SECTION 9

STABILISED POWER SUPPLIER PS2/9

9.1 Introduction

The PS2/9 is a stabilised power unit intended primarily for use with transistor audio-frequency amplifiers. It employs three transistors in a conventional stabiliser circuit and gives an output voltage of −24·5 volts, the maximum current being 500 mA. The working input voltage range is 190-260 volts at 50 c/s.

The unit is built on a CH1/18B chassis for mounting on a PN3/23 panel.

9.2 Circuit Description (Fig. 9.1)

9.2.1 *General*

A circuit diagram of the PS2/9 is given in Fig. 9.1.

The unit employs a full-wave bridge rectifier supplying a transistor circuit arranged to stabilise the output voltage against mains input variations and changes of load. This circuit also prevents ripple and other a.c. disturbances from appearing across the load.

The mains input voltage at 190-260 volts is taken to transformer T1 via a double pole on-off switch and 150-mA fuses in each leg. The secondary of the transformer feeds the bridge rectifier consisting of MR1-4, and smoothing is provided by C2 and C3 in parallel. R2 imposes a small constant load on the rectifiers and is provided to limit changes of voltage input to the stabilising circuit as the load current changes.

The output from the unit is taken in series with TR3 and with R7 and R10 in parallel. These resistors are current limiters and prevent damage to TR3 should the output of the unit be short-circuited. TR2 and TR3 together form a compound emitter-follower (or super-alpha pair) having a high current gain and low internal impedance, while TR1, operating as a common-emitter amplifier, is the control transistor. A reference potential of 9·1 volts is provided by the Zener diode MR5 in the emitter circuit of TR1; R6 provides the biasing current for the Zener diode. The value of R9, which is in parallel with R12, is set during initial tests to make the output voltage from the unit 24·5 volts at approximately half load.

9.2.2 *Stabilising Circuit*

The operation of the stabilising circuit is as follows.

The two transistors TR2 and TR3, as already stated, have a low output impedance, due to their interconnection as a super-alpha pair. Looking back from the load, this impedance is the source impedance, and as it is low, the regulation is inherently good. TR1, by providing amplified negative feedback from the output to the base of TR2, improves the regulation still further and enables the output voltage to be held very closely to the specified value. TR1 is fed from a potential divider, consisting of R11 and R12, which is connected directly across the output. Any changes in the output voltage are fed to the base of TR1 and then, after amplification and phase reversal, are applied to TR3, thus offsetting the original change. In this way the output impedance is made to appear very low indeed and the regulation correspondingly very good.

As an example of the stabilising action of the circuit, suppose the mains voltage to increase; the d.c. voltage across the output transistor and the load then increases correspondingly. This causes an increase of current in the load and therefore of the voltage across it. The tendency for the output voltage to increase is fed back from R12 to TR1, increasing the negative voltage across TR1 base/emitter junction, the emitter being locked to 9·1 volts. The current in TR1 collector circuit now tends to increase, causing the voltage at the base of TR2 to move positively. This positive potential change appears across R8 and therefore across the base/emitter junction of the output transistor TR3. The current input to TR3 is thus reduced, causing the collector current, which is also the load current, to drop. The change initiated by the increase of mains voltage is thus almost neutralised, and the mains input voltage can in fact change from 190 volts to 260 volts with only a 0·5-volt change in the output voltage.

A reduction of mains voltage is neutralised in the same way as that just described, except that the various voltage and current changes occur in the opposite directions to those mentioned previously.

A change of load current has a similar effect to a change of mains voltage. For example, if the load resistance falls, i.e., if more current is required, then the output voltage tends to fall also, thus making TR1 base voltage move positively, and making TR1 collector current fall. This allows more current to flow in TR2, and therefore in TR3 as was required. The d.c. resistance of TR3 is in fact either reduced or increased as the load current is increased or reduced, so that the voltage across the output is held essentially constant.

The elimination of ripple and hum from the output occurs in the same general way as described above, but the whole of the unwanted voltage is fed back via C5, which effectively short-circuits R11.

The resistors R5 and R8 have been included to improve the operating conditions for TR2. R8 allows TR2 to take current from the supply; without this resistor, the collector current of TR2 would be limited to the base current taken by TR3, which varies from a few microamperes up to about 20 mA according to the output current being supplied. R5 stabilises the base/emitter potential of TR2 with varying output load.

C6 is included to prevent oscillation at high frequencies which otherwise sometimes occurs.

C1 and R1 suppress surges which can damage the rectifiers MR1-4 when switching on or off.

9.3 Test Specification

1. With a load of about 250 mA, the output voltage should be 24·5 volts. (This is set during initial tests by adjustment of R9, an Erie Type 109 resistor (±2 per cent).
2. The output should not change by more than 0·5 volt as the load is varied from 0 to 500 mA.
3. With a load of 250 mA, the output voltage should not vary by more than 0·5 volt as the input volts are varied from 190 volts to 260 volts.
4. With an input mains voltage of 225 volts and with a load current of 500 mA, the ripple voltage across the output should not be greater than 70 dB as measured on an amplifier-detector connected in series with a 2-μF capacitor across the output.
5. The following voltage measurements should be obtained:

   Across C2/C3, about 43 volts.
   Across R3, 5·2 volts.
   Across R7/R10, 0·2 volt.

A.I.B. 5/64

COMPONENT TABLE: FIG. 9.1

Comp.	Loc.	Type	Tolerance per cent	Comp.	Loc.	Type	Tolerance per cent
C1	D5	Hunt B502K 150V		R4	H4	Erie 109 0·25W	2
C2	F6	Plessey CE17094 100V		R5	J4	Erie 109 0·25W	2
C3	F6	Plessey CE17094 100V		R6	J5	Erie 109 0·25W	2
C4	G6	Plessey CE17094 100V		R7	J3	Painton P301A	5
C5	J6	Universal SC596/7LS 25V		R8	K5	Erie 109 0·25W	2
C6	L6	Universal SC594/7LS 50V		R9	K7	Erie 109 0·25W	2
				R10	K3	Painton P301A	5
R1	D4	Erie 109 0·25W	2	R11	K6	Erie 109 0·25W	2
R2	G3	Erie 109 0·25W	2	R12	K7	Erie 109 0·25W	2
R3	H3	Erie 109 0·25W	2	R13	L6	Erie 109 0·25W	2

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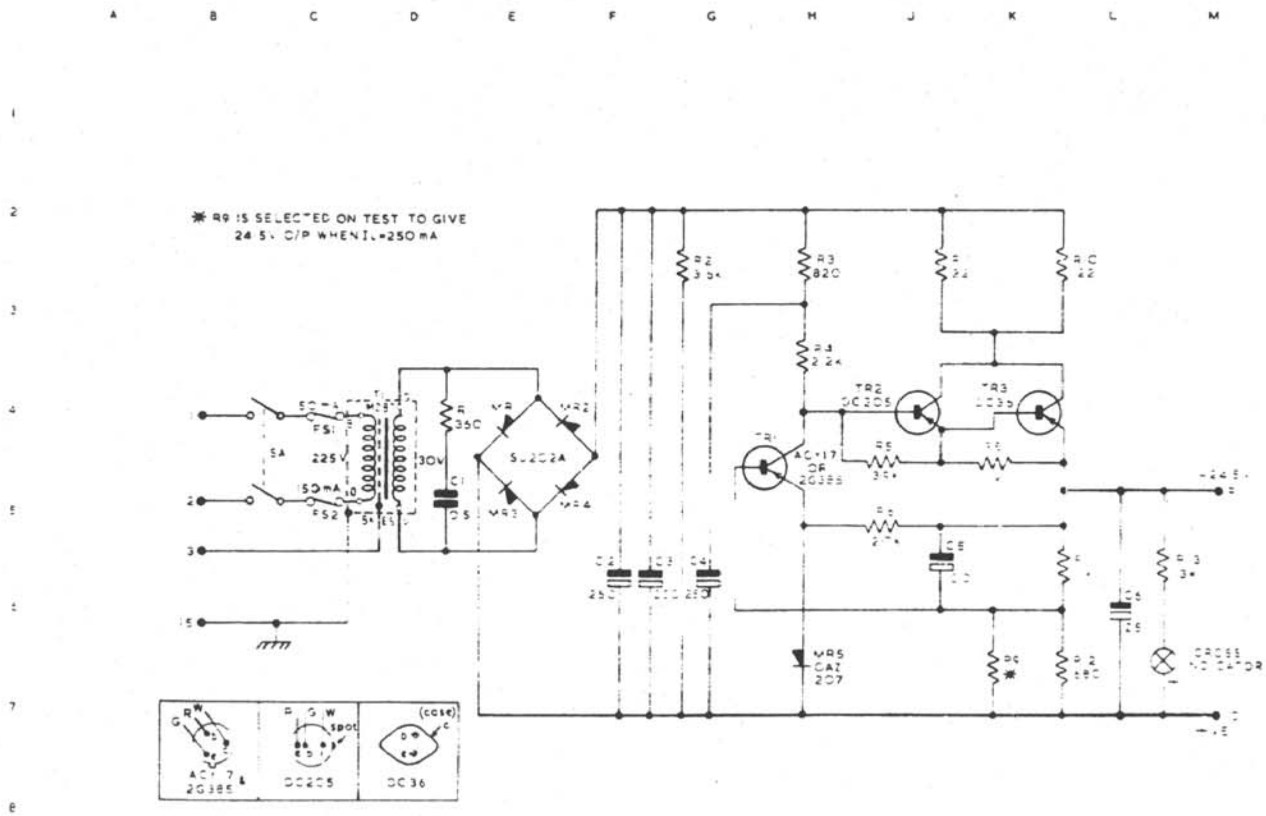

STABILISED POWER SUPPLIER PS2/9 : CIRCUIT

FIG.9.1
(ALSO IN 59)

G2
PART 2