Chapter 5

POWER AND RADIO UNIT TYPE 4192

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LIST OF ILLUSTRATIONS

INTRODUCTION

1. The power and radio unit Type 4192 provides HT power for the transmitter circuits; it has mounted on its chassis an audio amplifier (or modulator) sub-chassis known as the amplifying unit Type 4209.

2. In the power unit proper the main chassis carries a rotary transformer with outputs of 300V and 600V HT; both outputs are applied to the audio amplifier and transmitter circuits. Input power to the motor of the rotary transformer is from the aircraft 28V supply.

3. The input to the amplifying unit Type 4209 is from the intercommunications circuits of the equipment (microphone and key). A tone oscillator provides 1,000 c/s modulation on MCW and a parallel push-pull amplifier modulates the HT to the transmitter.

4. Amplifying unit Type 4209 will later be superseded by a unit with "speech-clipping" facilities; this unit will be known as amplifying unit Type 7435 (10U/16659) and all power and radio units Type 4192 will be retrospectively modified to incorporate the new amplifier.

GENERAL DESCRIPTION

Construction

5. The complete power and radio unit consists of a main chassis to which is attached the front panel measuring 8 by 10 inches and bearing the air intake dust filter (*fig.* 1). A removable dust cover fits over the whole chassis and is fixed at the rear of the unit by means of a quick release fastener. The depth of the unit is $12\frac{1}{2}$ inches.

6. The whole base of the unit consists of a chassis $2\frac{1}{2}$ inches deep and open on the underside. On the top surface of the chassis (*fig.* 2) is mounted the rotary transformer (left) and the amplifying unit Type 4209 (right). The modulating transformer (T3) is mounted to the rear of the amplifying unit.

7. A special bracket covers the HT brushes at the rear of the rotary transformer; this carries the valve heater dropping resistor R41 and can be swung clear for access to the brushes. The resistor is positioned in the cooling exhaust path to prevent overheating.

8. On the underside of the chassis (*fig.* 3) there is a group of control relays to the front left.

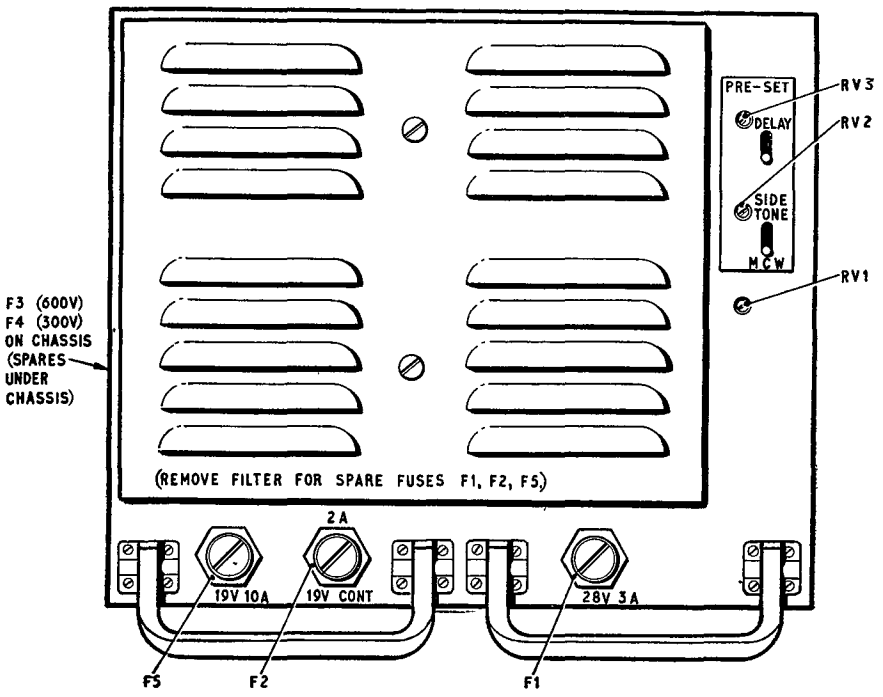

Fig. 1. Front panel of power and radio unit Type 4192

The centre of the chassis is occupied by a screened compartment which contains the rotary transformer connections, the noise suppression filters and the second relay of the motor start circuit.

9. The remainder of the chassis incorporates a motor start relay and components of the HT smoothing circuits.

10. Cooling air for the power and radio unit is drawn through the air filter box on the front panel (*fig.* 1) by a fan on the LT or front end of the rotary transformer.

11. Some of the air intake is passed through the rotary transformer and some is taken directly from the fan through a slot in the cowl and directed across the output valves of the amplifying unit Type 4209 by a duct-deflector. The air exhaust is through louvres in the rear top of the dust cover.

12. Two quick release fasteners enable the dust cover over the two air filters to be removed and the air filters freed. A further four fasteners allow removal of the baffle plate behind the filters. This permits the fan cowl of the rotary transformer to be withdrawn for inspection of the LT brushes. The spare input fuses for F1, F2, and F5 are mounted on the baffle plate.

13. A sliding cover beside the air filter on the front panel provides access to three pre-set adjustments on the audio amplifier. These are :—

(1) DELAY (in the V.O.G A.D. circuit)

(2) SIDETONE

(3) MCW

14. The rotary transformer is held in position by means of two clamp bands on a saddle. When these and the air duct are released and the electrical quick release connections freed, the rotary transformer can be removed.

15. The amplifying unit Type 4209 is fastened to the main chassis by means of four captive screws. Input connections are made by plug and socket (PL3, SK6—*fig.* 2). The output connections are made to the top caps of the output valves V5 to V8 ; plug PL4 and socket SK7 connect the input to the double diode V9.

Interconnection of ARI.5874

16. The interconnection of the power and radio unit within the installation is made by plugs and sockets fixed to the rear face of the chassis. In

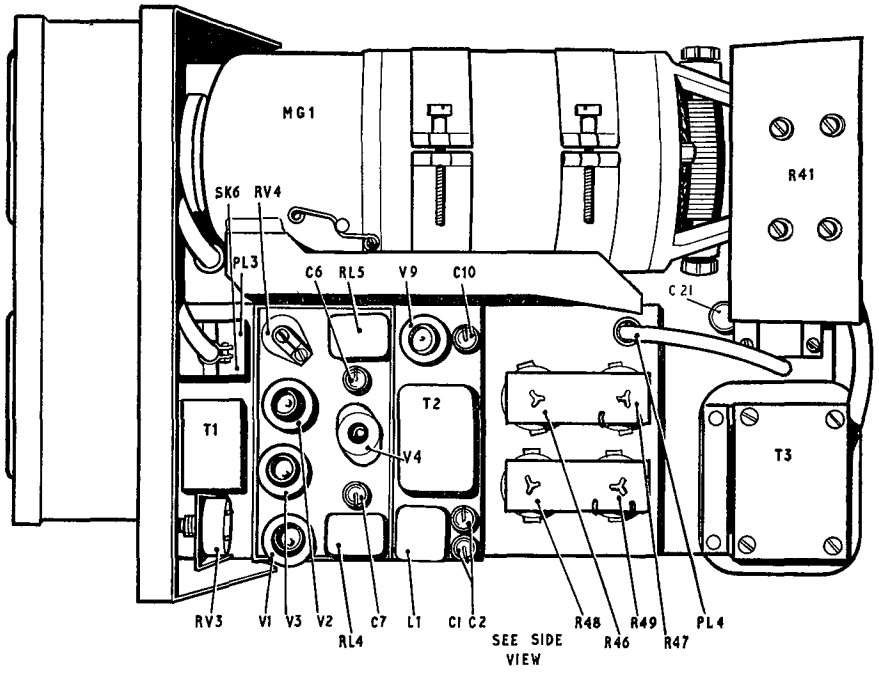

Fig. 2. Top of main chassis

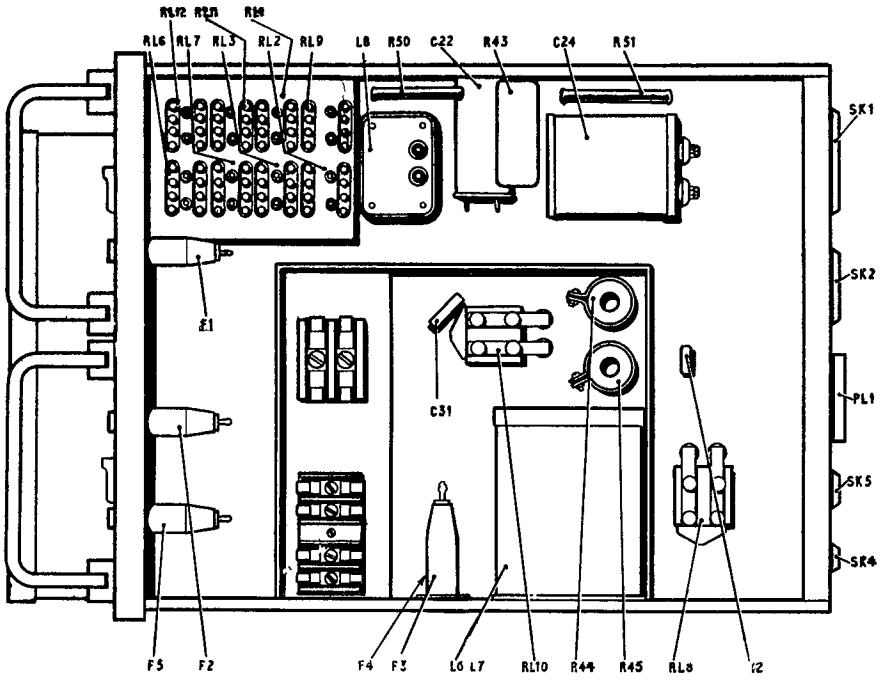

Fig. 3. Underside of main chassis

common with other units of the installation these plugs and sockets (seven in all) plug directly into a back-plate at the rear of the power and radio unit mounting assembly (*Chap.* 10).

17. The back-plate is interconnected to the remainder of the installation by means of connectors permanently wired to the back-plates of other units of the installation. Some details of the plugs and socket at the rear of the power and radio unit are given below; a more complete account is given in Chap. 10.

(3P)	PL1—20-pole plug	Power supply input.
(3E)	PL2—Coaxial plug	600V HT modulated output to transmitter.
(3D)	SK1—28-pole socket	Control and power supplies to transmitter.
(3A)	SK2—20-pole socket	Control and power supplies to control and drive unit.
(3J)	SK3—4-pole socket	Transmitter interlock.
(3N)	SK4—4-pole socket	Receiver connections.
(3F)	SK5—8-pole socket	Connections to intercommunications equipment (sidetone, key, mic. circuit and low power circuit).

Note . . .

PL2 and SK3 are mounted on a bracket above the chassis. The references in parenthesis are the backplate codings for the associated plugs or sockets.

CIRCUIT DESCRIPTION

Audio frequency circuits

18. The audio frequency circuits consists of (1) the amplifying unit Type 4209, which includes an audio amplifier and modulating unit (*fig.* 5) and (2) the modulating transformer T3 (*fig.* 2.)

19. A block diagram is given in fig 4 and a complete circuit diagram of the power and radio unit is given in fig. 7, the audio frequency circuits are shown at the left of the diagram. It should be noted that the following references are not used in the circuit diagrams :—

R31 to R40, C11, C13 to C20, C23.

20. The balanced microphone input enters the power and radio unit at pins 3 and 4 of SK5 and is taken through screened leads via socket SK6 and plug PL3 (pins 1 and 2) to the primary winding of the transformer T1. The secondary winding is connected to the input stage V2 and V3 operating in push-pull.

21. The anode supplies of these valves is switched by the relay contacts RL4A (V3) and RL4B (V4) and HT is applied in the R/T condition only, HT is from the 300V KEY terminal 17 on the 28-pole socket SK1 via pin 11 on SK6 and PL3 and resistor R13 etc. The screen connections to the valves is from the 300V supply through the dropping resistor R10.

22. The bias supply is obtained partly from the cathode-bias of R3 and RV4 (GAIN) in series, the latter providing a preset adjustment of the audio gain of the amplifier on R/T, and partly from the grid bias at the junction of R4 and R5. The grid bias is provided by the voice operated gain adjusting device (*para.* 29).

23. Coupling to the double-triode V4 is from the anodes via the relay contacts 4A and 4B, the anode load resistors R11 and R12 and the coupling condensers C6 and C7. The double-triode is connected in push-pull with its anodes supplied via the primary of the transformer T2; the centre-tap of the primary is connected to 300V HT via pin 12 of PL3 and SK6 and thence to pin 25 of SK1. This stage operates in Class A conditions and cathode-bias is provided by the 680-ohm resistor R16.

24. The output of V4 is coupled by winding 4—6 of the drive transformer T2 to the grids of the modulating stage of four valves V5–V8 operating in Class AB and connected in parallel push-pull. This stage is biased partly by the cathode resistor

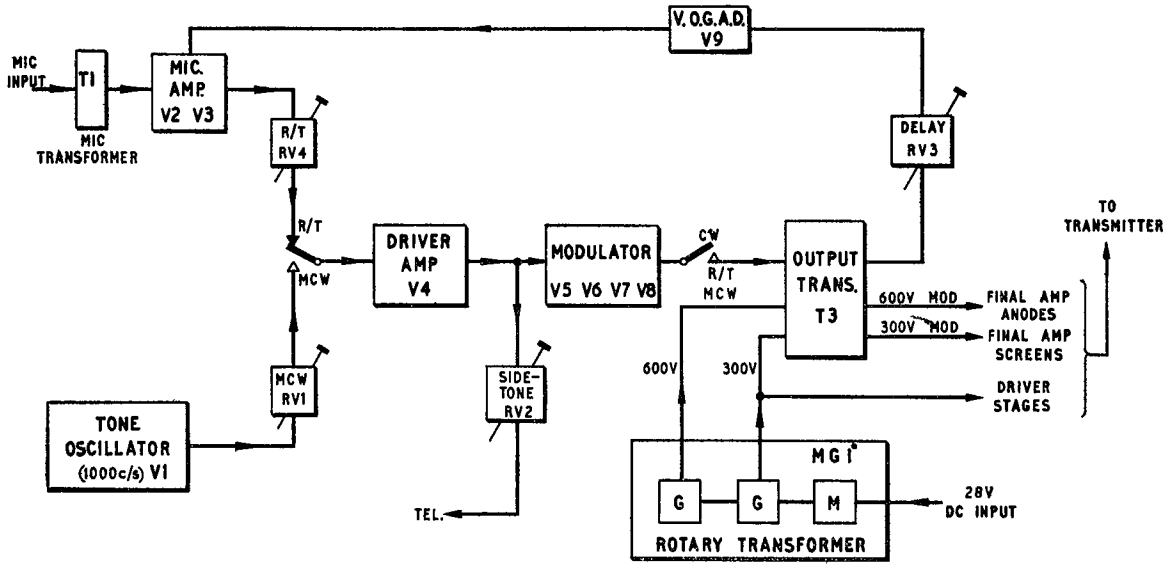

Fig. 4. Block diagram of power and radio unit

R23 (*fig.* 6) and mainly by the 28V supply from pin 3 of SK2; the connection is made via R23, pin 9 of PL3 and SK6, relay contact 2B, resistor R50 and relay contacts 1B and 3A. Contact 2B is paralleled by relay contact 5B connected through pin 8 of PL3 and SK6 ; the action of the relays is explained in para. 27.

25. When the 28V supply is removed, R24 acts as an extra cathode-bias resistor and biases the stage to cut-off. This occurs in the conditions described in para. 27 and is described in conjunction with the provision of sidetone.

26. A second winding (7—9) of the transformer T2 provides sidetone from the transmitter ; adjustment of the sidetone level is by means of the preset resistor RV2 (SIDETONE) (*para.* 27).

Relay function in audio circuits

27. The following sub-paragraphs describe the function of the relays in the audio amplifier with relation to the selected position of the services switch on the remote control unit.

(1) **CW.** For CW facilities the modulator stage is not required ; relay RL3/2 is un-energized and contact 3A remains open thus biasing off the modulator valves. The tone oscillator relay RL4/2 and the sidetone relay RL5/2 are operated, contacts 4A and 4B close and connect the output of the tone oscillator V1 to the grids of the double-triode V4. Sidetone is then available at the secondary of T2 and is selected at the lower level tap 8 by the closing of contact 5A. The closing of contact 5B is ineffective in the conditions obtaining. When the key is " made " relay RL2/2 is energized and contact 2A applies sidetone to the telephones via pin 1 of SK5. The closing of contact 2B is ineffective for the reason given for contact 5B. Closing the key circuit also applies 300V from pin 17 of SK1 to the tone oscillator V1 ; this circuit is completed by the operation of relay 2RL4 in the transmitter (*Chap.* 4).

(2) **MCW.** With MCW facilities the modulator stage is operated when the tone oscillator is keyed ; sidetone is again at a reduced level via the relay contact 5A. Relay RL3/2 is energized via pin 4 on SK2 and relay RL5/2 is energized from pin 13 of SK2 (28V supply). Bias is applied to the modulator via resistor R50, contacts 3A, 1B, and contact 5B.

(3) **R/T.** For transmission on R/T the modulator stage operates only when the key is " made ". Sidetone is selected at the higher level since contact 5A does not operate. Relay RL3/2 is energized from pin 4 of SK2 and bias is applied to the modulator via contact 3A. Contact 5B remains open and the modulator stage operates only when relay RL2/2 is energized thus closing contact 2B.

(4) **INT.** When the equipment is being set up in the INTERTUNE condition, relay RL1/2 is energized from, either contact pin 10 of SK1 or pin 10 of SK2 Contact 1B opens and effectively puts the modulator in the CW condition.

Tone oscillator

28. The double-triode V1 is connected as a push-pull audio oscillator operating at approximately 1,000 c/s. The fixed-tuned circuit consists of the coil L1 and the condensers C1 and C2. The valve is biased by the preset RV1 which provides adjustment of output level and consequently the modulator gain on MCW. The condensers C3 and C4 provide the necessary feedback from the anode loads R9 and R8, respectively. The oscillator is keyed in the HT supply via pin 17 of SK1.

Gain adjusting circuit (V.O.G.A.D.)

29. This circuit is generally known as a " voice operated gain adjusting device " or " V.O.G.A.D." A connection is taken from the " live " side of the 300V modulated winding of transformer T3 through C21, SK7 and PL4 to the cathode of V9

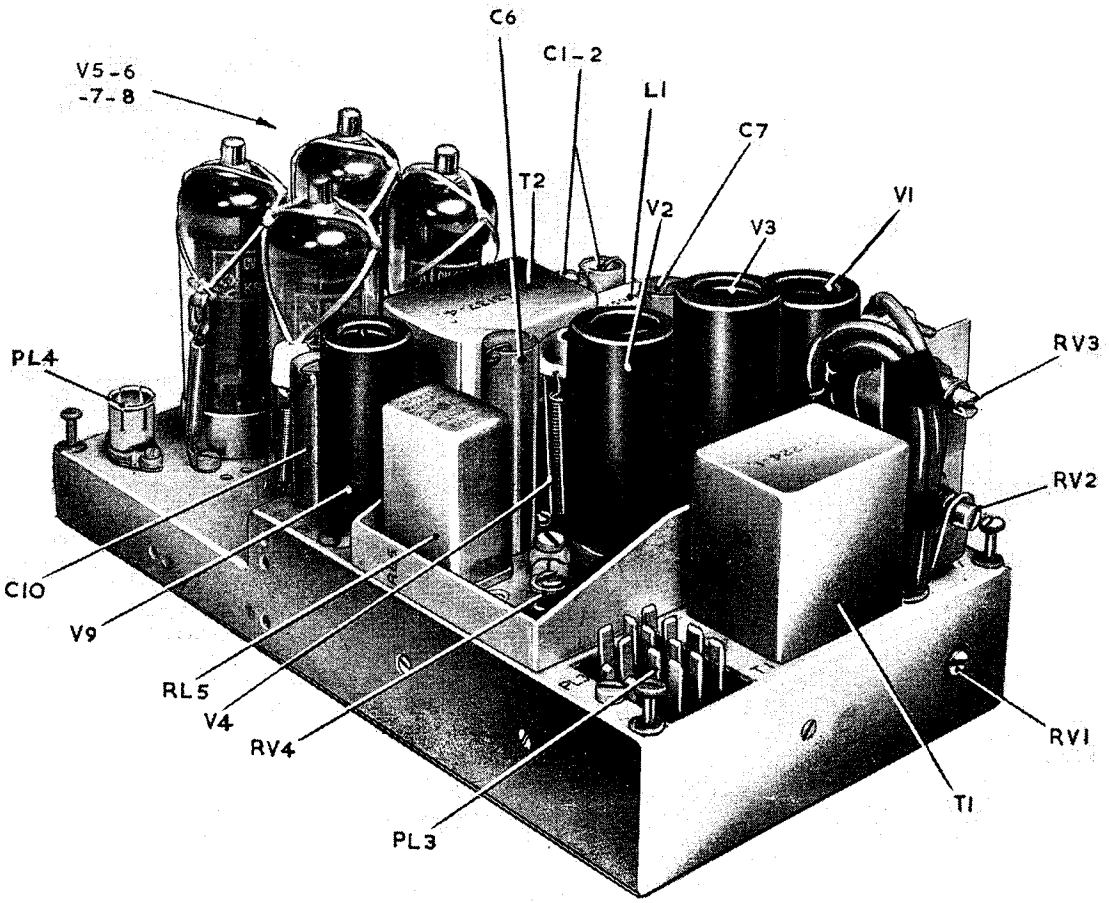

Fig. 5. Amplifying unit Type 4209—top

on the amplifier chassis. This valve is a double-diode CV140 connected in parallel.

30. During operation, some of the audio output of the amplifier is rectified and thus develops a negative DC potential across R26 in the diode anode. This is filtered by R25 and C10 and taken via a screened cable to the centre point of the resistors R4 and R5 in the input stage. The cathode of the V.O.G.A.D. valve V9 is positively biased by means of R28 and R27 from the 300V supply.

31. When the input rises above a certain level i.e., when the input to the diode exceeds the positive bias applied to its cathode by R28 and R27, the valves V2 and V3 are biased back in proportion to the increase in output to reduce the overall gain of the amplifier, thus preventing over-modulation. The amplifier gain and the V.O.G.A.D. delay is adjusted to operate on approximately half the normal microphone input so that some measure of compensation for under modulation is also applied. The potentiometer RV3 (DELAY) is used for adjustment of the audio voltage level applied to the diode and thus allows a point of operation to be preselected.

Valve heaters

32. The valve heaters are connected in series parallel with the 19V stabilized supply from pin 14 of SK2 through the 2-amp fuse F2 (*fig.* 7).

Modulating transformer

33. The anodes of the modulator valves V5, V6, V7 and V8 are connected to the primary of the modulating transformer T3, the anode supply being obtained from the 600V applied to the centre tap. This transformer is not a part of the chassis of the amplifying unit Type 4209 but is mounted adjacent to the rear end of this on the main chassis (*fig.* 1).

34. Of the secondary windings of the transformer, the output 5–6 is connected to supply 600V modulated to the transmitter P.A. anodes via co-axial plug PL2. Secondary 7–8 is connected to supply 300V modulated to the screen grids of the P.A. valves via pin 22 on socket SK1.

Remote control circuits

35. These are covered in Chap. 2 and will not be described here.

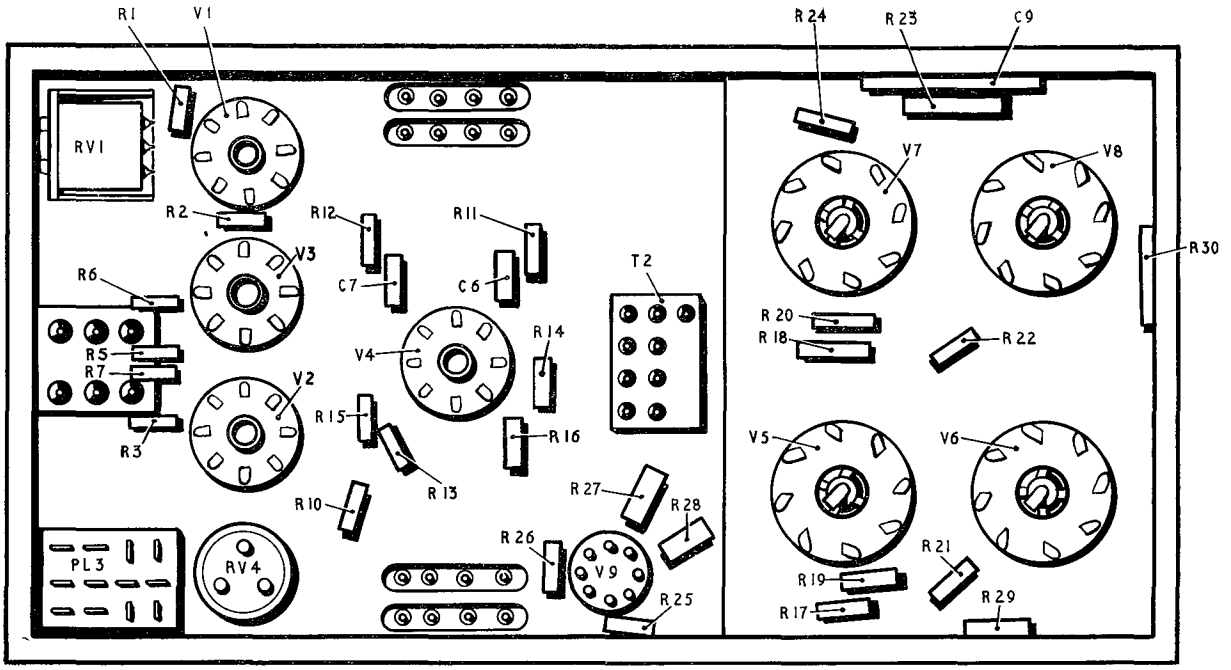

Fig. 6. Amplifying unit Type 4209—underside

Power supplies circuit

36. The input power supplies to the whole of the transmitter equipment is applied via PL1 ; with 28V positive on pins 13–20, 19V positive (regulated) on pins 11 and 12 and the common earth on pins 1–10.

37. When the equipment is switched to STANDBY the relay RL6/1 is energized and closes the contact 6A thus connecting the 28V supply through the 3-amp fuse F1 to the control circuit. Contact 6A also completes the circuit of the energizing coil of RL7/1 which closes contact 7A and connects the 19V positive lines to the control circuits and to all the valve heaters of the equipment.

38. The following fuses are mounted on the front panel of the equipment :—

(1) Fuse F1, 3-amp. Protects the 28V control circuits.

(2) Fuse F2, 2-amp. Protects the 19V control circuits and the valve heaters in control unit Type 4190 or Type 4243.

(3) Fuse F5, 10-amp. Protects all the 19V supplies.

Rotary transformer

39. The rotary transformer is intended to operate at a nominal input of 28V as normally provided by the aircraft battery supplies. There are two secondary windings giving 300V and 600V HT respectively. These outputs supply 300V and 600V HT to the incorporated amplifying unit Type 4209 ; and 300V HT to the crystal-controlled oscillator in the control unit Type 4190 ; the 300V supply (modulated and unmodulated), and the 600V supply (modulated) is applied to the transmitter unit.

Rotary transformer control circuits

40. In the HT ON or TX condition of the equipment relays RL8/1 and RL9/2 are energized from pin 2 of SK3. Contact 8A makes and connects the 28V supply from PL1 to the motor side of MG1 through the low value resistors R44 and R45. At rest, the armature approximates to a short-circuit and most of the volts are dropped across R44 and R45 so that RL10/1 cannot operate.

41. As the speed of the motor and the armature resistance increases, the back EMF builds up to approximately 20–24 volts and relay RL10/1 is energized through the closed contact 9A. Relay contact 10A closes and short-circuits the starting resistors R44 and R45, thus allowing the motor to reach its maximum speed.

42. The relay contact 9B breaks the circuit between pins 3 and 4 of SK3 and can be used to interlock with the circuit of any other equipment in the aircraft which may be connected to SK3. When SK3 is not connected to other equipment pin 1 and 2 are shorted by a special link which is plugged into the back-plate.

43. After transmission, the relays RL8/1 and RL9/2 are de-energized and the motor-generator switched off. Contact 9A breaks the circuit of RL10/1 and contact 10A reinserts the starting resistors in the motor circuit ready for any immediate restart.

44. The negative side of the motor winding is earthed via PL1. Noise suppression on the positive side is provided by the two-stage filter L6, C25 and L7, C26 mounted in a screened box. (*fig.* 3).

45. Outputs from the generator side of the machine are provided by two armature windings

giving, respectively, 300V HT and 600V HT. The 300V output is connected through the noise filter L5, C28 and L4, C27 and then through L8, C22 connected as a one-stage ripple filter.

46. The 600V output from the machine is taken through the noise filters L3, C30 and L2, C29 to the secondary winding of transformer T3 and C24 which gives some ripple suppression.

47. Fuses F3, 750mA and F4, 250mA protect the HT circuits and the " noise " filters. They are mounted inside the unit to avoid bringing unfiltered leads and dangerous voltages to the front panel of the equipment. Spare fuses for F3 and F4 are mounted under the chassis.

48. The resistor R43 in the 300V line to the secondary winding of transformer is brought into circuit by the breaking of relay contact 11A. Relay RL11/2 is energized when the equipment is in the SAFE condition (from pin 19 of SK2) and R43 limits the screen potential of the transmitter P.A. stage.

Reduced power conditions

SAFE

49. The SAFE condition is provided primarily to reduce the output power of the transmitter a safe l evel for the prevention of corona discharge which may occur at altitude in the event of a pressure leak in the suppressed aerial tuning unit (*Sect.* 2, *Chap.* 3).

50. This low power facility is also provided under control of the operator in the form of a HIGH/LOW power switch connected between pin 6 of SK5 and earth on the " Intercom " output socket.

51. SAFE conditions occur when the LOW POWER line is earthed by the LOW POWER switch or the barometric switch in the suppressed aerial tuning unit (*para.* 49). An immediate reduction in power is obtained since the screen potential of the P.A. stage is reduced by the potential divider formed by R43 and R51, the latter being taken to earth via pin 20 of SK2 and the control unit Type 4190 at 1RL7B (*Chap.* 3).

52. In addition to the reduced power obtained at the P.A. stage, relay contact 11B opens and inserts an extra cathode bias resistor R50 in the audio output stage V5—V8.

TUNE

53. When the TEST TUNE KEY on the control and drive unit or the suppressed aerial selector unit is in the TUNE position, the resistor R51 is removed from its earth connection by 1RL7B in the control and drive unit (via pin 20 of SK2—*fig.* 6). Tuning can then take place at nearly full power since only R43 remains to limit the screen voltage.

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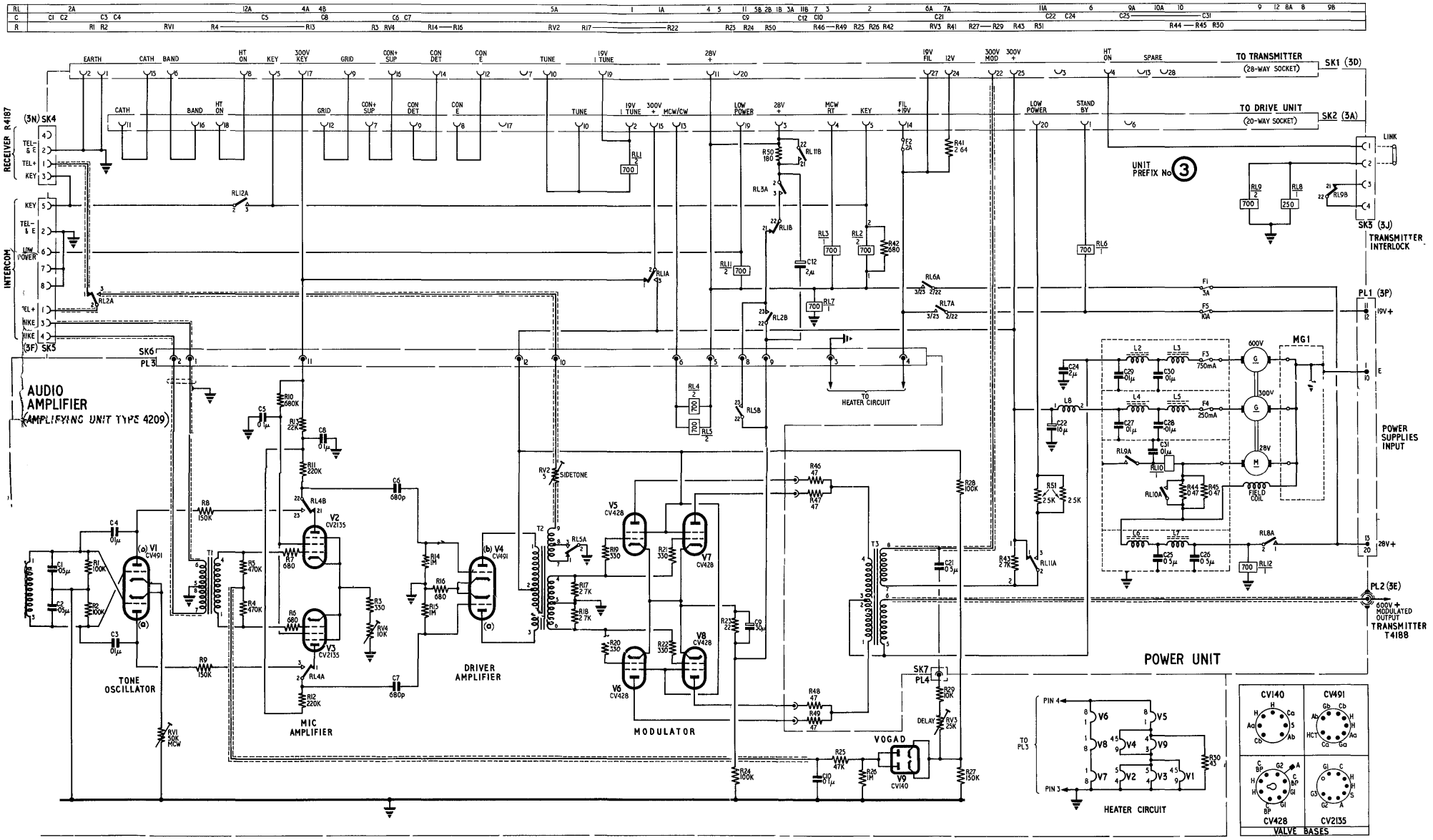

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Fig. 7

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