.c. voltmeter.

121. Proceed as follows:

(1) Set the CONT TEST INPUT switch to VARIAC.

(2) Set the RUN/START switch to START.

(3) Set the DC LT switch (power supply control panel) to OFF: wait for 2 minutes.

(4) Set the DC LT switch to ON.

(5) Set the ALTERNATOR START control to ON: observe that the DC ON CONTROLLER and SIMULATE SOLENOID lamps are lit.

(6) Set the CONT TEST INPUT switch to POWER AMPLIFIER.

(7) Set the RUN/START switch to RUN.

(8) Decrease the output of the test console power amplifier by adjusting the SET P.A. REGULATOR control until the a.c. voltmeter indicates a voltage of 105 ± 3V.

(9) At this value the SIMULATE SOLENOID lamp should become extinguished.

122. Proceed as follows:

(1) Set the RUN/START switch to START.

(2) Adjust the SET P.A. REGULATOR and SET P.A. DRIVE controls to give an indication of 117V on the a.c. voltmeter.

(3) Repeat para. 121 in entirety.

123. Proceed as follows:

(1) Adjust the OSCILLATOR FREQUENCY dial inner scale to a point between 2500c/s and 2650c/s: at this point the SIMULATE SOLENOID lamp should become extinguished.

(2) Set the RUN/START switch to START.

(3) Reset the OSCILLATOR FREQUENCY dial inner scale to 2·4kc/s.

(4) Repeat para. 121 in entirety.

(5) Adjust the OSCILLATOR FREQUENCY inner scale to a point between 2150c/s and 2250c/s: at this point the SIMULATE SOLENOID lamp should become extinguished.

124. The foregoing operations complete the testing of individual chassis of the B300 control unit under test: the following operations should now be performed.

(1) Shut down the H.M.L. test rig

(2) On the test console set the A.C. MAINS switch to OFF.

(3) Disconnect all flyleads and cable looms between the control unit under test and the test console.

(4) Reassemble the control unit, following the instructions given in para. 61 to 65.

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