Now 1135-0780-13A6

Chapter 14

CONTROL PANEL, TYPE 15 (Rotax U1502/1 and U1502/2)

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LEADING PARTICULARS

Control panel, Type 15...	*Ref. No. 5UC/5759*
Voltage output	*115V a.c.*±2 *per cent (average of line volts)*
Frequency	400 *c/s*±2 *per cent*
Weight	17 *lb.*
Length	12·375 *in.*
Width	7·875 *in.*
Height	6·937 *in.*

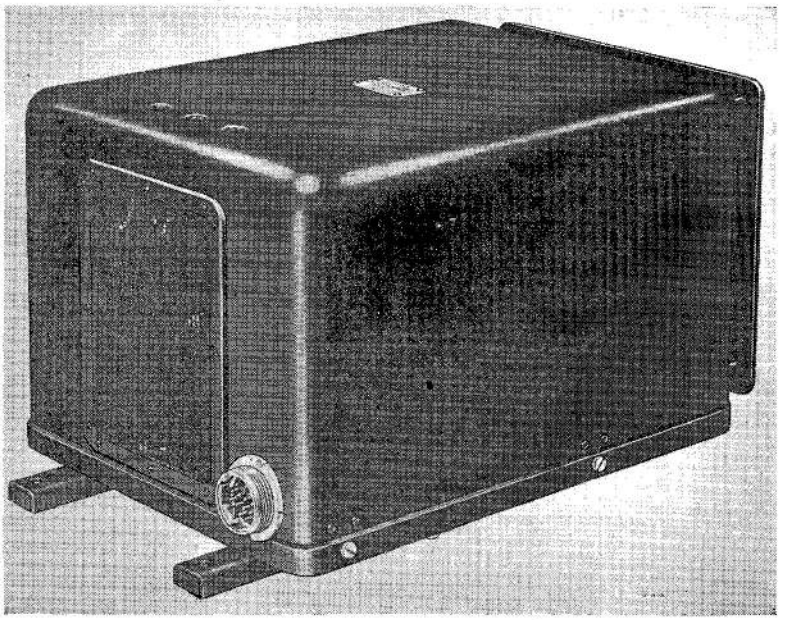

Fig. 1. General view (control panel, Type 15)

Introduction

1. The control panel, Type 15, is used to control the output voltage and frequency of the inverter Type 103 (having an input of 25–28V, d.c.). The output voltage is maintained at 115V a.c. ±2 per cent (average of line voltages) and the frequency at 400 c/s ±2 per cent, at load values of from 187·5 watt to 750 watt, and a power factor of 0·8 lagging to unity.

DESCRIPTION

2. The control panel (*fig.* 1) is a completely self-contained unit. It is provided with a 12-pole plug for connection direct to the Type 103 inverter, or in some cases to the Type 24 control panel and thence to the inverter.

3. The unit is in the form of a sheet metal box, the base of which forms the fixing panel for many of the components (*fig.* 2). Standing off on pillars from this base is an insulated deck (*fig.* 3), and from this deck, a sub-panel (*fig.* 4 *or* 5) to which are attached the rest of the components. The wiring is taken between the base and deck in proper cable form so that by releasing the four corner nuts the deck can be moved away, making the lower components accessible. The plug is fitted on a bracket fixed to the base. The cover enclosing all these components has a ventilating plate in the bottom, and a cut-out and gauze in the top with a removable protecting plate (it will be found that in some earlier models there is no gauze and the protecting plate is fixed).

4. On the front of the cover will be found three holes giving access to the controls. In the U1502/1 these three holes are in line towards the bottom of the unit. The centre one gives access to the voltage trimmer, and the two outer holes are to enable the test switches 5SW1 and 5SW2 on the voltage reference tube circuits to be operated. In the U1502/2 the holes for operating the two test switches remain in the same position, but the hole for the voltage trimmer is now towards the top of the unit and left of a central position. Voltage trimming in this model is in fact carried out with a different variable resistor, 5RV5.

5. Within the control panel the three-phase a.c. output from the inverter is taken to a three-phase rectifier 5MR5 and 5MR6 to supply the voltage control circuit. A single-phase is also taken to a transformer 5TR1 which in turn feeds the transductor in the voltage control circuit.

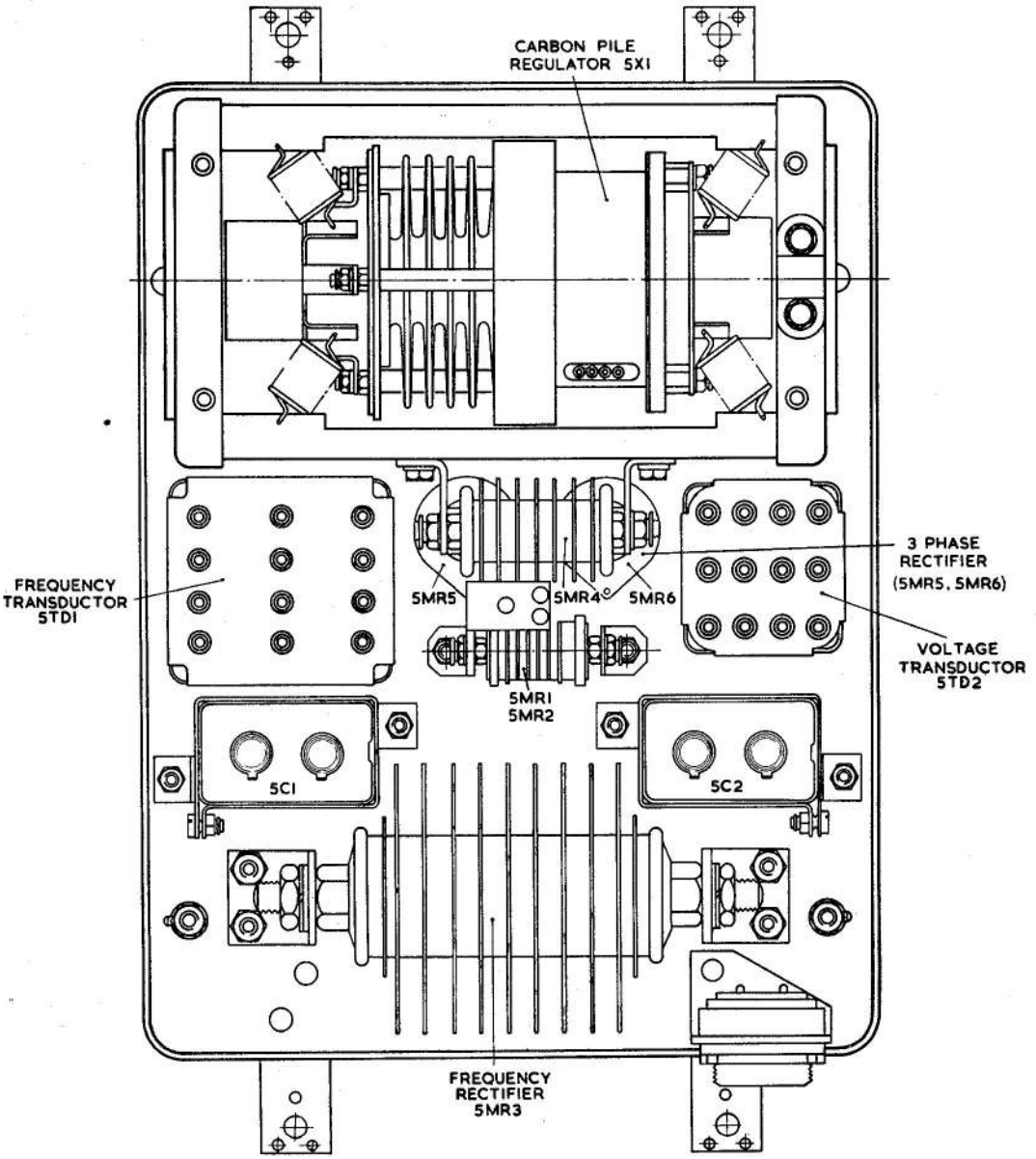

Fig. 2. Base components

Note . . .

Fig. 6 shows the composite circuit for the Type 103 inverter and Type 15 control panel. The references quoted in the following paragraphs are shown in this diagram.

Voltage control

6. The three-phase a.c. output from the inverter enters the control panel where a three-phase rectifier supplies a d.c. voltage across a bridge network. A single-phase also supplies transformer 5TR1. The rectified a.c. is fed into the two control windings of the transductor (5TD2), to the first winding (terminals A3, A4) through a pure resistance chain with linear characteristics, and to the second (terminals C3, C4) through resistors and voltage reference tubes (5V1 and 5V2).

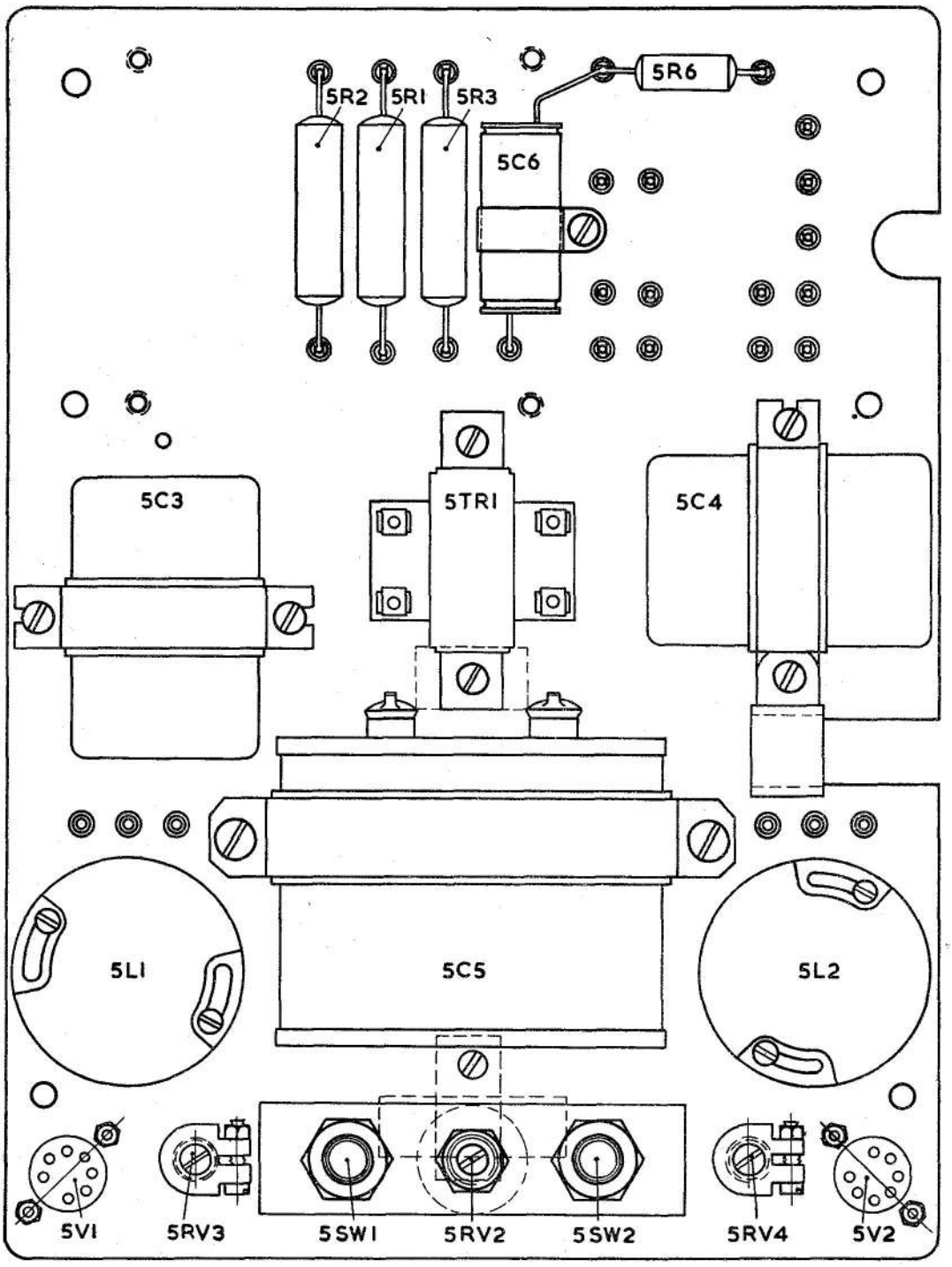

Fig. 3. Deck components

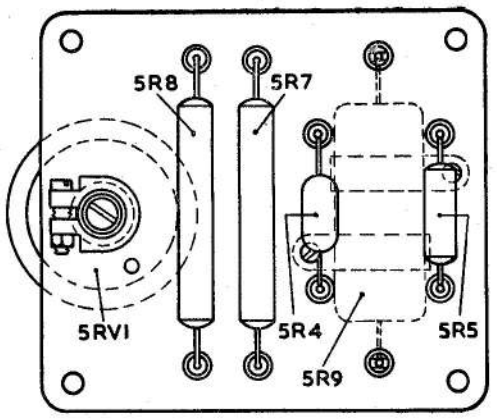

Fig. 4. Sub-panel components (U1502/1)

A.C. is being fed to the transductor from transformer 5TR1.

7. In the first instance, when the inverter begins to feed the rectifier bridge (5MR5 and 5MR6) the voltage is not high enough to strike either of the voltage reference tubes, and they therefore do not conduct. The output of the rectifier is therefore through the first control winding only. As the current in this control winding increases, it tends to decrease the flow through the transductor. The d.c. current from rectifier 5MR4 is small, and the ampere turns on the auxiliary winding of the carbon pile regulator 5X1 build up slowly. As the output of the generator increases the ampere turns of the main winding of 5X1 increase also (*fig.* 7).

8. So far, however, the current in both main and auxiliary windings is insufficient to open the carbon pile, and the excitation, and therefore output voltage, builds up rapidly. In actual fact the a.c. output voltage reaches 115V before the machine gets up to normal running speed. At approximately 115V a.c. one of the stabilizing tubes strikes. Current now flows in winding C3, C4 (5TD2), and as the winding is wound in the opposite sense to that of A3, A4, the two control currents are in opposition. Thus the current flow through the transductor increases, the ampere turns of the auxiliary winding increase rapidly and the carbon pile regulator opens. Excitation of the alternator drops, and the output voltage comes down to 115V. With the voltage reference tubes now referred to 115V, the output of the inverter is kept constant at that figure, within the permissible limits.

9. The voltage reference tube circuit is paralleled mainly to guard against tube failure. By depressing switch 5SW1 or 5SW2 either tube can be tested without removing it from the circuit. These switches may also be used for setting up the circuit.

Note . . .

Although both tubes are of the same type their characteristics are always slightly different. Thus the tube with the lower striking voltage will always strike first. Directly it has struck its burning voltage is only about 87V which is too low a voltage to strike the other tube. However with sudden short surges it is possible for both tubes to strike, and capacitor 5C7 has been included in the circuit to prevent this.

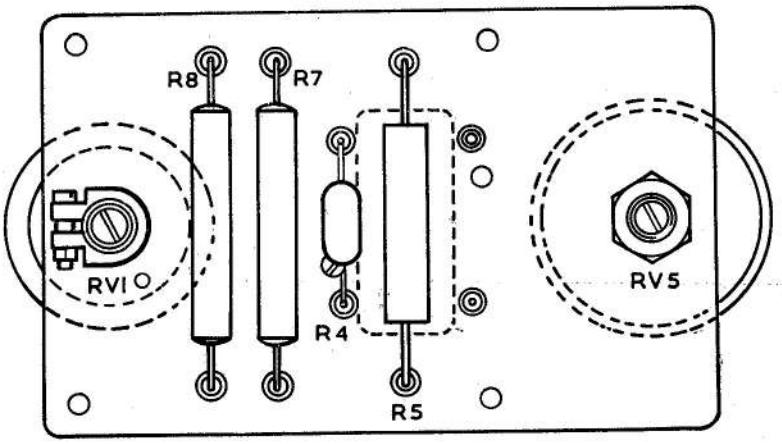

Fig. 5. Sub-panel components (U1502/2)

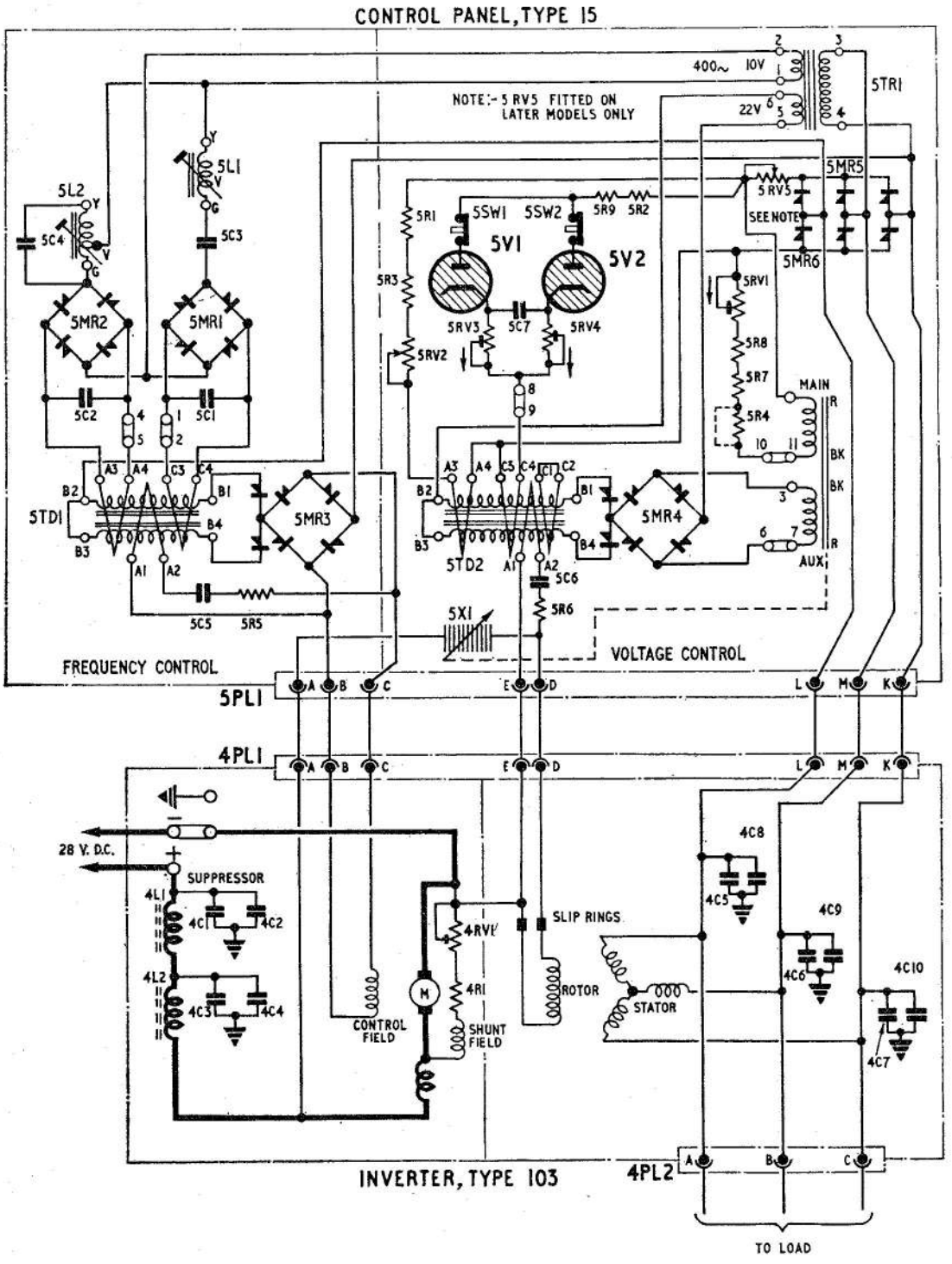

Fig. 6. Circuit diagram (Control panel Type 15 and inverter Type 103)

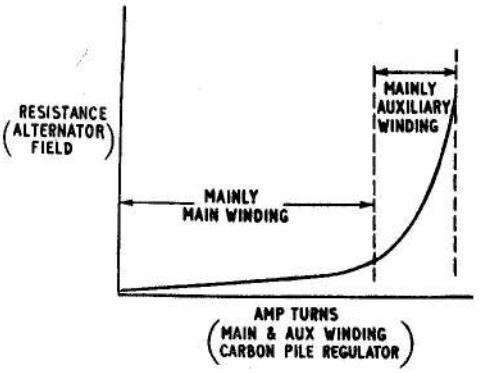

Fig. 7. Resistance—amp. turn curve

10. The third winding (terminals A1, A2) is fed back from the alternator field through resistor 5R6 and capacitor 5C6, and exerts a damping or stabilizing effect on the system. It is known as the feed-back or stabilizing winding. The fourth winding (terminals C1, C2), which is short circuited, is to smooth out harmonics.

11. Changes of resistance due to temperature in the main winding of the carbon pile regulator 5X1 would normally affect the excitation. But the changes are immediately referred to the output of the a.c. machine and thus fed on to the voltage stabilizer tubes. These tubes maintain the voltage constant and thus the initial resistance changes are accounted for.

12. A copper resistor 5R9, having a positive temperature coefficient, is incorporated to compensate for the negative coefficients of the bridge rectifier 5MR5 and 5MR6 and also the voltage reference tubes.

13. As previously mentioned (*para.* 4) the output voltage can be trimmed to the nominal 115V, a.c. by varying 5RV2 in the U1502/1 and 5RV5 in U1502/2.

Note . . .

Under normal conditions of operation (i.e. without pulse loading) the variable resistor must only be used for small adjustments to output voltage. Any large movement either way may completely upset circuit regulation.

Adjustment to obtain higher voltage

14. When the inverter is supplying a pulsing load through a Type 24 control panel and Type 15 control panel, a higher voltage nominally 118V, a.c., is required to account for cable voltage drops. In the U1502/2 this voltage can be obtained by adjustment of 5RV5. But for the U1502/1 (*para.* 4) the following procedure must be carried out.

15. With constant load and d.c. input voltage applied to the inverter, run the machine until the carbon pile regulator has warmed up (minimum 10 minutes). Measure the voltage across the regulator auxiliary terminals (3 negative, 7 positive) on main components board with a testmeter on the 10V d.c. range (reading 2 volts approximately). Rotate both 5RV1 and 5RV2 internal and external, clockwise, so that when the required a.c. voltage is obtained, the reading on the d.c. voltmeter across the auxiliary coil is unchanged. Subsequent trimming to correct the drift if necessary may be corrected by means of external trimmer 5RV2 only.

Note . . .

Even though the above method is adopted due to individual characteristics, it may not always be possible to get the voltage up to 118V, a.c. using the U1502/1 panel. In such a condition it will be necessary to fit a U1502/2 panel.

Frequency control

16. The frequency control circuit is fed from a single phase of the inverter output. A.C. at 10 volts is fed from transformer 5TR1 on to two tuned circuits, one series, and one parallel. The tuned circuits are tuned to dissimilar frequencies, both greater than 400 c/s, and the control on the transductor depends on the difference between the current

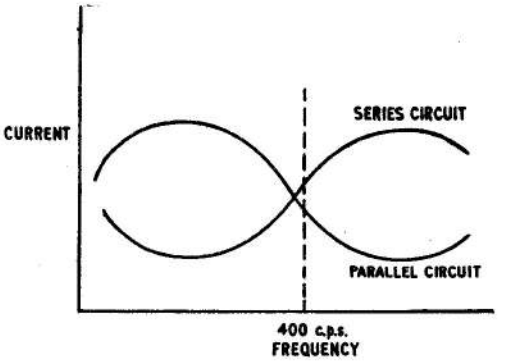

Fig. 8. Current—frequency curve

in these two circuits. At a frequency of 400 c/s the current in each will be practically the same (*fig.* 8), thus giving a state of equilibrium in the transductor (5TD1). The only difference in the currents is that required to bias the transductor.

17. Slight changes in frequency result in the rectified transductor output, which excites the motor field, being adjusted to the required level. The frequency at which the inverter output is controlled depends upon the setting of both tuned circuits.

18. A feedback circuit is incorporated, feeding a winding on the transductor 5TD1 (terminals A1, A2) through 5R5 and 5C5. It damps out any sudden changes, and has a stabilizing effect (therefore preventing hunting) on the whole frequency control system. The capacitors 5C1 and 5C2 increase the sensitivity of the circuit.

INSTALLATION

19. This control panel must be mounted with its mounting face in the vertical plane, and with the end marked TOP uppermost. There should be a space of at least three inches left beneath the perforated end to allow for adequate ventilation.

20. A 12-pole panel plug (Joint Service number Z.560150, mating socket Z.560180) is provided for connection to either the inverter, Type 103, or when used, the control panel, Type 24.

SERVICING

21. Little or no servicing can be done on these units apart from seeing that all cable connections and fixing devices are tight and free from corrosion, and that there are no signs of wires overheating or fraying.

Table 1

Circuit component details

Circuit Ref.	Description	Value	Code No.	Ref. No.
5C1	Capacitor	15 μF		5UC/6310
5C2	Capacitor	15 μF		5UC/6310
5C3	Capacitor	0·36 μF		5UC/6312
5C4	Capacitor	0·36 μF		5UC/6312
5C5	Capacitor	40 μF		5UC/6313
5C6	Capacitor	1 μF		10C/0115322
5C7	Capacitor	0·5 μF		10C/0115262
5L1	Inductor	450 mH $\pm$ 50 mH at max.	F3601/1	5UC/6535
5L2	Inductor	450 mH $\pm$ 50 mH at max.	F3601/1	5UC/6535
5MR1	Rectifier			5UC/6849
5MR2	Rectifier			5UC/6849
5MR3	Rectifier			5UC/6848
5MR4	Rectifier			5UC/6850
5MR5	Rectifier			5UC/6847
5MR6	Rectifier			5UC/6846
5R1	Resistor	14 K		5UC/6317
5R2	Resistor	U1502/1–6·6 K		5UC/6318
		U1502/2–5·8 K		5UC/6315
5R3	Resistor	U1502/1–14 K		5UC/6317
		U1502/2–13 K		5UC/6316
5R4	Resistor	180 Ω		10W/0243361
5R5	Resistor	5 K		5UC/6458

Table 1—*continued*

Circuit Ref.	Description	Value	Code No.	Ref. No.
5R6	Resistor	2 K		5UC/6321
5R7	Resistor	U1502/1–300 Ω		10W/9243142
		U1502/2–270 Ω		5UC/6319
5R8	Resistor	U1502/1–300 Ω		10W/9243142
		U1502/2–270 Ω		5UC/6319
5R9	Resistor	3·4 K		5UC/6324
5RV1	Variable resistor	363 Ω		5UC/6322
5RV2	Variable resistor	5 K		5UC/6325
5RV3	Variable resistor	5 K		5UC/6325
5RV4	Variable resistor	5 K		5UC/6325
5RV5	Variable resistor	U1502/2–100 Ω		5UC/6323
5SW1	Switch			5UC/6328
5SW2	Switch			5UC/6328
5TD1	Transductor		P4807	5UC/6308
5TD2	Transductor		P4806	5UC/6309
5TR1	Transformer			5UC/6332
5V1	Valve			5UC/6342
5V2	Valve			5UC/6342
5X1	Carbon pile regulator		Newton 37/55291-E	5UC/6337

P31029 134462/2478 6/61 2125 C & P Gp 375