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VOLUME 6

U H.F. TRANSMITTER-RECEIVER ARC 52

(AIRBORNE AND GROUND INSTALLATIONS)

REPAIR AND RECONDITIONING INSTRUCTIONS

(ADVANCE INFORMATION)

Prepared by direction of
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LIST OF ASSOCIATED PUBLICATIONS

	A.P.
ARI.23057 Standby UHF transmitter-receiver TR.10056	2531N
Common test gear for radio equipment	2536C
Concise details of radio test equipment	2276F
UHF Homing installations (ARI.18120 series)	2531L

A list of publications for the associated test equipment is given in Sect. 1, Chap. 1.

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SECTION 1

TEST EQUIPMENT

Chapter 1

GENERAL INFORMATION ON TEST EQUIPMENT

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Introduction

1. In order that all individual sub-units (modules) of the Type TR4/ARC52 and Type TR5/ARC52 transmitter-receivers can be successfully and easily serviced or tested, a range of special-to-type test equipment has been designed and developed. This equipment takes the form of separate bench test sets which, in conjunction with the minimum of associated electrical test gear, can be used to test the sub-units completely to the standards demanded by the test specifications.

2. In addition to the electrical test equipment, there is also a comprehensive range of jigs, fixtures and tools which supplement some of the test sets and also enable practically all normal servicing requirements to be met (para. 51 et seq.).

3. Items of ancillary equipment necessary to implement the testing and servicing procedure described in subsequent chapters of this volume have also been developed and are available to the Services at appropriate

lines of servicing. These are, for example, power supply units (para. 45) and a calibrator, frequency (para. 49); items which provide the matched facilities required in servicing and testing without the necessity for test gear.

4. The constructional details of test equipment for individual transmitter-receiver modules is described separately in the following chapters of Part 2, Sect. 1, of this Volume.

Facilities

5. The special-to-type electrical testing equipment provides the peculiar monitoring or signal source requirements for the sub-units where these cannot be readily or completely obtained by the use of standard items of test equipment.

6. This equipment, in all necessary instances, provides a suitable mounting pedestal for the module on test; enabling the operator to gain easy access to certain components, trimming points or voltage test points etc. For mechanically driven sub-units, the pedestal also incorporates means for accurately indexising the equipment to all test frequencies.

7. In order that each item of test equipment is correctly coupled to the power source (bench supply or power unit) and to the module on test, connector sets or cable assemblies are available for each test set. These are of the appropriate length and terminated in the correct plug or socket so that each one can be quickly and easily fitted. Details of the connectors for each test equipment are given in subsequent chapters of this Section; they are also summarized in para. 10 to 48.

8. Certain of the test sets, i.e. for r.f. modules such as the test set, amplifier (20-30 Mc/s IF) and the test set, amplifier (power amplifier), are fitted with associated modules of AN/ARC52 equipment in order to provide the correct dynamic loading or source impedances of the module under test. Such test sets are supplied complete with all necessary sub-units and do not require attention, other than the normal servicing requirements, before they may be used in service.

9. The main features of each test set and the facilities provided are summarized in para. 10 to 44. The test sets are also listed for quick reference in Tables 1 and 2 of this chapter. The servicing of individual test equipments, or any setting up procedure necessary, is detailed in the separate chapters of Section 1 of this Volume.

Electrical test equipment

Test set, electrical power (AC)

10. This equipment is collectively designated under No.6625-99-999-7813 and comprises an interconnecting box (head) 5821-99-913-3097, an interconnecting box (set) 5821-99-913-3096 and associated connectors (para. 12).

11. It is used in conjunction with the dummy load, electrical 5895-99-999-1866 to provide testing facilities for the power unit (AC) 5821-99-942-8546 and the rectifier unit 5821-99-942-8551 of Type TR4/ARC52 transmitter-receivers.

12. Connectors designed for use with this test set are as follows:-

(1) Cable assembly, power, electrical (4-way) 5995-99-945-5740

(2) Cable assembly, power, electrical (30-way) 5995-99-945-6450

(3) Cable assembly, power, electrical (120way) 5995-99-945-5738

(4) Cable assembly, power, electrical (40way) 5995-99-945-9895 (formerly connector Type 3430/1, Ref. No.10HA/8360)

(5) Cable assembly, power, electrical (25-way) 6150-99-999-4743

Test set, tuning unit

13. This equipment is listed collectively under No.6625-99-943-6906 and has the basic function of simulating the circuit supply conditions and operation of a control unit Type C1607/ARC52 incorporated in Type TR4/ARC52 and Type TR5/ARC52 installations. It provides the facilities for transferring all power requirements from the power unit to the tuning unit (mechanical) under test and also to enable immediate comparison to be made between a selected frequency channel and the calibrated drums of the unit on test.

14. The items comprising the test set, tuning unit, 6625-99-943-6906 are as follows:-

(1) Test set, tuning unit, 6625-99-945-2659

(2) Cable assembly, power, electrical, 5995-99-946-5090

(3) Cable assembly, power, electrical, 5995-99-946-5091

(4) Dummy load, electrical, 5985-99-945-2658

15. The required variation in d.c. output voltages necessary in testing is obtainable by the use of a variable auto-transformer (Variac) Type 200/CMH, Ref. No.5P/2491.

Test set, control unit

16. The test set, control unit, 6625-99-943-6905 is a single unit circuit continuity tester ohmmeter and a transmission measuring set or dB meter. By means of a lamp display, the continuity testing facility provides a rapid method of determining whether the channel selection circuits of the control unit Type C1607/ARC52 are complete. This facility is extended to apply to the testing of the function switch of the control unit. The ohmmeter provides a means of testing the resistance of the volume control whilst the dB meter facilitates the testing of its attenuation over the whole range of control of audio output.

17. Two connectors are supplied as follows:-

(1) Cable assembly, power, electrical, 5995-99-945-9896 (formerly connector Type 3429/1, Ref. No.10HA/8359)

(2) Connector 5995-99-932-3722 (30-way).

Test set. audio

18. This equipment is used in conjunction with the power supply (130V) 6130-99-999-7812, a signal generator Type 65 (or alternative), a multimeter CT38, a wattmeter CT44, an indicator distortion (10S/17639) and a headset Type 9. It is listed under No. 6625-99-943-6544 and supplied to facilitate the testing of gain, bandwidth etc., of the amplifier unit, AF 5821-99-942-8555 incorporated in both the Type TR4/ARC52 and Type TR5/ ARC52 transmitter-receivers.

19. No connectors are supplied with this test set. Connection to the power supply (130V) is made by means of the cable assembly which is provided with that unit.

Test set, relay

20. Issued under No.6625-99-943-6538, this test set is used for testing the operation of the relay unit 5821-99-942-8545. It incorporates rotary switches in conjunction with a lamp display which facilitates rapid semi-automatic testing of the relays and associated wiring and components.

21. The test set is powered from a power unit (AC) 5821-99-943-7136 and coupled to resistance and capacitance measuring equipment such as a multimeter Type 1 and a universal bridge CT375.

22. The test set is capable of transferring all power requirements from the power unit (AC) to the unit on test by way of the associated cable assembly, power, electrical, 5995-99-945-9895 (formerly connector Type 3430/1, Ref. No.10HA/8360).

Test set, amplifier (modulator)

23. This is a compound equipment issued under No.6625-99-943-6546 for testing the modulator, radio transmitter 5821-99-942-8548 incorporated in Type TR4/ARC52 and Type TR5/ARC52 equipments.

24. It comprises the test set, amplifier 6625-99-945-2655, an interconnecting box 6625-99-914-8341 and a cable assembly, power, electrical, 5995-99-945-2654. Power supplies are derived from a power unit (425V) 5821-99-932-2942.

25. For full testing of the module, additional equipment is required:-

(1) Signal generator, Type 65B, 6625-99-932-4976

(2) Multimeter, electronic CT38, Ref. No.10S/16308

(3) Indicator, distortion, Ref. No.10S/17639

(4) Simulator, microphone, 6940-99-943-6545 or 6625-99-945-0061

(5) Oscilloscope Type 13A, Ref. No.10S/831

Test set, oscillator

26. An equipment comprising the test set, oscillator, 6625-99-945-2946 and cable assembly, radio frequency, 5995-99-947-7716, which is listed collectively under No.6625-99-943-6547. It enables the output from an oscillator unit 5821-99-942-8553 to be measured; it also provides facilities for determination of the frequency accuracy of its crystals by comparison with an oscillator housed within the test set.

27. The test set forms a mounting for the oscillator under test and provides facilities for indexing the rotary type crystal switches so that the operation of all crystals may be tested. Means are provided for disabling either of the two oscillator circuits by application of a high grid bias voltage.

28. This test set is powered from a power supply (130V) 6130-99-999-7812. Monitoring facilities are afforded through terminals on the control panel which may be coupled to a multimeter, electronic CT38.

Test set, amplifier (power amplifier)

29. The amplifier, radio frequency (RF power amplifier) may be tested on the test set issued under No.6625-99-999-7814. This equipment provides simulated transmitter circuits by means of built-in modules, including an amplifier unit (main receiver and transmitter preamplifier) spectrum generator unit (amplifier-oscillator), IF unit (20-30 Mc/s), oscillator

unit, and tuning unit (mechanical) together with a gear plate assembly.

30. The module under test is indexed by means of a hand-operated indexing head. Provision is made for connection to an external blower unit (cooler, air, electronic equipment, 5820-99-945-9893), power unit (425V) 5821-99-932-2942 and an absorption wattmeter CT419. The test set is provided with internal metering of the u.h.f. power drive to the module on test.

Test set, radio (guard)

31. This equipment which includes the test set, radio, 6625-99-945-2947 and its associated cable assemblies and adaptors, is designed, and issued under No. 6625-99-943-6886, for testing guard receiver modules 5821-99-942-8558. It is used in conjunction with an external power supply (130V) 6130-99-999-7812 and signal sources. Two built-in crystal oscillators, resonant at 1.85 Mc/s and 34.45 Mc/s, provide accurate setting facilities for the external signal generators employed and the receiver unit local oscillators. In addition to these oscillators, a low frequency generator is embodied which is employed for testing the selectivity characteristic of the receiver at the 6dB and 60dB response levels, using the beat frequency method.

Test set. amplifier (1.85 Mc/s IF)

32. Issued under No. 6625-99-943-6536, this equipment comprises the test set, amplifier, 6625-99-945-2660 and cable assembly, radio frequency, 5995-99-932-4021. It is used for testing the IF unit (1.85 Mc/s) 5821-99-942-8556, with provision for monitoring the output levels of selected circuits in conjunction with associated test equipment.

33. This equipment is powered from a power supply (130V) 6130-99-999-7812. The associated performance monitoring equipments include a multimeter, electronic CT38, oscilloscope Type 13A, headset Type 9. The test signal source is provided by a signal generator Type 65 or equivalent.

Test set, amplifier (20-30 Mc/s IF)

34. This test set comprises the test set and two cable assemblies under the overall No. 6625-99-943-6537 and enables the IF unit (20-30 Mc/s) 5821-99-942-8557 to be operated and tested in either the transmit or receive condition.

35. The test set contains dynamic simulation of the input and output circuits of the amplifier unit (main receiver and transmitter preamplifier) together with a 1.85 Mc/s receiver. The test set is provided with a crystal controlled local oscillator which simulates the oscillator unit of the Type TR4/ARC52 and Type TR5/ARC52 equipments. A hand-operated indexing head is provided for the module under test. Power supplies are derived from a power supply (130V) 6130-99-999-7812.

36. Associated equipment required during testing includes a signal generator CT394 (or equivalent), a signal generator Type 56 (or equivalent), a multimeter, electronic, CT38, wattmeter CT44 and headset Type 9.

Test set, amplifier (main receiver and transmitter preamplifier)

37. Test equipment which enables the amplifier unit 5821-99-942-8554 to be operated and tested in either the receive or transmit condition. This is a compound test set, issued under the overall No.6625-99-999-7815, which includes a test jig, amplifier 6625-99-999-1872, a test set, amplifier, 6625-99-915-0262 and four cable assemblies. Power supplies are derived from a power supply (130V) 6130-99-999-7812.

38. The function of this test equipment is to simulate circuit supply conditions and facilitate the monitoring of the r.f. power output pass level of the amplifier module on test and also the output levels of the spectrum generator unit and IF unit (20-30 Mc/s). Built-in modules of AN/ARC52 equipment provide the simulated circuit conditions; these include an IF unit (20-30 Mc/s) and a 1.85 Mc/s receiver for receiver preamplifier tests. A spectrum generator unit and local oscillator are provided for transmitter preamplifier testing.

39. All internal modules are mechanically indexed by means of a gear plate assembly in conjunction with a tuning unit (mechanical) and simulated control unit switching. The module under test is indexed by means of a hand-operated indexing head.

Test set, electronic circuit, plug-in unit

40. This is a plug-in unit to facilitate continuity testing and insulation and resistance tests on the wiring of the main chassis assembly. To provide the required performance monitoring facilities an interconnecting box is issued with the test set; an external multimeter is also necessary. The test equipment is listed collectively under No.6625-99-999-7959; it includes the test set, the interconnecting box, the indicator, fault locating, and the associated cable assemblies.

41. The test set may also be used, in conjunction with the appropriate interconnecting box, for testing the wiring of any preformed cable assembly.

42. This equipment is powered from the a.c. mains supply.

Test set, oscillator (spectrum generator)

43. For testing the spectrum generator unit (amplifier-oscillator) 5821-99-942-8552. It is listed under No.6625-99-914-0152 but is almost identical to the equipment (6625-99-999-1046) supplied as part of the test kit, transmitter-receiver, radio, required at R.N. second line of servicing.

44. The test set is supplied from an external power supply (130V) 6130-99-999-7812 and used in conjunction with a milliwattmeter for monitoring the power output of a module on test.

<u>Ancillary equipment</u>

Power units

45. For the convenient supply of the voltages required during the testing of AN/ARC52 modules, two power units have been designed. These are power unit (425V) 5821-99-932-2942 and power supply (130V) 6130-99-999-7812.

46. The power unit (425V) provides h.t., l.t. and bias supplies for use when bench testing the modulator, radio transmitter and the amplifier, radio frequency (RF power amplifier). It is also used in conjunction with the test kit, transmitter-receiver, radio, for testing all modules at the R.N. second line of servicing. It operates from a.c. mains input supplies of 90-125V or 180-250V at 45-65 c/s. Power consumption is 580VA maximum.

47. The power supply (130V) is designed to provide the h.t., l.t., and bias supplies when bench testing all AN/ARC52 modules except the modulator and r.f. power amplifier units. It is also used in testing the homing equipments ARI.18120 series. Input supply can be either 110-120V or 200-250V a.c. mains at 50 c/s. Power consumption is 500VA maximum.

48. Both units provide adjustable, stabilized high tension supplies. Each unit is supplied complete with connectors, i.e. cable assembly, power, electrical (12-way) 5995-99-932-4017 (output) and cable assembly, power, electrical, 5995-99-945-9896 (formerly connector Type 3429/1, Ref. No.10HA/

8359) which is the 3-way input connector from the mains source.

Calibrator, frequency

49. This is an equipment for frequency alignment or the measurement of frequency errors when testing modules such as the spectrum generator unit (amplifier-oscillator), receiver unit (guard), and the IF unit (1.85 Mc/s). It is also employed in bench testing of associated equipment; for example, the test set, UHF equipment Type 15056 and the standby transmitter-receiver Type TR.10056. The functions of this instrument can be extended to measure the error of frequencies other than those associated with these modules and equipments, from 2 Mc/s to 20 Mc/s on fundamental frequencies, by the use of RCL style D plug-in type crystals.

50. The calibrator, frequency is powered from single phase a.c. mains supplies in the ranges 110-120V and 200-250V, 45-65 c/s. It is prepared for operation on different supply voltage levels by the adjustment of a voltage tap panel, the nominal 115V range being adjustable in 5V steps and the 230V nominal range in 10V steps. The Ref. No. for this equipment is 6625-99-999-2642.

TABLE 1

Special-to-type test equipment, electrical

Item	Nomenclature	Ref. No.	Further details
1	Test set, electrical power (AC)	6625-99-999-7813	Sect. 1, Chap. 4
2	Test set, tuning unit	6625-99-943-6906	Sect. 1, Chap. 5
3	Test set, control unit	6625-99-943-6905	Sect. 1, Chap. 6
4	Test set, audio	6625-99-943-6544	Sect. 1, Chap. 7
5	Test set, relay	6625-99-943-6538	Sect. 1, Chap. 8
6	Test set, amplifier (modulator)	6625-99-943-6546	Sect. 1, Chap. 9
7	Test set, oscillator	6625-99-943-6547	Sect. 1, Chap.10
8	Test set, amplifier (power amplifier)	6625-99-999-7814	Sect. 1, Chap.11
9	Test set, radio (guard)	6625-99-943-6886	Sect. 1, Chap.12
10	Test set, amplifier (1.85 Mc/s IF)	6625-99-943-6536	Sect. 1, Chap.13
11	Test set, amplifier (20-30 Mc/s IF)	6625-99-943-6537	Sect. 1, Chap.14
12	Test set, amplifier (main receiver and transmitter preamplifier)	6625-99-999-7815	Sect. 1, Chap.15
13	Test set, electronic circuit, plug-in unit	6625-99-999-7957	Sect. 1, Chap.16
14	Test set, oscillator (spectrum generator)	6625-99-914-0152	Sect. 1, Chap.17

TABLE 2

Special-to-type test equipment, ancillary electrical

Item	Nomenclature	Ref. No.	Further details
1	Power unit (425V)	5821-99-932-2942	Vol.1, Part 2 Sect. 1, Chap.5
2	Power supply (130V)	6130-99-999-7812	Sect. 1, Chap.2
3	Calibrator, frequency	6625-99-999-2642	Vol.1, Part 2, Sect.1, Chap.6

Note...

Other items of test gear required during testing are standard equipments which should normally be available to Service users; these items are listed in appropriate paragraphs of the relevant chapters of Sect. 1 or Sect. 2.

Mechanical equipment

General

51. In addition to electrical testing sets, the special-to-type equipment devised for the servicing of Type TR4/ARC52 and Type TR5/ARC52 transmitter-receivers includes a number of special jigs, tools and fixtures which are designed primarily to facilitate the drilling, pinning and setting of the couplers of mechanically tuned modules. In addition, some tools are provided to assist in rebuilding the sub-units; particularly when this requires precise settings or the accurate positioning of component parts.

52. Details of each item of mechanical testing or servicing gear are given in the appropriate chapters of Section 1, with the methods of using each item described in the chapters of Section 2. A summary of these items is shown in Table 3 which lists, also, the equipment modules for which they are intended.

TABLE 3

Special-to-type servicing and test equipment, mechanical

Item	Nomenclature	Ref. No.	Other details and use
1	Drill and ream jig	10AG/940	Amplifier unit (main receiver and transmitter preamplifier) Sect. 2, Chap.3
2	Checking fixture	10AG/937	
3	Torque tester	5120-99-943-9324	
4	Height gauge	10AG/955	
5	Height gauge plate	10AG/959	
6	Cover, r.f. amplifier, test side	5821-99-932-1806	
7	Cover, preamplifier, test side	5821-99-932-1804	
8	Tuning wand	5120-99-942-1514	
9	Aligning fixture	10AG/956	IF unit (20-30 Mc/s) Sect.2, Chap.4
10	Setting plate	10AR/4892	
11	Drill and ream jig	10AG/957	
12	Checking fixture	10AG/958	
13	Height gauge plate	10AG/959	
14	Depth gauge	10AG/961	
15	Drill and ream jig	10AG/968	Spectrum generator unit (amplifier-oscillator) Sect.2, Chap. 7
16	Height gauge	10AG/955	
17	Checking fixture	10AG/969	
18	Test side cover	5821-99-932-1916	
19	Tuning wand	5120-99-942-1514	

TABLE 3 (contd.)

Item	Nomenclature	Ref. No.	Other details and use
20	Drill and ream jig	10AG/944	Amplifier, radio frequency (RF power amplifier) Sect.2, Chap.8
21	Height gauge	10AG/955	
22	Height gauge plate	10AG/959	
23	Checking fixture	10AG/943	
24	Tuning wand	5120-99-942-1514	
25	Assembly base	10AG/971	Modulator, radio transmitter. Sect.2, Chap.9
26	Cover, guard receiver, test side	5821-99-932-2388	Receiver unit (guard) Sect. 2, Chap. 10
27	Gauge, plug, plain cylindrical	10AG/1850	For power unit (DC) Sect.2, Chap.14
28	Gauge, depth, dial indicating	10AG/1854	
29	Gauge, plug, taper, cylindrical	10AG/1849	
30	Alignment tool, dynamotor end housing	10AG/1851	
31	Gauge, flush pin, rectangular	10AG/1852	
32	Alignment tool, dynamotor end housing	10AG/1855	
33	Gauge, flush pin, rectangular	10AG/1853	
34	Took kit, special	10AG/9431512	Tuning unit (mechanical) Sect.2, Chap.15
35	Roll pin applicator	10AG/945	
36	Bearing support tool (drive end)	T336939	
37	Bearing press tool (drive end)	T336906	
38	Housing support tool (commutator end)	T336947	
39	Bearing press tool (commutator end)	T336916	
40	Bearing and shaft ejector	T336945	
41	Torque test fixture	10AG/938	
42	Support jig and punch	T336948	
43	Clutch spring assembly tool	10AG/949	
44	Assembly fixture	10AG/951	
45	Spanner Type 550	10AG/950	
46	Torque testing wrench	10AG/946	
47	Torque test and running-in fixture	10AG/948	
48	Torque gauge	10AG/947	
49	Cam setting plate	10AG/962	
50	Cam setting gauge	10AG/953	
51	Drill and ream jig	10AG/952	
52	Height gauge	10AG/955	
53	Checking fixture	10AG/954	
54	Adjuster, spring, communications equipment	10AG/1897	
55	Anvil tool, gear and pin assembly	10AR/6052	

Item	Nomenclature	Ref.No.	Other details and use
56	Extractor, ball race	10AG/1889	
57	Driver plug, bearing and bush	10AR/6051	
58	Driver plug, bearing and bush	10AR/6053	
59	Driver plug, bearing and bush	10AR/6054	
60	Driver plug, bearing and bush	10AR/6055	
61	Driver plug, bearing and bush	10AR/6056	
62	Fixture, gear plate alignment	5821-99-943-6854	Chassis assembly (main) Sect.2, Chap. 16
63	Backlash bias tool	10AG/974	
64	Checking gauge, gear plate	10AG/942	
65	Checking gauge	10AG/939	
66	Preload tool	10AG/941	
67	Acceptance gauge	10AG/934	
68	Plug gauge	10AG/933	
69	Adaptor, tensiometer	10AD/3999	
70	Drill and ream jig	10AG/964	Oscillator unit Sect.2, Chap.19
71	Assembly fixture	10AG/965	
72	Switch setting piece	10AG/967	
73	Checking fixture	10AG/966	
74	Height gauge plate	10AG/960	
75	Depth gauge	10AG/961	

TABLE 4

Standard tools and equipment (supplementary)

Item	Nomenclature	Ref.No.	Details, references and uses
1	Plate, surface, scraped	1B/1256	Sect.2,Chap.3,4,7,8,15 & 16
2	Gauge, dial	1B/4764	Sect.2,Chap.3,4,7,8,15 & 16
3	Gauge, surface, universal	5120-99-910-5222 (formerly 1A/3690)	Sect.2, Chap.3,4,7,8,15 & 16
4	Screwdriver, torque	5120-99-943-9324	Sect.2, Chap.4,7 & 8
5	Bit, screwdriver	5120-99-120-0868	Sect.2, Chap.4,7 & 8
6	Cooler, air, electronic equipment or Cooler, air, electronic equipment	5821-99-913-2641 5821-99-913-2640	Sect.2, Chap.8
7	Fan, electrical	4140-99-110-2928 (formerly 5P/2341)	Sect.2, Chap.9
8	Gauge, thickness	5210-99-910-5207 (formerly 1B/4110)	Sect.2, Chap.15 & 18
9	Roll pin applicator (3/32 in. dia.)	10AG/970	Sect.2, Chap.18
10	Roll pin applicator (1/16 in. dia.)	10AG/945	Sect.2, Chap.18

Connectors

53. In order that each item of electrical test equipment is correctly coupled between the power source (whether mains supply or a power unit) and the module on test, connector sets or cable assemblies are issued for use with each test set. These are of a length appropriate to the equipment involved and are terminated in the correct plug or socket to enable each one to be quickly and easily fitted. Details of individual items are given for each test set in the chapters of this Section.

54. To ensure the continuance of satisfactory results, be sure that the connectors are maintained in good condition and that when not in use they are stored carefully with the test set in cool, dry conditions.

Environmental design considerations

55. Particular attention has been applied to the design of all items of special-to-type electrical test equipment to enable them to be stored and operated over a wide range of temperatures and humidity. Each test set will withstand, in its inoperative condition, ambient temperatures from -26°C to +70°C at the prevailing relative humidity. In the operative condition, the equipment will function continuously in an ambient temperature of +55°C at the prevailing relative humidity and in an ambient temperature of +40°C at a relative humidity of 95%. Each unit will function mechanically in ambient temperatures down to -26°C.

Maintenance and servicing

WARNING...

> Before handling any component of the test sets and before attempting any servicing, the power supply should be disconnected from the test equipment or, preferably, disconnected from the source.

Note...

(1) A number of the test equipments incorporate electrolytic capacitors. These should be discharged before any attempt is made to handle any component in the associated circuit.

(2) Take special care when servicing test equipment which includes neon valves and/or silicon diodes in the circuit. These components can be irreparably damaged by excessive heat; when renewing them, therefore, use a thermal shunt and make soldered connections as quickly as possible using the smallest soldering iron practicable. When renewing diodes, first note carefully the way in which polarity is effected; the new component must be similarly fitted.

56. The electrical test equipment must be maintained in a clean, dry and thoroughly serviceable condition to ensure that tests are carried out correctly. Care must be taken to avoid rough handling of the switches and controls provided on each piece of equipment; in most instances, guard handles are provided on the control panels to give some measure of protection to protruding items such as meters, fuseholders and indicating lamps, but the best policy to adopt is to treat the test equipment modules as delicate, high quality instruments. Keep the working area clear of servicing tools, soldering irons and unnecessary equipment.

57. Periodically, remove the detachable cover of each test set and inspect the switches and internal wiring. At the same time, examine all components within view for signs of obvious damage or deterioration. Whenever a fault is suspected in the wiring, a continuity test can readily be made using an approved multimeter; all terminal points and

circuit test points are accessible with the module cover removed.

58. All wiring employed in this test equipment conforms to DEF.5000 and any replacement wiring should be made in the same type of cable as originally fitted unless modification instructions demand a change. Replacement wiring should be made as neatly as possible with as little solder as practicable to ensure a good joint. Avoid making tracking paths, by removing any wire clippings or tails of excess solder when rewiring.

59. A circuit diagram of each test set is given at the end of each appropriate chapter in this Section. A study of these diagrams will provide all the information necessary for clearing normal faults. When repairs or replacement of component parts are necessary, tests should be made to determine that the test set is restored to a serviceable condition equivalent to that of a new unit, as issued, which has been inspected to the manufacturer's specification standards. Where this process is considered critical, or when it involves a departure from standard practice, details are given for the appropriate units in the chapters of this Section.

60. All the special-to-type mechanical equipment (Table 3) is based upon jigs, fixtures or gauges which were devised and developed for the assembly, setting or inspection of the sub-units at the factory. Each item is inspected and set up for use before leaving the manufacturer and should not require further attention apart from normal periodic maintenance.

61. The use of each item is explained in the relevant chapters of Sect. 1 or Sect.2. Also in Sect. 1, is a detailed description of any servicing recommended for these items. Any fault requiring servicing because of damage or which cannot be remedied by simple replacement of component parts should be communicated to the manufacturer. The accuracy of most of the jigs and gauges is critical and any equipment which is suspect should be returned to the factory for overhaul.

62. In general, the mechanical items of test gear are extremely robust and should have a long, trouble-free service life; but care should be taken to ensure that every item is handled as a precision tool and is not subjected to misuse.

CHAPTER 2

POWER UNIT (No.1) AND POWER SUPPLY (No.2)

LIST OF CONTENTS

LIST OF ILLUSTRATIONS

LEADING PARTICULARS

Power unit (No.1)

Ref. No.	5821-99-932-2942
Purpose	To provide h.t., l.t., and bias supplies when bench testing:- (a) Modulator and r.f. power amplifier modules of the ARC52. (b) All modules of the ARC52 in conjunction with the overall test kit (R.N.).
Input supply	90-125V or 200-250V a.c. mains 50 c/s.
Power consumption	580VA max.
Dimensions (approx.)	Height 10 1/2 in. Width 19 in. Depth 18 in.
Weight (approx.)	Unit 100 lb. Connector 2 lb.

Power supply (No.2)

Ref. No.	6130-99-999-7812
Purpose	To provide h.t., l.t., and bias supplies when bench testing all modules, except the modulator and r.f. power amplifier, of the ARC52. Also for the homing equipments ARI.18120 series.
Input supply	110-120V or 200-250V a.c. mains 50 c/s
Power consumption	500VA max.
Dimensions (approx.)	Height 7 in. Width 19 in. Depth 18 in.
Weight (approx.)	Unit 62 lb. Connector 2 lb.

Introduction

1. Two separate power supply units are available to provide stabilized high tension supplies and standard low tension and auxiliary power requirements for the bench testing of individual modules of the Type TR4/ARC52 and Type TR5/ARC52 transmitter-receivers, and the control unit Type C1607/ARC52.

2. Listed as power unit (No.1) (5821-99-932-2942) and power supply (No.2) (6130-99-999-7812), each has functions in servicing, appropriate to the facilities inherent in their design. These functions may be summarised thus:-

(1) The power unit (No.1) is used at all second line servicing and for third and fourth line testing of the modulator and the r.f. power amplifier modules. This unit is also the power source for the overall module test kit (6625-99-999-3075) used in R.N. second line servicing.

(2) The power supply (No.2) is for third and fourth line testing of all modules except the modulator and the r.f. power amplifier. Details of the required settings and outputs for the testing of individual modules are given with the description of each test in Sect. 2 of this Volume.

3. Each power supply unit is supplied complete with the necessary connectors i.e. connector, 12-way, (5995-99-932-4017) which is the output connector between the power supply unit and the test set in use (para. 13, 14 and 15), and the 3-way connector Type 3429/1 (Ref. 10HA/8359), which is the input connector between the mains supply and the power supply units.

4. Both power supply units operate from a single phase a.c. mains (50 c/s) supply and provide stabilized outputs which are adjustable over the ranges specified for each test. Provision is made for operation on supply voltages in the range of 90-125V or 200-250V in the case of the power unit (No.1) and 110-120V or 200-250V in the case of the power supply (No.2), by changing a link or links on integral tap changing panels. For power unit (No.1) the panel is mounted internally on the chassis; for power supply (No.2) the link panel is fitted through the front face of the equipment. At any one tap setting the equipment will operate safely without exceeding the rating of any component, for supply voltage variations of up to ± 6% of the rated voltage for that specific tapping.

Construction

5. Each power supply unit is housed within a fabricated metal chassis and is suitable for mounting in a standard 19 in. rack. Handles are fitted through the front panel for ease of removal and fitting of the units and also to protect the controls and instruments should the casing be inverted on the bench.

6. Because of the weight of these equipments, support dowels must be fitted through the rear of the cover when either of the two power supply units is mounted in a rack. For the same reason, care must be taken when removing or fitting these units to avoid damage due to mishandling.

7. Under normal operating conditions adequate ventilation is afforded with the cover in position on the power unit (No.1). If necessary, the cover can be removed to provide increased ventilation when the unit is mounted in a rack.

8. The internal layout and construction of these power supply units make it essential to ensure a free circulation of cooling air throughout the equipment when in operation. Rack mounting is recommended, therefore, whenever possible. On no account should the power supply (No.2) be operated whilst lying flat upon the bench.

9. All the controls, including the voltmeter and ammeter are grouped on the front panel on each unit. This includes the twelve 5A spring loaded terminals, fitted on the power unit (No.1), which are wired in parallel with the 12-way output sockets to facilitate test connections to any output rail.

10. A gate switch is fitted in the rear of each power supply unit chassis. This is a mains cut-off switch which is normally closed by a probe fitted into the casing of this equipment. When it is required to operate the unit with the cover removed (e.g. during servicing) the switch may be actuated and retained in the closed position by means of a plunger in the side of the switch. This switch should not require resetting before fitting the cover, as the action of the probe on the casing will release the switch retaining plunger.

11. The positions and layouts of controls and instruments for each type of power supply unit are illustrated in fig. 1 and 2.

12. Indicator lamps are fitted into the front panel on both units. These will light up to indicate that the equipment is operating and ready for use thus:-

(1) Power unit (No.1) - When the mains supply is ON and at the point when h.t. is available, showing that the thermal delay relay has operated and the 425V and 130V circuits are operative.

(2) Power supply (No.2) - When the mains supply is ON and when the h.t. switch is ON.

13. A Mk.4 12-way output socket is let into the front panel of each unit to accomodate the test connector supplied. An extra output socket is provided in the power unit (No.1).

14. The order of pole connections for each of the 12-way connectors with the power unit (No.1) is as follows:-

Pole	Supply
A	+425V d.c.
B	+130V d.c.
C	6.3V a.c.
D	26.5V a.c.
E	0 to -50V d.c.
F	6.3V a.c. (Common to pole C)
G	Earth
H	Earth
J	6.3V a.c.) Isolated)-heater
K	6.3V a.c.) supply
L	+27.5V d.c.
M	+28V d.c.

15. Pole connections for the 12-way connector with the power supply (No.2) are as follows:-

Pole	Supply
A	+130V d.c. h.t. for unit on test
B	+130V d.c. h.t. for test set
C	0-9V a.c. for heaters of unit on test
D	28V a.c. for crystal oven
E	0 to -50V d.c. bias
F	Voltmeter monitoring of unit on test
G	Earth
H	Voltmeter monitoring of unit on test
J)) K)	0-9V a.c. isolated heater supply for test set
L	+28V d.c. for relays
M	Earth

Fuses

16. Fuses are provided in both power supply units for the protection of all output rails (except the bias output) and for the main's input. The main fuses are contained separately in fuse units having screw caps which are fitted into the front panel; others are readily accessible through the upper and lower equipment apertures when the covers or casings are removed.

17. Fuse ratings and circuit references for the power unit (No.1) are as follows:-

Circuit ref.	Value	Line
FS1	5A	Mains input
FS2	5A	Mains input
FS3	250mA	27.5V d.c.
FS4	375mA	130V d.c.
FS5	375mA	425V d.c.
FS6	5A	6.3V a.c.
FS7	3A	26.5V a.c.
GS8	3A	6.3V a.c.

18. Fuse ratings and circuit references for the power supply (No.2) are as follows:-

Circuit ref.	Value	Line
FS1	5A	Mains input
FS2	1A	28V (relays)
FS3	500 mA	H.T. + output
FS4	2A	6.3V a.c. (V1 and V2 heaters)
FS5	7A	6.3V a.c. (V3, V5 and V6 heaters)
FS6	5A	28V (oven)
FS7	10A	0-9V a.c. (unit on test heaters)

Circuit ref.	Value	Line
FS8	10A	0-9V a.c. (test set heaters)
FS9	1A	T1 h.t. secondary
FS10	1A	T1 h.t. secondary
FS11	100mA	H.T. - output

Facilities

19. The supply facilities which are available from the power unit (No. 1) are as follows:-

(1)

Voltage d.c.	Current	Range
425V (nominal)	300mA	Variable, 375V to 475V
130V (nominal)	250mA	Variable, 90V to 200V at 250mA, 200V to 250V at 200mA.
0 to -50V	250uA	
28V	10mA	
27.5V	200mA	

(2)

Voltage a.c.	Current	
26.5V	2A	
12.6V	2A	Obtained by connecting the two 6.3V outputs in series by external link
6.3V	4A	
6.3V	2A	

20. Supply facilities available from the power supply (No.2) are as follows:-

(1)

Voltage d.c.	Current	Range
130V (nominal)	0-250mA	Variable, 90V to 200V at 0-250mA, 200V to 250V at 200mA.
0 to -50V	1.5mA	Variable 0 to -40V at 1.5mA, -40V to -50V at 250uA
28V	250mA	

(2)

Voltage a.c.	Current	
28V	2.4A (nominal)	
0 to 9V	6A (nominal)	
0 to 9V	6A (nominal)	
0 to 18V	6A (nominal)	Obtained by connecting the two 0-9V outputs in series by external link

Performance summary

21. The performance summary of the power unit (No.1) is as follows:-

(1) 425V d.c. supply (variable from 375V to 475V)

Ripple and noise:	Not exceeding 35mV r.m.s.
Stability:	From no load to full load, less than 3% variation at 375V and 475V, and less than 2% at 425V.
Voltage:	Stable within 1% of 425V at a current of 300mA with a variation of mains voltage up to ± 6% from 230V.
Output impedance:	Below 28 ohms at 425V.

(2) 130V d.c. supply (variable from 90V to 250V)

Ripple and noise:	Not exceeding 35mV r.m.s.
Stability:	From no load to full load, less than 3% variation at 90V, 200V and 250V, and less than 2% at 130V.
Voltage:	Stable within 2% of 130V at current of 250mA with a variation of mains voltage up to ± 6% from 230V.

(3) 0 to -50V bias supply

Ripple:	Not exceeding 10mV r.m.s. with an output of -50V at a current of 250uA.

(4) 27.5V d.c. supply

Voltage:	Not less than 22V at a current of 200mA on full load.

(5) 28V d.c. supply

Voltage:	Within ± 10% of 28V at a current of 10mA.
Ripple:	Less than 100mV r.m.s.

(6) 26.5V a.c. supply

Voltage:	Within ± 5% of 26.5V at full load

(7) 12.6V 2A a.c. supply

Voltage:	Within ± 10% of 12.6V at full load. This supply is compounded of the supplies in (8) below, which may be connected in series by an external link between poles C and J of the 12-way connectors.

(8) 6.3V a.c. supplies (two off)

Voltage:	Within +10% and -5% of 6.3V at full load.

(9) Power Consumption - Not exceeding 580VA (all outputs fully loaded).

(10) Meter accuracy - Accuracy of the internal measuring system and instruments is as follows:-

(a) Voltmeter: $\pm$ 5% for d.c. measurements and $\pm$ 10% for a.c. measurements

(b) Ammeter: 5%

22. The following is the performance summary of the power supply (No.2):-

(1) 130V d.c. supply

Stability: Better than $\pm$ 1% at 130V, from no load to full load, with up to $\pm$ 6% mains variation. The stabilized output is manually variable from 90V to 200V at a current of 0 to 250mA and 200V to 250V at a current of 200mA.

Hum and noise level: Below 20mV r.m.s. with outputs up to 250mA at 90V to 200V.

(2) 0 to -50V d.c. bias

Voltage: Continually variable from 0 to -50V. At 0 to -40V the current should be not less than 1.5mA and at -40V to -50V it should be not less than 250uA.

Ripple voltage: Below 20mV r.m.s.

(3) 28V d.c. (relays)

Voltage: Not less than 22V at a current of 250mA

(4) 28V a.c. supply

Output: Not less than 25V at 2.4A

(5) 0 to 9V a.c. supply

Voltage: Variable over the range 0 to 9V at a current of 2A and capable of a current of 6A over the range 0 to 7V.

(6) 0 to 9V a.c. supply

Voltage: Variable 0 to 9V at 2A and capable of a current of 6A over the range 0 to 7V

(7) 0 to 18V a.c. supply

Voltage: Variable over the range 0 to 18V at a current of 2A and capable of a current of 6A over the range 0 to 14V. This supply is compounded of (5) and (6) above, which are isolated supplies but which may be connected in series by an external link between poles C and J of the 12-way connector.

(8) Power consumption - Not exceeding 500VA with all outputs fully loaded.

(9) Meter accuracy - Accuracy of the internal measuring system and instruments is as follows:-

(a) Voltmeter: $\pm$ 5% for a.c. and d.c. measurements.

(b) Ammeter: $\pm$ 5% on both the 100mA and 250mA ranges.

Circuit description

Brief survey

23. Circuit diagrams for both power supply units are given in fig. 6 and 7 at the end of this chapter. From these, certain similarities in circuit functioning and the supplies facilities can be observed.

24. Component layouts for each of the two types of unit are given at fig. 3, 4 and 5. The components and component stations are marked with appropriate circuit references in clearly discernable positions in each unit.

25. In general, for each type of power supply unit an h.t. supply is derived from the rectified output from a transformer with a centre-tapped secondary winding, and regulated by voltage control valves (Type CV391) to provide a 130V (nominal) d.c. output. Power unit (No.1) includes an additional but similarly arranged circuit to provide a higher (425V) potential.

26. Full wave rectification of the transformer outputs is provided; in the power unit (No.1) by half-wave rectifier valves (Type CV2235), but in power supply (No. 2) by silicon diodes in series.

27. Voltage regulation in the power supply unit is achieved by the amplification of output voltage variations and the application of the resulting control voltages to the control gid of series regulator valves. The voltage amplifier in the control loop is fed with a manually adjustable input signal proportional to the difference between its grid voltage and cathode voltage (obtained from a neon reference valve). All resulting control voltage variations, which are thus applied to the series regulator valves, are in such a sense as to oppose, and thereby reduce, the change in output voltage. The steady operating point of the voltage amplifier may be manually adjusted, by means of a potential divider network across the output line, thus providing resetting of the output voltage to any value in its specified range.

28. In both types of power supply unit, a thermal relay valve is included to provide a warming-up (valve stabilizing) period between switching on the primary power and the energizing of a relay to complete the h.t. voltage circuit. The normal delay period is between 30 seconds and 70 seconds, and after this interval a lamp on the front

face of the power unit (No.1) will glow to indicate that h.t. is available. On the power supply (No.2) the circuit through the H.T. ON lamp is completed when the H.T. switch is set to ON. The relay will subsequently energize and this point is denoted by an audible click.

29. In addition to the main stabilized outputs of 425V and 130V from the power unit (No.1), and the 130V output from the power supply (No.2) two further principal supplies are generated in each power supply unit as follows:-

(1) 28V d.c. relay supply, derived from a full wave bridge rectifier circuit.

(2) 0 to -50V d.c. bias supply which in the power unit (No.1) is derived from a full wave bridge rectifier, and in the power supply (No.2) is derived from the stabilized negative line.

30. Adjustment of the setting for the 0 to -50V d.c. bias supply is, in each power supply unit, provided by the variable resistor RV1.

31. Also incorporated in each power supply unit is a second mains transformer, having secondary windings from which are derived the auxiliary supplies for test set heaters, oven supply and low voltage requirements described in para. 19 to 22 inclusive.

Power unit (No.1)

32. Mains supplies at 45-65 c/s are brought in to a three-pole Mk.4. plug PL1 and are coupled via the gate switch S10 to the double-pole mains on-off switch S1. Protection for each line to the transformers T1 and T2 is provided by the 5A fuses FS1 and FS2.

33. A link panel is fitted internally to enable the use of power supplies of 90V to 125V in steps of 5 volts, or 200V to 250V in steps of 10 volts, by changing a link or links as required. Each supply link is marked and may be compared with the link arrangement shown in fig. 6.

34. The 600-0-600V secondary winding of the transformer T1 is connected to the full wave rectifier circuit comprising the diodes V1 and V2 (Type CV2235). The centre tap of the secondary winding is connected to earth via the relay contacts RLA1, thermistor X1, and fuse FS5, in series. Other secondary windings on the transformer T1 provide the supplies for heating V1, V2, V5, V7, V8 and V12.

35. The d.c. output from this rectifier circuit is smoothed and stabilized and becomes the 425V output of the unit. The action of the stabilizer circuit is as follows. A portion of the output voltage is tapped off the divider R23, RV2, R22 and R24 and applied to the grid of the pentode valve V8. The cathode potential of this valve is stabilized by the neon V5 so that the anode current changes with the output voltage variations. The amplified and inverted versions at the anode of V8 is d.c. coupled to the grids of the series voltage control valves V7 and V12; thus tending to maintain the output voltage constant. The variable resistor RV2 is the front panel control 425V DC ADJ and varies the output between approximately 375V and 475V.

36. Transformer T2 has a 360-0-360V secondary winding that is connected to the anodes of a pair of diode valves V3 and V4 (Type CV2235), which

provide full wave rectification. The transformer centre tap is connected via the relay operated contacts B2 and fuse FS4 to earth.

37. The d.c. output from this rectifier circuit is smoothed and stabilized in a similar way to the 425V output (para 35). The fixed bias for the amplifier/inverter V10 is, in this case, obtained from a separate rectifier (MR 1) and applied to the control grid of the valve. In this way the full h.t. is applied to V.10. The variable resistor RV3 is the front panel 130V DC ADJ and varies the output between between approximately 90V and 250V. between 90V and 250V.

38. A Zener junction diode strap (MR8 and MR9) across this potential provides a +28V output supply at pin M of the multipole sockets SKT1, SKT2 and also at a terminal (TP2) on the instrument front panel.

39. A thermal relay V6 (5945-99-053-0333) is incorporated in the circuit to provide a 30 seconds to 70 seconds interval between switching on the SUPPLY switch and the energizing of relays RLA and RLB to complete the h.t. voltage circuits. This delay provides a warming-up period during which the valve heater supplies are applied to permit stabilizing of the control valves in both the 130V and 425V circuits.

40. Other secondary windings on the transformer T2 provide the supplies for heating V3, V4, V6, V9, V10, V11, V13 and V14, and for the auxiliary a.c. outputs described in para. 21. In addition, a 0 to -50V supply, drawn from the bridge rectifier MR2, is controlled by a 25-kilohm variable resistor RV1 which is operated from a knob on the front panel marked BIAS ADJ. An isolating switch S2, marked BIAS ON, is provided in this circuit.

41. Also, from another secondary winding of transformer T2, a 28.5V supply is rectified through the bridge rectifier MR3 and controlled by the switch S4 (which is marked 27.5V D.C. ON) to provide an output of 27.5V d.c. at the output sockets SKT1 and SKT2.

42. Facilities for reading the current consumption in the 425V d.c. 130V d.c. and 27.5V d.c. output lines are provided by the READ CURRENT switch S6 and milliammeter M1. The milliammeter is shunted by two resistors, R35 and R36, which are connected in series for the 0-300mA range and R36 can be short-circuited, by means of the switch S8, for the 0-500mA range.

43. The READ VOLTS switch S7 enables the output supplies to be connected in turn to the voltmeter M2, via the various metering resistors, to ensure that the voltages are correct. The a.c. output supplies are rectified by the bridge rectifier MR4, MR5, MR6, and MR7 before being fed to M2.

Power supply (No.2)

44. Mains input supplies at 50-60 c/s are brought in to a three-pole Mk.4 plug PLA and are coupled, via the gate switch SA and the double-pole switch SB, to the link panel LKA. This link panel is fitted externally to the front face of the power supply (No.2) and provides the facility for coupling the power unit to supplies other than the nominal 230V. These may be varied from 110V to 120V in steps of 5 volts and from 200V to 250V

in steps of 10 volts by means of a link or links accessible from the front of the unit.

45. Protection of the input line to the transformers T1 and T2 is provided by a single 5A fuse FS1.

46. The 370-0-370V secondary winding from transformer T1 is taken via 1A fuses FS9 and FS10 to two series of silicon diode full wave rectifier circuits. The first of these (MR7, 13, 15, 8, 14 and 16) provides a positive voltage, with respect to earth, which after smoothing and stabilizing becomes the main h.t. output of the unit, nominally 130V.

47. The h.t. voltage stabilizing circuit (V2, V3, V5 and V6) is similar to those in the power unit (No.1) (para. 35 and 37). The fixed bias is obtained from the neon V4 (para. 48); while the variable resistor RV2, front panel SET HT control, varies the output voltage over the range 90 - 250V.

48. The second set of silicon diodes connected to the 370 - 0 - 370V winding (para. 46), produce a voltage negative with respect to earth and stabilised by the neon V4. The potential divider R13 and RV1 is connected across this supply providing a bias voltage output from the unit which is variable over the range 0 to -50V. The full negative voltage is also used for bias for the h.t. stabilizing unit (para. 47).

49. Another secondary winding on the transformer T1, protected by a single 2A fuse FS4, provides a 6.3V heater supply for V1 and V2. The 6.3V heater supply for the voltage control valves V3, V5 and V6 is derived from a further secondary winding on the transformer T1, and is protected by a single 7A fuse FS5.

50. Across the 30V winding of the transformer T1, and protected by the 1A fuse FS2, are connected the SUPPLY lamp ILP1 and the H.T. ON switch SC, with its associated lamp ILP2. The a.c. output is rectified by the bridge rectifier MR9, MR10, MR11 and MR12 to provide the 28V d.c. supply for relays. The resistor R26 and capacitor C24 are included to reduce ripple.

51. The thermal relay V1 (5945-99-053-0333) is incorporated in this circuit to provide an interval of 30 seconds to 70 seconds between switching on the SUPPLY switch and the energizing of relay RLA to complete the h.t. circuit. This delay provides a warming-up, or valve stabilizing, period for the voltage control valves before operation commences.

52. Secondary windings on transformer T2 provide two separate 0 to 9V a.c. heater outputs at the socket SKTA, which are used for the heaters of the test set and unit on test. These output supplies are variable by means of Variacs, T3, and T4, which are set by means of control knobs on the front panel marked SET L.T. TEST SET and SET L.T. UNIT ON TEST respectively. Each output line is protected by separate 10A fuses, from T3 by fuse FS8 and from T4 by fuse ES7.

53. A 28V a.c. supply for heating the crystal oven, required when testing the spectrum generator unit (amplifier-oscillator), is provided by a 30V winding on the transformer T2, and taken via the 5A fuse FS6 and resistor R5 to the output socket at pole D.

54. The moving iron meter M1 is used to measure the various d.c. output voltages, which are connected into circuit by means of the switch SD. In addition, provision is made by means of the connections to poles F and H of SKTA for monitoring the heater voltage at the unit on test.

55. Facilities for measuring the h.t. voltage and current, and the bias volts, are provided by the meter M2, switch SE and associated metering resistors.

Servicing

56. Periodically examine the interior of the power units, making sure they are clean, free from dust and undamaged. Inspect for evidence of overheating which could result from operating the units without adequate internal air circulation.

57. Examine the connectors, before coupling up, for damage to the cable covering and pay attention to the condition of the multi-pole plugs. The plugs must be undamaged, clean and dry.

58. Standard techniques employed in servicing this class of equipment should enable any day-to-day failure to be quickly located and remedied. Reference to the circuit diagrams (fig. 6 and 7) at the end of this chapter should provide sufficient information for normal servicing and fault tracing. All components are readily accessible for inspection or renewal upon removal of the enclosing casing or cover.

59. Before using either of the two types of power supply unit, make a brief serviceability test. The indicator lamps should light up when the appropriate circuits are switched on and the meter readings should remain steady. Failure of lamps or meters can be investigated along the following sequence:-

(1) Mains supply lamp fails to light - Verify that the mains switch is ON and that the input connector is correctly fitted between the mains supply source and the power unit. Ensure that the correct mains supply is being used; the links may require adjustment to suit the bench source, as described in para. 4, 33 and 44. Examine the fuse FS1 (and FS2 on the power unit (No.1)). Ensure that the gate switch is operating and is closed by the probe on the casing; if the unit is used without its cover, the switch can be closed and locked in that position by a small plunger. When these measures fail to clear the fault, test the lamp or apply a substitute lamp which is known to be serviceable.

(2) H.T. ON lamp unlit - With the appropriate h.t. circuit switch operated, the first action to follow the switching ON of the power unit mains supply is to bring in the heater (valve stabilizing) circuits for the power control valves. The second action follows the energizing of the relay to complete the main h.t. circuit selected; this action is accompanied by an audible click. Should no relay click be noted, first ensure that the mains source switch is ON and that the mains supply switch on the power supply unit is operated. Then examine and renew, if necessary, the fuse FS3 in the power unit (No.1) or fuses FS2 and FS4 in the power supply (No.2). If the click is clearly heard, however, suspect the lamp; renewal can readily be made from the front of the instrument panel.

(3) Meter readings and output drift - First examine the fuses of the appropriate h.t. circuit (see circuit diagrams fig. 6 and 7). Then, on the power unit (No.1), suspect valves V8 and V10 according to the rail in use. On the power supply (No.2), suspect the valve V2. Drift may also be attributable to internal failure within the meter; a comparison test using a sub-standard instrument should readily confirm this fault. Drift may also occur in conditions of high humidity, by reason of a leak to the chassis mounting. It is important to note that in the event of a short-circuit at the output, damage to the meter may result. Should this occur, examine the unit under test for short-circuit or for conditions wherein loadings in excess of 250mA and 100mA can develop.

CONNECTOR (10HA/8359)

CONNECTOR
(5995-99-932-4017)

Fig.1 Power unit (No.1) (5821-99-932-2942) with connectors

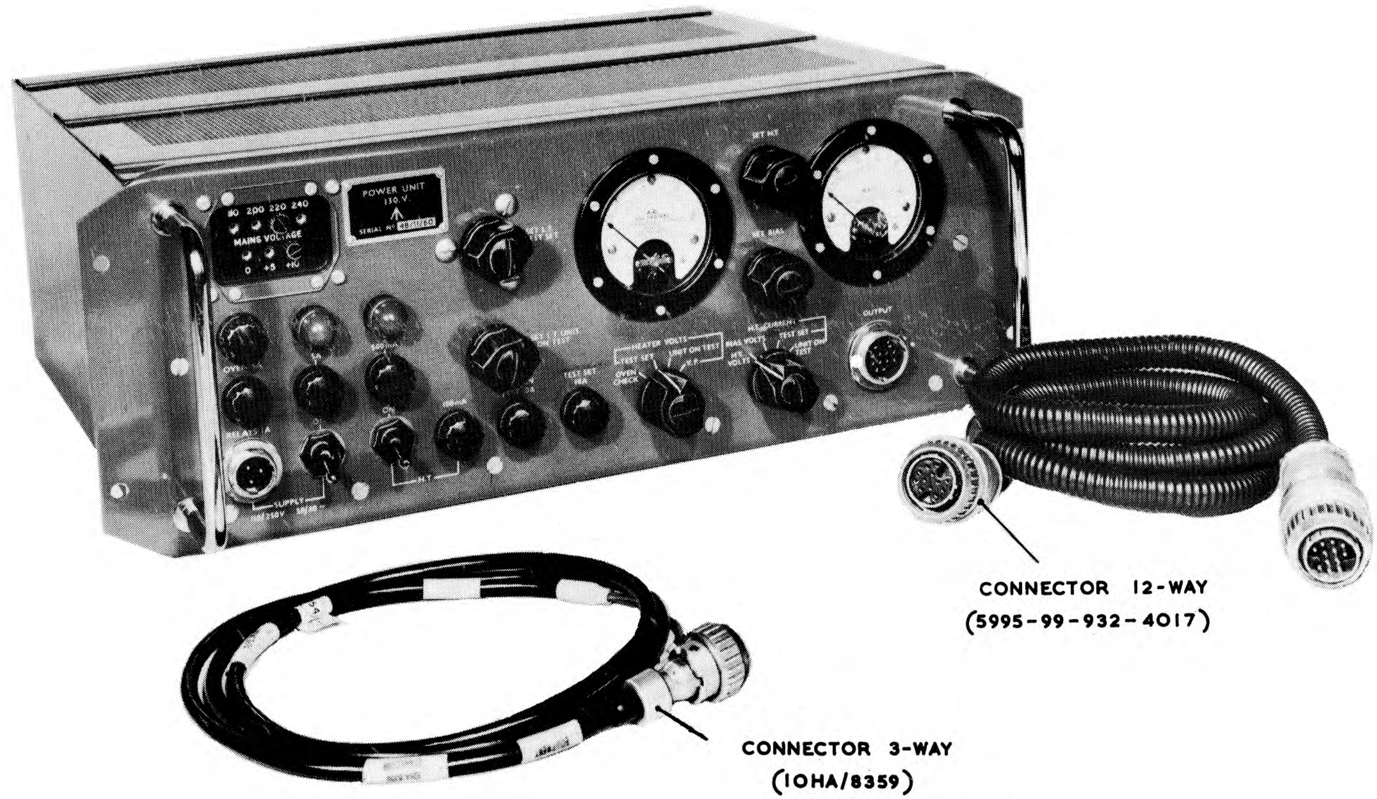


Fig.2. Power supply (No 2) (6130-99-999-7812) with connections

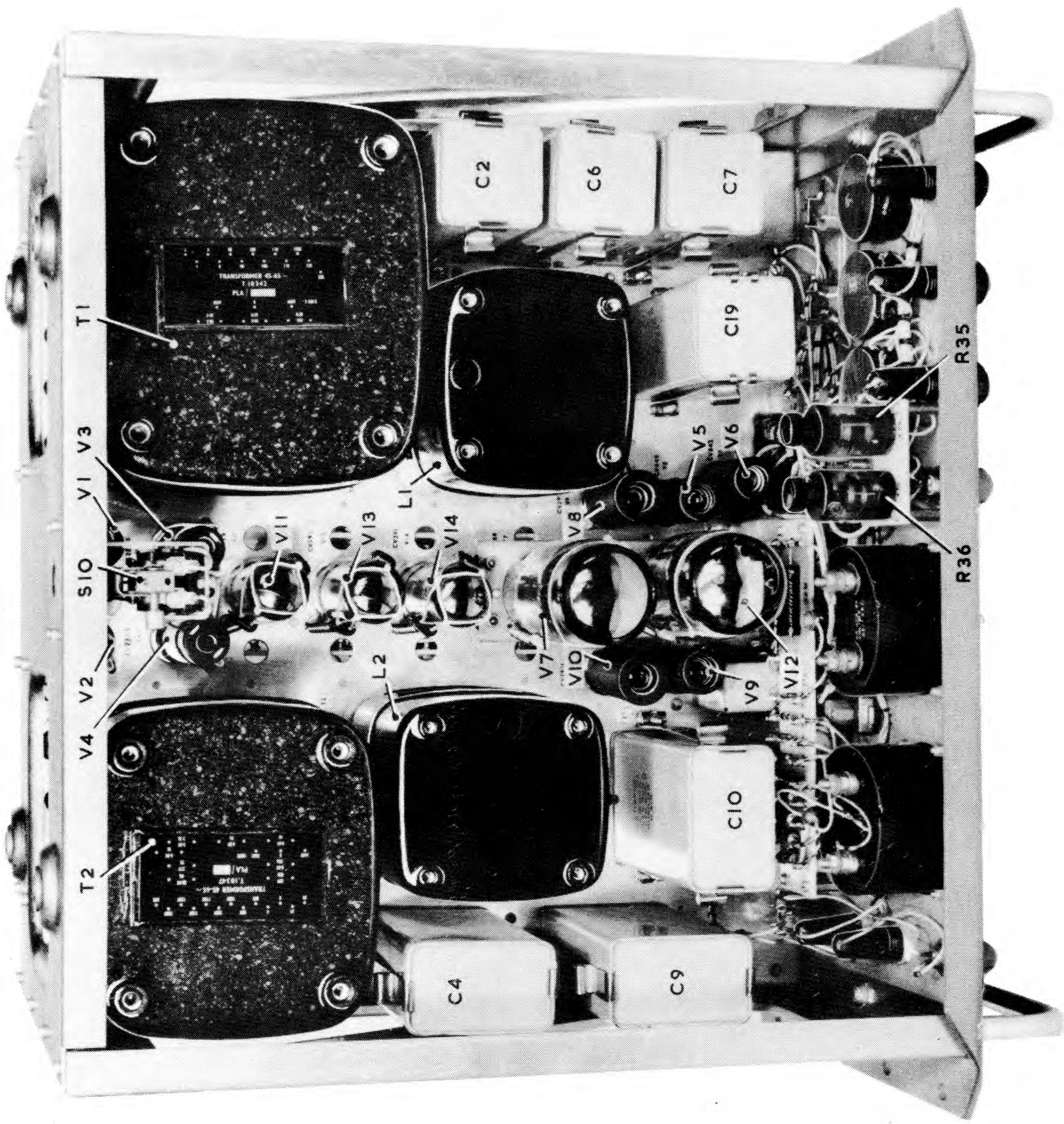


Fig. 3. Power unit (No. 1) top view with cover removed

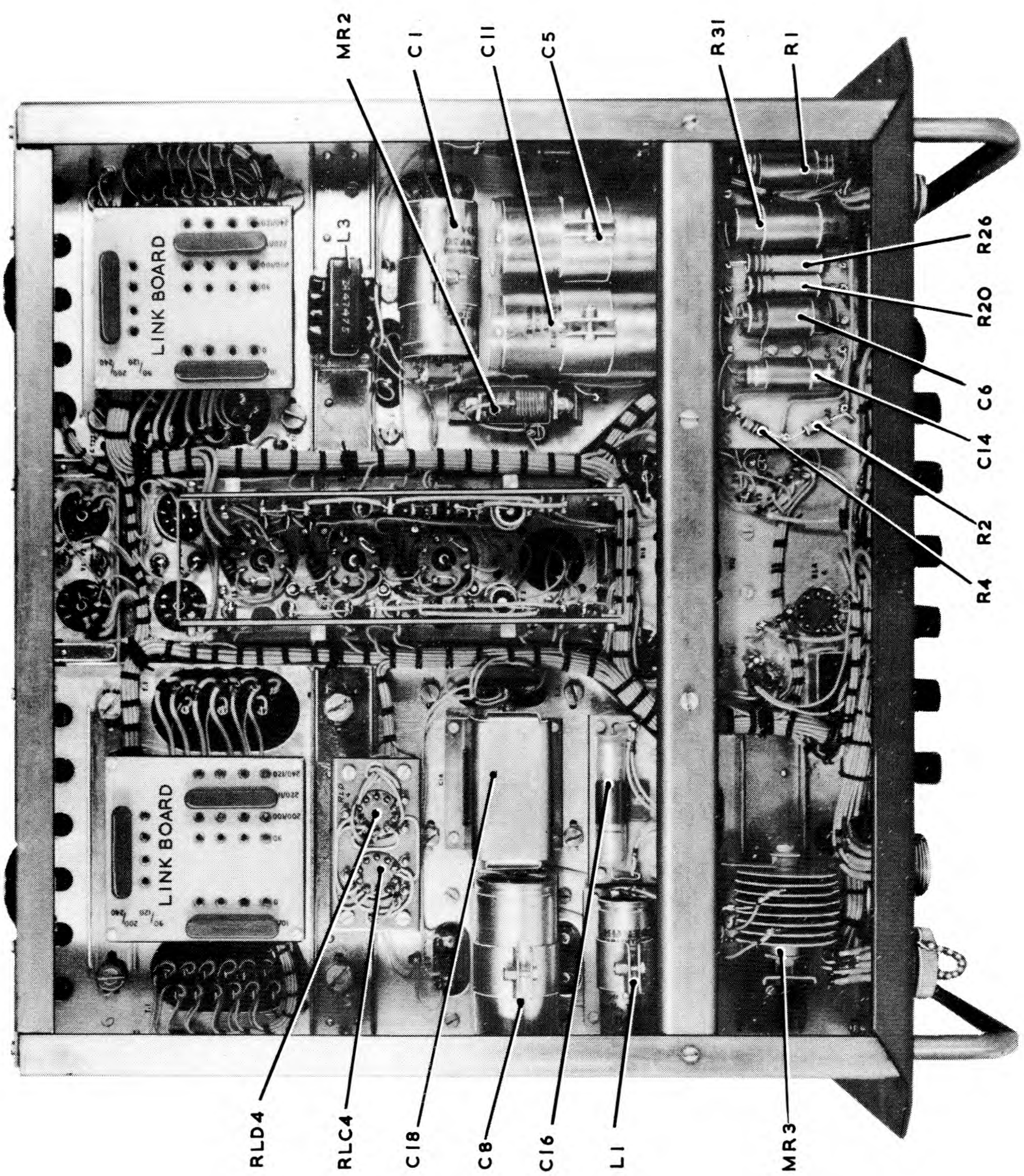


Fig. 4. Power unit (No. 1) underside view with cover removed

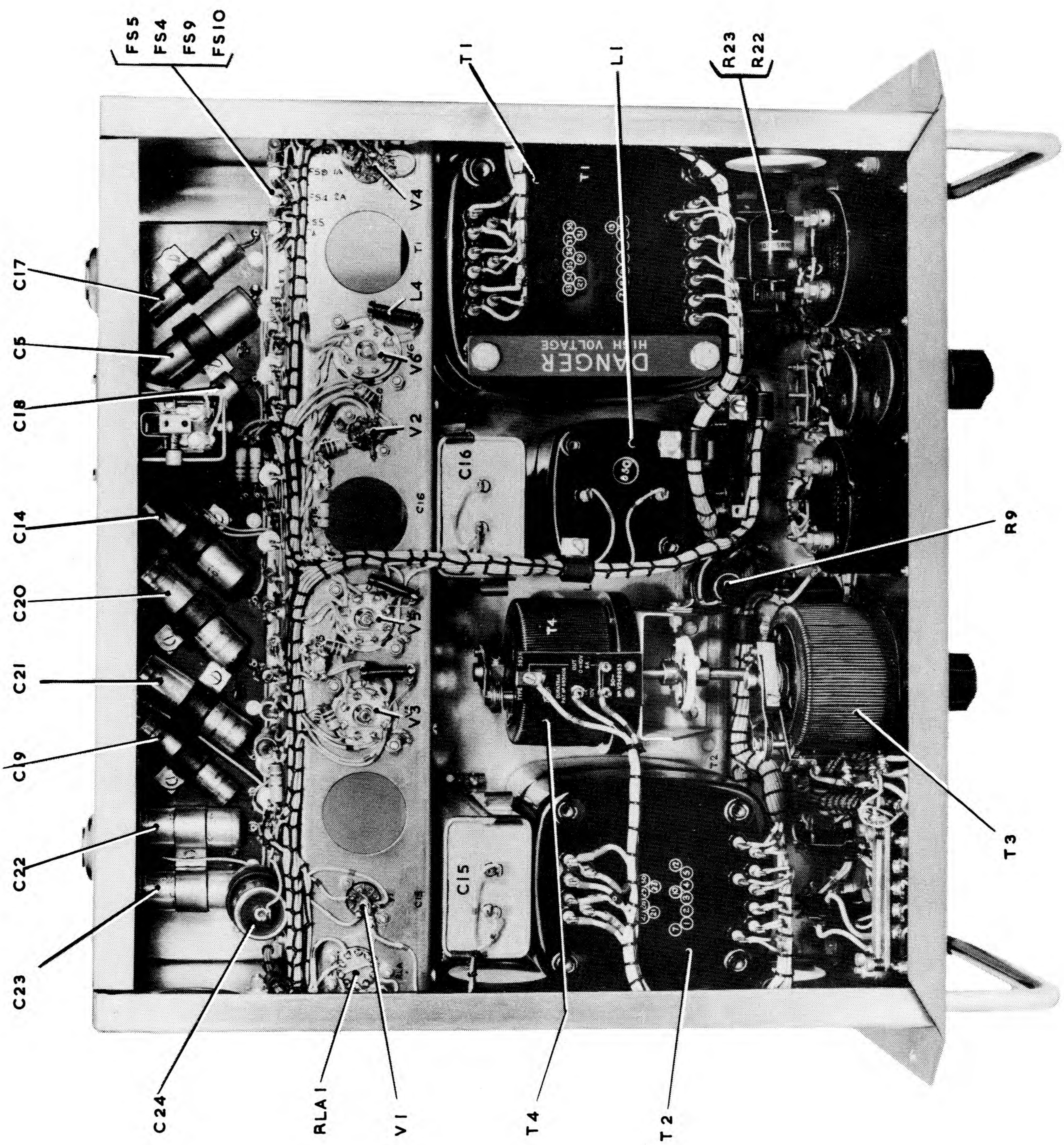


Fig. 5. Power supply (No.2) top view with cover removed

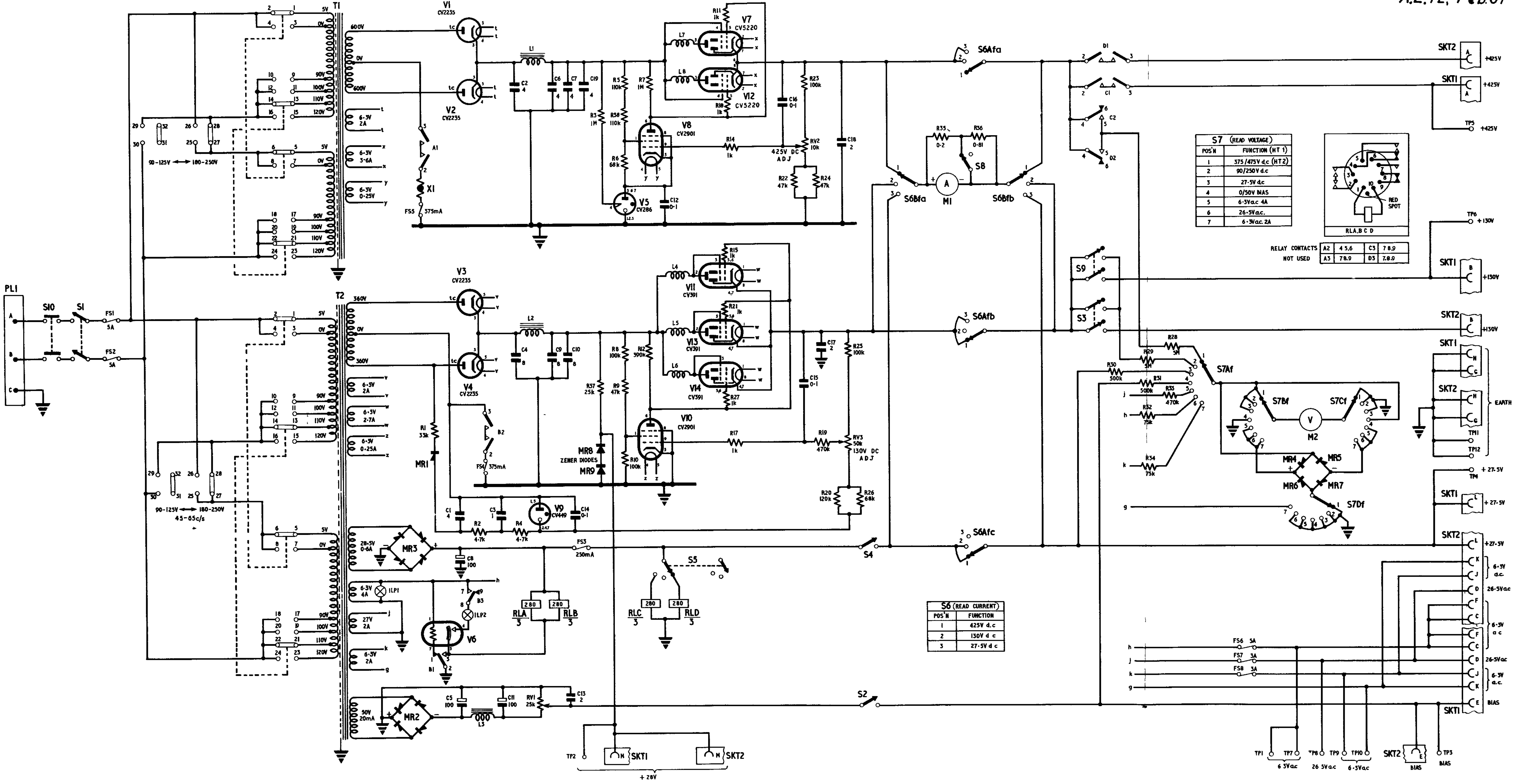


Fig. 6 Power unit (No. 1) 5821-99-932-2942: circuit

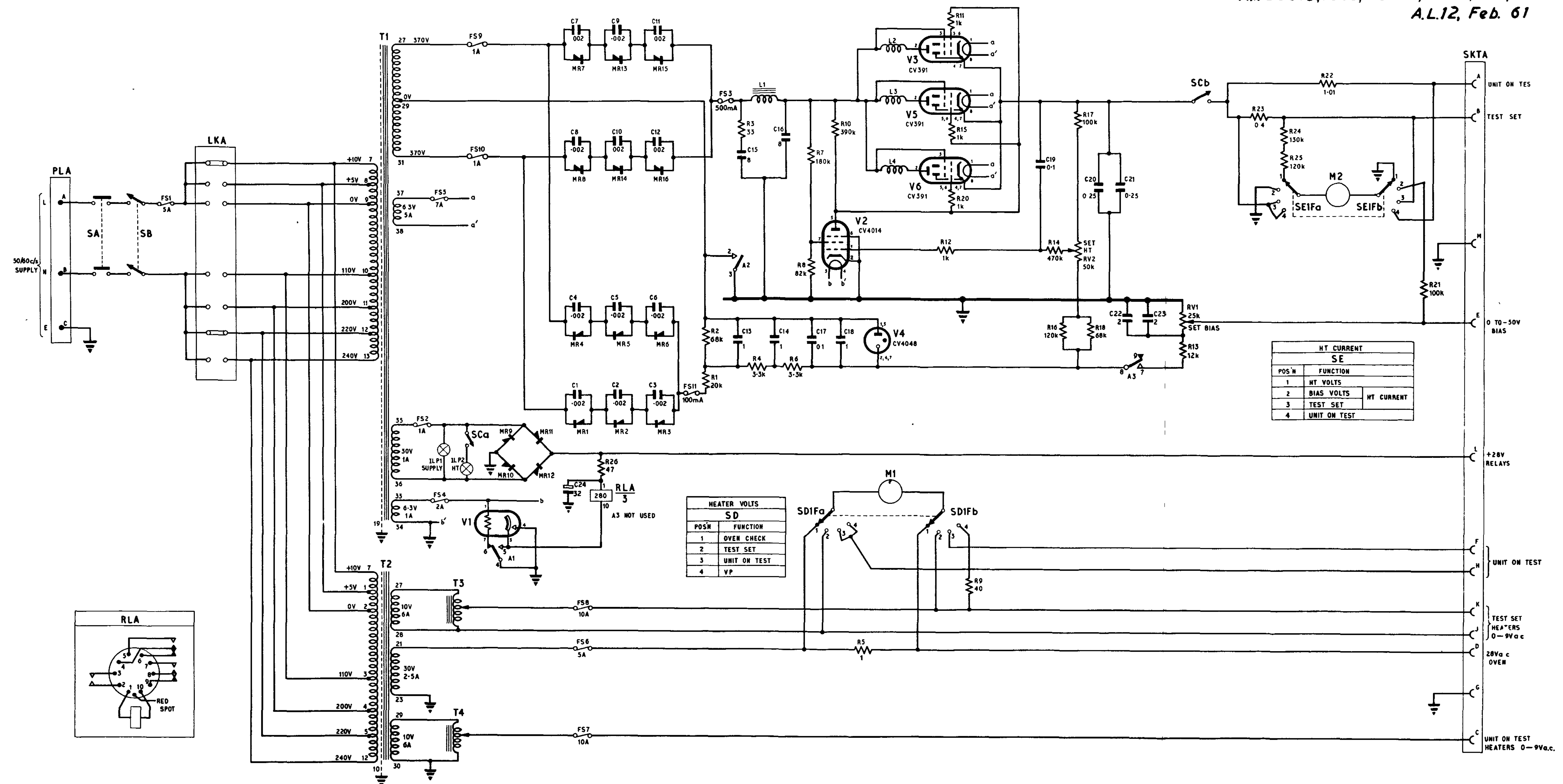


Fig. 7 Power supply (No 2) 6130-99-999-7812: circuit

Chapter 3

CALIBRATOR, FREQUENCY

LIST OF CONTENTS

LIST OF ILLUSTRATIONS

LEADING PARTICULARS

Designations	Test equipment for the measurement of frequency errors when testing units such as the spectrum generator unit (amplifier-oscillator, receiver unit (guard) and the I.F. unit (1.85 Mc/s). Comprising:- Frequency calibrator.
A.B.C.S. Cat. No.:	6625-99-999-2642
Function:	To simulate circuit supply conditions when testing units of the transmitter-receiver Type TR4/ARC52 and TR5/ARC52 and to measure errors in frequencies in the range 2 Mc/s to 20 Mc/s.
Dimensions (approx.)	19 in. x 7 in. x 18¼ in.
Weight (approx.)	49½ lb

Introduction

1. The calibrator, frequency 6625-99-999-2642 is an equipment for the frequency alignment of units such as the spectrum generator unit (amplifier-oscillator), receiver unit (guard) and the I.F. unit (1.85 Mc/s) modules of the TR4/ARC52 and TR5/ARC52. It is also used in the testing of associated equipment; for example, the test set, UHF equipment, Type 15056 and the standby transmitter-receiver Type TR.10056.

2. The functions of the instrument can be extended to measure the error of other frequencies (by using RCL style D plug-in type crystals) from 2 Mc/s up to 20 Mc/s on fundamental frequencies.

3. The calibrator, frequency is a self-contained instrument designed to operate from single phase a.c. mains supplies in the ranges 110V to 120V and 200V to 250V. It is prepared for operation on different supply voltage levels by the adjustment of a voltage tap panel on the front of the instrument. The nominal 115V range is adjustable in 5V steps and the 230V nominal range in 10V steps. The mains supply frequency should be within the range 45 c/s to 65 c/s.

4. A block diagram of the calibrator, frequency is shown in fig. 1. The instrument comprises, basically, a mixer circuit into which are fed the harmonics from one of five crystal controlled oscillators four of which have their crystals in a temperature controlled oven; the carrier of the unknown frequency is also fed into the mixer stage. The resultant difference frequency is passed through an a.f. amplifier to a limiter stage and finally to an a.f. counter-circuit. The output from this counter circuit is connected to a microammeter (calibrated 0-10 kc/s, f.s.d.) on the front panel. Provision is also made to monitor the difference frequency by means of headphones.

5. The four crystal oscillators (para. 4) resonate at fundamental frequencies of 10.0 Mc/s, 11.1 Mc/s, 12.15 Mc/s and 12.5 Mc/s. The required oscillator is selected by means of a switch on the front panel.

6. A fifth crystal oscillator operates on fundamental frequencies in the range 2 Mc/s-20 Mc/s. Ten crystal sockets are situated in a bank on the front panel and selected by the CRYSTAL BANK switch (S7); only five

crystals are supplied in the bank in current equipment (para. 12(3)). The output from this oscillator feeds into the mixer stage in a manner similar to that of the other four (para. 4).

7. With a power supply variation of not more than ± 6% and operating within the ambient temperature range of 0°C to 55°C, the frequency stability of the temperature controlled crystal oscillators is better than two parts in 10^6.

8. The signal to be measured is applied to a coaxial socket on the front panel. This signal of unknown frequency can be fed either directly to the mixer stage or through a 20dB attenuator pad and coaxial link (para. 12(12)).

9. The equipment is supplied complete with a connector (Ref. No. 10HA/8359), five feet in length, for coupling to the mains supply.

General description

10. The instrument is fabricated from light alloy sheet and enclosed within a thin gauge light alloy wrapping cover retained in position by cheese head screws. Removal of the cover provides access to all components on the chassis.

11. Two D shaped handles are fitted on the front panel to facilitate handling of the instrument and also to provide a measure of protection against damage to components mounted on the front panel.

Front panel controls

12. All operating controls are grouped on the front panel, as shown in fig. 2. The functions of these components are as follows:-

(1) METER switch (S6) - When set to the OFF position the meter is isolated from the rest of the equipment. In positions A, B, C, D, or E the meter indicates the grid current of the corresponding crystal oscillator. Setting the switch to H.T. enables the common h.t. voltage to be measured and in the OVEN H.T. position the voltage applied to the oven is indicated. Finally, at the position COUNT 10 KC/S F.S.D., the meter will read the frequency difference of the signal being measured.

(2) OSCILLATOR MC/S switch (S5) - When set to positions A 10.0, B 11.1, C 12.15, D 12.5 or E CRYSTAL BANK, h.t. is applied to the mixer and to the appropriate oscillator; also, the output of this oscillator is fed to the mixer. In the OFF position the switch isolates the mixer and oscillators from the h.t. supply.

(3) CRYSTAL BANK switch (S7) - With the OSCILLATOR MC/S switch set to position E CRYSTAL BANK the CRYSTAL BANK switch brings into circuit one of the external crystals; each crystal socket in the bank bears a number corresponding to the switch position.

(4) L.T. ON/OFF, (S2), H.T. ON/OFF (S1) and SUPPLY ON/OFF (S9) - Three toggle switches which control the appropriate supplies. Switches S1 and S2 are so connected that a d.c. voltage cannot be supplied to the valve anodes before the application of heater supplies (para. 40).

(5) L.T. (ILP3), H.T. (ILP2) and SUPPLY (ILP1) lamps - Three signal lamps which light when the appropriate switch (sub-para. (4)) is made.

(6) OVEN LOW (ILP5), CYCLING (ILP4) and HIGH (ILP6) lamps - Lamps ILP4 and ILP5 light up to indicate when the oven is at low and normal temperatures respectively; indicating lamp ILP6, when alight, is a warning that the oven temperature is too high (para. 80 and 89).

(7) Fuses FS1, FS2 and FS3 - Fuses FS1 and FS2, each rated at 2A, are in the mains supply; fuse FS3, rated at 500mA, is in series with the oven heating element.

(8) AF OUTPUT GAIN (RV2) - Controls the output level of a.f. to the headphones only.

(9) 150 OHMS PHONES - A post office type jack (JK1) making provision for plugging in a headset of 150Ω impedance.

(10) A three pole connector plug (PL1), annotated 110/250V, 45/65 c/s, which accepts the mains supply via the connector (Ref. No. 10HA/8359) (para. 9).

(11) M1 - A microammeter provided with three scales calibrated in current, voltage and frequency respectively; this meter is used in conjunction with METER SWITCH (S6) (sub-para. (1)).

(12) A coaxial link, situated beside the meter, may be set to one of two positions. When positioned to IN DIRECT the unknown signal is fed directly to the mixer state. For large signal inputs the link should be set to IN VIA ATTENUATOR. In this latter position the link introduces a 20dB attenuator pad in series with the incoming signal and the mixer circuit.

Component layout

13. As shown in fig. 3 and 4 all components, with the exception of those mounted on the front panel, are fitted to one main chassis.

14. The rear of the chassis is stepped to give the necessary clearance for the larger components. This portion of the chassis contains the power supply unit.

15. The mains transformer (T1) is secured to the chassis by four screws; two apertures serve to expose the terminal lugs of both the primary and secondary transformer windings. The smoothing choke (L1) is fitted similarly but the smoothing capacitors C1, C2, C3 and C4, together with the decoupling capacitor C7, are each retained in position by two clips.

16. At the rear of the capacitor C2 and choke L1 is situated the common h.t. rectifying valve (V1) together with its two voltage stabilizers (V2 and V3) and also the h.t. rectifier (V4) for the oven control circuit.

17. Fitted to the rear chassis, above choke L1, is an isolating switch (S8) which disconnects the input power supply when the cover is removed. When it becomes necessary to operate the unit with the cover removed (e.g. during servicing) the switch may be closed by a manual override plunger.

18. The crystal oven extends to the bottom of the instrument and is fixed to the chassis by four flanged plates. It is a self-contained unit which comprises the grid circuits for the four temperature controlled crystal oscillators. These grid circuits are connected to their respective valves via a ten-pole plug (PL2), integral with the oven unit, which mates with a ten-pole socket (SKT2).

19. Each grid circuit contained in the oven has coarse and fine trimming capacitors which are accessible for calibrating purposes from the underside of the oven. A cover plate, fixed to the oven underside, is removed by slackening two screws then sliding the plate to the rear before lifting it clear. Removal of the cover, exposes the eight trimmer spindles which are labelled COARSE, FINE and the related oscillator frequency i.e. either 10 Mc/s, 11.1 Mc/s, 12.15 Mc/s or 12.5 Mc/s.

20. On the outer casing of the oven is mounted a tagboard on which are fitted components of the oven heater control bridge. On the top of the chassis and adjacent to valve V7 is the variable resistor RV1 which is used for adjusting the oven working temperature.

21. The attenuator pad is held in position on the top of the chassis in two sleeved clips. The coaxial connecting cable is fitted with type N connectors which plug into the two ends of the attenuator.

22. All the valves are mounted on the chassis top and arranged in groups with the five oscillator valves V13, V14, V15, V16 and V17 situated in a row adjacent to the oven. The mixer valve is positioned separately and the valves of the a.f. amplifier (V5, V8, and V9) together with the limiter valve (V10) and counter valve (V11), form another row of five alongside the attenuator. The thyratron (V6) and its control valve (V7) are situated between the oven and the front panel.

23. The layout of the components on the underside of the chassis is a conventional arrangement of tagboards and direct wiring clearly depicted in fig. 4.

Operating instructions

24. Set the three switches marked SUPPLY, L.T. and H.T. all to the OFF position and adjust the MAINS VOLTAGE tapping to the mains supply voltage.

25. Connect the instrument to the mains supply using the connector (Ref. No. 10HA/8359), then set the SUPPLY switch to the ON position. The SUPPLY indicating lamp and OVEN LOW lamp should both light.

26. The crystal oven of the frequency calibrator should now be permitted to reach its normal working temperature; this is indicated when the OVEN CYCLING lamp begins to flicker on and off and the OVEN LOW lamp is extinguished. The period required for the oven to attain its normal working temperature depends upon the ambient temperature but will normally be in the region of thirty minutes.

WARNING

If, at any time, the OVEN HIGH lamp should glow continuously, the supply should be switched off immediately. Under no circumstances should the oven temperature be permitted to exceed 90°C.

27. Set the METER SWITCH to the H.T. position and set the L.T. switch to ON; the L.T. indicating lamp should glow immediately. After a pause of approximately thirty seconds, to allow the valve cathodes to obtain their normal operating temperatures, set the H.T. switch to the ON position. Between 10 seconds and 30 seconds after making the H.T. switch the neon stabilizing valves should strike; the H.T. lamp should then glow and the meter show a reading of between 248V and 372V.

28. With the calibrator, frequency now ready for use, connect to the appropriate input socket of the instrument the signal whose frequency is to be measured. The position of the coaxial link should be set as detailed in the servicing instructions applicable to the equipment on test; see Part 2, Sect. 2, or the Air Publication appropriate to the equipment.

29. The OSCILLATOR MC/S switch should be set so as to bring the required crystal oscillator into operation. The purposes for which the five positions are intended are as follows:-

(1) Position A 10.0 - For measuring the frequency error of all eighteen indexed positions of the spectrum generator unit.

(2) Position B 11.1 - For measuring the frequency error of the X oscillator of test set, UHF, Type 15076.

(3) Position C 12.15 - For measuring the frequency error of the Y oscillator of test set, UHF, Type 15076.

(4) Position D 12.5 - For measuring the frequency error of the Z oscillator of test set, UHF, Type 15076.

(5) Position E CRYSTAL BANK - Brings in the oscillator which is used in conjunction with any one of the external crystals as selected by the CRYSTAL BANK switch (para. 30).

30. When the OSCILLATOR MC/S switch is rotated to position E CRYSTAL BANK, the CRYSTAL BANK switch should be set to the position corresponding to that of the required crystal number. Operating frequencies and intended functions, corresponding to the selected crystal number, are as follows:-

(1) Crystals numbered 1 (2.97 Mc/s), 2 (2.0 Mc/s) and 3 (2.03 Mc/s) are intended for use in the i.f. alignment procedure of the standby transmitter-receiver Type TR.10056; crystals 1 and 3 resonate at the frequencies of the bandpass limits and crystal 2 at the i.f. proper.

(2) Crystal 4 (1.85 Mc/s) is intended for use in the second i.f. alignment procedure of the main and guard receivers of the TR4/ARC52 and TR5/ARC52 equipments.

(3) Crystal 5 (12.1 Mc/s) is intended for use in the alignment procedure of the receiver unit (guard) first i.f. of 36.3 Mc/s; at this position the third harmonic of the crystal frequency is used.

31. The METER switch should be set to the OSC. GRIDS position which corresponds to the selected position of the OSCILLATOR MC/S switch, i.e. A, B, C, D, or E. The meter should then indicate that the selected oscillator is drawing grid current.

32. Plug in a headset of 150Ω impedance to the front panel jack labelled 150 OHMS PHONES and adjust the GAIN control to give a suitable level of audio frequency output.

33. The calibrator, frequency is designed to measure a frequency difference of up to 10 kc/s. If the METER switch is positioned to COUNT 10 KC/S F.S.D. when the difference frequency exceeds 10 kc/s the meter needle will deflect hard over to full scale. Under such conditions damage to the meter may ensue and to prevent this the following precautionary procedure should be adopted:-

(1) Set the METER switch to the OFF position

(2) Adjust the frequency of the signal source being measured for a beat note, in the headset, which is the nearest approach to zero beat.

(3) Then set the METER switch to the COUNT 10 KC/S F.S.D. position and read the frequency difference in the meter.

Circuit description

Introduction

34. The circuit diagram for the calibrator, frequency is shown in fig. 5 at the end of this chapter. The circuit is drawn with each of the sub-circuits clearly defined and the following circuit description is divided under headings for each of these sub-circuits.

Power supplies

35. The mains supply is connected to the three-pole plug PL1. Pole C is earthed and the supply at poles A and B is fed via the isolating switch (S8), the double-pole SUPPLY ON/OFF switch (S9) and the two 2-amp. fuses (FS1 and FS2) to the MAINS VOLTAGE panel.

36. The primary winding of the mains transformer (T1) provides seven voltage tappings permitting the equipment to be operated from the following main supplies at 45 c/s to 65 c/s:-

(1)	110V	(7)	220V
(2)	115V	(8)	225V
(3)	120V	(9)	230V
(4)	200V	(10)	240V
(5)	205V	(11)	245V
(6)	210V	(12)	250V

37. The SUPPLY indicating lamp (ILP1), with a limiting resistor (R1) in series, is connected across the primary winding of transformer T1; the lamp will glow, therefore, only when the mains supply is connected across the primary winding.

38. The heater supplies to the valves are divided into four parallel networks, each of which is fed from its own 6.3V secondary winding of transformer T1; the four networks are detailed as follows:-

(1) Transformer (T1) terminals 14 and 15, winding marked Z (fig. 5) - supplying rectifier valve V1 (Type CV493) via one pole of the H.T. ON/OFF switch (S1).

(2) Transformer (T1) terminals 30 and 31, winding marked Y (fig. 5) - supplying rectifier valve V4 (Type CV493) with resistor R10 in series.

(3) Transformer (T1) terminals 23 and 24 - a 6.3V winding supplying thyratron V6 (Type CV1848) together with its associated control valve V7 (Type CV492); one end of the winding is taken to earth and also one heater pin of each valve to complete the return line.

(4) Transformer (T1) terminals 20 and 21, winding marked X (fig. 5) - supplying the remaining valve heaters via one pole of the L.T. ON/OFF switch (S2); this winding has the L.T. indicating lamp (ILP3) connected across it, on the heater side of switch S2.

39. The four remaining secondary windings of transformer T1 include:-

(1) A 6V winding which supplies the oven temperature control bridge.

(2) A 190V winding to the anodes of rectifier valve V4 which produces the 250V h.t. supply.

(3) A 230V winding for the oven heater.

(4) A 300V-0-300V winding to the anodes of rectifier valve V1 which produces the 300V h.t. supply.

40. The double-pole switches S1 and S2 are each connected with one pole in a valve heater supply line (para. 38 (1) and (4)) and the other pole in the 300V winding centre tap earth return line. This is a precautionary measure which ensures that the h.t. is not connected before the valve heater supplies are applied.

41. The 300V h.t. supply is derived from a conventional full wave rectifying circuit with choke-capacity smoothing. The anodes of the rectifier valve V1 are supplied from the 300V-0-300V winding of transformer T1 via the series resistors R2 and R4. Smoothing is provided by capacitors C1 and C2 and coil L1; the h.t. indicating neon (ILP2) with a limiting resistor (R3) is connected across the smoothed output. The h.t. output (at d of fig. 5) is fed, via resistor R76, to the METER switch (S6) for the purpose of monitoring the h.t. voltage.

42. The h.t. for the a.f. output pentode (V9), the limiter valve (V10) and the counter valve (V11) is supplied direct from an unstabilized h.t. direct from the smoothing filter.

43. The 300V h.t. output voltage is stabilized by the two voltage regulators (V2 and V3) to provide the h.t. supply for the mixer valve (V12) and the oscillator in use, via the OSCILLATOR switch (S5) and the a.f. amplifiers (V5 and V8).

44. The 250V h.t. supply for the double triode valve V7 is derived from a conventional half-wave rectifying circuit with resistance-capacity smoothing. The anodes of the rectifier valve V4 are strapped together and supplied directly from the 190V winding of transformer T1. Smoothing is provided by capacitors C3 and C4 and the h.t. output (at c of fig. 5) is fed via resistor R79 to the METER switch (S6) for monitoring purposes.

Crystal oscillators

45. The five crystal oscillators A, B, C, D and E (comprising respectively valves V13, V14, V15, V16 and V17, and their associated components), are all of the electronic coupled Colpitts type. The four valves V13, V14, V15 and V16 only, have temperature-controlled grid circuits; oscillator valve V17 operates in conjunction with a bank of plug-in crystals working at room ambient temperature.

46. The oscillators, A, B, C and D are four independent circuits, each of which is aligned to oscillate at the resonant frequency of its crystal. The circuits differ only inasmuch that the crystals employed resonate at different frequencies i.e. XL1 (10 Mc/s), XL2 (11.1 Mc/s), XL3 (12.15 Mc/s), XL4 (12.5 Mc/s).

47. One oscillator will be considered in detail and is shown in fig. 6. The valve used is an r.f. pentode (Type CV4014) with the suppressor grid strapped externally to the cathode. The Colpitts circuit is formed by the screening grid which acts as the anode. H.T. is applied to the screen via the OSCILLATOR MC/S switch (S5) and dropper resistor R58. The control grid is connected to one side of the crystal and the effective anode (screen) is connected to the earthy crystal plate, so far as r.f. is concerned, via capacitor C38. The cathode is capacitvely tapped by capacitors C25 and C27 which are connected across the crystal. A d.c. path to earth for the cathode is provided by inductor L3 and resistor R57; a similar function for the control grid is performed by resistor R53 via the metering resistor (R54). The coarse trimmer (C24) and the fine trimmer (C56) are for alignment purposes (para. 19).

48. The electron stream which passes through the screen is fluctuating at the crystal frequency and passes through the suppressor grid to the true anode. The fluctuating anode voltage across the anode load resistor (R59) is fed to the mixer grid via switch S5 and capacitor C36.

49. The oscillator E (V17) is fundamentally the same as the oscillator depicted in fig. 6. The trimming capacitor (C54) is adjusted during alignment to ensure that the nominal input capacity of each crystal bank socket is 30pF. The CRYSTAL BANK switch is wired so that both connections to the nine pairs of crystal sockets not in use are at earth potential.

Paraphase amplifier

50. The output of the selected oscillator A, B, C, D or E is fed to the triode valve V12 operating as a buffer with output connections in paraphase. The input is to the grid of valve V12, via switch S5, the balanced load R55 and R56 resulting in a push-pull output between the anode and cathode.

Input connections

51. The signal of unknown frequency is applied directly at socket SKT3 or via the attenuator at socket SKT5 to the terminating resistors R74 and R75; these two resistors provide resistive termination of the coaxial input connections at an impedance of 50Ω.

Mixer

52. The mixer circuit is a balanced type comprising the network of diodes (MR5 and MR6) and resistors (R62 and R63) fed from the selected crystal oscillator via the paraphase amplifier valve V12.

53. The balanced push-pull output of the paraphase amplifier is finally developed across resistors R62 and R63 which form two arms of the mixer network.

54. Depending upon the alternative positive and negative voltage excursions of the cathode and anode of valve V12, both diodes (MR5 and MR6) are alternatively biased in the forward and reverse condition.

55. The unknown frequency input is unbalanced (one line being earthed) and is connected between the junction of the diodes (MR5 and MR6) and earth.

56. The resultant output from the mixer circuit is developed across the resistors R69 and R70 and the required input to the following stage is tapped off at the junction of these resistors.

57. This signal developed across resistors R69 and R70 is a combination of the unknown frequency and the output of the selected crystal oscillator. The crystal oscillator outputs, however, contains harmonics of the crystal as well as the fundamental frequency so that the resultant developed across resistors R69 and R70 will contain components whose frequency is the difference between the fundamental and harmonics of fc, the crystal frequency, and the unknown frequency fx.

58. The calibrator, frequency will not identify the particular harmonic of the crystal oscillator, and it is assumed that the frequency of the unknown input will be roughly known.

59. This difference frequency (para. 57) will be observed as an audio frequency fa, where fa = nfm ± fx. Thus the condition of zero beat (fa = 0) will be obtained when fx = nfm.

60. The output of the mixer stage is fed to the input of the a.f. amplifier valve (V5) via coupling capacitor C8.

A.F. amplifier

61. The audio frequency derived from the mixer stage is amplified in a conventional manner through the triode V5 and double triode V8.

62. This amplified a.f. is taken to the squaring stage (i.e. the limiter valve V10) via capacitor C18 and also the control grid of the a.f. output valve V9 via capacitor C19 and resistor R33. Valve V9 is a CV1138 a.f. pentode employed in a conventional power output stage and is capable of delivering an a.f. power output of 50mW into a load of 150Ω impedance throughout the range 50 c/s to 10 kc/s. Negative feedback is incorporated from the secondary winding of transformer T2, via resistors R33 and R38, to the control grid. Audio power output is adjusted by the GAIN control (RV2), which is connected in parallel with the transformer T2 secondary, and fed to jack JK1 for use with a plug-in type headset for monitoring purposes.

Limiter and counter

63. The limiter and counter circuits consist of valve stages V10 and V11 together with the bridge rectifier network comprising diodes MR1, MR2, MR3 and MR4 and meter M1.

64. The amplified difference frequency at the output of the amplifier valve V8 is applied to the control grid of the limiter valve (V10) via capacitor C18. Valve V10 is operated with a low screen voltage derived from the divider network resistors R89 and R42. This low screen voltage

produces the characteristics of an effectively reduced control grid bias and the resultant waveform at the anode of limiter valve V10 approximates to a square wave having a mark-space ratio of approximately 1:1.

65. The square wave output of the limiter is fed via capacitor C28 to valve V11 which, with its associated components, operates as a Schmitt trigger circuit; the resultant waveform at the second anode of valve V11 is a steep edged square wave of constant amplitude. The amplitude is controlled by the trigger circuit and is unaffected by variations in signal frequency input.

66. Differentiation of this constant amplitude square wave is effected by the R-C network comprising the capacitor C30 plus the equivalent forward resistance of the diodes MR1-MR4 and resistor R51 together with the meter (M1); the resultant, differentiated signal is developed across the resistor R51.

67. Due to the rectifying action of the bridge network comprising the diodes MR1-MR4, all pulses developed across the resistor R51 are unidirectional.

68. The pulse repetition frequency is that of the a.f. input signal at V10, all the pulses being of constant amplitude. Thus, the mean current flowing in the meter is directly proportional to, and dependent upon, the frequency of the a.f. input signal at V10.

69. The meter scale is calibrated in cycles per second so that variations in mean current may be read directly as variations in frequency, up to a maximum of 10 kc/s.

Oven control

70. Control of the oven temperature is achieved by means of the Wheatstone bridge, a two-stage amplifier (V7) and a thyratron (V6).

71. Wound on the inner shell of the oven are three bifilar windings, each winding being in close contact with the shell and with each other. Two of the windings (crystal oven temperature sensing elements) are identical and are made from fine gauge, glass insulated, copper wire having a high positive temperature coefficient of resistance. These two windings form diagonally opposite arms of the Wheatstone bridge used in controlling the oven. The third winding is of glass insulated constantin wire and forms the oven heater (HR1).

72. The bridge consists of the two identical oven windings and two high stability wirewound resistors (R29 and R32), and is supplied with 6V a.c. at 50 c/s from a secondary winding on transformer T1. Also incorporated in the bridge are a variable resistor (RV1) and a third wirewound resistor (R27). The function of RV1 is to enable the oven temperature to be set to 75°C; the resistor R27 acts as a compensating resistance for the effect of ambient temperature changes on the oven temperature. The value of this resistor (1.8Ω) is such that the effect of reduced heat losses due to high ambient temperatures is effectively compensated in the range 0-65°C.

73. The bridge is coupled via capacitor C14 to the double triode amplifier (V7) which, in turn, is coupled via capacitor C12 to the control grid of the thyratron (V6). The thyratron is in series with the oven heater (HR1) and its supply. The heater is shunted by the lamp ILP4 with a resistor R11 in series.

74. On switching on, the bridge will be unbalanced due to the resistance of its oven windings being lower than that of the fixed arms. As a result, a.c. voltage will appear at the grid of valve V7 and the amplifier output is fed via capacitor C12 to the grid of the thyratron.

75. The anode of the thyratron is supplied with an alternating voltage in phase with the voltage supplied to the bridge. An a.c. bias is applied to the cathode of the thyratron valve such that, at any instant, the voltages at the grid and anode are always 180° out of phase.

76. On each positive half cycle of voltage applied to the anode the thyratron will strike. During this half cycle current will pass through the oven heater HR1 causing the oven temperature to rise.

77. As the oven rises in temperature so the two temperature sensing elements increase in resistance, bringing the bridge nearer to the balanced condition. The result is a decrease in the amplitude of the alternating voltage applied to the thyratron grid via valve V7.

78. This voltage will continue to decrease until eventually it is insufficient to overcome the standing bias on the thyratron. At this point the thyratron ceases to conduct, current no longer flows through the oven heater HR1 and the oven starts to cool. As the oven cools the bridge becomes unbalanced and the cycle is repeated.

79. Since the output of a Wheatstone bridge, fed with an alternating voltage, undergoes a phase reversal when the bridge is taken through balance it is impossible for the oven to overshoot its preset temperature unless a component breakdown occurs.

80. The thermal switch (S4) is adjusted so that, in the event of the oven temperature increasing beyond 82°C, the contacts will close thus completing the circuit for the OVEN HIGH lamp (ILP6); the thermal switch S3 is so adjusted that its contacts open, switching off the OVEN LOW lamp (ILP5), when the oven temperature increases beyond approximately 68°C.

Servicing

General

81. The equipment should be maintained in a clean, dry and undamaged condition throughout its service life. Care must be taken to avoid rough handling of the switches and controls and to prevent the meter from being broken whilst the unit is on the bench. Keep the working area clear of any servicing tools, soldering irons, etc.

82. Periodically remove the cover and inspect the switches and wiring; access can be gained by removing the cheese head screws securing the cover.

83. When it is required to operate the unit with the cover removed, the isolating switch S8 (para. 17) may be closed by a manual override plunger.

WARNING

> Before attempting to renew any component, wiring, etc, suspected of being faulty, ensure that the isolating switch (S8) is open, the mains supply is switched off and disconnected from the unit.

84. Whenever a fault is suspected within the internal wiring a continuity test can readily be made using the multimeter Type 1 or similar instrument. Wiring is either of tinned copper 22 s.w.g., electrical equipment Type 2, 23/.0076 in. pink (6145-99-910-0191) or electrical equipment Type 2, 14/.0076 in. pink (6145-99-910-0185). Any renewal of wiring should be made only with

with the correct grade of wire; the connections should be made as neatly as possible, with care taken to avoid tails of excess solder. Remove any wire clippings and excess solder before replacing the cover or front panel.

85. Examine the connectors each time before coupling them to the frequency calibrator, the equipment on test and the mains supply. They should be undamaged and dry, with the plug and socket terminations making good, firm contact with the mating components on the related equipment; threads on connectors, etc., should have a thin film of grease applied periodically to facilitate their removal.

Overall testing

86. A circuit diagram of the complete unit is provided at fig. 5; a study of the diagram gives all the information necessary for clearing normal faults.

87. Before disconnecting either an electrolytic capacitor or a diode suspected of being faulty, note carefully the way in which the polarity is effected and fit the new component similarly.

88. Renewal of either the mixer valve (V12), crystal oscillator valves (V13-V17), or their associated components will necessitate realignment of the oscillators. Details are given in para. 49 and 102.

89. Extreme care should be exercised, when changing components associated with the crystal oven, to ensure that the correct replacements are used. Failure to do so may lead to overheating of the oven and possible damage to the crystals.

WARNING

If, at any time, the OVEN HIGH lamp should glow continuously, the supply should be switched off immediately. Under no circumstances should the oven temperature be permitted to exceed 90°C.

90. When repairs or replacements have become necessary, tests should be made to determine that the equipment has been restored to a serviceable condition equivalent to that of a new unit, as issued, which has been inspected to factory standards.

91. Crystal oven and frequency counter circuits should be tested, therefore, to conform to the following standards of requirements which have been based the manufacturer's production schedule.

Oven testing

92. If, due to renewal of components, etc., adjustment to the oven circuits should become necessary, the following procedure should be adhered to:-

(1) Set the front panel switches as follows:-

L.T. - OFF
H.T. - OFF
METER - OVEN H.T.
OSCILLATOR MC/S - E CRYSTAL BANK
CRYSTAL BANK - any blank position

(2) Take out the thyratron (V6) and its control valve (V7).

(3) Set the MAINS VOLTAGE tapping to 230V.

(4) Apply 230V $\pm$ 1V to the input plug and note the time between making contact to the mains and the h.t. measured at the junction of resistors R8 and R9 and capacitor C3 to reach 30 volts. This delay should be within the limits 20 sec - 40 sec.

(5) The final voltage at this point should be 250V $\pm$ 10%.

(6) Ensure that the reading of the voltmeter on the front panel is within $\pm$ 10% of the voltage measured in sub-para. (5).

(7) The voltage measured at pole 3 of the thyratron valve (V6) should now be 250V a.c. $\pm$ 10%, and the voltage measured between poles 2 and 7 should be 6.3V a.c. $\pm$ 0.6V.

(8) Disconnect the mains supply and insert the thyratron (V6) and the control valve (V7).

(9) Ensure that the heaters of the rectifier valves V1 and V4 are cool, re-connect the mains supply and switch on.

(10) The OVEN LOW lamp (ILP5) should light immediately whilst the OVEN CYCLING lamp (ILP4) should glow continuously after an interval of 20-40 seconds.

(11) Now set the oven temperature preset control (RV1), located on the extreme right-hand side of the chassis, to approximately its mid-way position. Remove the plate from the oven lid and insert a thermometer of range 0°C-100°C in the centre hole. (The thermometer should be fitted with a copper foil sleeve about one inch long, enclosing the mercury bulb, to give close contact with the chassis inside the oven).

(12) Clip a resistor (180Ω $\pm$ 10%, ¼W) across the capacitor C17 which is mounted on the oven assembly. This unbalances the bridge control circuit; the OVEN CYCLING lamp (ILP4) will glow continuously and the oven temperature will increase rapidly.

WARNING

It is imperative that the oven temperature should not exceed 90°C.

(13) At a temperature between 60°C and 74°C the OVEN LOW lamp (ILP5) should become extinguished.

(14) At a temperature between 77°C and 90°C the OVEN HIGH lamp (ILP6) should light.

WARNING

If the OVEN HIGH lamp fails to light when a temperature of 90°C is reached, switch off the MAINS SUPPLY switch (S1) immediately and investigate the fault.

(15) On completion of the oven testing to this stage, switch off the mains supply and remove the 180Ω test resistor.

Oven adjustment

93. Allow the thermometer reading to fall to 70°C then switch on the mains supply and allow 30 minutes for the oven to reach operating temperature; this is normally shown by a slow flickering of the OVEN CYCLING lamp ILP4. To set the oven operating temperature to 75°C ± 5°C proceed as follows:-

(1) Note the initial oven temperature; if high reduce the temperature by rotating the oven temperature control (RV1) in a counter-clockwise direction.

(2) Allow half an hour for the oven temperature to stabilize then note the temperature again and repeat as necessary. At least one hour must be allowed after the final adjustment and before the end of the test; note the exact temperature of the oven at the end of the test.

(3) Remove the thermometer and copper foil and replace the oven lid cover plate.

<u>Note...</u>

If oven adjustment cannot be easily affected, the frequency calibrator requires extensive servicing.

(4) On completion of this oven adjustment procedure the unit should be set up for the prevailing supply of a.c. mains voltage before further service.

Counter adjustment and functional test

94. The equipment necessary for the testing of this part of the circuit is:-

(1) An a.f. milliwattmeter, having a characteristic impedance of 150Ω, with a scale of 0-100mW; it should be calibrated at power levels, relative to 50mW, of -6dB and + 6dB.

(2) An a.f. signal generator capable of delivering a signal at levels of between 200mV and 25V at a frequency continuously variable from 15 c/s to 10 kc/s; the frequency accuracy of the a.f. signal generator should be within ± 1% of the correct frequency between 150 c/s and 10 kc/s.

95. Connect the a.f. output meter to the jack JK1 marked A.F. OUTPUT 150 OHMS PHONES on the front panel. Connect the a.f. generator to the junction of resistors R69 and R70 and capacitor C44 and set the A.F. OUTPUT GAIN CONTROL (RV2) to maximum.

96. Close the L.T. switch (S2), wait 30 seconds then close the H.T. switch (S1) and verify that the time delay, between closing the switch and steady striking of the neon stabilizers (V2 and V3), is from 10-30 seconds.

97. Ensure that the voltage measured on the meter M1 is 310V ± 10%.

98. Set the a.f. signal generator to give an output of 200μV at 1 kc/s; the a.f. output measured at the 150 OHMS PHONES jack JK1 should be not less than 50mW.

99. Now set the a.f. signal generator to give an output of 50mW and ensure that the output does not fall by more than 3 dB over the range 50 c/s to 10 kc/s.

100. Adjust the a.f. signal generator to give 1mV output at 2.5 kc/s ± 1%. Then rotate the counter control (RV3), located on the left-hand side of the chassis, so that the meter indicates exactly 2.5 kc/s.

101. Observe that the meter reading corresponds, within ± 5%, to the nominal input frequency over the range 1 kc/s to 10 kc/s.

102. Remove the a.f. signal generator and ensure that the meter now reads zero.

Oscillator test and calibration

103. Alternative methods of oscillator alignment are given in the following paragraphs and either method may be employed.

104. The procedure outlined below may also be applied to the 11.1 Mc/s, 12.15 Mc/s and 12.5 Mc/s oscillators, using the relevant switch positions and trimmer capacitors accordingly. The equipment necessary for these tests is as follows:-

(1) A standard frequency source of frequencies 2.000 Mc/s, 11.1 Mc/s, 12.15 Mc/s and 12.5 Mc/s; the accuracy of this source should be better than one part in 10^7.

(2) A pair of headphones of 150Ω impedance provided with a Post Office type jack plug for connection to jack JK1 of the equipment.

(3) An oscilloscope with a d.c. signal amplifier provided in its Y plate connections capable of indicating low frequency beat signals during standardization of the internal oscillator of the calibrator, frequency.

(4) A trimmer tool (5120-99-9597) or equivalent.

(5) A Q-meter, provided with a suitable test coil and test leads, capable of measuring the input capacity of the crystal bank (nominal capacitor 30pF) at a frequency of 1.0 Mc/s.

(6) Am a.f. milliwattmeter as described in para. 94(1).

105. Before carrying out the procedure ensure that the crystal oven is operating in the manner specified in para. 92. Proceed as follows:-

(1) Set the OSCILLATOR MC/S switch (S1) to position A 10.0, METER SWITCH (S6) to OSC. GRIDS A and ensure that the 10.0 Mc/s oscillator is functioning.

(2) Adjust the fine trimmer capacitor (C56) to its mid-way position.

(3) Adjust the output of the standard frequency source to 10.0 Mc/s and connect to socket SKT3 (IN DIRECT).

(4) Plug in the headphones to jack JK1 on the front panel and adjust the AF OUTPUT GAIN CONTROL (RV2) to give a suitable output level.

(5) Connect the oscilloscope to the junction of capacitor C8 and resistor R12 in its Y plate signal amplifier.

(6) The 10.0 Mc/s oscillator can now be adjusted, by means of the trimmer capacitors C24 and C56, until a condition of zero beat is obtained in the headphones and, simultaneously, a null is indicated on the oscilloscope. Final adjustment of the oscillator should be made by means of the fine trimmer (C56) using the trimmer tool.

(7) Couple the output of the a.f. signal generator to the X plates of the oscilloscope, set the frequency of the signal generator to 30 c/s and adjust the output to give a suitable waveform on the oscilloscope.

(8) By means of the fine trimmer capacitor (C56) the oscillator frequency should be adjusted until a 1:1 ratio Lissajous figure is obtained on the oscilloscope.

(9) Disconnect the a.f. signal generator.

(10) Repeat the procedure outlined in sub-para. (6); the oscillator grid current should now be not less than 25μA.

106. The alternative method of oscillator alignment requires an external frequency counter capable of measuring frequencies of 2.00 Mc/s, 10.00 Mc/s, 11.1 Mc/s, 12.15 Mc/s and 12.5 Mc/s to an accuracy better than one part in 10^7; this source should be capable of operating with a sine wave input of 0.5V r.m.s. or more and should be capable of being calibrated against a standard external signal.

107. The procedure is as follows:-

(1) Connect the output of the frequency counter to the junction of capacitor C36 and resistor R52 (i.e. the control grid of the mixer valve V12).

(2) The oscillators should then be aligned and tested for stability by reading the frequency of each directly from the frequency counter scale, using the relevant OSCILLATOR MC/S switch (S1) positions and trimmer capacitors.

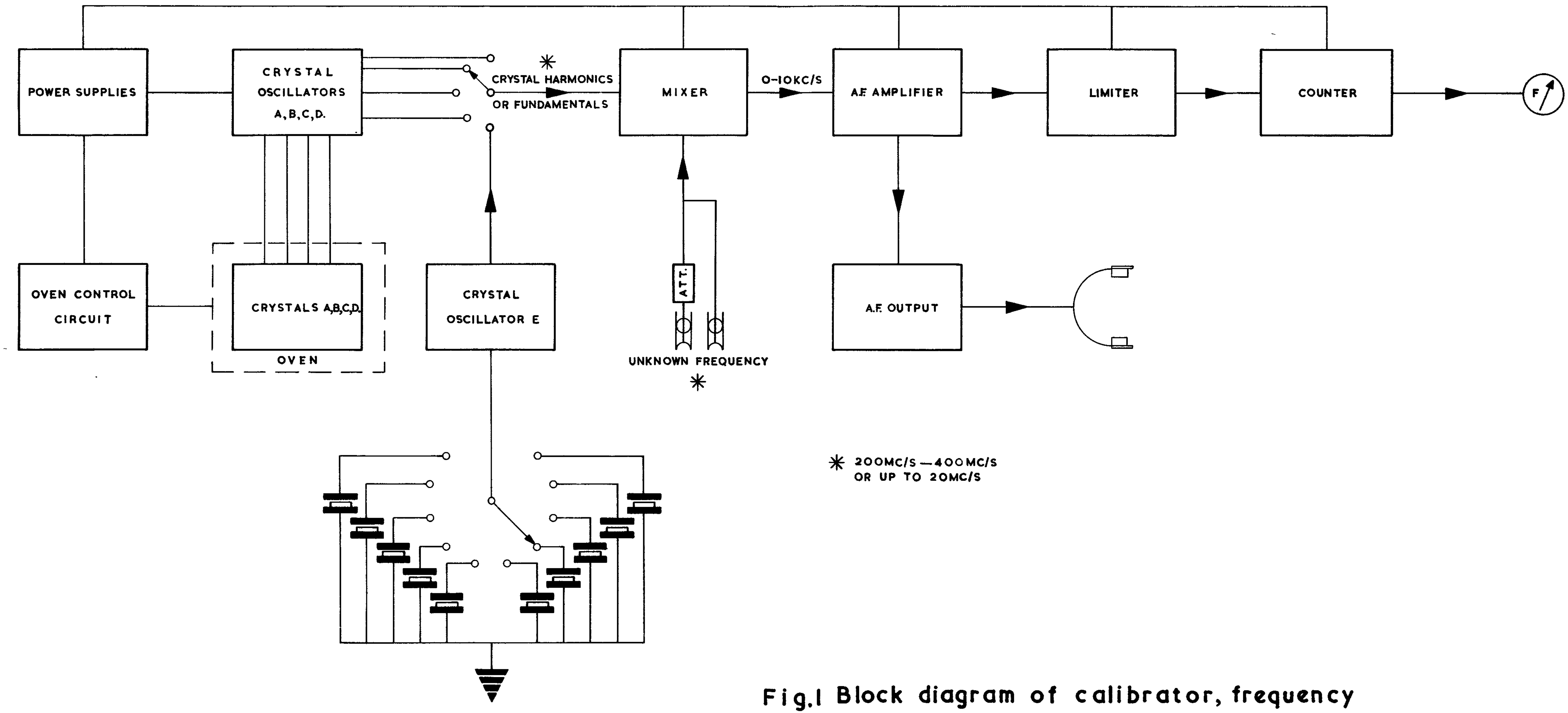


Fig.1 Block diagram of calibrator, frequency

Fig. 2. Front panel layout

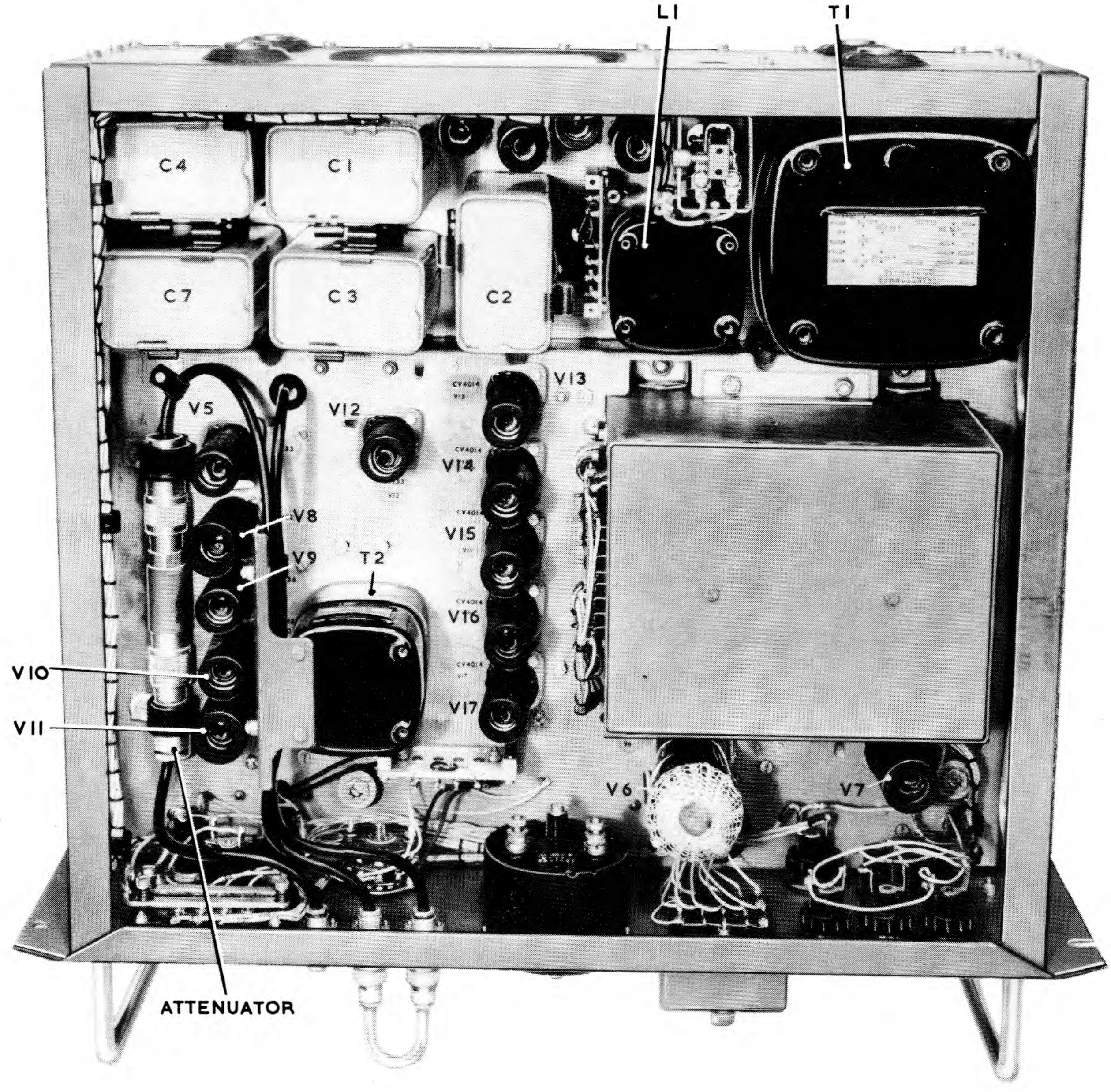


Fig. 3. Component layout above chassis

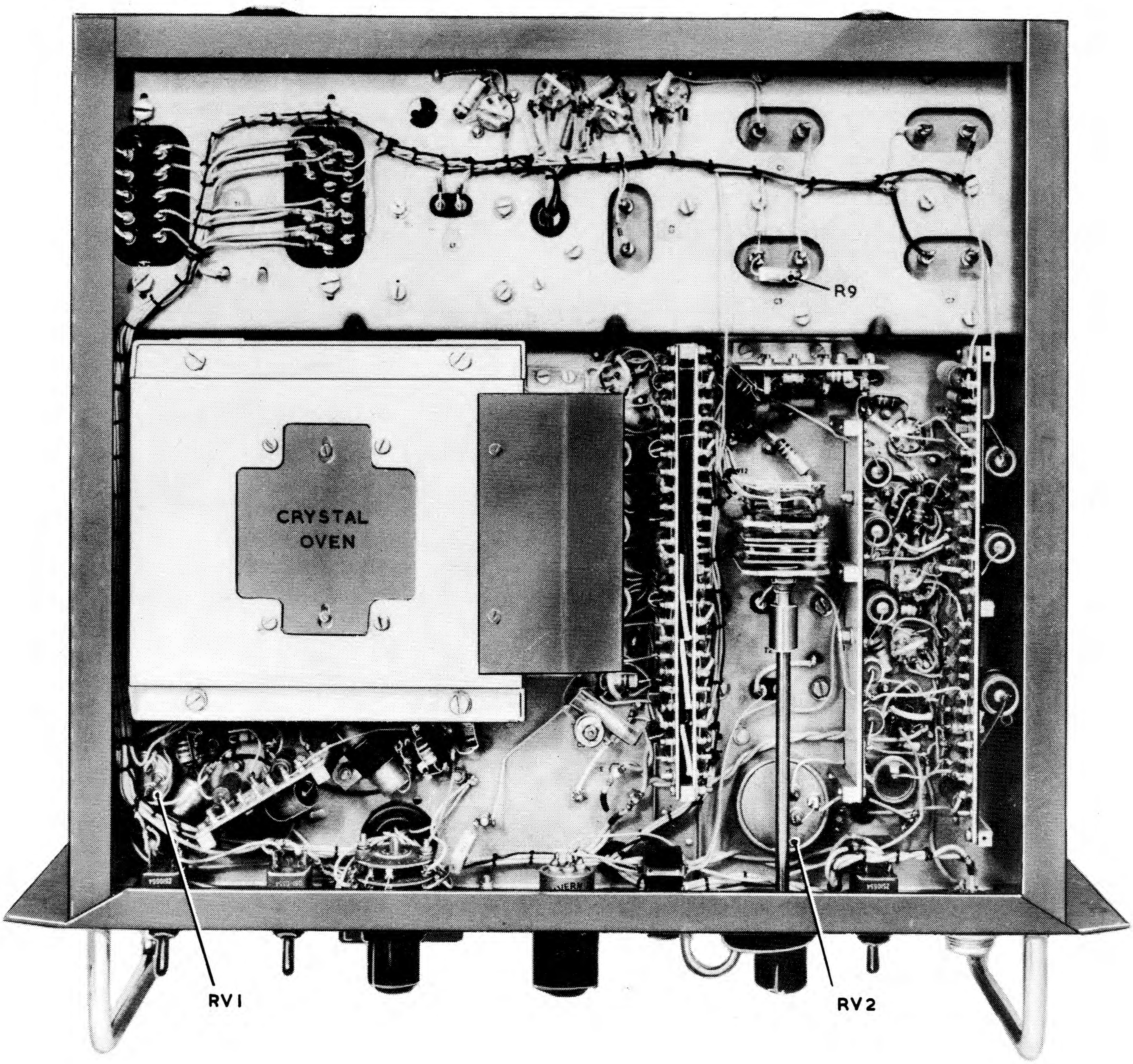
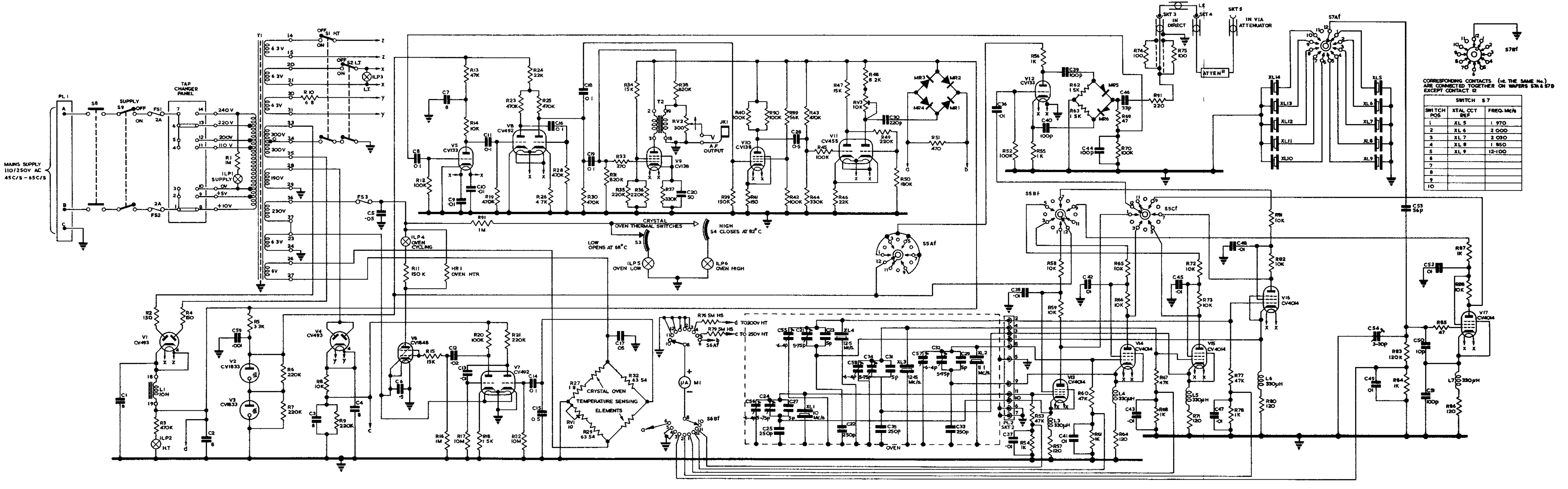


Fig. 4. Component layout under chassis



SWITCH S7		
SWITCH POS	XTAL CCT REF	FREQ. Mc/s
1	XL 5	1 970
2	XL 6	2 000
3	XL 7	2 030
4	XL 8	1 850
5	XL 9	12·100
6		
7		
8		
9		
10		

Fig. 5. Calibrator, frequency 6625-99-999-2642 — circuit

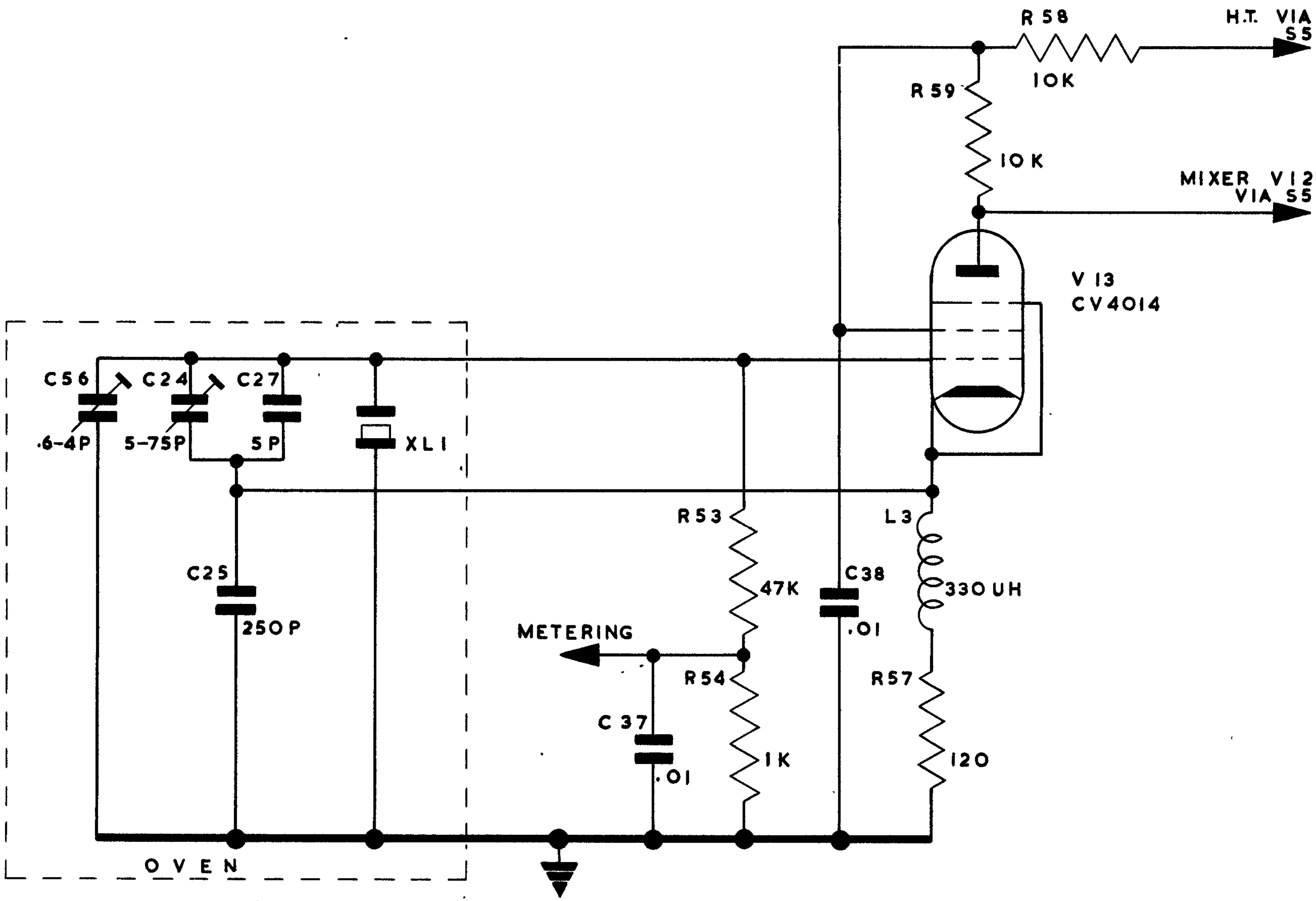


Fig.6 Circuit diagram of a typical oscillator
as used in the calibrator, frequency

Chapter 4

TEST, SET ELECTRICAL POWER (AC)

LIST OF CONTENTS

LIST OF ILLUSTRATIONS

LEADING PARTICULARS

Ref. No.	10S/6625-99-999-7813
Purpose	Testing of power unit (AC) and rectifier unit (modules of TR4/ARC52)
Component parts	(1) Interconnecting box (head) 5821-99-913-3097
	(2) Interconnecting box (set) 5821-99-913-3096
	(3) Connectors
Additional equipment required	(1) Dummy load, electrical, 5985-99-999-1866
	(2) Multimeter CT429 or CT54
Power supplies	A.C., 115V, 3-phase, 400 c/s D.C., 27.5V

Dimensions (approx.)

Interconnecting box (head)	Height	4 in.
	Width	9 in.
	Depth	5 in.
Interconnecting box (set)	Height	7 in.
	Width	11 in.
	Depth	6 in.

Introduction

1. This equipment is collectively designated test set, electrical power (AC) (10S/6625-99-999-7813) and comprises the interconnecting box (head) (5821-99-913-3097), the interconnecting box (set) (5821-99-913-3096) and the associated connectors described in para. 7 and 8.

2. This equipment is used in conjunction with the dummy load, electrical (5985-99-999-1866) (Vol. 1, Part 2, Chap. 2 and 7 of this Air Publication) and its purpose is to provide the required facilities for third and fourth line testing of the power unit (AC) (5821-99-942-8542) and the rectifier unit (5821-99-942-8551) incorporated in TR4/ARC52 transmitter-receiver equipments.

3. General views of the interconnecting box (head) and the interconnecting box (set) are given at fig. 1 and 2 respectively. From fig. 1 the basic construction described in para. 10-16 inclusive can be followed and, in addition, the connector plugs for each of the two modules under test (power unit (AC) and rectifier unit) can be compared with the sockets provided at the interconnecting box (set) shown in fig. 2. Constructional details of the interconnecting box (set) are described in para. 17-24 inclusive.

4. This equipment is classified under Inter-Services specification K114 as K114/D, ground equipment (protected) for use in permanent buildings. It is rated to function correctly in ambient temperatures of +55°C at the prevailing relative humidity and at an ambient temperature of +40°C at a relative humidity of 95%. The equipment will function correctly in ambient temperatures down to -26°C.

Associated test equipment

5. To provide the required performance monitoring facilities when testing the power unit (AC) or rectifier unit, the following types of a.c./d.c. valve voltmeter are required:-

(1) Multimeter CT429 (6625-99-943-8384)
or
(2) Multimeter CT54 (F19/6625-99-943-2418)

6. The load unit approved for use with this equipment is the dummy load, electrical (5985-99-999-1866).

Connectors

7. This test equipment is supplied with all connectors required for coupling the interconnecting box (set) to the bench source of supplies (para. 9) and between the interconnecting box (head), the interconnecting box (set) and the dummy load, electrical.

8. Details of the connectors provided are as follows:-

(1) Connector 4-way Mk.4 (Plessey Part No. CP242145/3) for coupling the 3-phase 115V a.c. bench supply to the interconnecting box (set).

(2) Connector, 4-way Mk.4 Type 3430/1 (Ref. 10HA/8360) for coupling the nominal 27.5V d.c. supply from the bench source to the interconnecting box (set).

(3) Connector, 30-way Modaconnector type (Plessey Part No. CP242145/2) for connection between the interconnecting box (head) and the interconnecting box (set) to convey the primary power supplies and output voltages of the power unit (AC) under test;

(4) Connector, 12-way Mk.4 (Plessey Part No. CP242145/4) for the coupling between the interconnecting box (head) and the interconnecting box (set) to convey the input and output from the rectifier unit under test.

(5) Connector, 25-way Mk.4 (6150-99-999-4743) for coupling between the interconnecting box (set) and the dummy load, electrical.

Power supplies

9. Primary power supply requirements for the correct operation of this test equipment are to be provided from station bench sources as follows:-

(1) A.C. supplies - To be star connected, 3-phase, 4-wire (three phase lines and one neutral). The nominal line to neutral voltage is to be supplied at 115V r.m.s. and the periodicity within the range 380 c/s to 420 c/s. The actual on load line to neutral voltage should be arranged to be adjustable over the range 110V to 120V. The distortion factor of the output waveform of each phase should not exceed 5%, and the depth of modulation by any other frequency than the fundamental should not exceed 2%. The amplitude factor of the phase voltage must be within 1.41 ± 0.14.

(2) D.C. supply - To be + 27.5V (nominal), capable of adjustment over the limited range $\pm$ 0.5V from nominal. This supply should be derived from an approved bench source; e.g. power unit, a.c. (ground) (10K/5921-99-943-7136).

Construction

Interconnecting box (head)

10. As illustrated in fig. 1, this equipment comprises a fabricated metal box with provision for inlet and output connectors required for testing both the power unit (AC) (5821-99-942-8546) and the rectifier unit (5821-99-942-8551) under simulated operating conditions.

11. Forming the top closure of this box is a heavy metal platform for mounting either of the two units on test. The platform is fitted with a 20-way Amphenol socket (5935-99-931-1028) and a 15-way Cannon socket (5935-99-940-2180) into which can be inserted the multipole plugs in the base of the power unit (AC) and the rectifier unit undergoing test. This top platform is contrived as a facsimile of the appropriate portion of the main chassis, into which the modules are fitted to form the TR4/ARC52 equipment (fig. 3 and 4).

12. Through the top of the interconnecting box (head) protrude ten screw threaded captive studs which engage with the appropriate number of tapped holes in the base of each unit on test in order to clamp them firmly in position throughout the test.

13. The captive studs are accessible from the underside of the box and are provided with large knurled heads to permit the requisite firmness of the tightening to be made entirely by hand.

14. Through one side of the box are fitted two multipole connector plugs; one is a 30-way Modaconnector plug type T2070, PL1 supplying the 20-way Amphenon socket SKT1 for testing the power unit (AC), the other is a 12-way Mk.4 plug PL2 supplying the 15-way Cannon socket SKT2 for testing the rectifier unit. Both of these side mounted plugs are for connection via the appropriate connectors (para. 8) to the interconnecting box (set). The correct fitting of the connectors is facilitated by the screen-printed markings adjacent to each plug of both interconnecting boxes.

15. Within the interconnecting box (head) are contained the loomed cableforms connecting the side mounted plugs PL1 and PL2 to the platform mounted sockets SKT1 and SKT2.

16. The box dimensions of this unit are 9 in. x 5 in. x 4 in. (229m.m. x 127 m.m. x 102 m.m.).

Interconnecting box (set)

17. This unit is a fabricated metal box, finished in grey enamel, into which are fitted the plugs and sockets for interconnection (by means of the connectors listed in para. 8) between the interconnecting box (head) with the units under test and the dummy load, electrical (5985-99-999-1866).

18. The top panel of this unit is fitted with switches and all controls required during the testing of the power unit (AC) and the rectifier unit modules of the TR4/ARC52 equipment. In addition, the top panel carries test sockets to permit continuous monitoring of the output voltages from the components undergoing test. The retaining caps for protective fuse links are fitted through the top panel and also a supply warning lamp. A view of this top panel of the interconnecting box (set), showing the complete control layout and the markings for each component, is given at fig. 5.

19. Stainless steel studs are fitted, one at each corner on the top panel, to afford protection for the controls and instruments, allowing the unit to be inverted on the bench. The studs also provide mounting feet when the top panel is removed during servicing or inspection of the internal wiring of the box.

20. A panel at one end of the box carries the two multipole sockets SKT3 and SKT4, by which connection is made to the rectifier unit and the power unit (AC) respectively via the interconnecting box (head). The first of these sockets, is a standard 12-way Mk.4 type which is coupled by a connector (para. 8(4)) to the Mk.4 plug PL2, marked RECTIFIER UNIT on the side of the interconnecting box (head). The second socket is a 30-way Modaconnector type T2070, rectangular in shape and fixed by two cheese-head screws and locknuts; this socket is coupled through its connector (para. 8(3)) to the plug PL1 marked P.S.U. (A.C.), which is of similar shape and dimensions, in the side panel of the interconnecting box (head).

21. Through the rear side panel of the interconnecting box (set) are fitted two 4-way Mk.4 type plugs for coupling to the bench supplies of

115V 3-phase a.c. and 27.5V (nominal) d.c. Both positions are readily identifiable from the screen-printed markings above each position. In addition, this side panel carries two larger multipole Mk.4 type sockets of dissimilar size; the smaller of the two is a 12-way, the connections of which are in parallel with the test points on the front panel. This socket could be used in conjunction with a separate metering panel and/or meter switch for rapid metering. The larger of the two sockets is a 25-way component, which couples, via the connector (6150-99-999-4743), to the appropriately marked plug on the dummy load, electrical.

22. All internal wiring and the components fitted to the underside of the top panel are readily accessible for servicing or replacement when the panel is removed. It is retained in position by eight cheese head screws which engage into anchor nuts rivoted to the underside of a continuous flange formed around the top edge of the box.

23. With the exception of the plugs and sockets and the associated loomed cableforms, all operating components such as switches, controls and fuses, are fitted to the underside of the top panel by means of screws and lock--nuts. The component layout of the interior of this unit is shown in fig. 6. A network of four resistors is carried within the box; these are supplementary components incorporated to modify the loadings required in certain tests (para. 32).

24. The box dimensions for this unit are 11 in. x 7 in. x 6 in. (279m.m. x 178m.m. x 152m.m.).

Circuit description

Interconnecting box (set)

25. The circuit diagram for this unit is given in fig. 7 at the end of the chapter.

26. The 27.5V (nominal) d.c. supply from bench sources enters the interconnecting box (set) by way of the 4-way Mk.4 plug PL1. This line is protected by the single 5A fuse FS1 and is connected in circuit with the SUPPLY lamp ILP1 on the front panel. This lamp will glow when the SUPPLIES switch S3 is switched ON.

27. A three-phase a.c. primary power supply from bench sources at 115V nominal enters the interconnecting box (set) through the 4-way Mk.4 plug PL2. By means of the PHASE VOLTS and PHASES switches (S4 and S5), each phase of the mains supply may be monitored both at the points of entry and emergence from the power unit (AC) undergoing test.

28. Each phase line is protected by a single 5A fuse link, marked appropriately on the top panel PHASE 1, PHASE 2 and PHASE 3.

29. The coupling of each phase line to the MODULE on test is made by the contacts of the relay RLA (fig. 7) which is energized from the nominal 27.5V d.c. supply through the action of the SUPPLIES switch (S3).

30. The contacts of a second relay RLB are also energized from the 27.5V (nominal) d.c. supply to connect the e.h.t. load in the dummy load, electrical to the module on test. An anti-surge capacitor C1 (2μF) is provided between this line and earth.

31. A switch (marked CHECK RELAY) (S1) is wired in series with a 100 ohms, 1 watt resistor R1 to bring about the energizing of the relay of the power unit (AC) undergoing test by means of the nominal 27.5V d.c. supply.

32. Load requirements for the modules under test are provided in this equipment by the dummy load, electrical (5985-99-999-1866). But in order to modify certain loads to the required values, a further network of resistors is incorporated within the interconnecting box (set). These resistors and their functions are summarized as follows:-

(1) Two 15 ohms ± 5%, 3 watt resistors (R4 and R5) are each placed across the 6.3V heater leads and earth.

(2) One 330 ohms ± 5%, 3 watt resistor (R2); across pole E of the 25-way socket SKT2 and earth.

(3) One 24 ohms ± 5% 3 watt resistor (R3); between pole O of the 25-way socket SKT2 and pole H of the 12-way socket SKT3.

Interconnecting box (head)

33. The interconnecting box (head) provides direct connections between the modules undergoing test and the interconnecting box (set). These connections are shown in the circuit diagram, fig. 8, at the end of the chapter.

Dummy load, electrical (5985-99-999-1866)

34. This item is the approved load unit for use in conjunction with the test set, electrical power (AC) (6625-99-999-7813) for third and fourth line testing of the power unit (AC) (5821-99-942-8546) and the rectifier unit (5821-99-942-8551) incorporated in TR4/ARC52 equipment.

35. The dummy load, electrical comprises an enclosed fabricated metal box mounted upon four insulated feet. A removable, expanded metal mesh panel at the top allows the ventilation required for cooling during operation. An inlet plug of standard Mk.4 type is let into one side of the box and is coupled by means of the connector (6150-99-999-4743) to the interconnecting box (set).

36. The resistors incorporated in the dummy load, electrical are of wire-wound type. The function of these resistors is two-fold; first, to provide the resistive loads for terminating the voltage outputs from the power unit (AC) and rectifier unit under test and, second, to simulate the various circuits in the complete transmitter-receiver Type TR4/ARC52.

37. These load resistors are collectively convection cooled, without mechanical means for dissipating the heat generated during use. Care must be taken, therefore, to ensure that at all times of use the dummy load, electrical is free standing and that no other equipment or obstruction is placed over the top panel to impede the essential free air circulation throughout the unit.

38. Access for replacement of components or for circuit testing of the resistor network and associated cableform is readily available upon removal of the enclosing cover. This is box shaped and retained in position upon the base plate by meas of screws which are removable from the underside of the unit.

39. Further information on the dummy load, electrical is given in Vol.1, Part 2, Chap. 2 and 7 of this Air Publication, to which reference should be made.

Servicing

40. It is essential that each piece of equipment is maintained in a clean, dry condition throughout its service life.

41. Periodically examine the interior of each unit and ensure that they are clean, free from dust and undamaged. Inspect for evidence of over-heating or short-circuits.

42. Examine the connectors before coupling up and replace any that are damaged or damp. Pay attention to the plugs and sockets to ensure that they are undamaged and a good fit with the mating sockets and plugs on each unit of the test equipment.

43. Standard techniques for servicing this class of equipment should enable any failure or malfunctioning to be readily traced and remedied. Reference to the circuit diagrams (fig. 7 and 8) should provide all the information necessary for normal servicing and fault tracing.

44. Information for servicing and the methods for using the associated multimeter, whether CT429 or CT54 equipment, may be found in the relevant Air Publications.

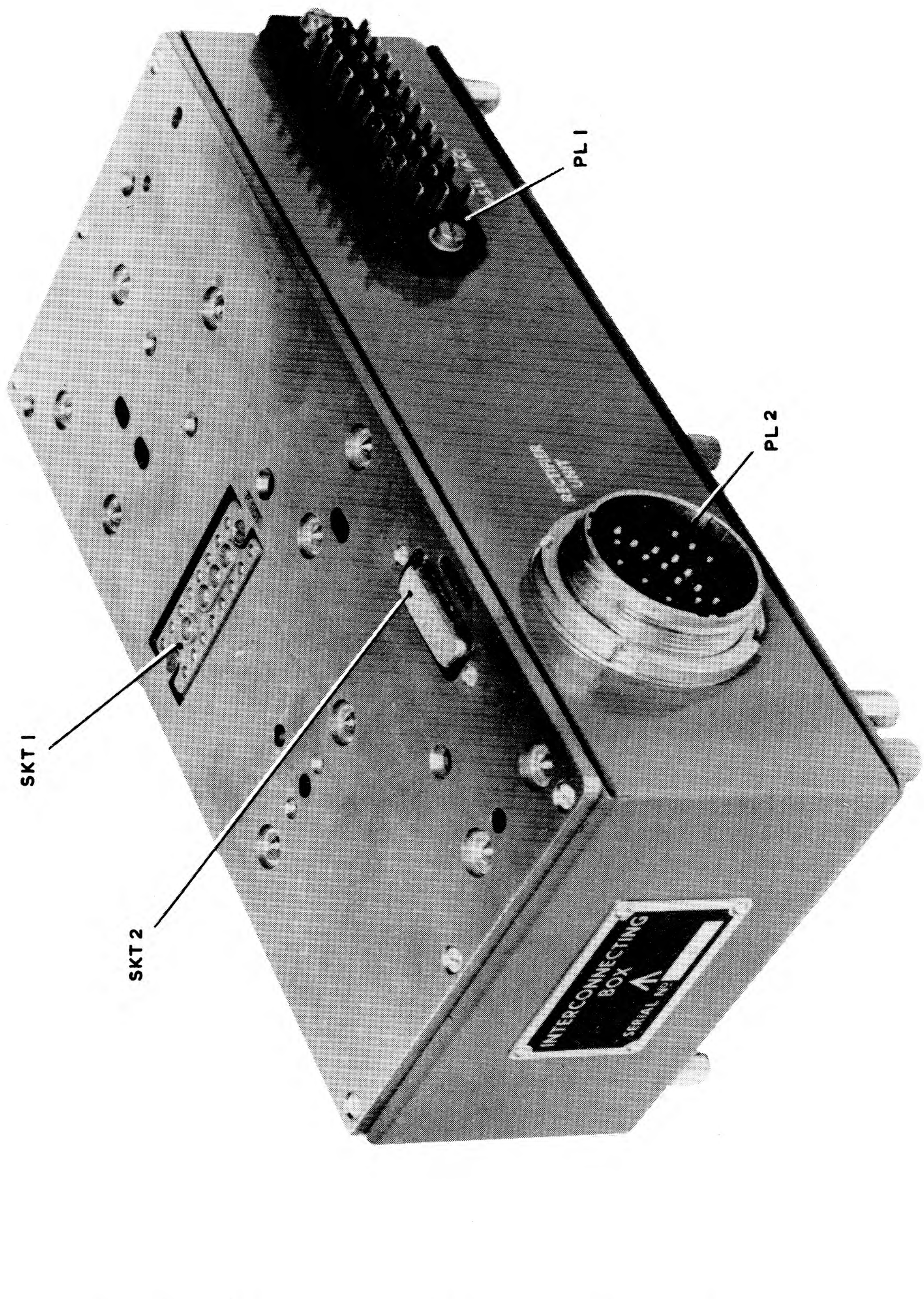


Fig. 1. Interconnecting box (head)

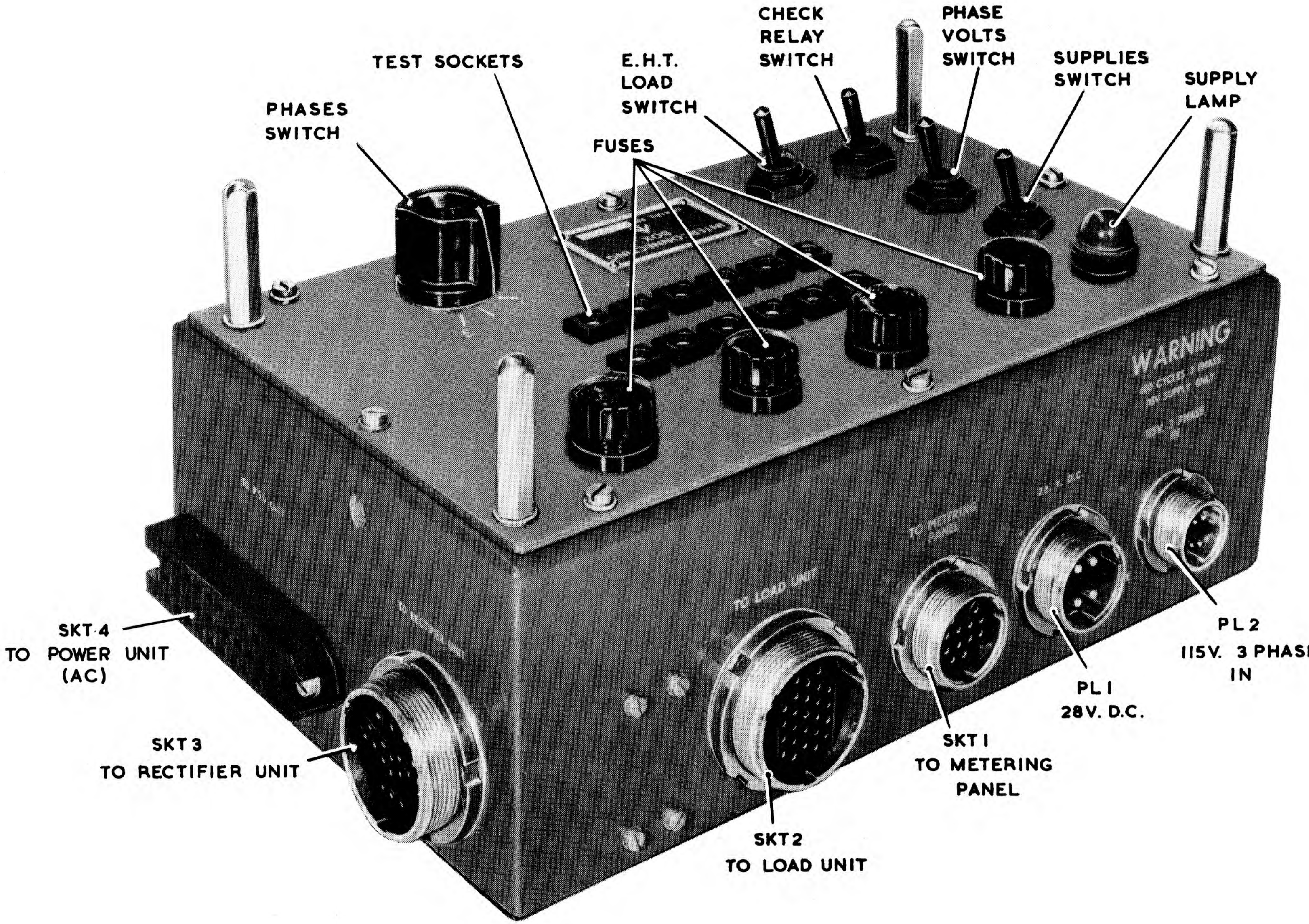


Fig. 2. Interconnecting box (set)

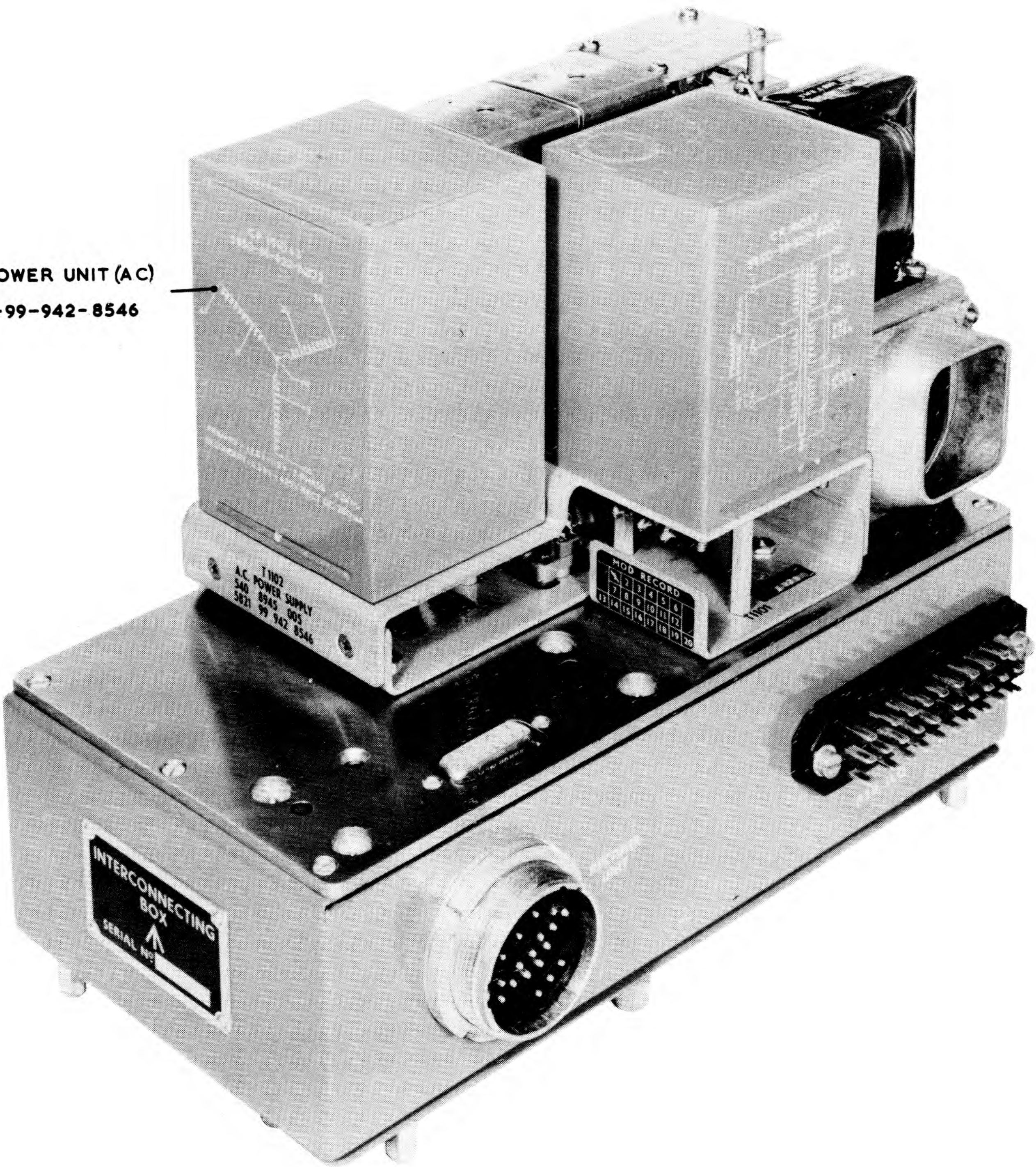


Fig. 3. Interconnecting box (head) with power unit (AC) in test position

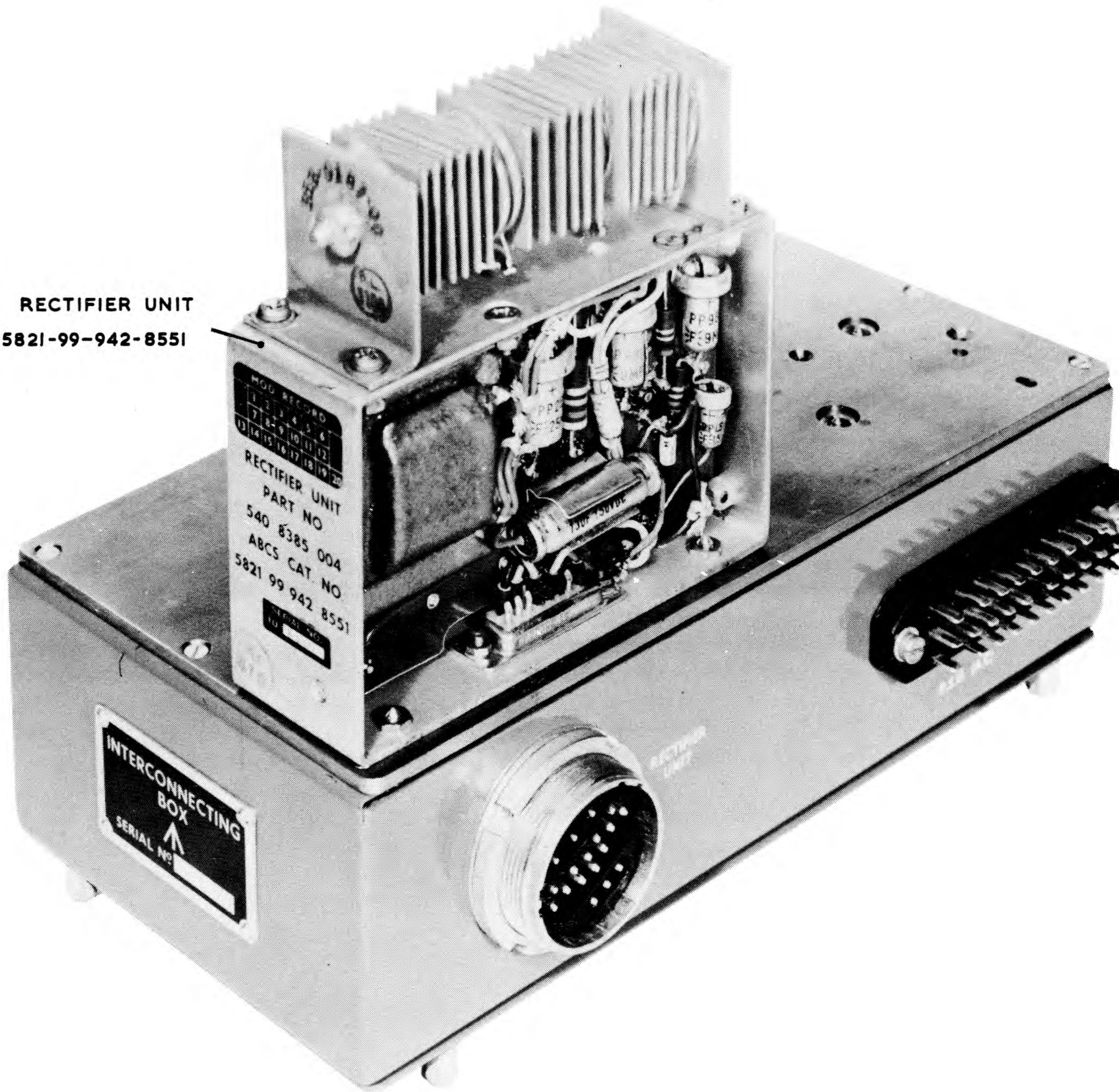


Fig. 4. Interconnecting box (head) with rectifier unit in test position

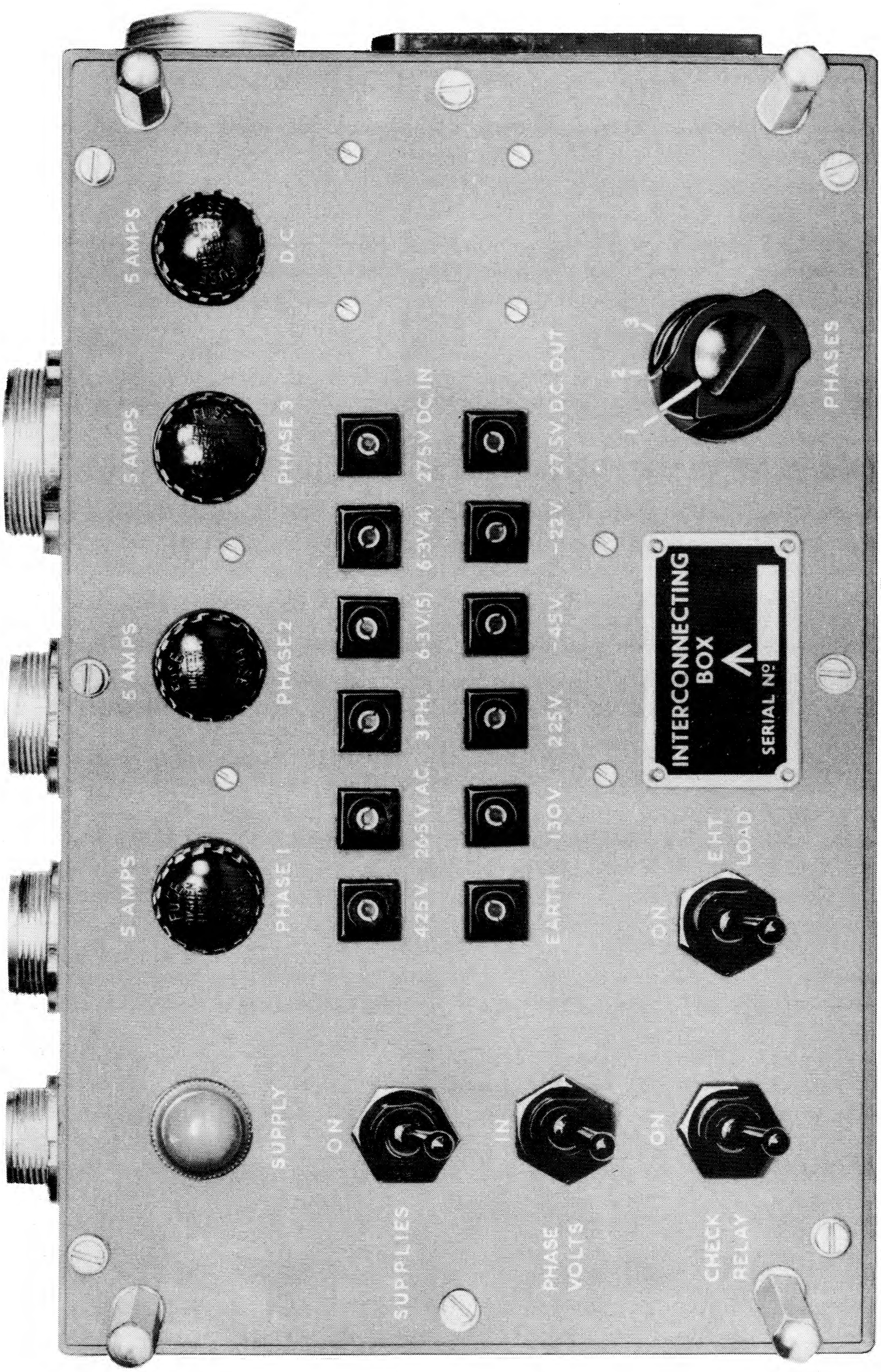
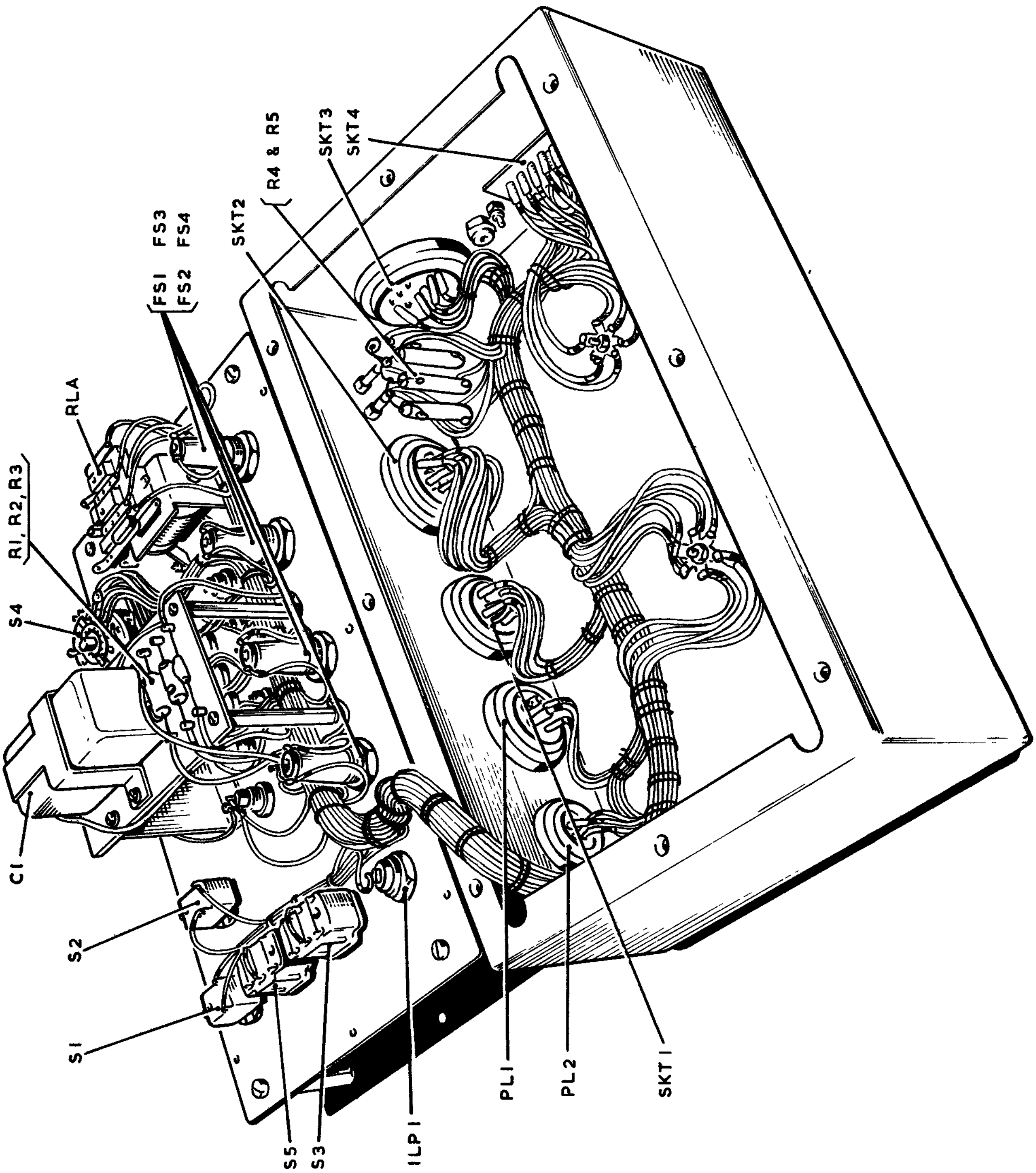


Fig. 5. Interconnecting box (set)–top panel layout



6. Interconnecting box (set) - component layout - interior

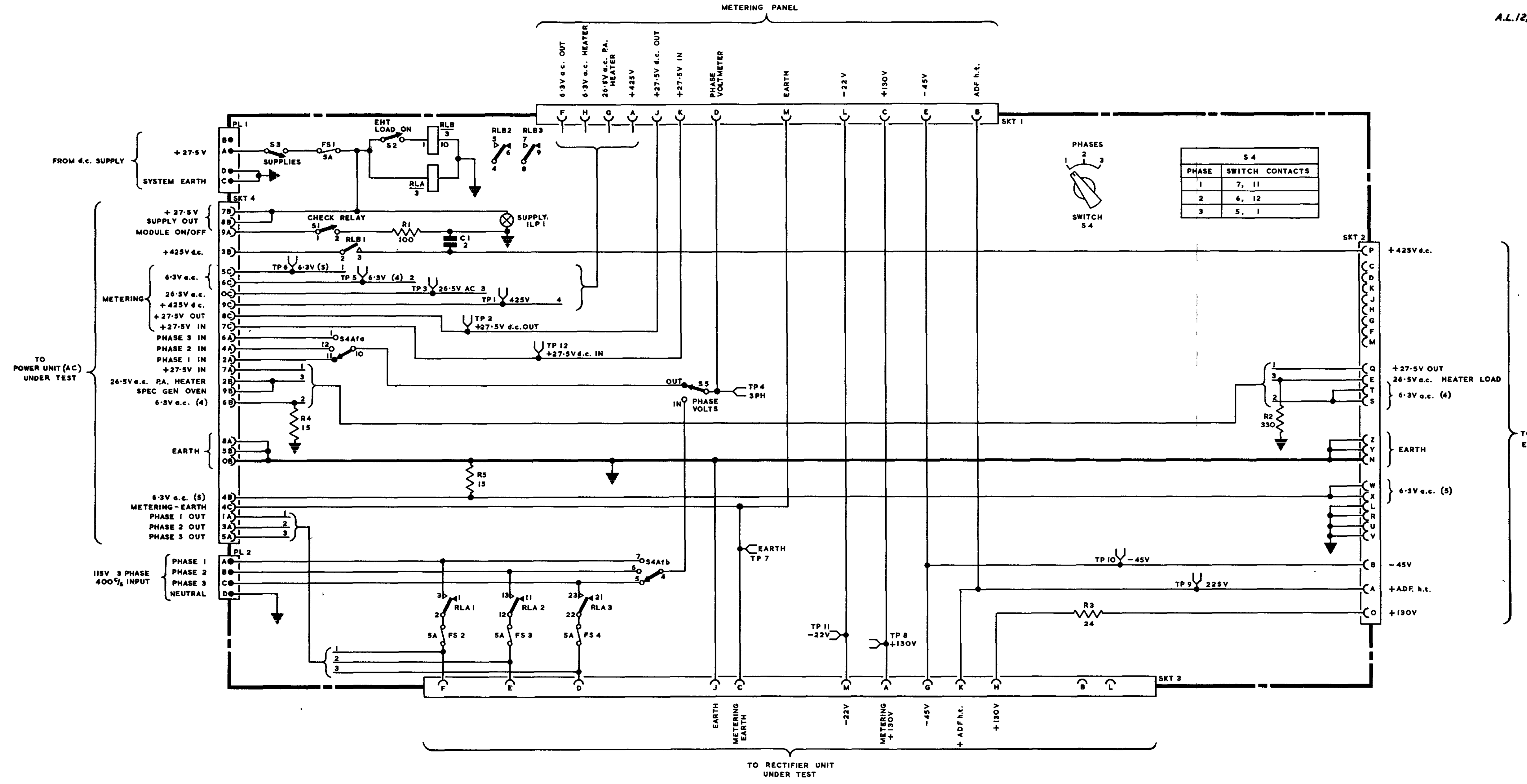


Fig. 7 Interconnecting box (set) (5821-99-913-3096) - circuit

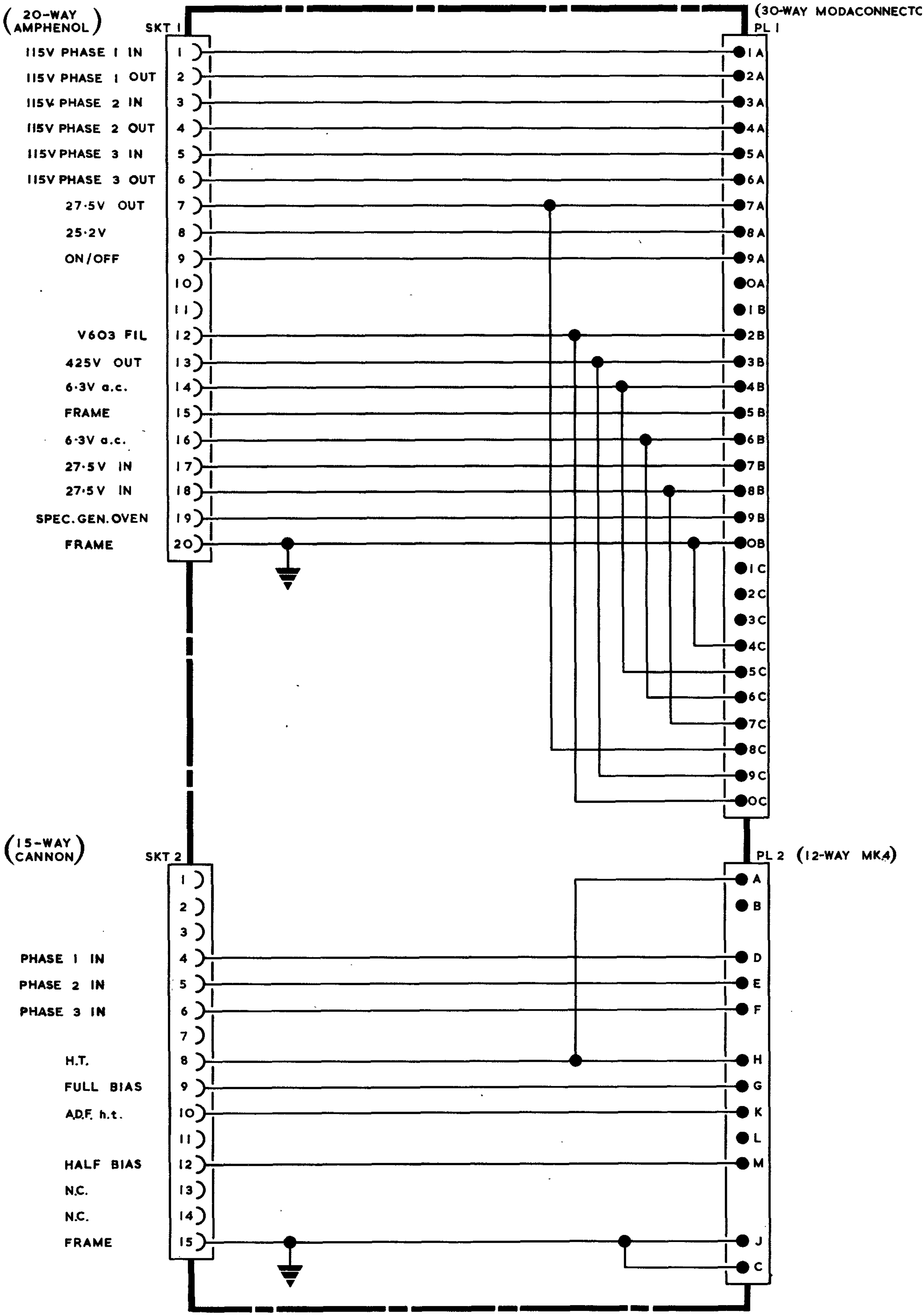


Fig.8 Interconnecting box (head) (5821-99-913-3097) - circuit

Chapter 5

TEST EQUIPMENT & TOOLS FOR TUNING UNIT (MECHANICAL)

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LIST OF ILLUSTRATIONS

LEADING PARTICULARS

Designation:	Test set, tuning unit.
	Comprising: test set, tuning unit, dummy load, electrical and two connectors.
A.B.C.S. Cat.No.:	6625-99-943-6906
Function:	To simulate circuit supply conditions and the operation of the control unit Type C1607/ARC52 (5821-99-942-8543) in testing and servicing of tuning unit (mechanical) (5821-99-942-8549).
Dimensions (approx.):	Test set, tuning unit, 10½in. x 7in. x 8in. Dummy load, electrical, 10⅝in. x 3½in. x 4in.
Weight (approx.):	Test set, tuning unit, 5 lb Dummy load, electrical, 3 lb Connectors, 1 lb

Introduction

1. The test equipment and tools required for third and fourth line testing and servicing of the tuning unit (mechanical) 5821-99-942-8549, which is a component part of TR4/ARC52 and TR5/ARC52 transmitter-receiver equipments, comprises essentially three main categories of equipment; viz. test equipment, electrical; test equipment, electro-mechanical and servicing tools.

2. Each of these categories of equipment is reviewed separately in this chapter and this review includes a general description and illustrations of the equipment, a brief summary of the methods of use and details of servicing recommended to maintain the equipment in full working order. In addition, for electrical test equipment, circuit descriptions and circuit diagrams are provided.

3. Full details of all tests which can be made using the test equipment and which are required to ensure the serviceability of the tuning unit (mechanical) are given in Part 2, Sect. 2, Chap. 15 of this Volume.

Test equipment, electrical

Test set, tuning unit

4. The equipment is listed as test set, tuning unit and is held in Service stores under A.B.C.S. Cat. No. 6625-99-943-6906. A general view of this equipment is given at fig. 1.

5. This test set has the basic function of simulating the circuit supply conditions and the operation of the control unit Type C1607/ARC52 5821-99-942-8543 incorporated in installations of TR4/ARC52 and TR5/ARC52 equipments. It provides the facilities for transferring all power requirements from the power supply (para. 10) to the tuning unit (mechanical) undergoing test and, also, for proving that the mechanical assembly and wiring of the channel selecting switches are correctly made. In addition, provision is made to enable immediate comparison of the selected frequency channel to be observed between the test set and the calibrated drums of the unit undergoing test.

6. A further feature of this equipment is the inclusion of a DISABLE lamp which is fitted to the control panel to indicate the cut-off point at which the disable circuit within the tuning unit is operative. This circuit disables the transmitter-receiver when the equipment is channelling.

7. For correct operation, this test set requires a 28V d.c. power supply nominally at 10A capacity and variable over the range 18V to 28V (para. 10 and 11).

8. This test equipment is supplied complete with flexible connectors and the requisite dummy load, electrical (Plessey Part No. CP.243719) which functions as an input bleeder box for improving the regulation of the power supply to the test set (para. 10).

9. The complete test set equipment is classified under the Inter-Services Specification K.114, as K.114/D ground equipment (protected) for use in permanent buildings. It is rated to function correctly in ambient temperatures of +55°C at the prevailing relative humidity and at an ambient of +40°C at a relative humidity of 95%. This equipment will operate correctly in ambient temperatures down to -26°C.

Power supply

10. A d.c. supply unit which will provide voltages over the range 16V to 28V, is available to Service users. This supply unit is designed to operate from the a.c. mains at 50c/s frequency and is held under the Service designation of power unit, a.c.(ground) 5821-99-943-1736 (Ref. No. 10K/9431736). Full details of the methods of use together with descriptive chapters will be found in the relevant Air Publication.

11. The required variation in d.c. output voltages necessary for complete testing is obtainable by use of an ancillary variable auto-transformer, e.g. transformer, 230V (Variac) Type 200/CMH (Ref. No. 5P/2491).

Connectors

12. Two flexible connectors, each two feet in length and terminated by Mk.4 plugs and sockets, are supplied with the equipment to provide the coupling between the d.c. power source and the test set. These are as follows:-

(1) Connector (Plessey Part No. CP.243718/1).

(2) Connector (Plessey Part No. CP. 243718/2).

13. Associated with the connectors and interposed in the d.c. supply to the test set is a bleeder box, or resistor network. This component is fitted with Mk. 4 plugs and sockets and is coupled in series between the two connectors with the function of supplementing the load unit used and preserving the stabilization of output voltage when testing with only a light load. It is designated dummy load, electrical (Plessey Part

No. CP.243719).

Associated equipment

14. For monitoring purposes, during torque and current tests, a multi-meter is required. Instruments meeting the requirements and which are normally available from Service stores are as follows:-

(1) Multimeter, Type 1 (Ref. No. 5QP/16411) - AVO 8.

(2) Multimeter, Type 9980 6625-99-943-1524 (Panclimatic).

(3) Multimeter, Type F (Ref. No. 10S/1) - AVO 7.

(4) Multimeter, Type D1 (Ref. No. 10S/10610).

15. A full description and details of the methods of using the ohmmeter selected from the list in para. 14 can be found in the relevant Air Publication, to which reference should always be made before attempting to operate any instrument which may be unfamiliar.

Description

16. The test set, tuning unit 6625-99-943-6906 is fabricated from light-alloy sheet into the shape of a shallow open topped box which is supported on four stainless steel feet. The top aperture is closed by a heavy gauge metal plate secured by eight countersunk screws which engage into anchor nuts riveted to the underside of a wide continuous flange formed around the lip of the box.

17. The top plate constitutes the control panel of the test set and, in conjunction with a vertical fabricated metal bracket, forms a mounting platform of the tuning unit undergoing test. A general view of the assembled, complete set is given at fig. 1.

18. A view of the control panel is given at fig. 2 from which the layout of switch positions and indicating lamps can be observed. Also evident is the facility afforded for fuse replacement from the front of the panel in the event of failure of the single fuse link.

19. The mounting bracket for the tuning unit on test is fitted with three screws, by means of which the tuning unit may be firmly clamped into the correct position throughout the electrical testing. These screws are made captive to avoid loss and are provided with large knurled heads to enable the requisite firmness of tightening to be made entirely with the fingers; i.e. without the necessity for spanners or pliers to achieve adequate security of attachment.

20. Through apertures in the top of the mounting bracket are fitted two sockets, 15-way 5935-99-940-2180. These sockets are connected by an internal cable loom to the switches and controls of the top (control) panel and form the mating sockets equivalent to those in the chassis assembly (main) for the 15-way plugs fitted into the base of each tuning unit (mechanical) in both the TR4/ARC52 and TR5/ARC52 transmitter-receiver equipments.

21. All switches, the lamps and the fuse carrier are secured to the underside of the top closure, or control panel (fig. 1). Switches are fixed by means of countersunk screws, fitted through from the top face and engaged by locknuts. For ease of access, should any servicing or inspection be required, the top plate may be removed complete with all operating components except the cableform. The circuit remains complete even when the box is thus opened. Frame connections are not made by any of the

eight screws which must be removed to permit the control panel to be lifted off for access to the internal components (fig. 3).

22. Four steel studs are fitted, one at each corner of the top plate, to provide mounting feet for the control panel when removed and inverted on the bench for access to control components. The studs also afford a measure of protection for the switch levers and lamps should another component be stacked on top of the test set or in case of inadvertent tumbling of the test set on the bench.

Wiring

23. The input supply from the d.c. bench source is brought in to the set by way of a single 4-way Mk.4 plug (Z.560535). Internal wiring between test set sockets and the control switches is cableformed into looms, laced at short intervals and secured in position by clamps fixed with countersunk screws and locknuts fitted through the base of the box.

24. The wiring carrying power from the input plug to the multipole test sockets is made in wire, electrical equipment Type 2, 23/.0076-in. pink 6145-99-910-0191. All other wiring is in wire, electrical equipment Type 2, 14/.0076-in. pink 6145-99-910-0185. Every wire is identifiable at each end by means of identification sleeves, Type B.

Fuse

25. The single fuse incorporated in the test set circuit is provided for the protection of the input supply line. It is of cartridge type 5920-99-011-9925, rated at 10-amp. The fuse link carrier is of the screwed-cap Type 5920-99-012-0231 and fitted through the panel to permit access for fuse replacement without the need to remove the top panel.

26. Should fuse replacement become necessary, first ensure that the correct type of spare is available. Then, before changing the fuse verify that the power source is correct, that the supply is controlled to the specified operating range (para. 10) and is coupled to the test set by means of the approved connectors (para. 12).

Circuit description

27. A circuit diagram is given at fig. 4 from which the related details of circuit operation can be followed.

28. The test unit is coupled to a variable d.c. power supply from the bench source (para. 10) by means of the connector and dummy load, electrical link, entering the test set by way of the single 4-way Mk.4 plug PL1 fitted into the rear wall of the metal box. Pole A is coupled to the positive pole of the supply and pole D is connected to the negative, poles C and D are wired to the test set chassis. Except for poles C and D of the 4-way power plug PL1, no other part of the circuit is connected to the frame.

29. With the SUPPLY switch (S2) operated to the ON position the d.c. input supply at 18V to 28V is fed past the anti-surge capacitor C1 and through the fuse link FS1. The positive potential of the power input supply is connected to pole 4 and pole 5 of the multipole plug P1202 of the equipment under test via poles 4 and 5 of socket SKT2 in the test set. The negative potential is coupled to poles 7 and 8 through socket SKT2.

30. Into the positive line, and immediately following the supply switch S2, is connected a red warning lamp ILP1 which will glow whenever the

test set is coupled with d.c. power over the range 18V to 28V and the SUPPLY switch is on; that is, with the test set supplied and ready for use.

31. The indexing circuit comprises four switches (S4, S5, S6 and S7) and the associated wiring. The switches are manually operated from the top panel, upon which are marked the appropriate position and facilities provided by each switch, as follows: HUNDREDS (S4), TENS (S5), UNITS (S6) and DEC. (for decimals) (S7). The complete set of switches simulate the functions of the MANUAL switches incorporated in the control unit Type C1607/ARC52. The switches S5, S6 and S7 are rotary switches, switch S4 is a two-position toggle switch operable between the two fixed positions marked 2 and 3 which correspond to the 200 Mc/s and 300 Mc/s bands.

32. The indexing switch circuits terminate in the two multipole sockets SKT1 and SKT2 which are fitted through the mounting bracket to receive the mating plugs of the tuning unit (mechanical) undergoing electrical tests. The switch terminals and their associated poles of sockets SKT1 and SKT2 can be traced from the circuit (fig. 4) and then compared with the wiring diagram for the tuning unit (mechanical) given in Part 2, Sect. 2, Chap. 15 of this Volume.

33. A disable lamp (ILP2) is connected between poles 4 and 6 of the multi-pole socket SKT2 and poles 4 and 6 of plug P1202 of the equipment under test. The lamp will light up (green) when the armature of any of three relays in the tuning unit (mechanical) on test is operated during any change of channel. This action will prove that the disabling earth of the unit under test is functioning correctly. This earth is used in the complete transmitter-receiver to revert all relays to the receive condition via K902, whenever the equipment is channelled. The disable lamp is rated at 28V, to draw a nominal 40 milliamps.

34. The sequence and method of procedure for all electrical testing is given in detail in Part 2, Sect. 2, Chap. 15 of this Volume.

Servicing

35. The equipment should be maintained in a clean, dry condition throughout its service life; and care must be taken to ensure that the instruments and controls are not damaged through mishandling.

36. Periodically remove the control panel and inspect the switches and wiring. Access can be gained by removing the eight countersunk head screws in the top panel and lifting the panel clear. Four stainless steel studs, which protrude one from each corner, permit the panel to be inverted on the bench without damage to the switch levers or lamps. The cable loom is formed with sufficient free length to allow the top panel to be moved clear without the necessity for uncoupling at any wiring terminal. Further, the circuit remains complete with the cover lifted off, no frame connections being made by any of the eight screws that are required to be removed.

37. The switches must be kept clean and dust-free, and there should be no evidence of arcing or burning of the contacts. Should cleaning become necessary, first attempt to remove dust or debris by means of a camel hair brush or by a jet of dry air. Dirty contacts may then be carefully wiped using a piece of clean, fluff-free cloth moistened with trichlorethylene.

38. Slight burning of the contacts can be treated by careful use of crocus paper (a very fine grade polishing medium). On no account use emery cloth or other grades of abrasive material for contact cleaning. When contacts are burnt to a degree where reclamation by the described method is unavailing, the faulty switch must be removed and replaced with a new item.

Investigation should be made into the causes for contact burning before the equipment is again brought into service.

39. From time to time it is advisable to make a continuity test of the cableform and associated circuit components. Individual wires are marked with wiring references which may be used to facilitate point-to-point tests. Whenever wiring is found faulty it should be replaced with wire, electrical equipment Type 2 of the appropriate diameter (para. 24). Care should be taken when resoldering any connections which are disturbed, to make the connection as neatly as possible and avoid tails of excess solder. Clean off any wire clippings or solder droppings before replacing the top panel of the test set.

40. By means of the control switches the test set provides key electrical connections between certain poles of the sockets SKT1 and SKT2 (fig. 4) for each channel selected. To enable continuity tests to be made of this system the interconnections are tabulated in Tables 1, 2 and 3. These tests should ensure that the wiring of the equipment conforms to the relevant production specification and that no inadvertent interconnections, including any with the frame, exist due to wiring errors, breaks or damage and to servicing faults such as excessive solder or wire clippings. A continuity tester (para. 14) should be available from Service stores for test purposes.

TABLE 1

Channel selecting circuits - hundreds and tens

Digits Selected		Poles connected to frame	Poles connected as a group (isolated from frame)	Poles individually isolated
		SKT1	SKT1	SKT1
Blank	Blank		1	2,3,4,5,6,7
Blank	0	2,3,	1,2	5,6,7
2	Blank	3	1,2	4,5,6,7
2	0	2,3	1,4	5,6,7
2	1	2,4	1,5	3,6,7
2	2	1,2,5		3,4,6,7
2	3	1,2,6		3,4,5,7
2	4	1,2,7		3,4,5,6
2	5	1,3	2,4	5,6,7
2	6	1,4	2,5	3,6,7
2	7	1,5	2,6	3,4,7
2	8	1,6	2,7	3,4,5
2	9	1,7	2,6	3,4,5
3	0	2,3	1,4	5,6,7
3	1	2,4	1,5	3,6,7
3	2	2,5	1,6	3,4,7
3	3	2,6	1,7	3,4,5
3	4	2,7	1,3	4,5,6
3	5	3	1,2,4	5,6,7
3	6	4	1,2,5	3,6,7
3	7	5	1,2,6	3,4,7
3	8	6	1,2,7	3,4,5
3	9	7	1,2,6	3,4,5

TABLE 2

Channel selecting circuits - units

Digit selected	Poles connected to frame	Poles connected as a group (isolated from frame)	Poles individually isolated
	SKT1	SKT1	SKT1
Blank		8	9,10,11,12,13
0	8,9		10,11,12,13
1	8,10		9,11,12,13
2	8,11		9,10,12,13
3	8,12		9,10,11,13
4	8,13		9,10,11,12
5	9	8,10	11,12,13
6	10	8,11	9,12,13
7	11	8,12	9,10,13
8	12	8,13	9,10,11
9	13	8,12	9,10,11

TABLE 3

Channel selecting circuits - decimals

Digit selected	Poles connected to frame	Poles connected as a group (isolated from frame)	Poles individually isolated
Blank		SKT2 9	SKT1 14,15 SKT2 1,2,3
.0	SKT2 1,9		SKT1 14,15 SKT2 2,3
.1	SKT2 2,9		SKT1 14,15 SKT2 1,3
.2	SKT2 3,9		SKT1 14,15 SKT2 1,2
.3	SKT1 14 SKT2 9		SKT1 15 SKT2 1,2,3
.4	SKT1 15 SKT2 9		SKT1 14 SKT2 1,2,3
.5	SKT2 1	SKT2 2,9	SKT1 14,15 SKT2 3
.6	SKT2 2	SKT2 3,9 SKT1 14	SKT1 14,15 SKT2 1
.7	SKT2 3	SKT2 9 SKT1 15	SKT1 15 SKT2 1,2
.8	SKT1 14	SKT2 9 SKT1 14	SKT2 1,2,3
.9	SKT1 15	SKT2 9	SKT2 1,2,3

41. An examination should be made during the circuit tests described to ensure that poles 7 and 8 of the socket SKT2 and poles C and D of the plug PL1 are permanently connected to the frame of the test set. In addition, verify that poles 10, 11, 12, 13, 14 and 15 of the socket SKT2 and pole B of the plug PL1 are permanently open circuit.

42. Connectors should be carefully examined each time before use. They should be undamaged and dry, with particular care taken to ensure that the plug and socket terminations are undamaged and make good, firm contact with the mating terminations at the power source, the dummy load, electrical and the test set.

Test equipment, electro-mechanical

General

43. Two functioning tests are required in third and fourth line servicing of the tuning unit (mechanical) which involve electro-mechanical test equipment. Full details of the test requirements are given in Part 2, Sect.2, Chap. 15 of this Volume, but they may be summarized thus:

(1) Correct operation of the relays and motor on both normal and reduced voltages.

(2) The torque settings of the clutch drums on tens, units and decimals operating shafts.

Torque test fixture

44. The equipment devised for rapid assessment of the conditions outlined at (1) and (2) of para. 43 is supplied under Ref. No. 10AG/938 and designated torque test fixture, tuning unit (mechanical).

45. General views of this torque test fixture, showing the front and rear layout of controls and components are given at fig. 5 and 6.

Description

46. The fixture comprises, basically, a vertical plate to which is mounted the tuning unit on test and two flanking pillars carrying torque test gauges; the whole being mounted on a rigid heavy gauge metal base plate.

47. The unit mounting plate is fitted with two screws by which the tuning unit under test is secured to the back of the fixture. Each of the screws has a tommy-bar head to enable the tuning unit to be fastened securely by finger pressure alone. The threaded portion of the screws engage into screw holes in the base of the tuning unit which are normally used to retain the unit in position upon the chassis assembly (main) when incorporated into TR4/ARC52 and TR5/ARC52 equipments. Clearance holes are provided in the back of the mounting plate to receive the locating dowels which are also fitted to the base of each tuning unit (mechanical).

48. Protruding through the front of the vertical plate are three rods which carry pivot arms to engage with the actuating levers of the three torque gauges. These fulcrum rods pass through the mounting plate and terminate at the rear in Oldham coupler plates which are so positioned as to engage with the tens, units and decimals couplers of the tuning unit under test.

49. To enable the couplers to be correctly and easily engaged there is a distance plate fitted to the front face of the mounting plate. The distance plate is pivoted at the lower end and may be locked by a third tommy-bar screw positioned just above and to the right of the large-headed pivot screw. When the locking screw is released, the distance plate is permitted to fall to the right and thus enable the fulcrum rods and their coupler plates to be manipulated into correct engagement with the couplers on the tuning unit under test before the final tightening of the unit clamping screws. The appearance and positions of the screws are shown clearly in fig. 5.

50. When the couplers are correctly engaged, the distance plate may then be returned to the vertical position where it will serve as a distance piece between each of the pivot arms and the front of the mounting plate. The plate should be secured in this position, by means of the locking screw, before proceeding with testing.

51. To one side of the central unit mounting plate (the left-hand side when viewed from the front, as in fig. 5) is fitted a rectangular mounting plate on which is carried a terminal block connected electrically with the supply circuit of the fixture. This terminal block is fitted with five plunger-type contacts which engage with the appropriate test terminals on the tag-board T1202 on the tuning unit undergoing test. The terminal block is mounted on spring-loaded screwed rods which ensure a constant pressure throughout the tests, yet enable the block to be pressed back out of the way when fitting and securing the tuning unit into the testing position. A quick release lever holds the terminal block back from engagement during the fitting procedure.

52. The mounting plate carries, also, an ammeter. This is mounted above the unit on test and is wired to the terminal block to enable current tests to be made during operation of the tuning unit (Part 2, Sect. 2, Chap. 15 of this Volume).

53. Two mounting pillars flank the unit mounting plate; that on the left (when viewed from the front) carries a single Correx dial gauge which engages the operating lever for the tens shaft and clutch, whilst the pillar on the right carries two Correx gauges. The upper of these two gauges is operated during the tests by the torque from the decimals shaft and clutch, and the lower gauge by the units shaft and clutch.

54. The dials of each gauge for some sets of test equipment are masked to show only the graduated working range within which the indicating needle should operate; on other sets of test equipment which may be supplied, the gauges are provided with a setting hand which may be set manually to the nominal torque for purposes of comparison during the testing.

55. The lengths of the pivot arms are carefully set at the factory, before despatch, to ensure that when the dial lever arm is bearing correctly on the cam-formed tip of the pivot arm the correct dial indication will be made; this includes the calculated factor of compensation for the increase or decrease of the effective length of the operating arm from the nominal position when the torque is being measured. Similarly, the gauges are carefully set before issue to give an accurate indication over the torque range specified; and although provision is made for adjustment of the angular disposition of each gauge, it is advisable to return the test equipment complete to the factory for overhaul in the event of damage necessitating the replacement of either a gauge or operating arm.

56. The position and operating components for each dial torque indicator are shown in fig. 5. The single gauge (A) is operable from the torque reaction on the tens shaft and clutch and is graduated in grammes over the range of 4-7 lb in. representing the specified torque range of 1032 gm. to 1810 gm. The gauges (B and C) for testing the decimals shaft and clutch and the units shaft and clutch, respectively, are both also graduated to give a direct torque reading in grammes over the range 600 gm. to 1360 gm., representing the specified torque range of 2-$4\frac{1}{2}$ lb in.

57. The mounting base plate of this fixture is milled out on the underside to accommodate the electrical wiring carrying the d.c. supply for operation of the tuning unit (mechanical) undergoing tests. A schematic wiring diagram for the fixture is shown at fig. 7.

58. To the front and left of the base plate is mounted the push-button stop and start switch controlling the d.c. supply from an approved bench source into the fixture. The two buttons (fig. 5) are coloured, one green (start) and the other red (stop), and both protrude through a metal cover enclosing the switch contacts and supply terminals. Access to either the contacts or the terminals can be gained by removing the single Allen screw which retains the cover in position.

59. At the rear of the fixture and also mounted on the base plate is a series 596 relay incorporating three sets of contacts, one for each of the three clutch and operating shafts in the tuning unit (mechanical) undergoing tests, and a thermal switch. This switch disconnects the supply after approximately 20 seconds to prevent overheating of the motor; one minute must elapse after the switch has tripped before the motor can be switched on again. Both the relay unit and the delay switch are enclosed within a metal box cover secured by two cheese head screws which engage into tapped holes in the base plate.

Servicing

60. The test fixture is carefully set up and accurately graduated before issue into service. It is of robust construction generally, so that with reasonable care no adjustment or compensation should be necessary. Care must be taken with the dial gauge operating levers, however, to guard against damage and knocks which may distort the levers and give rise to false torque measurements or unsatisfactory tests. Whenever the fixture is to be moved in transit it should be encased in a stout wooden box and carefully packed to prevent damage.

61. Should the accuracy of the dial gauges be suspected they may be replaced with standard Correx instruments, but since the setting up procedure is necessarily extremely precise it is advised that the complete equipment be returned to the manufacturer for overhaul.

62. Failure of the tuning unit under test to operate with the initial application of 16V d.c. is in most instances due to a faulty contact between the terminal block plungers and the tagboard test points. A test may be carried out by bridging the two points by means of the tip of an insulated screwdriver. If now the unit will operate, the terminal block should be examined and cleaned before proceeding with the test.

63. A schematic wiring diagram is given at fig. 7 and a circuit diagram is shown at fig. 8. Study of both diagrams should provide all the information necessary to fulfill any servicing or fault tracing required in the elctrical circuit of the test fixture.

Servicing and rebuilding tools

General

64. Under this collective heading are grouped all the fixtures, jigs and gauges required during servicing or rebuilding of the tuning unit (mechanical) at third or fourth lines of servicing. Each piece of equipment is based on tools or gauges devised and produced for the assembly and inspection of the parent equipment at the factory. Every item is inspected and set up before leaving the manufacturer and is ready for use upon issue.

Assembly fixture

65. When rebuilding a tuning unit (mechanical) or replacing the shafts and clutch drums it is essential to ensure that the drums are securely tightened to the shafts before these are fitted into the unit.

For this purpose there is available an assembly fixture, (Ref. No. 10AG/951), which comprises a platform for securely holding the top plate of the tuning unit (mechanical) during the tightening of the nut of each assembled shaft and clutch drum with the associated torque spanner. Full details of clutch assembly are given in Part 2, Sect. 2, Chap. 15 of this Volume.

66. A general view of this equipment is given at fig. 9 showing the heavy metal base plate, the two Brauer clamps which securely retain the tuning unit plate in position, and the two drum clamps for holding the clutch drums during the tightening of the nut. Brass mandrels are provided to slide down into the drums to prevent them from crushing when clamped. Hardened steel platforms are fitted to the base plate to engage with the detent wheel on each shaft and prevent rotation during the tightening of the nuts. The detent wheels of the 10 Mc/s, 1 Mc/s and 0.1 Mc/s shafts are notched wheels which serve as positioning stops for the drives to the tuned modules. The number of notches varies with each wheel, making identification during servicing a simple matter; the wheel for the 10 Mc/s shaft has eighteen detents or notches, the 1 Mc/s shaft has twenty-four and the 0.1 Mc/s shaft has ten.

67. With the tuning unit plate and assembled shafts and drums clamped in position, a trefoil top plate is fitted over three spigots screwed into the base plate of the fixture. The top plate is thus held at a distance of $2\frac{1}{2}$ in. from the base plate and, by means of appropriately drilled holes, provides a steadying template for use when applying the torque spanner. It is possible to tighten the nuts without using the trefoil plate in position, but this plate is intended to provide, in addition, a measure of protection to prevent damage to the precision finished components should the torque spanner slip or be clumsily applied.

68. The torque spanner used in conjunction with the assembly fixture is accurately made to fit the clutch drum securing nuts and to pass over the operating shafts. It is produced as a high-class box or tube spanner, supplied as a piece of test equipment and, therefore, should be used only for the job intended. The top end of the spanner is machined to fit a standard Acratork wrench type A (Ref. No. 10AG/950) which must be accurately set to a torque loading equivalent of 75 lb in. It is recommended that frequent tests are made to verify that the torque setting remains unaltered.

69. Torque wrenches may be set by means of the torque testing tool (Ref. No. 10AG/946) supplied with the assembly fixture (fig. 10). This set comprises a thirteen inch steel bar with provision at one end for snapping on to the square stud on the Acratork wrench and at the other for suspending a $7\frac{1}{2}$ lb weight. Adjustment can be made to the spring loading of the wrench by rotating the knurled handle clockwise to increase the loading, or anticlockwise to relieve it. With the wrench held firmly in the hand, adjustments of the knurled handle should be made until the break action of the wrench just takes place.

Torque test and running in fixture

70. This equipment provides a method of verifying the correct assembly of the clutches and shafts and is listed under Ref. No. 10AG/948. Associated with this fixture is a clutch spring assembly tool (Ref. No. 10AG/949), shown in fig. 12.

71. The fixture comprises a base plate with a vertical mounting plate upon which is clamped the assembled relay plate with shafts and clutches. The clamping plate is fitted with clamping hand nuts which bring stops into engagement with the detent wheel on each shaft to prevent them from rotating during the test. A general view of this fixture is given at fig.11.

72. The fixture is motorized by means of a 1/10 h.p. B.T.H. electric motor working off an a.c. mains supply at 230V. This motor imparts a drive, through a gear train integral with the mounting plate, to the clutch drums at a speed to simulate operation of a complete, serviceable tuning unit (mechanical).

73. The first test is made by clamping the assembled unit base plate securely into position and operating the switch to run the motor. By means of the drive through the fixture gear train, each clutch drum is revolved to bed-in the clutches. The running-in period for new clutches is three minutes.

74. The second function of this fixture is to enable accurate measurements to be taken of the torque reaction at each shaft when motored. For this the clamping plate formerly used during the running in period is removed and substituted with a torque gauge plate. This gauge plate is provided with stop posts appropriately placed in relation to three holes through which can be passed the operating shaft of a dial torque indicator. The operating shaft is terminated in a fitting to engage with the detent wheels and thus register the torque reaction on the dial indicator for each of the three shafts in turn, i.e. tens, units and decimals shafts. The torque readings for each of these clutches is read in grammes directly on the dial indicator as follows:-

(1) Tens clutch - 726 to 834 grammes (4-7 lb in.)

(2) Units clutch - 437 to 543 grammes (2 - 4.5 lb in.)

(3) Decimals clutch - 437 to 543 grammes (2 - 4.5 lb in.)

Servicing

75. The 1/10 h.p. driving motor should normally provide efficient service for an extended life, but in case of failure it may be removed for servicing or replacement. Two cap-head Allen screws secure the motor to the base plate; both are accessible from the underside of the plate.

76. The drive gearing is straight cut and each wheel is readily accessible for cleaning or replacement, if required. The gears are unbushed, running on stub axles which are riveted into the vertical mounting plate. It is recommended that periodic attention is paid to lubrication; the axles should each be given two drops of light machine oil each week and the gear teeth cleaned regularly and lubricated with a thin smear of a light-bodied grease. Avoid over lubrication, however, particularly at the gear teeth.

Clutch spring assembly tool

77. The clutch spring assembly tool (fig. 12) is used to compress the "C" springs so that they can be fitted and removed from the clutch lining. The silver steel pegs of the tool are each machined with a $\frac{1}{8}$ in. diameter stem which fits into a drilled hole, to provide a push fit, on each short arm of the tool; the stem is peened over after assembly to secure the peg. The pegs are hardened and tempered for long life, but care must be taken to avoid knocking the thin lands on the pegs or they may become bent or broken off.

Cam setting plate and cam setting gauge

78. Both of these tools are provided, each having slight differences in pin diameters appropriate to the use in assembly or for testing.

The cam setting plate (Ref. No. 10AG/962) is used in assembly for the setting of the differential cam to the correct radial position before tightening the two grub screws by which it is locked to the shaft. The cam setting gauge (Ref. No. 10AG/953) is employed to verify the setting of the cam during subsequent inspection after assembly of the tuning unit. The pin of the cam setting gauge is made of smaller diameter to permit a tolerance of ± 3 deg. from the reference position specified for the differential cam (fig. 13).

Note...

Both the cam setting plate and cam setting gauge are issued for use on tuning units fitted with a nominal size roller only. This roller is .184/.190 in. diameter, but other rollers may have been fitted during initial assembly of the tuning units in service. Since spare rollers covering the complete range of tolerances are supplied, however, it should be a simple matter to measure the rollers using a micrometer and to substitute the nominal sized roller before using the plate or gauge. Be sure to refit the original roller before proceeding with other tests on this unit or before returning it to service.

79. Full details of the methods of using both the cam setting plate and cam setting gauge are given in Part 2, Sect. 2, Chap. 15 of this Volume. The cam setting gauge is shown in use at fig. 14 of this chapter, the cam setting plate is identical except for the gauge pin diameter, thus:

(1) Cam setting gauge - pin diameter .094 in.

(2) Cam setting plate - pin diameter .123 in.

Drill and ream jig and height gauge

80. The drill and ream jig is a box-like enclosure, robustly made in metal plate, to retain the tuning unit precisely in position to permit the accurate drilling of the shaft and plate portion of the Oldham coupler when replacement is required. Provision is made to take up all backlash in the gear train before drilling is commenced. The complete jig is listed under Ref. No. 10AG/952.

81. The base plate forms the mounting platform which is profiled to receive the couplers, electrical plugs and locating dowels of the tuning unit receiving attention. In addition, hand screws are provided to clamp the tuning unit firmly into position. Into the edge of the base plate are fitted slip type bushes made of hardened steel which guide the drill (fig. 15).

82. To one side is fitted the adjustable pawl for engaging the differential gear and for biasing the gear train of the tuning unit on test to eliminate backlash before drilling of the shaft and coupler plate takes place.

83. Two thin metal spacer plates are supplied with the drill and ream jig. These are profiled to fit snugly beneath the coupler plates to be drilled in order to provide the correct clearance between the underside of the coupler plates and the top surface of the unit base plate. When not in use, these spacers are fixed by a single Allen screw to the side of the drill and ream jig immediately above the backlash pawl, as shown in fig. 13.

84. An additional item of equipment associated with the drilling of coupler plates and shafts is the height gauge (Ref. No. 10AG/955). This small steel component (fig. 14) is a simple GO/NO GO gauge which is used to verify the correct clearance between the inner face of the coupler plate and the unit base plate, after the drilling and pinning of the coupler plate to the shaft. The height of the coupler plate should be between 0.070 in. and 0.080 in. above the unit base plate; and one step of the gauge is recessed by 0.070 in. the other step by 0.080 in. On sliding the height gauge across

the base plate, the height of the coupler plate can be assessed within the prescribed limits if the 0.080 in. step will pass over the coupler plate but the 0.070 in. step will not.

85. By careful use of the drill and ream jig and the metal spacer plates, accuracy of drilling should naturally follow. But because of possible discrepancies in the bore of the coupler plate or in the diameter of the appropriate shaft some small error may bring about a larger or smaller clearance between the coupler plate and the relay plate. It is important, therefore, to apply the height gauge at several points around the circumference of the coupler plate after drilling and pinning. Rarely, if ever, should there be any tilting of the coupler plate on the appropriate shaft. When this does occur it will most probably be a consequence of damaged or distorted spacer plates coupled with insecure fitting of the tuning unit into the drill and ream jig.

86. The positioning accuracy of the tuning steps is determined by the mechanical accuracy of the detent wheels and pawls. During assembly at the factory, the couplers are pinned to an accuracy of $\pm$ 6 minutes of arc (equivalent to a rise or fall of 0.00175 in. across the diameter of the coupler), and although slight adjustments can be made to the radial movement of the shaft by means of the eccentric bearing of the pawls, it is important to take great care during any subsequent replacement of components in order to reproduce the same degree of accuracy.

Servicing the drill and ream jig

87. All operating portions of the drill and ream jig are made of hardened steel to ensure long life without wear. But the hand screws, which are in mild steel with 2 B.A. threads, may become slack after use. For replacement parts, if these are not available from stores, the original screw may be used as a pattern provided that the lengths and any undercutting are faithfully copied.

88. The brass catch for engagement of the differential gearing should be treated carefully at all times. If the sharpness of the point becomes bruised or bent it must be repaired at once using a fine file. Take care not to remove too much metal during repair or difficulty may be met when attempting to engage the differential gear.

89. The two spacer plates should be fixed to the side of the jig, using the Allen screw provided, whenever they are not in use. The plates should always be carefully handled and not left upon the bench where they may become distorted or bent through damage. The plates are made from gauge plate, hardened and tempered, then ground to a thickness of 0.034 in.

Checking fixture

90. This equipment (fig. 16) is physically similar to the drill and ream jig (Ref. No. 10AG/952) (para. 80) but with the function of enabling the alignment of the fitted Oldham coupler plates to be verified. It is supplied under Ref. No. 10AG/954 and is used in conjunction with a dial test indicator and standard height gauge upon a surface plate or surface table.

Motor servicing tools

91. Where extensive servicing of the motor or replacement of component parts is required, the motor unit should be removed from the tuning unit (mechanical). Some maintenance can be carried out without removal, however, and this should prove sufficient to enable the rectification of most faults arising from normal service.

92. When removal of the motor is required for extensive servicing, reference should be made to Part 2, Sect. 2, Chap. 15 of this Volume for details of all essential information, including a table of motor bearing fits and clearances, which are required for dismantling and reassembly.

93. The equipment supplied for motor servicing comprises, principally, a set of bearing fitting and removal tools (Plessey No. T.336939)(fig.17) but includes a set of tools (Plessey No. T.336948) for the removal and fitting of the pinion gear taper pin. A brush gear aligning bar is also required, but this can be devised locally from a 2-in. length of silver steel bar of 0.1250 in. diameter. The tools for the taper pin and the aligning bar are illustrated in Sect. 2 Chap. 15.

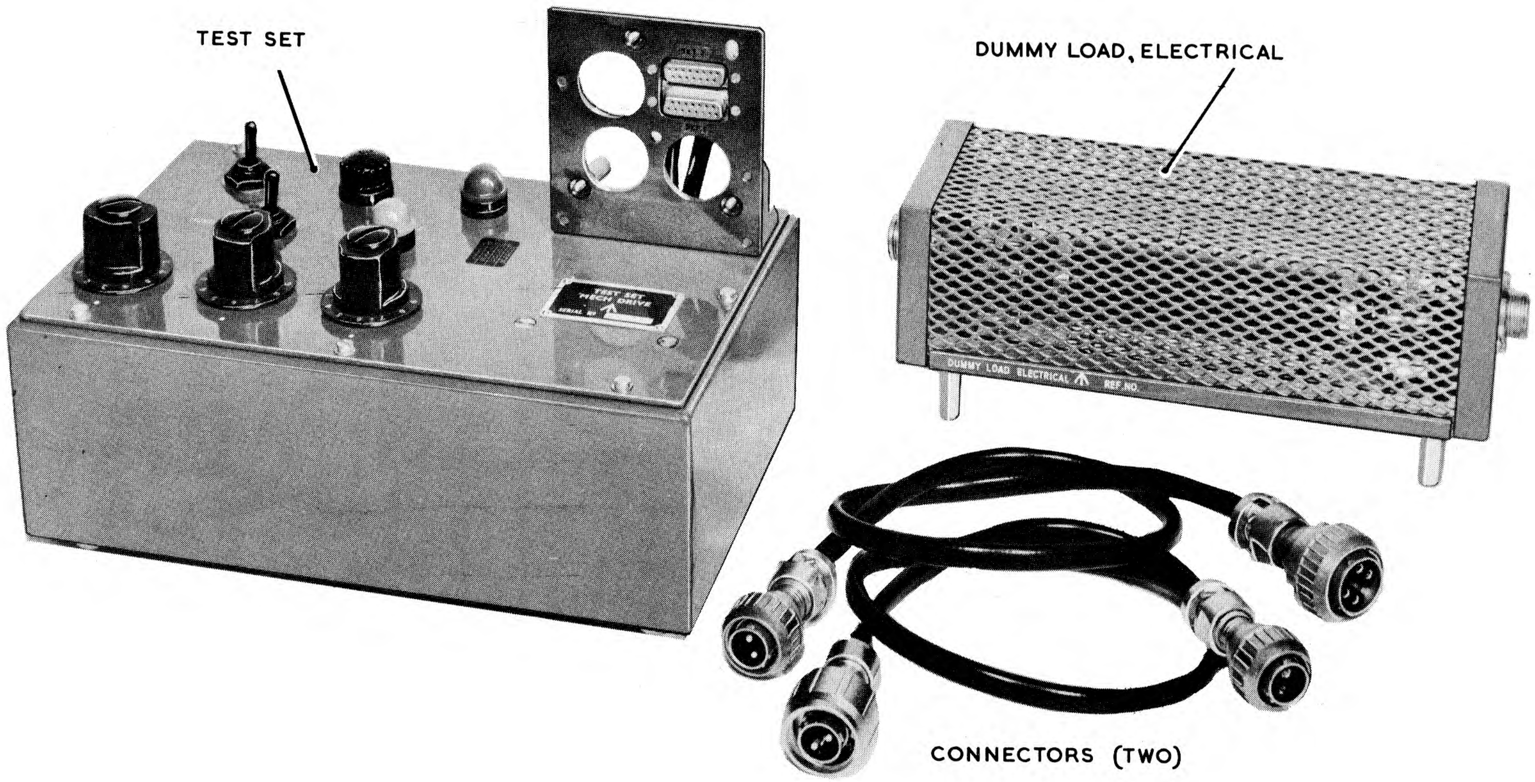

Fig.1. Test set, tuning unit 6625-99-943-6906

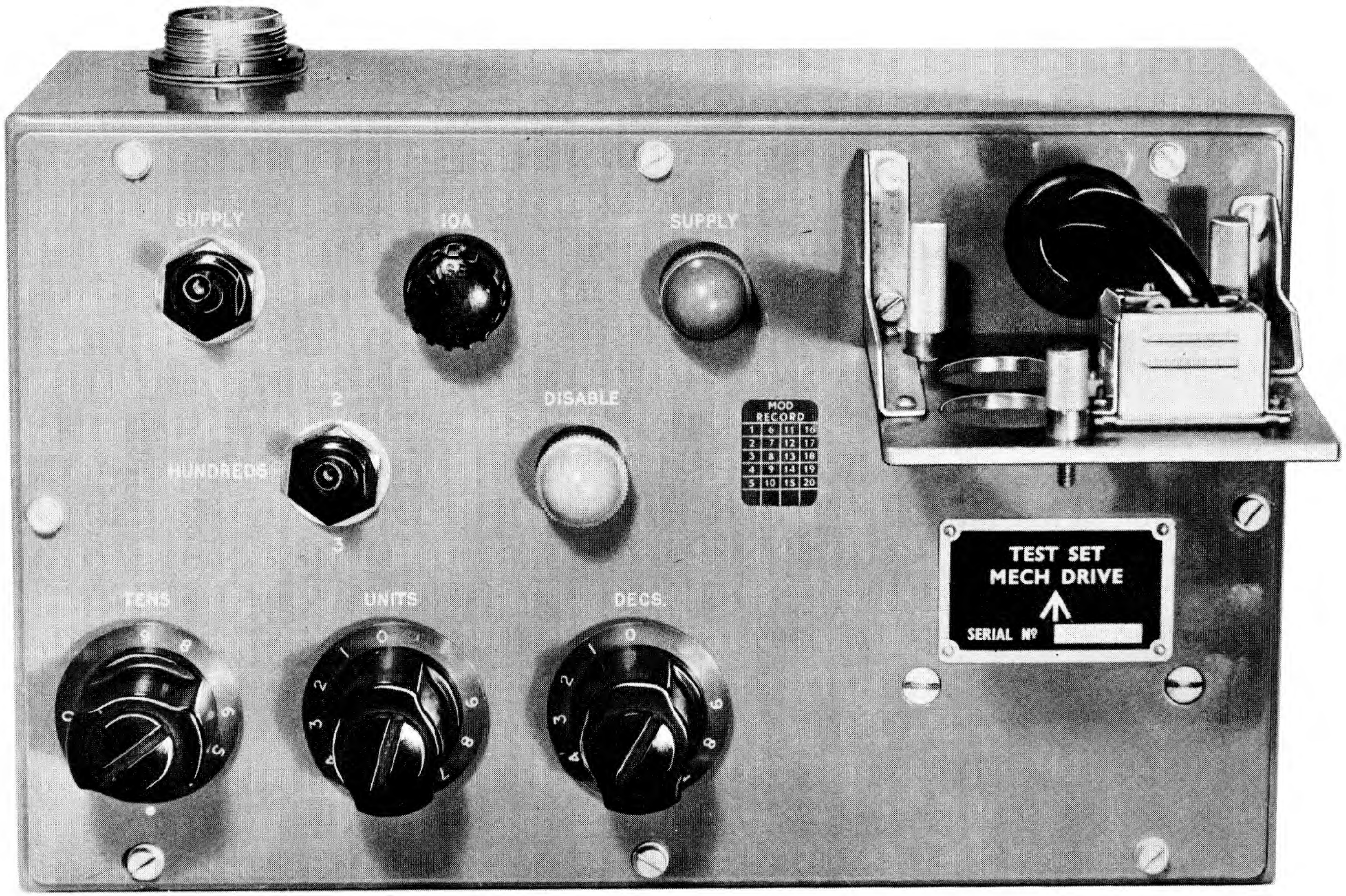

Fig. 2. Test set, tuning unit : top panel layout

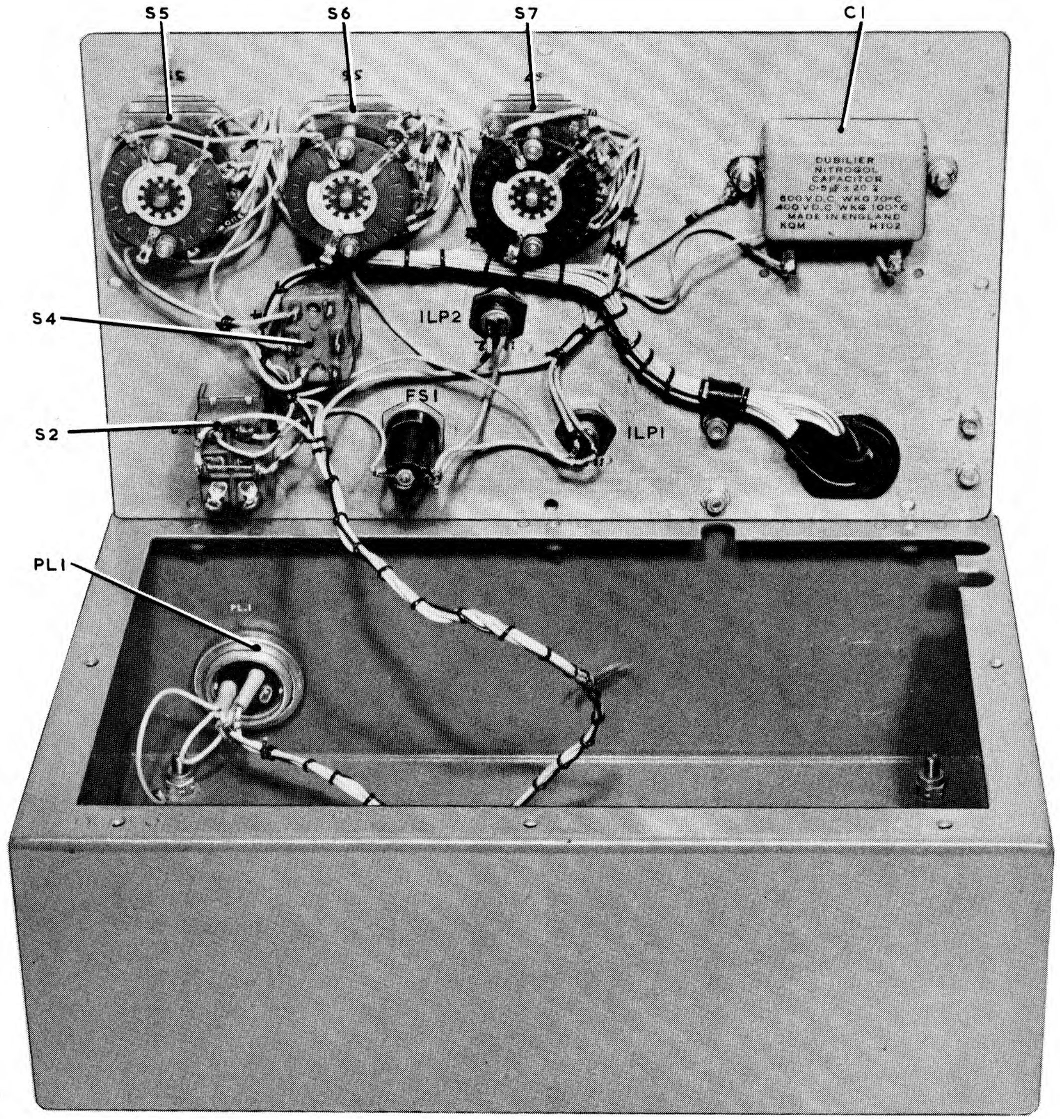

Fig. 3. Test set, tuning unit : component layout

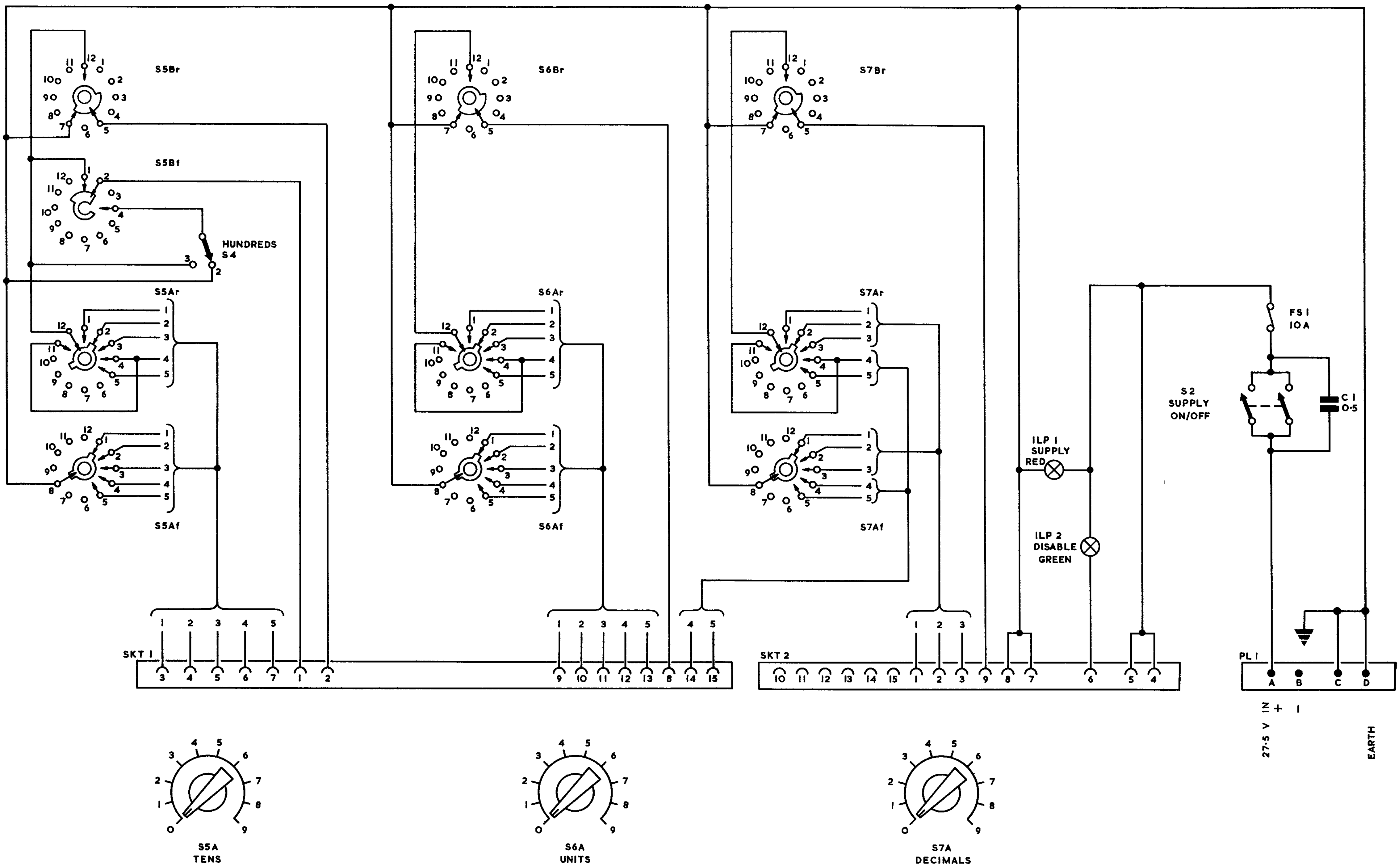

Fig. 4 Test set, tuning unit (6625-99-943-6906) – circuit

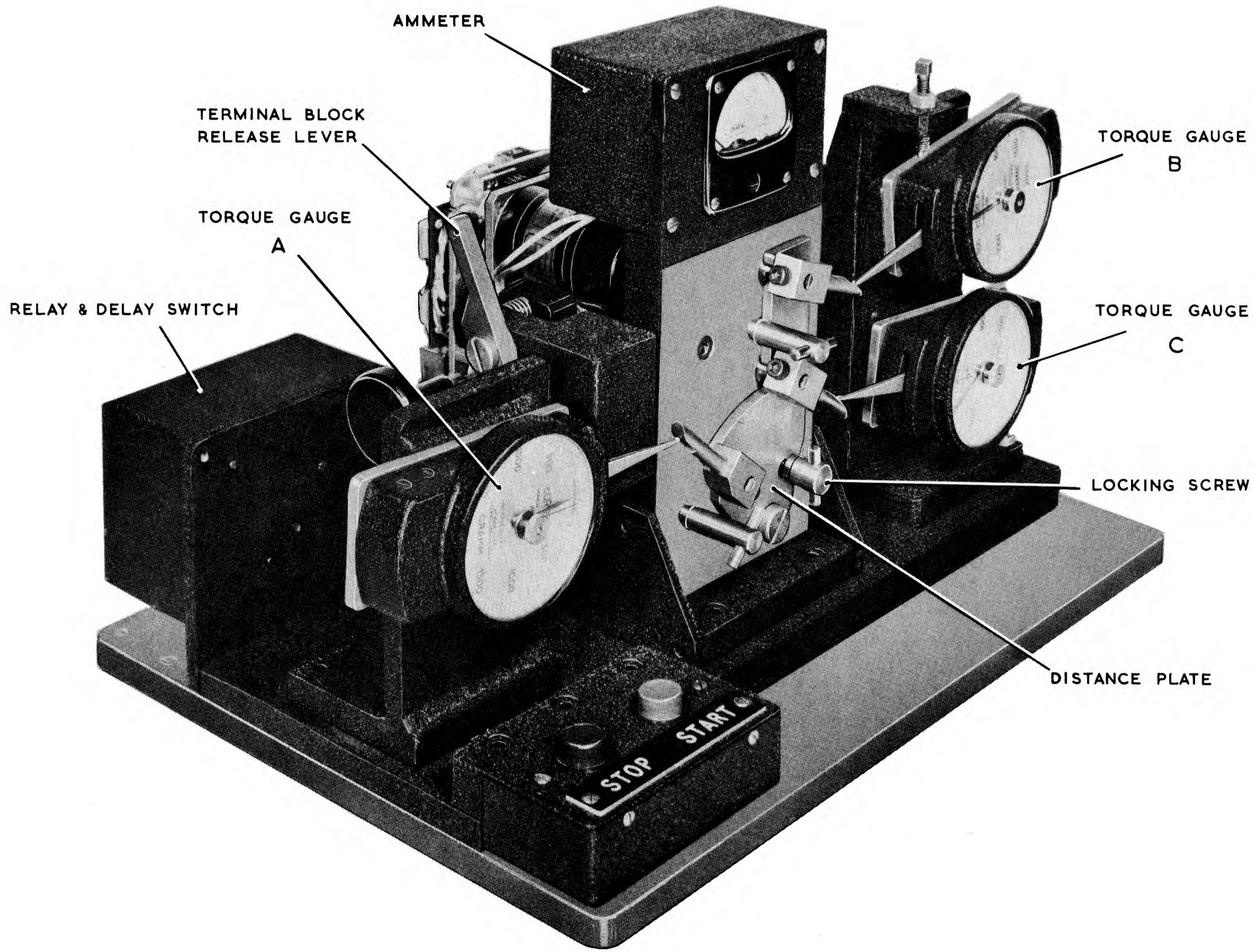

Fig.5. Torque test fixture: front

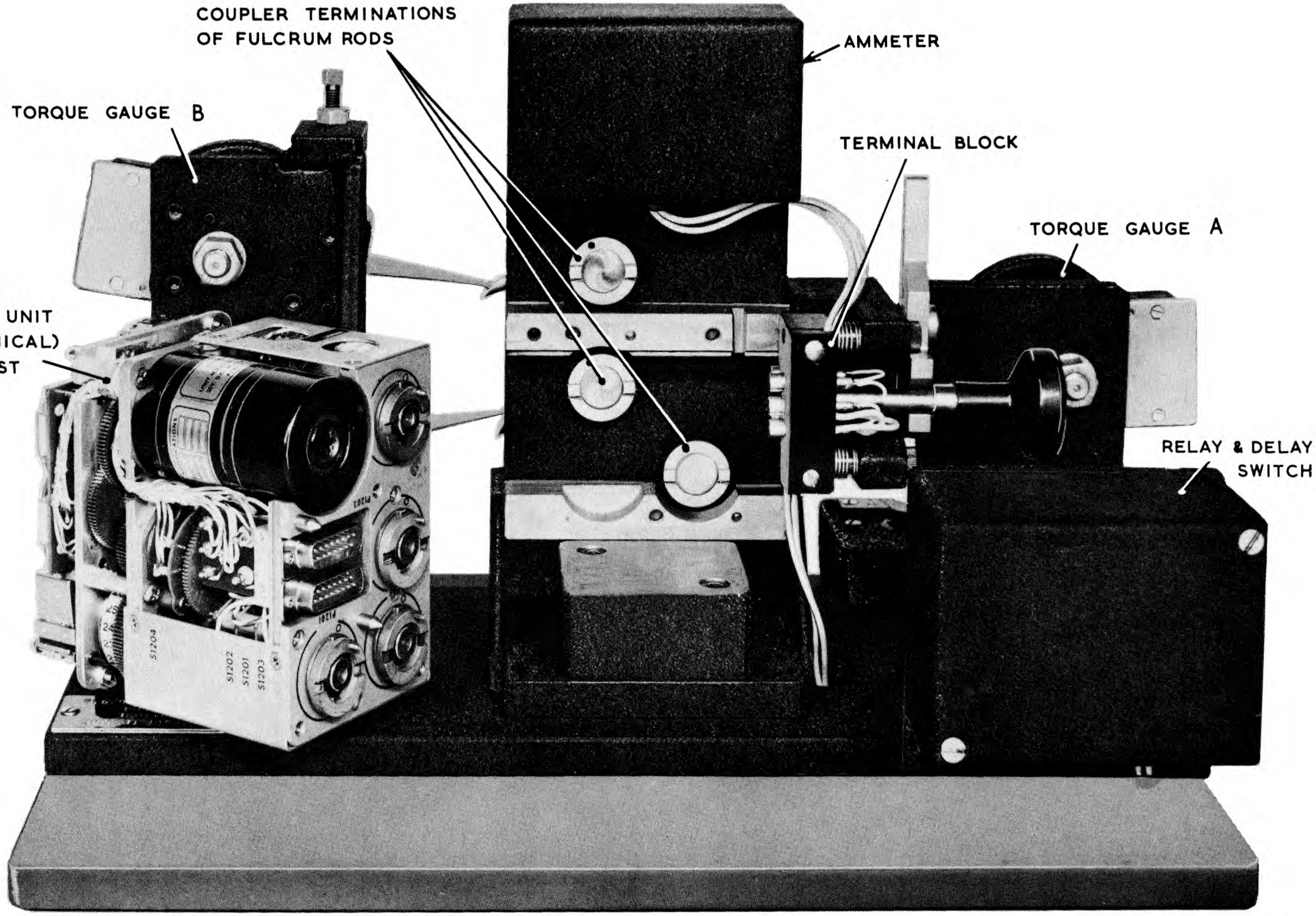

Fig. 6. Torque test fixture: rear

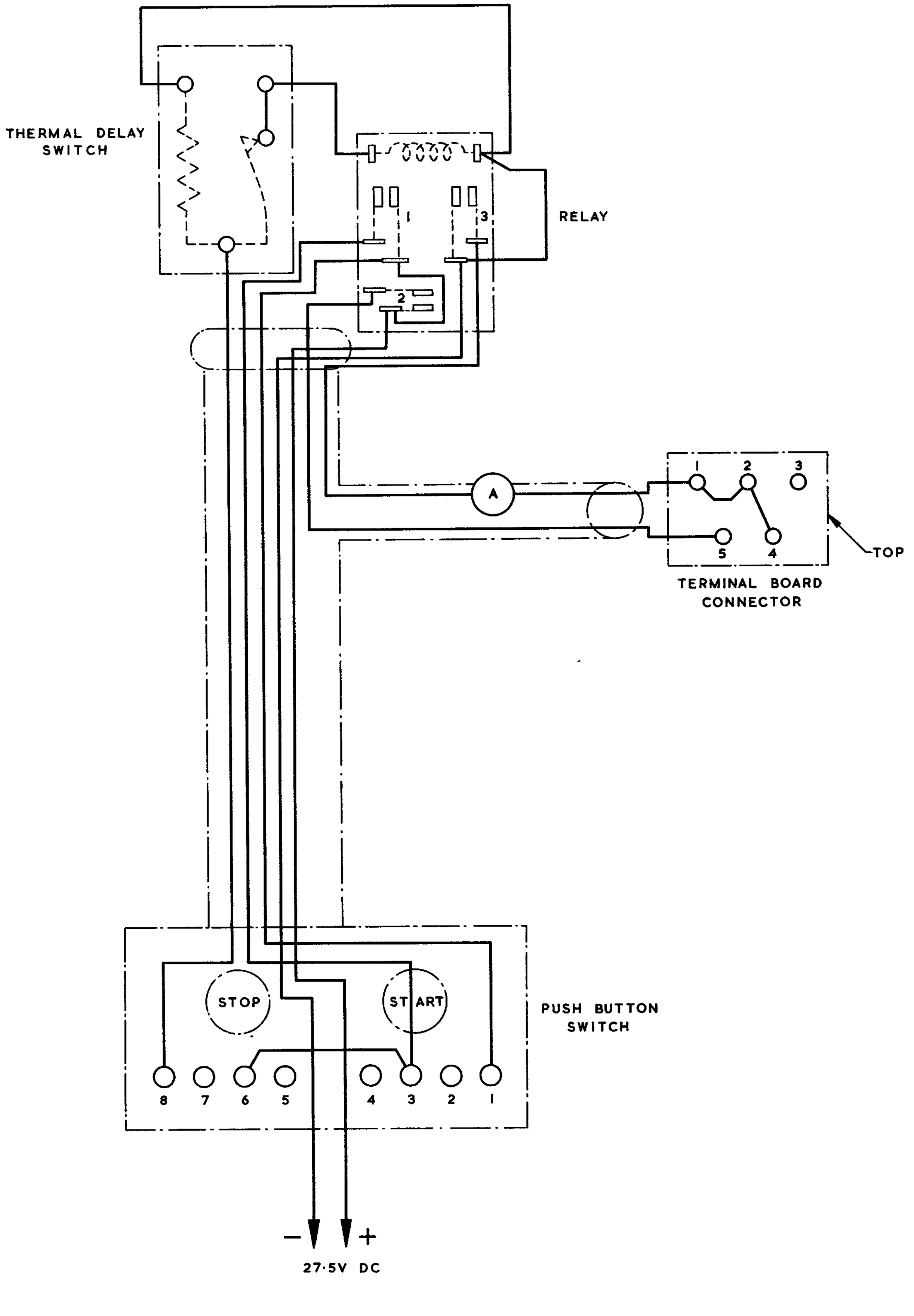

Fig. 7 Torque test fixture (Ref. 10AG/938) – wiring diagram

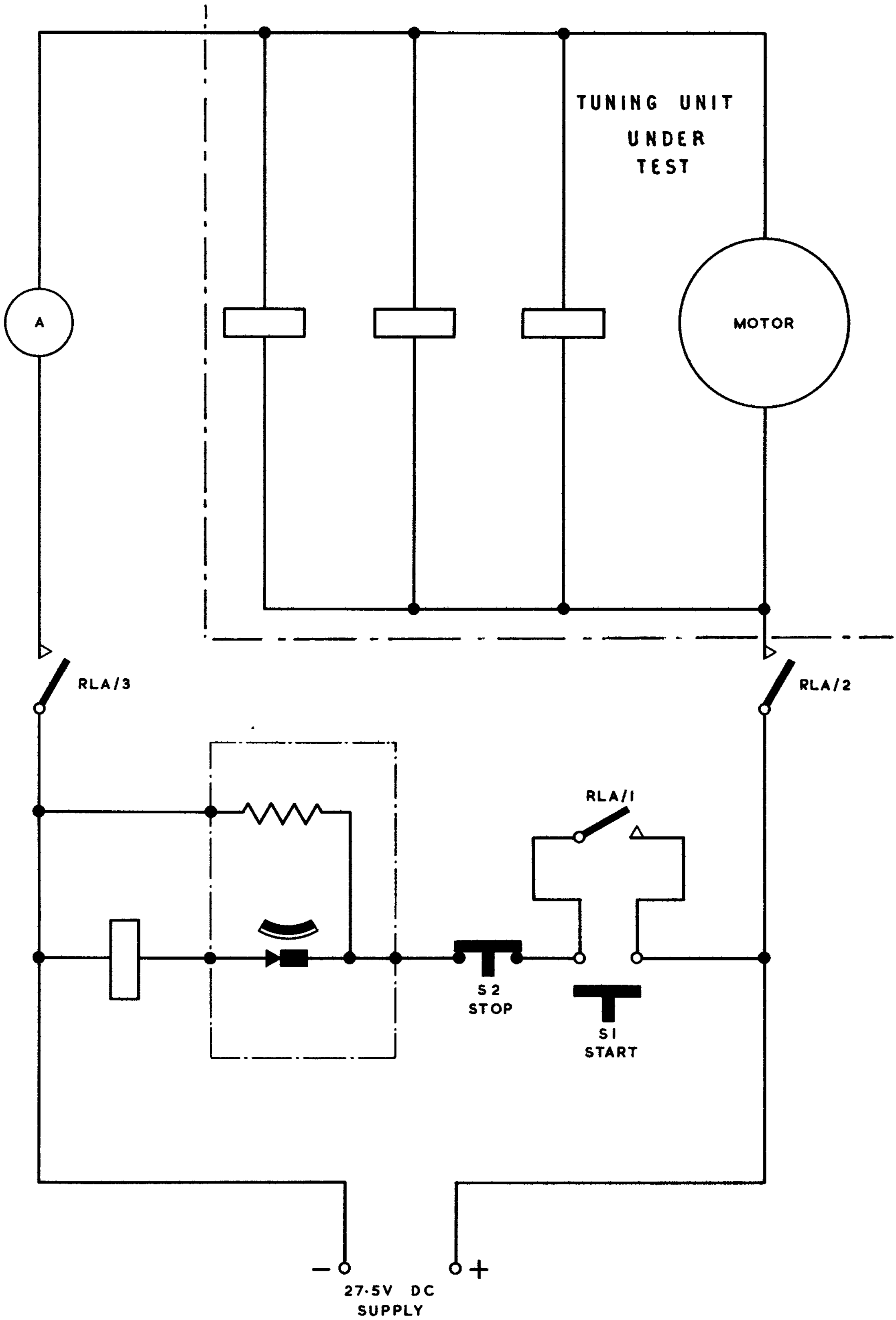

Fig. 8 Torque test fixture (Ref. 10AG/938) — circuit

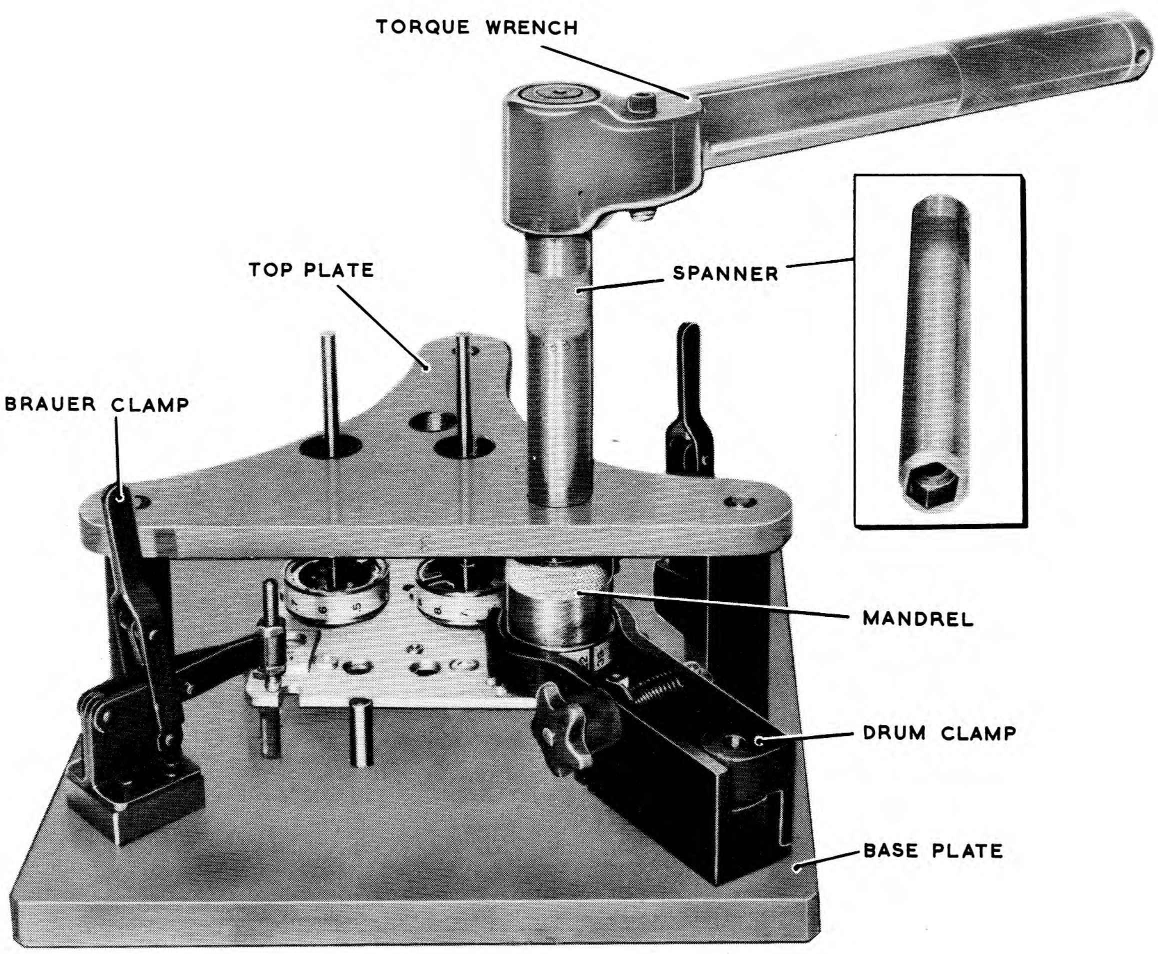

Fig.9. Assembly fixture: general view

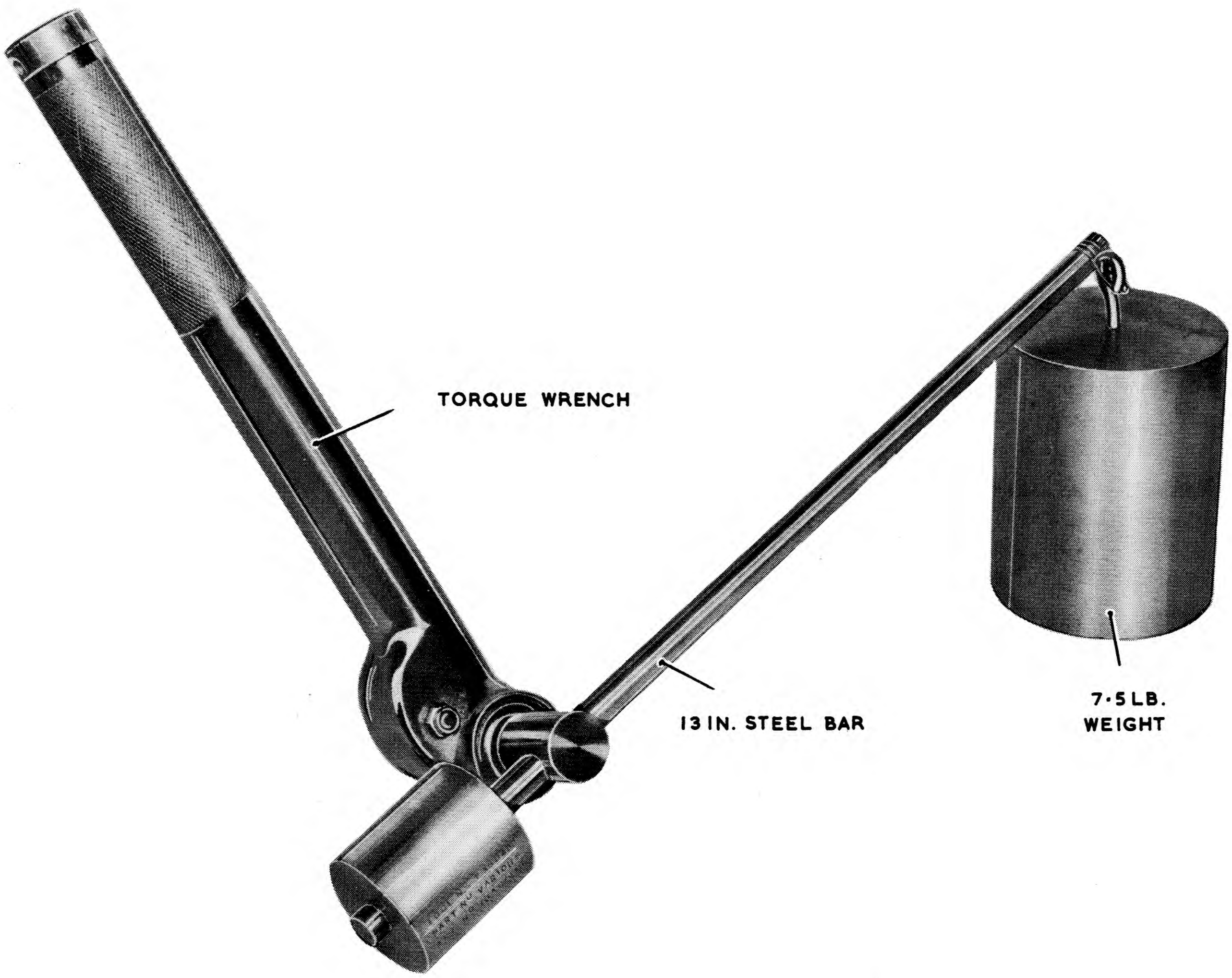

Fig. 10. Adjustment of torque wrench

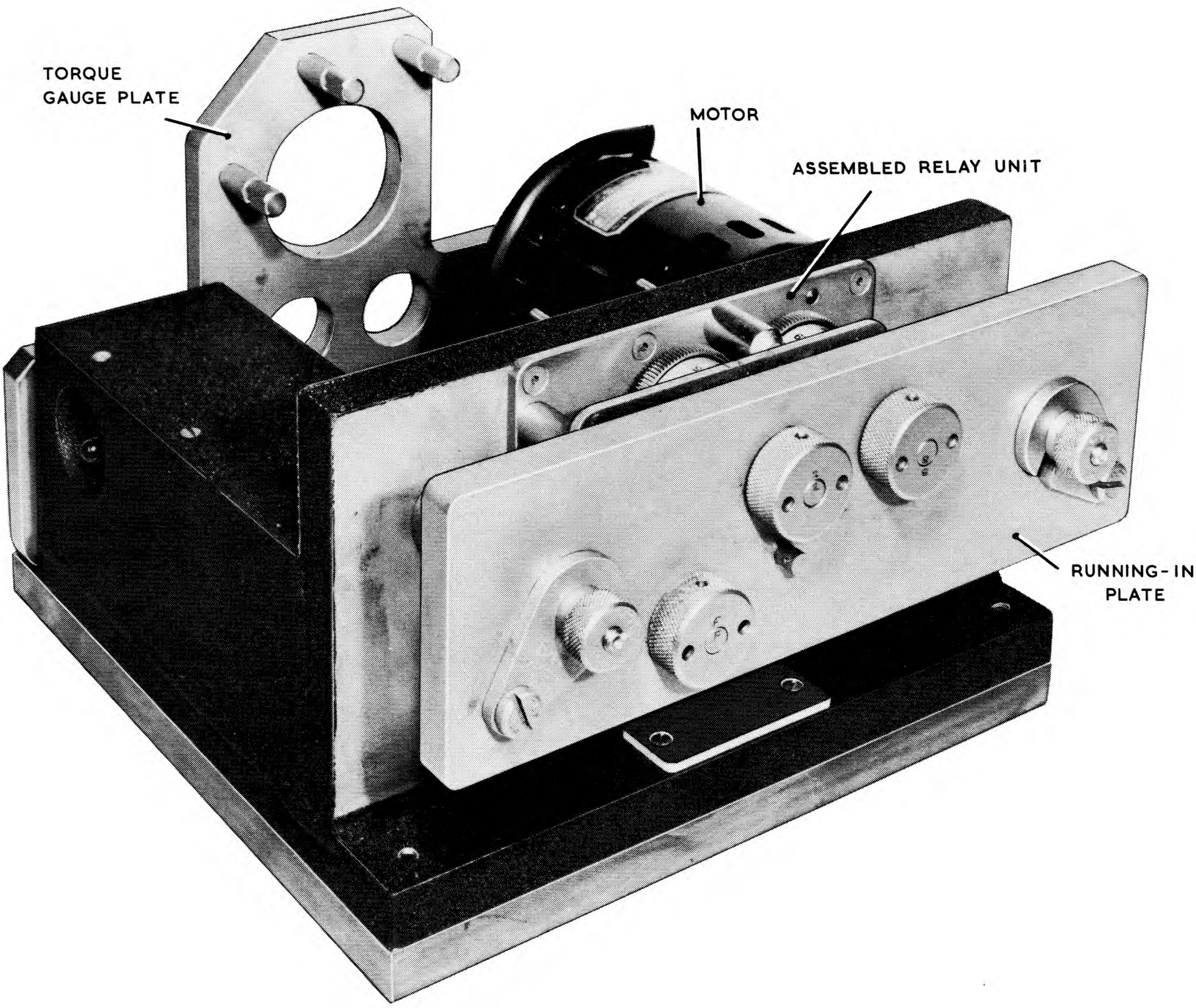

Fig. 11. Torque test and running-in fixture

Fig.12. Clutch spring assembly tool

Fig.13. Cam setting gauge (10AG/953) –
inset, pin of cam setting plate

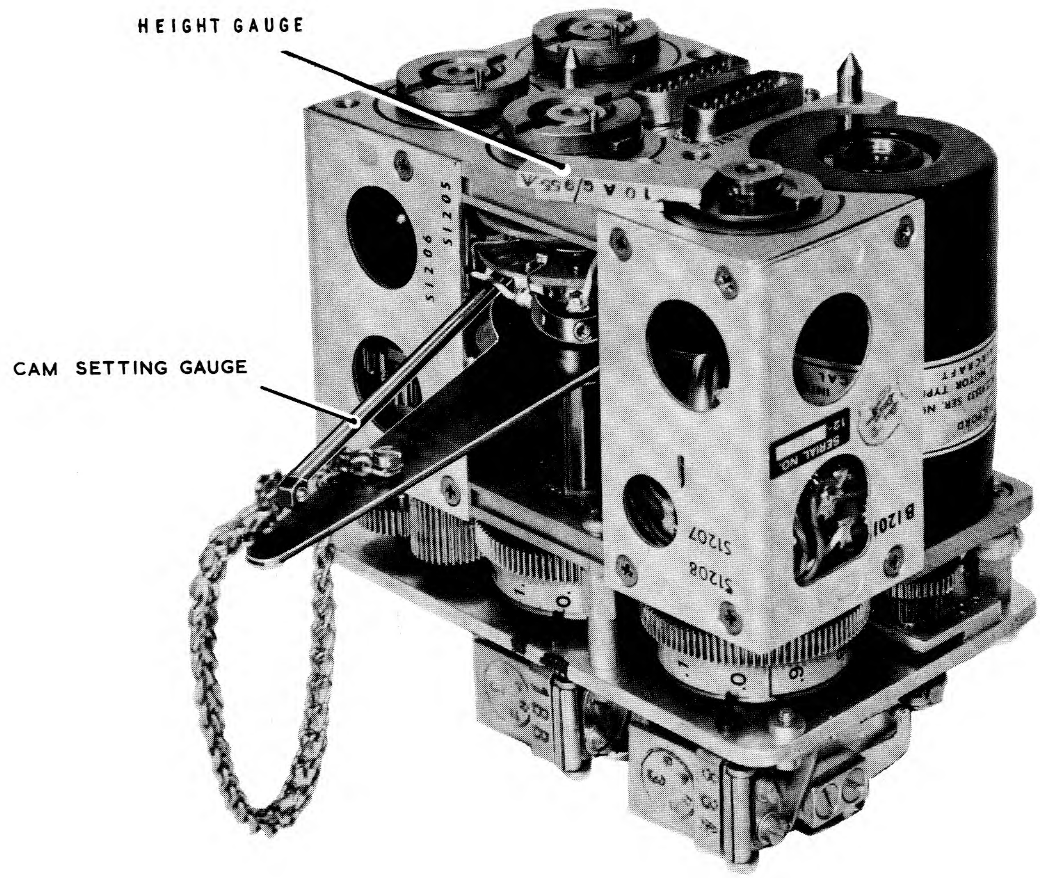

Fig. 14. Cam setting and height gauge in use

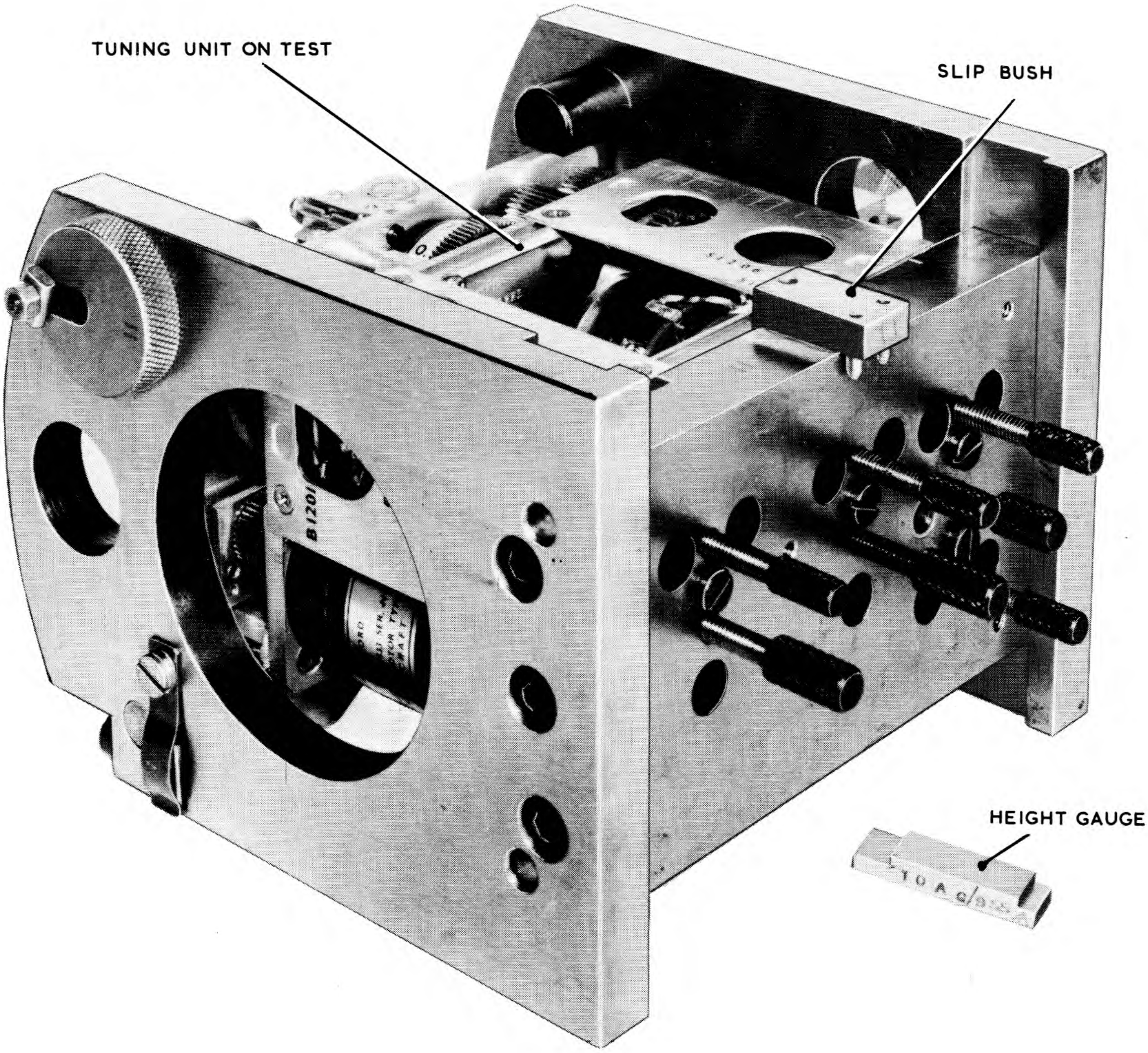

Fig.15. Drill and ream jig

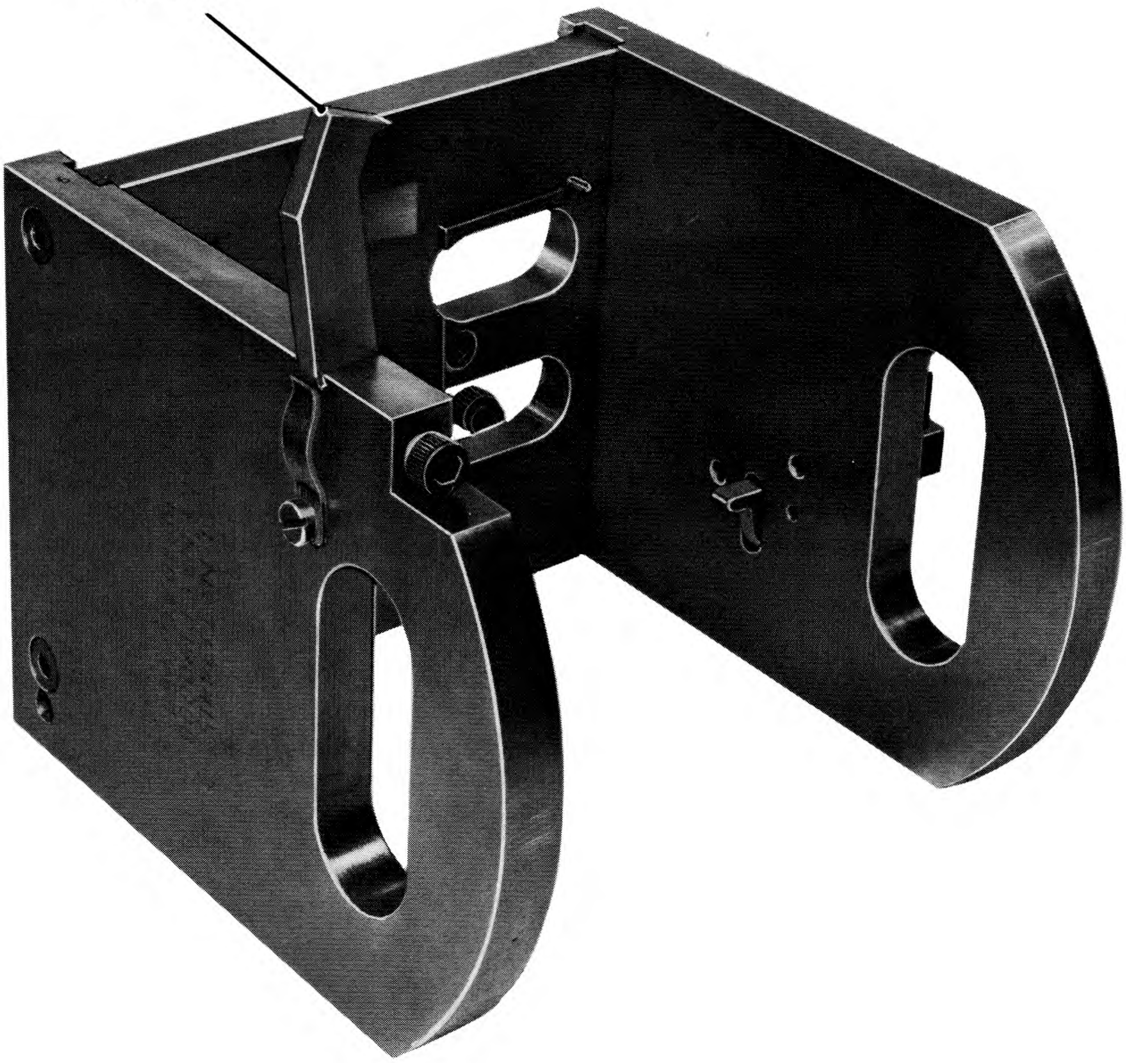

Fig 16 Checking fixture

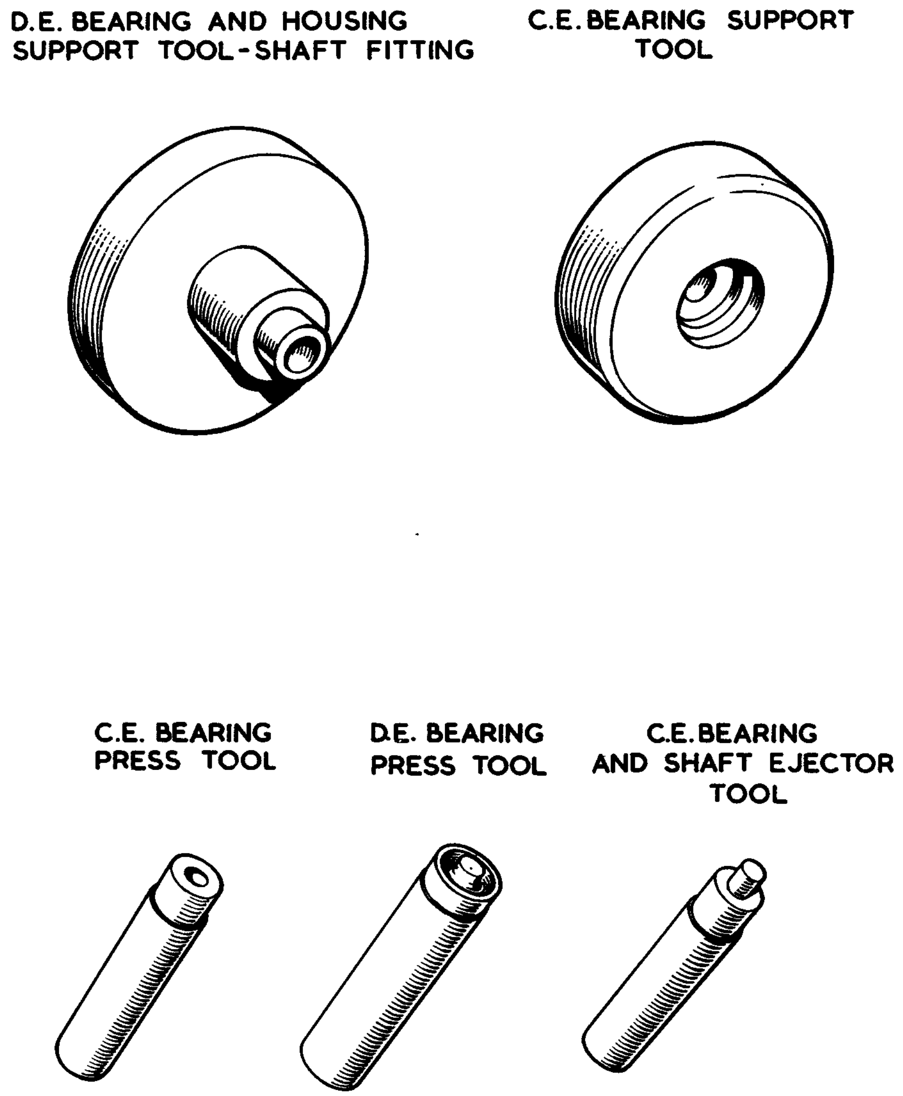

Fig.17. Motor bearing fitting and removal tools

Chapter 6

TEST SET, CONTROL UNIT

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LIST OF ILLUSTRATIONS

LEADING PARTICULARS

A.B.C.S. Cat. No.	6625-99-943-6905
Purpose	Comprehensive testing of the control unit Type C1607/ARC52
Power supply	110V-120V or 200V-250V, 45-60 c/s a.c. mains
Power consumption	300mA
Dimensions (approx.)	Height 6 in. Width $13\frac{3}{4}$ in. Depth 10 in.
Weight (approx.)	Test set $19\frac{1}{2}$ lb Connectors $2\frac{3}{4}$ lb

Introduction

1. The test equipment devised for all third and fourth line testing of the control unit Type C1607/ARC52 (5821-99-942-8543) is designated test set, control unit and listed under A.B.C.S. Cat. No. 6625-99-943-6905.

2. The complete test set is illustrated in the general view at fig. 1. It comprises a single unit embodying a circuit continuity tester, an ohmmeter and a transmission measuring set, or dB meter. By means of a system of lamps, all of which are fitted on the front panel of the test set, the continuity testing facility which provides a rapid method of determining whether the channel selection circuits of the control unit on test are complete and that no inadvertent interconnections exist. This facility is extended to apply to the testing of the function switch of the control unit.

3. The associated ohmmeter provides a means of testing the resistance of the volume control whilst the dB meter facilitates the testing of its attenuation over the whole range of control of audio output.

4. This test equipment is supplied complete with flexible connectors (para. 8) and is classified under the Inter-Service Specification K.114 as K.114/D ground equipment (protected) for use in permanent buildings. It is rated to function correctly in ambient temperatures of +40°C at a relative humidity of 95%. The equipment will operate correctly in ambient temperatures down to -26°C.

5. Details of all relevant tests required to ensure the full serviceability of the control unit are given in Part 2, Sect. 2, Chap. 18, of this Volume. A full description of the frequency selector mechanism, incorporating the control unit in conjunction with the tuning unit (mechanical), is given in Vol. 1 of this Air Publication.

Power supplies

6. The test set operates from a single phase a.c. supply within the range 110V to 120V or 200V to 250V at a frequency between 45 c/s and 65 c/s. Circuit adjustments to meet the actual supply are made by means of a voltage selection link board, mounted on the control panel of the test set. A supply isolating switch and fuse are provided.

7. The internal circuits of the test set operate from 12V and 24V a.c. supplies derived from the tappings of two transformers incorporated in the built-in power supply (para. 19 and 20).

Connectors

8. Two flexible connectors are provided with each test set to provide the coupling between the supply and the test set, and between the test set and control unit under test. These are as follows:-

(1) Mains supply - Connector Type 3429/1, five feet long, (Ref.No. 10HA/8359)

(2) Test set to control unit - Connector, 30-way, Mk.4 terminations (Ref. No. 3995-99-932-3722).

Fuse

9. The single fuse incorporated in this test set is provided for the protection of the input supply line. It is of cartridge type (5920-99-059-0109) rated for one ampere. The cartridge is contained within a screwed-cap type link carrier to Style FU.8 (5920-99-012-0231) which is

fitted into the control panel to permit access for fuse changing without the necessity for removal of the panel.

10. When the fuse replacement becomes necessary, first ensure that the correct spare item is available. Then, before fitting the new fuse link, verify that the voltage selection board is appropriately adjusted to meet the supply, in order to avoid an immediate repetition of fuse failure.

Lamps

11. A distinctive feature of this equipment is the display of coloured-lens lamps on the control panel. These all operate from the 24V internal supply; each is rated at 28V to draw a nominal 40 milliamps.

Construction

12. The test set is fabricated from light alloy sheet into the form of a shallow rectangular box, supported on four moulded rubber feet and closed by a heavy gauge vertical plate which constitutes the control panel. This panel is fitted with four steel studs projecting one from each corner to provide a measure of protection for the instruments, lamps and switches should the test set become inverted on the bench; it also provides a support for the control panel when removed during servicing of the test set.

13. The control panel is secured by seven cheese head screws which engage into anchor nuts riveted on the inside of a wide flange formed around the periphery of the box. After removal of these securing screws the panel may be lifted off to provide access to the rear of the instruments and controls and wiring connections.

14. Access for servicing or examination of component parts such as transformers is achieved by removing a wrapper cover which is secured by nine cheese head screws. A component layout of the test set, with cover removed, is given in fig. 2.

15. Into the rear wall of the box are fitted the fixed plug and the socket for (respectively) the mains input supply and to receive the connector between the test set and the control unit on test.

CIRCUIT DESCRIPTION

Test set circuit

16. Input power supplies are brought in to the test set by way of the connector Type 3429/1 (Ref. No. 10HA/8359) which is coupled to the input plug PL1 (fig. 3). At this plug, pole A is connected to the line side of the supply and pole B to the neutral. Pole C is wired directly to the test set chassis.

17. The input supply is connected, by means of an isolating switch (S2) marked SUPPLY on the front panel, through the single 1-amp fuse (FS1) to the primary windings of the transformers T1 and T2.

18. From the transformer T2 a 24V secondary winding provides the supply to each indicating lamp (ILP1 to ILP11 inclusive) and to the socket SKT1 via the denary switch (S5). Socket SKT1 is coupled by way of the 30-way connector (3995/99-932-3722) to the control unit on test.

19. In addition to the mains transformer (T2) a constant voltage transformer (T1) is incorporated, its primary winding being in parallel with the primary of transformer T2. The secondary winding of transformer T1

provides a 12V supply at 2-amp for the meter via the meter switch (S1) and the rectifier bridge (MR1) and resistor network comprising R2 and R3. An attenuator test resistor of 51 ohms ± 1% is included, shown as R4.

20. The operation of the circuit can best be followed by a study of the circuit diagram (fig. 3) in conjunction with the following reviews of the functions of the test set in circuit continuity testing and in the measurement of input impedance and attenuation of the audio volume control.

Circuit continuity testing

21. In the circuit of the test set is incorporated a three-way switch (S5) which is used to select, in turn, each of the decimals, units and tens denary circuits of the control unit on test. The correct circuit conditions set up by the channel switches of the control unit are indicated by five digit lamps and two auxiliary lamps. The five digit lamps (ILP2 to ILP6, inclusive) will light up appropriately with the selected circuit, thus:-

Digit lamp	Selection
ILP2	0 or 5
ILP3	1 or 6
ILP4	2 or 7
ILP5	3 or 8
ILP6	4 or 9

22. One of the auxiliary lamps (ILP7) when glowing indicates that the 0 to 4 group of digits has been selected, but when not lighted the indication is that the 5 to 9 group is selected. The other auxiliary lamp (ILP8) when glowing indicates that the 200 group of channel frequencies is selected; when not lighted, however, it signifies that the 300 group has been selected.

23. An auxiliary switch (S6) which is operated in conjunction with the 0 to 4 group digit lamp, is provided to afford a means of verifying that the re-entrant earth switch circuit of the control unit on test is functioning correctly.

24. Three lamps (ILP9, 10, and 11) marked respectively T/R +G, and A.D.F., are provided to indicate that the function switch of the control unit is operating correctly. Further information on the operation and sequence of frequency selection can be obtained from Vol. 1 of this Air Publication.

Ohmmeter and dB meter

25. The operating power for the incorporated ohmmeter and dB meter is derived from the secondary winding of the constant voltage transformer (T1). The working voltage is nominally at 12V.

26. Function selection is made by means of the 3-way switch (S1), the middle position of which disconnects the indicating instrument from the power source. The other two positions are marked RES and ATT to indicate the resistance and attenuation circuits respectively.

27. A mechanically-biased attenuation range switch (S4) is fitted. In the normal (biased) position of the switch the dB meter will indicate the lowest attenuation of the attenuator of the control unit on test; in the operated position (marked 35) the meter will indicate the highest

attenuation. An attenuator test terminating resistor (R4) rated at 51 ohms ± 1% is included in the test set. Details of the tests required on the volume control are described in Part 2, Sect. 2, Chap. 18 of this Volume.

28. Standardisation adjustment is made possible by the provision of pre-set rheostats (para. 57, 58, and 59).

Operation

29. The operation of the test set, control unit is described in Sect. 2, Chap. 18 to which reference should be made.

SERVICING

General

30. The equipment must be maintained in a clean, dry and undamaged condition throughout its service life. Care must be taken to avoid rough handling of the switches and controls and to prevent the lamps and meter from being knocked and broken whilst the test set is on the bench. Keep the test area clear of any servicing tools, soldering irons, etc.

31. Periodically remove the cover and inspect the switches and wiring. Access can be gained by removing the nine cheese head screws securing the cover to the test set box. Before probing within the box among the components, however, ensure that the power supply is switched off or (preferably) disconnected from the test set.

32. Whenever a fault is suspected within the internal wiring a continuity test can readily be made using an approved multimeter. Each wire is made in wire, electrical equipment Type 2,14/.0076 inch, pink (6145-99-910-0185) with identification sleeves Type B provided at each end. Any replacement of wiring should be made only with the correct grade of wire; the connections should be made as neatly as possible, with care exercised to avoid tails of excess solder. Clean off any wire clippins or solder spatter before replacing the wrapper cover or front panel.

33. Examine the connectors each time before coupling them to the mains supply, the test set and the control unit on test. They should be undamaged and dry, with the plug and socket terminations making good, firm contact with the mating components of the related equipment.

Overall testing

34. A circuit diagram of the complete test set is provided at fig. 3. A study of the diagram, coupled with experience of the few standard components incorporated in this equipment, will provide all the information necessary for clearing normal faults.

35. By substituting for the control unit on test one which is known and proven to be completely serviceable, the correct functioning of the test set can be rapidly established.

36. In this substitution test, the known control unit is coupled up exactly as for testing and with power applied the test sequences described in Sect. 2, Chap. 18 can be made in order to verify that the lamps of the test set light up appropriately for each selection.

Meter circuits

37. When repairs or replacements have become necessary, tests should

be made to determine that the equipment has been restored to a serviceable condition equivalent to that of a new test set, as issued, which has been inspected to factory standards.

38. Metering circuits should be tested, therefore, to conform to the following standards of requirements which have been based on the manufacturer's production schedule. These tests are described, in following paragraphs, for resistance measurement and attenuation measurement.

Resistance measurement

39. The test set should be supplied with power from the station source at 230V by means of the supply connector (10HA/8359), with the connector (5995-99-932-3722) also coupled to the test set but not, however, to the control unit. The METER switch (S1) should be operated to the RES position.

40. To set the resistance calibration of the meter, first connect together (by a short length of wire) the poles E and F of the free end of the control unit to test set connector. The calibrating potentiometer (RV1) of the test set should then be adjusted so that the meter (M1) registers 51 ohms.

41. Resistance calibration tests at 30 ohms and 120 ohms should be made, as follows:-

(1) 30 ohms test. The connection between the poles E and F of the connector should remain tied as in para. 40 above. Then a high resistance transfer (a rheostat having a total resistance of 100 ohms and rated for not less than 150 milliamps) should be connected across the 51 ohms resistor (R4) and adjusted so that the meter (M1) registers 30 ohms. The resistance placed in the circuit by the rheostat is measured on a Wheatstone bridge, which should be capable of measuring resistance in the range of one ohm to 10,000 ohms to an accuracy not worse than ± 1%. The resistance reading for a satisfactory test should be 75 ohms ± 10%. The tie between poles E and F of the connector must afterwards be removed.

(2) 120 ohms test. The high resistance transfer should then be connected to the poles E and F of the free end of the control unit connector and adjustments made so that the meter (M1) registers 120 ohms. The resistance placed in the circuit by the rheostat should be measured on a Wheatstone bridge and should be 73 ohms ± 10%.

Attenuation measurement

42. The test set should again be supplied with power from the station source at 230V, and the connector (5995-99-932-3722) fitted to the test set but not to the control unit. The METER switch (S1) should be operated to the ATT position for a 0.5 dB attenuation test and during the 35 dB attenuation calibration.

43. 0.5 dB attenuation test. A low resistance transfer (that is, a rheostat having a total resistance of 10 ohms and rated for not less than 250 milliamps) should be connected across the poles E and F of the free end of the test connector whilst adjustment is made so that the test set meter registers 0.5 dB. The resistance placed in the circuit by the rheostat can be measured by a Wheatstone bridge; resistance should not be less than 2.5 ohms nor more than 5.0 ohms.

44. 35 dB attenuation calibration. An attenuation calibration standard (a 2,700 ohms ± 1% resistor, rated to dissipate not less than ¼ watt) should be connected to the poles E and F of the test connector. The

calibrating potentiometer (RV2) of the test set should then be set fully counter-clockwise and, with the 0.5 dB-35 dB switch (S4) depressed, the calibrating potentiometer (RV2) should be adjusted so that the meter (M1) registers 35 dB.

Current consumption

45. Evaluation of the total load on the supply when, for example, setting up the complete servicing equipment, can be assisted by the following test to determine current consumption. This test will also afford facilities for verifying the correct functioning of all component circuits in the test set, control unit.

46. The test set should be coupled to a control unit Type C1607/ARC62 which is known to be serviceable and then supplied with a.c. power at 230V. The manual controls of the test control unit should then be set for the 220.0 Mc/s channel, the CHAN control set to the M position, the VOL control set fully clockwise,and the function switch to T/R +G position (Table 1).

47. On the test set, the SUPPLY switch (S2) should be operated to the ON position, the PRESS TO CLEAR ADF switch (S3) should be in the raised position, the CHECK RE-ENTRANT EARTH switch (S6) also in the raised position, the DENARY switch (S5) set at TENS, the METER switch (S1) set to the ATT position and the 0.5 dB - 35 dB switch (S4) raised (Table 1).

48. The cartridge fuse link should now be temporarily removed from its holder in the test set and an a.c. ammeter (multimeter Type 9980 or Type 1) very carefully connected across the fuseholder terminals. The current registered under these conditions should not exceed 300 milliamps.

49. Be sure to refit the fuse link into the holder before making any further tests or before issuing the test set for use.

TABLE 1

Current consumption and stabilization tests

Test set control settings		Control unit settings	
Control	Position	Control	Position
SUPPLY switch	ON	MANUAL	220.0 Mc/s
PRESS TO CLEAR ADF	Raised	CHAN	M
CHECK RE-ENTRANT EARTH	Raised	VOL	Clockwise
DENARY	TENS	Function switch	T/R +G
METER SWITCH	ATT.		
0.5 dB/35 dB switch	Raised		

Stabilization

50. The equipment should be set up as described for current consumption tests (summarized in Table 1) but with the fuse link refitted into the holder. The voltage developed across the secondary winding of the constant voltage transformer (T1) should be noted and used as a reference.

51. The mains supply voltage selection board (S7) should then be set up successively for 210V and 250V supplies and each deviation in the voltage developed across the secondary of the transformer (T1) due to these changes should not exceed ± 2% of the reference voltage.

52. The voltage selection board should be set up for the prevailing supply of a.c. mains voltage before putting the test set again into service.

CONNECTOR TYPE 3429/1
(10HA/8359)

CONNECTOR 30-WAY
(3995-99-932-3722)

Fig. 1. Test set, control unit (6625-99-943-6905)

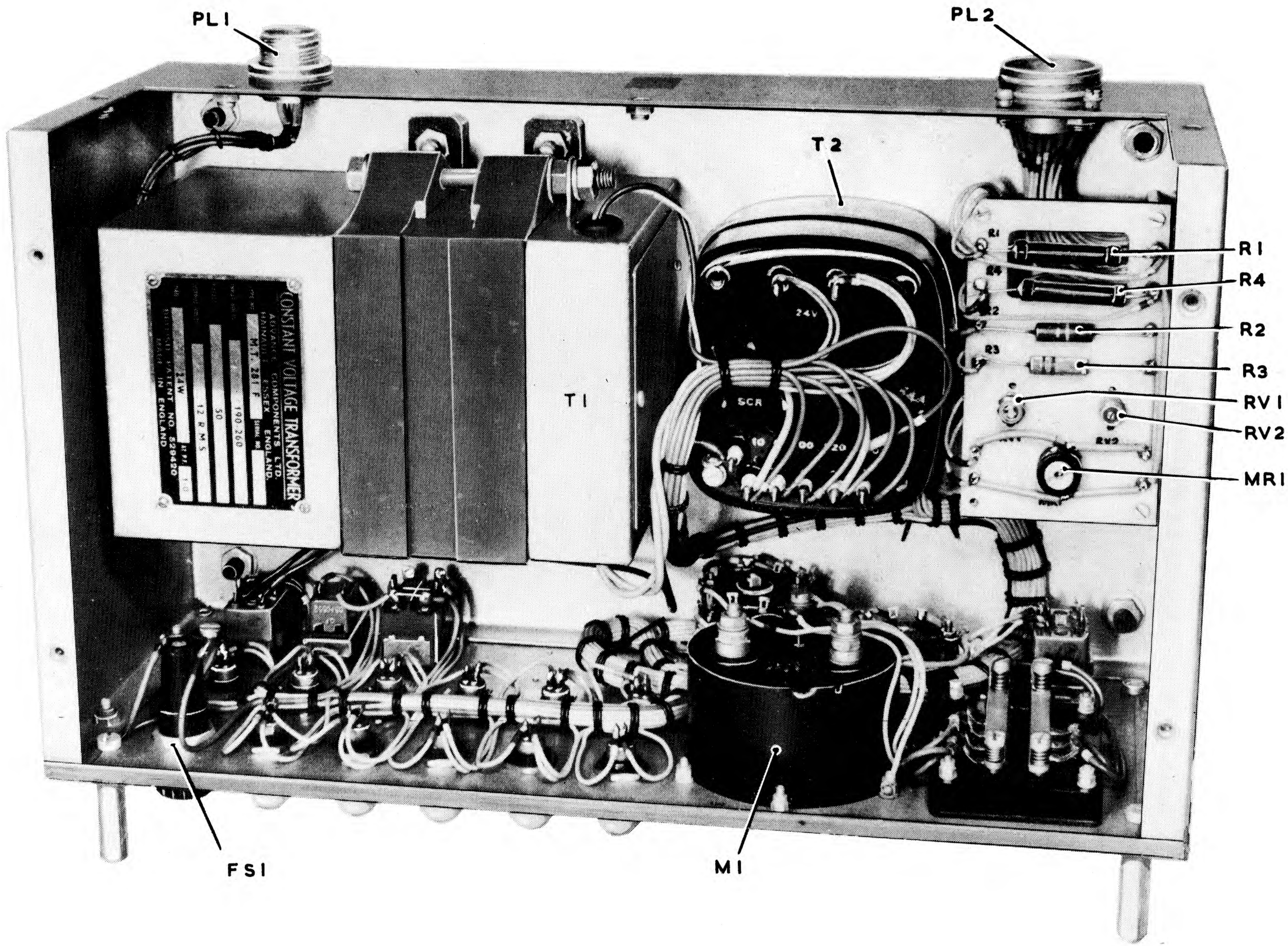

Fig. 2. Test set, control unit — component layout

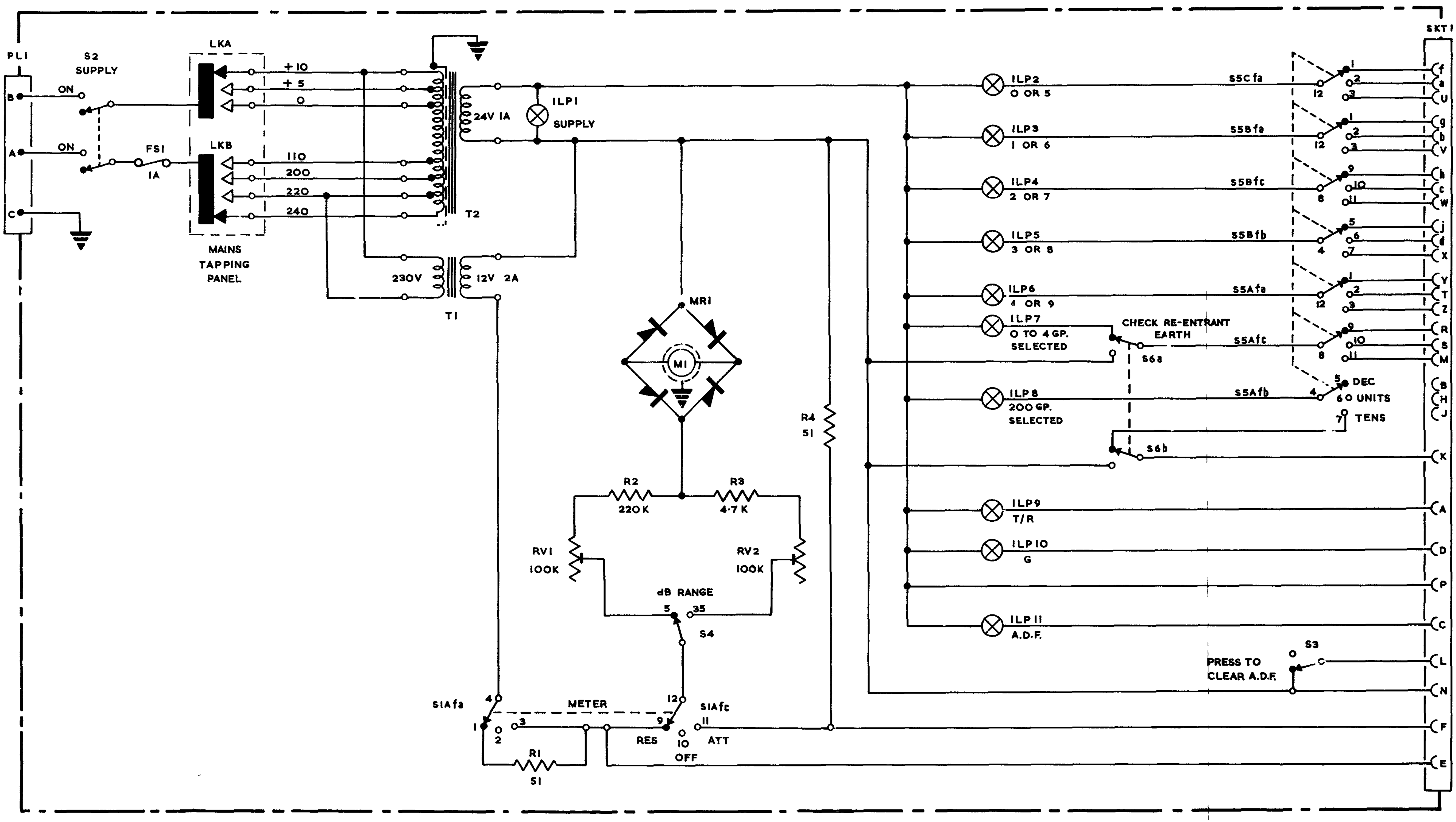

Fig.3 Test set, control unit (6625-99-943-6905) — circuit

Chapter 7

TEST SET, AUDIO

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LEADING PARTICULARS

Designation	Test set, audio
A.B.C.S. Cat. No.	6625-99-943-6544
Function	Third and fourth line testing of the amplifier unit, A.F. (5821-99-942-8555)
Dimensions (approx.)	$10\frac{1}{2}$ in. x $6\frac{1}{2}$ in. x $3\frac{3}{4}$ in.
Weight (approx.)	6 lb
Supplies	Derived from power supply (No. 2) (A.B.C.S. Cat. No. 6130-99-999-7812). The test set, audio contains a special smoothing circuit permitting unrestricted use of this power supply.

Introduction

1. In conjunction with other items of test equipment (Table 1), the test set, audio 6625-99-943-6544 (fig. 1) has been designed to facilitate third and fourth line testing of the amplifier unit, A.F. 5821-99-942-8555 which is part of the transmitter-receiver Type TR4/ARC52 and Type TR5/ARC52.

2. This test set is classified under Inter-services Specification, K114, as K114/D ground equipment (protected) for use in permanent buildings. It is rated to function correctly in an ambient temperature of +55° C at the prevailing humidity and at an ambient temperature of +40°C at a relative humidity of 95%. The equipment will function correctly in ambient temperatures down to -26°C.

Construction

3. The unit is basically a shallow rectangular box ($10\frac{1}{2}$ in. long, $6\frac{1}{2}$ in. wide and $3\frac{3}{4}$ in. high) supported on four stainless steel feet. The upper face constitutes the control panel (fig. 2) and on this are mounted all controls, switches and screw terminals. On the right of the control panel a stainless steel bracket is provided to accommodate the amplifier unit under test. Provision for the protection of the controls and switches is made by means of four hexagonal pillars, mounted one on each corner of the front panel. The rear face of the test set (fig. 3) houses the power supply service plug.

Associated test equipment

4. To provide the required performance monitoring facilities when testing the amplifier unit, AF, additional items of test equipment are required. The functions and descriptions of these equipments are listed in Table 1; further particulars of individual items may be obtained by reference to the publication listed.

TABLE 1

Associated test equipment

Item	Nomenclature	Reference No.	Further details
1	Power supply (No. 2)	6130-99-999-7812	Chap. 2
2	Signal generator Type 65 or Signal generator Type 65B	10S/16344 10S/16499	A.P.2536C and A.P.2879AD
3	Multimeter, electronic CT38 or	10S/16308	A.P.2879AG
	Valve voltmeter CT54	F19/6625-99-943-2418	A.P.2536C
4	Wattmeter, absorption AF No. 1, CT44	F19/6625-99-943-0510	A.P.2536C
5	Indicator, distortion	10S/17639	
6	Headset, Type 9	10AH/14	

Facilities

Power supplies

9. The test set, audio is capable of transferring all power requirements from the power supply (No. 2), via the approved connector, to the unit on test.

6. The output from the associated power supply (No. 2) is not sufficiently smooth for the supply of squelch bias, relay amplifier positive bias, or for use as a carrier squelch signal source; for these purposes, therefore, the test set, audio contains a special smoothing circuit permitting the unrestricted use of the power supply (No. 2).

Carrier squelch signal source

7. Provision is made for the connection of a voltmeter (Table 1) to measure the e.m.f. of the carrier squelch signal source. This signal source is adjustable over the range of 0V to 10V; the source impedance is 470kΩ ± 10% and the ripple content not greater than 1mV, r.m.s.

Signal source

8. An a.f. signal generator (Table 1) may be connected to the test set and the generator output then switched in turn to the input of each of the amplifiers of the unit to be tested.

Monitoring and metering

9. Provision is made for monitoring the output of the main audio channel of the amplifier unit on test. This is achieved either visually by connecting the wattmeter (Table 1) into the circuit, or aurally by inserting a headset (Table 1) in the jack provided.

10. The voltmeter (Table 1) may also be employed for metering, via the test set, the output of the auxiliary audio channel of the unit on test.

11. Provision is also made so that the automatic relaying bias may be applied to the unit on test via a switch and limiting resistor.

Circuit description

12. A circuit diagram of the test set, audio is shown at fig. 4 at the end of this chapter. This circuit is drawn with each of its functions clearly defined and the following circuit description is divided under headings for each of these facilities.

Power supplies

13. Power supply (No. 2), from which all power requirements are derived, is connected to the test set, audio via a 12-way plug (PL1) on the test set.

14. All outgoing supplies are connected from socket SKT1 to the amplifier unit, AF on test.

15. A supply of +130V is applied at pole A of plug PL1 and routed via the single pole switch (H.T. on/off) and pole 12 of socket SKT1 to the unit on test.

16. To provide the smoothed positive bias required by the unit on test, a +130V supply is also applied at pole B of plug PL1 and this is routed via four series-connected components (resistors R1, R2, R3 and potentiometer RV1) forming a voltage divider network across the 130V supply. A d.c. potential of 28V is developed across the pair of diodes MR1 and MR2, which are connected in parallel with R3 and RV1, and this smoothed voltage is routed via pole 2 of socket SKT1 to the unit on test. With switch S3 in the NORMAL position this smoothed 28V d.c. supply is applied only to pole 2 of socket SKT1; setting the switch S3 to the DISABLE position applies the 28V d.c. supply to pole 1 also of socket SKT1 and to terminal TP3 (SQUELCH BIAS) for monitoring purposes.

17. The variable resistor RV1 (CARRIER SQUELCH LEVEL) is adjustable to provide an output, variable between 0V and +10V, which is applied via R4 to pole 10 of socket SKT1 as a carrier squelch source for the unit on test. For monitoring purposes, the potential is also applied to terminal TP1, marked CARRIER SQUELCH LEVEL, on the front panel. The resistor R4 provides a source impedance of 470 kilohms for the carrier squelch signal, which has a ripple content not greater than 1mV, r.m.s.

18. Radio relay quieting facilities are provided by the application, at pole L of plug PL1, of the 28V d.c. supply which is routed via switch S2 in the ON position and resistor R6 to pole 6 of socket SKT1.

19. The valve heater supply, which is variable between 0V and 10V a.c., is applied at pole C and G of plug PL1 and routed directly to poles 15 and 14 of socket SKT1. Poles C and G are linked to poles F and H respectively, where monitoring of the heater supply voltage at the equipment under test may be made.

Signal source

20. The output from an a.f. signal generator (Table 1) is applied across terminals TP4 and TP5 (A.F. GEN. INPUT) and connected to the SIGNAL INPUT 5-way rotary switch S4. The a.f. signal can then be applied via the appropriate pole on socket SKT1, to each of the amplifiers of the unit on test by rotating the switch S4 successively to the positions marked MAIN AUDIO, MAIN+AUX. AUDIO, AUX. AUDIO, GUARD AUDIO and SIDETONE. Except when indexed

to GUARD AUDIO, the capacitor C1 and resistor R5 are connected across this input.

21. All wiring from switch S4 to socket SKT1 is screened to prevent interaction between the input circuits of the various amplifiers of the unit on test.

Monitoring and metering

22. An a.f. wattmeter (Table 1) may be connected across terminals TP6 and TP7 (A.F. POWER OUTPUT) for monitoring visually the audio output of the unit on test, when applying a signal input across terminals TP4 and TP5 with switch S4 in the MAIN AUDIO position.

23. An additional aural monitoring facility is provided by the jack (JK1) to accept headphones (Table 1).

24. With switch S4 in the AUX. AUDIO position and an a.f. signal applied across terminals TP4 and TP5, the appropriate a.f. output voltage from the unit on test may be monitored across terminals TP8 and TP9 with a voltmeter (Table 1).

Servicing

25. The equipment should be maintained in a clean, dry and undamaged condition throughout its service life. Care must be taken to avoid rough handling of the switches and controls. Whilst the test set is on the bench, keep the working area clear of any servicing tools, soldering irons, etc.

26. Periodically remove the control panel and inspect the switches and wiring; access can be gained by removing the eight cheese head screws securing the control panel.

27. Whenever a fault is suspected within the internal wiring, a continuity test can be readily made using an approved multimeter. Wiring employed conforms to DEF.10, DEF.12A or DEF.14 as applicable and replacement wiring should be made with the correct grade of wire; the connections should be made as neatly as possible with care taken to avoid tails of excess solder. Remove any wire clippings and excess solder before replacing the control panel.

28. Examine the connections each time before coupling them to the audio test set, the equipment on test and the power supply (No. 2). They should be undamaged and dry, with the plug and socket terminations making good firm contact with the mating components on the related equipment.

Overall testing

29. A circuit diagram of the complete unit is shown at fig. 4, and a study of the diagram will provide all the information necessary for clearing normal faults.

30. Before disconnecting a diode suspected of being faulty, note carefully the way in which the polarity is effected and fit the new component similarly.

31. Particular care should be taken to avoid rough handling of the high stability resistors (R7 and R8).

32. When repairs or replacements have become necessary, tests should be made to determine that the equipment has been restored to a serviceable condition equivalent to that of a new unit, as issued, which has been inspected to factory standards.

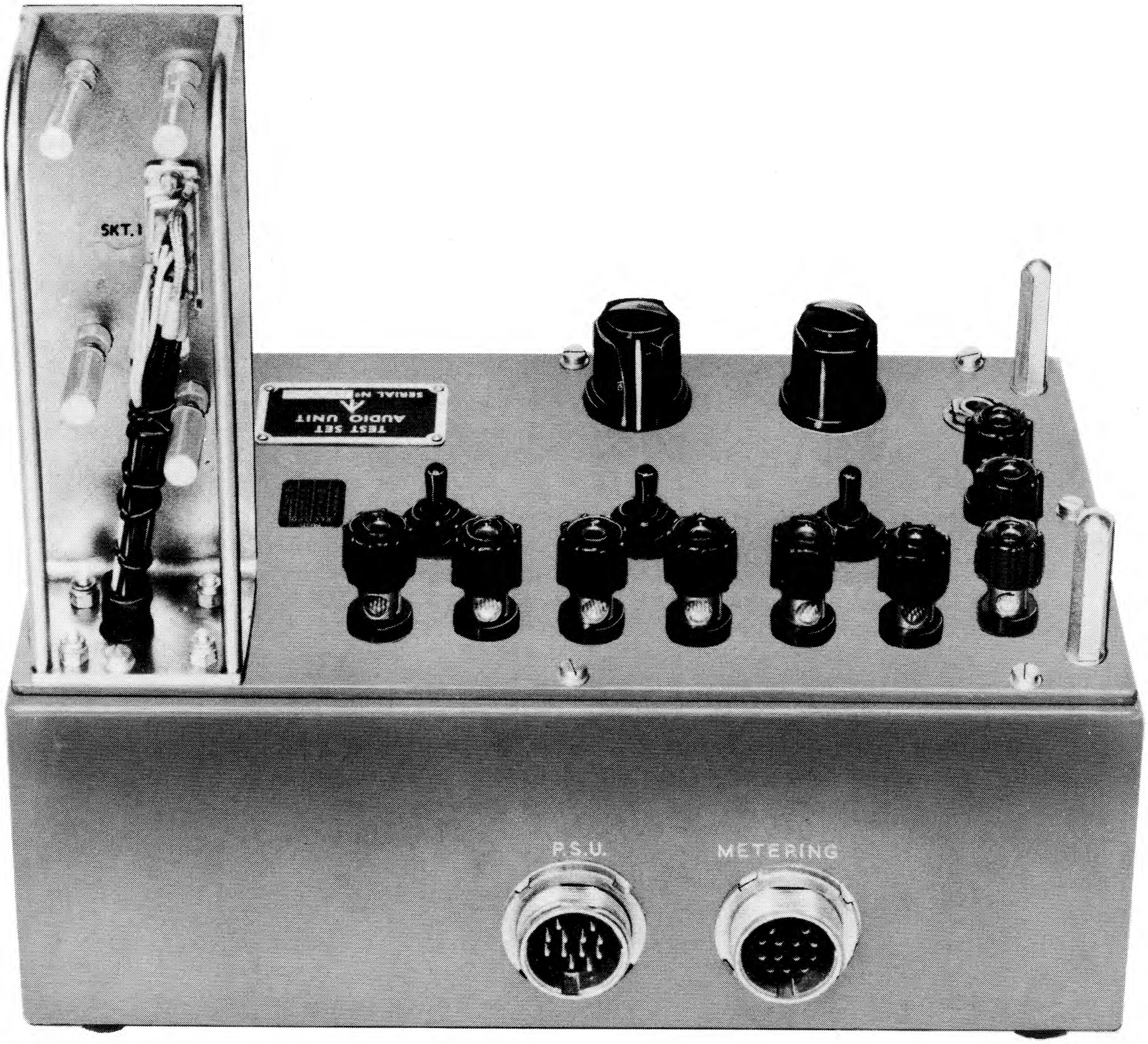

Fig. 1. Test set, audio 6625-99-943-6544

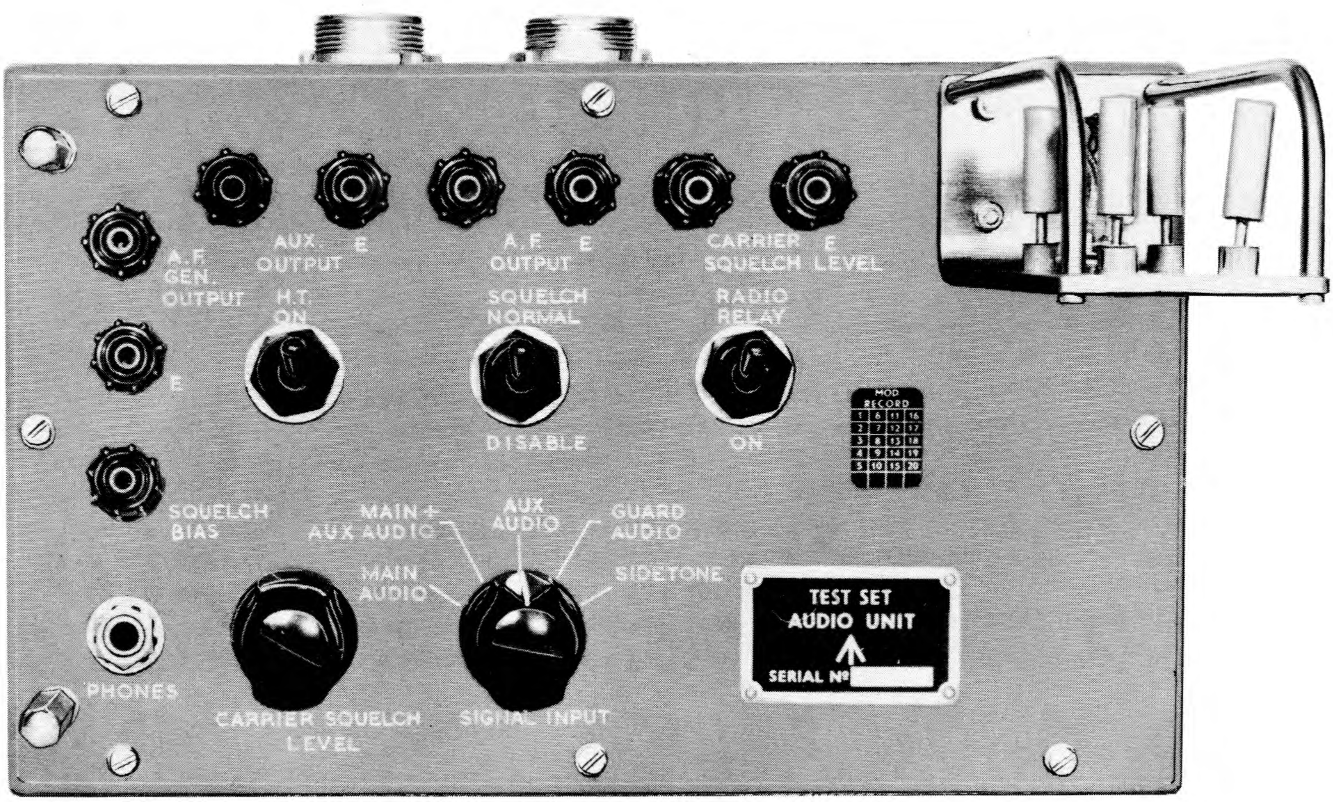

Fig. 2. Test set, audio - control panel layout

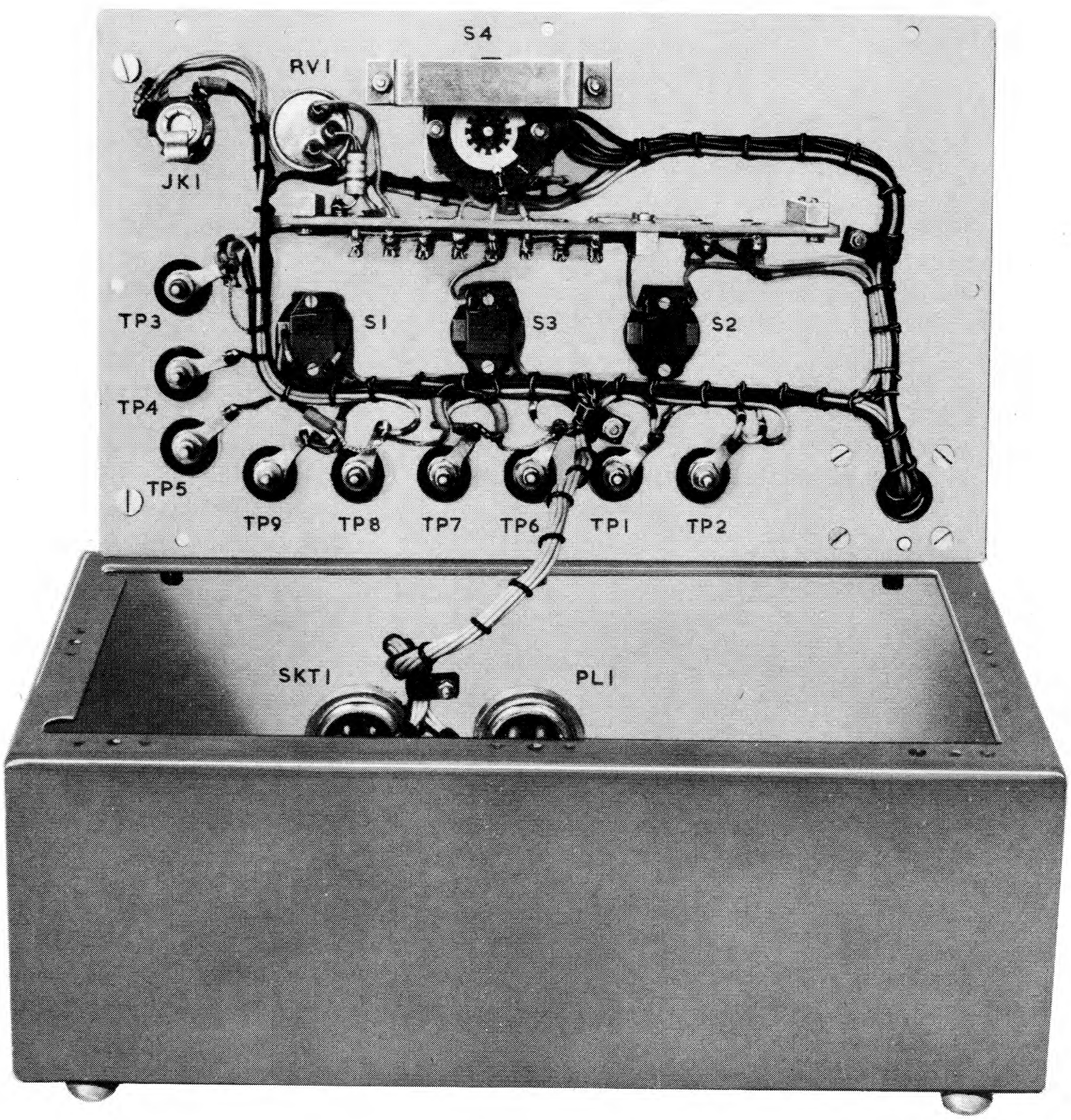

Fig. 3. Test set, audio-component layout (interior)

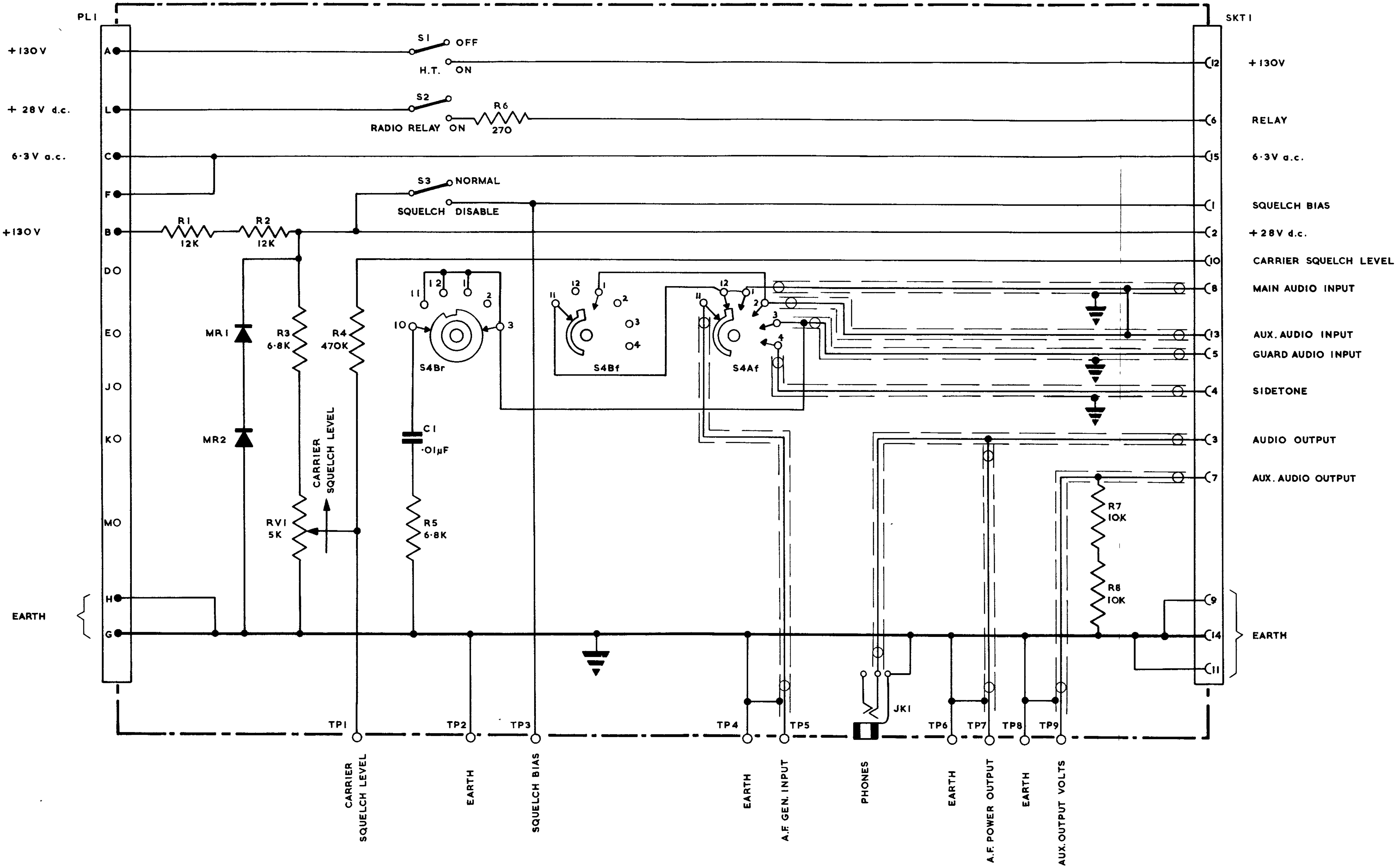

Fig. 4 Test set, audio 6625-99-943-6544 — circuit

Chapter 8

TEST SET, RELAY

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LEADING PARTICULARS

Designation:	Test equipment for continuity tests on relay coils and contacts in the relay unit.
Comprising:	Test set, relay, A.B.C.S. Cat. No. 6625-99-943-6538.
Function:	For testing the operation of the relay unit, using rotary switches in conjunction with lamps which facilitate rapid semi-automatic testing of the relays, wiring and components of the unit.
Dimensions (approx.):	$10^1/2$ in. x 6 in. x $6^7/16$ in.
Weight (approx.):	$6^1/2$ lb.

Introduction

1. In conjunction with other items of general test equipment (Table 1), the test set, relay, 6625-99-943-6538 has been designed to facilitate third and fourth line testing of the relay unit (5821-99-942-8545) which is part of the transmitter-receiver TR4/ARC52 and TR5/ARC52.

2. This test set is classified under Inter-Service Specification K114, as K114/D ground equipment (protected) for use in permanent buildings. It is rated to function correctly in an ambient temperature of +55°C at the prevailing humidity and at an ambient temperature of +40°C at a relative humidity of 95%. The equipment will function correctly in ambient temperatures down to -26°C.

3. A general view of the unit is given at fig. 1.

Construction

4. The unit is basically a shallow rectangular metal box supported on four stainless steel feet. The upper face constitutes the control panel (fig. 2) and on this are mounted the fuse holder and all controls, switches, screw terminals and lamps. In the top centre of the control panel a stainless steel bracket is provided to accommodate the unit under test. The rear face of the test set (fig. 1) houses the power supply service plug.

5. Provision for the mechanical protection of the control panel components is made by means of two hexagonal pillars mounted one on each front corner of the control panel.

Associated test equipment

6. To provide the required performance monitoring facilities when testing the relay unit, additional items of test equipment are required. The functions and descriptions of these auxiliary equipments are listed in Table 1; further particulars of individual items may be obtained by reference to the publication listed.

TABLE 1

List of associated test equipment

Item	Nomenclature	Reference No.	Further details
1	Power unit (AC)	5821-99-943-7136	
2	Connector 4-way, Type 3430/1	10HA/8360	
3	Multimeter, Type 1	5QP/16411	A.P. 2536C
	or		
	Multimeter, Type 9980	6625-99-943-1524	
	or		
	Multimeter, Type F	10S/1	
	or		
	Multimeter, Type D1	10S/10610	
4	Universal bridge CT375	6625-99-943-2442	

Facilities

Power supplies

7. The test set, relay is capable of transferring all power requirements from the power unit (AC) 5821-99-943-7136, via the approved connector, to the unit on test.

Resistance and capacitance indication

8. Provision is made for connecting the relay coils, resistors and capacitors of the equipment to be tested to terminals on the control panel of the test set; to these terminals can also be connected the equipment (Table 1) suitable for measuring resistance and capacitance.

9. Rotary switches, in conjunction with lamps, facilitate rapid semi-automatic testing of the relays and wiring of the unit on test.

10. One switch selects individually the various capacitors, resistors and solenoids of the equipment to be tested and connects them to a meter (para. 8). Other switches, with the aid of lamps mounted on the front panel, indicate:

(1) The operation or non-operation of any relay.

(2) The absence or otherwise of inadvertent connections or open circuits in the equipment on test.

11. Six lamps are employed; one for each of the four relays showing the operation of its armature, one to indicate an inadvertent connection and another to indicate a correct connection.

Power control

12. The equipment contains a double pole single throw switch to isolate both poles of the d.c. supply. A 500mA fuse is included on the equipment side of the switch, in the incoming positive line.

13. A flexible connector (Table 1) provides electrical connection between the test set and the power unit.

Circuit description

14. The circuit diagram of the test set, relay is given in fig. 4, at the end of this chapter. This circuit is drawn with each of its functions clearly defined and the following circuit description is divided under headings for each of these facilities.

15. The test set is arranged to supply the relay coils (K901-K904) of the unit under test with 27.5V d.c. (nominal), via plug PL1; also, the continuity of each relay contact, both in its normal and operated positions, is verified by means of lamps in series with the d.c. supply. There are four rotary switches (S1-S4) which are employed for selection of the required function of the test set. When making a short-circuit test, the wire to be tested is isolated and tested for continuity between all other wires and the chassis. The d.c. resistance of each relay coil, together with the values of the resistors and capacitors used in the unit on test are also tested. These tests are made by switching the ends of each component in turn to pairs of terminals (TP1-TP4) to which can be connected a suitable instrument (Table 1).

Power supply

16. The power unit (AC) 5821-99-943-7136, from which the required stabilized supply of 27.5V d.c. is derived, is connected to the test set relay via a 4-way plug (PL1), on the test set and a 4-way connector (Table 1). All outgoing supplies are connected from socket SKT1 to the relay unit on test.

17. The positive pole of the power unit is connected to pole A of plug PL1 and routed via one pole of the double pole switch S5 (SUPPLY) and a 500mA fuse (FS1) to the test set. The negative pole of the power unit is connected to poles C and D of plug PL1 and routed to the test set chassis via the remaining pole of the double pole switch S5 (SUPPLY).

Functions

18. The correct functioning of the relay unit may be established by use of the FUNCTIONS switch (S1). The RES & CAP switch (S2) and the TEST switch (S4) must both be set to the FUNCT position; the setting of the SHORT-CIRCUITS switch (S3) is immaterial. The T/R, TONE and GUARD lamps (ILP2, ILP3 and ILP4 respectively) light up when those relays have a voltage applied to them; the relays do not necessarily operate, however, the T/R relay is energized by contacts K904/1 of the TONE relay in positions F, G, H and J, so that lighting of the T/R lamp is really a test of the operation of the TONE relay. The DISABLE lamp (ILP1) lights when a voltage is applied to the relay and the contacts K902/1 change over.

19. The FUNCTIONS switch positions are lettered from A to K inclusive:-

A. GUARD relay energized. The CORRECT (green) lamp will light if a circuit exists between poles 1 and 2 of the relay unit, thus the back contacts (K904/4) of the T/R relay are tested. The FAULT (red) lamp will light if there is an earth on pole 24, or on the circuits connected up to poles 21 and 6; no connections are made by the test set to poles 6 or 21.

B. GUARD relay energized. The CORRECT (green) lamp will light if a circuit exists between poles 21 and 24, thus the contact (K903/2) of the GUARD relay are tested. The FAULT (red) lamp will light if there is an earth on pole 2, or on the circuit to pole 1, which is connected via the back contact (K901/4) of the T/R relay or pole 7 via contacts K903/1. No connection is made by the test set to pole 1.

C. T/R relay energized. The CORRECT (green) lamp will light if a circuit exists between poles 1 and 15 of the relay unit, thus testing the make contacts (K901/4) of the T/R relay. The FAULT (red) lamp will light if an earth exists on pole 2 or in the circuit connected. Pole 1 is earthed by the test set, so that the break contact (K901/4) of the T/R relay is tested.

D. GUARD relay energized. The CORRECT (green) lamp lights if a circuit exists between poles 2 and 7, thus the contacts K903/1 are tested. The FAULT (red) lamp will light if there is an earth on pole 15 or the circuit connected. Pole 1 is earthed by the test set so that the opening of contact K901/4 is tested.

E. GUARD relay energized. The CORRECT (green) lamp will light if a circuit exists between poles 24 and 6, thus the make contacts K903/2 and back contacts of K901/3 are tested. The FAULT (red) lamp will light if an earth is present on pole 20 and the circuit up to the contact K904/2.

F. TONE relay energized; T/R relay also energized due to contacts K904/1 of the TONE relay. The CORRECT (green) lamp will light if a circuit exists between poles 20 and 18, thus the contacts K904/2 are tested. The FAULT (red) lamp will light if an earth is present on pole 16 and the circuits connected, which includes the capacitor C901, the resistor chain, and the relay contacts K901/1 and K901/2. No connection is made by the test set to pole 4.

G. TONE and T/R relays energized. The CORRECT (green) lamp will light if a circuit exists between poles 16 and 4, thus the contacts K901/1 and K901/2 of the T/R relay are tested. The FAULT (red) lamp will light if an earth exists on the circuits connected to pole 20, which includes the contacts K904/2, K901/3 and the wiring up to poles 6 and 18.

H. TONE and T/R relays energized. The CORRECT (green) lamp will light if a circuit exists between poles 20 and 6, thus the contacts of K904/2 and K901/3 are tested. The FAULT (red) lamp will light if an earth is present on pole 22 and the wiring up to the contact K902/2; the contact itself is tested since the moving contact is permanently earthed at pole 25.

I. DISABLE relay energized. The CORRECT (green) lamp will light if the contacts close properly and earth pole 22. The FAULT (red) lamp will light if an earth is present on pole 24 or the wiring connected. Pole 21 is earthed by the test set so that the opening of contacts K903/2 is tested.

J. None of the relays energized. The CORRECT (green) lamp lights by action of the test set switches; this is not a test of the relay unit. The FAULT (red) lamp will light if an earth is present on pole 20 and the circuits connected up to the contacts K904/2.

K. None of the relays energized. Both the CORRECT (green) and the FAULT (red) lamps are connected across the supply by the test set switches; this position may therefore be used as a test for the lamps themselves.

Short-circuit tests

20. These tests are to establish that no inadvertent short-circuits exist either to earth or to other circuits in the relay unit. This is done by connecting to earth most of the poles of SKT1 (via S3Bf of the SHORT-CIRCUITS switch) and testing for an earth on one isolated pole. The FAULT (red) lamp will light if a short-circuit is present. For these tests none of the relays are energized and the CORRECT (green) lamp remains alight all the time and is not part of the test.

21. The FUNCTIONS switch should be set to K, the RES & CAP switch at FUNCT and the TEST switch at SHORTS. The SHORT-CIRCUITS switch has eleven positions marked N to X inclusive:-

N.	Pole 2 being tested	Those poles not being tested are connected to earth (pole 25)
O.	Pole 22 being tested	
P.	Pole 20 being tested	
Q.	Pole 16 being tested	
R.	Pole 4 being tested	
S.	Pole 18 being tested	
T.	Pole 21 being tested	
U.	Poles 11, 12, 13 and 14 being tested	
V.	Pole 3 being tested	
W.	Pole 24 being tested	
X.	Pole 15 being tested	

Resistance and capacitance tests

22. For these tests (para. 8) an external ohmeter and capacitance meter are required; they should be connected to the appropriate terminals on the front panel of the test set. The TEST switch (S4) should be set to R & C, the settings of the FUNCTIONS (S1) and the SHORT-CIRCUITS (S3) switches is immaterial. The RES & CAP switch (S2) has nine test positions:-

DISABLE	The resistance of the DISABLE relay winding.
TONE	The resistance of the TONE relay winding.
GUARD	The resistance of the GUARD relay winding.
T/R	The resistance of the T/R relay winding.
R901	The resistance of R901.
R902	The resistance of R902 with R902A in parallel.
C901	The capacitance of C901.
C902	The capacitance of C902.
C903	The capacitance of C903. (Introduced by modification No. 6109)

Servicing

23. The equipment should be maintained in a clean, dry and undamaged condition throughout its service life. Care must be taken to avoid

rough handling of the switches and controls. Whilst the test set is on the bench, keep the working area clear of any servicing tools, soldering irons, etc.

24. Periodically remove the control panel and inspect the switches and wiring; access can be gained by removing the eight cheese head screws securing the control panel.

25. Whenever a fault is suspected within the internal wiring, a continuity test can be readily made using an approved multimeter (Table 1). Wiring employed in the test set is wire, electrical equipment, Type 2, 23/.0076 in. pink (6145-99-910-0191) and wire, electrical equipment, Type 2, 14/.0076 in. pink (6145-99-910-0185) and any replacement wiring should be made with the correct grade of wire. The connection should be made as neatly as possible with care taken to avoid tails of excess solder. Remove any wire clippings and excess solder before replacing the control panel.

26. Examine the connectors each time before coupling them to the relay unit test set, the equipment on test and the power unit. They should be undamaged and dry, with the plug and socket terminations making good, firm contact with the mating components on the related equipment.

Overall testing

27. A circuit diagram of the complete unit is shown in fig. 4 at the end of this chapter and a study of the diagram will provide all the information necessary for clearing normal faults.

28. When repairs or replacements have become necessary, tests should be made to determine that the equipment has been restored to a serviceable condition equivalent to that of a new unit, as issued, which has been inspected to factory standards.

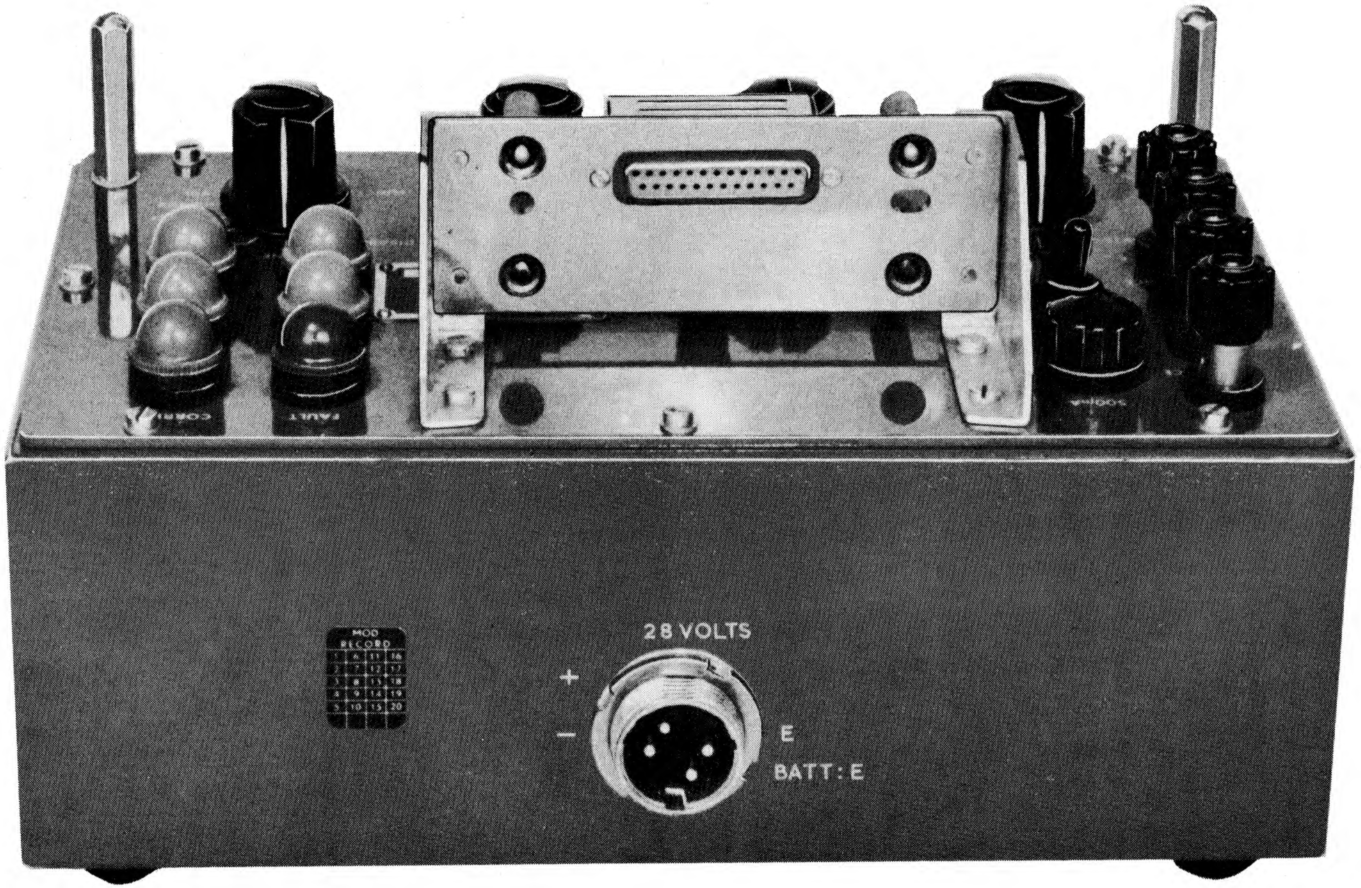


Fig.1 Test set, relay

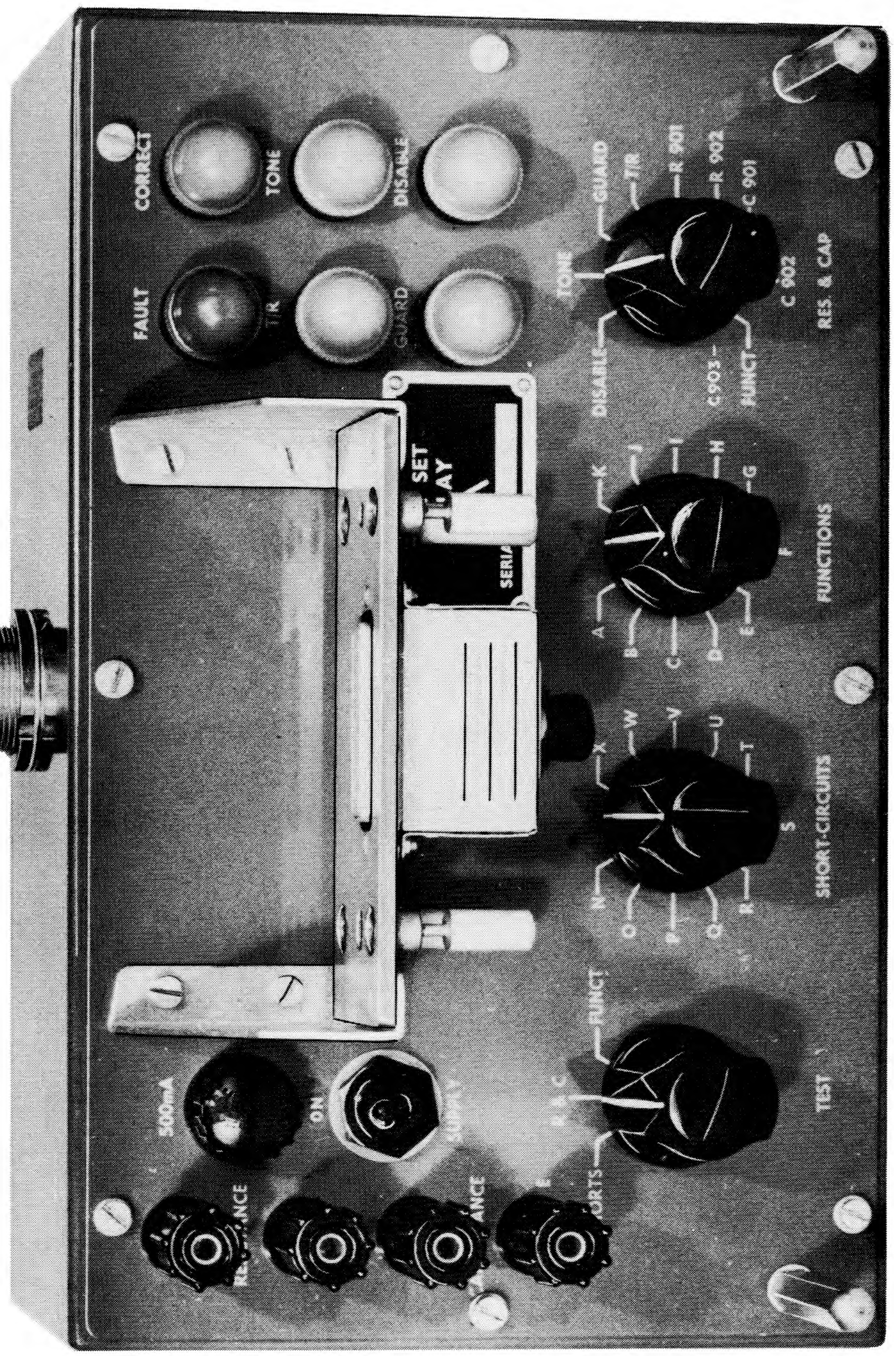


Fig.2 Test set, relay: control panel layout

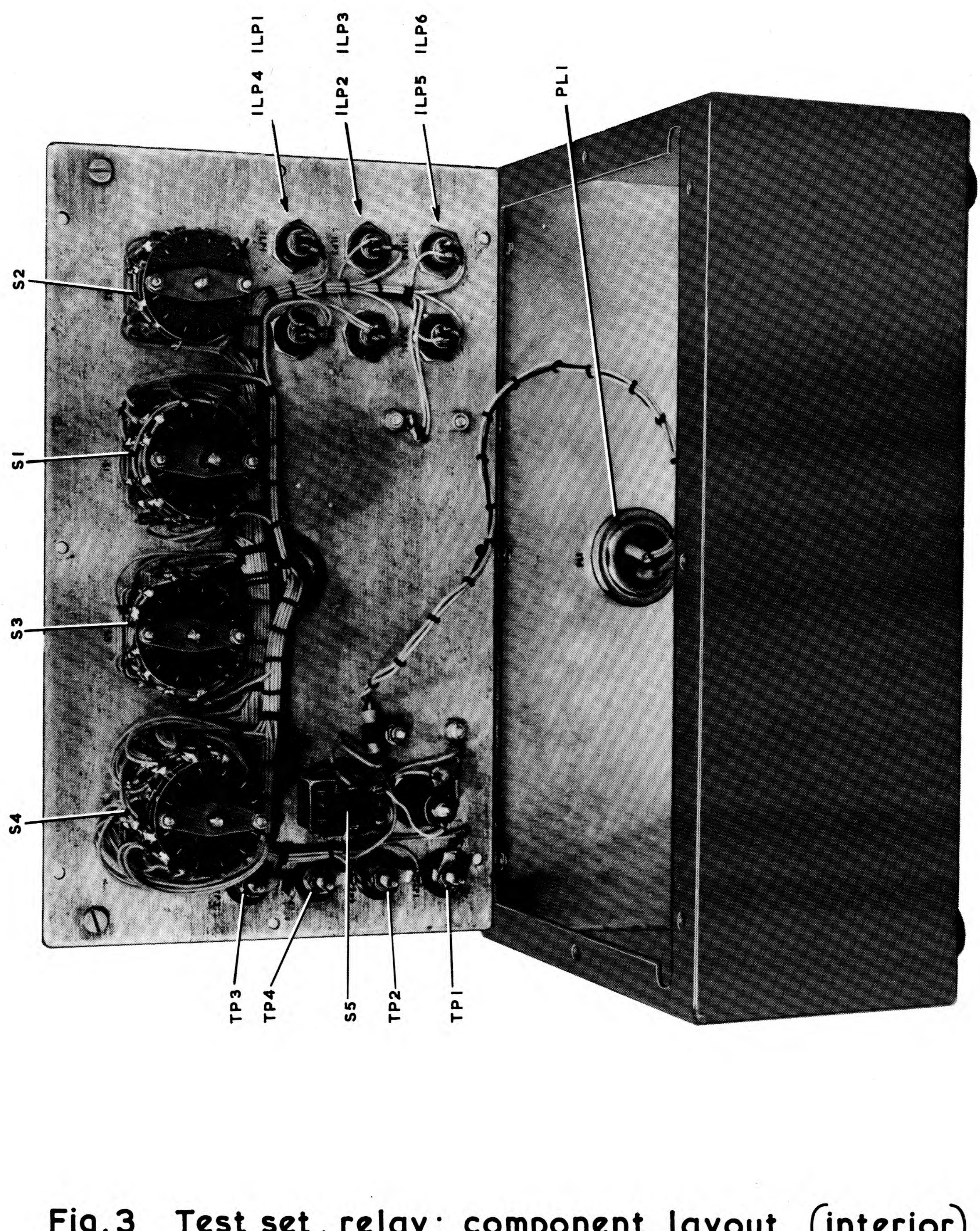
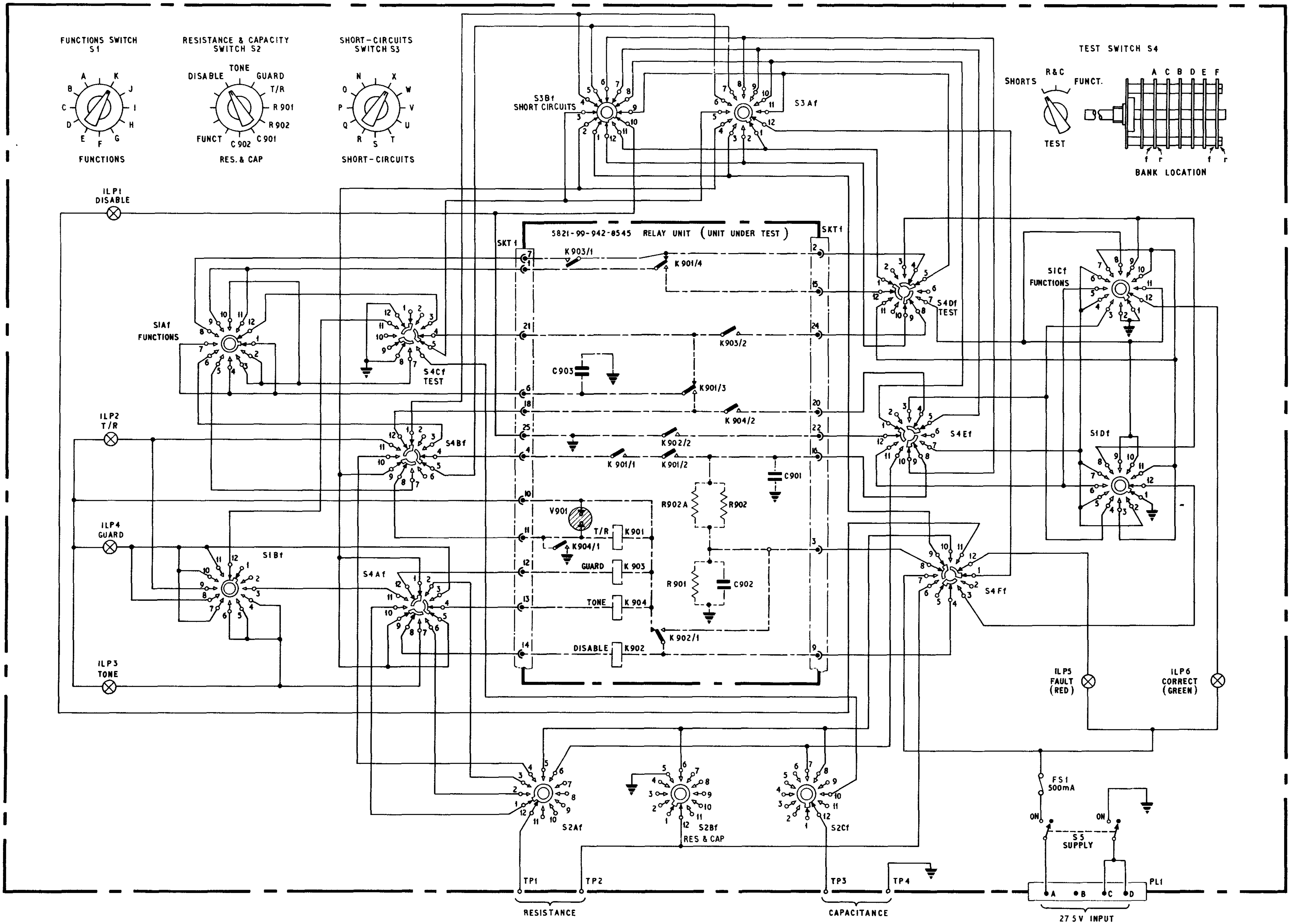


Fig.3 Test set, relay: component layout (interior)


FUNCTIONS SWITCH S1
FUNCTIONS
RESISTANCE & CAPACITY SWITCH S2
DISABLE
TONE
GUARD
T/R
R 901
R 902
C 901
C 902
FUNCT
RES. & CAP
SHORT-CIRCUITS SWITCH S3
SHORT-CIRCUITS
S3Bf SHORT CIRCUITS
S3Af
TEST SWITCH S4
SHORTS
R&C
FUNCT.
TEST
BANK LOCATION
ILP1 DISABLE
ILP2 T/R
ILP4 GUARD
ILP3 TONE
ILP5 FAULT (RED)
ILP6 CORRECT (GREEN)
S1Af FUNCTIONS
S4Cf TEST
S4Bf
S1Bf
S4Af
S1Cf FUNCTIONS
S4Df TEST
S4Ef
S1Df
S4Ff
SKT1
5821-99-942-8545 RELAY UNIT (UNIT UNDER TEST)
K903/1
K901/4
K903/2
C903
K901/3
K904/2
K902/2
K901/1
K901/2
C901
V901
R902A
R902
T/R
K901
K904/1
GUARD
K903
TONE
K904
R901
C902
K902/1
DISABLE
K902
S2Af
S2Bf
RES & CAP
S2Cf
FS1 500mA
ON
S5 SUPPLY
PL1
TP1
TP2
TP3
TP4
RESISTANCE
CAPACITANCE
27.5V INPUT

Chapter 9

TEST SET, AMPLIFIER (MODULATOR)

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LIST OF ILLUSTRATIONS

LEADING PARTICULARS

A.B.C.S. Cat. No.	6625-99-943-6546
Designation	Test set, amplifier (modulator) Comprising: Interconnecting box, test and load unit, and connector.
Purpose	Comprehensive testing of the modulator, radio transmitter 5821-99-942-8548.
Power supply	From power unit (No. 1) 5821-99-932-2942
Dimensions (approx.)	Test and load unit, 11 in. x 7 in. x $5\frac{3}{4}$ in. Interconnecting box, $7\frac{3}{8}$ in. x $3\frac{5}{8}$ in. x 4 in.
Weight (approx.)	Test and load unit, $7\frac{1}{4}$ lb. Interconnecting box, $2\frac{1}{2}$ lb. Connector, 14 oz.

Introduction

1. This compound equipment, required for third and fourth line testing and servicing of the modulator, radio transmitter 5821-99-942-8548 which is incorporated in Type TR4/ARC52 and Type TR5/ARC52 transmitter-receiver,

is collectively designated test set, amplifier (modulator) and issued under A.B.C.S. Cat. No. 6625-99-943-6546.

2. As shown in fig. 1, this equipment comprises an interconnecting box, a test and load unit and a flexible connector, with functions as follows:-

(1) The interconnecting box constitutes a head unit into which the modulator under test may be fitted.

(2) The test and load unit is in the form of a metal box containing the load and switching components; the upper face being the control panel, complete with monitoring test points.

(3) The connector, for coupling the interconnecting box with the test and load unit.

3. For tests required to ensure the full serviceability of the modulator, radio transmitter, equipment other than the test set is necessary. These items are standard equipment which should normally be available from Service stores and are listed in Table 1. They are not integral parts of the test set 6625-99-943-6546. A full description and details of methods of using the associated equipment are given in the relevant Air Publications, to which reference should always be made before attempting to use any instrument which may be unfamiliar.

4. Full details of all tests which can be made using the test set and the associated equipment are given in Sect. 2, Chap. 9 of this Volume.

TABLE 1

Associated test equipment

Item	Description	Ref. No.	Other details
1	Power unit (No. 1)	5821-99-932-2942	Chap. 2
2	Signal generator Type 65B	10S/16499	A.P.2879AD
3	Multimeter, electronic, CT38	10S/16308	A.P.2879AG
4	Indicator, distortion	10S/17639	Marconi Type TF.152F
5	Simulator, microphone	6940-99-943-6545	Vol. 1 of this A.P.
6	Oscilloscope Type 13A	10S/831	A.P.2879AF

5. The complete equipment is classified under Inter-Services Specification K.114, as K.114/D ground equipment, protected for use in permanent buildings. It is rated to function correctly in ambient temperatures of +40 deg. C at a relative humidity of 95%. This equipment will operate correctly in ambient temperatures down to -26 deg. C.

Interconnecting box

Construction

6. The interconnecting box comprises principally a metal box, served by a detachable coupling plug, and attached to one end of a fabricated steel fixture into which is fitted the modulator undergoing tests.

7. A pressing in sheet steel, the interconnecting box is fitted with an end cover through which is positioned an 18-way Mk.4 fixed plug which is the mating part of the socket of the flexible connector between the interconnecting box and the test and load unit. The end cover is secured

to the box by four cheese head screws fitted with locknuts.

8. The wiring of the interconnecting box is cable-formed and led to a Cannon D type socket fitted through the mounting plate of the fixture to receive the mating plug of the modulator on test.

9. The fixture is stoutly constructed in heavy steel plate with one open side andapertures through which access can be gained for servicing the modulator undergoing tests. The base plate is raised to provide a well accommodating the cable loom and to protect the underside of the Cannon socket and the hand screws by which the modulator is secured in position during testing. Portions of the mounting plate are cut away to afford clearance for components on the underside of the modulator when fitted in the test position, and holes are provided to receive the locating dowels of the modulator.

10. When fitting the modulator unit into the test fixture, carefully mate the locating dowels into the holes in the mounting plate and ensure that the Cannon plug and socket are correctly aligned before tightening the four knurled-head securing screws. These screws enter tapped holes in the base of the modulator unit which are normally used to secure the unit into the main chassis assembly of the parent equipment. Take care not to over-stress the securing screws; finger tightness only should be sufficient to retain the unit firmly in position throughout all tests.

Test and load unit

Construction

11. The test and load unit is fabricated into a rectangular open topped box which is supported on four stainless steel feet. The top aperture is closed by a heavy gauge metal plate secured by twelve countersunk screws which engage with anchor nuts riveted on the underside of a continuous flange formed around the lip of the box.

12. The top plate consitutes the control panel of the test and load unit. The layout of all controls and the monitoring test points is shown in fig.2.

13. Both the top plate and the base of the box are each pierced by a large aperture. These are covered by expanded metal mesh and provide a cooling airflow for the dissipation of heat generated within the box by the load resistors. In addition, a metal partition is fitted transversely within the box to shield the remaining switch components, relay and transformer which are fitted into this unit.

14. It is important that this unit is free standing when operated and that the apertures are unobstructed. To this end, a large metal plate is fitted to guard the top aperture yet permit adequate ventilation of the load resistor compartment. The mounting feet raise the complete box from the surface of the bench to permit a free flow of air through the base of the unit.

15. Into the rear wall of the box is fitted the input connector plug from which the internal wiring is cable-formed. The output socket, mating with the inter-unit connector, is fitted into the side wall at the switch compartment.

16. The cable-formed wiring is of sufficient length to enable the top plate to be removed without the necessity for unsoldering or for disconnecting the circuit. This facility is of considerable value when any servicing of components is required.

17. On the top plate, and protruding one from each corner, are fitted four stainless steel studs. These permit the top plate to be inverted on the bench when removed for access to components within the box or on the under side of the top plate, e.g. switches, transformer. The steel studs also provide a measure of protection for the switches on the top cover should the unit be inadvertantly tumbled on the bench or if other equipment is stacked upon the test and load unit.

18. The layout of components within the test and load unit is shown in fig.3.

Facilities

19. The test and load unit provides the primary facility of transferring all power requirements from the associated power unit (No. 1) to the interconnecting box and thus to the modulator undergoing tests. In addition, a supply is provided within the unit to give a smooth d.c. source for carbon microphone operation; this supply is derived from the h.t. source of the power unit (No. 1). The voltage is at 27.5V $\pm$ 10% with a ripple level not greater than one millivolt r.m.s. for a load current of 50 milliamps. Its source impedance is less than 10 ohms.

20. An isolating switch is provided, marked FINAL AMP, which operates in conjunction with a relay to provide an e.h.t. of +410V d.c. simultaneously with an h.t. of +130V d.c.

21. Provision is made for connection with a microphone simulator (Table 1), with a switch marked UNBAL. MIC/BAL. MIC. giving alternative test conditions to simulate unbalanced microphone and balanced microphone simulation. This switch also isolates the h.t. supply of the power unit (No. 1) from the carbon microphone polarizing source when balanced microphone tests are made.

22. The unit also contains the test power load for the modulator under test. Total resistance is 2,600 ohms $\pm$ 5%, rated for continuous power dissipation of not less than 75 watts.

23. On the top panel, provision is made for the connection of suitable meters (Table 1) for the simultaneous measurement of sidetone characteristics and the output voltage and distortion factor of the generated available modulation power of the unit under test. The voltage available for distortion measurements is nominally 3V.

24. A switch marked TONE OFF ON (S3) is also provided on the top panel, and this makes operative tone modulation by the unit on test. Operation of this switch also electrically isolates the microphone simulator when tone modulation tests are made.

Circuit description

25. A circuit diagram of the complete test equipment (test and load unit together with the interconnecting box) is given in fig. 4 at the end of the chapter.

26. From the associated power unit (No. 1), supplies are brought into the test set at the plug PL1. A supply at 27.5V d.c. is switched through S1 to operate the relay RLA. The contacts of relay RLA1 and RLA2 couple the e.h.t. supply of +410V from pole A of plug PL1 through poles Q of the socket SKT5 and plug PL2 into the interconnecting box via poles Q of the socket SKT6 and plug PL3 and thence to pole 1 of the socket SKT7. The h.t. supply at +130V is coupled directly through the poles C of SKT5 and PL2 to the interconnecting box. At relay RLA3, coupling of the +130V supply is made with poles B of socket SKT5 and PL2 and thus to socket SKT6 and plug PL3. By means of the switch S3, this input of +130V d.c. may also be switched through poles A of socket SKT5 and plug PL2.

27. The h.t. supply is also fed through switch S2 to the voltage divider network, comprising R7, R9 and MR1, and the smoothed d.c. voltage developed across MR1 is used for energizing the carbon (unbalanced) microphone.

28. Through pole E of the input plug PL1 is brought a negative potential of 40V d.c. which is fed to poles L of socket SKT5 and plug PL2, via the 22k ohms resistor R10, to provide the bias supplies required at pole 5 of the socket SKT7.

29. Heater supplies of 6.3V a.c. are brought in through poles C and F of the inlet plug PL1 and are connected directly through the poles N and S of the socket SKT5 and plug PL2 into the interconnecting box, emerging at poles 11 and 13 of socket SKT7 for application to the modulator on test.

30. Those parts of the equipment associated with the input and output circuits of the test equipment are each separately screened. The microphone circuit screening is made electrically common at the interconnecting box and connected as directly as possible to the frame pole of the multi-pole plug of the modulator on test. It is not bonded to any framework. The sidetone circuit screening is treated in a similar manner.

31. The output from the microphone simulator (Table 1) is applied during operation of the equipment to the terminals TP3, TP4 and TP5 (MIC (a), MIC (b) and E). The microphone simulator is designed to simulate the impedance of three types of microphone used with the Type TR4/ARC52 and Type TR5/ARC52 equipments. These may be 82 ohms carbon (unbalanced) microphone, 82 ohms dynamic (balanced) microphone or 200 ohms dynamic (balanced) microphone.

32. With the switch S2 in the UNBAL. MIC. position and the TONE switch S3 in the OFF position, the input applied across the terminals TP3 and TP5 is connected across pole 7 of socket SKT7 and earth.

33. With the switch S2 in the BAL. MIC. position and the TONE switch S3 in the OFF position, the input applied across terminals TP3 and TP4 is connected across poles 7 and 15 of the socket SKT7.

34. When the TONE switch S3 is placed at the ON position, the +130V d.c. supply applied at pole B of the plug PL1 is routed to pole 4 of socket SKT7 and open circuits the microphone inputs from TP3 and TP4.

35. The modulator output load, comprising the resistors R1 to R6, totals 2,600 ohms and is directly coupled through the connector from pole 9 of the socket SKT7. Distortion factor meter terminals are connected across the 51 ohms resistor R3 and may be monitored at terminals TP1 and TP2 (marked DFM). Output voltmeter terminals are connected across the whole load at the sockets SKT1 and SKT2 (OUTPUT).

36. Sidetone output from the modulator on test is coupled from pole 6 of the socket SKT7, through the connector, and is routed to the output voltmeter terminals at SKT3 and SKT4 (SIDETONE) via the 0.01 microfarad capacitor C1 which is wired in series with the 150k ohms resistor R8.

Servicing

37. The equipment should be maintained in a clean, dry condition throughout its service life. Care should be taken to avoid rough handling of switches and controls.

38. Periodically remove the top (control) panel and inspect the unit internally for evidence of overheating. Access can be gained by removing the twelve countersunk screws securing the top panel to the test set box.

The cable-formed wiring is sufficiently long to enable the top panel to be removed without the necessity for disturbing any of the wiring connections. Four steel studs which protrude from the top face enable the panel to be stood inverted on the bench during servicing.

39. Before making any attempt to probe within the box or touch any of the components, be sure that the power supply is switched off or (preferably) switched off and disconnected from the test set. Voltages of up to +410V d.c. are carried by some of the wiring.

40. Whenever a fault is suspected within the internal wiring or cable loom, a continuity test can readily be made using an approved multimeter. Each wire is provided with identification sleeves Type B at each end. Any replacement of the wiring should be made in the appropriate grade of wire, electrical equipment, Type 2, as follows:-

(1) Valve heater current conductors - 23/.0076 in. pink (Ref. No. 6145-99-910-0191)

(2) Microphone simulator signal wiring - 14/.0076 in. pink (Ref. No. 6145-99-942-4171)

(3) All other wiring - 14/.0076 in. pink(Ref. No. 6145-99-910-0185)

41. Wiring connections should be made as neatly as possible, with care taken to avoid tails of excess solder. Clean off any wire clippings or solder spatter before replacing the top panel.

42. Examine the connectors used with this equipment every time before coupling them between units or to the power supply. They should be dry and undamaged, with the plug and socket terminations always making good, firm contact with the mating components of the related equipment.

43. Should the necessity arise for changing the Zener diode (MR1), care must be taken to wire the new component correctly with respect to polarity: there is a red dot at the cathode (positive) lead of the diode.

Operative tests

44. Evaulation of the load on the supply source can be assisted by the following tests to determine current consumption. In addition, these tests will also afford facilities for verifying the correct functioning of the circuit components.

45. A relay supply of 27.5V d.c. should first be connected between the frame and pole L of the input plug PL1 (fig. 4). Then with e.h.t. and h.t. supplies connected, current consumption tests can be made as follows:-

(1) With e.h.t. of 470V d.c. between the frame and pole A of the input plug PL1, current consumption should be approximately 180mA.

(2) With h.t. of 130V d.c. between the frame and pole B of the inlet plug PL1, current consumption should be approximately 115mA.

46. For a performance test (that is for determining the average output voltage across the Zener diode MR1 under average load conditions) the following connections should be made:-

(1) Poles 1 and 9 of the socket SKT7 (interconnecting box) should be short circuited.

(2) A 560 ohms ± 10%, 2W resistor should then be connected between the frame and pole 12 of the socket SKT7.

(3) Controls on the top panel should be set with the microphone switch in the position marked UNBAL. MIC. and the FINAL AMP. switch in the ON position. The position of the TONE switch is immaterial.

(4) The voltage across the 560 ohms resistor should then be measured and its level should be 27V ± 3V.

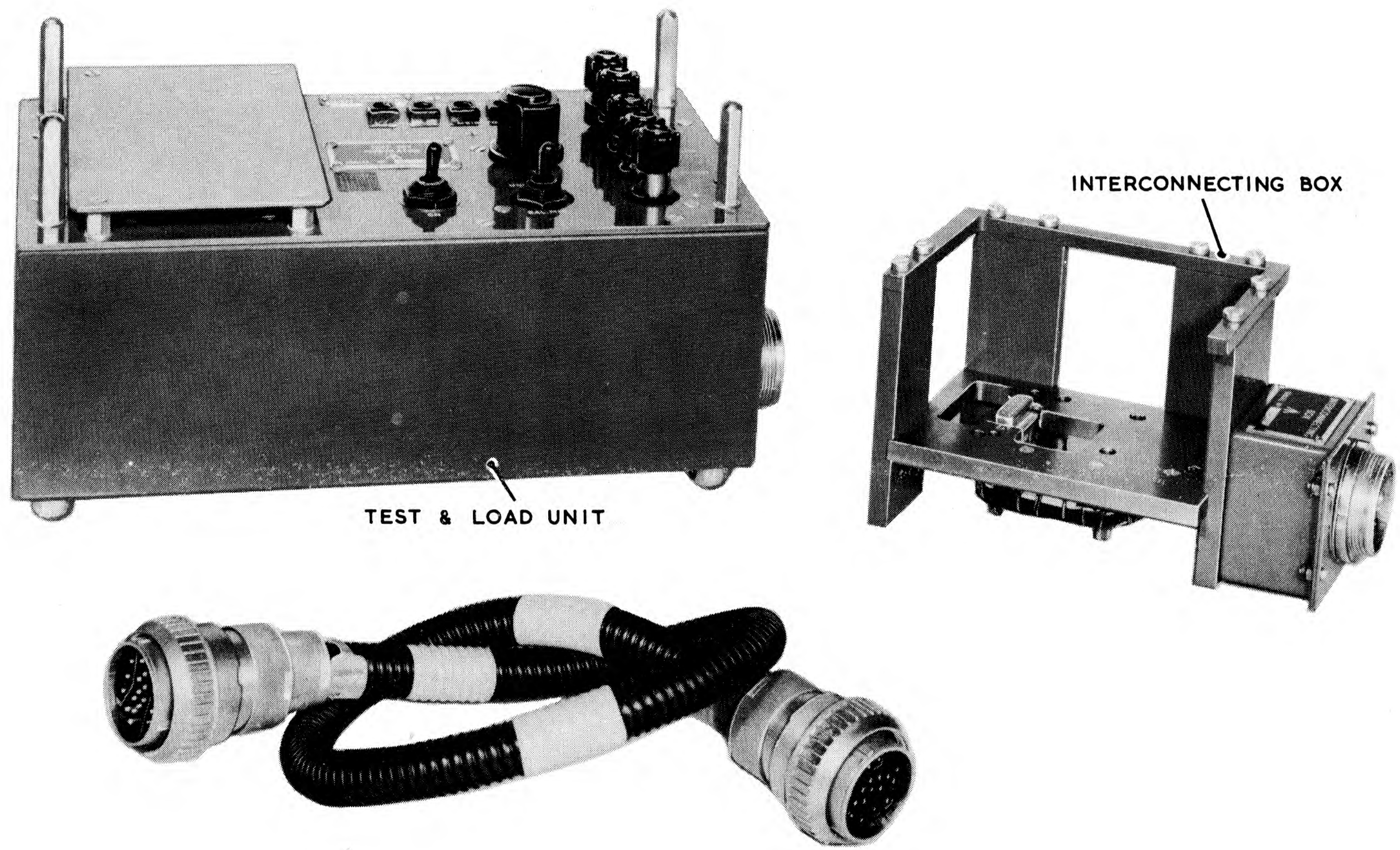

Fig. 1. Test set, amplifier (modulator) 6625-99-943-6546

Fig. 2. Test and load unit : control panel layout

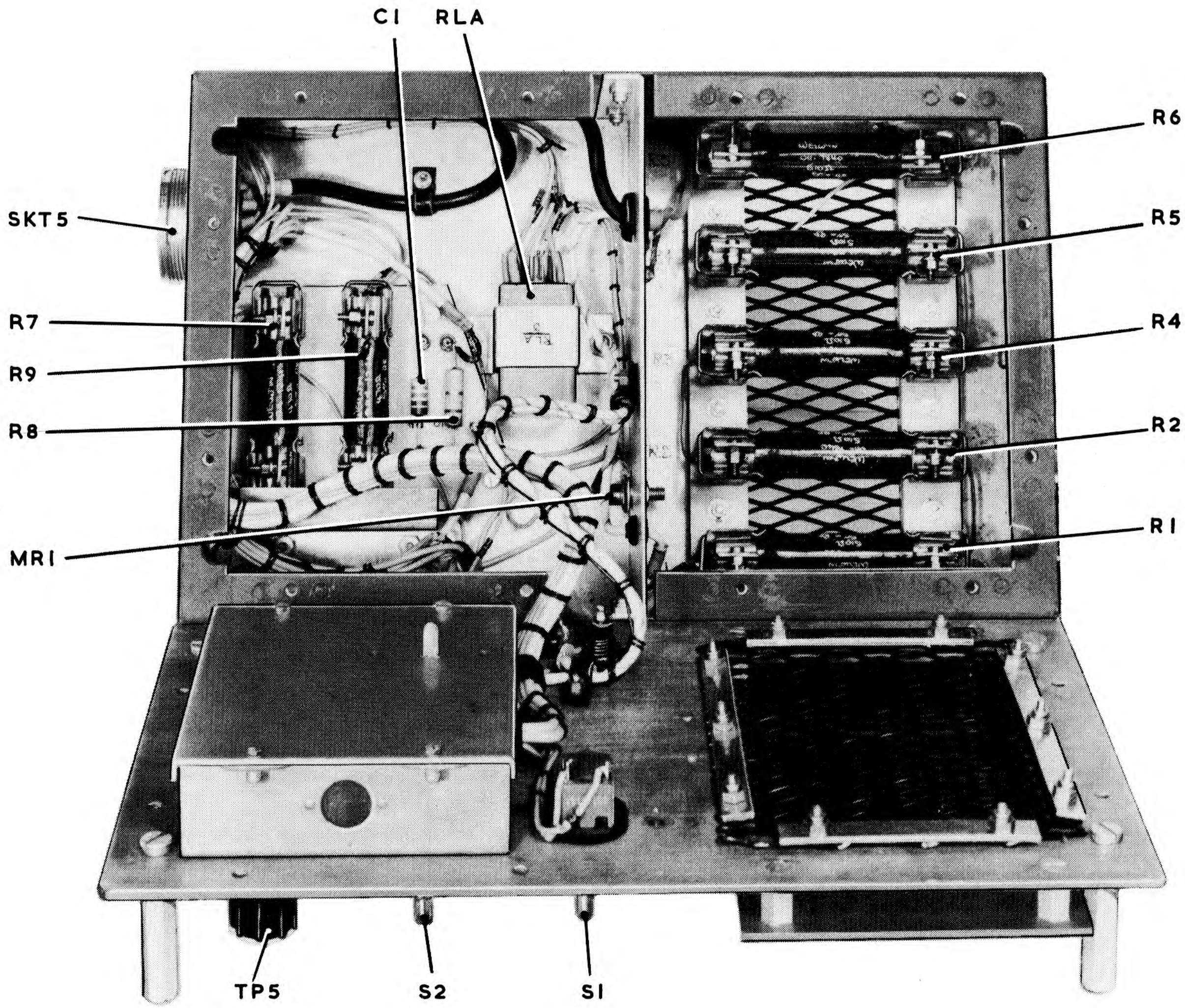

Fig. 3. Test and load unit: component layout

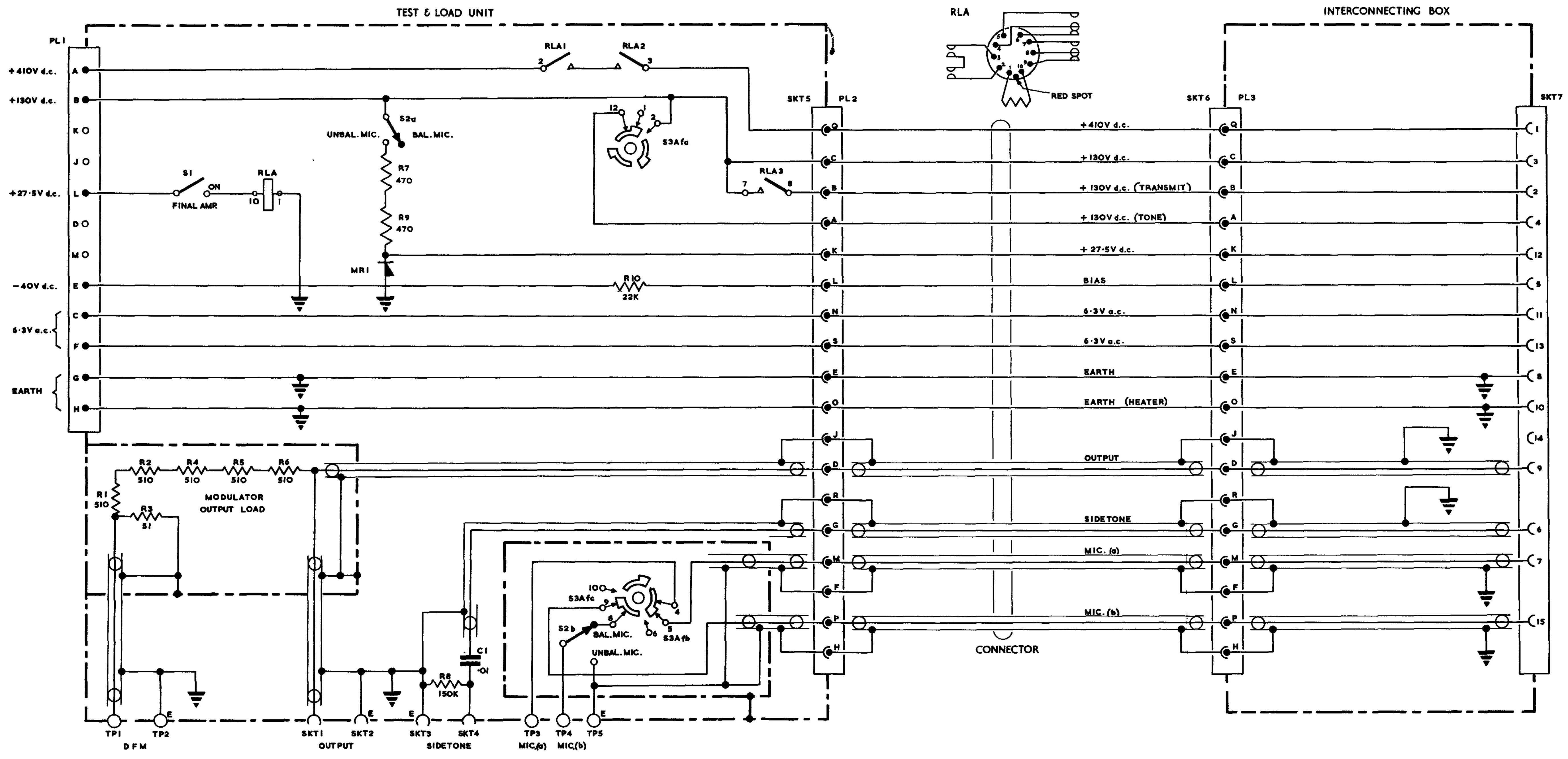

Fig. 4 Test set, amplifier (modulator) 6625-99-943-6546 : circuit

Chapter 10

TEST EQUIPMENT FOR OSCILLATOR UNIT

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LEADING PARTICULARS

<u>Test set, oscillator</u>

A.B.C.S. Cat. No.: 6625-99-943-6547

Purpose: To enable the output from an oscillator unit 5821-99-942-8553 under test to be measured, and provide facilities for the frequency accuracy of its crystals to be determined by comparison with an oscillator housed within the test set.

Comprises:	A test load, comparator oscillator, frequency mixer and meter, mechanical indexing pedestal.
Dimensions:	$12\frac{1}{2}$ in. x $8\frac{1}{2}$ in. x 7 in.
Weight:	$17\frac{3}{4}$ lb.
	Tools and jigs
Ref. No. 10AG/967:	Setting piece, for switch rebuilding and alignment.
Ref. No. 10AG/965:	Assembly fixture, for shaft and coupler alignment.
Ref. No. 10AG/964:	Drill jig, for drilling shaft and coupler.
Tool T.133914:	Distance plate, for determination of correct coupler height above oscillator unit frame during drilling.
Ref. No. 10AG/960:	Height gauge plate, used with depth gauge (Ref. No. 10AG/961) to verify correct coupler height setting after drilling.
Ref. No. 10AG/966:	Checking fixture for verification of switch settings.

TEST SET OSCILLATOR

Introduction

1. In conjunction with other items of general service test gear (listed in Table 1), the test set, oscillator 6625-99-943-6547 has been designed to facilitate third and fourth line servicing and testing of the oscillator unit 5821-99-942-8553 which forms part of the transmitter-receiver TR4/ARC52 and TR5/ARC52.

2. The test set forms a mounting for the oscillator unit under test and provides facilities for indexing the rotary crystal switches incorporated so that the operation of all crystals may be tested. Since the oscillator unit contains two crystal oscillator circuits which combine to give one output, means are provided by the test set for disabling either oscillator by the application of a high grid bias voltage.

3. Housed within the test set, and in a temperature controlled oven, is an oscillator unit which is used as a comparator oscillator. This comparator is a standard ARC52 oscillator which is modified by the fitting of crystals having a temperature range corresponding to the working temperature of the test set oven. The crystal switches of the comparator oscillator are linked with the indexing system and the disabling bias is interconnected with that to the unit under test. The test set provides means for comparing the outputs of the two oscillator units and displaying the frequency difference on a meter (fig. 1).

Construction

4. The test set is basically a rectangular metal box with removable front panel and fitted with diecast aluminium mounting blocks which serve as mounting feet. The mounting feet are arranged to tilt the test set when in use on the bench in order to provide ease of access for operation and alignment during testing.

5. The front face of the set constitutes the control panel, upon which are mounted the meter, controls, switches and screw terminals, and the power supply input plug. To the right of the control panel a test pedestal is provided to accommodate the oscillator unit on test.

6. Provision for the protection of front panel components, such as switches, indicator lamp and meter, is made by means of two hexagonal steel pillars mounted one at each corner of the front panel remote from the test pedestal.

7. The front (control) panel is detachable for servicing of internal components (fig. 2). The complete panel may be lifted clear of the casing after the removal of ten cheese head screws which are spaced around the periphery of the panel. Do not, however, remove the four cheese head screws of similar size which are set in a short distance from the edge of the panel; these retain the four pillars on which is mounted the stand-off plate carrying the components (valves, resistors etc.) which are not fitted through the control panel.

8. Also within the casing and attached to the rear of the front panel is the comparator oscillator, enclosed within a thermostatically controlled oven of composition material. The oven is retained simply by a spring clip arrangement, so that access to oscillator components is achieved by pulling the box-like cover carefully upward clear of the test set; the cableform wiring to the oscillator and thermostat winding is of sufficient length to enable the oven to be lifted completely free.

Associated test equipment

9. To provide the required performance monitoring facilities when testing the oscillator unit, additional items of test gear are required. These are listed in Table 1, together with details of relevant instructional or reference publications.

TABLE 1

List of associated test equipment

Item	Description	Ref. No.	Further details
1	Power supply (130V)	6130-99-999-7812	Sect. 1, Chap.2
2	Multimeter, electronic, CT38	10S/16308	A.P.2879AC

Facilities

Power supplies

10. From the power supply (130V) as shown in the circuit diagram (fig. 8).

Monitoring and metering

11. Incorporated in the test set is a temperature controlled comparator oscillator which heterodynes with the oscillator on test, the difference frequency being displayed on a panel mounted meter. A rotary switch on the front panel performs the function of disabling either the 1 Mc/s or 0.1 Mc/s oscillators of both the unit under test and the comparator oscillator, in order that measurements may be made on the oscillator circuit left operating.

12. Terminals mounted on the front panel make provision for the connecting of a voltmeter (Table 1) for monitoring the outputs of

the comparator oscillator. Provision is also made to enable the output of the unit on test to be applied to the mixer circuit of the test set and, simultaneously, to monitor this signal on a voltmeter (Table 1).

13. A red lamp positioned on the front panel indicates cycling of the comparator oscillator oven.

Circuit description

14. A circuit diagram of the test set, oscillator is shown at fig. 8 at the end of this chapter. This circuit is drawn with each of its functions clearly defined and the following circuit description is divided under headings for each of these facilities.

Power supplies

15. Power supply (130V) from which all power requirements are derived is connected to the test set, oscillator via the power supply connecting cable (5995-99-932-4017) to plug PL1 on the test set.

16. All outgoing supplies are connected from socket SKT1 to the oscillator unit on test.

17. A supply of +130V is applied at pole A of plug PL1 and routed via the single-pole switch S1 (H.T. ON) and pole 6 of socket SKT1 to the oscillator unit on test.

18. A supply of +130V is also applied at pole B of plug PL1, providing h.t. for the test set.

19. Heater supplies, variable between 0V and 10V a.c., are applied at poles C and G of plug PL1 and routed directly to pole 1 of socket SKT1 and earth, respectively. Poles C and G are linked to poles F and H where monitoring of the heater supply voltages at the unit on test may be made.

20. At poles D and G of plug PL1, 28V a.c. is applied for operating the oven of the comparator oscillator.

21. A bias voltage, variable between 0V and -50V with respect to the frame, enters the test set at pole E of plug PL1 and is routed to test points J and K on the comparator oscillator and, for monitoring purposes, to terminals TP4 and TP3, via the DISABLE OSC. switch (S2).

22. With switch S2 in position J the oscillators of test points J of both the comparator oscillator and the unit on test are biased to cut-off; with switch S2 indexed to position K the oscillators of test points K of both the comparator oscillator and the unit on test are biased to cut-off. An isolated heater supply, variable between 0V and 10V a.c., enters at poles J and K of plug PL1, pole J being connected to the frame of the test set.

Test load

23. The test load for the unit on test is the non-inductive 10-kilohms resistor R5; one terminal of this resistor is connected to the test set h.t. supply through an r.f. decoupling network comprising resistor R3 and capacitor C2 shunting both resistor R3 and the h.t. supply. The other terminal of resistor R5 is connected to socket SKT6 and so coupled to the unit on test.

24. A similar load is provided for the comparator oscillator; in this case the non-inductive load is resistor R4, the decoupling network comprises resistor R2 and capacitor C1 and connection to the comparator oscillator is effected via socket SKT5.

Comparator oscillator

25. The comparator oscillator is, effectively, a duplicate of the oscillator under test but is fitted with crystals having a different temperature range. This oscillator is enclosed in a thermostatically controlled oven (fig. 2) maintaining an internal temperature between 76°C and 80°C.

Frequency mixer and meter

26. The mixer valve V1 has the output frequency of the comparator oscillator applied via capacitor C3 to its suppressor grid and the incoming frequency from the unit on test applied via capacitor C4 to its control grid. The resultant heterodyne frequencies are then fed from the anode of valve V1 via capacitor C6 to a filter network.

27. This network, comprising resistors R11, R12 and R13 and capacitors C7, C8 and C9, is designed to pass only the lower heterodyne frequency. This beat note, now in the a.f. range and of sinusoidal waveform, is applied to the grid of valve V2; the amplified a.f. signal at the anode of valve V2 is fed to the pulsing valve (V3) via capacitors C10 and C11 and resistor R19.

28. Valve V3 is operated with a low screen voltage, derived via resistor R20. This low screen voltage produces the effect of a reduced control grid bias and the resultant waveform at the anode of valve V3 is approximately a square wave.

29. The square wave output of valve V3 is applied to the grid of the beam tetrode (V4) via capacitor C15. At this stage further amplification takes place and the signal is then fed to the anodes of the double diode valve V6.

30. A stabilized bias voltage for valve V6 is supplied by valve V5 and resistor R27.

31. Valve V6 and its associated components function as a frequency counter, the repetition frequency being displayed on meter M1 directly in cycles per second. Two ranges are available, either can be selected by the switch S3; these ranges are 0-100 c/s and 0-1000 c/s. When switched to the position marked 0-100 c/s, capacitor C17 is in series with the anodes of valve V6 and the potentiometer RV1 is in series with diode MR1. When switch S3 is indexed to the position marked 0-1000 c/s, capacitor C18 and potentiometer RV2 are brought into operation.

32. Because of the rectifying action of the diode MR1, all pulses developed across RV1 or RV2 are unidirectional. The pulse repetition frequency is that of the a.f. input signal at V2, all the pulses being of constant amplitude.

33. The pulses developed across either RV1 or RV2 are applied to the meter M1, in series with the multiplier resistor R28. The meter scale is directly calibrated in cycles per second so that variations in mean current may be read directly as variations in frequency up to a maximum of 1000 c/s.

Mechanical indexing system

34. Provision is made for mounting the indexing system with the pedestal fitted through the front panel of the test set. As shown in fig. 1, this pedestal is provided with shafts, couplers and appropriate dowel holes, to enable both the unit on test and the comparator oscillator (within the test set) to be accurately positioned on it.

35. The shaft that is coupled to the switch which selects the frequencies in the range 24.9 Mc/s to 33.9 Mc/s is provided with

a twelve-position indexing plate and a registration dial so marked that, with clockwise rotation, the numbers 0 to 9 are successively indexed; with two blank positions between the numbers 9 and 0. The dial is positioned on the shaft so that when 0 is indexed, the crystal Y1901 of the unit on test is made to oscillate. As the numbers 1 to 9 are indexed consecutively, so the crystals Y1902 and Y1910 respectively are made to oscillate.

36. The shaft coupled to the switch which selects the frequencies in the range 2.15 Mc/s to 3.05 Mc/s is provided with a ten-position (equally spaced) indexing plate and a registration dial marked so that, with clockwise rotation, the numbers .0 to .9 are consecutively indexed. The dial is so positioned on the shaft that when .0 is indexed the crystal Y1911 of the unit on test and also that of the comparator oscillator is made to oscillate; as the numbers .1 to .9 are indexed in succession so the crystals Y1912 to Y1920 are made to oscillate.

37. The indexing head sets the switch shafts of the unit on test and the comparator oscillator accurately to within $\pm$ 1° of arc of the nominal positions.

Servicing

38. The equipment should be maintained in a clean, dry and undamaged condition, throughout its service life. Care must be taken to avoid rough handling of the switches and controls. Whilst the test set is on the bench keep the working area clear of any servicing tools, soldering irons, etc.

39. Periodically remove the front panel and inspect the switches and wiring; access can be gained by removing the eight cheese head screws securing the front panel.

40. Whenever a fault is suspected within the internal wiring, a continuity test can be readily made using an approved multimeter. Wiring employed conforms to DEF.10, DEF.12A or DEF.14 as applicable and replacement wiring should be made with the correct grade of wire; the connections should be made as neatly as possible with care taken to avoid tails of excess solder. Remove any wire clippings and excess solder before replacing the front panel.

41. Examine the connectors each time before coupling them to the oscillator test set, the equipment on test and the power supply (130V). They should be undamaged and dry, with the plug and socket terminations making good, firm contact with the mating components on the related equipment.

Overall testing

42. A circuit diagram of the complete unit is shown at fig. 8 at the end of this chapter and a study of the diagram will provide all the information necessary for clearing normal faults.

43. Before disconnecting a semi-conductor diode suspected of being faulty, note carefully the way in which the polarity is effected and fit the new component similarly.

44. Particular care should be taken to avoid rough handling of any high stability resistors.

45. When repairs or replacements have become necessary, tests should be made to determine that the equipment has been restored to a serviceable condition equivalent to that of a new unit, as issued, which has been inspected to factory standards.

Switch rebuilding tools

46. The double wafer switch S1901 of the oscillator unit may be replaced complete or, following repair, it can be rebuilt for further service. For the purposes of rebuilding and aligning the switch before fitting it into the oscillator unit a special tool is available, supplied under Ref. No. 10AG/967. This tool is shown in fig. 3.

47. The setting piece Ref. No. 10AG/967 comprises a heavy steel base plate into which are fitted two large diameter screwed pillars for the correct spacing of the top plate, correct spacing being essential for faultless operation of the two switch wafers when assembled. A large thumb nut is provided for each of the two screwed pillars to clamp the top plate in position. Both thumb nuts are threaded to provide a quick release action, requiring only a part turn to release the top plate.

Coupler assembly tools

48. The complete procedure for replacement of switch shafts and the subsequent fitting of Oldham coupler plates is described in Sect.2, Chap. 19 of this Volume. The equipment described therein comprises the assembly fixture Ref. No. 10AG/965, the drill jig Ref. No. 10AG/964, the height gauge plate Ref. No. 10AG/960 and checking fixture Ref. No. 10AG/966. Each piece of test gear is described in subsequent paragraphs with a general review of its function; for further details of methods of use refer to Sect. 2, Chap. 19.

49. The assembly fixture Ref. No. 10AG/965 (fig. 4) comprises a base plate upon which is mounted the oscillator unit whilst the switch shaft is clamped in a shaft anvil by means of the Brauer clamps to enable drilling and reaming of the assembled coupler plate and shaft to be done.

50. For the drilling and reaming of the coupler plate and shaft, the drill jig Ref. No. 10AG/964 (fig. 5) is used. This jig is secured in position over the coupler end of the oscillator unit by means of the two finger screws. End play of the switch shaft is taken up by means of the central knurled finger screw, then the coupler alignment pieces on the underside of the drill jig are brought into engagement with the coupler plate by means of the two lower finger screws. Holes are drilled through the plate to enable the engagement to be viewed. The correct gap between the face of the oscillator unit frame and the underside of the coupler is set by means of the distance plate, Plessey tool No. T.133914.

51. When drilling and reaming is completed, the height of the coupler above the end face of the oscillator unit frame must be carefully ascertained. In other modules of the transmitter-receiver a small go/no go gauge is used, but as the frame of the oscillator unit is of light alloy sheet the height gauge plate Ref. No. 10AG/960 (fig. 6) is used to avoid any discrepancies which may occur due to distortion of the oscillator unit frame. The height gauge plate is fitted to the end face of the oscillator unit with the assembled coupler plates engaged in large diameter holes drilled through the plate. The height gauge plate is secured in position by four finger screws which engage into tapped holes in the oscillator unit. The depth gauge Ref. No. 10AG/961 may then be placed squarely on top of each coupler plate in turn and tested with a straight edge across the face of the height gauge plate. The top of the depth gauge is accurately ground with a 0.010 in. step, corresponding to the 0.070 in./0.080 in. tolerance allowed during the fitting of all coupler plates.

52. The checking fixture Ref. No. 10AG/966 is shown in fig. 7 and comprises a flat plate with two securing screws, by which it is fitted over the coupler end of the oscillator unit, and with a raised base which is drilled with four pairs of holes. A knurled headed pin is provided for insertion into each hole of each pair in turn during the verification of the switch settings, as described in Sect. 2, Chap. 19.

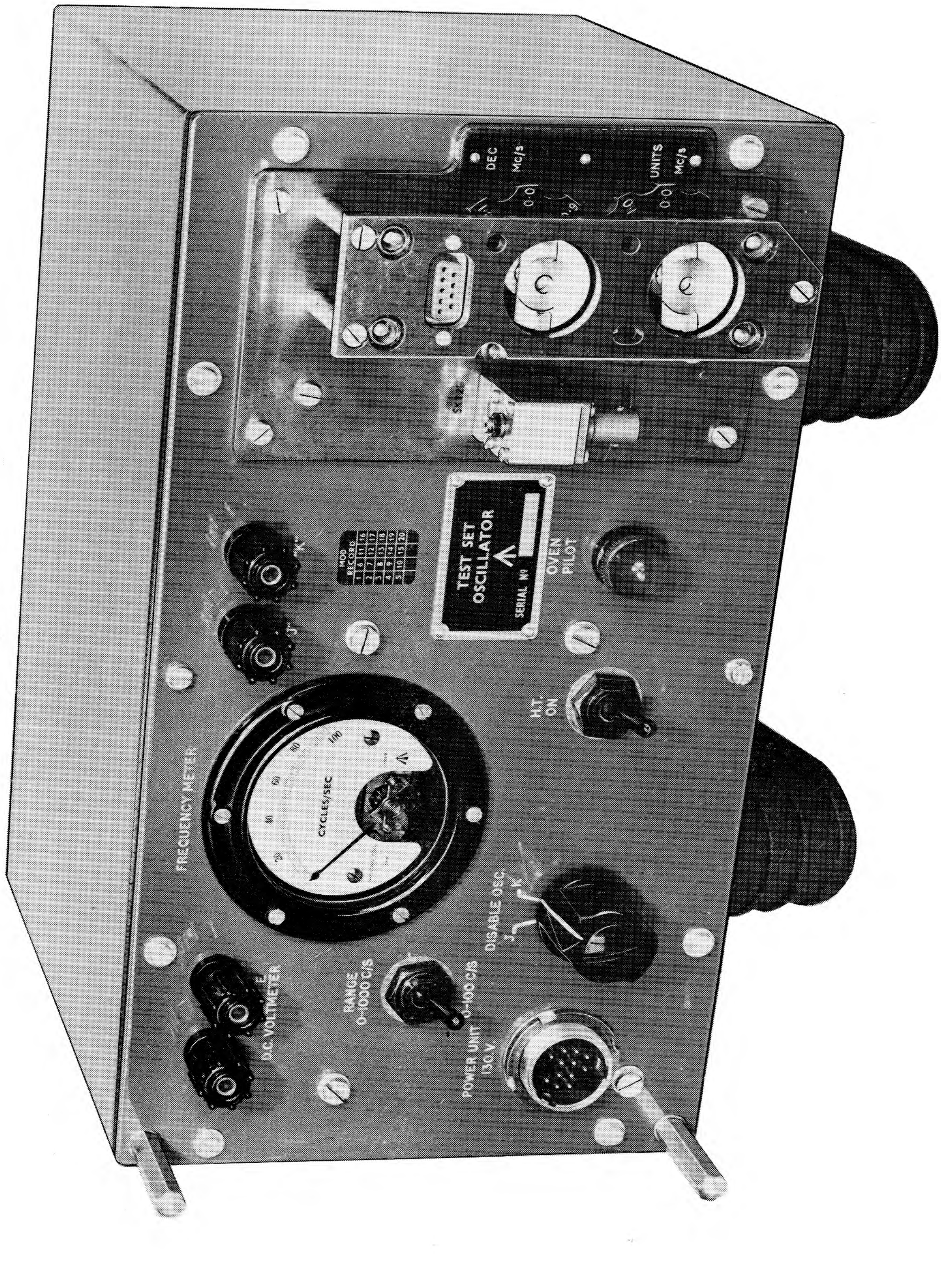

Fig. 1. Test set, oscillator – general view showing control panel layout

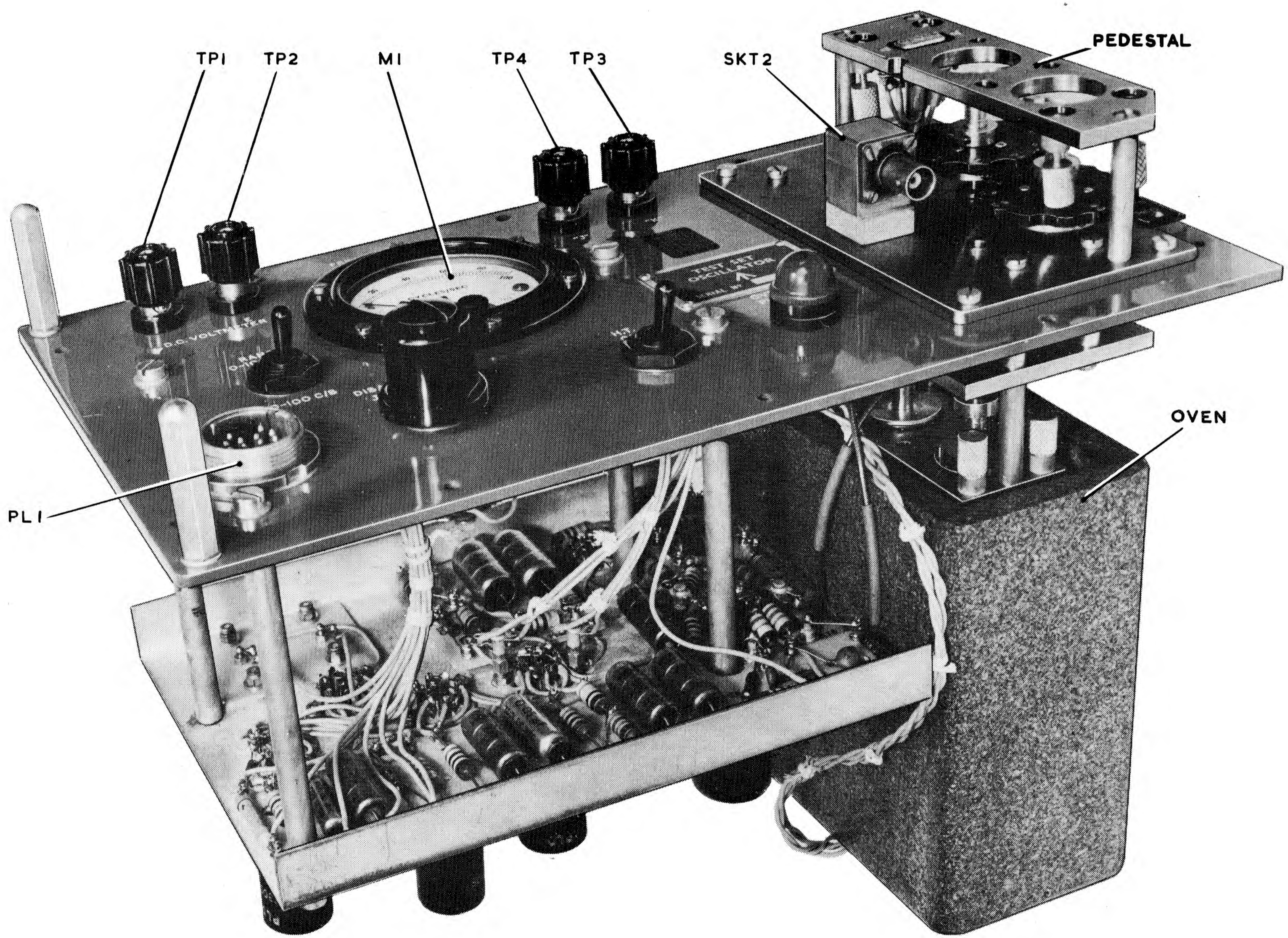

Fig. 2. Test set, oscillator; component layout (interior)

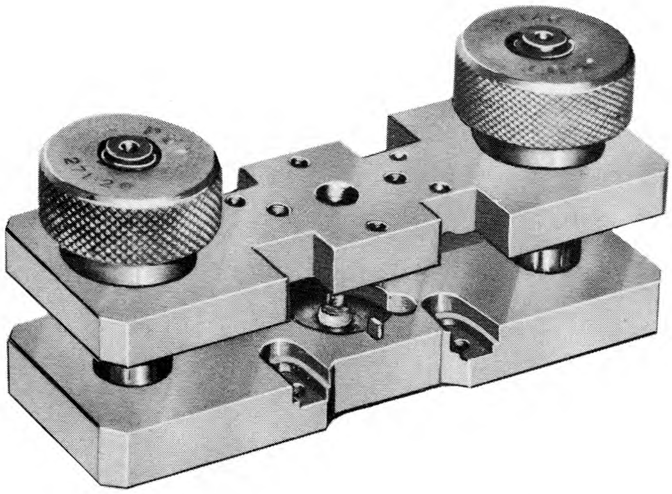

Fig. 3. Setting piece Ref. No. 10AG/967

Fig. 4. Assembly fixture Ref. No. 10AG/965

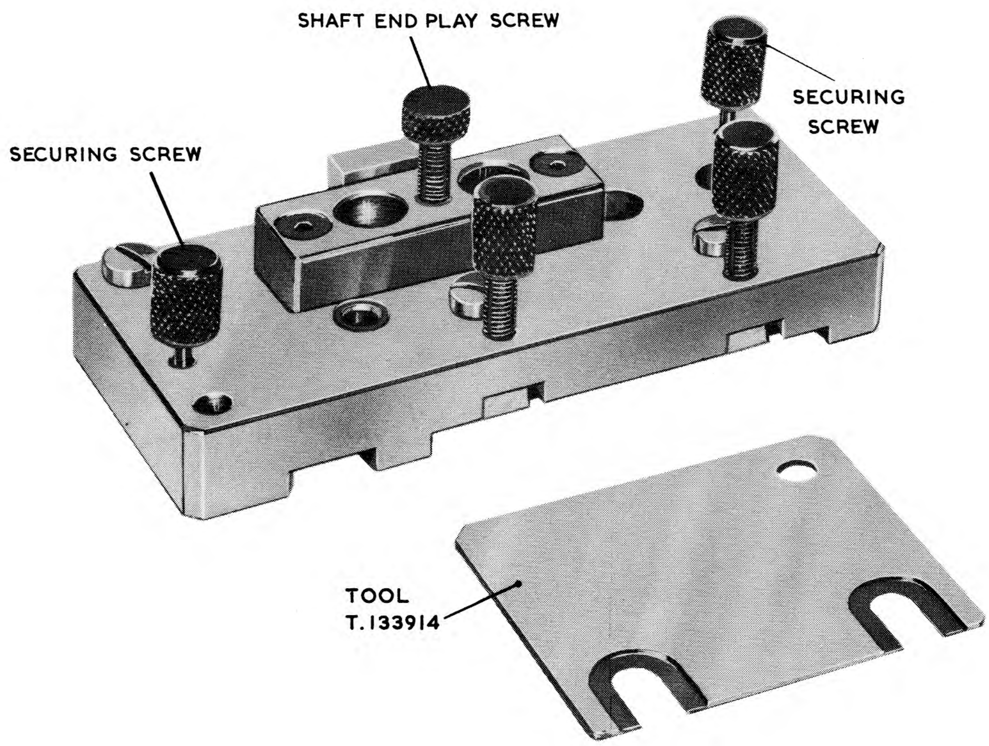

Fig. 5. Drill jig Ref. No. 10AG/964 and tool T.133914

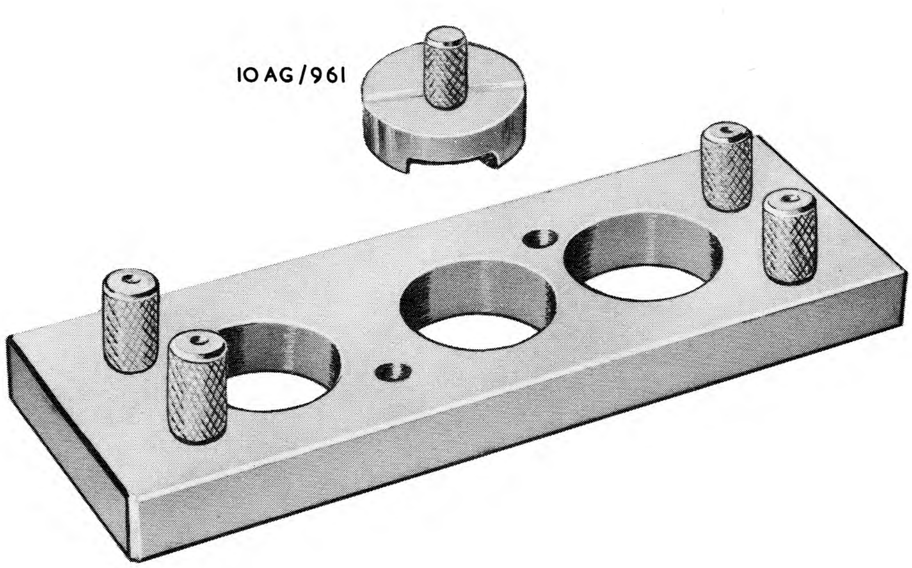

Fig. 6. Height gauge plate Ref. No. 10AG/960

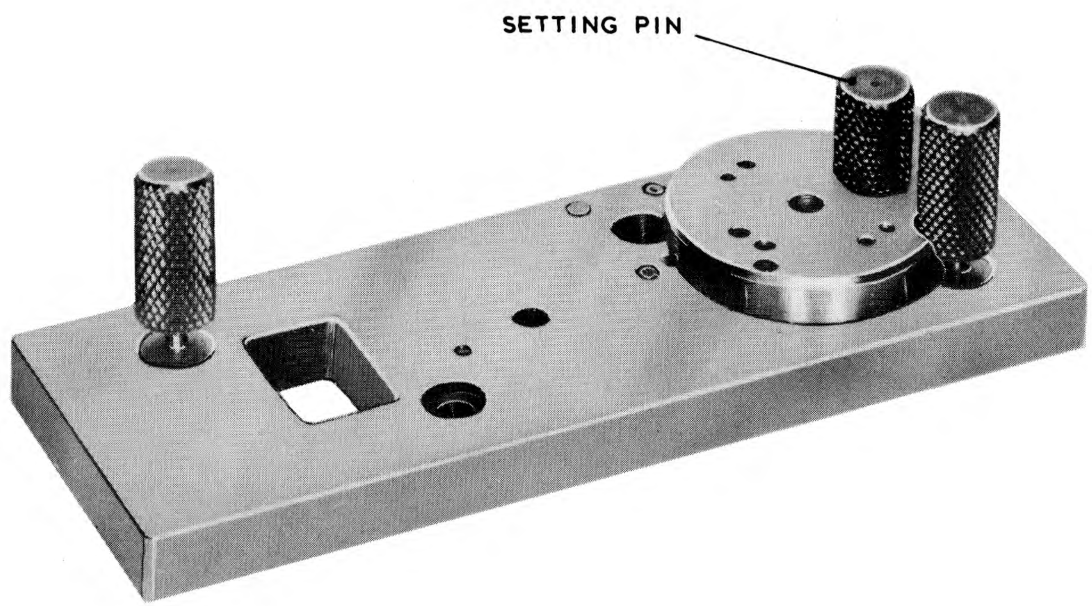

Fig. 7. Checking fixture Ref. No. 10AG/966

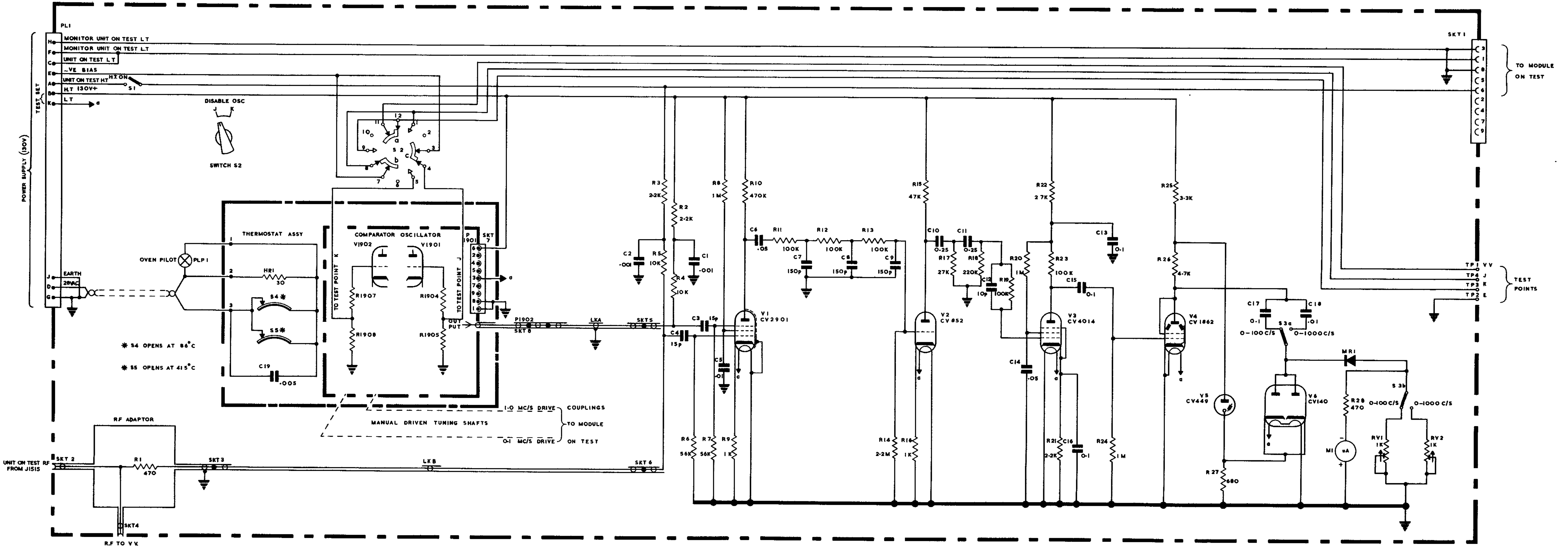

Fig. 8 Test set, oscillator 6625-99-943-6547 circuit

Chapter 11

TEST EQUIPMENT & TOOLS FOR AMPLIFIER, RADIO FREQUENCY (RF POWER AMPLIFIER)

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LIST OF TABLES

LIST OF ILLUSTRATIONS

LEADING PARTICULARS OF THE TEST SET, AMPLIFIER (P.A.)

Purpose : Test equipment to enable the amplifier, radio frequency (RF power amplifier) to be operated and tested.

Comprises:-		(1) Test set, amplifier, 6625-99-945-2657
		(2) Test unit, amplifier, 6625-99-945-2656
		(3) Cable assembly, power, electrical (10-way), 5995-99-914-7510
		(4) Cable assembly, power, electrical, Type 3430/1 (4-way), Ref. No.10HA/8360
		(5) Cable assembly, power electrical, Type 3429/1 (3-way), Ref. No. 10HA/8359
		(6) Cable assembly, radio frequency, Plessey Part No. CP.243439/3
		(7) Cable assembly, radio frequency, 5995-99-932-2130
		(8) Socket assembly, electrical, 5935-99-932-2381
		(9) Blower, air, Plessey Part No. CP.243705
		(10) Hose assembly, air duct, 4720-99-915-0270
Cat. No.	:	6625-99-999-7814
Functions	:	(1) To simulate circuit supply conditions when testing units of the transmitter-receiver Type TR4/ARC52 and Type TR5/ARC52.
		(2) To monitor the r.f. power and drive output pass level of the unit on test.
		(3) To monitor the output level of the amplifier unit (main receiver and transmitter preamplifier).
		(4) To monitor the e.h.t. and h.t. currents drawn by the unit on test.
		(5) To monitor the valve heater supplies.
		(6) To facilitate the alignment of the tank circuits in the unit on test.
Dimensions (approx.)	:	Test set, amplifier - $17\frac{1}{4}$ in. x $15\frac{3}{4}$ in. x $10\frac{3}{8}$ in.
		Test unit, amplifier - 7 in. x $6\frac{3}{4}$ in. x 4 in.
		Blower, air - $5\frac{1}{2}$ in. x 5 in. x 6 in.
Weight (approx.)	:	Test set, amplifier - 34 lb.
		Test unit, amplifier - 6 lb.
		Blower and hose assembly - $4\frac{1}{2}$ lb.
		Connectors - $2\frac{1}{4}$ lb.

Introduction

1. In conjunction with the other items of general service test gear, listed in Table 1, the test set, amplifier (P.A.), 6625-99-999-7814 (fig. 1) has been designed to facilitate third and fourth line testing of the amplifier, radio frequency (RF power amplifier) which is part of the transmitter-receiver Type TR4/ARC52 and Type TR5/ARC52.

2. In order to perform full functional tests on the amplifier, radio frequency (RF power amplifier) it is necessary to connect it to a number of other sub-units of the transmitter-receiver so that its inputs and outputs are supplied and loaded as during normal operation. This test set, which is designed for full functional testing of the r.f. power amplifier unit, contains one of each of the necessary sub-units and all the interconnections between them, both electrical and mechanical. For reliable results to all tests made using the test set, all these sub-units must be completely serviceable; they should, therefore, be tested regularly as described in the appropriate chapter in Sect. 2 of this Volume.

Construction

3. The test set, amplifier, 6625-99-945-2647 is based on a standard instrument case, complete with side mounted carrying handles and instrument panel cover. The cover is a dished pressing in sheet metal with rubber moulding fitted round the lip. Ten large headed screws are provided to secure the cover in position during transit or storage of the equipment.

4. The front panel constitutes the control panel of the test set and on this are mounted the meter, controls, input and output plugs and sockets, indicator lamps and monitoring sockets. Provision for the protection of control panel components against damage whilst the equipment is in use is made by means of four hexagonal steel pillars, mounted one at each corner of the control panel.

5. The test unit, amplifier, (Cat. No. 6625-99-945-2656) (fig. 1) which is associated with the test set, is principally a raised mount upon which is fitted the amplifier unit undergoing test. Provision is made for engagement of the Oldham coupler into an indexing gear which may be adjusted by means of a hand control in the base of the test unit, amplifier. In addition, a two-position key is provided to lock or free the indexing setting. Electrical connection is made by means of the ten-way connector fitting into the socket marked TEST UNIT, AMPLIFIER on the test set front panel and mating with a plug terminal on the side of the test unit, amplifier. This plug is, in turn, connected by a short cable loom to the Cannon socket in the mounting plate provided to receive the integral plug termination of the r.f. power amplifier unit on test.

6. The test set, amplifier incorporates the following items as used in the Type TR4/ARC52 and Type TR5/ARC52 equipments:-

(1) Oscillator unit, 5821-99-942-8553

(2) Spectrum generator unit (amplifier-oscillator), 5821-99-942-8552

(3) IF unit (20 - 30 Mc/s), 5821-99-942-8557

(4) Amplifier unit (main receiver and transmitter preamplifier), 5821-99-942-8554

(5) Tuning unit (mechanical), 5821-99-942-8549

(6) Gear plate assembly, 5821-99-943-7805

7. The chassis wiring of the equipment is such that the units specified in para. 6 are operated in their transmit condition.

Associated test equipment

8. To provide the required performance monitoring facilities when testing the r.f. power amplifier unit, additional items of test equipment are required. The functions and descriptions of these auxiliary equipments are listed in Table 1; further particulars of individual items may be obtained by reference to the publication listed.

TABLE 1

Associated test equipment

Item	Nomenclature	Ref. No.	Further details
1	Power unit (425V)	5821-99-932-2942	Sect. 1, Chap. 2
2	Power unit (AC)	5821-99-945-7136	Vol. 1
3	Wattmeter, absorption, CT 419	6625-99-943-5568	

Facilities

Power requirements

9. The test set is capable of transferring all power requirements from the power unit (425V) via the appropriate connector to the unit on test; provision is also made for coupling to the power unit (AC) to obtain the 27.5V d.c. required for the tuning unit (mechanical) and for the relays.

Mechanical

10. The test unit, amplifier is capable of setting the Oldham coupler of the unit on test to the datum positions of 220 Mc/s, 225 Mc/s and to all the other positions up to 395 Mc/s at intervals of 10 Mc/s and also the 399.9 Mc/s position, to an accuracy of not worse than $\pm$ 6' of arc.

11. The test unit, amplifier is provided with a 10-pole fixed plug for connection, via the appropriate connector, to the power outlet socket of the test set.

Mode of operation

12. Each of the units incorporated in the test set, amplifier (para. 6) is operated in its transmit condition. A toggle switch, S5 (RF DRIVE SET/PA), mounted on the control panel of the test set, ensures that e.h.t. cannot be applied to the unit on test without at the same time also applying r.f. drive power to the unit on test.

Output circuits

13. The output from the amplifier unit (main receiver and transmitter pre-amplifier) is passed to the unit on test through a coaxial relay.

Metering

14. Provision is made for measuring the levels of selected circuits of the unit on test by means of a meter mounted on the control panel of the test set (fig. 2). A seven-position rotary switch is employed to select the required monitoring facility as follows:-

(1) EHT mA : E.H.T. current for the unit on test, meter f.s.d. calibrated to 250 mA to an accuracy of 5%.

(2) HT mA : H.T. current for the unit on test, meter f.s.d. calibrated to 250 mA to an accuracy of 5%.

(3) HEATERS 25.2V : A.C. heater voltage for the unit on test, the 25.2V level being represented by a red line at the scale centre of the meter.

(4) HEATERS 6.3V : A.C. heater voltage for the unit on test, the 6.3V level being represented by a red line at the scale centre of the meter.

(5) RF. DRIVE : R.F. drive level to the unit on test, a power level of 130 mW being represented by a red line at the scale centre of the meter to an accuracy of not worse than 15%.

(6) V TP : Drive volts to the grid of V603 in the unit on test, meter f.s.d. calibrated to 50V to an accuracy of not worse than 5%.

(7) R603 TP : Cathode voltage of V602 in the unit on test, meter f.s.d. calibrated to 2.5V to an accuracy of not worse than 5%.

Control panel items

15. Further facilities are provided by panel mounted components as follows:-

(1) Fuses FS1-FS6 which protect, respectively, the incoming mains supply (1A), the 25.2V heater supply (1A), the 6.3V heater supply (3A), the 27.5V d.c. supply (10A), the e.h.t. supply (500 mA) and the h.t. supply (250 mA).

(2) A pair of screw terminals, coded TEST POINTS V and R603, to be connected by flyleads to the appropriate test points in the unit on test.

(3) Three wirewound potentiometers (RV3, RV5 and RV6) for adjusting, respectively, the level of the r.f. drive, the 25.2V a.c. heater and 6.3V a.c. heater voltages.

(4) Six toggle switches (S1, S5, S6, S7, S8, S9) for controlling, respectively, channel selection, r.f. drive, module h.t., 27.5V d.c., mains supply to the test set and to the blower motor, module heater supply.

Cooling

16. An internal blower is provided in the test set to maintain a steady circulation of air during operation. An external blower is also provided; it is connected via the test unit, amplifier to the unit on test and forces air at the ambient temperature through an aperture in the base of tho unit on test.

Warning lamps

17. Two indicating lamps (ILP1 and ILP2), coloured red, are positioned on the control panel of the test set, to give warning that the 27.5V d.c. supply is connected and that the blower motor is operating, respectively.

Circuit description

18. A circuit diagram of the test set, amplifier (P.A.) is shown in fig. 8 at the end of this chapter. This circuit is drawn with each of its functions clearly defined and the following circuit description is divided under headings for each of these facilities.

Power supplies

19. All power requirements are derived from the power unit (425V), an a.c. mains supply of 110-120V or 200-250V at 45-65 c/s and the power unit (AC); these are connected to the test set at plugs PL1, PL2 and PL3 respectively.

20. Positive e.h.t. is applied at pole A of plug PL1 and routed via one set of changeover contacts on relay RLA, fuse FS5 (EHT. 500 mA), meter shunt R2 and pole A of socket SKT1, to the unit on test.

21. Positive h.t. is applied at pole B of plug PL1 providing h.t. for the test set. This supply is also routed via switch S6 (PA HT) or one set of contacts on relay RLA, fuse FS6 (HT 250 mA), meter shunt R1 and pole B of socket SKT1 to the unit on test.

22. At poles C and G of plug PL1, an a.c. voltage which is variable between 0V and 10V is applied as the heater supply for the whole of the test set units with the exception of the amplifier unit (main receiver and transmitter preamplifier) which is supplied via pole J of plug PL1. Poles C and G are linked to poles F and H respectively of plug PL1 to facilitate monitoring of the heater supplies.

23. At pole D of plug PL1, 28V a.c. is applied for operating the oven of the spectrum generator unit.

24. A mains supply of 110-120V or 200-250V at 45-65 c/s is applied at poles A(L), B(N) and C(E) of plug PL2. From pole A the incoming supply is routed via one side of switch S8 (MAINS & BLOWER), fuse FS1 (MAINS 1A) and link LKA on the MAINS VOLTAGE selector to one end of the primary winding of the heater transformer T1; from pole B the incoming supply is routed via one side of switch S8 and link LKB to the other end of the primary winding of the heater transformer T1.

25. An a.c. voltage of approximately 230V, which is obtained from the primary winding of transformer T1, is routed directly to poles A(L) and B(N) of socket SKT15 to supply the motor of the external blower (para. 16). This voltage is also applied via resistor R10, in parallel with lamp ILP2 (MAINS & BLOWER), to the motor of the internal blower, BL1.

26. A d.c. supply of 27.5V is applied at poles A (positive) and C and D (negative) of plug PL3, the negative side being routed directly to the chassis. From pole A the positive supply is routed through switch S7 (27.5V DC) and fuse FS4 (27.5V 10A) to the IF unit (20 - 30 Mc/s) and to

the tuning unit (mechanical); this supply is also applied to lamp ILP1 (27.5V DC).

Output circuits

27. The test signal from the amplifier unit (main receiver and transmitter preamplifier) is passed to the unit on test via relay contacts RLB1, with coaxial relay RLB in the energized condition, and socket SKT12. With relay RLB in the de-energized condition, the test signal is fed via the 50 ohms load AL1, the preset potentiometer RV4 (CAL R.F. OUTPUT) and switch S10 (MONITOR) in the RF. DRIVE position to meter M1 (METERING) for monitoring purposes.

28. Terminals TP1 (R603) and TP2 (V) are provided for the connection of flyleads to the appropriate test points in the unit on test. Monitoring of the alignment of the three tank circuits in the unit on test is then achieved by indexing the switch S10 (MONITOR) in turn to positions V TP or R603TP.

29. Outputs from the two separate secondary windings of transformer T1 supply the 25.2V and 6.3V required for the heaters of the unit on test. The 25.2V a.c. supply is routed via one side of switch S9 (PA HEATERS), fuse FS2 (25.2V 1A) and potentiometer RV5 (SET 25.2V) to pole D of socket SKT1; in a similar manner the 6.3V a.c. supply is routed via one side of switch S9, fuse FS3 (6.3V 3A) and potentiometer RV6 (SET 6.3V) to pole J of socket SKT1. Monitoring of these heater supplies to the unit on test is then achieved by indexing the switch S10 (MONITOR) in turn to the positions HEATERS 25.2V or HEATERS 6.3V.

Operation

30. The CHANNEL selector switches (S1-S4) are four manually operated switches that make provision for channelling the equipment to any frequency which is an integral multiple of 100 kc/s over the range 225 Mc/s to 399.9 Mc/s.

31. At each of these frequencies the test set is capable of delivering 130 mW of r.f. power from the amplifier unit (main receiver and transmitter preamplifier) to a 50 ohms load (i.e. either to the unit on test or, for calibrating purposes, to the 50 ohms dummy load (AL1) in the test set). Power calibration accuracy should be not worse than 15%; adjustment of this power level is achieved by controlling the h.t. voltage to the amplifier unit (main receiver and transmitter preamplifier) by means of potentiometer RV3 (SET RF. DRIVE).

32. The four components comprising the bridge rectifier MR1 function solely to rectify a.c. voltages applied at poles F and C of socket SKT1; in the positions HEATERS 25.2V and HEATERS 6.3V of switch S10, these rectified voltages are then applied to meter M1.

33. The e.h.t. supply is applied to the unit on test by indexing the switch S5 (RF. DRIVE) to the PA position, with switch S7 (27.5V DC.) in the ON position; this action applies the energizing voltage to the coils of relays RLA and RLB. Contacts RLA1 route the e.h.t. supply to the unit on test and, at the same time, contacts RLA3 close, ensuring that h.t. is applied to the unit on test whether or not switch S6 (PA HT) has been operated to its ON position. Thus, e.h.t. cannot be applied to the unit on test without first applying h.t. to the unit on test. Contacts RLB1 switch the output of the amplifier unit (main receiver and transmitter preamplifier) to the unit on test thus ensuring that e.h.t. is not applied without r.f. drive power to the unit on test.

Blowers

34. The internal blower (BL1) is fitted with a motor designed to operate at 230V, 45-65 c/s, this voltage being obtained from the primary winding of the stepdown transformer T1. A warning lamp, ILP2 (MAINS & BLOWER) is connected in series with the blower to give indication that the blower motor is operating.

35. The external blower (para. 16) is fitted with a similar motor which also obtains its power supply from the primary winding of transformer T1 via poles A and B on socket SKT15.

Servicing

36. The equipment should be maintained in a clean, dry and undamaged condition throughout its service life. Care must be taken to avoid rough handling of the switches and controls. Whilst the test set is on the bench keep the working area clear of any servicing tools, soldering irons, etc.

37. Periodically remove the control panel and inspect the switches and wiring; access can be gained by removing the fourteen cheese head screws securing the control panel to the main casing.

38. Whenever a fault is suspected within the internal wiring, a continuity test can be readily made using an approved multimeter. Wire employed in the test set is wire, electrical equipment, Type 2, 23/.0076 in. pink (6145-99-910-0191) and wire, electrical equipment, Type 2, 14/.0076 in. pink (6145-99-910-0185) and any replacement wiring should be made with the correct grade of wire. The connections should be made as neatly as possible with care taken to avoid tails of excess solder. Remove any wire clippings and excess solder before replacing the control panel.

39. Examine the connectors each time before coupling them to the test set, the equipment on test and the amplifier, radio frequency (RF power amplifier). They should be undamaged and dry, with the plug and socket terminations making good, firm contact with the mating components on the related equipment.

Overall testing

40. A study of the component layout illustrations (fig. 3 and 4) and the circuit diagram (fig. 8) should provide all information necessary for clearing all normal faults.

41. When repairs or replacements have become necessary, tests should be made to determine that the equipment has been restored to a serviceable condition equivalent to that of a new unit, as issued, which has been inspected to factory standards.

Drill and ream jig

42. This equipment is supplied under Service Ref. No. 10AG/944 for the correct drilling of the Oldham coupler of the amplifier, radio frequency (RF power amplifier). A view of the jig is given in fig. 5, showing the face of the jig which is placed in contact with the base of the r.f. power amplifier unit.

43. The drill and ream jig is shown with the r.f. power amplifier unit in position in fig. 6. In addition, the specially shaped plate (T.133338) is shown in position under the coupler plate of the r.f. power amplifier unit in order to ensure the correct clearance between the coupler and the unit chassis. Full details of the method of

drilling are given in Sect. 2, Chap. 8.

Checking fixture

44. This equipment is supplied under Service Ref. No. 10AG/943 and is used for verifying the correct coupler alignment after drilling and pinning of the coupler plate to the shaft of the r.f. power amplifier unit. It is used in conjunction with a surface plate and dial test indicator, as described in Sect. 2, Chap. 8. A view of the checking fixture with the r.f. power amplifier unit in position for the alignment tests is shown in fig. 7.

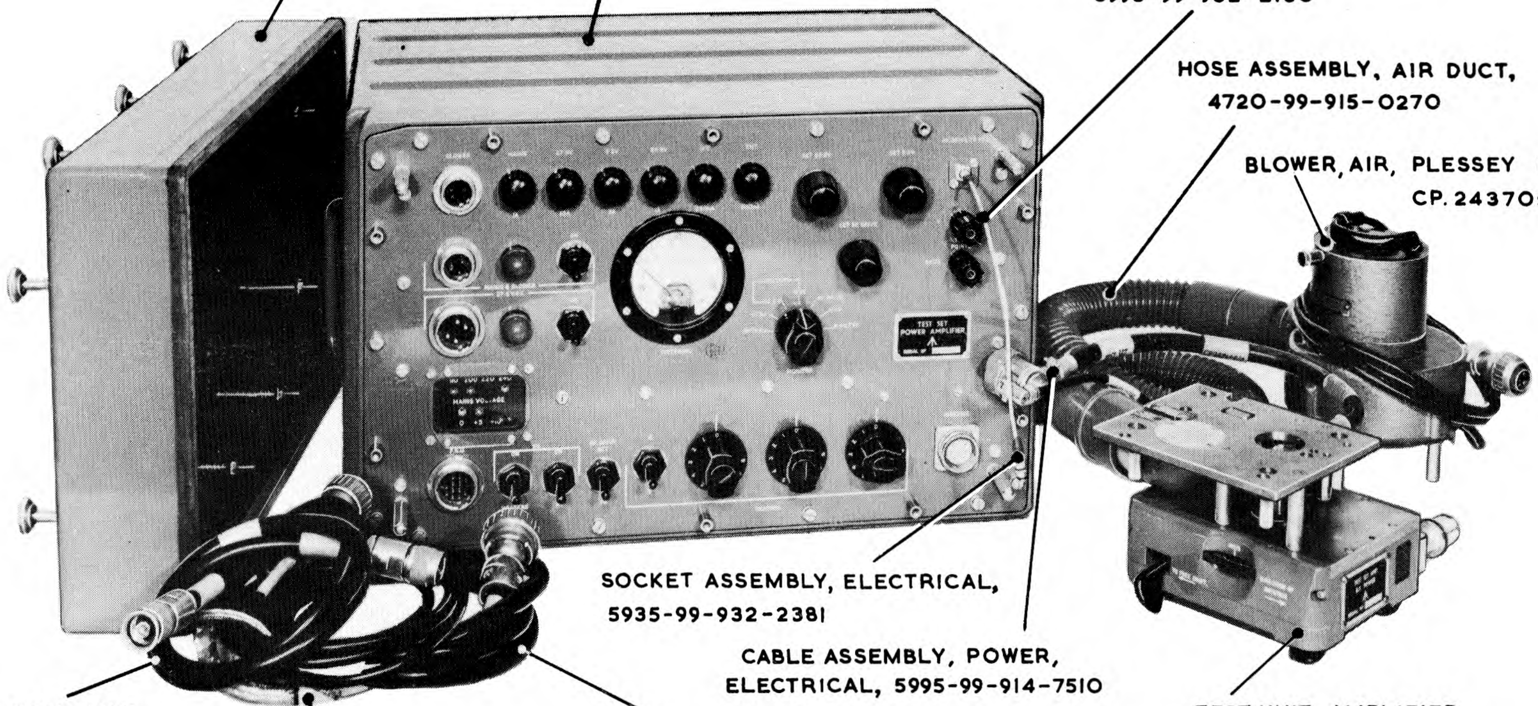

Fig.1. Test set, amplifier (P.A.) 6625-99-999-7814

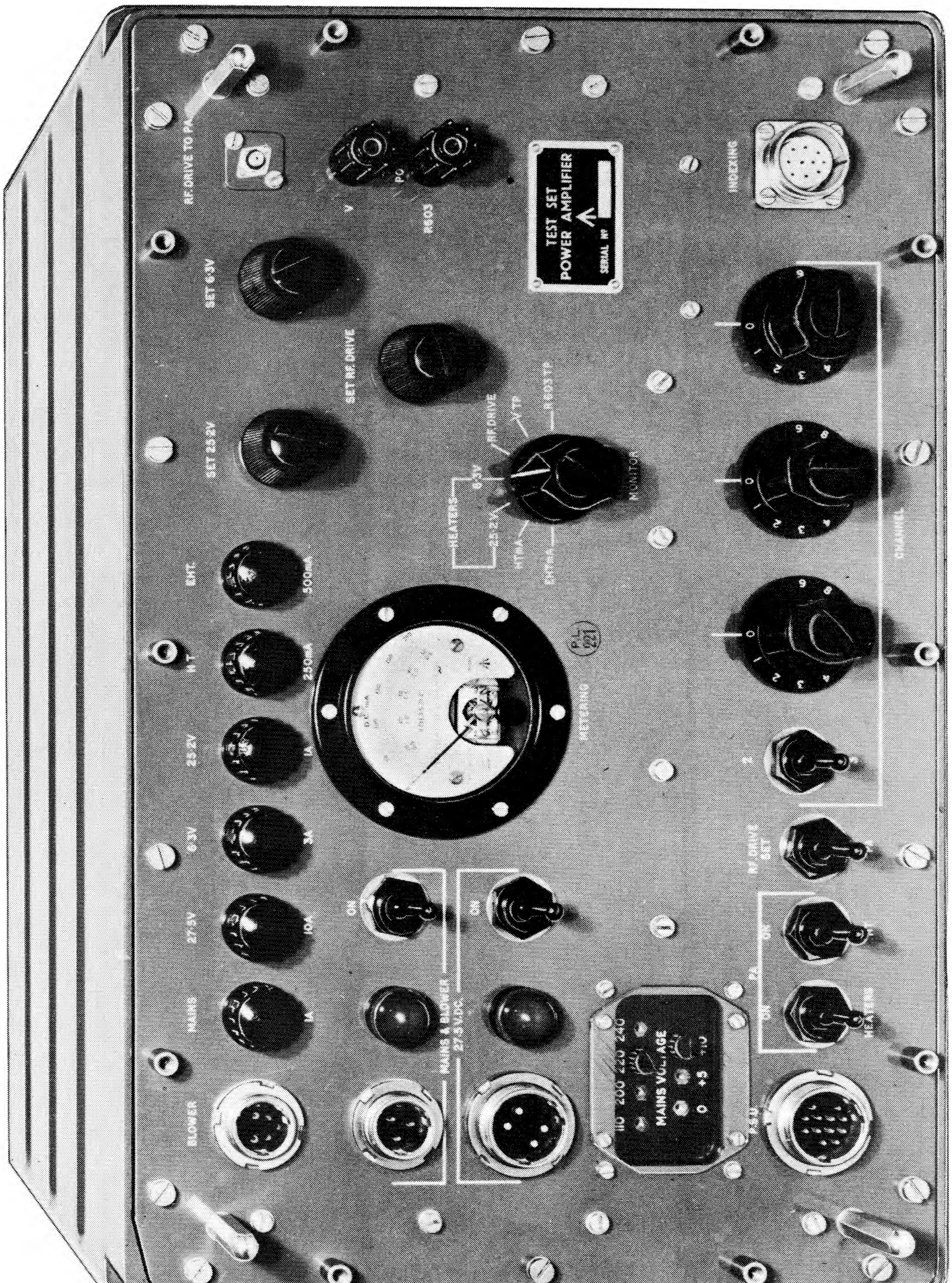

Fig.2. Test set, amplifier : control panel layout

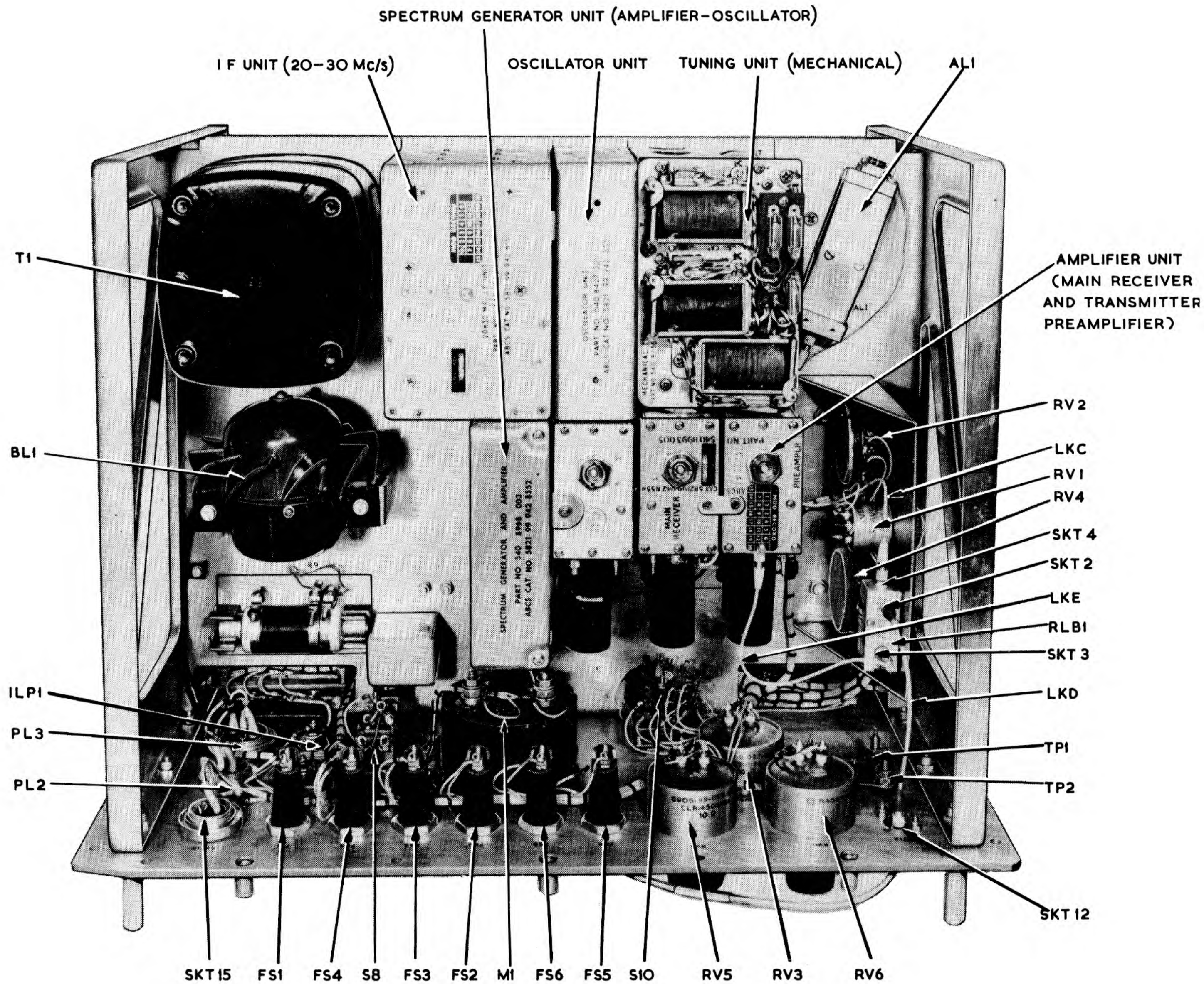

Fig.3. Test set, amplifier : component layout above chassis

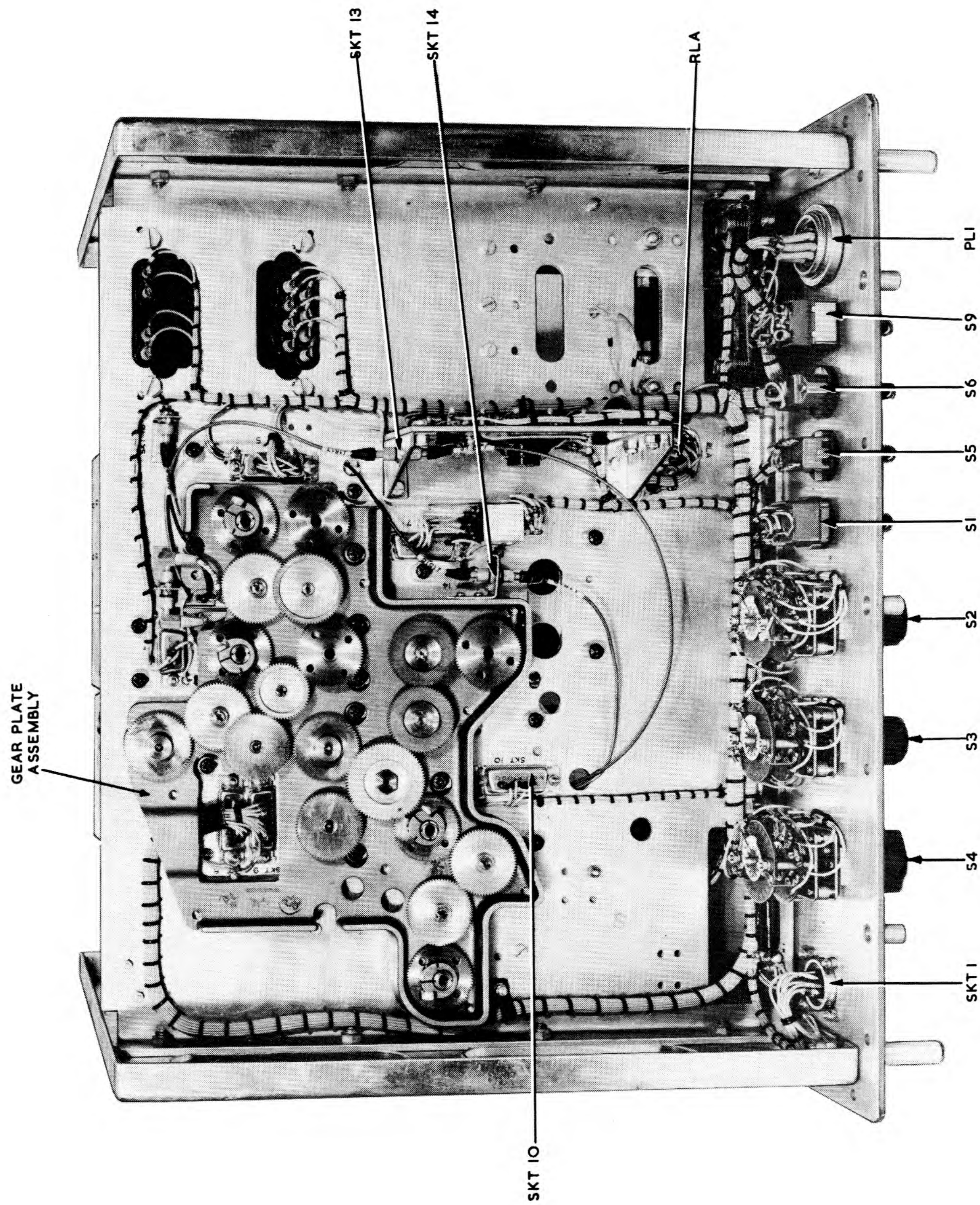

Fig. 4. Test set, amplifier : component layout below chassis

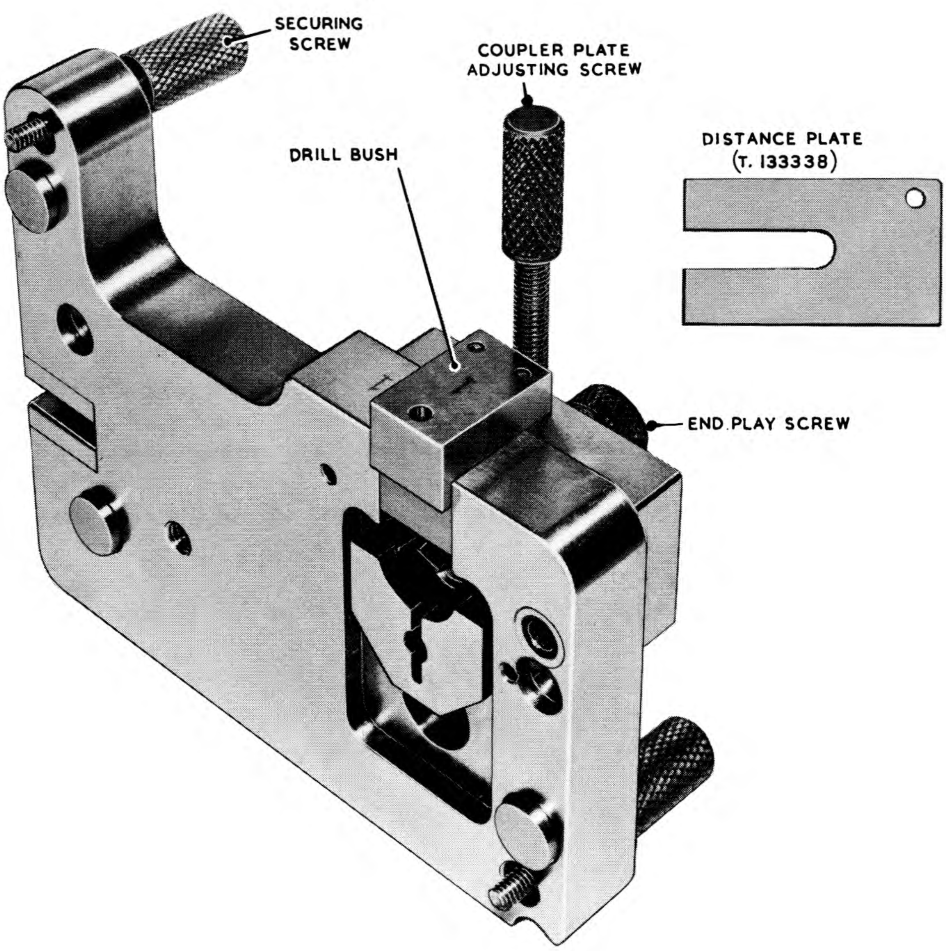

Fig.5. Drill and ream jig, Ref. No. 10AG/944

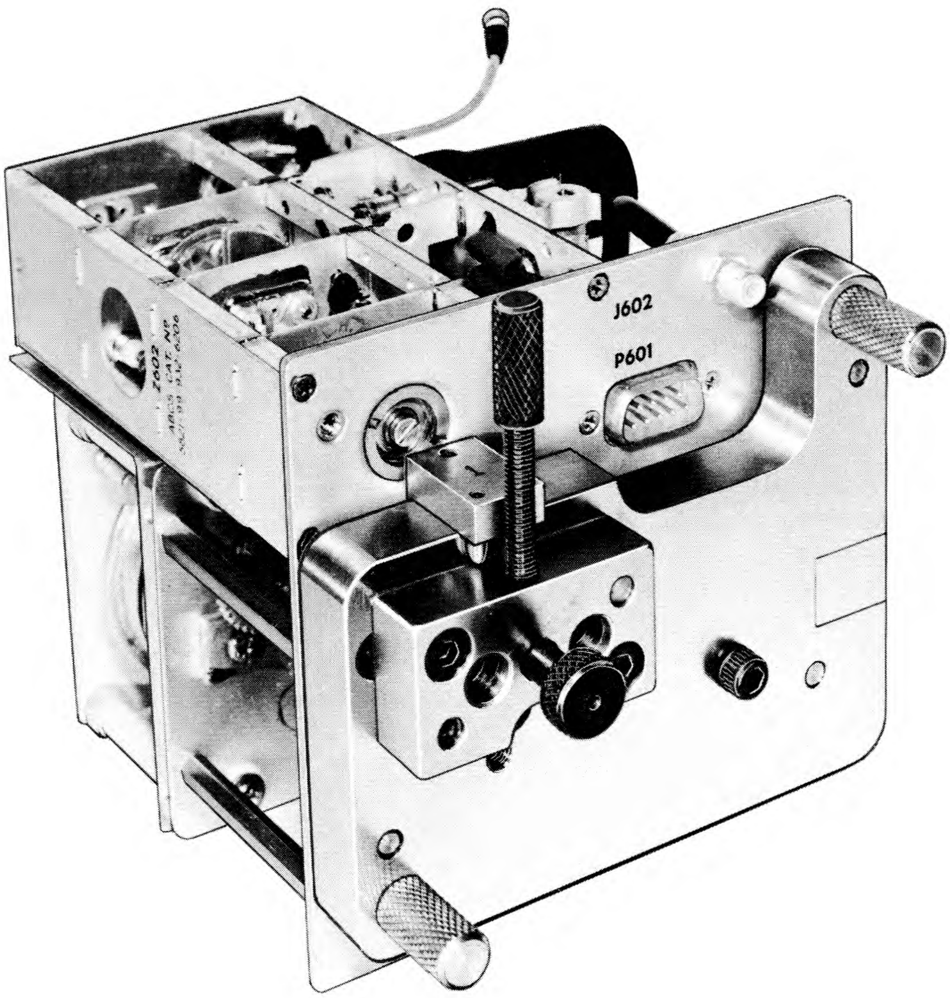

Fig. 6. Drill and ream jig, with amplifier unit in position

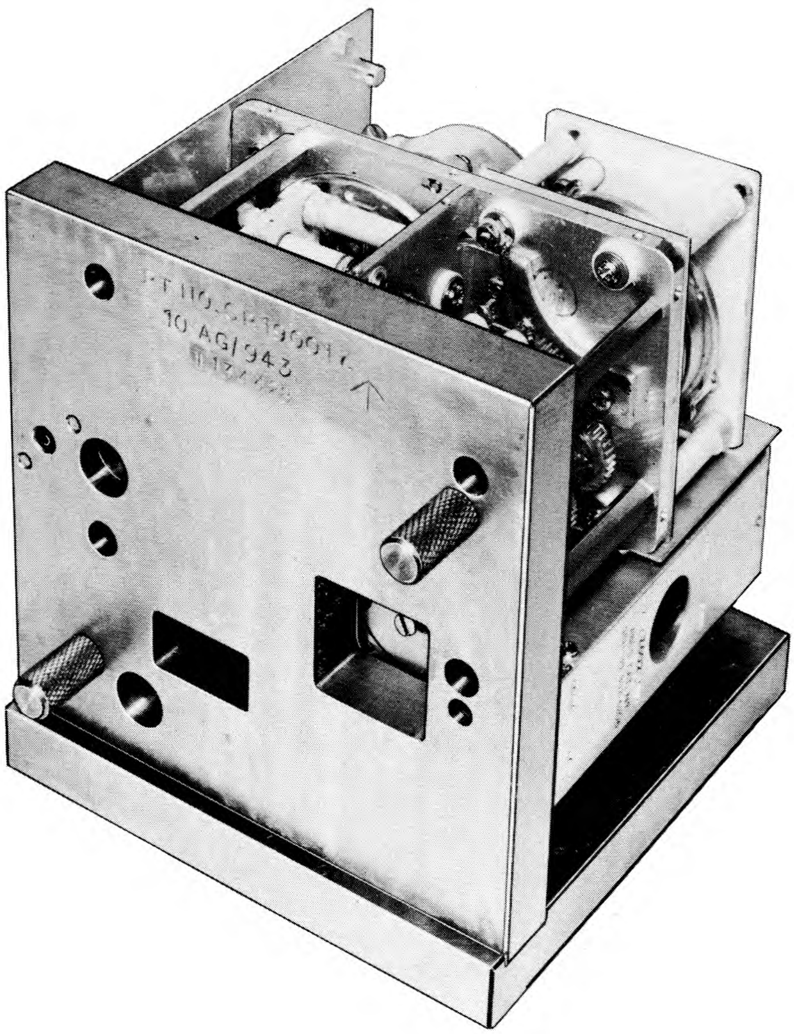

Fig. 7. Checking fixture, Ref. No. 10AG/943, with amplifier unit in position

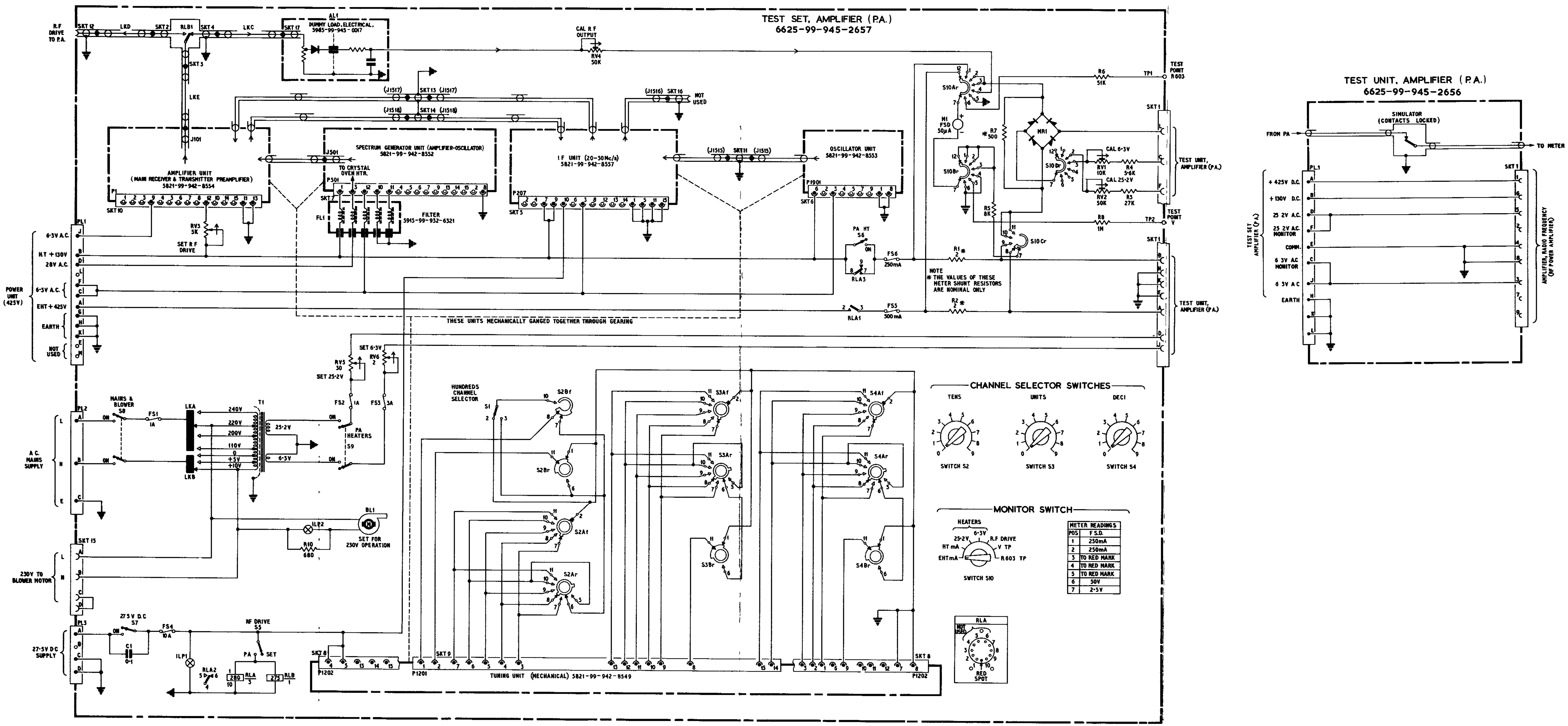

Fig. 8 Test set amplifier (P.A.), 6625-99-999-7814 : circuit

Chapter 12

TEST SET, RADIO (GUARD)

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LEADING PARTICULARS

Purpose	:	Test equipment to enable the receiver unit (guard) to be tested in its operative condition; and, in conjunction with other test equipment, to provide facilities for sensitivity and band-width tests, measuring detector, a.g.c. and audio voltages and monitoring the performance of the 34.45 Mc/s crystal in the unit on test.
A.B.C.S. Cat. No.	:	6625-99-943-6886
Power supplies	:	Derived from power supply (130V) 6130-99-999-7812

Dimensions (approx.) : $10\frac{1}{2}$ in. x $10\frac{1}{2}$ in. x 7 in.

Weight (approx.) : Test set, radio (guard) - 7 lb. 1 oz.
Cable assemblies and adaptors - 2 lb.

Introduction

1. In conjunction with other items of general test equipment (Table 1), the test set, radio (guard) 6625-99-943-6886 has been designed to facilitate third and fourth line testing of the receiver unit (guard) 5821-99-942-8558 which is associated with the transmitter-receivers Type TR4/ARC52 and Type TR5/ARC52.

2. This test equipment (fig. 1) is supplied for use complete with adaptors and flexible test connectors (para. 8). With the aid of signal generators and monitoring instruments this test set provides facilities for effecting sensitivity, bandwidth, detector, a.g.c. and audio voltage measurements on the receiver unit (guard). For the purpose of bandwidth and sensitivity measurements, the test set contains 1.85 Mc/s and 34.45 Mc/s crystal controlled oscillators which are used in conjunction with an external low frequency signal generator, the signal from which is fed to terminals on the top panel of the test set. The test set 34.45 Mc/s crystal is used also as a comparator for testing the 34.45 Mc/s crystal of the unit undergoing test. The side test cover 5821-99-932-2388 should be fitted to the unit undergoing tests on this test equipment.

3. Details of all relevant tests required to ensure the full serviceability of the receiver unit (guard) are given in Part 2, Sect. 2, Chap. 10 of this Volume.

Construction

4. The unit is basically a shallow metal box supported on four stainless steel feet. The upper face of the box is closed by a heavy gauge plate which constitutes the control panel (fig. 2) upon which are mounted all controls, switches and screw type monitoring terminals.

5. Provision for the mechanical protection of the controls and switches is made by means of two hexagonal steel pillars, mounted one at each corner on the left-hand side of the control panel.

6. On the right-hand side of the control panel a mounting bracket (or test pedestal) is provided to accommodate the receiver unit undergoing test. This is a facsimile of the mounting arrangements and connections for the receiver unit (guard) when installed in the main chassis assembly of the transmitter-receiver.

Associated test equipment

7. For tests required to ensure the full serviceability of the receiver unit (guard), equipment other than the test set is necessary. These items are standard equipment which should normally be available from Service stores; they are not integral parts of the test set. A full description and details of methods of using the associated equipment are given in the relevant Air Publications to which reference should always be made before attempting to use any equipment which may be unfamiliar.

TABLE 1

Associated test equipment

Item	Description	Ref. No.	Other details
1	Power supply (130V)	6130-99-999-7812	Chap. 2
2	Signal generator CT394A-Set.	10S/17134	A.P.2531HA
3	Signal generator Type 56	10S/647	Marconi type TF.144/G4
	or		
	Signal generator Type 56A	10S/16822	A.P.2879D
	or		
	Signal generator Type 57	10S/695	A.P.2538J; Marconi type TF.144/G6
	or		
	Signal generator Type 57A	10S/16823	A.P.2538J
4	Signal generator Type 16728	10S/17703	Marconi type TF.1101
5	Multimeter, electronic CT38	10S/16308	A.P.2879 AG
	or		
	Wattmeter, absorption, AF, No. 1, CT44	6625-99-943-0510	A.P.2536C
	or		
	Output meter Type 2	F1A/54708(10S/11934)	
6	Valve voltmeter CT54	6625-99-943-2418	A.P.2536C
7	Indicator, distortion	10S/17639	Marconi TF.142F
8	Oscilloscope Type 13A	10S/831	A.P.2879 AF
9	Headset Type 9	10AH/14	A.P.830
10	Cover, guard receiver, test side	5821-99-932-2388	

Adaptors and flexible connectors

8. This test equipment is supplied with all the adaptors and connectors for coupling to the associated test equipment; details of the connectors provided are as follows:-

(1) Cable assembly, radio frequency, 5935-99-932-4021

(2) Cable assembly, radio frequency, 5995-99-945-0786

(3) Cable assembly, radio frequency, 5995-99-945-0031

(4) Cable assembly, radio frequency, 5995-99-945-0785

(5) Adaptor, plug to plug, electrical, 5935-99-932-2819

(6) Adaptor, plug to socket, 5935-99-940-1652

Facilities

Power requirements

9. The test set, radio (guard) is capable of transferring all power requirements from the power supply (130V), via the approved connector and one terminal (225V NOM.) on the control panel to the receiver unit (guard) on test.

Signal source

10. A path is provided for the input signal from the u.h.f. signal generator (Table 1, item 2) to be applied to the unit on test.

Calibration

11. Frequency calibration of signals at 1.85 Mc/s and any other frequency within 200 kc/s of 1.85 Mc/s is provided by means of a 1.85 Mc/s crystal oscillator and mixer incorporated in the test set in conjunction with an r.f. signal generator (Table 1, item 3).

Monitoring and metering

12. By means of a meter in the power supply (130V), the heater supply to the equipment under test may be monitored at the test set.

13. Provision is made for measuring the output levels of selected circuits of the unit on test by means of a four-way rotary switch, marked VOLTMETER.

14. Aural monitoring of the beat note signal from the unit on test is obtained by inserting a headset (Table 1, item 9) in the jack provided (PHONES). Visual monitoring of the output signal from the unit on test may be obtained by connecting an oscilloscope (Table 1, item 8) to the appropriate terminals on the test set.

Senisitivity and squelch controls

15. Sensitivity and squelch controls, simulating those provided in the parent receiver main chassis assembly, are provided; these controls are adjustable from the top panel on the test set by means of controls marked, appropriately, SENSITIVITY and SQUELCH.

Circuit description

16. A circuit diagram of the test set, radio (guard) is given in fig. 4 at the end of this chapter. The circuit is drawn with each of its functions clearly defined and the following description of the circuit is divided under headings for each of these functions.

Power supplies

17. The power supply (130V), from which all power requirements are derived, is connected to the test set by means of a 12-way Mk. 4 plug, PL1, and one terminal (225V NOM.) on the control panel of the test set. All outgoing supplies are connected from the socket SKT1 to the receiver unit (guard) undergoing test.

18. The h.t. supply of +130V for the module under test is applied at pole A of plug PL1 and is routed via one side of the double pole change-over switch S2 (H.T. ON) to pole 9 of socket SKT1.

19. The h.t. supply for the test set is derived from a +130V supply at pole B of plug PL1. Switch S1 (1.85 Mc/s ON) enables the d.c. supply to the combined oscillator and mixer valve V1 and valves V3 and V4 to be switched on or off as required. The d.c. supply to the anodes of V2 is

separately controlled by switch S3 (34.45 Mc/s ON).

20. A heater supply, which is variable between 0 and 10V a.c., is applied at poles C and G of plug PL1 and routed directly to poles 10 and 15 respectively of socket SKT1. Poles C and G are linked to poles F and H respectively, where monitoring of the heater supply voltage to the unit under test may be made.

21. At poles J and K on plug PL1 a separate heater supply (also variable between 0 and 10V a.c.) is available for the valves of the test set.

22. At pole D, a 26.5V a.c. crystal oven heater supply is applied and routed to the heating element HR1 via switch S6 in the crystal oven.

23. A biasing voltage which is variable between 0 and -50V is applied at pole E of plug PL1 and routed directly to pole 12 of socket SKT1.

24. The h.t. supply of +225V is derived from the power supply (130V), which has been modified to provide this facility, and is applied at terminal TP2 (225V. NOM.) on the control panel of the test set and routed via one side of the double pole changeover switch S2 (H.T. ON) to pole 4 of socket SKT1.

Signal source

25. Provision is made for the application of a test signal to the unit on test by way of the test set. This is achieved by coupling the u.h.f. signal generator (Table 1, item 2) to socket SKT3 (U.H.F. GEN.) via the 'T' junction adaptor (para. 8 (5)). This adaptor also couples a C-R circuit (comprising capacitors C7 and C8 and resistor R6) to the input of the unit on test, thus simulating the aerial circuit of the main receiver of the transmitter-receiver.

1.85 Mc/s crystal oscillator and mixer

26. With switch S1 (1.85 Mc/s ON) in the ON position, h.t. is applied to the anodes of valves V1, V3 and V4; the 1.85 Mc/s output taken from the anode of the oscillator section (V1B) of valve V1 is applied, via capacitor C5 to the grid of the mixer section (V1A).

27. With the output from the l.f. signal generator (Table 1, item 4) connected to the cathode of the mixer section of valve V1 via terminal TP1 and capacitor C21, the 1.85 Mc/s output can be modulated by a frequency in the range 70 c/s to 200 kc/s. This is fed via capacitor C15 to the grid of the second mixer valve V3 to provide facilities for bandwidth measurements.

34.45 Mc/s crystal oscillator and mixer

28. With switch S1 closed and switch S3 (34.45 Mc/s ON) in the ON position, h.t. is applied to the anode of the oscillator valve V2. The frequency of this oscillator is determined by the 34.45 Mc/s crystal in the cathode circuit; this crystal is contained in an oven which is maintained at a temperature of 85°C. The output from valve V2B anode is fed via capacitor C6 to the cathode of valve V3 where it is mixed with the output from the 1.85 Mc/s oscillator to produce a frequency of 36.3 Mc/s; this provides facilities for calibrating the r.f. signal generators, which may be connected to the test set via socket SKT2 (GEN. CALIBRATE).

Output

29. In the CAL. position of switch S5 (CAL./AUDIO) the output from the mixer valve V3 is applied via capacitor C16, potentiometer RV1 (BEAT NOTE GAIN) and resistor R10 to the control grid of the audio amplifier valve, V4.

30. In the AUDIO position of switch S5 the a.f. output from the unit on test is routed from pole 6 of socket SKT1 via potentiometer RV1 and resistor R10 to the control grid of valve V4.

31. The output of valve V4 is applied via transformer T1 to jack JK1 (PHONES) for monitoring by means of the headset (Table 1, item 9).

Squelch and sensitivity

32. Squelch and sensitivity controls for the unit on test are provided by two potentiometers (RV2 and RV3) on the test set, designated SQUELCH and SENSITIVITY respectively.

Monitoring and metering

33. Provision is made for measuring the output level of various circuits of the unit on test which are selected by means of the 4-way rotary switch S4 (VOLTMETER).

34. The wiper arm of the rotary switch (S4) is connected to terminal TP3 (V.V.); indexing the switch successively to BIAS, DET, A.G.C. and AUDIO permits measurements of the selected output to be made on the voltmeter (Table 1, item 6) connected across terminals TP3 and TP4 (E).

35. Monitoring of the a.f. output of the unit on test may be obtained by connecting a C.R.O. (Table 1, item 8) to terminal TP5 (C.R.O.) and a distortion factor meter (Table 1, item 7) to terminal TP7 (D.F.M.).

Servicing

36. The equipment should be maintained in a clean, dry condition throughout its service life. Care should be taken to avoid rough handling of switches and controls.

37. Periodically remove the top (control) panel and inspect the unit internally for evidence of overheating. Access can be gained by removing the eight cheese head screws securing the panel. Before attempting to remove any suspect wiring or component, however, ensure that the power supply is either switched off or, preferably, disconnected from the test set.

38. Whenever a fault is suspected within the internal wiring, a continuity test can readily be made using an approved multimeter. The wiring employed conforms to the specifications DEF 10, DEF 12 or DEF 14 as applicable. Any replacement wiring should be made with the correct grade of wire and connections made as neatly as possible, avoiding tails of excess solder. Remove any wire clippings or solder spatter before refitting the control panel.

39. Examine the connectors each time before use. The cover screw threads should be lightly lubricated with molybdenum disulphide grease in order to prevent binding. The connectors should be clean and undamaged, with the plug and socket terminations making good contact with the mating components of the selected equipment.

40. The h.t. current drawn from the associated power supply (130V) should not exceed 55 mA for the test set and 85 mA for the unit on test.

Overall testing

41. A circuit diagram of the complete test set is given in fig. 4 at the end of the chapter. A study of this diagram should provide sufficient information and guidance for the clearing of all normal faults arising out of service.

42. Particular care should be taken to avoid the rough handling of high stability resistors employed in the test set circuit.

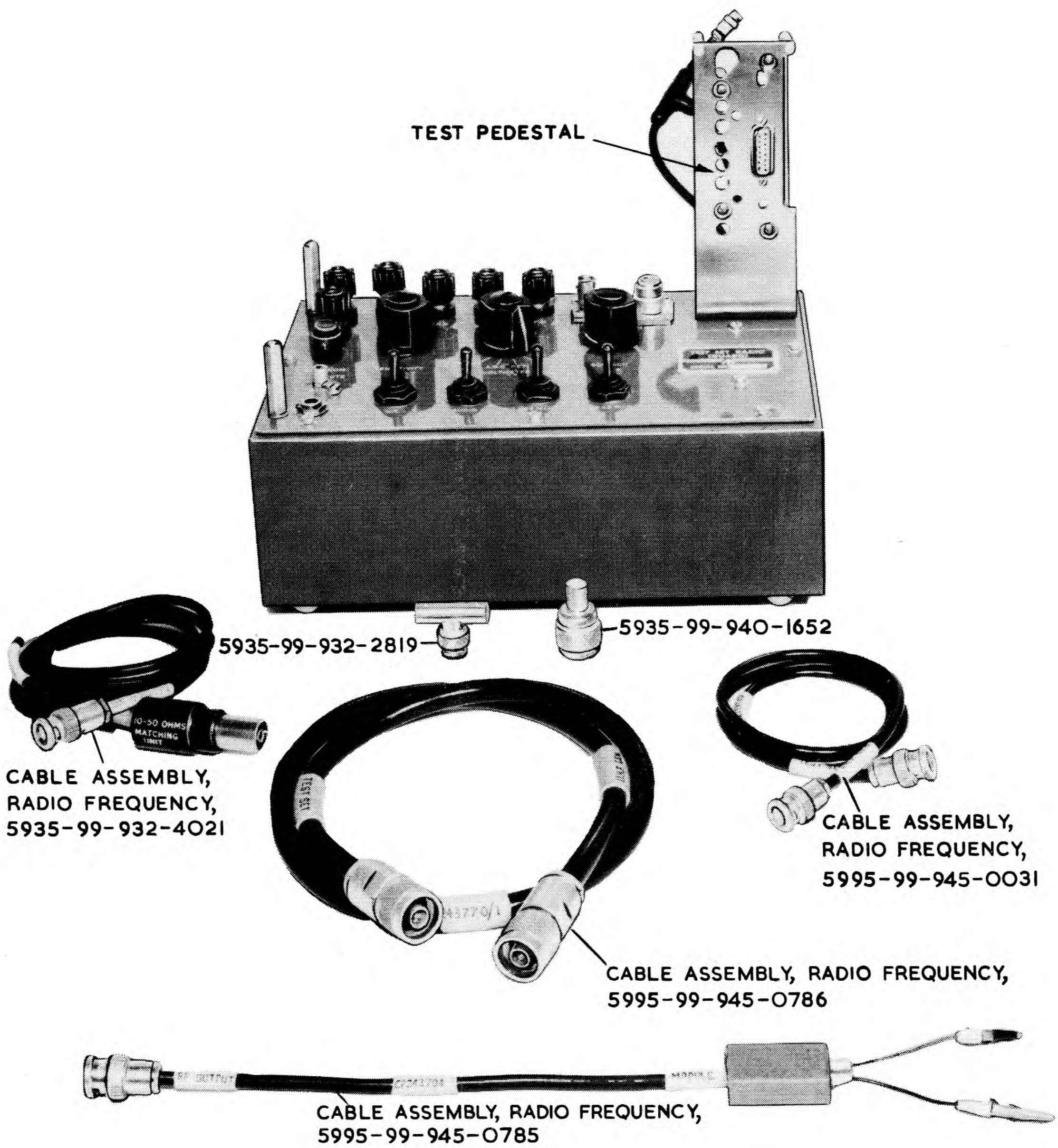

Fig. 1. Test set, radio (guard) 6625-99-943-6886 and connectors

Fig. 2. Test set, radio (guard): control panel layout

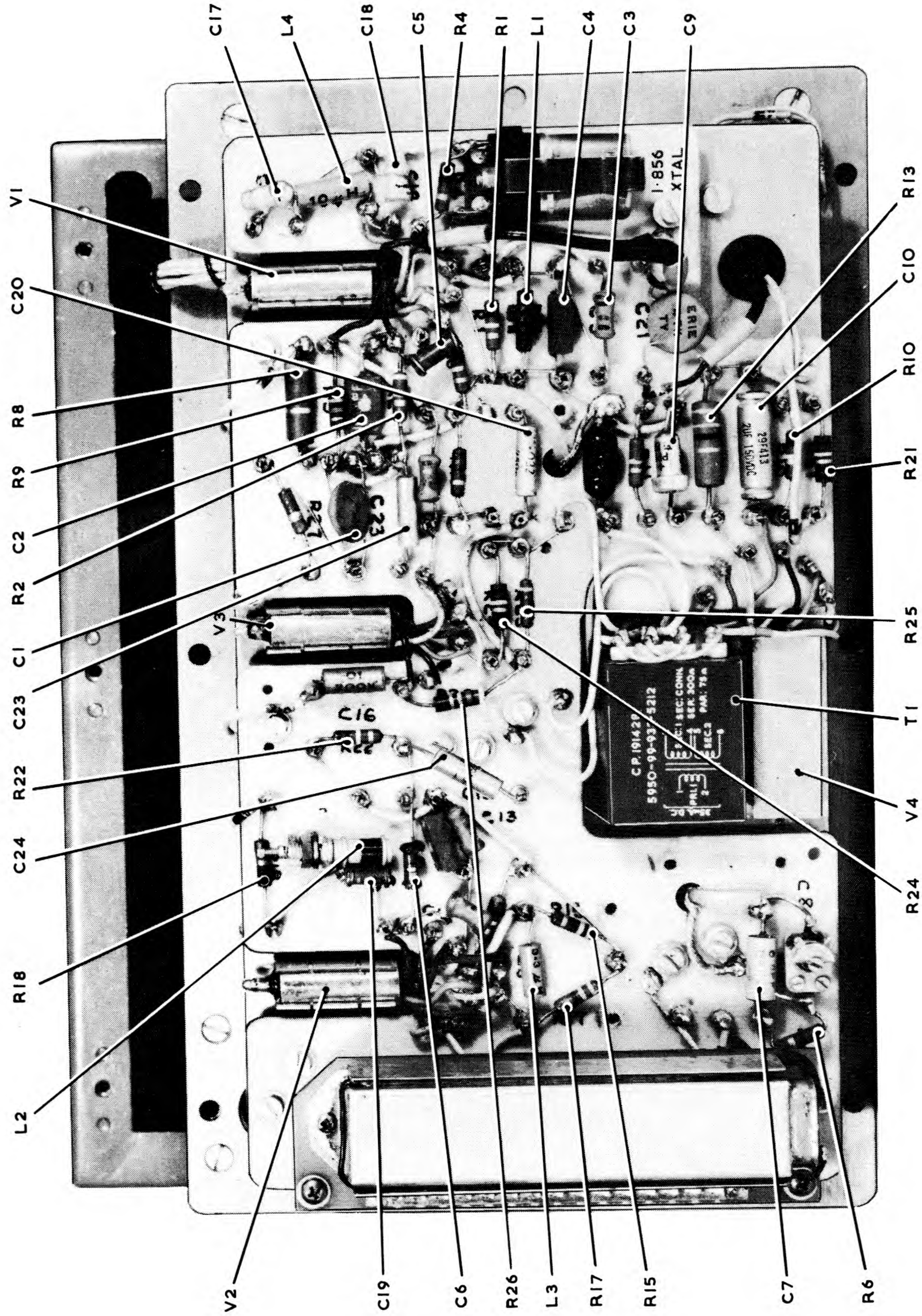

Fig. 3. Test set, radio (guard) : component layout – interior

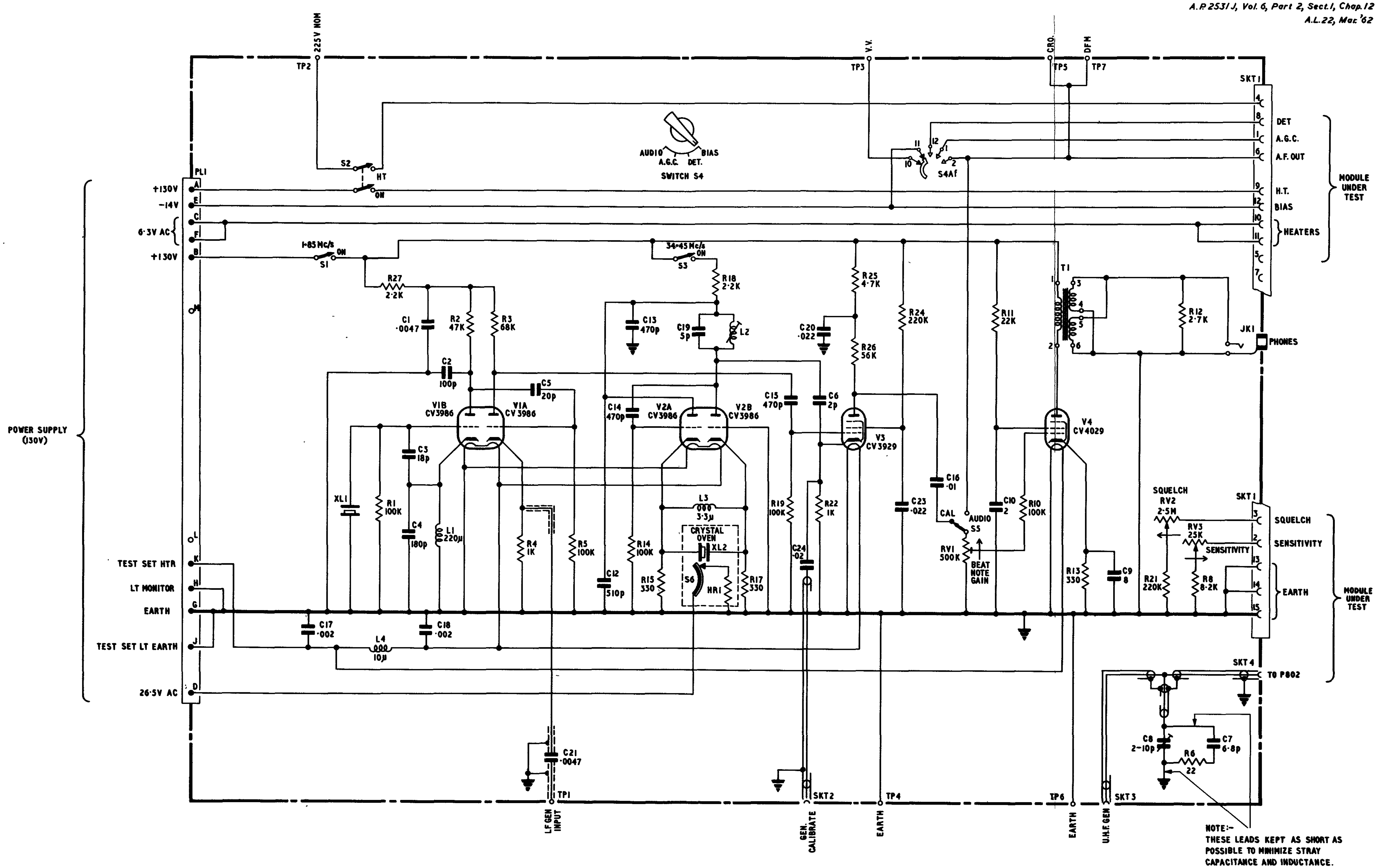

Fig.4 Test set, radio (guard) 6625-99-943-6886 : circuit

Chapter 13

TEST SET, AMPLIFIER (1.85 Mc/s IF)

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LEADING PARTICULARS

Designation:	Test equipment for testing and servicing of the IF unit (1.85 Mc/s) 5821-99-942-8556, with provision for monitoring the output levels of selected circuits in conjunction with associated test equipment.
Ref. No.	6625-99-943-6536
Power supplies:	Derived from power supply (No. 2) 6130-99-999-7872
Dimensions (approx.):	$10\frac{1}{2}$ in. long and $6\frac{1}{2}$ in. wide x $3\frac{3}{4}$ in. high.
Weight(approx.):	Test set, amplifier, $6\frac{3}{4}$ lb Connector, $\frac{1}{4}$ lb

Introduction

1. In conjunction with other items of test equipment (Table 1) the test set, amplifier (1.85 Mc/s IF) (fig. 1) is designed to facilitate third and fourth line testing of the IF unit (1.85 Mc/s) 5821-99-942-8556, which is a component part of both Type TR4/ARC52 and Type TR5/ARC52 transmitter-receiver equipments.

2. This test set is issued under A.B.C.S. Ref. No. 6625-99-943-6536 and classified under Inter-Services specification K.114, as K.114/D ground equipment (protected) for use in permanent buildings. It is rated to function correctly in ambient temperatures of + 55 deg. C at the prevailing humidity and at an ambient of + 40 deg. C with a relative humidity of 95%. The equipment will function correctly in ambient temperatures down to - 26 deg. C.

Construction

3. The unit is basically a shallow rectangular metal box supported on four stainless steel feet. The upper face of the box is closed by a heavy gauge plate which constitutes the control panel (fig. 2) upon which are mounted all controls, switches and screw type monitoring terminals.

4. Provision for the mechanical protection of the controls and switches is made by means of two hexagonal steel pillars, mounted one at each corner on the left-hand side of the control panel. These pillars also serve as mounting feet, permitting the panel to be inverted on the bench, when removed from its box during the servicing of control components.

5. On the right-hand side of the control panel a mounting bracket is provided to accommodate the i.f. unit undergoing test. The rear face of the unit (fig. 3) houses the power supply service plug, the signal generator coupling socket and a metering socket.

Associated test equipment

6. To provide the required performance monitoring facilities when testing the i.f. unit, additional items of test equipment are necessary. The functions and description of these auxiliary items are listed in Table 1; further details of individual items may be obtained by reference to the relevant Air Publication. All items listed should be readily available from Service stores.

TABLE 1

Associated test equipment

Item	Description	Ref. No.	Other details
1	Power supply (No. 2)	6130-99-999-7872	Chap. 2
2	Multimeter electronic, CT38	10S/16308	A.P.2879AG
3	Signal generator Type 57A (R.N.)	10S/16823	A.P.2538J
	or		
	Signal generator Type 56A (R.A.F.)	10S/16822	A.P.2879D
4	Signal generator Type 65B	6625-99-932-4976	
	or		
	Signal generator Type 16728	10S/17703	
	or		
	Signal generator Type 65	10S/16344	A.P.2536C
5	Oscilloscope Type 13A	10S/831	A.P.2879AF
6	Headset Type 9	10AH/14	A.P.830
7	Connector	5995-99-932-4021	Vol. 1 of this A.P.

Facilities

Power Supplies

7. The test set, amplifier (1.85 Mc/s IF) is capable of transferring all power requirements from the power supply (No. 2), via the approved connector to the i.f. unit on test.

8. The + 130V d.c. supply derived from the power supply (No. 2) is routed to the unit undergoing test by way of a switch and filter circuit; the filter circuit simulates the d.c. smoothing provided in the parent transmitter-receiver.

Signal source

9. A path is provided for the input signal from the r.f. signal generator (item 3, Table 1) to be applied to the unit on test.

Calibration

10. Frequency calibration of signals at 1.85 Mc/s and any other frequency within 120 kc/s of 1.85 Mc/s is provided by means of a 1.85 Mc/s crystal oscillator and mixer incorporated in the test set in conjunction with an l.f. signal generator (item 4, Table 1).

Monitoring and metering

11. Monitoring of the heater supply voltage to the equipment under test may be effected at either the input plug or the output socket fitted to the test set.

12. Provision is made for measuring the output levels of selected circuits of the unit on test by means of a five-way rotary switch.

13. Aural monitoring of the output signal from the unit on test is obtainable by inserting a headset (Table 1) in the jack provided, while visual monitoring may be obtained by connecting an oscilloscope

(item 5, Table 1) to the appropriate terminals on the test set.

Sensitivity control

14. A sensitivity control, simulating that provided in the parent transmitter-receiver, is provided. This control is adjustable from the top panel.

Circuit description

15. A circuit diagram of the test set, amplifier (1.85 Mc/s IF) is given at fig. 4 at the end of this chapter. The circuit is drawn with each of its functions clearly defined. The following description of the circuit is divided under headings for each of these functions.

Power supplies

16. The power supply (No. 2), from which all power requirements are derived, is connected to the test set by means of a 12-way Mk. 4 plug PL1, on the test set. All outgoing supplies are connected from the socket SKT3 to the i.f. unit undergoing test.

17. A supply at + 130V is applied at pole A of plug PL1 and is routed via the single pole switch S2 to poles 1 and 10 of the socket SKT3. In series with the switch S2 and pole 1 is an r.f. choke L2, and connected from pole 1 to earth is the capacitor C9. A similar filter circuit, comprising the r.f. choke L3 and capacitor C11, lies between the switch and pole 10 of socket SKT3. These filter circuits simulate the r.f. filters provided in the transmitter-receiver.

18. The h.t. supply for the test set is derived from a + 130V supply at pole B of the plug PL1. Switch S1 (1.85 Mc/s OSC.) enables the d.c. supply to the anode of the combined oscillator and mixer valve V1 (Type CV3986) to be switched on or off as required.

19. A heater supply, which is variable between 0 and 10 V a.c., is applied at poles C and G of the plug PL1 and routed directly to poles 14 and 15 of the socket SKT3. The poles C and G are linked to poles F and H, respectively, where monitoring of the heater supply voltage to the unit under test may be made.

20. At poles J and K on plug PL1, a separate heater supply (variable also between 0 and 10 V ac.) is available for the valves of the test set.

21. A biasing voltage which is variable between 0 and - 50 V is applied at pole E of the plug PL1 and routed directly to pole 12 of the socket SKT3.

Signal source

22. Provision is made for the application of a test signal to the equipment on test by way of the test set. This is achieved by coupling an r.f. signal generator (item 3, Table 1) to socket SKT1 (SIG.GEN.INPUT).

Crystal oscillator and mixer

23. With the switch S1 (1.85 Mc/s OSC.) in the ON position, h.t. is applied to the anodes of the double triode valve V1. The 1.85 Mc/s output taken from the anode of the oscillator section is applied via capacitor C5 to the grid of the mixer section.

24. For the purpose of testing the activity of the oscillator, a test point U (fig. 4) is brought out to a tagboard mounted on the underside of the control panel. With the switch S1 in the ON position, not more than 2.8 V negative with respect to the frame of the test set is developed at this point.

25. The 1.85 Mc/s signal from the crystal oscillator is coupled, via pole 6 of SKT3, into the IF unit (1.85 Mc/s) under test where it mixes with the signal from the r.f. signal generator (para. 22). The difference between the two frequencies, in the form of a beat note, appears at the main audio output of the IF unit (1.85 Mc/s) and is amplified by V3A and V2 in the test set and passed to the headphones. Thus the r.f. signal generator can be calibrated at 1.85 Mc/s.

26. If the output of an l.f. signal generator (item 4, Table 1) is fed into the mixer V1, via the terminals TP1 and TP2, it will mix with the 1.85 Mc/s signal from the crystal oscillator and sideband frequencies will be produced. These frequencies, of up to 120 kc/s above and below 1.85 Mc/s, may similarly be used to calibrate the r.f. signal generator. This facility is useful when conducting bandwidth measurements.

Main audio channel

27. The demodulated signal output of the IF unit (1.85 Mc/s) on test is applied to the test set at pole 6 of socket SKT3 and is fed to the grid (pin 7) of valve V3A.

28. The valve V3A has an input resistance of 1 megohm and a gain of approximately unity at 1,000 c/s; it has a frequency response curve, which is flat to within ± 0.2dB over the range 70 c/s to 20 000 c/s.

29. Monitoring of the audio frequency level at the anode (pin 8) of valve V3A is obtainable by rotating the switch S3 to the position marked MAIN AUDIO and connecting a voltmeter (Table 1) across the terminals TP3 and TP4. The waveform of the a.f. signal at the anode (pin 8) of valve V3 may be studied on an oscilloscope which is connected across terminals TP5 and TP6.

30. Audio monitoring of the amplified a.f. signal is provided by the insertion of a headset (Table 1) in the jack JK1 (PHONES).

Auxiliary audio channel

31. The auxiliary audio signal from the unit on test is applied to pole 4 of the socket SKT3 and fed to the grid of triode valve V3B via the capacitor C22 and resistor R22. This valve has similar characteristics to V3A (para. 28). With the switch S3 now indexed to the AUX. AUDIO position, the a.f. output can be monitored at the terminals TP3 and TP4 by means of a voltmeter.

Sensitivity control

32. A sensitivity control, simulating that provided in the parent transmitter-receiver equipment, is provided by the potentiometer RV2 (SENS.) which is connected from pole 7 of the socket SKT3 to the frame of the test set.

Monitoring and metering

33. Provision is made for measuring the output levels of various circuits of the unit on test which are selected by means of the 5-way rotary switch S3 (VOLTMETER).

34. The wiper of the rotary switch S3 is connected to terminal TP3; therefore indexing of the switch successively to MAIN AUDIO, AUX. AUDIO, A.G.C. (FULL), SQUELCH, and A.G.C. (HALF) permits measurements of the selected output to be made on the voltmeter connected across the terminals TP3 and TP4.

Servicing

35. The equipment should be maintained in a clean, dry and undamaged condition throughout its service life. Care must be taken to avoid rough handling of the switches and controls. Whilst the test set is being operated keep the working area of the bench clear of servicing tools, soldering irons, etc.

36. Periodically remove the control panel to enable an inspection to be made of the switches and wiring. Access can be gained by removing the eight cheese head screws securing the panel.

37. Whenever a fault is suspected within the internal wiring, a continuity test can be readily made using an approved multimeter. The wiring employed conforms to the specifications DEF 10, DEF 12 or DEF 14 as applicable. Any replacement wiring should be made with the correct grade of wire and connections made as neatly as possible, avoiding tails of excess solder. Remove any wire clippings or solder spatter before refitting the control panel.

38. Examine the connectors each time before use. They should be dry and undamaged, with the plug and socket terminations making good contact with the mating components of the related equipment.

39. The h.t. current drawn from the associated power supply (No. 2) should not exceed 45 mA for the test set and 40 mA for the unit on test.

Overall testing

40. A circuit diagram of the complete test set is given at fig. 4 at the end of the chapter. A study of this diagram should provide sufficient information and guidance for the clearing of all normal faults arising out of service.

41. Before disconnecting an electrolytic capacitor suspected of faulty operation, note carefully the way in which the polarity is effected. Replace the new component similarly.

42. Particular care should be taken to avoid the rough handling of high-stability resistors employed in the test set circuit.

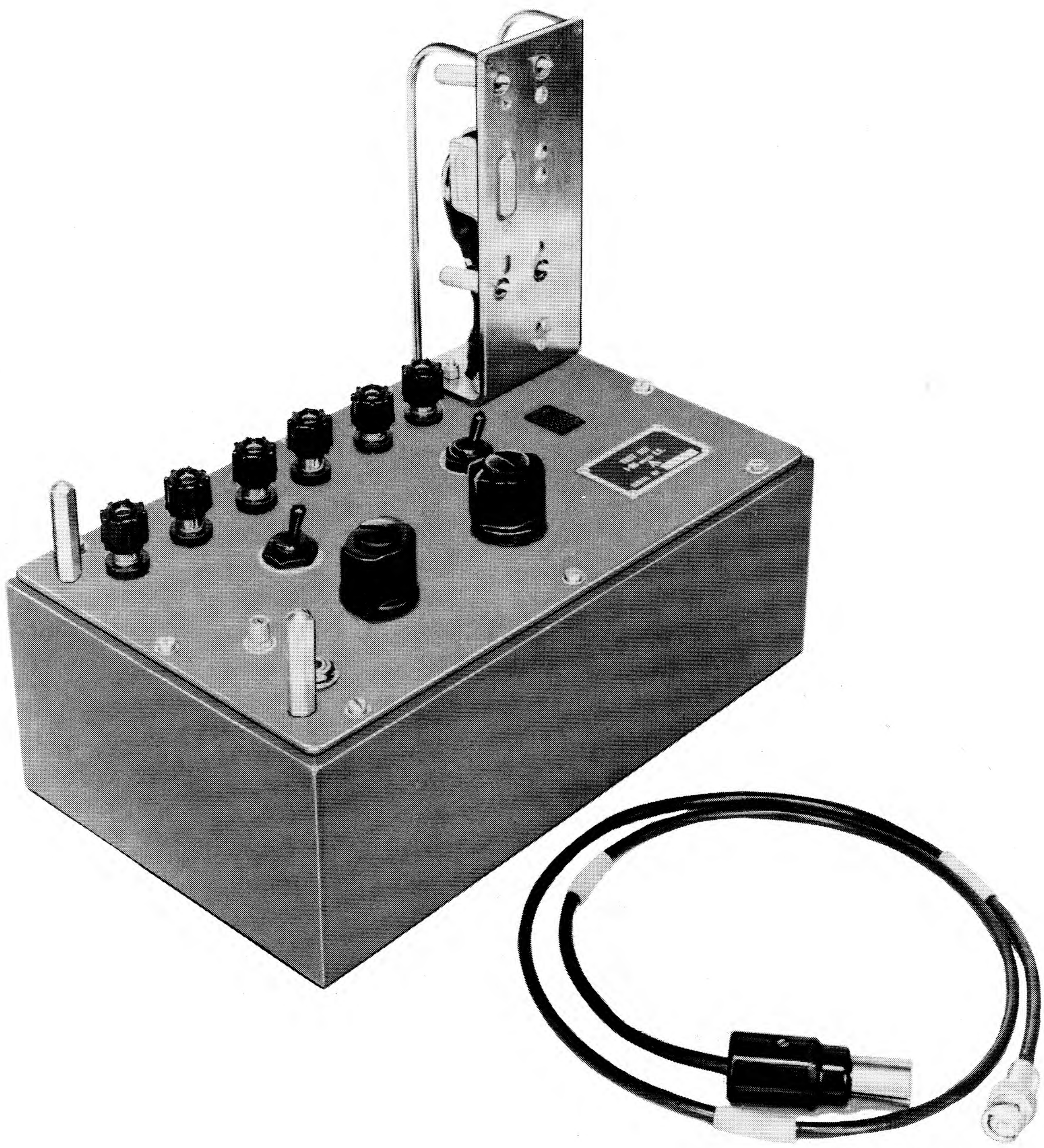

Fig. 1. Test set, amplifier (1·85Mc/s IF)

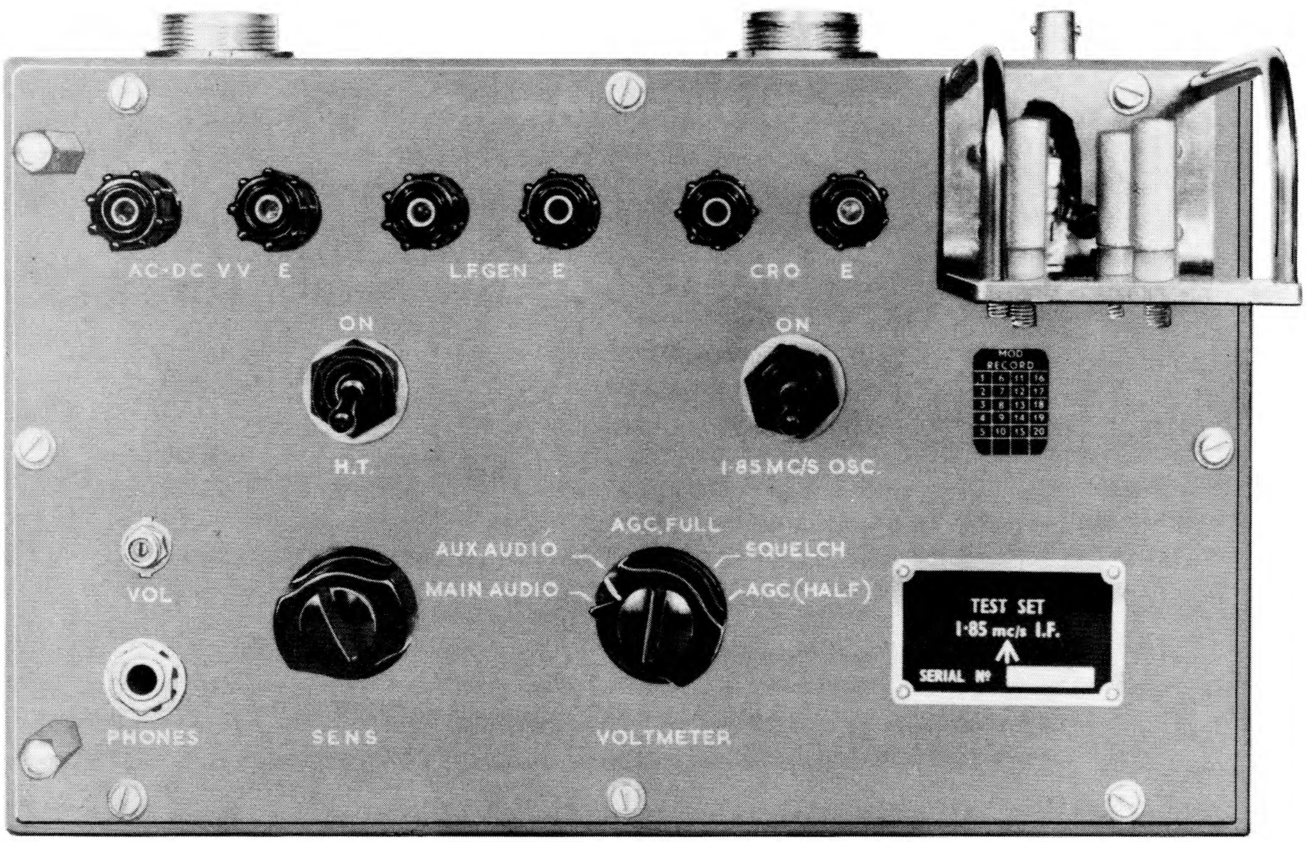

Fig. 2. Control panel layout

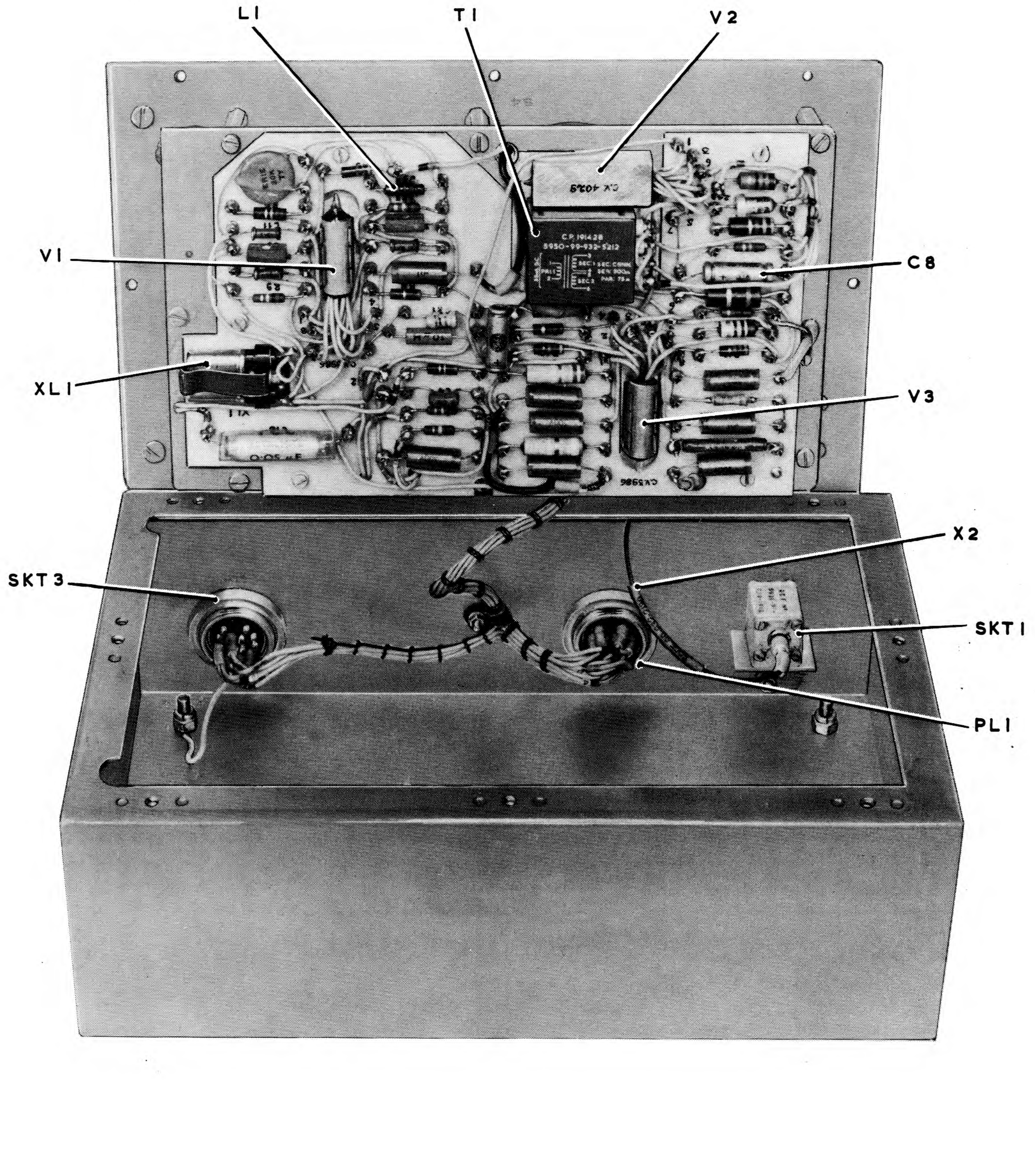

Fig. 3. Component layout: interior

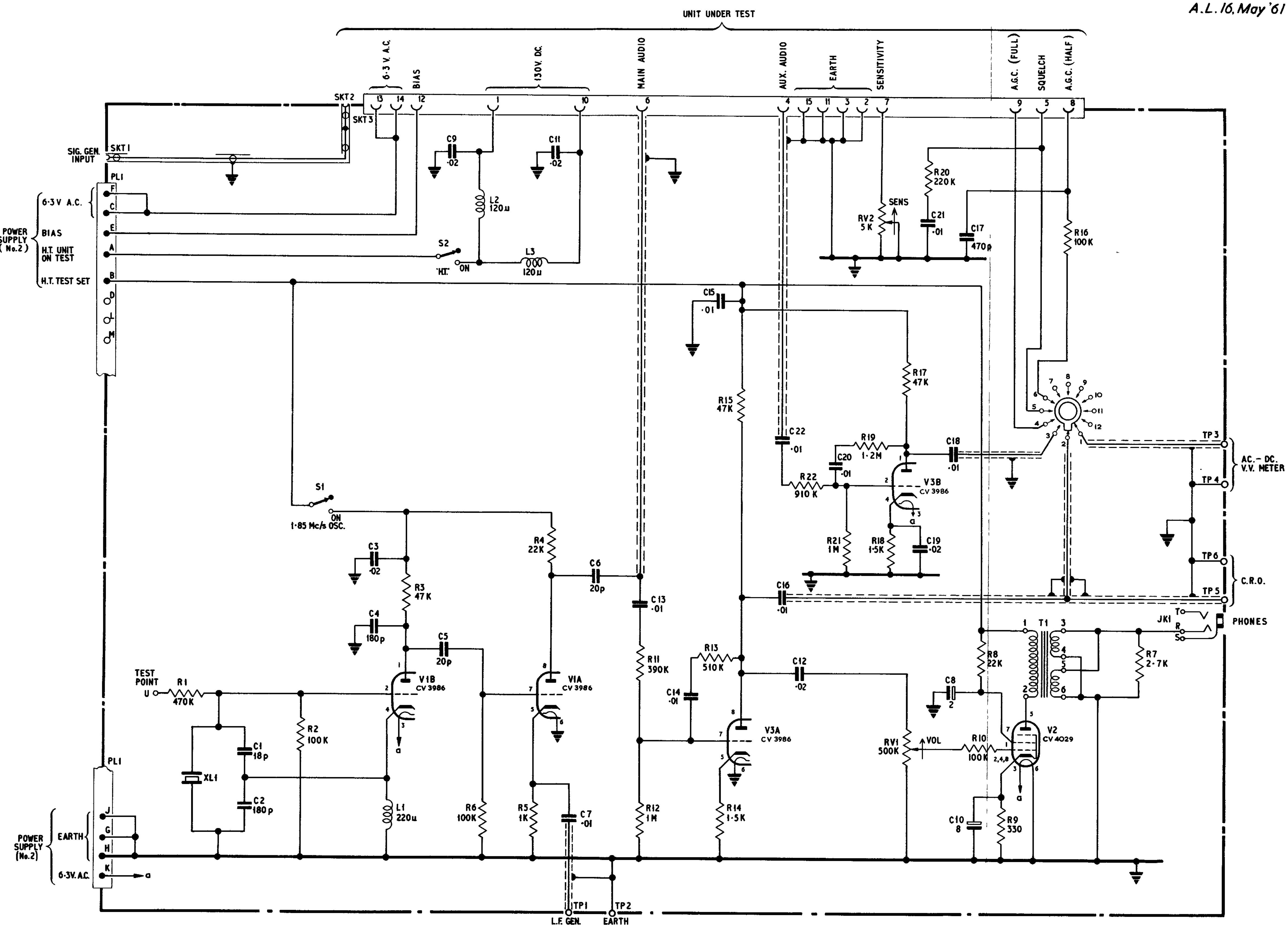

Fig. 4 Test set, amplifier (1·85 Mc/s. IF) 6625-99-943-6536: circuit

Chapter 14

TEST SET, AMPLIFIER (20-30 MC/S IF)

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LIST OF ILLUSTRATIONS

LEADING PARTICULARS OF THE TEST SET, AMPLIFIER (20-30 MC/S)

Designation:	Test equipment to enable the IF unit (20-30 Mc/s) to be operated and tested in either its transmit or receive condition. Comprises:- (1) Test set, amplifier, 6625-99-945-2948 (2) Cable assembly, radio frequency (5 ft.) 5995-99-932-1905 (3) Cable assembly, radio frequency (Marconi to BNC) 5995-99-932-4201
Overall Ref.No.:	6625-99-943-6537
Dimensions: (approx.)	$17\frac{3}{8}$ in. x $12\frac{1}{8}$ in. x 15 in.
Weight: (approx.)	Test set, amplifier - 56 lb. Cable assemblies - 3 lb.
Power supplies:	Derived from the power supply (130V) 6130-99-999-7812

Introduction

1. In conjunction with other items of general service test gear listed in Table 1, the test set, amplifier (20-30 Mc/s IF) 6625-99-943-6537 (fig. 1) has been designed to facilitate third and fourth line testing of the IF unit (20-30 Mc/s) which is a component part of the transmitter-receivers Type TR4/ARC52 and Type TR5/ARC52.

2. In order to make full functional tests on the IF unit (20-30 Mc/s), it is necessary to connect it to a number of other sub-units of the ARC52 so that its various inputs and outputs are supplied and loaded as during normal operation. This test set contains one each of the necessary sub-units and all the interconnections between them, both electrical and mechanical. Normal ARC52 sub-units are used, the amplifier unit (main receiver and transmitter preamplifier) and the amplifier unit, AF being modified. For reliable results to all tests made using the test set, the sub-units must be completely serviceable; they should, therefore, be tested regularly as described in the appropriate chapters in Sect.2 of this Volume.

Construction

3. The test set is contained in a standard instrument case, complete with side mounted carrying handles and instrument panel cover. The cover is a dished pressing in sheet metal with rubber moulding fitted around the lip. Ten large-headed screws are provided to secure the cover in position during transit or storage of the equipment.

4. The front panel (fig. 2) constitutes the control panel of the test set and on this are mounted the meter, controls, switches, input and output plugs and sockets, monitoring terminals and mechanical indexing head. Provision for the protection of control panel components against damage whilst the equipment is in use is made by means of four hexagonal steel pillars, mounted one at each corner of the control panel.

5. The test set, amplifier incorporates the following sub-units, the first two of which are as used in the Type TR4/ARC52 and Type TR5/ARC52:-

(1) IF unit (1.85 Mc/s) 5821-99-942-8556

(2) Oscillator unit 5821-99-942-8553

(3) Frequency meter sub-assembly 6625-99-947-7559 (modified version of the amplifier unit, AF)

(4) Mixer stage, frequency 5821-99-947-7558 (modified version of the amplifier unit (main receiver and transmitter preamplifier)).

Associated test equipment

6. To provide the required performance monitoring facilities when testing the amplifier module, additional items of test equipment are required. The function and descriptions of these ancillary equipment are listed in Table 1; further particulars of individual items may be obtained by reference to the publication listed.

TABLE 1

List of associated test equipment

Item	Nomenclature	Ref. No.	Further details
1	Power supply (130V)	6130-99-999-7812	Chap. 2
2	Signal generator, CT394	6625-99-943-1911	A.P.2531H
	or		
	Generator, signal (CT394A)	6625-99-972-6346	A.P.2531HA
3	Signal generator, Type 56	10S/647	A.P.2879
	or		
	Signal generator, Type 56A	10S/16822	A.P.2879
	or		
	Signal generator, Type 57A	10S/16823	A.P.2538J
4	Multimeter, electronic, CT38	10S/16308	A.P.2879AG
	or		
	Voltmeter, electronic (CT54)	6625-99-943-2418	
5	Wattmeter, absorption, AF (CT44)	6625-99-943-0510	
	or		
	Output meter, Type 2	10S/11934	
6	Headset, telephone, Type 9	10AH/14	A.P.830

Facilities

Power supplies

7. The test set is capable of transferring all power requirements from the power supply (130V) via the appropriate connector to the module on test.

Mechanical

8. The mechanical indexing head is capable of setting the Oldham couplers of the module on test to any position required. In particular, it is capable of indexing the mechanical shafts of the module to the nominal positions of 20.5 Mc/s, 25.5 Mc/s and 29.5 Mc/s to an accuracy of not worse than ± 6' of arc and the tenths Mc/s coupler to the 0.2 Mc/s position to an accuracy of not worse than ± 12' of arc.

Mode of operation

9. The test equipment may be made to operate in either the receive condition or the transmit condition, by means of a rotary switch

(FUNCTION) which is mounted on the front panel. This switch applies h.t. appropriate to the mode of operation of the equipment, as shown in the circuit diagram.

Output circuits

10. The output from the simulator unit is passed to the module on test via coaxial links. Provision is made for facilitating the accurate setting of the frequency of the test signal generator (Table 1, item 2) by providing an audible heterodyne in the headphones (Table 1, item 6). The frequency meter, operated from the amplifier unit, AF, registers frequency over the range 50 c/s to 1000 c/s at a sensitivity down to 1 volt, r.m.s. open circuit.

Front panel items

11. Further facilities are provided by panel mounted components as follows:-

(1) A pair of screw terminals coded D.C. V.V. which are provided for the connection of a d.c. valve voltmeter.

(2) A pair of screw terminals coded AF OUTPUT for the connection of an a.f. wattmeter.

(3) An a.f. gain control marked AUDIO CONTROL.

Circuit description

12. A circuit diagram of the test set, amplifier (20-30 Mc/s IF) is shown in fig. 14 at the end of this chapter. This circuit is drawn with each of its functions clearly defined and the following circuit description is divided under appropriate headings for each of these facilities.

Power supplies

13. The power supply (130V), from which all power requirements are derived, is connected to the test set at plug PL1.

14. Positive h.t. is applied at pole A of plug PL1 and routed via the isolating toggle switch S4 (H.T.) to the FUNCTION switch S3 and thence to the unit on test. A supply of +130V is also applied at pole B of plug PL1, providing h.t. for the test set.

15. Heater supplies, variable between 0V and 10V a.c., are applied at poles C and G of plug PL1 and routed directly to poles 3 and 1 (earth) respectively of socket SKT8. Poles C and G are linked to poles F and H respectively so that monitoring of the heater supply voltages to the unit on test may be made.

16. At pole E of plug PL1, a bias voltage is available from the power supply (130V). This bias may be varied between 0 and -50V with respect to the frame by a potentiometer situated on the power supply (130V). Before connecting up, this voltage should be adjusted to -15V ± 1V to suit the test requirements. The bias voltage is applied directly to the IF unit (1.85 Mc/s) in the test set and is still further reduced by a divider network in the test set before being applied to the module on test (para. 32).

17. An isolated heater supply, variable between 0V and 10V a.c., enters at poles J and K of plug PL1, pole J being connected to the frame of the test set. This provides heater supplies to all modules of the test set.

18. At pole L of plug PL1 a positive voltage of 27.5V d.c. is applied and routed directly to socket SKT8 to provide a relay operating voltage for the unit on test during transmit conditions only.

1.85 Mc/s calibrating receiver

19. The IF unit (1.85 Mc/s) and the amplifier unit, AF comprise a 1.85 Mc/s calibrating receiver for the test set; associated with the calibrating receiver is a 1.85 Mc/s beat frequency oscillator (V4 and associated components) and an a.f. electronic frequency meter (V3, V5A, V6, M1 and associated components).

20. The calibrating receiver input is controlled by the position of switch S2 (REC. INPUT). In position J1516 of switch S2 the output of the unit on test is connected via J1516, socket SKT6, poles 9 and 7 of switch S2 and socket SKT13 to the input of the IF unit (1.85 Mc/s).

21. Rotation of switch S2 to the position GEN. connects the output of the 1.85 Mc/s signal generator (Table 1, item 3) via X3, socket SKT5, capacitor C2, poles 10 and 7 of switch S2 and socket SKT13 to the input of the IF unit (1.85 Mc/s).

22. Rotation of switch S2 to its third position of TRANS. OSC. connects the output of the transmitter oscillator in the unit on test via pole 9 of socket SKT8, capacitor C4, poles 11 and 7 of switch S2 and socket SKT13 to the input of the IF unit (1.85 Mc/s).

23. Monitoring of two of the outputs from the IF unit (1.85 Mc/s) is achieved by connecting a meter (Table 1, item 4) to terminals TP1 and TP2 (D.C. V.V.) then operating switch S1 (D.C. V.V.) in turn to the positions A.G.C. and REC. REF. to measure, respectively, the a.g.c. output and auxiliary audio output from the IF unit (1.85 Mc/s).

24. The audio output from the IF unit is applied from pole 6 of socket SKT14 via capacitor C16 to pole 8 of socket SKT17 thence to the amplifier unit, AF at pole 8 of plug PL3. The amplified signal output is taken from the amplifier unit, AF at pole 13 of plug PL3, via pole 13 of socket SKT17, potentiometer RV2 (AUDIO CONTROL) and can then be monitored aurally at the headphone jack JK1 (PHONES) by means of the headphones or visually at terminals TP3 and TP4 (AF OUTPUT) by means of a wattmeter (Table 1, item 5).

25. H.T. is applied to the anodes of valve V4 in the beat frequency oscillator circuit by operating switch S6 (B.F.O.) to the ON position. The beat frequency oscillator is controlled by crystal XL1, operating at 1.85 Mc/s ± 92.5 c/s and the output of the oscillator is taken from pin 8 of valve V4 and routed via capacitor C21 and resistor R7 to switch S2 (REC. INPUT). In the position TRANS. OSC. of switch S2 this signal is then coupled to the input of the IF unit (1.85 Mc/s) via poles 11 and 7 of switch S2 and socket SKT13 producing a heterodyne with any suitable signal passing into the IF unit (1.85 Mc/s) from the oscillator unit (para. 22).

26. The electronic frequency meter is operated from the amplifier unit, AF, in the test set, when switch S2 is indexed to TRANS. OSC. Meter M1 is calibrated to register frequency over the range 50 c/s to 1000 c/s to an accuracy of not worse than ± 10%.

2nd i.f. injection oscillator

27. The 2nd i.f. injection oscillator is a standard oscillator unit as used in the transmitter-receivers Type TR4/ARC52 and Type TR5/ARC52; the shafts of the oscillator unit are controlled at the front panel of the test set by means of the switch designated INJ. OSC. This switch may be set according to the test i.f. channel selected; i.e. either 20.7 Mc/s, 25.7 Mc/s or 29.7 Mc/s. The output from the oscillator is routed via a coaxial cable to socket SKT9, socket SKT7 and J1515.

Simulator unit

28. The simulator unit comprises the input portion of the transmitter preamplifier and the output portion of the receiver amplifier of the amplifier unit (main receiver and transmitter preamplifier).

29. For the transmitter portion, the output from the module on test is applied to the grid of valve V2 via socket SKT4, link X5, connector J1517, capacitor C7 and inductor L2. Monitoring of the grid excitation of valve V2 is then achieved, by routing the voltage obtained at the grid via resistor R2, pole 1 of plug PL2 and pole 1 of socket SKT15 to the d.c. voltmeter (Table 1) connected across terminals TP1 and TP2, by indexing switch S1 to the position TRANS. OUTPUT.

30. For the receiver portion, a signal from the 20-30 Mc/s signal generator (Table 1, item 2), when applied at the coaxial socket designated 20-30 Mc/s SIG. GEN., is routed to the grid of valve V1 via link X4, socket SKT11 and capacitor C6. The output from valve V1 is then applied via capacitor C5 and connector J1518 to the unit on test.

31. H.T. is applied to either the transmitter portion or the receiver portion of the simulator unit from pole B of plug PL1 by indexing switch S3 either to TRANS. or REC.

Bias voltage

32. A bias voltage of -15V ± 1V is applied at pole E of plug PL1 (para.16) and fed to a voltage divider comprising R12-R15. With switch S5 (0.5 BIAS VOLTS) indexed to ON, a negative potential of approximately 0.5V, derived from the divider network, is applied to the module on test via pole 15 of socket SKT8.

Operation

33. The equipment may be made to operate in either the receive condition or the transmit condition; this is achieved by means of the rotary switch S3 (FUNCTION) which applies h.t. and 27.5V d.c. voltage appropriate to the mode of operation of the equipment.

Servicing

34. The equipment should be maintained in a clean, dry and undamaged condition throughout its service life. Care must be taken to avoid rough handling of the switches and controls. Whilst the test set is on the bench keep the working area clear of any servicing tools, soldering irons, etc.

35. Periodically remove the control panel and inspect the switches and wiring; access can be gained by removing the fourteen cheese head screws securing the control panel to the main casing.

36. Whenever a fault is suspected within the internal wiring, a continuity test can be readily made using an approved multimeter. Wire employed in the test set is wire, electrical equipment, Type 2, 23/.0076 in. pink (6145-99-910-0191) and wire, electrical equipment, Type 2, 14/.0076 in. pink (6145-99-910/0185) and any replacement wiring should be made with the correct grade of wire. The connections should be made as neatly as possible with care taken to avoid tails of solder. Remove any wire clippings and excess solder before replacing the control panel.

37. Examine the connectors each time before coupling them to the test set and the equipment on test. They should be undamaged and dry, with the plug and socket terminations making good, firm contact with the mating components on the related equipment.

Overall testing

38. The layout of components is shown in fig. 3 and 4 whilst a circuit diagram of the complete unit is given at fig. 14 and a study of these diagrams should provide all the information necessary for clearing normal faults.

39. When repairs or replacements of component parts have become necessary, tests should be made to determine that the equipment has been restored to a serviceable condition equivalent to that of a new unit, as issued, which has been inspected to factory standards.

MECHANICAL TESTING AND SERVICING EQUIPMENT

General

40. In order to facilitate the accurate drilling of coupler plates and shafts of the IF unit (20-30 Mc/s) when replacement is required, a special drill and ream jig has been developed. Then to enable an accurate determination to be made of the drilling and reaming, a checking fixture and height gauge plate have been designed. For assistance and verification of accuracy during assembly of the IF unit (20-30 Mc/s), after repair or overhaul for example, a setting plate and aligning fixture have been devised.

Drill and ream jig

41. This equipment is issued under Ref. No. 10AG/957 for the accurate drilling of Oldham couplers and their associated switch shafts. As shown in fig. 5, it comprises an L-shaped steel base within which is fitted the IF unit 20-30 Mc/s under repair. On the front face of the jig are a number of finger screws (fig. 6), two of which are for engagement into the tapped holes of the unit base in the same way in which the unit is retained in the main chassis assembly of the parent transmitter-receiver. The remaining finger screws are for engagement of the couplers in order that end play of the shafts can be eliminated before drilling and, also, to align the couplers correctly with the two switch shafts.

42. To ensure the correct clearance between the couplers and the face of the module, a coupler height plate (T133914) is provided. This plate is secured within the jig by a socket head screw (fig. 5) when not in use; it is removed when the IF unit (20-30 Mc/s) is fitted into the jig and then placed between the couplers and the end face of the module before the securing screws are tightened. This will provide the working clearance necessary between coupler and module chassis when the module is operative. A drill slip bush is provided which can be fitted in two positions on the jig base in order to drill accurately through each of the two couplers and shafts. This bush is accurately machined to accommodate a No. 50 (0.070 in.) drill. The method of drilling and reaming is described in fuller detail in Sect. 2, Chap. 4 of this Volume.

Checking fixture

43. The position of the coupler plates in relation to the cam positions of the IF unit (20-30 Mc/s) can be verified after the drilling and reaming of coupler plates and shafts by means of the checking fixture Ref. No. 10AG/958. This fixture is shown in fig. 7 and then also in fig. 8 showing the module in position and the checking fixture set up on a surface plate with the alignment testing equipment.

44. The IF unit (20-30 Mc/s) is fitted into the fixture and secured in position by means of the two diagonally disposed finger screws in the vertical face of the checking fixture whilst the dial test indicator is

used to align the position of the cam and the coupler plate of each switch shaft in turn. Full details of the checking procedure are given in Sect. 2, Chap. 4 of this Volume.

Height gauge plate and depth gauge

45. The height of the coupler plate with respect to the unit baseplate (i.e. working clearance) is set initially by means of the coupler height plate (T.133914) during drilling operations. But in order to verify this distance either after repair or during routine inspection a height gauge plate is provided under Ref. No. 10AG/955. This is used in conjunction with the depth gauge Ref. No. 10AG/961 (fig. 9).

46. The height gauge plate is secured to the base of the module by four finger screws which engage into the tapped holes provided for securing the IF unit (20-30 Mc/s) in the main chassis assembly of the parent transmitter-receiver. The depth gauge is then placed in turn in each of the two holes in the height gauge plate and resting on the coupler plates (fig. 10). The top surface of the depth gauge is machined with a step, to function as a GO and NO GO gauge, which can be tested by means of a straight edge held across the surface of the height gauge plate. Further details of this operation are given in Sect. 2, Chap. 4 of this Volume.

Aligning fixture

47. Whenever the 0.1 Mc/s cam or shaft is renewed, alignment is necessary using the aligning fixture Ref. No. 10AG/956 (fig. 11). This fixture is shown also in fig. 12 with the unit chassis and shaft in position. Full details of the procedure for aligning the cam and shaft are given in Sect. 2, Chap. 4 of this Volume.

Setting plate

48. To assist during assembly of the slug rack assembly into the IF unit (20-30 Mc/s) and subsequently to verify and restrain the switch shafts against end play, the setting plate Ref. No. 10AR/4892 is employed (fig. 13).

49. This plate is fitted against the base plate of the module and retained in position by two finger screws. Full details of the assembly procedure and use of this setting plate are given in Sect. 2, Chap. 4 of this Volume.

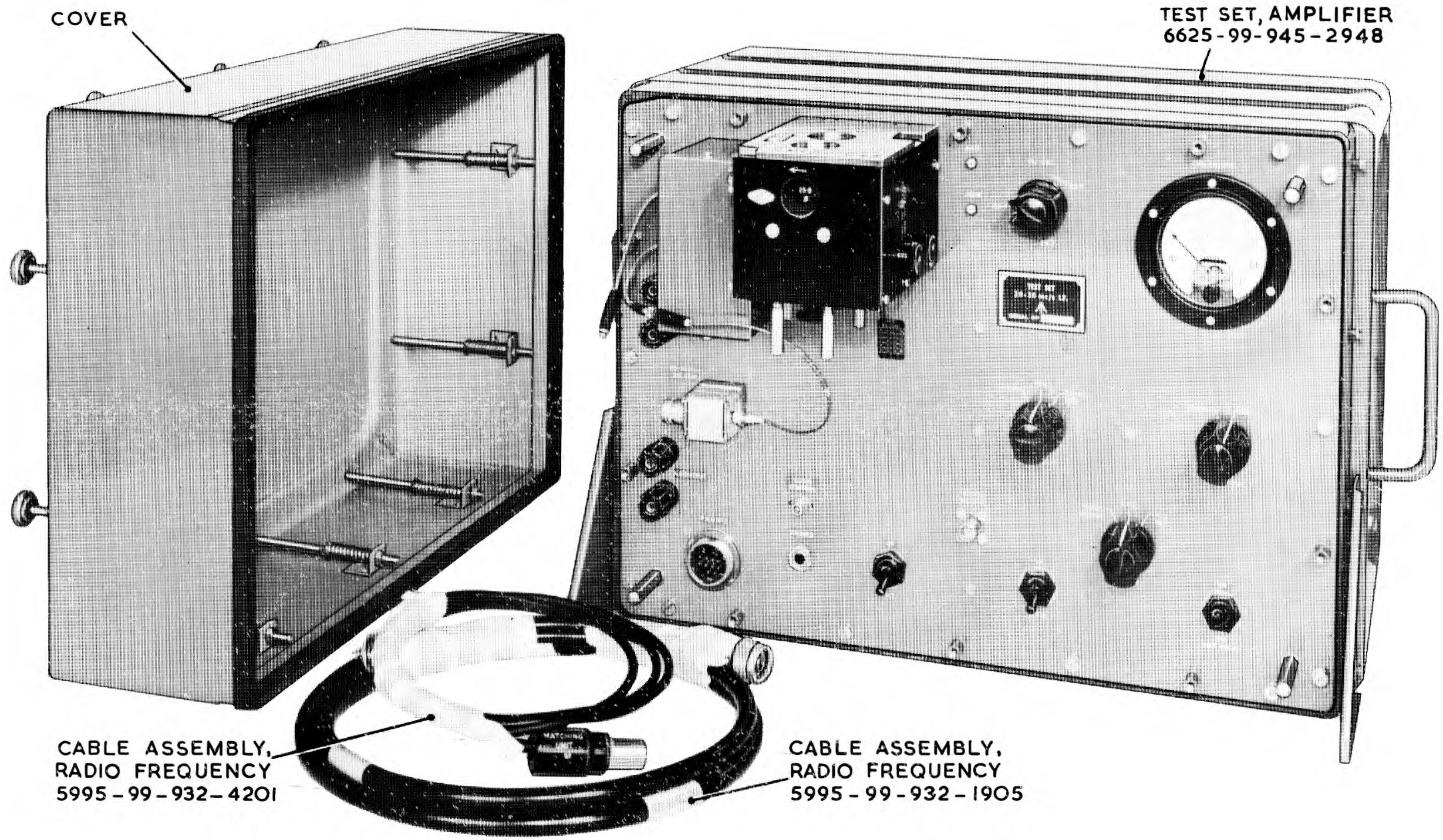

Fig. 1. Test set, amplifier (20-30Mc/s I F) 6625-99-943-6537

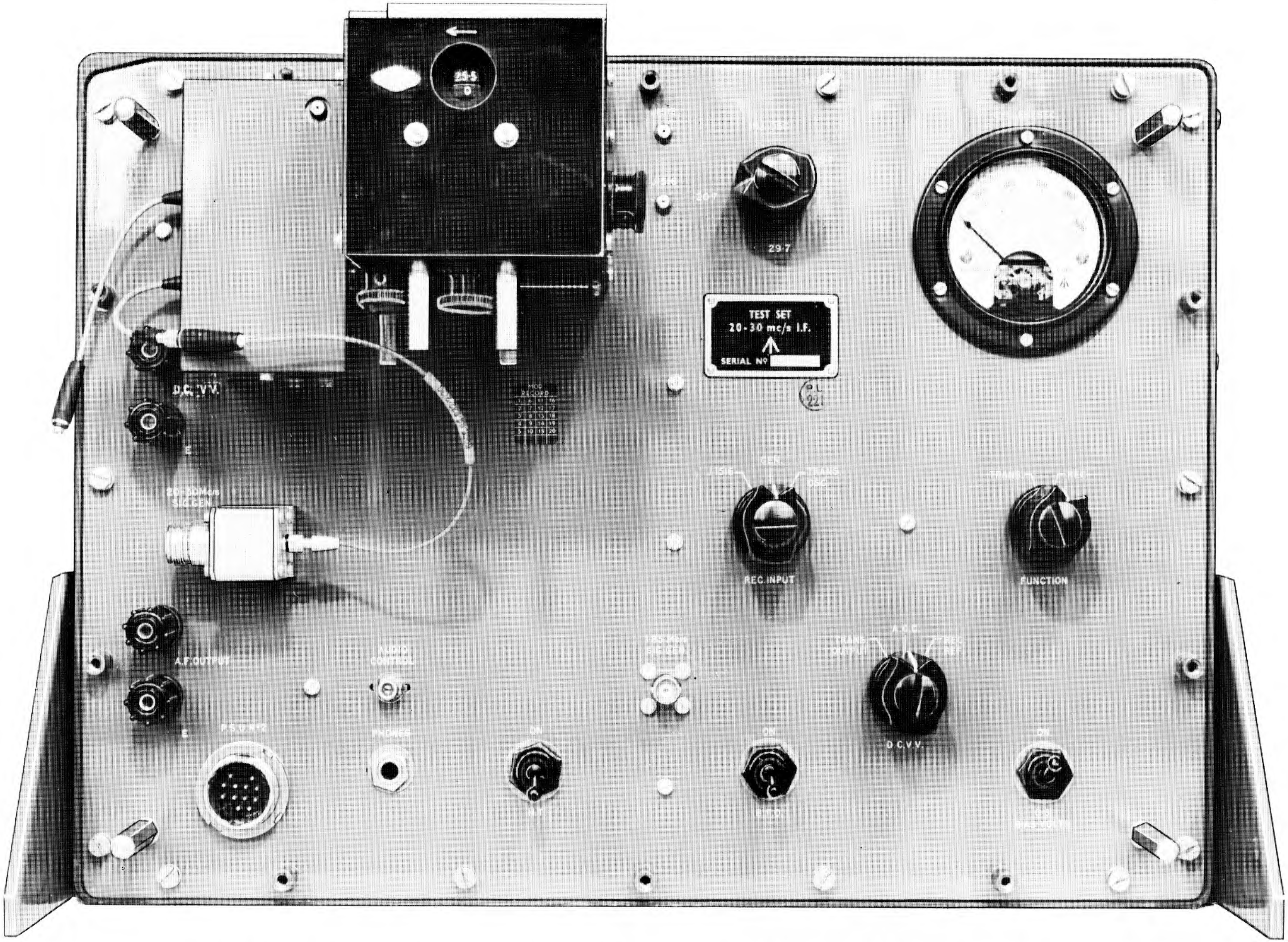

Fig. 2. Test set, amplifier : control panel layout

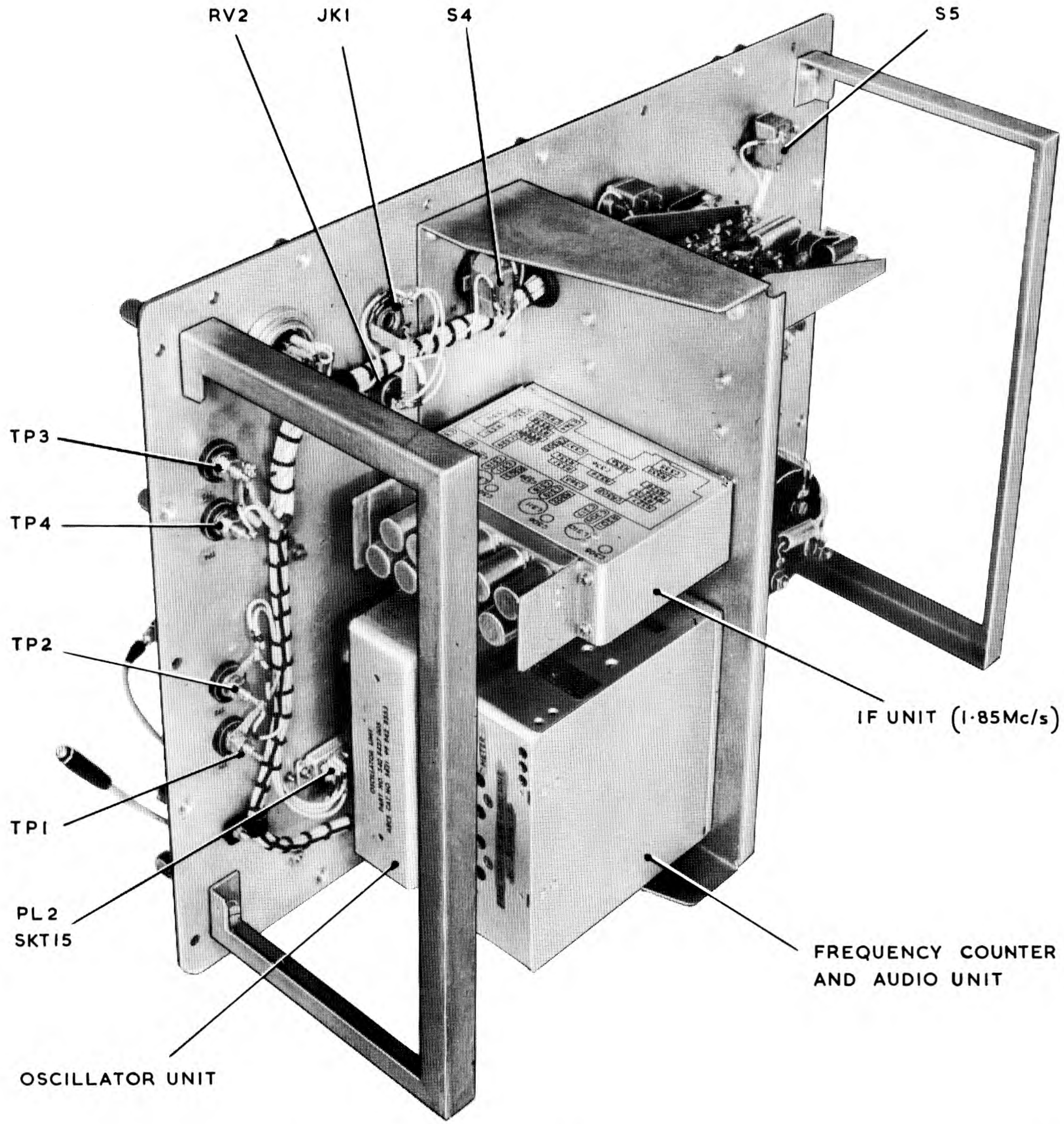

Fig. 3. Test set, amplifier : component layout on rear of control panel, from right-hand side

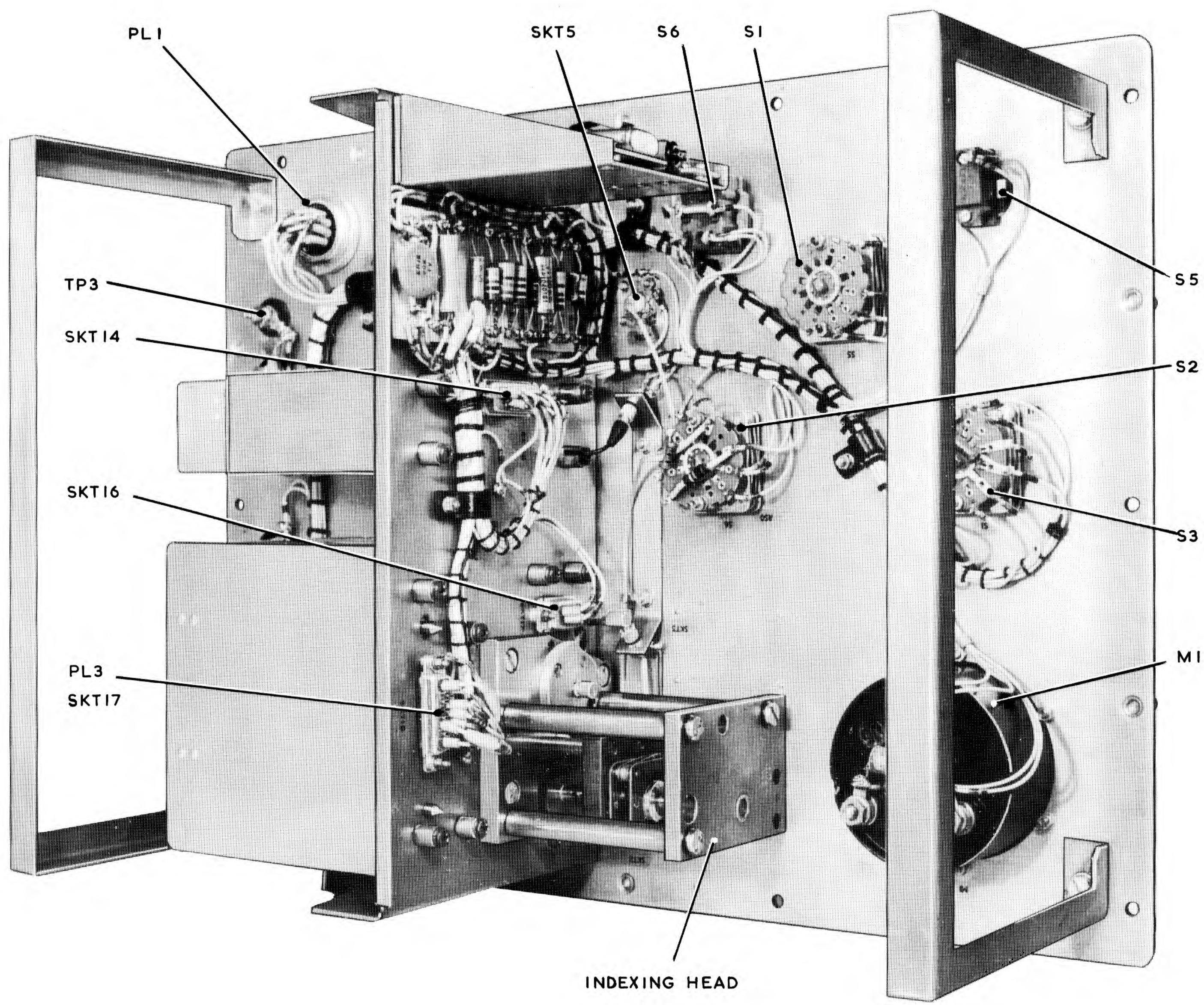

Fig. 4. Test set, amplifier : component layout on rear of control panel, from left-hand side

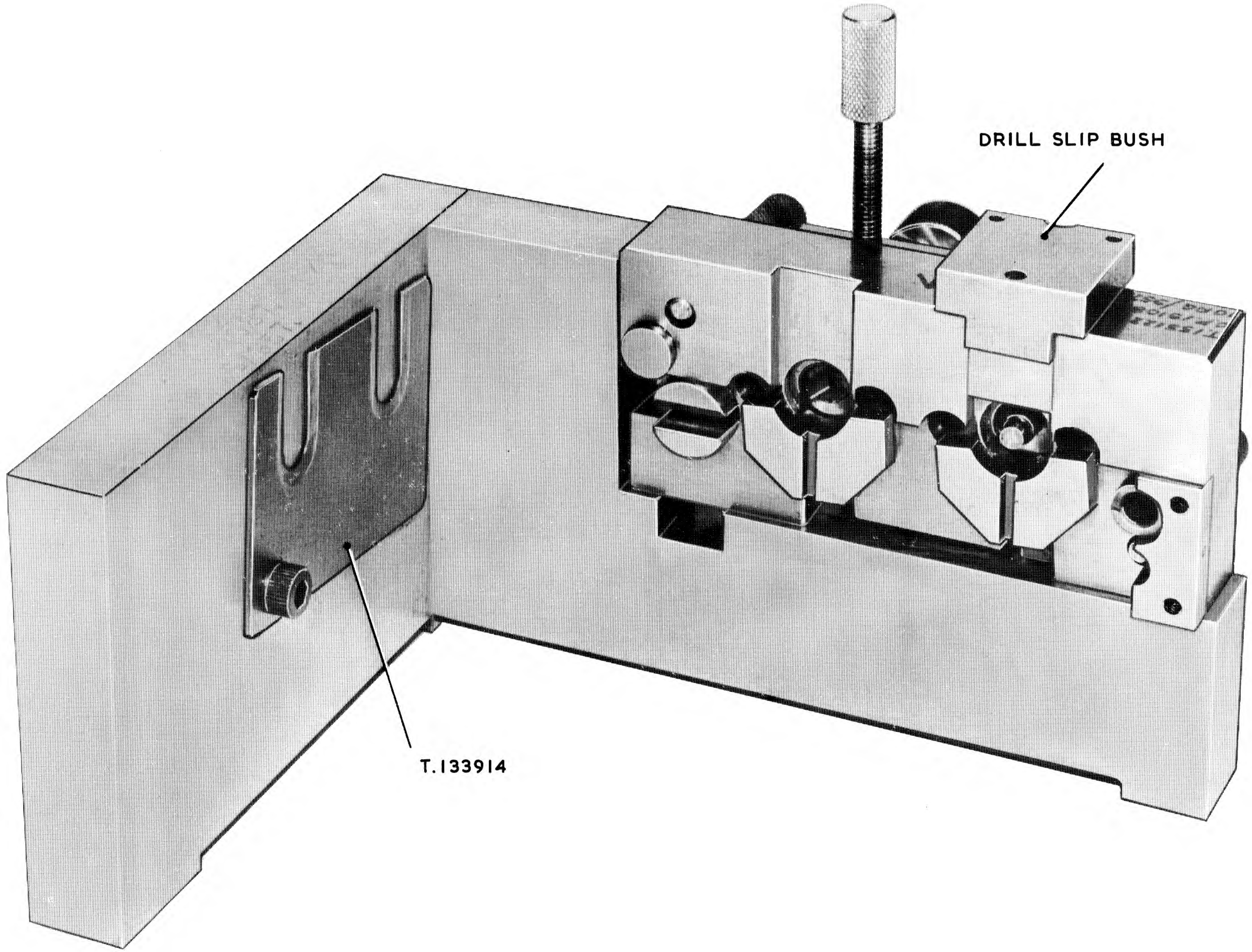

Fig. 5. Drill and ream jig Ref No. 10AG/957

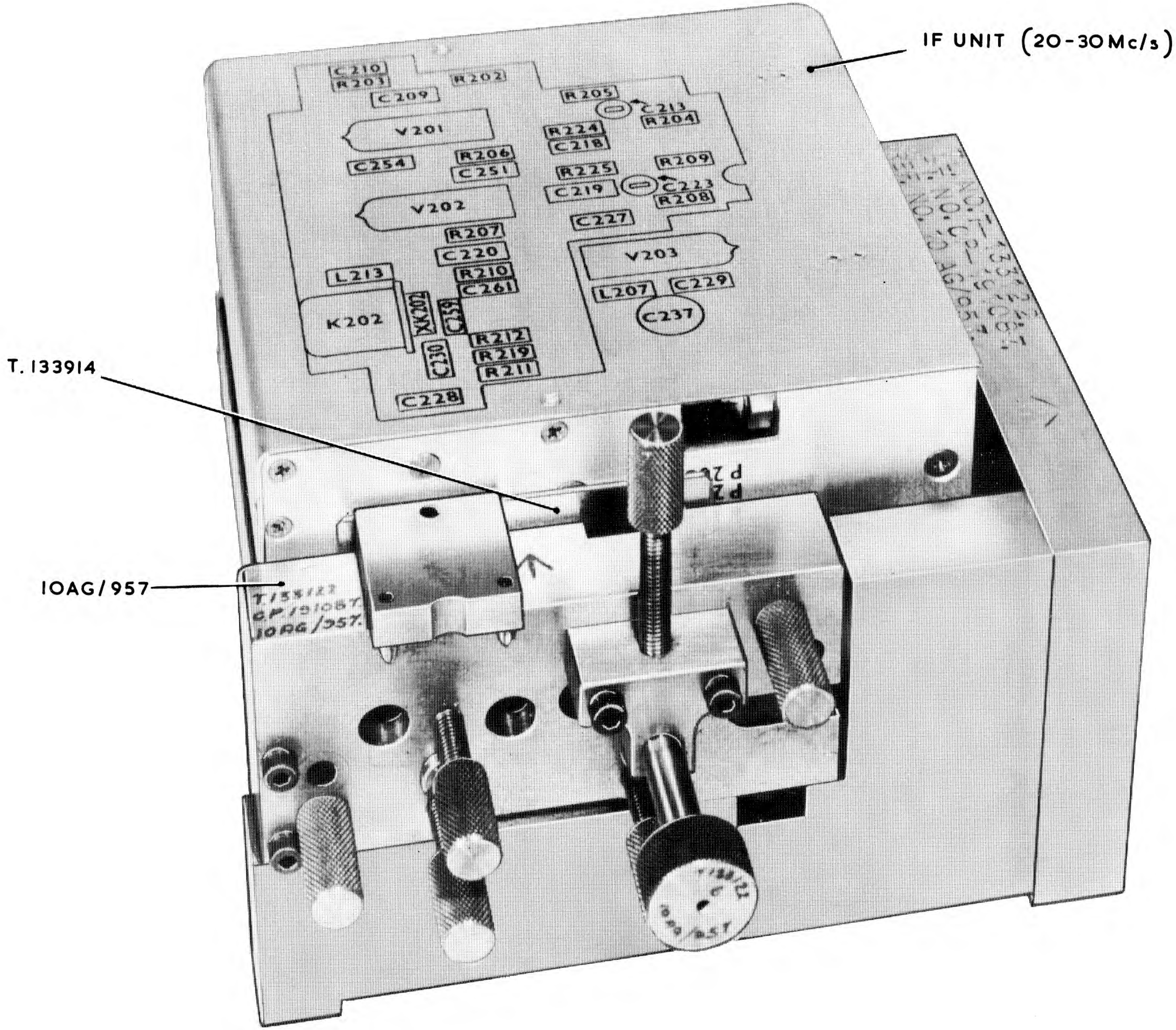

Fig. 6. Drill and ream jig with IF unit (20 - 30Mc/s) in position

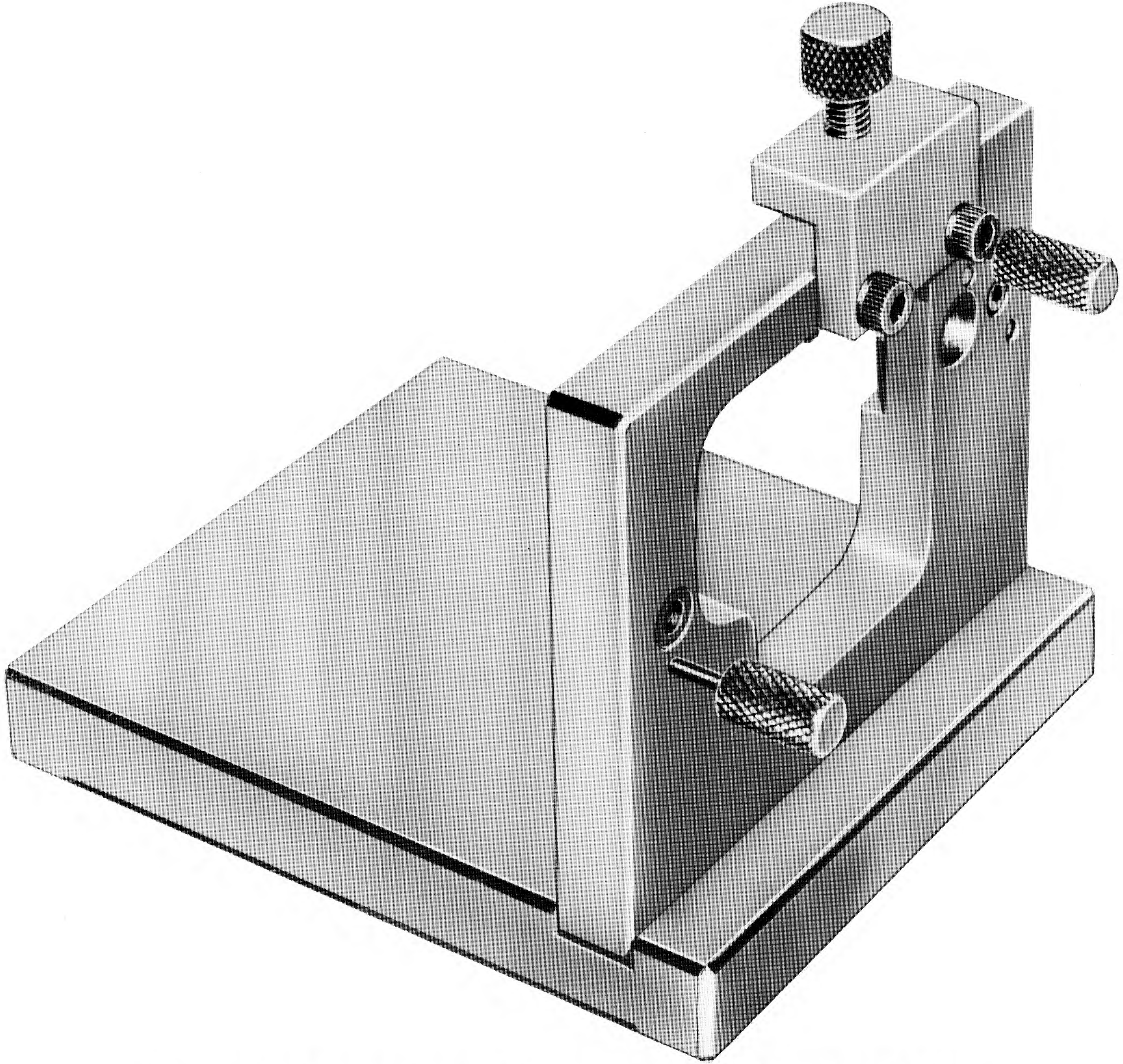

Fig. 7. Checking fixture Ref. No. 10AG/958

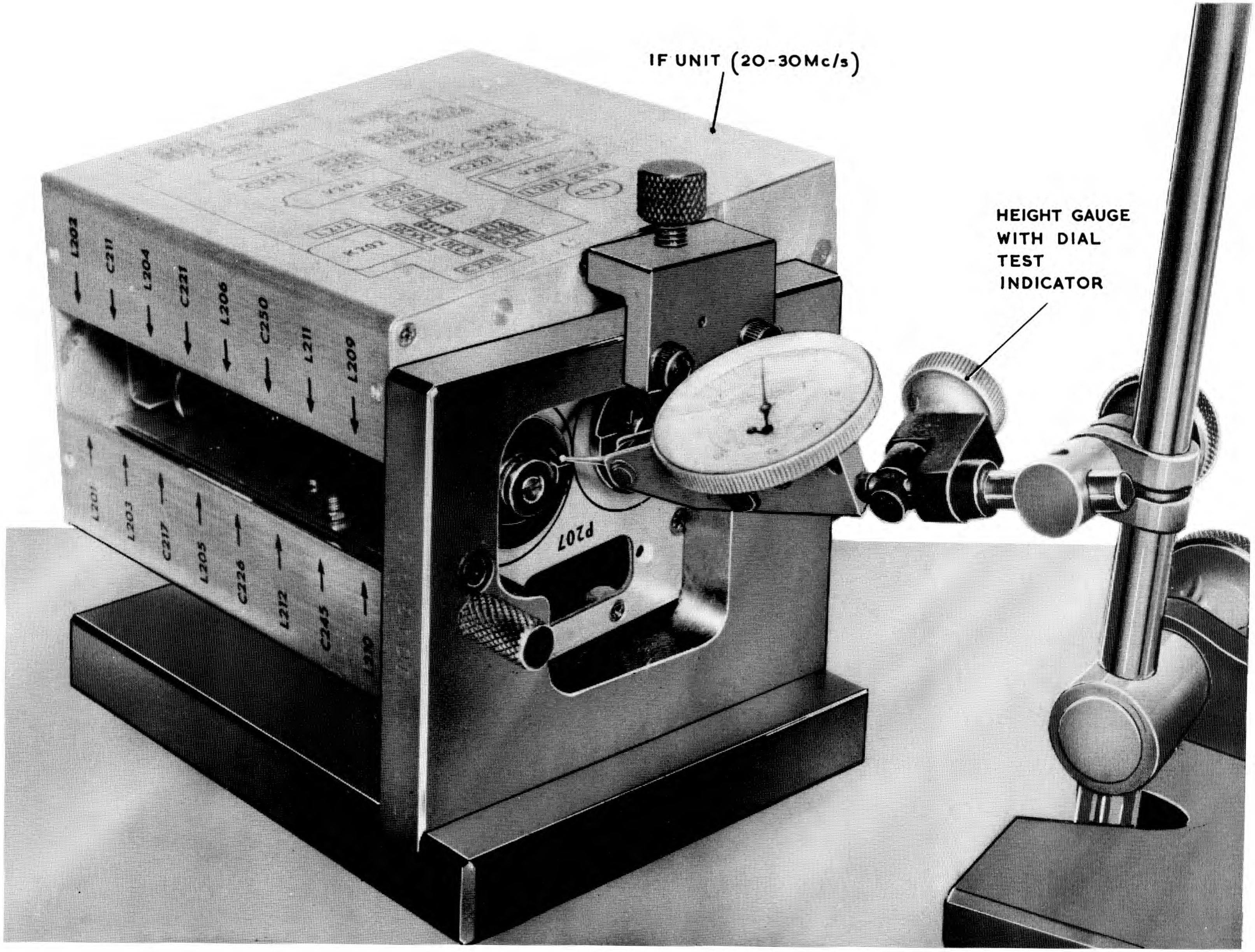

Fig. 8. Checking fixture with IF unit (20 - 30Mc/s) in position

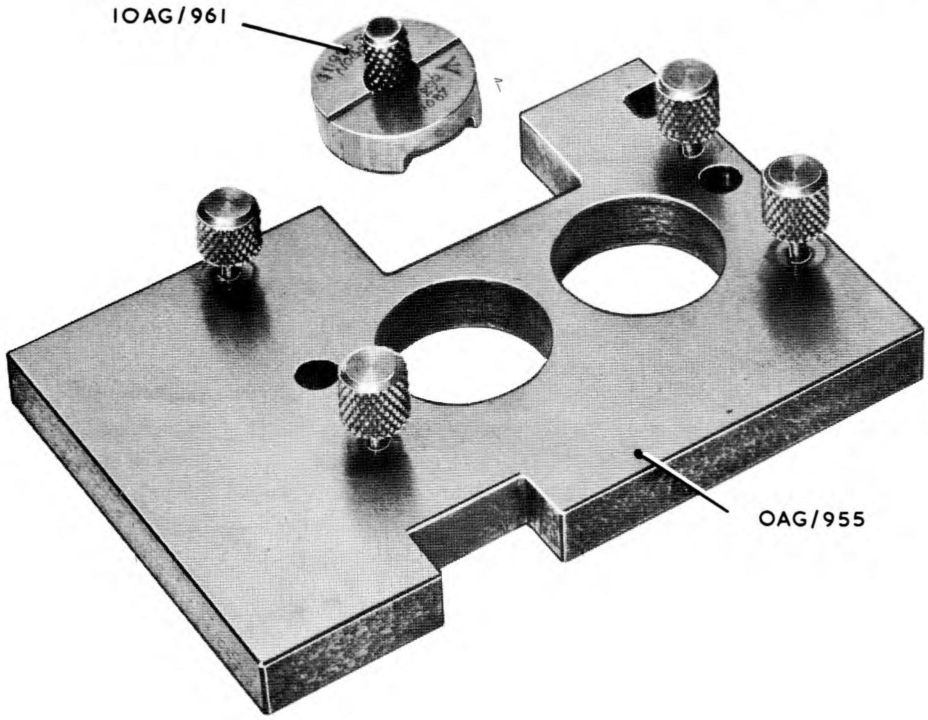

Fig. 9. Height gauge plate Ref. No. IOAG/955 and depth gauge Ref. No. IOAG/961

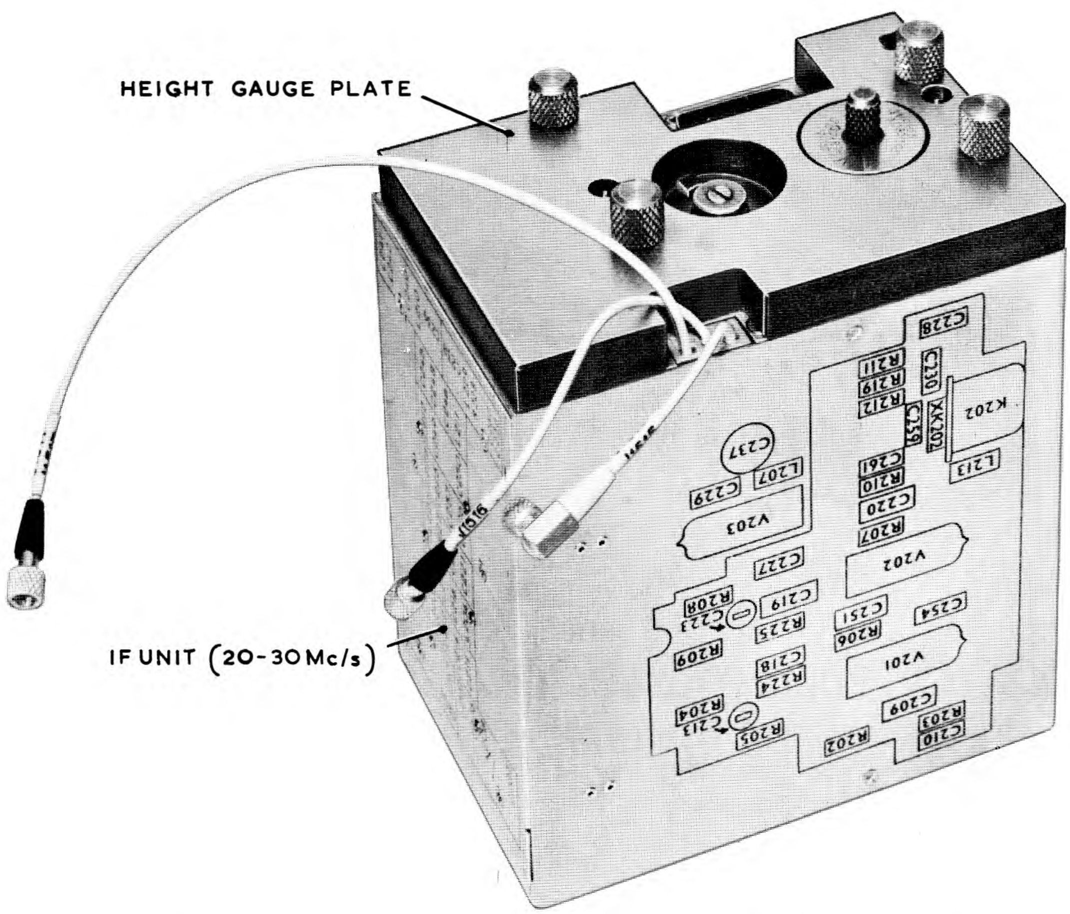

Fig. 10. Height gauge plate and depth gauge fitted to IF unit (20-30Mc/s)

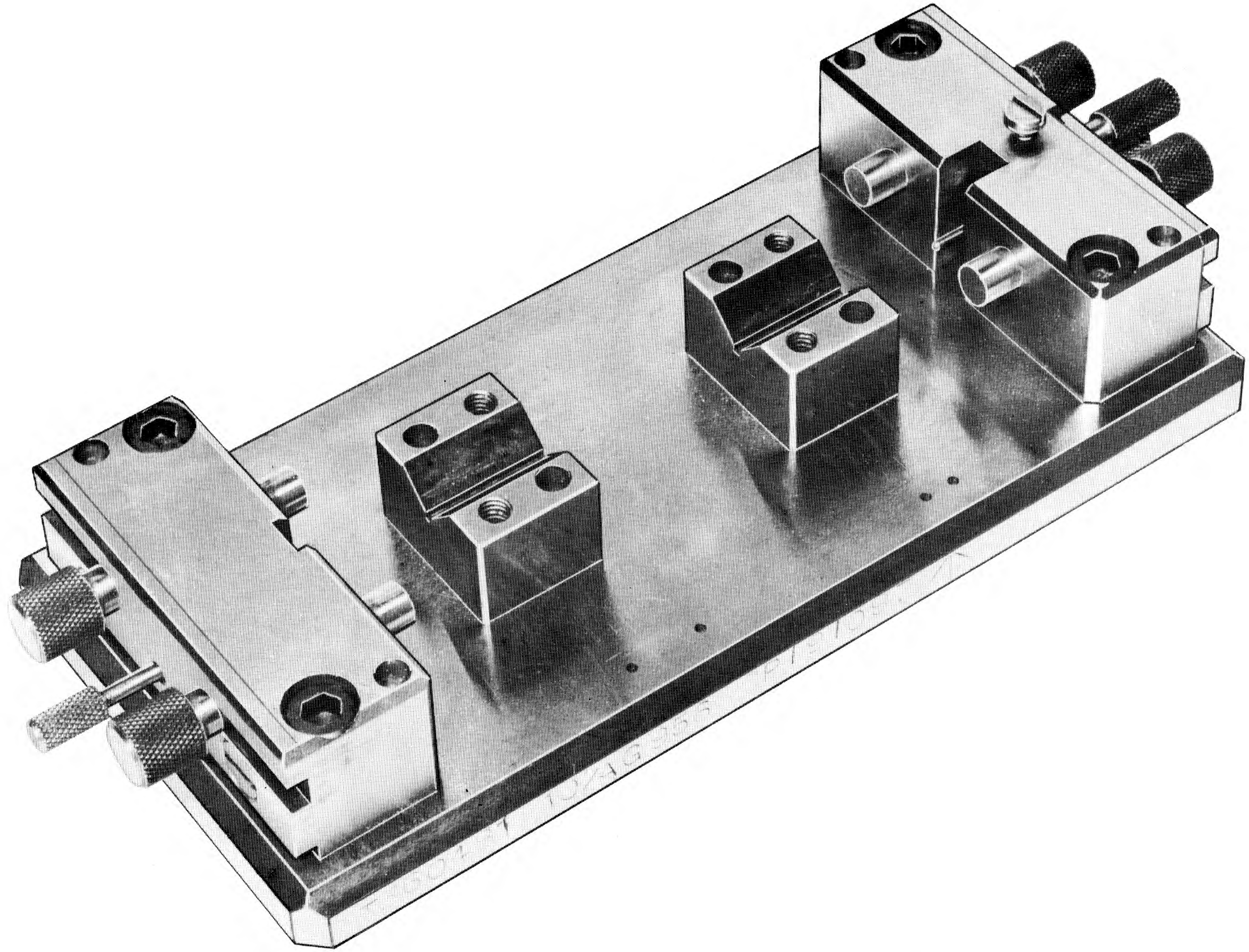

Fig. 11. Aligning fixture Ref. No. 10AG/956

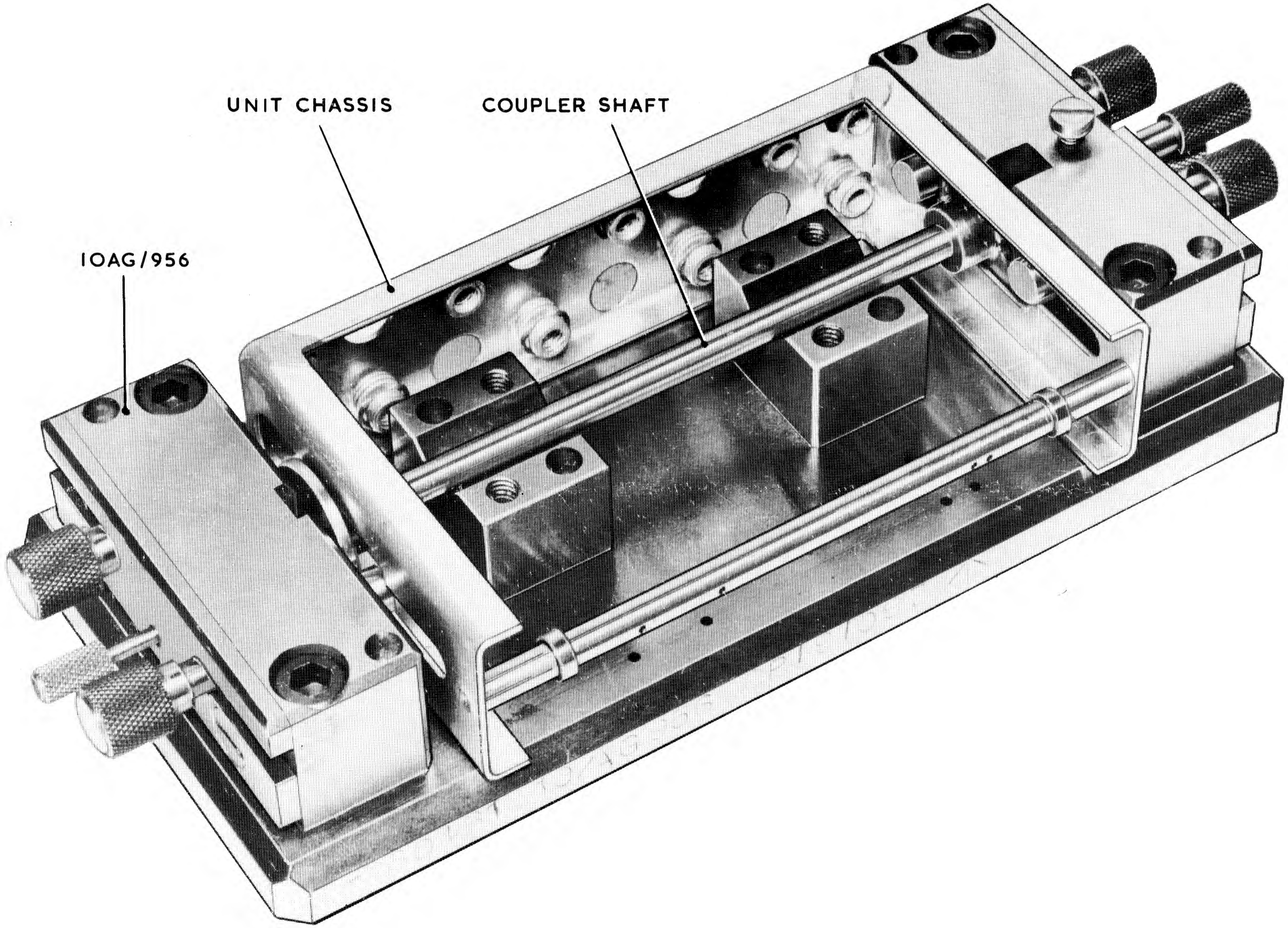

Fig. 12. Aligning fixture with unit chassis and shaft in position

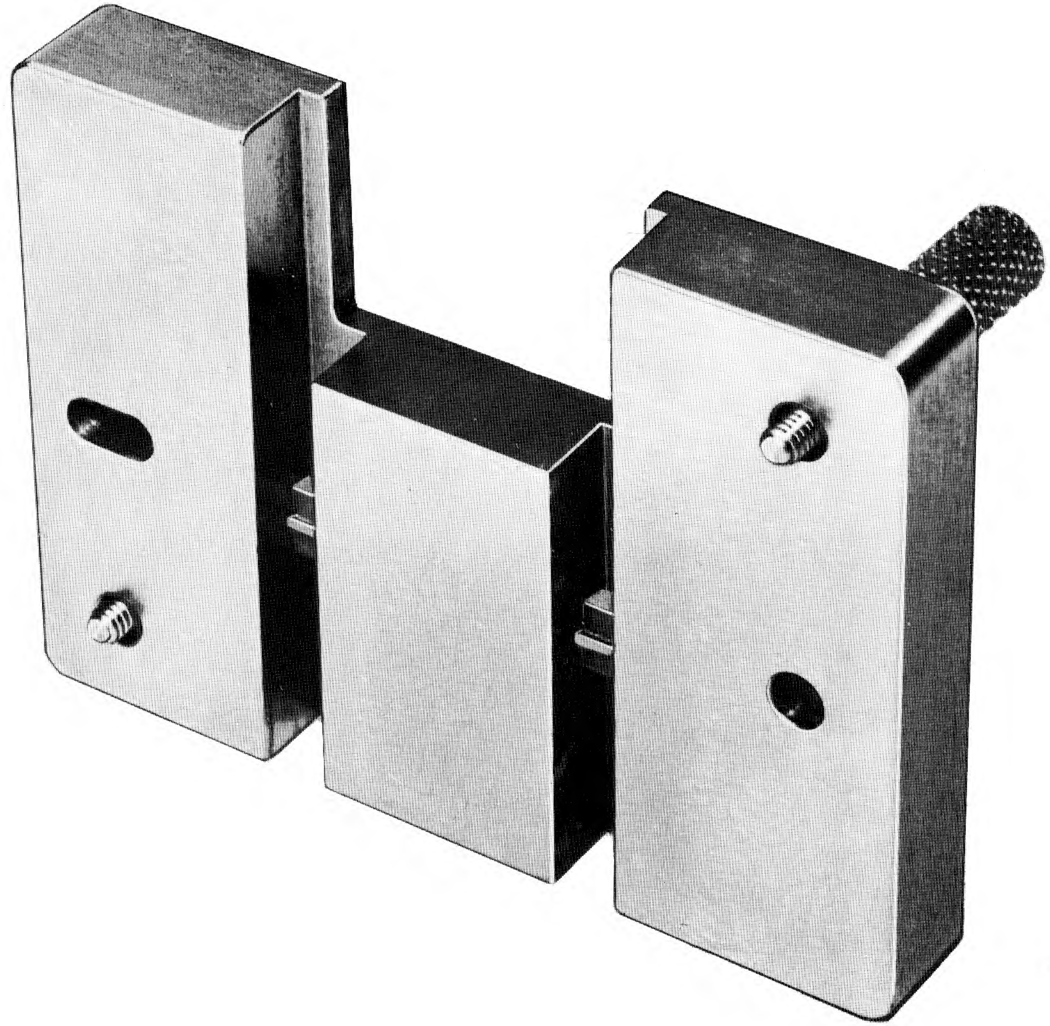

Fig. 13. Setting plate Ref. No. 10AR/4892

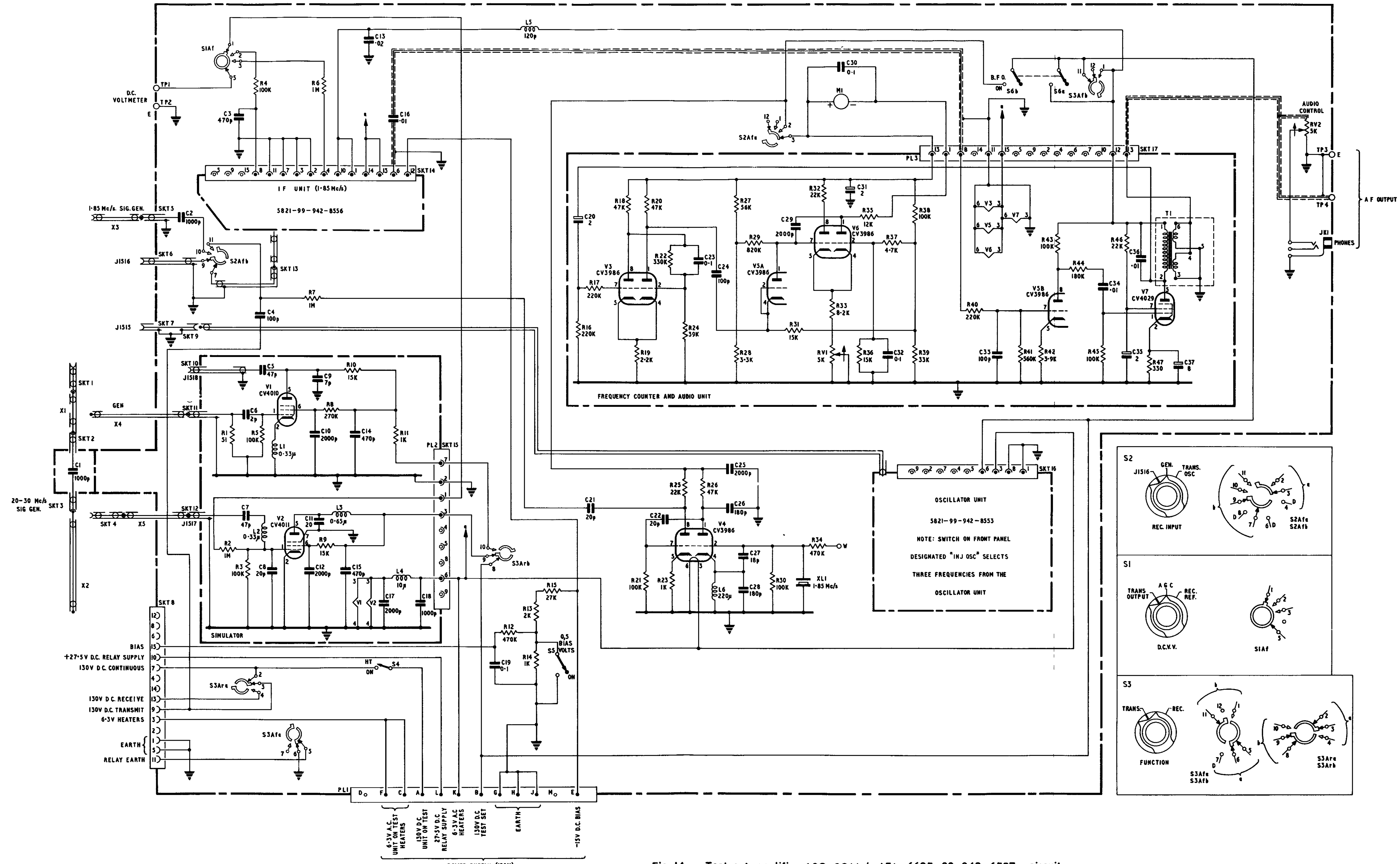

Fig. 14 Test set, amplifier (20-30 Mc/s IF) 6625-99-943-6537 : circuit

Chapter 15

TEST EQUIPMENT FOR AMPLIFIER UNIT (MAIN RECEIVER RF AMPLIFIER & TRANSMITTER PREAMPLIFIER)

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LEADING PARTICULARS OF THE TEST SET, AMPLIFIER (MAIN RECEIVER RF AMPLIFIER AND TRANSMITTER PREAMPLIFIER)

Designation:	Test equipment to enable the amplifier unit (main receiver RF amplifier and transmitter preamplifier) to be operated and tested in either its receive or transmit condition.

Comprising:-

(1) Test set, amplifier, Plessey Part No.CP241801.

(2) Test jig, amplifier, 6625-99-999-1872.

(3) Connector Type 3430/1, Ref. No.10HA/8360.

(4) Cable assembly, radio frequency, 5995-99-932-2130.

(5) Cable assembly, radio frequency, 5995-99-932-1907.

(6) Connector, Plessey Part No.CP242146/3.

Overall Ref. No.	6625-99-999-7815.
Functions:	To simulate circuit supply conditions when testing units of the transmitter-receiver Type TR4/ARC52 and Type TR5/ARC52, to monitor the r.f. power output pass level of the unit on test and to monitor the output levels of the spectrum generator unit (amplifier-oscillator) and the IF unit (20-30 Mc/s).
Dimensions: (approx.)	Test set, $17\frac{1}{2}$ in. x $10\frac{1}{2}$ in. x $15\frac{1}{2}$ in. Test jig, $5\frac{1}{2}$ in. x $5\frac{1}{4}$ in. x 4 in.
Weight: (approx.)	Test set, 40 lb. Test jig, 5 lb. Connectors, $1\frac{1}{2}$ lb.

Introduction

1. In conjunction with other items of general service test gear, listed in Table 1, the test set, amplifier (main receiver RF amplifier and transmitter preamplifier) 6625-99-999-7815 (fig. 1) has been designed to facilitate third and fourth line testing of the amplifier unit (main receiver RF amplifier and transmitter preamplifier) which is part of the transmitter-receiver Type TR4/ARC52 and Type TR5/ARC52.

2. In order to perform full functional tests on the amplifier unit (main receiver RF amplifier and transmitter preamplifier), it is necessary to connect it to a number of other sub-units of the ARC52 so that its various inputs and outputs are supplied and loaded as during normal operation. This test set, which is designed for full functional testing of the amplifier unit, contains one of each of the necessary sub-units and all the interconnections between them, both electrical and mechanical. Normal ARC52 sub-units are used, only the spectrum generator unit is modified and this is merely to permit variation of the h.t. supply to its two final amplifier valves so that the output from this sub-unit can be set for a standard reading. For reliable results to all tests made using the test set, all these sub-units must be completely serviceable; they should, therefore, be tested regularly as described in the appropriate chapter in Sect. 2 of this Volume.

Construction

3. The test set is based on a standard instrument case, complete with side mounted carrying handles and instrument panel cover. The cover is a dished pressing in sheet metal with rubber moulding fitted around the lip. Ten large headed screws are provided to secure the cover in position during transit or storage of the equipment.

4. The front panel constitutes the control panel of the test set and on this are mounted the meter, controls, switches, input and output plugs and sockets, indicator lamps and monitoring sockets. Provision for the protection of control panel components against damage whilst the equipment is in use is made by means of four hexagonal steel pillars, mounted one at each corner of the control panel.

5. The test jig, amplifier 6625-99-999-1872 (fig. 1) is principally a raised mount upon which is fitted the amplifier unit undergoing test. Provision is made for engagement of the Oldham coupler into an indexing gear which may be adjusted by means of a hand control in the base of the test jig. In addition, a two-position key is provided to lock or freee the indexing setting. Electrical connection is made by means of the ten-way connector fitting into the socket marked INDEXING HEAD on the test set front panel and mating with a plug terminal on the side of the test jig. This plug is, in turn, connected by a short cable loom to the Cannon socket in the mounting plate provided to receive the integral plug termination of the amplifier unit on test.

6. The test set, amplifier incorporates the following items as used in the Type TR4/ARC52 and Type TR5/ARC52:-

(1) Oscillator unit 5821-99-942-8553.

(2) Spectrum generator unit (amplifier-oscillator) - modified.

(3) IF unit (20-30 Mc/s) 5821-99-942-8557.

(4) IF unit (1.85 Mc/s) 5821-99-942-8556.

(5) Amplifier unit, AF 5821-99-942-8555.

(6) Tuning unit (mechanical) 5821-99-942-8549.

(7) Gear plate assembly 5821-99-943-7805.

7. The amplifier unit, AF is set for signal to noise squelch operation.

Associated test equipment

8. To provide the required performance monitoring facilities when testing the amplifier unit, additional items of test equipment are required. The functions and descriptions of these auxiliary equipments are listed in Table 1; further particulars of individual items may be obtained by reference to the publication listed.

TABLE 1

List of associated test equipment

Item	Nomenclature	Ref. No.	Further details
1	Power supply (130V)	6130-99-999-7812	Chap. 2
2	Power unit (AC)	5821-99-943-7136	
3	R.F. signal generator, CT394	6625-99-943-1911	A.P.2531H
	or		
	R.F. signal generator, CT394A	10S/17134	A.P.2531HA
4	Multimeter, electronic, CT38	10S/16308	A.P.2879AG
	or		
	Valve voltmeter, CT54	F19/6625-99-943-2418	
5	Wattmeter, absorption, CT44	F19/6625-99-943-0510	
	or		
	Output meter Type 2	F1A/54708 (10S/11934)	

Facilities

Power supplies

9. The test set is capable of transferring all power requirements from the power supply (130V) via the appropriate connector to the unit on test; provision is also made for coupling to the power unit (AC) to obtain the supply of 27.5V d.c. required for the tuning unit (mechanical) and for the relays.

Mechanical

10. The test jig is capable of setting the Oldham coupler of the unit on test to the datum position of 220 Mc/s, 225 Mc/s, and to all other intervals of 10 Mc/s to 395 Mc/s and to the 399.9 Mc/s position, to an accuracy of not worse than ± 6' of arc.

11. The test jig is provided with a 10-way fixed plug for connection, via the appropriate connector, to the power outlet socket of the test set.

Mode of operation

12. The equipment may be made to operate in either the receive condition or transmit condition by means of a rotary switch (designated FUNCTION) which is mounted on the front panel. This switch applies h.t. and 27.5V d.c. appropriate to the mode of operation of the equipment.

Output circuits

13. The outputs from both the spectrum generator unit (amplifier-oscillator) and the IF unit (20-30 Mc/s) are passed to the unit on test via coaxial relays. Provision is made for monitoring both of these output levels and also the r.f. power output pass level of the unit on test, by means of a meter mounted on the front panel of the test set. A

three-position rotary switch is employed to select the required monitoring facility.

14. Each of these output levels (spectrum generator units test signal, IF unit (20-30 Mc/s) test signal, r.f. power output level) is represented to an accuracy of not less than 15%, 20% and 15% respectively, by a single red mark at centre scale on the meter; calibrating potentiometers are provided for setting up these principal levels.

Front panel items

15. Further facilities are provided by panel mounted components as follows:-

(1) A double-pole changeover toggle switch (S4) to extend the range of the meter when monitoring high output levels of the unit on test.

(2) A toggle switch (S11) to apply to the unit on test a.v.c. bias in one position and fixed bias in the other position.

(3) A pair of screw terminals, coded T and G, to be connected by flyleads to test points T and G of the unit on test.

(4) A pair of screw terminals making provision for the connection of a d.c. valve voltmeter.

(5) A third pair of screw terminals for the connection of an a.f. wattmeter.

Cooling

16. A blower is provided in the test set to maintain a steady circulation of air during operation.

Warning lamps

17. Three indicating lamps, coloured red, are positioned on the front panel of the test set to give warning that (a) the blower motor is operating, (b) the 27.5V d.c. supply is connected and (c) that h.t. voltages are switched to the unit on test.

Circuit description

18. A circuit diagram of the test set, amplifier is shown at fig. 8 at the end of this chapter. This circuit is drawn with each of its functions clearly defined and the following circuit description is divided under headings for each of these facilities.

Power supplies

19. The power supply (130V) and power unit (AC), from which all power requirements are derived, are connected to the test set at plugs PL1 and PL2 respectively.

20. Positive h.t. is applied at pole A of plug PL1 and routed via the isolating toggle switch S2 (MODULE H.T.) to the FUNCTION switch (S9) and thence to the unit on test. A supply of + 130V is also applied at pole B of plug PL1, providing h.t. for the test set.

21. Heater supplies, variable between 0V and 10V a.c., are applied at poles C and G of plug PL1 and routed directly to poles K and J (earth) of socket SKT25 respectively. Poles C and G are linked to poles F and H at

the test jig so that monitoring of the heater supply voltage to the unit on test may be made.

22. At pole D of plug PL1, 28V a.c. is applied for operating the oven of the spectrum generator unit; this voltage is also applied to the step-up transformer T1 for operation of the blower motor.

23. A bias voltage is available from the power supply (130V); this may be varied between 0 and -50V with respect to the frame by a potentiometer situated on the power supply (130V). Before connecting up, this should be adjusted to -15V ± 1V to suit the test requirements. This voltage is still further reduced by the divider R5 and R6 in the test set before it is applied to the unit under test (para. 30).

24. At pole L of plug PL1 a positive voltage of 27.5V d.c. is applied and routed to the amplifier unit, AF, to provide the bias voltage for V402.

25. An isolated heater supply, variable between 0V and 10V a.c. enters at poles J and K of plug PL1, pole J being connected to the frame of the test set. This provides heater supplies to all modules of the test set.

Output circuits

26. The test signal from the spectrum generator unit is passed to the unit on test via the coaxial relay RLA. One of the output sockets of this relay is connected to a 50 ohms u.h.f. transformer AL1. From the u.h.f. transformer the signal is fed via the preset potentiometer RV2 (CAL. SPEC. GEN) and switch S3 (MONITOR) to the meter M1. The preset potentiometer RV2 is for calibrating purposes. The remaining output socket of relay RLA is connected to socket SKT1 (J501) when the relay is de-energized.

27. Similarly, the output from the IF unit (20-30 Mc/s) is passed to the unit on test via the coaxial relay RLB. One of the output sockets of this relay is connected to a 50 ohms load AL3; from the load the signal is fed via the preset potentiometer RV3 (CAL. 20-30) and switch S3 (MONITOR) to the meter M1. The preset potentiometer RV3 is for calibrating purposes. The remaining output socket of relay RLB is connected to socket SKT17 (J1517) when the relay is de-energized.

28. In the remaining position of switch S3 the r.f. power output pass level of the unit on test is monitored in meter M1. The output load is an u.h.f. transformer AL2 and calibration is effected by adjustment of the potentiometer RV4 (CAL. OUTPUT).

29. When monitoring high output levels of the unit on test, the meter M1 may be desensitized. This is achieved by closing switch S4 (WATTMETER) which switches resistor R2 across the meter.

30. A bias voltage of -15V ± 1V is applied at pole E of plug PL1 (para. 23) and fed to a voltage divider consisting of resistors R5 and R6. With switch S11 (BIAS) indexed to FIXED a negative potential of approximately 0.45V, derived from the divider network, is applied to the unit on test via pole E of socket SKT25.

31. If the switch S11 is set to A.V.C., the bias voltage developed in the IF unit (1.85 Mc/s) and fed to the IF unit (20-30 Mc/s) is also fed to the unit on test via pole E of socket SKT25. Monitoring of this voltage is achieved by indexing switch S10 (VOLTAGE TEST) to A.V.C. and connecting a valve voltmeter (Table 1) to terminals TP5 and TP6.

32. Terminals TP3 (T) and TP4 (G) are provided for the connection of fly leads to test points T and G of the unit on test. Monitoring of the bias voltages of the mixer valves (V3 and V101 of the unit on test) is then achieved by connecting a valve voltmeter (Table 1) to terminals TP5 and

TP6 and indexing switch S10 (VOLTAGE TEST) in turn to position T and G.

33. Monitoring of the a.f. output of the amplifier unit, AF is effected by connecting an a.f. wattmeter (Table 1) to terminals TP1 and TP2.

Operation

34. The equipment may be made to operate in either the receive condition or the transmit condition; this is achieved by means of the rotary switch S9 (FUNCTION) which applies h.t. and 27.5V d.c. voltages appropriate to the mode of operation of the equipment.

35. The CHANNEL SELECTOR SWITCHES (S5-S8) are four manually operated switches that make provision for channelling the equipment to any frequency which is an integral multiple of 100 kc/s over the range 225 Mc/s to 399.9 Mc/s.

36. At each of these frequencies the test set is capable of delivering, in the transmit condition, 200mW of r.f. power from the spectrum generator unit (amplifier-oscillator) to a 50 ohms load and 30mW of r.f. power from the IF unit (20-30 Mc/s) to a 50 ohms load. The power calibration accuracy should be not worse than 15% and 20% respectively; adjustment of these power levels is achieved by controlling the h.t. voltages to the spectrum generator unit (amplifier-oscillator) and the IF unit (20-30 Mc/s). In the spectrum generator unit (amplifier-oscillator), the two final amplifier stages are adjustable, by means of potentiometer RV1 (SET SPEC. GEN).

37. In the receive condition the test set is capable of delivering 200mW of r.f. power from the spectrum generator unit (amplifier-oscillator) to a 50 ohms load. Also in the receive condition, the test set is capable of being set to give, over the frequency range 225 Mc/s to 399.9 Mc/s, 50mW of a.f. power into a 50 ohms load for an input signal of 5 open circuit microvolts, modulated to 30% by a 1,000 c/s tone, and a signal noise ratio of not worse than 14dB.

Cooling

38. The blower (BL1) is fitted with a motor designed to operate at 115V, 50 c/s a.c. This voltage is obtained from the secondary winding of the step-up transformer T1, which is rated for 115V r.m.s. at 175mA r.m.s. A warning lamp, ILP1 (BLOWER) is connected in series with the blower to give indication that the blower motor is operating.

Servicing

39. The equipment should be maintained in a clean, dry and undamaged condition throughout its service life. Care must be taken to avoid rough handling of the switches and controls. Whilst the test set is on the bench keep the working area clear of any servicing tools, soldering irons, etc.

40. Periodically remove the control panel and inspect the switches and wiring; access can be gained by removing the fourteen cheese head screws securing the control panel to the main casing.

41. Whenever a fault is suspected within the internal wiring, a continuity test can be readily made using an approved multimeter. Wire employed in the test set is wire, electrical equipment, Type 2, 23/.0076 in. pink (6145-99-910-0191) and wire, electrical equipment, Type 2, 14/.0076 in. pink (6145-99-910-0185) and any replacement wiring should be made with the correct grade of wire. The connections should be made as neatly as

possible with care taken to avoid tails of excess solder. Remove any wire clippings and excess solder before replacing the control panel.

42. Examine the connectors each time before coupling them to the test set, the equipment on test and the amplifier unit. They should be undamaged and dry, with the plug and socket terminations making good, firm contact with the mating components on the related equipment.

Overall testing

43. A circuit diagram of the complete unit is given at fig. 8 and a study of the diagram should provide all information necessary for clearing all normal faults.

44. When repairs or replacements have become necessary, tests should be made to determine that the equipment has been restored to a serviceable condition equivalent to that of a new unit, as issued, which has been inspected to factory standards.

Drill and ream jig

45. This equipment is supplied under Service reference number 10AG/940 for the correct drilling of the Oldham coupler of the amplifier unit. A view of the jig is given in fig. 5, showing the face of the jig which is placed in contact with the base of the amplifier unit.

46. The drill and ream jig is shown with the amplifier unit in position in fig. 6. In addition, the specially shaped plate (T.133338) is shown in position under the coupler plate of the amplifier unit in order to ensure the correct clearance between the coupler and the unit chassis. Full details of the method of drilling are given in Sect. 2, Chap. 3.

Checking fixture

47. This equipment is supplied under Services reference number 10AG/937 and is used for verifying the correct coupler alignment after drilling and pinning of the coupler plate to the shaft of the amplifier unit. It is used in conjunction with a surface plate and dial test indicator, as described in Sect. 2, Chap. 3. A view of the checking fixture with the amplifier unit in position for the coupler alignment tests is shown in fig. 7.

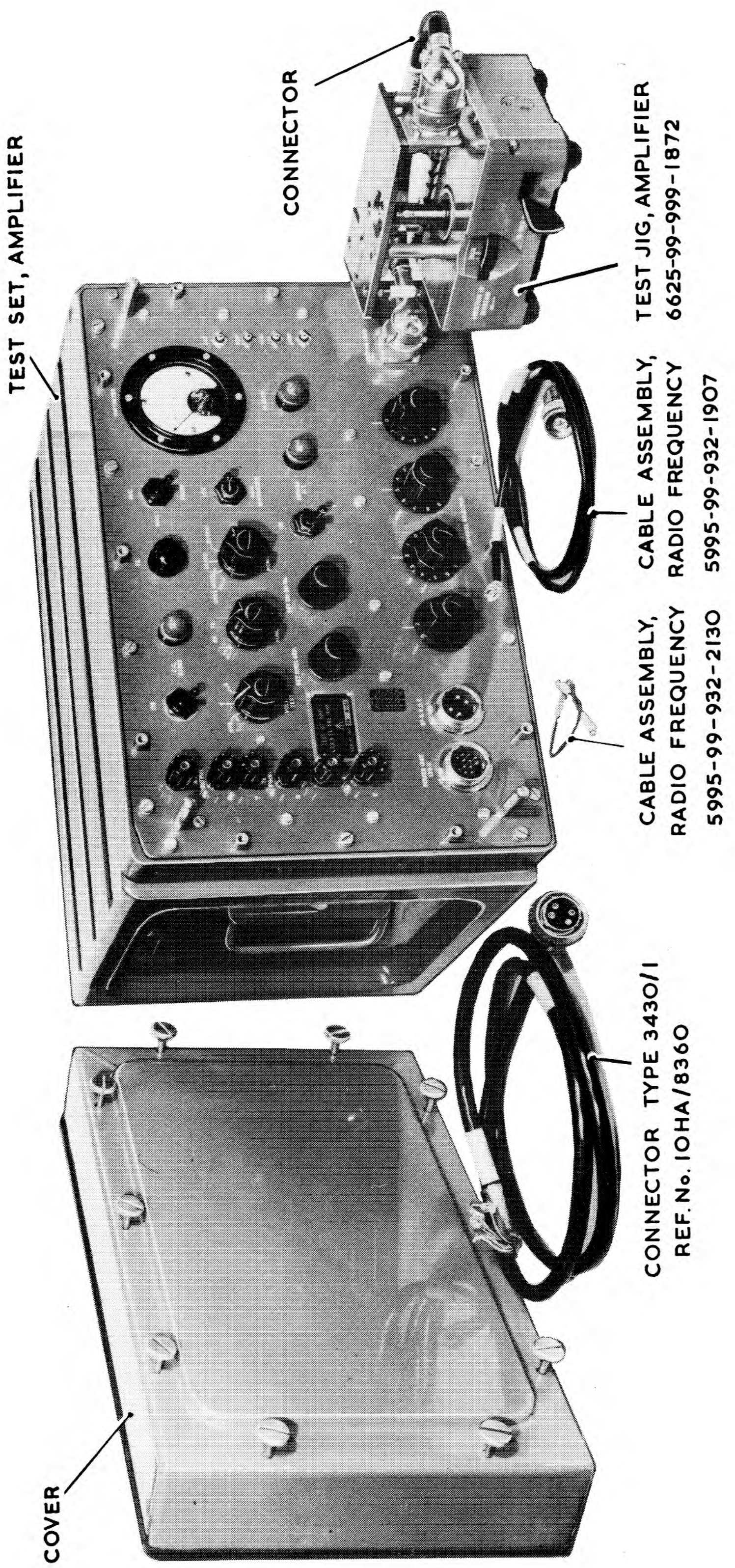

Fig. 1. Test set, amplifier (main receiver RF amplifier and transmitter preamplifier) 6625-99-999-7815

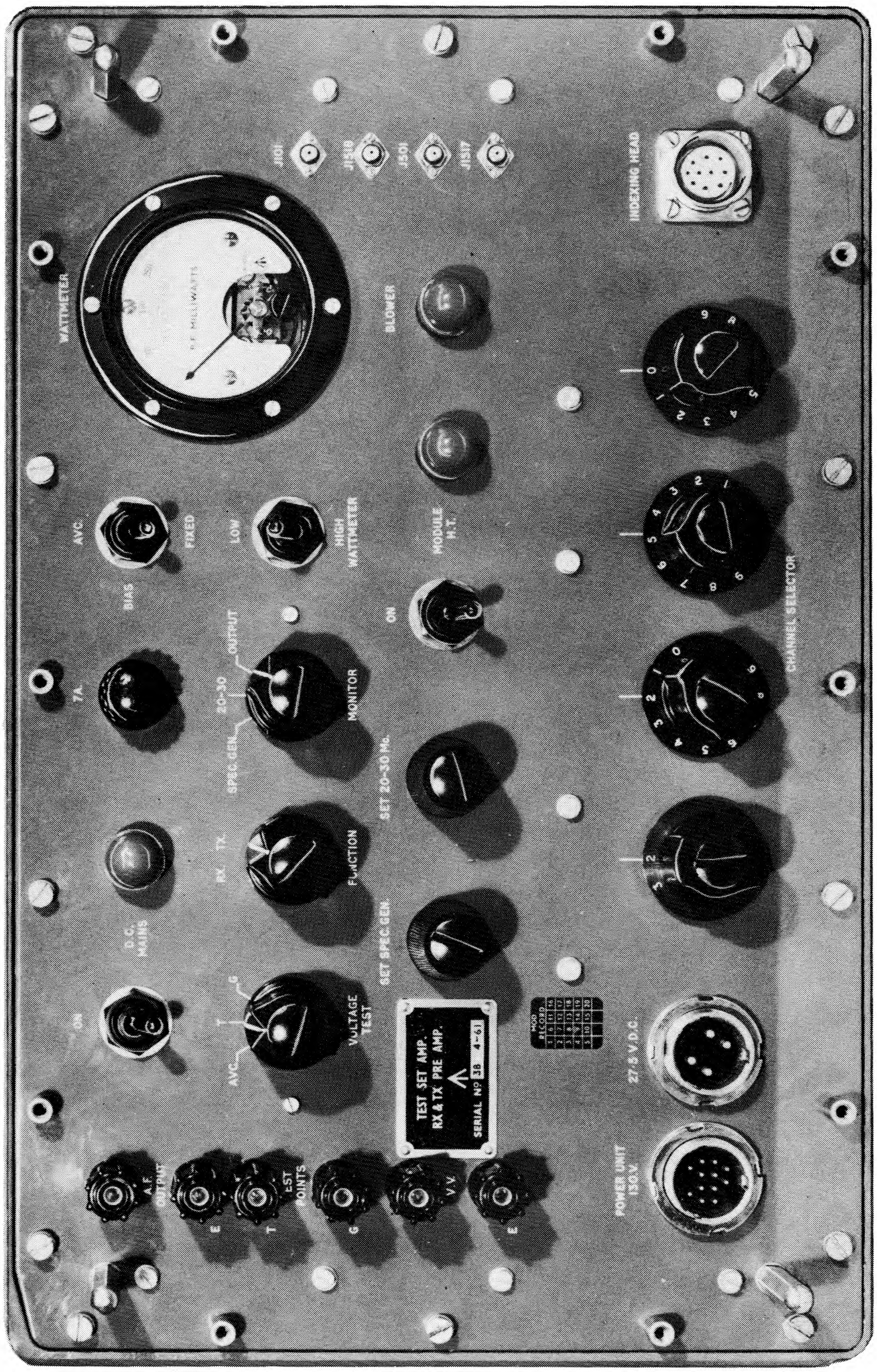

Fig. 2. Test set, amplifier: control panel layout

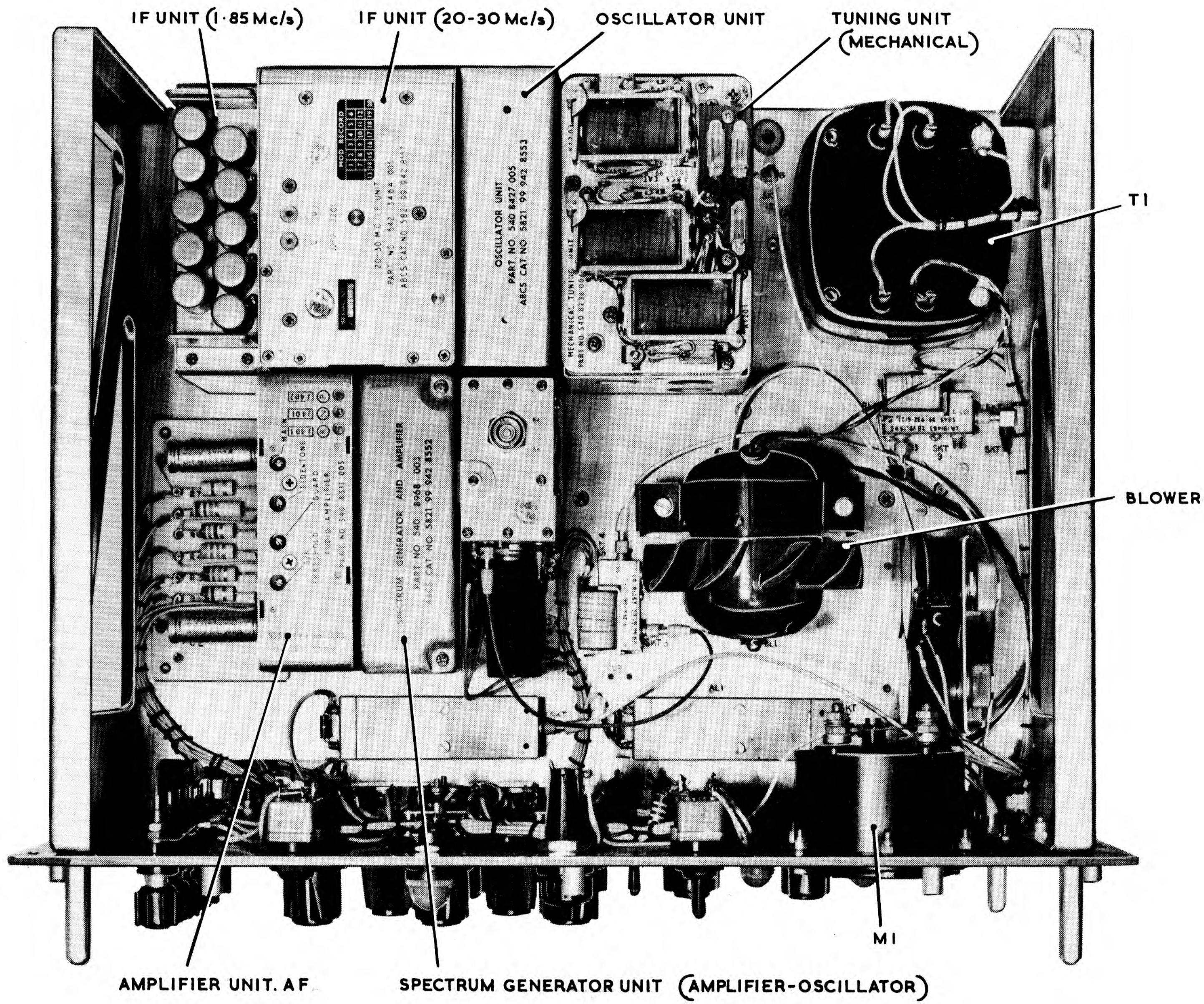

Fig.3. Test set amplifier: component layout above chassis

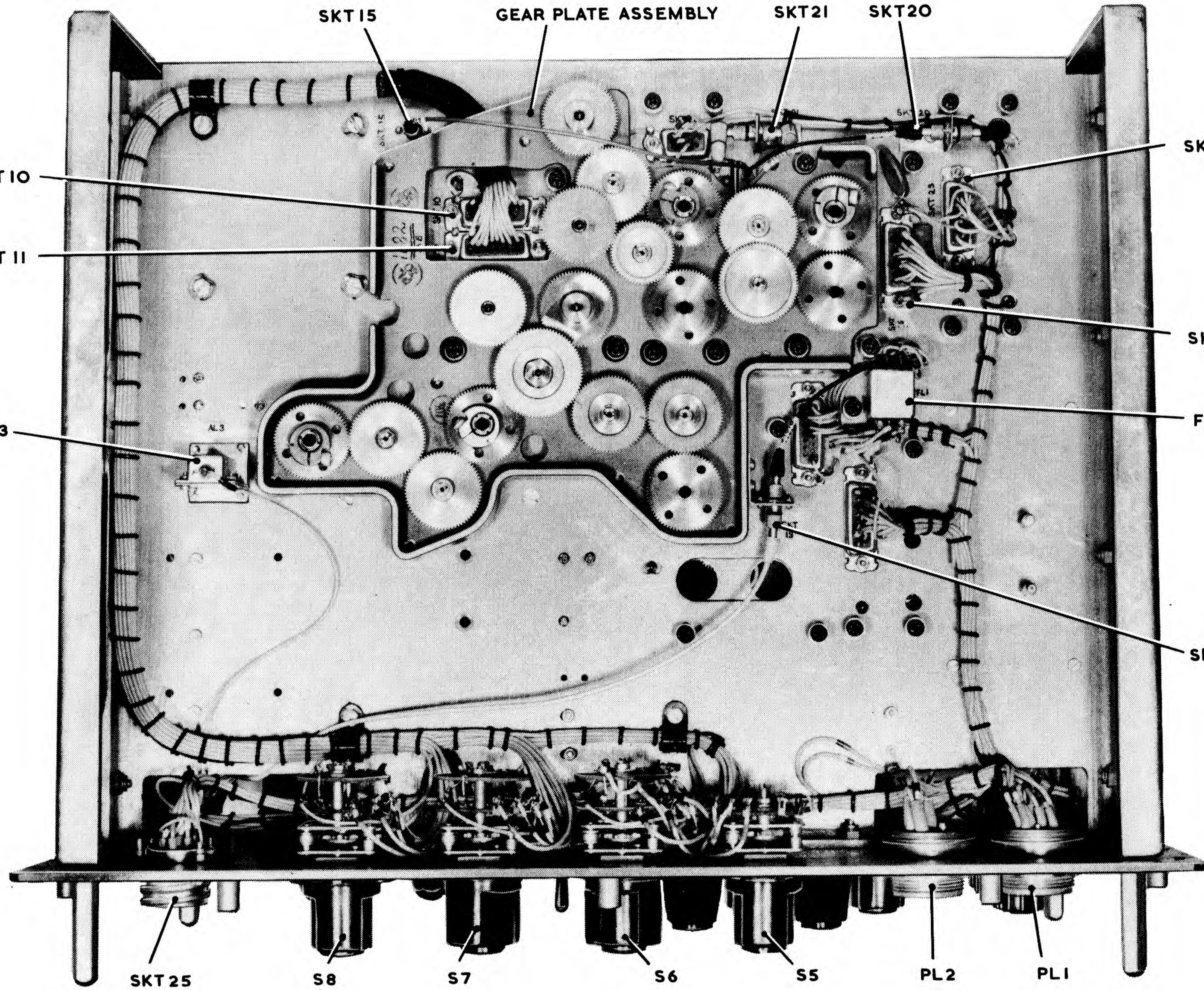

Fig.4. Test set amplifier: component layout below chassis

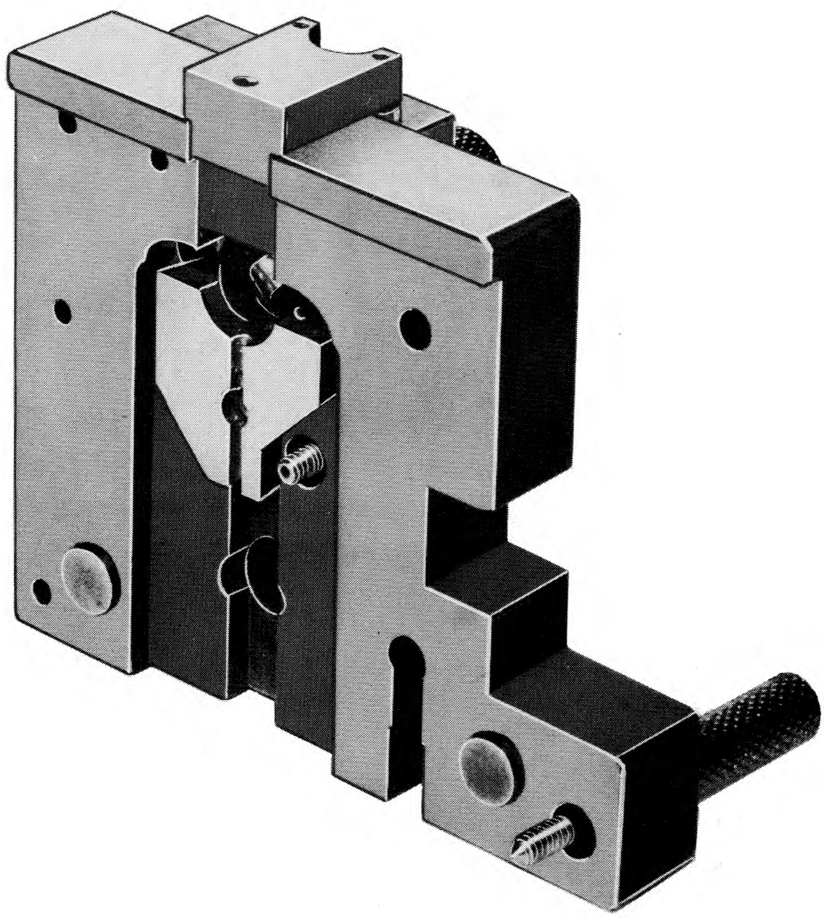

Fig. 5. Drill and ream jig, Ref. No. 10AG/940

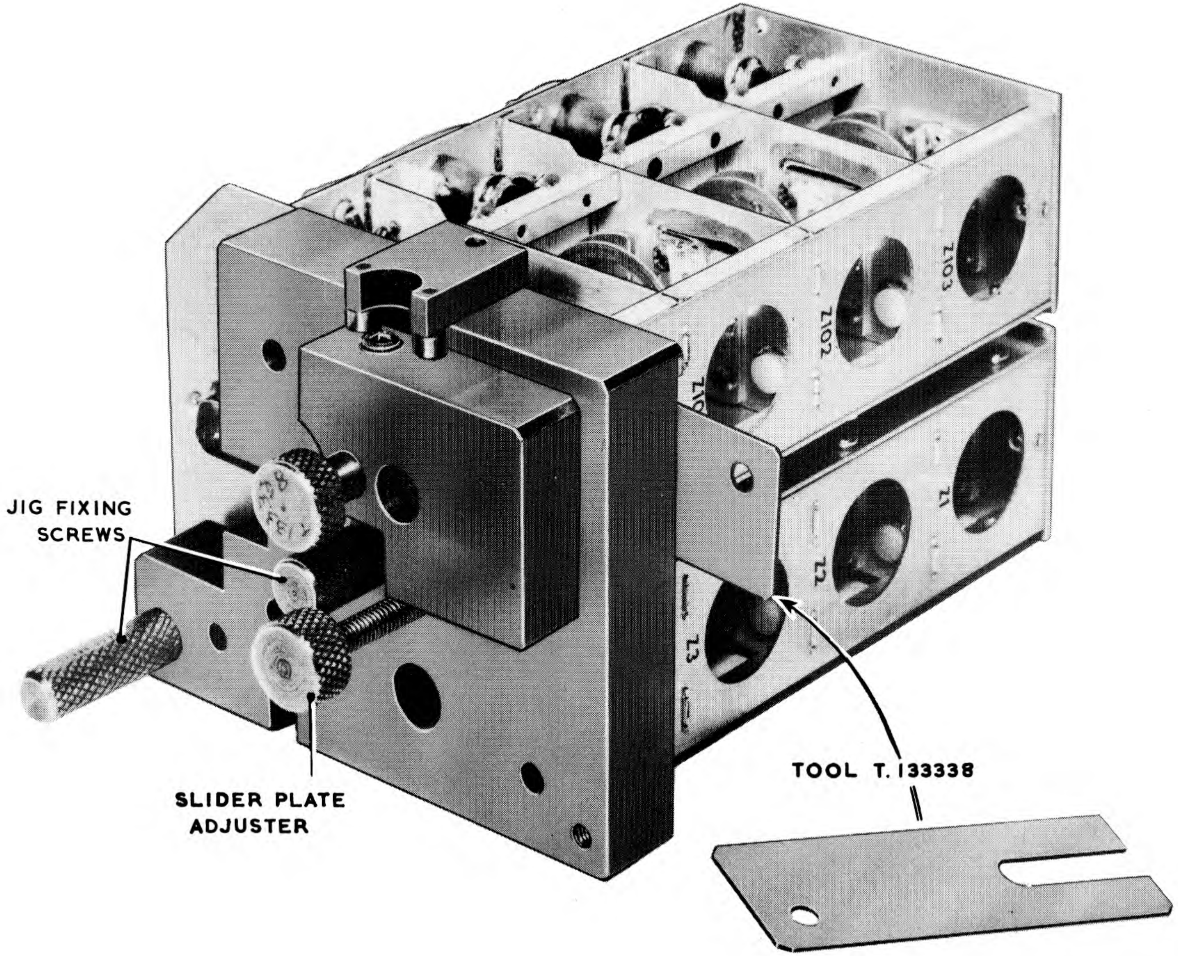

Fig.6. Drill and ream jig, with amplifier unit in position

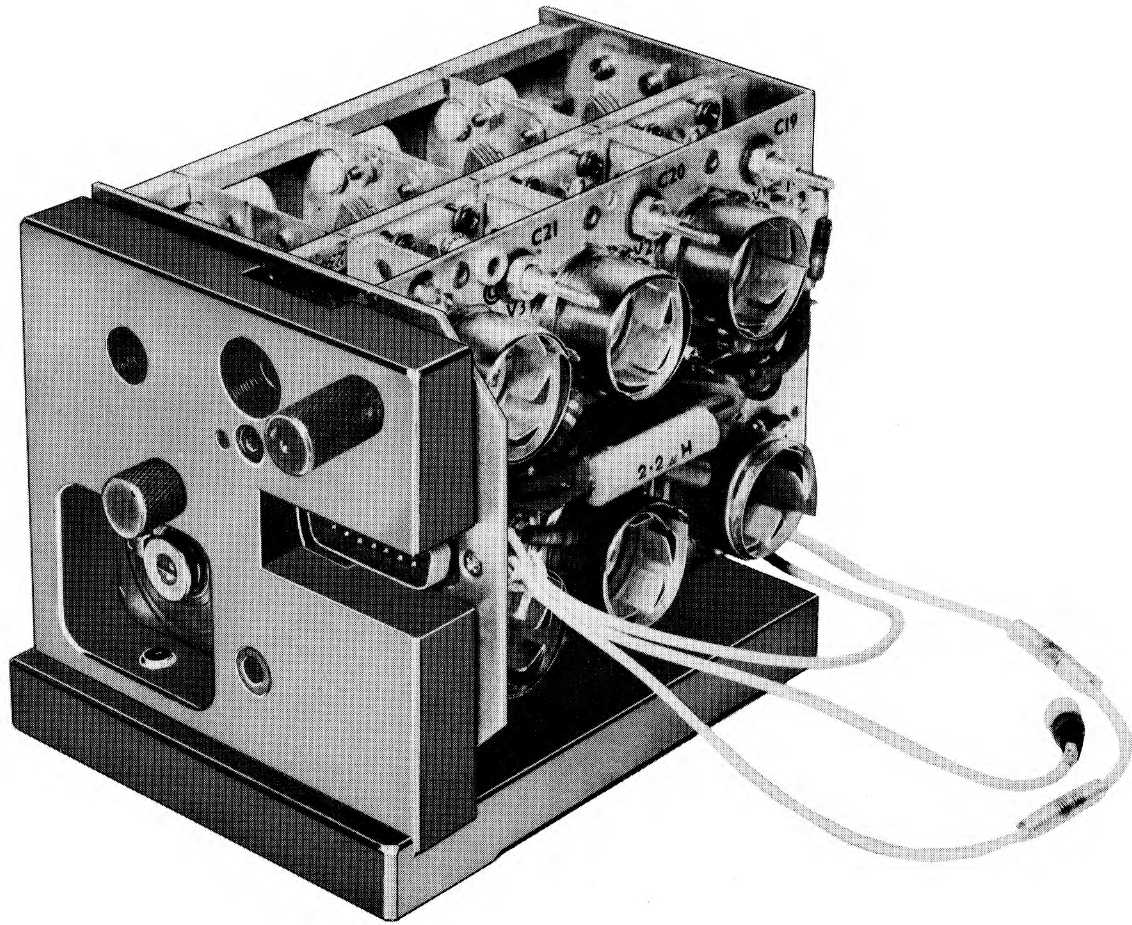

Fig. 7. Checking fixture, Ref. No. 10AG/937, with amplifier unit in position

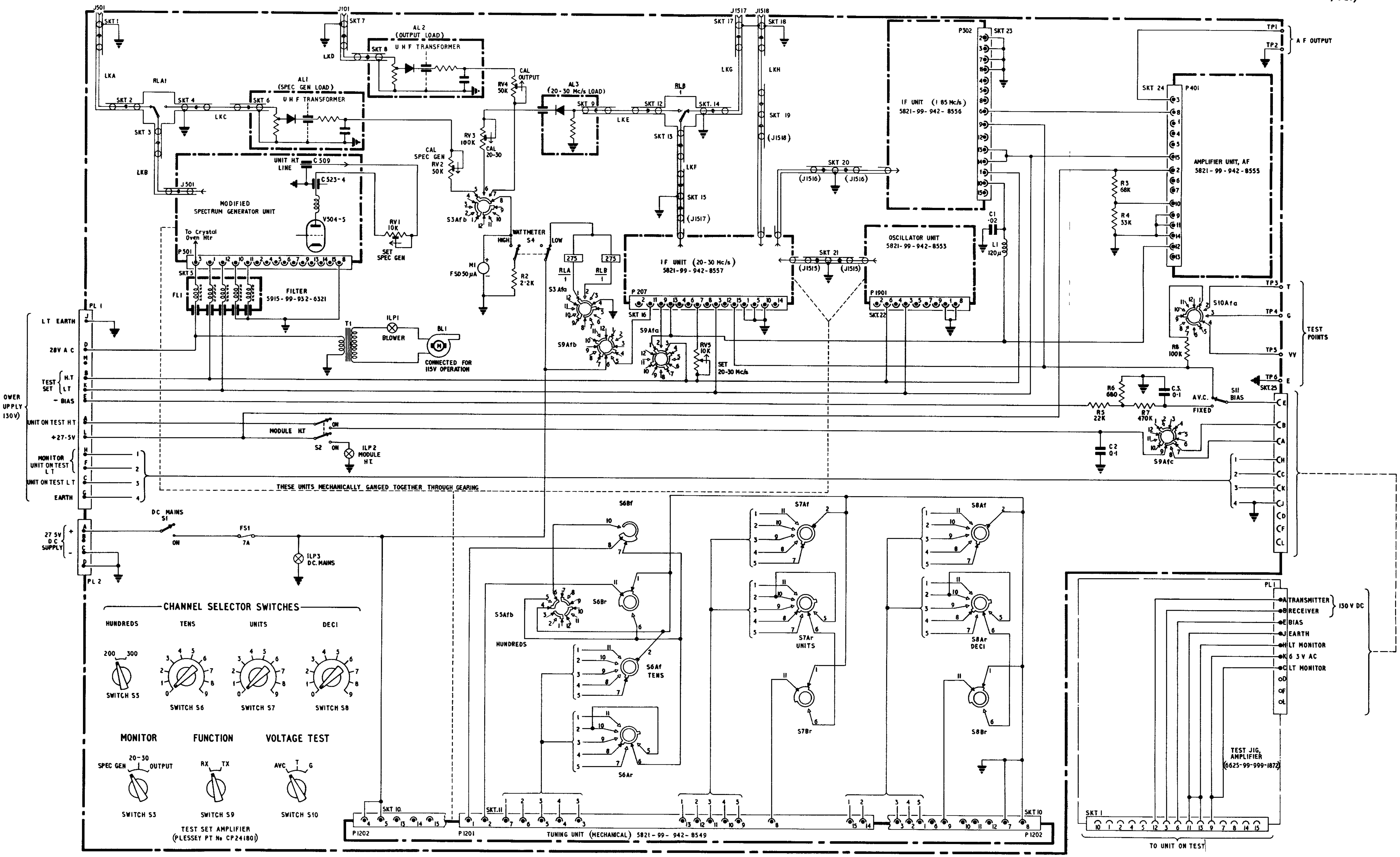

Fig. 8 Test set, amplifier (main receiver RF amplifier and transmitter preamplifier) 6625-99-999-7815: circuit.

Chapter 16

TEST EQUIPMENT FOR CHASSIS ASSEMBLY (MAIN)

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LIST OF ILLUSTRATIONS

Introduction

1. The test set, electronic circuit, plug-in unit (fig.1), which consists of the items listed in Table 1, has been designed to facilitate third and fourth line testing of the chassis assembly (main) which forms the basic portion of the transmitter-receivers Type TR4/ARC52 and Type TR5/ARC52. It may also be utilized in testing many other associated and similar preformed wiring assemblies for continuity, insulation and resistance.

TABLE 1

Test set, electronic circuit, plug-in unit, 6625-99-999-7959: constituent items

Item	Nomenclature	Ref. No.
1	Test set, electronic circuit, plug-in unit consisting of:-	6625-99-946-9486
	(1) Test set, electronic circuit, plug-in unit	6625-99-946-9490
	(2) Cable assembly, power, electrical (3-way)	5995-99-945-9896
2	Interconnecting box consisting of:-	5820-99-946-9489
	(1) Interconnecting box	5820-99-946-9487
	(2) Cable assembly, power, electrical (12-way)	5995-99-946-9488
3	Indicator, fault locating consisting of:-	6625-99-946-8897
	(1) Indicator, fault locating	6625-99-946-8898
	(2) Cable assembly, power, electrical (2-way)	5995-99-946-8900
	(3) Cable assembly, power, electrical (10-way)	5995-99-946-8901

Construction

Test set, electronic circuit, plug-in unit, 6625-99-946-9490

2. This test set (Table 1, item 1(1)) consists, basically, of a set of three multi-bank rotary switches which are mounted on an open framework fitting into the bottom tray of a rectangular aluminium case. In this chapter, it is referred to as the circuit tester. An instrument panel which houses the indicator lamps, control switches, fuse and mains voltage selector panel is mounted on pillars on the bottom tray so that, when the top cover is fitted to the case, the instrument panel is accessible through a cut-out provided in the cover. The right-hand side of the case houses the control knobs for operating the multi-bank switches. The units switch has, in addition, a knob on the left-hand side panel to permit two-hand operation.

3. Six 80-way output sockets for coupling the interconnecting box to the circuit tester are mounted along the rear of the bottom tray of the case; the mains input plug and three test point terminals are mounted on the left-hand side panel, towards the rear.

4. For servicing purposes (para.20) it is possible to remove the open framework supporting the multi-bank rotary switches by following the procedure outlined below:-

(1) Remove the case top cover.

(2) Remove the instrument panel. The cableform to the panel is sufficiently long to enable the panel to be placed to one side of the case without necessity for disconnecting the wiring.

(3) Disconnect the two connections to the common (centre) terminals of the LAMPS/METER switch (SB) and remove the large clamp assembly from the centre of the case.

(4) Remove the left-hand switch knob, metal mounting and retaining cap. Then remove the 4-BA screws securing the switch unit assembly; there are twelve screws on the underside of the case securing the framework, and six screws in the right-hand side panel.

(5) Now remove the screws securing the 80-way sockets and withdraw the sockets through the cut-outs provided in the case.

(6) Remove the complete assembly, taking care to support the socket cableform assemblies to prevent damage.

5. Monitoring and metering: terminals are provided for the connection of an external ohmmeter (para.10) and in conjunction with the panel mounted toggle switch bring the meter into circuit as an alternative to the indicator lamp for the purposes of measuring circuit resistance.

6. Front panel facilities: panel mounted components provide the following facilities:-

(1) Control of mains supply to the circuit tester, by a double-pole toggle switch SA (MAINS).

(2) A mains voltage selector panel enables the unit to be operated from mains supplies over the ranges 110-120V and 200-250V a.c. at 45-65c/s.

(3) Protection of the incoming mains supply system is provided by a single 1A fuse, FS1.

(4) Selection of either the internal indicator lamp or external meter (para.5) to indicate circuit resistance is brought about by means of a double-pole toggle switch SB (LAMPS/METER).

7. Warning lamps: three lamps are positioned on the front panel of the circuit tester to indicate as follows:-

(1) That mains voltage is being applied (ILP1, MAINS SUPPLY).

(2) Continuity is being obtained in the circuit under test (ILP2, CONTINUITY).

(3) Insulation breakdown is occurring in the circuit under test (ILP3, INSULATION).

Interconnecting box and cable assembly

8. This assembly (Table 1, item 2) provides for all interconnections between the unit under test and the test set, electronic circuit, plug-in unit, 6625-99-946-9486. It consists of a long, rectangular junction box, with cable connectors attached. The cable connectors are fitted with suitable terminations for connection to each plug and socket of the main chassis assembly under test and the six 80-way sockets of the circuit tester.

Indicator, fault locating

9. This item (Table 1, item 3) is used for testing the serviceability of the circuit tester. A nominal 27.5V d.c. supply is required to operate the instrument. Its use is described in para. 25-30.

Associated test equipment

10. To provide the performance monitoring facilities required when testing the main chassis assembly, one of the multimeters listed below is required:-

(1) Multimeter Type 1 (Ref. No. 5QP/16411)

(2) Multimeter Type 9980 (Cat. No. 6625-99-943-1524)

(3) Multimeter Type F (Ref. No. 10S/1)

(4) Multimeter Type D1 (Ref. No. 10S/10610)

Circuit description

11. A circuit diagram of the test set, electronic circuit, plug-in unit, 6625-99-946-9486 is shown in fig. 5 at the end of this chapter. The following circuit description should be read in conjunction with the diagram in order to trace the several facilities into which the text is sub-divided.

Power supplies

12. The a.c. mains supply in the range 110-120V or 200-250V at 45-65c/s is applied to poles A (L), B (N) AND C (earth) of the plug PLG. From pole A the supply is routed via one side of switch SA (MAINS), the fuse FS1 and link LKA on the mains voltage selector panel to the appropriate tapping on the primary winding of the mains transformer T1. From pole B the incoming supply is routed via the other side of switch SA and link LKB to the appropriate tapping on the other end of the primary winding of the mains transformer (T1). From pole C the mains supply earth connection is routed to the chassis.

13. Two secondary windings are provided on the mains transformer T1; these are the 6.3V winding for supplying the MAINS SUPPLY indicator lamp ILP1, and also, when appropriate, the CONTINUITY indicator lamp ILP2. The 230V winding has its output rectified by means of MR1 and the resulting d.c. is then smoothed by the capacitors C1 and C2 and resistor R3 to give approximately 300V d.c. for operation of the neon INSULATION indicator lamp ILP3, when appropriate.

Monitoring and metering

14. The MAINS SUPPLY indicator lamp (ILP1) is in circuit the whole time and, with switch SB in the LAMPS position, the lamps ILP2 and ILP3 are switched into circuit by the rotary wafer switches SC, SD and SE for the appropriate tests. With the switch SB in the METER position, all of the indicator lamps are inoperative and monitoring of the condition of the main chassis assembly on test is then obtainable by means of an external meter (para. 10) which may be connected across the terminals TP1 and TP2. The circuits tested in each of the 239 positions which may be selected are given in Table 2.

Operation

15. The three rotary wafer switches (SC, SD and SE) control, respectively, the selection of hundreds, tens and units of the test sequence. The setting to which each of the three switches is indexed is shown on the display panel

in the front of the casing. Position 000 is reserved solely for the purpose of verifying the circuit tester; and at these settings of the rotary switches, both the CONTINUITY lamp (ILP2) and the INSULATION lamp (ILP3) should be glowing.

Continuity testing

16. Indexing of the rotary switches to any setting from 001 to 239 inclusive gives an indication of the continuity state between the appropriate terminals on the output sockets of the circuit tester (Table 2); e.g. at setting 001, continuity is indicated between pole a1 and pole b1 of socket SKTA by the lighting up of lamp ILP2. An open circuit or high resistance is indicated if the lamp fails to glow.

Insulation and resistance testing

17. An indication of insulation or high resistance between the appropriate terminals of the output sockets and the chassis is given (Table 2) when the rotary switches are indexed to any of the settings from 001 to 239. A state of insulation or of high resistance between the appropriate terminals of the output sockets is indicated when the rotary switches are indexed as follows:-

(1) Any setting from 100 to 159 inclusive where the unit setting is 0, 2 or 5.

(2) Any setting from 160 to 179 inclusive where the unit setting is 0 or 4.

(3) Any setting from 180 to 210 inclusive where the unit setting is 0.

For example: at the setting of 001, insulation resistance of better than 5 M ohms is indicated from pole a1 of socket SKTA to earth by the failure to light of lamp ILP3. An insulation breakdown is occurring if under these conditions the lamp is glowing.

Using the circuit tester

18. Connect the interconnecting box (Table 1, item 2) and the mains supply to the circuit tester, set the three rotary switches (SC, SD and SE) each to position 0, switch on the mains supply and ensure that both the CONTINUITY lamp and INSULATION lamp are glowing. Connect the multimeter (para. 10) to the METER terminals (TP1 and TP2).

19. Ensure that the main chassis assembly is complete and undamaged and that all fuses are of correct value and in position, then verify that all potentiometers are set fully clockwise. Connect up the interconnecting box to the main chassis assembly and plug in a microphone and headset jacks at the appropriate sockets. Connect, now, the appropriate wire to the test points on the main chassis assembly as follows:-

Red	-	S1501 'a'	White	-	P1405 (Test point A)
Blue	-	S1501 'b'	Black	-	P1406 (Test point M)
Green	-	TB1501/1	Violet	-	Z1401 A' (filter)
Yellow	-	TB1501/4			

The connections to switch S1501 'a' and 'b' will be determined by obtaining continuity when the selector switches are set to 151 and 197 respectively.

TABLE 2

Test schedule for main chassis assembly

Selector switches SC, SD, SE	METER/LAMPS switch SB	LAMPS INSULATION	LAMPS CONTINUITY	Meter reading	Circuit tested From	Circuit tested To	Remarks
001	LAMPS	Off	On	-	J1401 D	J1509 12	Guard h.t. on-off
002	"	"	"	-	" F	J1504 6	Auto relay control
003	"	"	"	-	" H	J1511 9	Power on-off
004	"	"	"	-	" S	J1507 15	Dynamic microphone
005	"	"	"	-	" T	J1509 13	Tone on-off
006	"	"	"	-	" U	J1512 3	Tens 0-5 frequency control
007	"	"	"	-	" V	" 4	Tens 1-6 frequency control
008	"	"	"	-	" W	" 5	Tens 2-7 frequency control
009	"	"	"	-	" X	J1511 1	115V, phase 1
010	"	"	"	-	" Y	" 3	115V, phase 2
011	"	"	"	-	" Z	" 5	115V, phase 3
012	"	"	"	-	" a	J1512 9	Units 0-5 frequency control
013	"	"	"	-	" b	" 10	Units 1-6 frequency control
014	"	"	"	-	" c	" 11	Units 2-7 frequency control
015	"	"	"	-	" d	" 12	Units 3-8 frequency control
016	"	"	"	-	" e	" 13	Units 4-9 frequency control
017	"	"	"	-	" f	J1513 1	Deci 0-5 frequency control
018	"	"	"	-	" g	" 2	Deci 1-6 frequency control
019	"	"	"	-	" h	" 3	Deci 2-7 frequency control
020	"	"	"	-	" i	J1512 14	Deci 3-8 frequency control
021	"	"	"	-	" j	" 15	Deci 4-9 frequency control

TABLE 2 (continued)

Selector switches	METER/LAMPS switch SB	LAMPS		Meter reading	Circuit tested		Remarks
		INSULATION	CONTINUITY		From	To	
022	LAMPS	Off	On	-	J1401 k	J1512 1	200-300 frequency control
023	"	"	"	-	" m	" 2	Tens Hi-lo frequency control
024	"	"	"	-	" n	" 6	Tens 3-8 frequency control
025	"	"	"	-	" p	" 7	Tens 4-9 frequency control
026	"	"	"	-	" q	" 8	Units Hi-lo frequency control
027	"	"	"	-	" r	J1513 9	Deci Hi-lo frequency control
028	"	"	"	-	J1511 4	J1510 5	Phase 2 switched
029	"	"	"	-	" 6	" 6	Phase 3 switched
030	"	"	"	-	" 12	J1506 5	25.2V for 4x150D heater
031	"	"	"	-	" 13	J1509 4	E.H.T. bus
032	"	"	"	-	" 19	J1505 3	Oven heater
033	"	"	"	-	J1510 10	J1509 1	A.D.F. h.t. continuous
034	"	"	"	-	J1509 3	J1504 1	Squelch amplifier bias
035	"	"	"	-	J1509 14	J1513 6	Disable control
036	"	"	"	-	" 16	J1507 1	E.H.T. switched
037	"	"	"	-	" 20	" 4	Tone oscillator h.t.
038	"	"	"	-	" 24	J1508 9	Guard receiver h.t.
039	"	"	"	-	J1507 9	J1506 1	P.A. e.h.t.
040	"	"	"	-	J1504 5	J1508 6	Guard receiver output
041	"	"	"	-	" 8	J1503 6	Main receiver detector output
042	"	"	"	-	" 10	" 5	Carrier squelch signal
043	"	"	"	-	" 13	" 4	Auxiliary audio

TABLE 2 (continued)

Selector switches SC, SD, SE	METER/LAMPS switch SB	LAMPS INSULATION	LAMPS CONTINUITY	Meter reading	Circuit tested From	Circuit tested To	Remarks
044	METER	Off	Off	470 k ohms ±63 k ohms	J1507 6	J1504 4	† (R1506) Modulator sidetone
045	"	"	"	See remarks	J1508 2	Earth	† R1402 to R1404 (R1402 clockwise 8.2 k ohms ±1 k ohms; counter-clockwise 33.2k ohms ± 6.6 k ohms) guard receiver sensitivity
046	"	"	"	See remarks	" 3	"	† R1507 to R1508 (R1507 clockwise 2.8 M ohms ± 800 k ohms; counter-clockwise 220 k ohms ± 30 k ohms) guard squelch
047	"	"	"	See remarks	TB1501 1	"	† (R1403) +ve on TB1501 1, 15 k ohms ± 2 k ohms, sidetone (1401 & CR 1401) -ve on TB1501 1, not greater than 1 k ohms
048	LAMPS	"	On	-	J1510 3	J1509 7	
049	"	"	"	-	" 7	J1508 4	
050 to 099	"	"	"	-			Not used
100	"	"	"	-	J1401 A	J1511 17	*) 27.5V d.c. in
101	"	On	"	-	"	" 18	)
102	"	Off	"	-	" J	J1509 22	*)
103	"	On	"	-	"	J1504 3	) Main & guard audio
104	"	"	"	-	"	J1403 Mid	)

TABLE 2 (continued)

Selector switches SC, SD, SE	METER/LAMPS switch SB	LAMPS		Meter reading	Circuit tested		Remarks
		INSULATION	CONTINUITY		From	To	
105	LAMPS	Off	On	-	J1509 18	J1506 6	*)
106	"	On	"	-	"	J1501 12	)
107	"	"	"	-	"	J1507 2	) Transit h.t.
108	"	"	"	-	"	J1502 9	)
109	"	"	"	-	"	TB1501 4	)
110	"	Off	"	-	J1401 L	J1510 11	*) A.D.F. h.t.
111	"	On	"	-	"	J1509 2	) (switched)
112	"	Off	"	-	J1509 21	J1501 3	*)
113	"	On	"	-	"	J1502 13	) Receiver h.t.
114	METER	Off	Off	4 ohms ± 1.5 ohms	"	J1503 10	(L1501))
115	LAMPS	"	On	-			*)
116	"	"	"	-			)
117	"	"	"	-			) Not used
118	"	"	"	-			)
119	"	"	"	-			)
120	"	"	"	-	J1401 N	J1501 1	*) Main receiver a.g.c.
121	"	On	"	-	"	Test point M	)
122	"	Off	"	-	J1510 9	J1503 12	*)
123	"	On	"	-	"	J1508 12	) Standing bias
124	METER	Off	Off	4.7k ohms ± 600 ohms	"	J1507 5	(R1509))

TABLE 2 (continued)

Selector switches SC, SD, SE	METER/LAMPS switch SB	LAMPS INSULATION	LAMPS CONTINUITY	Meter reading	Circuit tested From	Circuit tested To	Remarks
125	LAMPS	Off	On	-			
126	"	"	"	-			
127	"	"	"	-			Not used
128	"	"	"	-			
129	"	"	"	-			
130	"	"	"	-	J1401 R	J1507 7	* Carbon and dynamic microphone
131	"	On	"	-	"	J1404 Mid	
132	"	Off	"	-			* Not used
133	"	On	"	-	J1502 10	J1509 10	27.5V relay bus
134	"	"	"	-	"	J1511 10	
135	METER	"	Off	280 ohms ± 60 ohms	J1502 11	J1502 10	(K1401) aerial relay
136	LAMPS	"	On	-	"	J1404 Tip	
137	"	"	"	-	"	J1509 11	
138	"	"	"	-	"	J1511 11	Press to transmit
139	"	"	"	-	"	J1401 E	
140	"	Off	"	-	J1501 6	J1502 15	* A.G.C.
141	"	On	"	-	"	J1503 9	

TABLE 2 (continued)

Selector switches SC, SD, SE	METER/LAMPS switch SB	LAMPS		Meter reading	Circuit tested		Remarks
		INSULATION	CONTINUITY		From	To	
142	LAMPS	Off	On	-			*
143	"	"	"	-			Not used
144	"	"	"	-			
145	"	"	"	-			
146	"	"	"	-			
147	"	"	"	-			
148	"	"	"	-			
149	"	"	"	-			
150	"	"	"	-	J1511 2	J1510 4	* Phase 1 switched
151	"	On	"	(Determine connections for S1501 'a' and 'b'. For correct connections full brilliance should be obtained on CONTINUITY lamp)	"	S1501 'a'	Thermal switch
152	"	Off	"	-			*
153	"	"	"	-			
154	"	"	"	-			Not used
155	"	"	"	-			*
156	"	"	"	-			
157	"	"	"	-			

TABLE 2 (continued)

Selector switches SC, SD, SE	METER/LAMPS switch SB	LAMPS		Meter reading	Circuit tested		Remarks
		INSULATION	CONTINUITY		From	To	
158	LAMPS	Off	On	-			Not used
159	"	"	"	-			
160	"	"	"	-			*
161	"	On	"	-	J1401 C	J1503 7	Main receiver sensitivity
162	METER	Off	Off	See remarks	"	Earth	R1401 (clockwise not greater than 26 ohms; counter-clockwise 5K ohms ± 1.2K ohms) Main receiver sensitivity control
163	LAMPS	On	On	-	J1511 14	J1506 3	
164	METER	Off	Off	47 ohms ± 6 ohms	"	Earth	R1502
165	LAMPS	On	On	-	"	J1501 9	6.3V heater
166	"	"	"	-	"	J1502 3	
167	"	"	"	-	"	J1514 3	
168	"	"	"	-	"	J1513 13	
169	"	"	"	-	"	J1508 11	
170	"	Off	"	-			*
171	"	"	"	-			Not used
172	"	"	"	-			
173	"	"	"	-			
174	"	"	"	-			*

TABLE 2 (continued)

Selector switches SC, SD, SE	METER/LAMPS switch SB	LAMPS		Meter reading	Circuit tested		Remarks
		INSULATION	CONTINUITY		From	To	
175	LAMPS	Off	On	-			Not used
176	"	"	"	-			
177	"	"	"	-			
178	"	"	"	-			
179	"	"	"	-			
180	"	"	"	-	J1401 P	J1513 4	* 27.5V d.c. out
181	"	On	"	-	"	" 5	
182	"	"	"	-	"	J1511 7	
183	"	"	"	-	"	J1509 9	
184	"	"	"	-	"	J1507 12	
185	"	"	"	-	"	J1504 2	
186	"	"	"	-	"	Test point A	
187	METER	Off	Off	Not greater than 30 ohms	J1401 K	J1504 7	R1505) Auxiliary audio out
188	"	"	"	See remarks	"	Earth	R1504 and R1505 (clockwise 6k ohms ± 1.3k ohms; counter-clockwise 1010 ohms ± 140 ohms)
189	LAMPS	"	On				Not used

TABLE 2 (continued)

Selector switches SC, SD, SE	METER/LAMPS switch SB	LAMPS INSULATION	LAMPS CONTINUITY	Meter reading	Circuit tested From	Circuit tested To	Remarks
190	LAMPS	Off	On	-	J1510 8	J1509 6	*) Continuous main h.t.
191	"	On	"	-	"	J1504 12	)
192	"	"	"	-	"	J1502 7	)
193	"	"	"	-	"	J1514 6	)
194	"	"	"	-	"	J1505 1	)
195	"	"	"	-	"	J1507 3	Modulator continuous h.t.
196	METER	Off	Off	4 ohms ± 1.5 ohms	"	J1503 1	(L1507) Continuous h.t.
197	LAMPS	On	On	-	Z1401 'A'	S1501 'b'	Thermal switch
198	METER	Off	Off	See remarks	"	Earth	TR4/ARC52, 40 ohms ± 10 ohms; TR5/ARC52, 10 ohms ± 5 ohms } Motors
199	LAMPS	"	On	-			Not used
200	"	"	"	-	J1511 15	J1506 4	*)
201	"	On	"	-	"	J1501 11	)
202	"	"	"	-	"	J1507 11	)
203	"	"	"	-	"	J1504 14	)
204	"	"	"	-	"	J1502 5	) 12.6V heater
205	"	"	"	-	"	J1514 1	)
206	"	"	"	-	"	J1503 2	)
207	"	"	"	-	"	J1508 13	)
208	"	"	"	-	"	J1505 11	)

TABLE 2 (continued)

Selector switches SC, SD, SE	METER/LAMPS switch SB	LAMPS INSULATION	LAMPS CONTINUITY	Meter reading	Circuit tested From	Circuit tested To	Remarks
209	LAMPS	Off	On	-			Not used
210	"	On	"	-	J1511 8	J1507 13	)
211	"	"	"	-	"	J1504 9	)
212	"	"	"	-	"	J1503 11	)
213	"	"	"	-	"	J1508 15	) 25.2V heater
214	"	"	"	-	"	J1505 10	)
215	METER	Off	Off	68 ohms ±9 ohms	J1511 16	J1511 8	R1501
216	LAMPS	On	On	-	"	J1507 10	)
217	"	"	"	-	"	J1504 15	)
218	"	"	"	-	"	J1503 14	) 18.9V heater
219	"	"	"	-	"	J1508 10	)
220	"	"	"	-	"	J1505 12	)
221	"	Off	"	-			) Not used
222	"	"	"	-			)
223	"	"	"	-			)
224	"	"	"	-			)
225	"	On	"	-	Earth	J1401 B	)
226	"	"	"	-	"	J1511 20	)
227	"	"	"	-	"	J1510 15	) Earths
228	"	"	"	-	"	J1509 25	)
229	"	"	"	-	"	J1507 8	)

TABLE 2 (Continued)

Selector switches SC, SD, SE	METER/LAMPS switch SB	LAMPS		Meter reading	Circuit tested		Remarks
		INSULATION	CONTINUITY		From	To	
230	LAMPS	On	On	-	Earth	J1506 8	)
231	"	"	"	-	"	J1513 7	)
232	"	"	"	-	"	J1513 8	) Earths
233	"	"	"	-	"	J1501 13	)
234	"	"	"	-	"	J1514 8	)
235	"	"	"	-	"	J1505 8	)
236	"	"	"	-	"	J1504 11	)
237	"	"	"	-	"	J1502 1	)
238	"	"	"	-	"	J1508 14	)
239	"	"	"	-	"	J1503 3	)
240							Not used

Note ...

Insulation tests are made on switch positions 1-99 (with the exception of those marked ✝) and also on those marked thus*.

Servicing

20. The equipment must be maintained in a clean, dry and undamaged condition throughout its service life if continued efficient usage is expected. Care must be taken to avoid rough handling of the switches and controls; and precautions should be made to avoid bumping or dropping this test gear. Whilst the equipment is in use on the bench, keep the working area clear of any other servicing equipment, tools, soldering irons, etc.

21. Whenever a fault is suspected within the internal wiring of the circuit tester a continuity test can readily be made using the continuity test set (indicator, fault locating, 6625-99-946-8897) as described in para. 25-30. Wire employed in the circuit tester is wire, electrical equipment, Type 2, 7/.0076 in. pink and issued under Cat.No. 6145-99-910-0174. Any replacement wiring should be made with the correct grade of wire, as used originally, or an approved substitute (i.e. approved either by modification notice or by authority of the Signals Officer). All connections should be made as neatly as possible in the approved manner, with care taken to avoid tails of excess solder at the terminals. Remove any wire clippings and solder splatter before closing the access panels.

22. Examine all connectors each time before coupling them to the circuit tester and the equipment on test. Connectors should be undamaged and dry, with the plug and socket terminations making good, firm contact with the mating components on the associated equipment.

Overall testing

23. A study of the circuit diagram (fig. 5), which is given at the end of this chapter, should provide all the information required for clearing normal faults. When repairs or replacements have become necessary, tests should be made to determine that the equipment has been restored to a serviceable condition equivalent to that of a new unit.

24. The following preliminary tests should be made if at any time the circuit tester does not operate or if it becomes unsatisfactory in use:-

(1) Examine the mains fuse (FS1) on the front panel to ensure that it is sound and of the correct value (1A). Replace it with a new one if it is faulty.

(2) Ensure that indicator lamps are fitted correctly. Examine them to be sure they are sound and of the correct type and value for this equipment.

(3) Verify that the mains voltage tap panel is set correctly to correspond with the local mains source of supply.

Circuit tester serviceability

25. In order that the serviceability of the chassis test equipment can be constantly verified, a continuity test set (indicator, fault locating, 6625-99-946-8897) has been produced by the manufacturer. This is basically a metal box incorporating a lamp display for testing the continuity of switched circuits within the circuit tester. The continuity test set is used in conjunction with either a sensitive valve voltmeter (e.g. multimeter, electronic CT38) having an accuracy over the range 0.5mV of not worse than ± 5%, or an oscilloscope (e.g. Type 13A), coupled with a multi-range volt-amp meter (e.g. multimeter Type 1), a nominal 27.5V d.c. supply, two 75 ohms, ± 10% resistors rated at ½W and a cable connector. The cable connector is supplied with the continuity test set and has a plug for insertion into a section of 10 poles of the output sockets on the circuit tester.

26. The test equipment thus described should be set up when required as follows:-

(1) Connect one of the 75-ohm resistors between the test points TP1 and TP3 on the circuit tester. Then fit the other resistor between TP3 and TP2.

(2) Couple the 10-way plug from the continuity test set into section 1 of the socket SKTA of the circuit tester, i.e. that section of the socket containing pins a and b from 1 to 5. Also, join the chassis of the circuit tester to the chassis of the continuity test set.

(3) Connect the continuity test set to a nominal 27.5V d.c. source, using the 2-way connector provided.

27. Now set the switch SB of the circuit tester to the position marked METER and operate the selector switch knobs to read 001. Switch on the 27.5V d.c. supply to the continuity test set and note the lighting up of the lamps on the display panel. The sequence should correspond with that shown on the continuity test chart (fig.4).

28. Reset the selection switches to read 002 and again compare the sequence display of lit and unlit lamps with the continuity test chart. Continue throughout for the settings 003, 004 and 005.

29. Now remove the 10-way plug from SKTA and re-insert it into section 2 of the socket, i.e. pins a and b, 6 to 10. Then set the selection switches to read 006 and note the lamp display resulting. Continue for the settings 007, 008, 009 and 010; at each setting the lit and unlit lamps should correspond with the continuity test chart (fig.4).

30. Repeat the sequence of testing for all sections of the socket SKTA through to switch position 40, rotating the selection switches five positions for each section to, thus, cover all possible sequences available. Then continue the testing in the same manner for the sockets SKTB, SKTC, SKTD and SKTE (i.e. from switch position 41 to 239). Note, each time, the lamp display in comparison with the continuity test chart.

Power supply testing

31. Set the circuit tester switches to the position 000, then remove the 10-way test set connector and the two 75-ohm resistors. Connect the mains supply into the circuit tester and switch on, then set the switch SB to the position marked LAMPS. With the circuit tester MAINS switch on, verify that the MAINS SUPPLY lamp is lit and that the INSULATION and CONTINUITY lamps are glowing.

32. Connect the multimeter Type 1 (on the 500V range) to the junction of R4, R6 and chassis. The voltage at this point should be 165V ± 15%. Now turn the selector switches to 001; the open circuit voltage should be 290V ± 5%.

33. Reset the selector switches to 000, remove the multimeter Type 1 and reconnect it (this time on the 10V a.c. range) to the junction of R2, ILP2 and earth. The voltage at this point should be 6.3V ± 15%.

34. Remove the multimeter Type 1 (or alternative), then by means of the sensitive valve voltmeter (para.25) or oscilloscope measure the ripple voltage at the junction of R3, C2. The amplitude should not exceed 20mV r.m.s.

35. Remove the test equipment (valve voltmeter or oscilloscope), set the selector switches to a reading of 001 and verify that the INSULATION and CONTINUITY lamps are extinguished.

Power consumption

36. For a comparative power consumption assessment, set the selector switches to 000 and couple the multimeter Type 1 in series with the mains input. Switch on the supply and measure the current. Power consumption should be within the limits 7.5VA $\pm$ 15%.

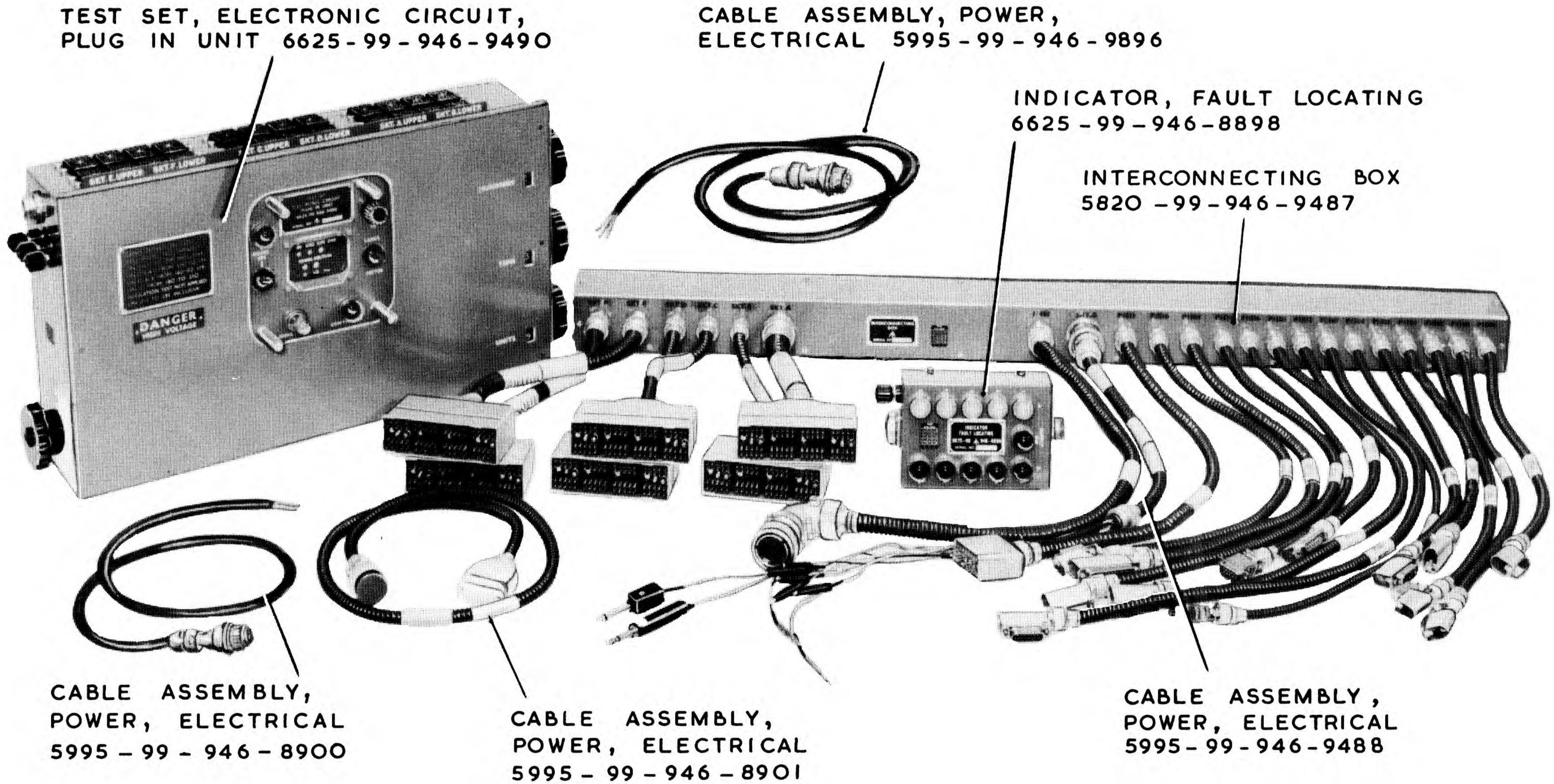


Fig.1. Test set, electronic circuit, plug-in unit, 6625-99-999-7959

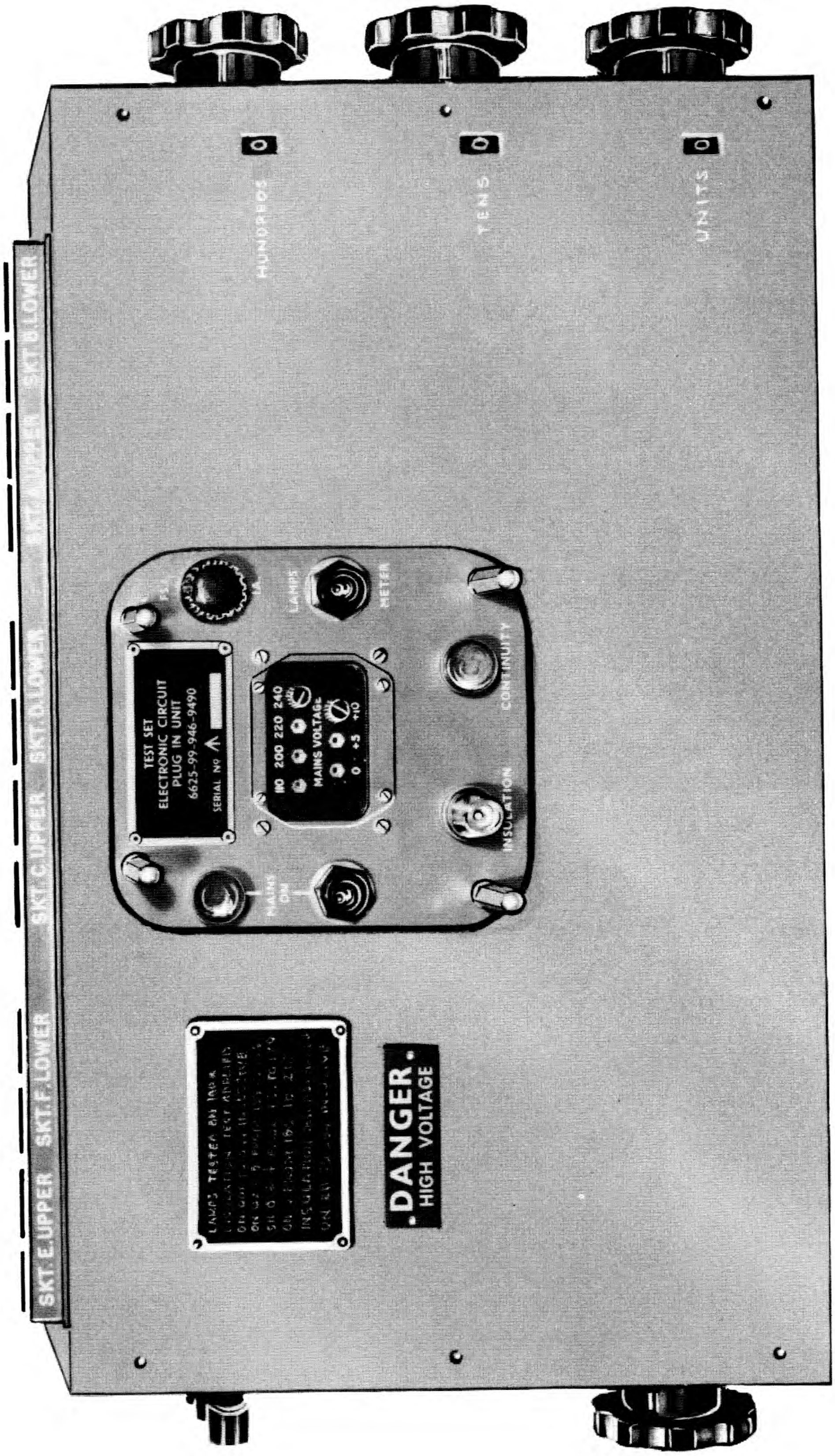


Fig. 2. Circuit tester: front panel layout

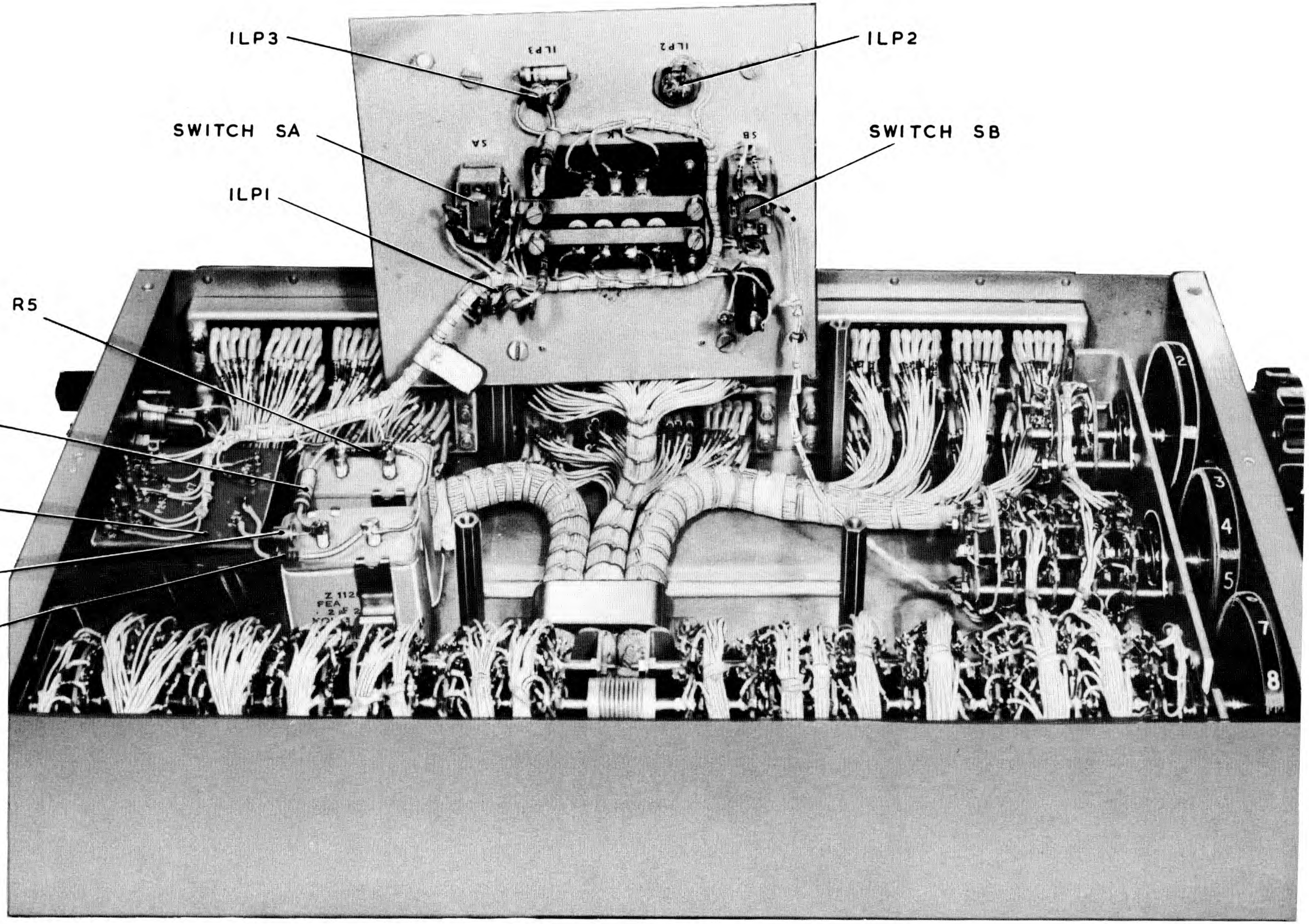
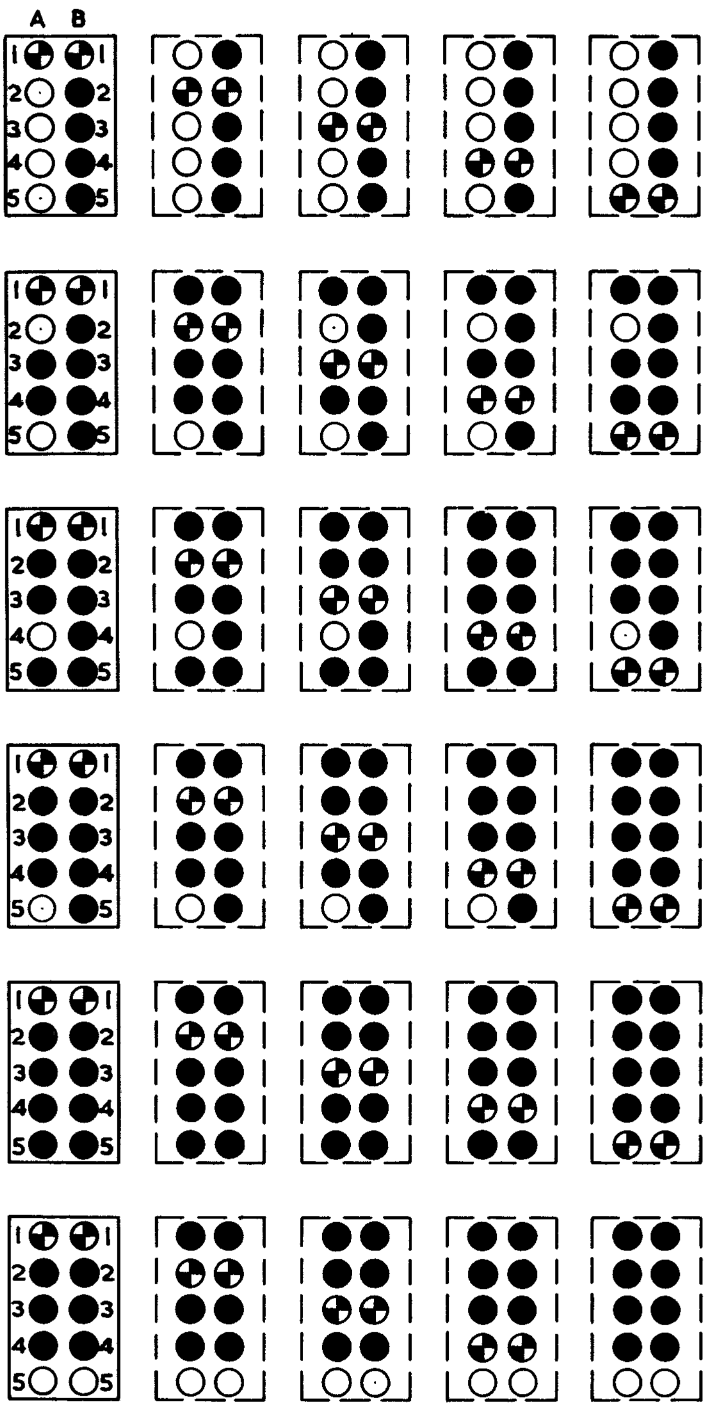


FIG. 3. Circuit tester : component layout - interior



SKT.	SECTIONS
A	1 2 3 4 5 6 7 8
B	1 2 3 4 5 6 7 8
C	1 2 3 4

C	5 7
D	1 3 5 7

E	1 3

C	6 8
D	2 4 6 8
E	2 4 6 8
F	2

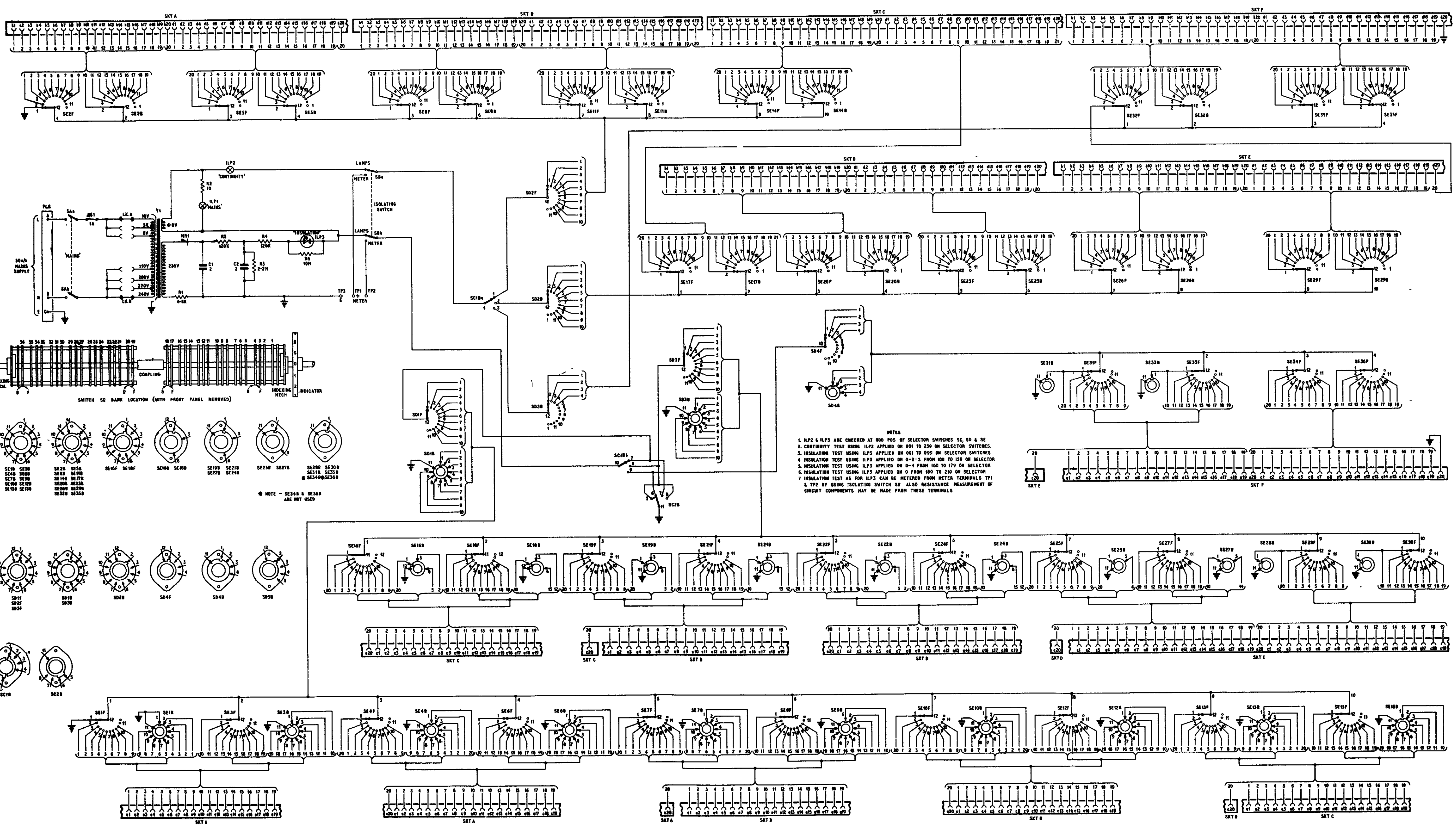
E	5 7
F	1 3 4 5 6 7

F	8

KEY
○ FULL BRILLIANCE
◐ HALF BRILLIANCE
● LAMP OFF

SKT. A SECT.	SKT. A SWITCH POSNS.	SKT. B SECT.	SKT. B SWITCH POSNS.	SKT. C SECT.	SKT. C SWITCH POSNS.	SKT. D SECT.	SKT. D SWITCH POSNS.	SKT. E SECT.	SKT. E SWITCH POSNS.	SKT. F SECT.	SKT. F SWITCH POSNS.
1	1- 5	1	41- 45	1	81- 85	1	121-125	1	161-165	1	201-205
2	6- 10	2	46- 50	2	86- 90	2	126-130	2	166-170	2	206-210
3	11- 15	3	51- 55	3	91- 95	3	131-135	3	171-175	3	211-215
4	16- 20	4	56- 60	4	96-100	4	136-140	4	176-180	4	216-220
5	21- 25	5	61- 65	5	101-105	5	141-145	5	181-185	5	221-225
6	26- 30	6	66- 70	6	106-110	6	146-150	6	186-190	6	226-230
7	31- 35	7	71- 75	7	111-115	7	151-155	7	191-195	7	231-235
8	36-40	8	76- 80	8	116-120	8	156-160	8	196-200	8	236-240

NOTE:- POSITION 240 IS NOT AVAILABLE



NOTES

1. ILP2 & ILP3 ARE CHECKED AT ODD POS OF SELECTOR SWITCHES SC, SD & SE
2. CONTINUITY TEST USING ILP2 APPLIED ON 001 TO 239 ON SELECTOR SWITCHES.
3. INSULATION TEST USING ILP3 APPLIED ON 001 TO 099 ON SELECTOR SWITCHES
4. INSULATION TEST USING ILP3 APPLIED ON 0-2-3 FROM 100 TO 159 ON SELECTOR
5. INSULATION TEST USING ILP3 APPLIED ON 0-4 FROM 160 TO 179 ON SELECTOR
6. INSULATION TEST USING ILP3 APPLIED ON 0 FROM 180 TO 210 ON SELECTOR
7. INSULATION TEST AS FOR ILP3 CAN BE METERED FROM METER TERMINALS TP1 & TP2 BY USING ISOLATING SWITCH SB ALSO RESISTANCE MEASUREMENT OF CIRCUIT COMPONENTS MAY BE MADE FROM THESE TERMINALS

Fig.5 Test set, electronic circuit, plug-in unit, 6625-99-946-9486: circuit

Chapter 17

TEST EQUIPMENT & TOOLS FOR THE SPECTRUM GENERATOR UNIT (AMPLIFIER-OSCILLATOR).

LIST OF CONTENTS

LIST OF ILLUSTRATIONS

LEADING PARTICULARS OF THE TEST SET, OSCILLATOR (SPECTRUM GENERATOR)

Purpose:	Test equipment for the testing and servicing of the spectrum generator unit (amplifier-oscillator) 5821-99-942-8552. Comprises:- (1) Test jig, oscillator, 6625-99-913-1340 (2) Cable assembly, power, electrical 6150-99-999-8158 (3) Cable assembly, radio frequency, 5995-99-932-1909
Overall Ref. No.:	6625-99-914-0152
Dimensions: (approx.)	$5\frac{1}{2}$ in. x $5\frac{1}{2}$ in. x 4 in.
Weight: (approx.)	Test jig - 5 lb. Cable assemblies - 2 lb.
Power supplies:	Derived from the power supply (130V) 6130-99-999-7812

General

1. This test equipment is designed for third and fourth line testing and servicing of the spectrum generator unit (amplifier-oscillator) 5821-99-942-8552 which is included in both the Type TR4/ARC52 and the Type TR5/ARC52 transmitter-receivers. The test equipment provides the means for electrical testing, servicing and testing the module mechanically.

2. For electrical testing, the equipment available is designated test set, oscillator (spectrum generator) and issued under A.B.C.S. Cat. No. 6625-99-914-0152. It comprises the test jig, oscillator (spectrum generator), 6625-99-913-1340 and two associated connectors as follows:-

(1) Cable assembly, power, electrical, 6150-99-999-8158.

(2) Cable assembly, radio frequency, 5995-99-932-1909.

3. For mechanical servicing, a drill and ream jig (Ref. No.10AG/968) is available for the accurate drilling of the Oldham coupler plate and switch shaft, and may be required during overhaul of the unit. Then, to enable the drilling and consequent setting of the coupler to be verified, a checking fixture (Ref. No. 10AG/969) is available. This checking fixture is used in conjunction with a surface gauge and dial gauge, which should be available at all units undertaking repair and reconditioning of AN/ARC52 sub-units.

Test jig, oscillator

4. This equipment comprises a mechanical indexing head which has a test pedestal to accommodate the spectrum generator unit undergoing tests. The test pedestal (fig. 1) is a facsimile of the appropriate portion of the main chassis assembly, into which the module is fitted when installed in the complete transmitter-receiver. The indexing head is capable of transferring the necessary power supplies from an associated power supply (130V) by way of the power connector (para. 2 (1)). It also incorporates a coaxial cable coupling for connecting the output to the power meter cable (para. 2 (2)). Mechanically, the indexing head is designed to set the Oldham coupler of the unit on test to the 200.0 Mc/s (datum) position and thence to eighteen angular intervals in multiples of twenty degrees from this position; i.e. over the range 200 Mc/s to 370 Mc/s in 10 Mc/s steps.

Associated test equipment

5. In addition to the test equipment described in this chapter, two other items of special-to-type test equipment and two items of common test equipment will be required to implement the tests and adjustments of Sect. 2, Chap. 7.

(1) The special-to-type equipments are:-

(a) Power supply (130V), 6130-99-999-7812 (Chap. 2 of this Part).

(b) Calibrator, frequency, 6625-99-999-2642 (Chap. 3 of this Part).

(2) The common test equipment is:-

(a) Multimeter, valve CT429 (Ref. No. 6625-99-943-8384).

(b) Wattmeter, absorption (20mW - 1.5W), CT443 (Ref. No. 6625-99-999-3591).

Construction

6. The test jig, oscillator is principally a steel plate mounted upon an indexing head. The plate is machined to enable the spectrum generator unit on test to be fitted as it is normally installed in the transmitter-receiver and holes are provided in the plate to accommodate the locating dowels of the module to ensure correct location of the Cannon plug and socket connection between the module and the test jig. Provision is made for engagement of the Oldham coupler of the module with an indexing shaft in the base of the test jig. The shaft may be set to any one of eighteen test positions which correspond with the frequency selection facilities

afforded by the module. A two-position key is provided which enables the indexed position to be locked against inadvertent alteration during testing.

Circuit

7. A circuit diagram of the test jig, oscillator is given at fig. 5 at the end of this chapter. This shows the interconnections between the connector terminations, shown in fig. 1 which are mounted beneath the raised plate of the test jig. Plug PL1 is the Mk. 4 plug which is the termination for the connector between power supply and test jig; SKT1 is the Cannon socket protruding through the mounting plate of the test jig into which is engaged the integral plug of the module on test. The two sockets SKT2 and SKT3 provide the means of coupling the output socket of the module on test with the power meter, via the coaxial coupler on the indexing head and the power meter connector.

Operating instructions

8. Full details of the method of arranging the complete test equipment and the operation of the units for testing the spectrum generator unit (amplifier-oscillator) are given in Sect. 2, Chap. 7 of this Volume.

Servicing equipment (mechanical)

9. This equipment includes the drill and ream jig (Ref. No. 10AG/968) and the checking fixture (Ref. No. 10AG/969), which are shown (respectively) at fig. 2 and 3. The checking fixture is shown also in fig. 4, this time with the spectrum generator unit in position.

10. The drill and ream jig (fig. 2) is a heavy gauge plate incorporating two long knurled head screws by which it is clamped into position on the coupler end of the spectrum generator unit; the screws engaging with the tapped holes normally used to secure the module into the main chassis assembly. Provision is made by means of the shaft pin to position the shaft accurately to the datum position (by engagement of the bevelled end of the pin with the slot in the shaft); in addition, a coupler alignment screw is provided to enable the coupler to be adjusted to the correct angular displacement before drilling and reaming is carried out. The distance plate T.133338 is supplied to be positioned between the underside of the new coupler and the chassis of the spectrum generator unit in order to maintain the correct working clearance between the two.

11. The checking fixture is provided to enable verification of the correct coupler alignment following drilling and reaming and insertion of the coupler pin. As sho n in fig. 4, the spectrum generator unit is clamped in position with the two knurled head screws; the datum position having first been selected in order that the two driving dogs are horizontal. The checking fixture is then placed on a clean surface table and, by means of a surface gauge and lever type dial indicator, the linearity of the two dogs is tested to be within $\pm$ 0.0015 in. as described in Sect. 2, Chap. 7.

Test set servicing

12. Whenever a fault is suspected within the test jig, oscillator a continuity test can be readily made using an approved multimeter. Reference to the circuit diagram given at fig. 5 will assist in identification of the wiring.

13. Wiring within the test jig is made in wire, electrical equipment Type 2, 23/.0076 in., pink; any replacement wiring must be of the correct grade as in the original and terminations made as neatly as possible.

14. Examine the connector terminations each time before using the equipment. The cover screw threads should be lightly lubricated with molybdenum disulphide grease in order to prevent binding. The connectors should be clean and undamaged and mating firmly with the coupling components on each appropriate item of test equipment. Renew any connectors which appear unsound or damp.

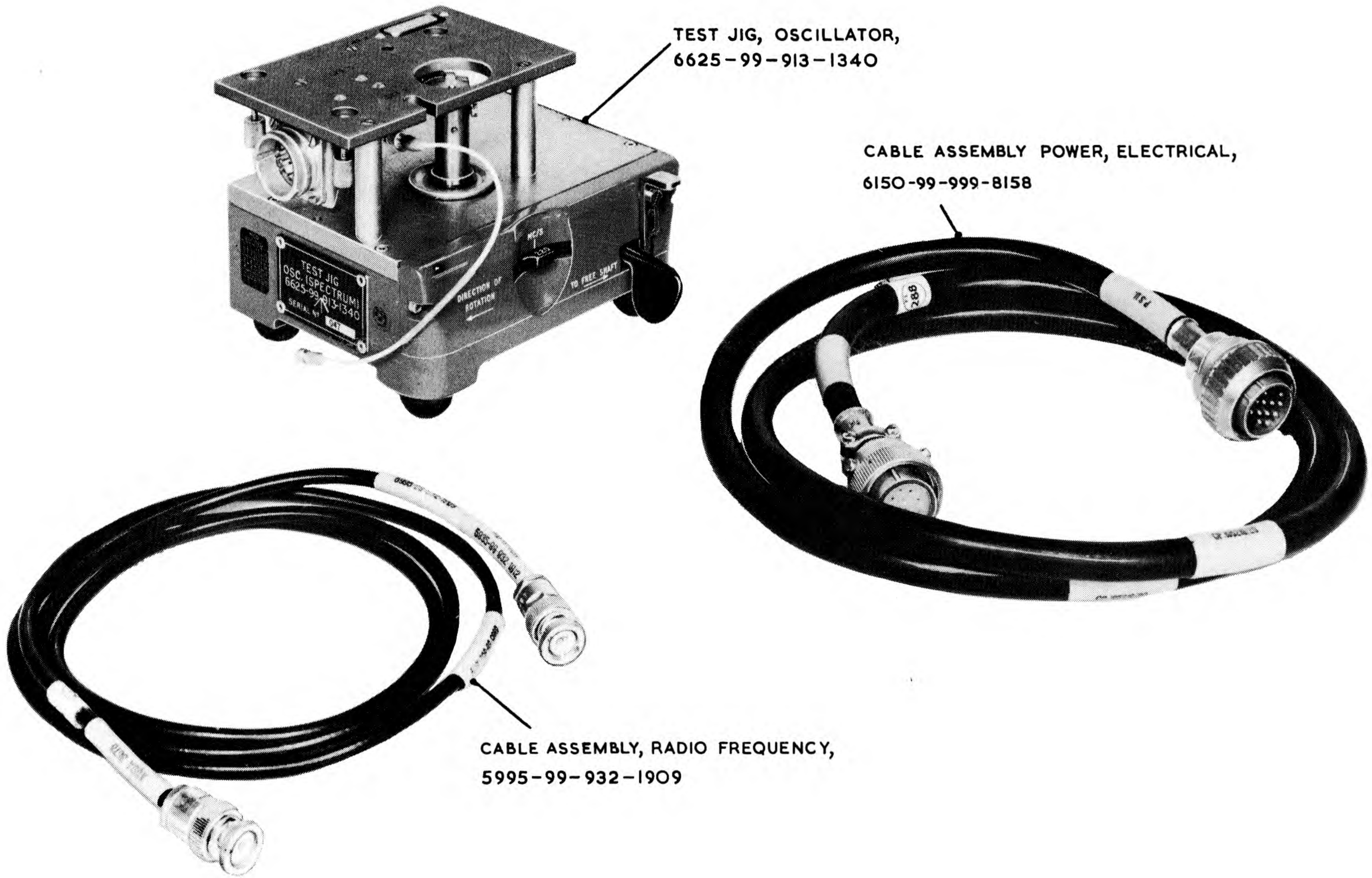


Fig. 1. Test set, oscillator (spectrum generator), 6625-99-914-0152

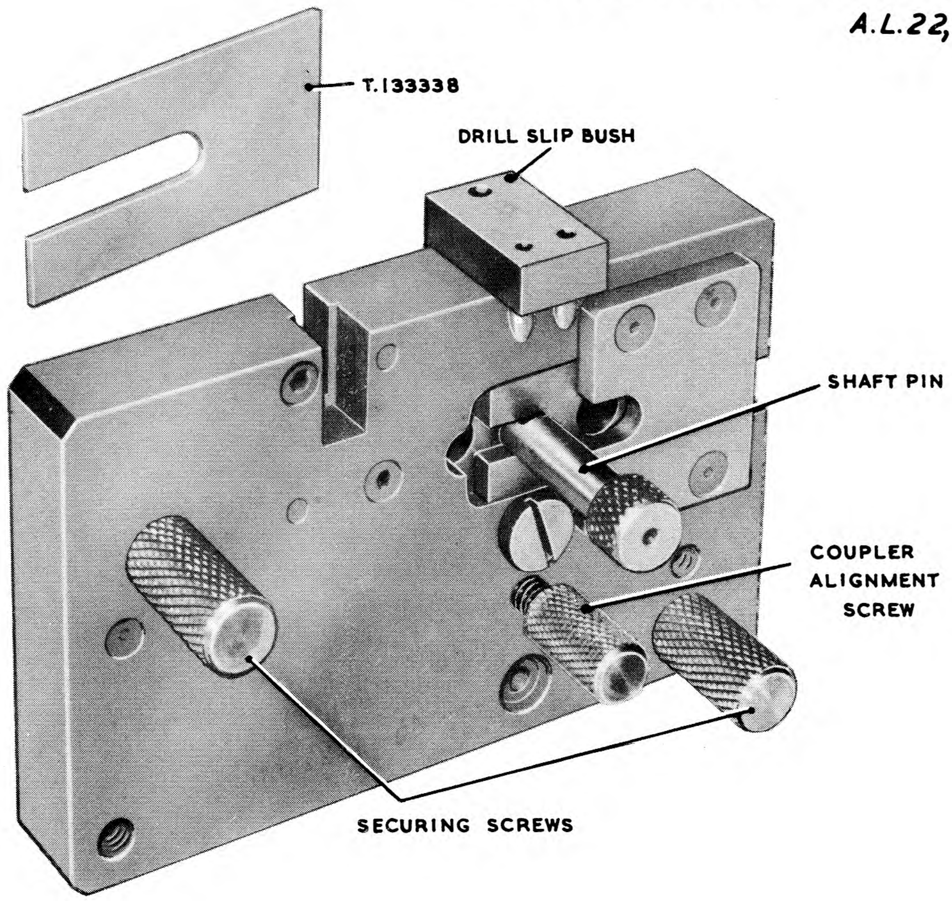


Fig. 2. Drill and ream jig Ref. No. 10AG/968

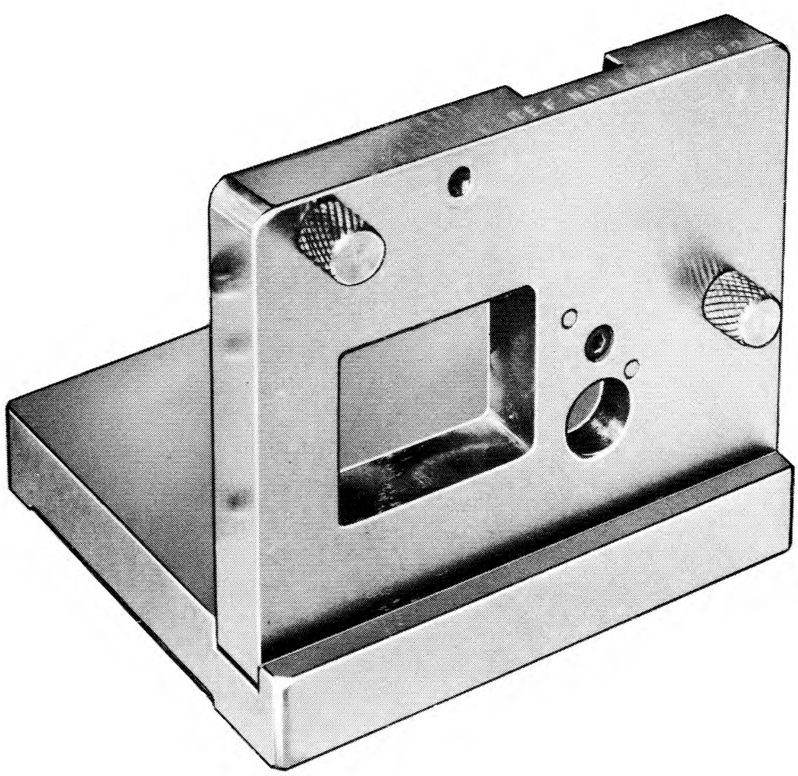


Fig. 3. Checking fixture Ref. No. 10AG/969

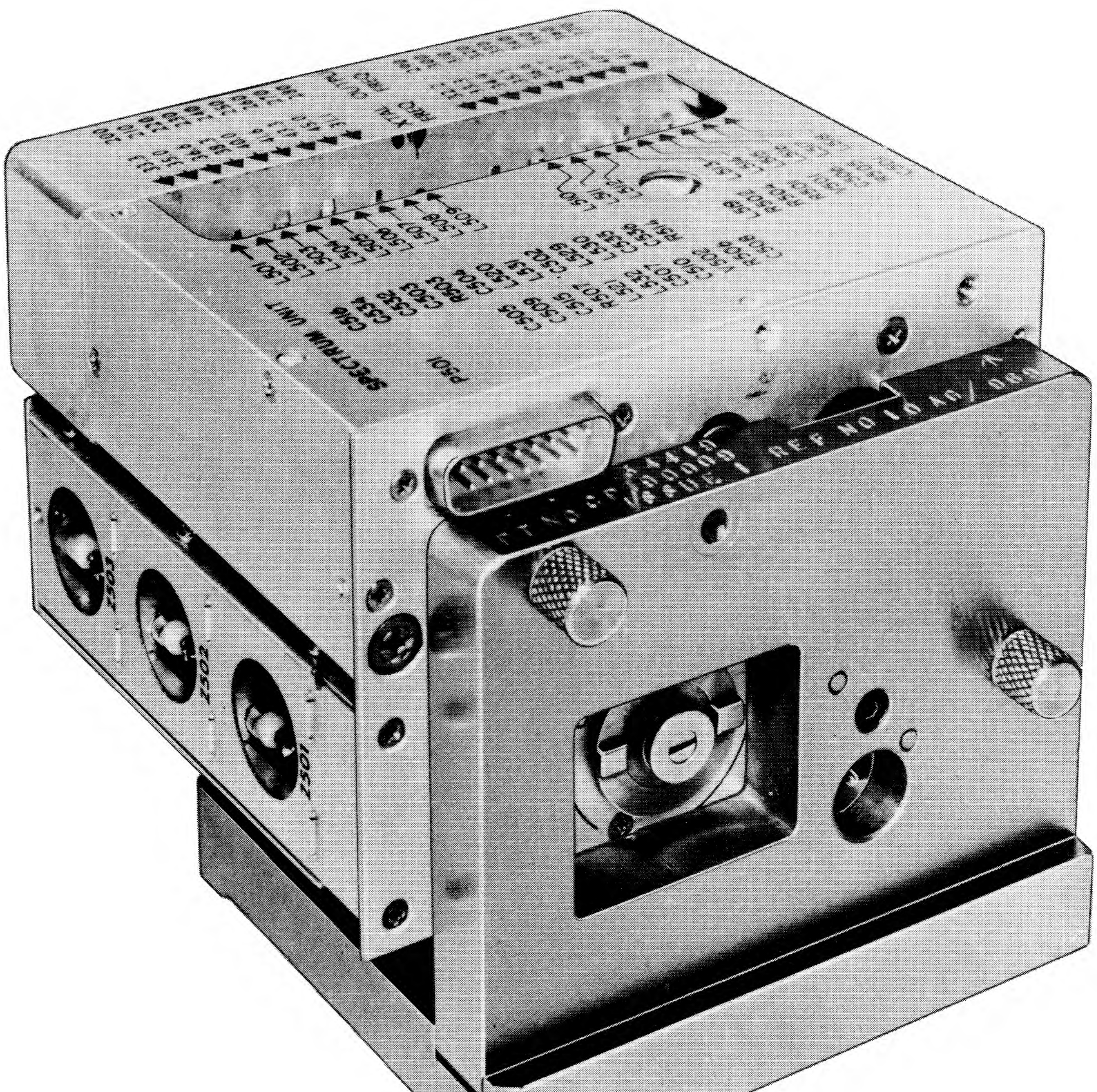


Fig. 4. Checking fixture Ref. No. 10AG/969 with spectrum generator unit in position

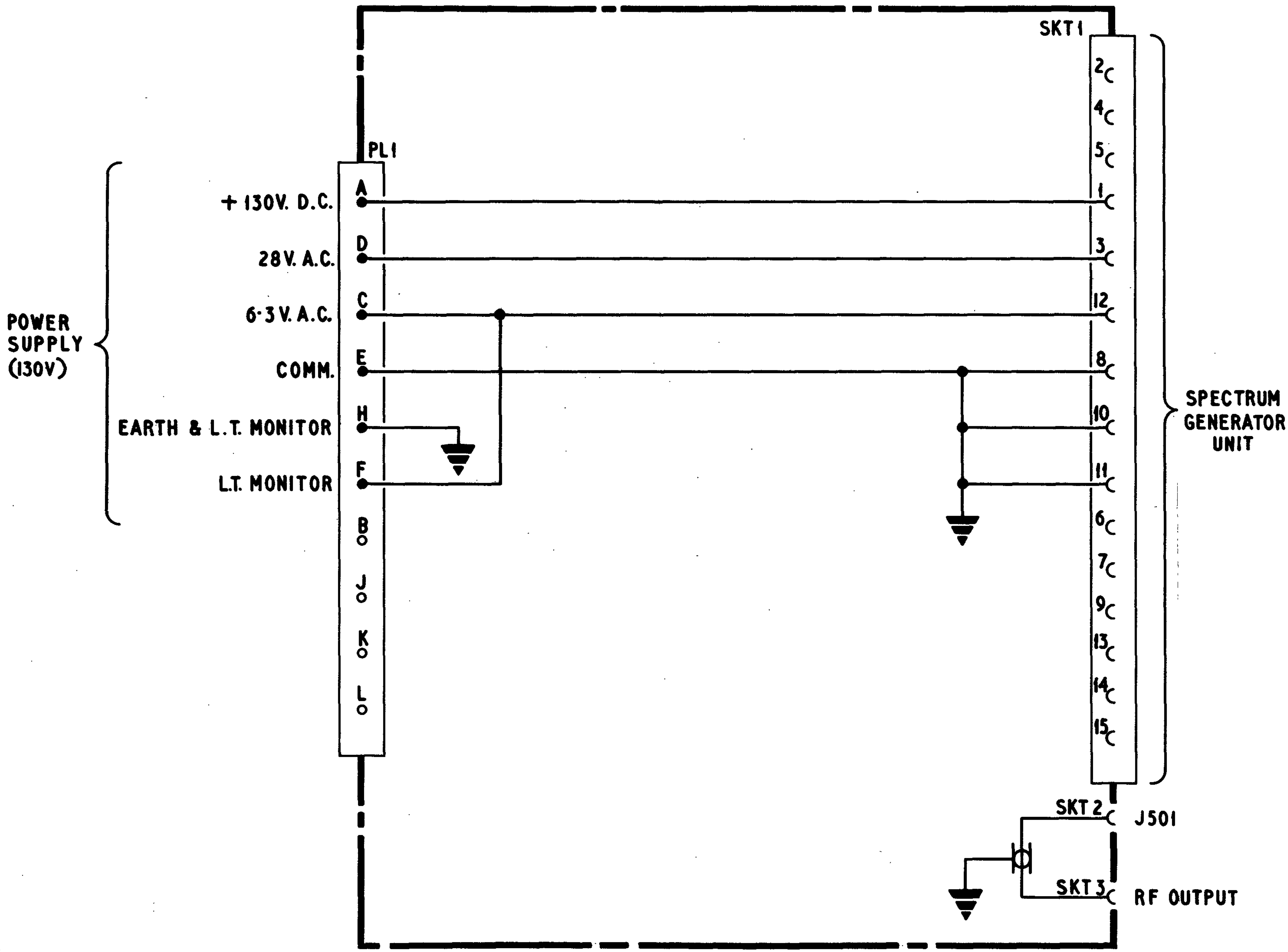


Fig. 5 Test jig, oscillator (spectrum generator) 6625-99-913-1340: circuit

SECTION 2

TESTING AND SERVICING

Chapter 1

OVERALL TESTS

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LIST OF ILLUSTRATIONS

GENERAL

1. To facilitate repair and efficient servicing, the transmitter-receivers Type TR4/ARC52 and Type TR5/ARC52 are constructed of individual sub-units mounted on a common chassis. These units and the chassis are fully dealt with in the subsequent chapters of this Section.

2. This chapter is concerned with testing the overall performance of the equipment after the individual units have been tested to the standard required in the relevant chapter and assembled together.

MECHANICAL EXAMINATION

3. Before testing, examination should be made of the equipment to ensure that the sub-units have been correctly fitted to the main chassis (Vol.1, Part 1, Chap.5). All plugs and sockets should make good electrical connection and the sub-units must be firmly secured in position with the Oldham couplers correctly engaged.

4. The mechanical tuning system should be tested by connecting a d.c. supply (nominally 27.5V) with the positive pole to test point A and the negative pole to the main chassis. Then depress the armatures of relays K1202 and K1203, on the top of the mechanical tuning unit, (fig. 1), whereupon the mechanical tuning system should freely rotate.

TEST EQUIPMENT

5. The power supplies required for operating the equipment are as follows. A nominal 27.5V d.c. supply which should be adjustable from 17V to 30V and fitted with a monitoring ammeter. The a.c. supply should be a nominal 115V (phase to neutral) 400 c/s, 3 phase, star connected supply capable of being adjusted from 80V to 125V. It should be fitted with an ammeter which will monitor any one phase when required.

6. The equipment required for testing the transmitter-receiver is listed in Table 1. Further information on the individual items may be obtained by reference to the publication referred to.

TABLE 1

List of test equipment

Item	Ref. No.	Nomenclature	Para.	Further details
1	5920-99-932-4381	Fuse, concentric, r.f.	11(1)	A.P.2531HA
2	10S/17134	Signal generator CT394A - set	10(3)	A.P.2531HA
3	6625-99-943-5568	Wattmeter, absorption, CT419	9,10(2)	-
4	10S/831	Oscilloscope Type 13A	10(2), 11(2)	A.P.2879AF
5	6625-99-943-7328	Monitor, audio/radio frequency	10	Vol.1,Part 2,Chap.2&7
6	6625-99-943-8384	Multimeter, valve, CT429	12	Marconi TF1041B
7	6625-99-943-7031	Test kit (R.N.)	8(1)	Vol.1,Part 2,Chap.2&7
8	6629-99-943-7032	Test kit (R.A.F.)	8(1)	Vol.1,Part 2,Chap.2&7
9	5821-99-942-8543	Control unit Type C1607/ARC52	8(1)	Vol.1,Part 2,Chap.5
10	5821-99-943-3247	Control, receiver muting (R.N.)	8(1)	See note below.
11	6940-99-943-6545	Simulator, microphone	8(2)	Vol.1, Part 2,Chap.2&7
12	10S/16499	Signal generator Type 65B	8(3)	A.P.2879AD
13	6625-99-943-0510	Wattmeter, absorption, AF No.1, CT44	11(2)	-
14	10S/17639	Indicator,distortion	11(2)	Marconi TF142F
15	5P/2341	Fan, circulating, desk	13	G.E.C. 8 in.
16	6B/117	Stop watch Mk.3	48(1)	-
17	5995-99-932-1905	Connector	9	Vol.1,Part 2,Chap.2
18	5995-99-932-2130	Connector	70	Vol.1,Part 2,Chap.2
19	5935-99-932-1911	Adaptor	70	Vol.1,Part 2,Chap.2

NOTE...

For R.A.F. maintenance units, a muting voltage shall be derived from a d.c. source having a potential of between 10V and 12V. It should be connected to SKT4 of the interconnecting box (Table 1 item 8) with the negative pole to pin A and the positive pole to pin D.

Arrangement of test equipment

7. The equipment to be tested should have its cover removed and be situated on the test bench in such a position that will permit free access to the majority of test points and preset controls (fig. 1).

8. The test equipment should be arranged on the test bench as follows:-

(1) With the connectors provided in the test kit (Table 1, item 7 or 8), connect the control unit (Table 1, item 9), transmitter-receiver under test, power supplies (para. 5) and the control, receiver muting (Table 1, item 10) to the interconnecting box (Table 1, item 7 or 8). Both ends of each connector are clearly marked, indicating the termination to which it should be connected.

(2) Connect the microphone simulator (Table 1, item 11) terminals marked OUTPUT to the interconnecting box terminals marked MIC. (a) and MIC. (b) respectively; the EARTH terminals of both items should be connected together.

(3) The a.f. signal generator (Table 1, item 12) should be connected to the INPUT terminals of the microphone simulator i.e. 0 and 600Ω or 0 and 1000Ω, depending on the output impedance of the signal generator used.

9. When testing under transmit conditions (para. 24 and 44) the wattmeter CT419 (Table 1, item 3) fulfils the function of the transmitter output load and should be connected direct to the aerial connector J1402 of the equipment on test using the connector (Table 1, item 17).

10. When measuring the modulation characteristics of the transmitter (para. 49) the monitor (Table 1, item 5) is used in conjunction with other items of test equipment as follows:-

(1) Connect the TX socket of the monitor (Table 1, item 5) to the aerial connector J1402, of the equipment under test, using the connector provided.

(2) The oscilloscope (Table 1, item 4) should be connected to the monitor socket marked OUTPUT and the wattmeter CT419 (Table 1, item 3) connected to the monitor socket annotated 50 OHM LOAD.

(3) The signal generator CT394A (Table 1, item 2) should be connected to the monitor at the socket marked INPUT A.

11. When the equipment on test is set to operate under receive conditions, certain items of test equipment should be rearranged as follows:-

(1) The signal generator (Table 1, item 2) should be connected to the aerial socket J1402 of the equipment on test. To safeguard the attenuator network of this instrument, should the equipment be inadvertently set to transmit, the concentric fuse (Table 1, item 1) should be fitted in series with the signal generator output and J1402.

(2) The wattmeter CT44 (Table 1, item 13), distortion indicator (Table 1, item 14) and oscilloscope (Table 1, item 4) should be connected to the interconnecting box terminals marked EARTH and PHONE.

12. The multimeter, valve (Table 1, item 6) is used for various voltage measurements and test point readings on the equipment under test and the points to which it should be connected are described in the test procedure (para. 15 to 110). The test point readings are relative to the chassis unless otherwise stated.

13. The fan (Table 1, item 15) is used to simulate the external air blower of the transmitter-receiver equipment on test. The fan should be situated in such a position as to direct its air-stream at the rearward uppermost edge of the equipment so that the hot air is driven over the uppermost forward edge of the transmitter-receiver.

14. For certain tests it is necessary to rearrange the test equipment (para. 7 to 13). These rearrangements are described at the appropriate point in the test procedure (para. 15 to 110).

TEST PROCEDURE

General conditions for testing

15. The TR4/ARC52 and TR5/ARC52 equipments are designed to function from primary power supply levels above and below the nominal 115V a.c. and 27.5V d.c. (Vol.1, Part 1, Chap.1). To ensure that the equipment on test is capable of meeting this requirement, four test conditions are imposed and they are as follows:-

	TR5/ARC52	TR4/ARC52
Standard test conditions	27.5V d.c.	27.5V d.c. & 115V, 400 c/s, 3 phase a.c.
Service test conditions, higher level	29V d.c.	29V d.c. & 121V, 400 c/s, 3 phase a.c.
Service test conditions, lower level	25V d.c.	25V d.c. & 108V, 400 c/s, 3 phase a.c.
Special service test conditions	22V d.c.	22V d.c. & 102V, 400 c/s, 3 phase a.c.

16. Unless otherwise directed in the test procedure, the test channels to be used are listed in Table 2 and the control unit should be set up to these preset channels (Vol.1, Part 1, Chap.4). When the transmitter-receiver is required to operate on frequencies other than those listed in Table 2, the manual frequency selection should be used (Vol.1, Part 1, Chap.4).

TABLE 2

Channel	Frequency (Mc/s)
1	225.0
2	235.1
3	246.0
4	254.2
5	267.3
6	275.0
7	288.0
8	295.4
9	309.2
10	315.5
11	320.9
12	335.6
13	341.9
14	355.7
15	362.9
16	375.8
17	383.9
18	399.9

17. Unless instructed by a particular paragraph to the contrary, the TONE, MUTE/NORMAL and TRANSMIT/RECEIVE switches of the interconnecting box should be set as follows:-

(1) TONE switch - to the OFF position

(2) MUTE/NORMAL switch - to the NORMAL position

(3) TRANSMIT/RECEIVE - to the RECEIVE position when operating the equipment on test as a main or guard receiver and to the TRANSMIT position when operating as a transmitter. The use of the TRANSMIT position of the switch should be restricted to a minimum; it should only remain in this position for as long as is necessary to take a particular reading or to effect a particular adjustment.

18. During the tests contained in this chapter it will be necessary to measure the average depth of modulation. With the modulation envelope displayed on the oscilloscope, use the graticule to find the peak to peak and trough to trough values. The average depth of modulation may then be evaluated by substituting the values in the following expression:-

$$\text{Average depth of modulation} = \left(\frac{A-B}{A+B} \times 100\right)\%$$

where A is the peak to peak value

and B is the trough to trough value.

19. For the purpose of tests described in this chapter the following definitions of terms are included:-

(1) Amplitude limiting - refers to that capacity of the modulator unit to limit the peak or trough level of the modulation envelope. When the modulated carrier waveform is displayed on the oscilloscope, it is indicated by a distinct flattening of the peak or trough displacement.

(2) Squelch - is that characteristic of the receiver which causes the audio output to be muted when signals are not present; there are two squelch systems. Signal to noise squelch is responsive to changes in the modulation depth of the input carrier, whilst carrier operated squelch is responsive to changes in the level of the input carrier voltage. Under squelch operation a receiver is considered to be at the threshold of being muted or not muted as follows:-

(a) Threshold of being muted - when the modulation (or input carrier voltage) is reduced to that depth (or level) where the squelch just operates and the audio output power suddenly falls.

(b) Threshold of being not muted - when the modulation (or input carrier voltage) is increased to that depth (or level) where the squelch becomes inoperative and the audio power suddenly increases.

20. Whenever the signal generator CT394A is used for testing the main or guard receiver, it should be set accurately to the required frequency by fine-tuning the signal generator for maximum a.g.c. voltage. The main receiver a.g.c. may be measured with the multimeter, valve, CT429 connected between test point M and chassis; for the guard receiver, the a.g.c. voltage is measured with the CT429 connected between test point Y (pole 1 of J1508) and chassis. The a.g.c. voltage can also be measured at the AVC socket on the test kit interconnecting box. The carrier

voltage level of the CT394A should be small and sufficient only to give an indication in the CT429.

TEST POINT READINGS AND SUB-UNIT MATCHING

21. Although the sub-units of TR4/ARC52 and TR5/ARC52 equipments are designed to be interchangeable, certain sub-units have to be matched electrically for optimum performance when they are fitted in a complete equipment. The tests under this heading (para. 21 to 40) describe the procedure for inter-unit matching and also include details of test point readings for a complete transmitter-receiver.

22. It is stressed that the test readings are only intended to provide a quick indication that an equipment is functioning or as an aid to fault diagnosis. The full functional tests, which fulfil the manufacturer's test specification requirements, are contained in para. 45 to para. 86 inclusive.

23. Unless otherwise stated, the test point readings should be measured under standard test conditions (para. 15). The position of the test points and preset controls are shown in fig. 1 at the end of this chapter.

24. Terminate the aerial socket (J1402) of the equipment on test with the wattmeter CT419 (para. 9) and the interconnecting box terminals marked EARTH and PHONE with the wattmeter CT44.

25. All the preset controls of the equipment on test should be set fully clockwise and the control unit should be set to channel 10 (Table 2).

26. Apply power to the test bench and set the control unit function switch to the T/R+G position. The a.f. signal generator should remain inoperative and the interconnecting box switches should be set as follows:-

D.C. SUPPLY to either TR4 or TR5 (as applicable)

3 PHASE SUPPLY to ON (when applicable)

TRANSMIT/RECEIVE switch to RECEIVE

MUTE/NORMAL switch to NORMAL

TONE switch to OFF

Microphone switch to BAL. MIC. (DYNAMIC).

27. Switch on the fan (para. 13) and allow the equipment fifteen minutes to thermally stabilize before commencing the following tests.

28. Using the multimeter, valve, CT429 (para. 23) take readings at the test points as follows:-

(1) Primary d.c. supply - the voltage level at test point A should be the same as the d.c. supply voltage, (i.e. interconnecting box VOLTAGE TEST POINTS marked +27.5V)

(2) Primary a.c. supply (TR4/ARC52) - the voltage levels at test points B, C and D should equal those of the interconnecting box VOLTAGE TEST POINTS annotated PH.1, PH.2 and PH.3.

(3) Heater supplies - the heater supply levels should be as follows:-

for TR4/ARC52 equipments:-

at TP3	6V to 6.6V a.c.
at TP1	6V to 6.6V a.c.
at Z1501/2	25.2V to 27.8V a.c.

for TR5/ARC52 equipments:-

at TP3	6V to 6.6V d.c.
between TP2 and TP3	6V to 6.6V d.c.
between TP1 and TP2	6V to 6.6V d.c.
between TP4 and TP1	6V to 6.6V d.c.
at TP4	23.9V to 26.5V d.c.

(4) Main h.t. supply - the voltage level at test point E should be between 130V and 140V for TR4/ARC52 equipments and between 125V and 140V for TR5/ARC52 equipments.

(5) Standing bias supply - measured at test point X, the negative voltage level should be between 13.5V and 15.5V. When measured under the higher and lower service test conditions (para. 15) the reading should be within 0.2V of that prevailing under standard test conditions.

29. Operate the equipment on test as a tone transmitter by setting the TONE switch to ON. Test point V should first be monitored to ensure that the drive to the r.f. power amplifier is more than 15V. Then continue taking the test point readings as follows:-

(1) E.H.T. supply - the voltage at test point S should be between 413V and 457V for TR4/ARC52 equipments and between 405V and 450V for the TR5/ARC52 equipments.

(2) Main h.t. supply - as for the receive conditions (para. 28(4)).

(4) Standing bias supply - as for the receive conditions (para. 28(5)).

(4) Fixed bias on V703 and V704 - the negative voltage level at test point W should be between 1V and 3V.

(5) 1.85 Mc/s oscillator activity - the negative voltage at test point U should be not less than 3V.

30. Set the TONE switch to the OFF position and the control unit function switch to T/R+G.

31. The spectrum generator output should be measured with the equipment on test set to operate on 225 Mc/s, 260 Mc/s, 315 Mc/s, 355 Mc/s, and 399 Mc/s. At each of these frequencies the test point readings should be as follows:-

G	not less than 0.9V
T	not less than 2.5V
H	not less than 5.0V

32. The oscillator unit feed to the IF unit (20-30 Mc/s) should next be measured at the test points J, K and L on each of the following frequencies:-

320.0 Mc/s)	
321.1 Mc/s)	
322.2 Mc/s)	J not less than 1.0V
323.3 Mc/s)	
324.4 Mc/s)	K not less than 0.75V
325.5 Mc/s)	
326.6 Mc/s)	L not less than 2.0V
327.7 Mc/s)	
328.8 Mc/s)	
329.9 Mc/s)	

33. Ensure that the equipment is set to RECEIVE, then disconnect J501 on the spectrum generator unit and remove the e.h.t. fuse F1504. The voltage level at test point T should be measured with the transmitter-receiver set to operate on 320.0 Mc/s and 329.9 Mc/s; first in the receive, and then in the transmit condition. When operated in the transmit condition, the readings at test point T should be not less than 1V more negative than the readings taken in the receive condition. After the readings have been taken switch to RECEIVE and refit the fuse F1504.

34. Index the transmitter-receiver to 399.5 Mc/s and set the interconnecting box TRANSMIT/RECEIVE switch to TRANSMIT. Connect the CT429 between the test point V and earth and then match the amplifier, radio frequency (RF power amplifier) as follows:-

(1) Trim the capacitors C115, C116, C117, C609 and C611 for a maximum negative voltage reading in the CT429.

(2) Trim C627 for maximum power output as indicated in the wattmeter CT419.

(3) The equipment on test should be set to operate on all the test channels (Table 2) and, on each channel, the power output should be not less than 16 watts and the test point V reading in the CT429 should be not less than 25V negative.

35. The aerial derived sidetone should be tested with the equipment set to operate on channel 12 (Table 2) as a transmitter. When the interconnecting box, TRANSMIT/RECEIVE switch is set to TRANSMIT the voltage reading at pin 1 of TB1501 should be not less than 1.5V. On TONE, with the modulation set 3 dB below amplitude limiting and the blowers operating, measure the distortion at pin 1 of TB1501; it should be not more than 10%.

36. The modulator derived sidetone should be tested with the equipment operating as a tone transmitter. Set the TONE switch on the interconnecting box to the ON position. The reading should be not less than 250 mW.

37. Set the TRANSMIT/RECEIVE switch on the interconnecting box to the RECEIVE position and arrange the test equipment as described in para. 11. The main receiver should now be tested as follows:-

(1) Alignment - set the CT394A carrier, unmodulated, to 399.5 Mc/s (para. 20). Then adjust the trimming capacitors C20 and C21 for maximum a.g.c. voltage as indicated in the CT429 at test point M. The trimming capacitor C19 should be adjusted for a minimum reading in the CT44.

(2) R.F. gain - set the carrier output voltage level of the CT394A to zero and position the control unit function switch to T/R. Connect

the CT429 to test point N and rotate the CHAN switch of the control unit until the test frequency has been found which gives rise to a maximum reading in the CT429. On this channel, set the r.f. gain of the main receiver by adjusting the stage gain capacitors C339 and C340 until the CT429 indicates a voltage of between 2V negative and 1V positive.

(3) Sensitivity - the CT394A carrier should be modulated to a depth of 30% by 1,000 c/s tone at a voltage level of 5μV. Set the variable resistor R415 for a reading in the CT44 of 50 mW on each of the channels 1, 5, 10, 14 and 18 of Table 2. When modulation of the CT394A carrier is switched off, the reading in the CT44 should fall by not less than 8 dB for each channel tested.

(4) Squelch discriminator - set the equipment on test to channel 10 (Table 2) and modulate the CT394A carrier to a depth of 30% by 1,000 c/s tone at an output voltage level of 1 mV. The voltage reading at test point R should be not less than 4V.

38. Leave the transmitter-receiver on channel 10; set the function switch of the control unit to T/R+G and mute the main receiver by setting R407 fully counter-clockwise. Then test the guard receiver as follows:-

(1) Alignment - tune the CT394A to the guard receiver frequency (para.20) with its carrier set, unmodulated, to a voltage level of 1.5μV. Connect the CT429 to test point Z and adjust L801 for a maximum negative voltage in the CT429. Decrease the carrier output voltage level of the CT394A if the reading at test point Z goes more negative than 10V.

(2) Gain - modulate the CT394A carrier to a depth of 30% by 1,000 c/s tone and increase the carrier output voltage level to 1,000μV. For this level of r.f. input, the a.c. voltage at test point P should be not less than 5V and the d.c. voltage at test point Y not less than 1V negative with respect to frame; this is an a.g.c. measurement.

(3) Sensitivity - reduce the CT394A carrier voltage level to 5μV and set R425 for a reading of 50 mW in the CT44. When the modulation of the CT394A carrier is switched off the output power, indicated in the CT44 should fall by not less than 6 dB.

39. The primary input power should be measured under transmit, channel change, and receive conditions; the crystal oven should also be drawing current and the internal (TR4/ARC52 only) and external blowers made to operate by shorting the thermostatic switch S1501.

40. Set the control unit function switch to the T/R+G position and the CHAN switch to position 2; for channel change readings the CHAN switch should be rotated from position 2 to position 1 under receive conditions. The primary input readings should be as follows:-

(1) TR5/ARC52 equipment - under receive conditions, not more than 12.5A and under transmit and channel change conditions, not more than 17A.

(2) TR4/ARC52 equipment - the d.c. drawn for the three conditions are:

Receive - not more than 1.1A

Transmit - not more than 1.5A

Channel change - not more than 7.5A.

The apparent a.c. total power delivered should be not more than 275VA on receive and channel change; on transmit it should be not more than 430VA.

FUNCTIONAL TESTS

41. Unless directed otherwise, the preset controls of the transmitter-receiver should be set at the commencement of each test as follows:-

R1401, R1402, R407, R1507	Fully clockwise	R415, R425	Midway
		R702, R418	Fully counter-clockwise

R1505 should be set fully clockwise when the equipment is operating as a transmitter or main receiver (T/R). When operating as a main receiver and guard receiver (T/R+G), R1505 should be set fully counter-clockwise.

42. Connect the circuit linkages for signal to noise operated squelch (Table 3).

43. The functional tests should be conducted with the primary power supplies set for standard test conditions (para. 15). When the equipment on test is operated under any other test condition, this will be stated in the instructions for the test concerned.

Transmitter

Preparation for tests

44. The test bench should be prepared in the following manner:-

(1) Connect the equipment as described in para. 8 and 9

(2) Set the interconnecting box switches thus:-

Microphone switch to BAL. MIC. (DYNAMIC)

TRANSMIT/RECEIVE switch to RECEIVE

D.C. SUPPLY switch to TR4 or TR5 (as applicable)

3 PHASE SUPPLY to ON (if applicable)

TONE to OFF

Muting switch to NORMAL.

(3) Set the MICROPHONE SELECTOR switch to the microphone simulator to the 200Ω DYNAMIC MIC. position.

(4) Set the control unit function switch to the T/R position.

(5) Switch on the a.f. signal generator, tune it to a frequency of 1,000 c/s and set the carrier voltage level to zero.

(6) Depress the D.C. SUPPLY breaker of the interconnecting box and allow the equipment to stabilize thermally for 15 minutes.

R.F. characteristics

45. Set the interconnecting box TRANSMIT/RECEIVE switch to the TRANSMIT position, as necessary (para. 17(3)) and measure the available r.f. power of the transmitter under the four test conditions (para. 15) as follows:-

(1) Standard test conditions - the available r.f. power indicated on the CT419, for each test channel (Table 2) should be not less than 16W. With the CT429 connected between test point V and chassis, the reading should be not less than 25V negative.

(2) Service test conditions, lower level - on channel 12 the CT419 reading should be not less than 9W.

(3) Service test conditions, higher level - on channel 12 the r.f. power output, as measured in the CT419, should be not less than 9W.

(4) Special service test conditions - on channel 12 the reading in the CT419 should be not less than 500 mW.

46. The accuracy of automatic tuning should be tested with the transmitter operating under service test conditions at both the higher and lower levels (para. 15) in turn. The method is to first set the manual dials of the control unit to any convenient frequency (para. 16). Then set the tenths dial to 0.1 Mc/s below that frequency and measure the r.f. output in the CT419.

47. Note the reading in the CT419 and repeat the test a further four times; the available r.f. power readings should remain constant to within 0.5 dB of the highest reading.

48. The channel selection time should be measured with the equipment on test operating under the lower level of service test conditions (para. 15) as follows:-

(1) Set the manual dials of the control unit to 235.1 Mc/s (para. 16) and prepare the stop watch (Table 1, item 16) ready for use.

(2) The tenths manual dial should be switched from 0.1 Mc/s to 0.0 Mc/s (i.e. 235.0 Mc/s) and the stop watch started at the same instant as the dial is switched. At the instant when the sidetone becomes available, the stop watch should be stopped and the time recorded by it should not exceed 6 seconds. The commencement of sidetone is indicated either by a deflection in the CT44 or, if used, aurally in the headset.

Modulation characteristics

49. Remove the CT419 from the aerial socket J1402 and terminate the aerial as described in para. 10. Then adjust the power supplies for operation under the standard test conditions (para. 15).

50. The noise modulation should be measured on channel 12 (Table 2) as follows:-

(1) The internal and external blower motors should be made to operate by placing a temporary connection across the thermostatic switch S1501.

(2) Increase the carrier voltage level of the a.f. signal generator until the meter needle of the microphone simulator is at 75% of F.S.D., i.e. on the calibration mark.

(3) Set the CT394A frequency to 300 kc/s above or below the transmitter frequency (i.e. 335.9 Mc/s or 335.3 Mc/s) and fine-tune the CT394A

for a good trace of the modulation envelope in the oscilloscope.

(4) Adjust R702 for the setting at which amplitude limiting commences (para. 19(1)).

(5) The signal plus noise to noise ratio in the sidetone output should be determined, first by noting the audio output reading in the CT44. Then by setting the carrier voltage level of the a.f. signal generator to zero and again noting the CT44 reading. The two readings obtained should differ by not less than 32 dB.

(6) Set the a.f. signal generator carrier level as in sub-para. (2) and remove the temporary connection across S1501.

51. Set R702 to the fully clockwise position and measure the average depth of modulation (para. 18) which should be not less than 80%.

52. The test should be repeated with the transmitter and CT394A (para.50(3)) set to operate on channels 5, 8, 11, 14 and 18 of Table 2.

53. The average depth of modulation at the commencement of amplitude limiting, should be measured with the equipment indexed to channel 12. It will be seen that when R702 is adjusted, as in para. 50(4), amplitude limiting will first commence on the peak (or trough) displacement of the modulation envelope. At this point the average depth of modulation should be not less than 70%. R702 should then be reset so that amplitude limiting also commences on the trough (or peak) of the modulation envelope; the average depth of modulation should again be not less than 70%.

54. The average depth of modulation should be measured with the transmitter modulated from the tone oscillator as follows:-

(1) Set the a.f. signal generator output to zero.

(2) Set the TONE switch of the interconnecting box to the ON position.

(3) Measure the average depth of modulation which should be not less than 80%.

55. Measure the modulation distortion at the aerial derived sidetone circuit in the following manner:-

(1) Set the TONE switch on the interconnecting box to the OFF position and increase the output of the a.f. signal generator for 75% of full scale deflection in the microphone simulator meter. Switch to TRANSMIT.

(2) Adjust R702 for an average modulation depth of 80%. Then adjust the input signal level from the a.f. signal generator to the point at which amplitude limiting commences, now reduce this level by 3 dB.

(3) Connect the distortion indicator (Table 1, item 14) between the chassis and pin 1 of T31501. The distortion factor of the a.f. output waveform should not exceed 10%.

56. Leave the equipment set up as in para. 55(2) and note the power output level in the CT419. Using this as a reference level, alter the frequency of the a.f. signal generator to 150, 600 and 20,000 c/s and note the deviation of output power; this should not exceed the limits listed, as follows:-

Modulation frequency (c/s)	Limits of deviation from reference level (dB)
1,000	reference level
150	-7 or lower
600	+1 to -2
20,000	0 to -10

57. Retune the a.f. signal generator to a frequency of 1,000 c/s, set R407 and R1402 to their fully counter-clockwise positions; R702 should remain set for an average modulation depth of 80%. Then measure the sidetone characteristics as follows:-

(1) Intercommunication level - adjust R418 for a reading of 250 mW in the CT44. Position the function switch of the control unit to T/R+G and the interconnecting box TRANSMIT/RECEIVE switch to the RECEIVE position. Under these conditions the CT44 reading should be not less than 250 mW.

(2) Noise modulation - set the TRANSMIT/RECEIVE switch on the interconnecting box to TRANSMIT, and reduce the a.f. signal generator carrier level to zero. The CT44 reading should not exceed 160 microwatts under these conditions.

(3) Distortion - connect the distortion indicator as in para. 11(2) and set the a.f. signal generator output as in para. 55(2). The reading in the distortion indicator should not exceed 15%.

58. The ADF h.t. level should be measured under transmit conditions. Connect the CT429 between VOLTAGE TEST POINT + 225V and EARTH on the interconnecting box and set the TRANSMIT/RECEIVE switch to TRANSMIT. The CT429 reading should not exceed 95V.

Main receiver

Preparation for tests

59. Disconnect the test equipment from the aerial socket J1402 and arrange the test equipment as instructed in para. 11; the control unit function switch should be set to T/R.

60. Throughout the main receiver tests the oscilloscope should be used as a visual indication for evidence of instability.

61. Set the TRANSMIT/RECEIVE switch on the interconnecting box to RECEIVE and switch off the a.f. signal generator. Then provide power for the equipment and allow it to thermally stabilize before commencing the tests.

Receiver blocking

62. Blocking is that characteristic of the receiver which causes a fall in the a.f. output power level for an increase in input signal level and should be tested in the following manner:-

(1) Set the control unit CHAN switch to channel 10 and tune the CT394A to the main receiver (para. 20). The carrier output voltage level should then be set to 1,000 μV open circuit and modulated to a depth of 30% by 1,000 c/s tone.

(2) R415 should be adjusted for an a.f. output power level of 250 mW in the CT44.

(3) The carrier output voltage level of the CT394A should be slowly increased to 500,000μV open circuit, whereupon the reading in the CT44 should not fall below 50 mW.

Noise modulation

63. The noise modulation of the main receiver a.f. output waveform should be measured with the equipment still indexed to channel 10 as follows:-

(1) Operate the blowers by placing a short-circuit across S1501 (para. 50(1)).

(2) The CT394A carrier should be modulated to a depth of 30% by 1,000 c/s tone and its output voltage level set to 10,000μV open circuit.

(3) Adjust R415 to the setting which will produce an a.f. output power level of 250 mW in the CT44. Then switch off the modulation of the CT394A and note the CT44 reading which should fall by not less than 30 dB.

A.F. capability

64. Set the carrier output voltage level of the CT394A to 100μV open circuit and modulate it to a depth of 30% by 1,000 c/s tone. It should be then possible to obtain a reading of 250 mW in the CT44 by adjusting R415.

Sensitivity

65. The main receiver sensitivity should be measured under each of the four test conditions (para. 15). The method is to inject an r.f. signal, at a given carrier level, from the CT394A, modulated to a depth of 30% by 1,000 c/s tone; then adjust R415 for a 50 mW reading in the CT44. The modulation of the CT394A carrier should then be removed and the fall in audio output noted. The ratio between the two readings, expressed in dB, gives the signal plus noise to noise ratio. The test channels, input carrier level and the limits for the signal plus noise to noise ratio for each test condition are as follows:-

Test condition	Test channel	Carrier level (open circuit)	S+N/N ratio
Standard	All channels	5μV (see note below)	Not less than 8 dB
Service (higher and lower levels)	1,10,18	20μV	Not less than 10 dB
Special service	1,10,18	10,000μV	Not less than 10 dB

NOTE...

On test channel 3, the input carrier level should set to 10μV open circuit instead of 5μV open circuit.

A.F. characteristics

66. The a.f. characteristics for the main receiver should be measured with the equipment operating on test channel 10 under standard test conditions as follows:-

(1) Distortion factor - set the input carrier level to 100µV open circuit and modulate to a depth of 30% by 1,000 c/s tone. Adjust R415 for a reading in the CT44 of 250 mW when the distortion indicator should read not more than 10%. The limits of the distortion factor should also not exceed 10% when the carrier level is increased to 100,000µV and R415 readjusted for an a.f. output power level of 250 mW.

(2) Main audio frequency response - set the CT394A carrier level to 1,000µV open circuit, modulated to a depth of 30% by 1,000 c/s; then adjust R415 for a 250 mW reading in the CT44. The modulation frequency of the CT394A should then be set to the frequencies listed below and the a.f. power output deviations in the CT44 noted.

Modulation frequency	Limits of deviation from reference level
300 c/s	Not more than +1 dB to -3 dB
1,000 c/s	Reference level
3,000 c/s	Not more than +1 dB to -4 dB

(3) Auxiliary audio voltage level - set the input carrier level of the CT394A to 1,000µV, modulated to a depth of 30% by 1,000 c/s tone. With R1505 in the fully clockwise position the r.m.s. voltage, measured at the AUX AUDIO VOLTAGE TEST POINT on the interconnecting box, should be not less than 1.5V in the CT429.

(4) Auxiliary audio frequency response - set R1505 for a reading of 1.5V r.m.s. in the CT429. Taking this level as 0 dB the a.f. voltage in the CT429 should not exceed the deviation limits given when the modulating frequency of the CT394A is set to the following frequencies:-

Modulating frequency (c/s)	Limits of deviation from reference level (dB)
70	+2 to -3
100	+2 to -3
300	+2 to -3
1,000	Reference level
4,000	+2 to -3
7,000	+2 to -3
20,000	+2 to -10

(5) Noise peak limiter - set the CT394A carrier level to 1,000µV open circuit and modulate to a depth of 30% by 1,000 c/s tone. Then adjust R415 for a reading of 250 mW in the CT44. Increase the modulation depth of the CT394A and note when clipping of the main a.f. output waveform commences in the oscilloscope; clipping should commence when the depth of modulation is between 40% and 65%.

Accuracy of automatic tuning

67. Set the CT394A carrier level to 100µV open circuit and modulate to a depth of 30% by 1,000 c/s tone; then set R415 for a reading in the CT44 of 250 mW.

68. The CHAN switch of the control unit should be set first to position 11 then back to position 10 and the reading in the CT44 noted. Successive selection of channel 10 in this manner should not produce a wider variation in the CT44 reading than 0.5 dB of 250 mW.

A.G.C. characteristic

69. The a.g.c. characteristics should be measured on test channels 3, 10 and 18 (Table 2) in the following manner:-

(1) Set the CT394A carrier level to 1,000µV open circuit and modulate to a depth of 30% by 1,000 c/s tone. Then adjust R415 for a reading of 250 mW in the CT44.

(2) Change the carrier level successively to 10µV, 100µV, and 10,000µV open circuit when the CT44 reading should not vary by more than ±3 dB of 250 mW. However, when testing on channel 3, the carrier level should be set to 20µV open circuit instead of 10µV open circuit.

(3) Raise the carrier level to 100,000µV open circuit when the CT44 reading should not rise by more than 3 dB above 250 mW.

Selectivity

70. The selectivity of the main receiver should be tested on channel 10 (Table 2). Remove the CT394A connector from J1402 and couple it to the connector (Table 1, item 18) using the adaptor (Table 1, item 19). Then remove the Microdot plug P3 from the IF unit (20-30 Mc/s) and connect the connector (Table 1, item 18) to the vacated socket. Then proceed as follows:-

(1) Connect the CT429 between the VOLTAGE TEST POINTS annotated AVC and EARTH on the interconnecting box; the CT429 should now be used as an a.v.c. monitor.

(2) Set the CT394A to a frequency of 25.5 Mc/s. The carrier should be unmodulated and its output voltage set to that level which produces an a.v.c. of 1V negative in the CT429.

(3) Increase the carrier output voltage level by 6 dB and lower the CT394A frequency until the CT429 again reads 1V negative, note the frequency.

(4) Raise the CT394A frequency above 25.5 Mc/s until the CT429 reads 1V negative; note this frequency.

(5) The difference frequency between that obtained in (3) and in (4) should not be less than 90 kc/s and the 25.5 Mc/s i.f. should lie equidistant between the two frequency readings to within 15 kc/s.

(6) The procedure should be repeated but with the CT394A carrier level increased by a further 54 dB; the difference between the two frequency readings obtained should be not more than 200 kc/s.

(7) Remove the CT394A connector from the adaptor and refit it in the aerial socket J1402. Then remove the adaptor and connector and refit the Microdot plug P3.

Signal to noise squelch characteristics

71. This test should be conducted, with the equipment operating on channel 10, as follows:-

(1) Set R407 to the fully counter-clockwise position.

(2) Set the CT394A carrier voltage level to 5µV open circuit and modulate it by 400 c/s tone. The depth of modulation should be set for the

threshold of being not muted (i.e. the point at which the relay in the a.f. unit is heard to click and the CT44 shows a power reading). This depth of modulation should be not less than 30%.

(3) Reset R407 to the fully clockwise position and adjust the depth of modulation for a signal plus noise to noise ratio of 1 dB in the CT44. This is accomplished, as before, by switching the modulation of the carrier on and off and noting the difference of power output in the CT44.

(4) Reset R407 for the threshold of being muted i.e. the point at which the relay in the a.f. unit is heard to click and the CT44 indicates no a.f. power output.

(5) Increase the depth of modulation until the receiver is at the threshold of being not muted and note the CT44 reading.

(6) Switch off the modulation of the CT394A carrier and at the same time quickly note the CT44 reading before the receiver becomes muted. The difference between this reading and the one noted in (5) should be not more than 6 dB i.e. signal plus noise to noise ratio.

Manual muting capability

72. Modulate the CT394A carrier to a depth of 30% by 1,000 c/s tone and set the output voltage level to 1,000µV open circuit. Then adjust R415 for a reading in the CT44 of 250 mW.

73. Set the muting switch of the interconnecting box to the MUTE position whereupon the reading in the CT44 should fall by not less than 40 dB. Set the muting switch to the NORMAL position.

A.D.F. h.t. supply

74. Connect the CT429 between the VOLTAGE TEST POINTS annotated EARTH and +225V. With the main receiver functioning, the CT429 reading should be between 210V and 260V.

<u>Guard receiver</u>

Preparation for tests

75. For these tests the main receiver should be left operating on channel 10, but muted by setting R407 to its fully counter-clockwise position.

76. Set the control unit function switch to the T/R+G position and tune the CT394A to the guard receiver frequency (243.0 Mc/s).

Receiver blocking

77. Set the input carrier level of the CT394A to 1,000µV open circuit and modulate it to a depth of 30% by 1,000 c/s tone. Then adjust R425 for a reading of 250 mW in the CT44.

78. Slowly raise the input carrier level to 500,000µV open circuit when the reading in the CT44 should not fall below 50 mW.

Noise modulation

79. Operate the blowers as in para. 50(1) and set the CT394A carrier level to 10,000µV modulated to a depth of 30% by 1,000 c/s tone. Then set R425 for a 250 mW in the CT44.

80. Switch off the modulation of the CT394A carrier when the CT44 reading should fall by not less than 25 dB.

Output power capability

81. Set the CT394A carrier level to 100µV open circuit, modulated to a depth of 30% by 1,000 c/s tone. Under these conditions it should be possible to adjust R425 for a reading in the CT44 of 250 mW.

Sensitivity

82. The sensitivity of the guard receiver is measured using the same method as was adopted for the main receiver (para. 65) except that R425 is adjusted instead of R415. The input carrier level and signal plus noise to noise ratio for each test condition is as follows:-

Test condition	Carrier input level	S+N/N ratio
Standard	5µV open circuit	Not less than 6 dB
Service (higher and lower levels)	20µV open circuit	Not less than 6 dB
Special service	10,000µV open circuit	Not less than 6 dB

A.F. characteristics

83. The a.f. characteristics of the guard receiver should be assessed in the following manner:-

(1) Distortion factor - the CT394A carrier should be set to a level of 100µV open circuit and modulated to a depth of 30% by 1,000 c/s tone. Then set R425 for a reading of 250 mW in the CT44 when the distortion indicator should show a distortion factor of not more than 12%. The distortion factor should not exceed 12% when the carrier input level is increased to 100,000µV open circuit and R425 is readjusted for 250 mW in the CT44.

(2) A.F. response - set the CT394A carrier and R425 as in para. 77. The modulating frequency should be then varied for corresponding limits of deviation from 250 mW, read in the CT44, as follows:-

Modulation frequency	Limits of deviation
300 c/s	+1 dB to -3 dB
1,000 c/s	0 dB (250 mW)
3,000 c/s	+1 dB to -4 dB

(3) Noise limiter operation - set the CT394A carrier and R425 as in para. 77. The oscilloscope should be monitored to indicate when peak clipping of the a.f. output waveform commences as the CT394A depth of modulation is increased. Amplitude limiting should commence when the modulation depth of the CT394A carrier is between 40% and 65%.

A.G.C. characteristics

84. Set the CT394A carrier and R425 as in para. 77. The input carrier level should then be set successively to 10µV, 100µV, 10,000µV and 100,000µV open circuit and for each setting the CT44 reading should be noted. The audio output power level, indicated in the CT44, should not deviate by more than ±3 dB of 250 mW.

R.F. gain control capability

85. Control over the r.f. gain should be tested in the following manner:

(1) Modulate the CT394A carrier to a depth of 30% by 1,000 c/s tone and set the input signal level to zero.

(2) Set R418, R415 and R1401 to their fully counter-clockwise positions and R1402 to the fully clockwise position.

(3) If, under these conditions, the guard receiver is muted then the carrier input level should be increased to the point at which the receiver is not muted; this input carrier level should be not more than 1μV open circuit.

(4) Set R1402 to the fully counter-clockwise position. Then adjust the input carrier level to the point at which the guard receiver is not muted. This input signal level should be not more than 10μV open circuit.

Carrier squelch threshold slope

86. Set the input carrier level to 5μV open circuit and adjust R1402 to the point at which the receiver is just muted. Then raise the input level by 1 dB whereupon the CT44 reading should rise by not less than 10 dB.

Low voltage test

87. The purpose of this test is to ensure that damage to the transmitter-receiver does not ensue if the primary power supplies fall below those of the special service test conditions (para. 15).

88. Set the primary power supplies to 17V d.c. and 80V a.c. (if applicable) and proceed as follows:-

(1) Set the control unit CHAN switch to M and set the MANUAL dials to 315.9 Mc/s. Then prepare the stop watch ready for use.

(2) Operate as a main receiver and switch, successively, the tenths dial from position 9 to position 0. The channel selecting mechanism should start and stop within 15 seconds for each channel tested.

(3) Remove the CT394A from J1402 and connect the CT419 (para. 9). Then operate the equipment on test as a transmitter and repeat the procedure of sub-para. (2) for the same limit of test.

FINAL ADJUSTMENTS

89. The circuit linkages (Table 3) of the TR4/ARC52 and TR5/ARC52 equipments will generally be connected for signal to noise operated squelch (para. 71) and dynamic mic. operation. Should the necessity arise to operate an equipment under the alternative methods of carrier operated squelch and/or carbon microphone operation, the appropriate performance tests of Chap.6 and 9 of this Section should have been performed.

90. Ensure that circuit linkages are now connected for signal to noise operated squelch and dynamic microphone operation (Table 3).

TABLE 3

Circuit linkages

British terminations	American Terminations	
(1) Dynamic 200Ω microphone operation	(2) Dynamic 82Ω microphone operation	(3) Carbon microphone operation
<u>Modulator unit</u>	<u>Modulator unit</u>	<u>Modulator unit</u>
Terminals A and B open circuit.	Terminals A and B linked.	Terminals A and B linked.
Terminals 2 and 3, 6 and 7, 8 and 9, 10 and 5 linked as pairs.	Terminals 2 and 6, 6 and 7, 8 and 9, 10 and 5 linked as pairs.	Terminals 1 and 4, 5 and 6, 7 and 8, 9 and 10 linked as pairs.
Terminals 1 and 4, 5 and 6, 7 and 8, 9 and 10 open circuit.	Terminals 1 and 4, 5 and 6, 7 and 8, 9 and 10 open circuit.	Terminals 2 and 3, 6 and 7, 8 and 9, 10 and 5 should be open circuit.
<u>TB1501</u>	<u>TB1501</u>	<u>TB1501</u>
Terminals 2 and 3, 5 and 6 linked as pairs.	Terminals 1 and 2, 4 and 5 linked as pairs.	As for dynamic microphone operation.
Terminals 1 and 2, 4 and 5 open circuit.	Terminals 2 and 3, 5 and 6 open circuit.	

TABLE 3 (continued)

British terminations		American terminations	
(1) S/N operated squelch, 50Ω output	(2) Carrier operated squelch, 50Ω output	(3) S/N operated squelch, 300Ω output	(4) Carrier operated squelch 300Ω output
<u>A.F. unit</u>	<u>A.F. unit</u>	<u>A.F. unit</u>	<u>A.F. unit</u>
Linkages numbered 1,2,3,4,5, 6 and 7 connected to terminals marked s/n; linkages to terminals marked c should be removed.	Linkages 1,2,3,4,5,6 and 7 connected to terminals marked c; linkages to terminals marked s/n should be removed.	Linkages 1,2,3,4,5,6 and 7 connected to terminals marked s/n; linkages to terminals marked c should be removed.	Linkages 1,2,3,4,5,6 and 7 connected to terminals marked c; linkages to terminals marked s/n should be removed.
The T401 terminals 3 and 5, 4 and 6 should be linked as pairs and any existing connection across terminals 4 and 5 removed.	The T401 connections are the same as those for signal to noise operated squelch.	The T401 terminals 4 and 5 should be linked as a pair. The terminals 3 and 5, 4 and 6 should not be linked.	The T401 connections are the same as those for signal to noise operated squelch.

Main receiver

91. The function switch of the control unit should be positioned to T/R and the CHAN switch set to position 10. The interconnecting box TRANSMIT/RECEIVE switch should be set to the RECEIVE position and J1402 terminated as in para. 11(1).

Main gain audio control

92. Set the input carrier level to 1,000µV open circuit and modulate it to a depth of 25% by 1,000 c/s tone. Then set R415 for a reading in the CT44 of 125 mW.

Auxiliary audio control

93. Increase the depth of modulation to 30% and connect the CT429 between EARTH and AUX. AUDIO VOLTAGE TEST POINTS of the interconnecting box. Then set R1505 for a reading in the CT429 of 1.5V.

Signal to noise threshold control

94. Set the MANUAL dials of the control unit to 315.5 Mc/s and position the CHAN switch to M.

95. The CT394A carrier should be modulated to a depth of 15% by 400 c/s tone and set to a level of 5µV open circuit. Then set R407 to the point at which the receiver is at the threshold of being muted (para. 19(2)).

96. The input carrier level should then be reduced to zero and the CT394A disconnected from the aerial socket J1402. The CT419 should be then connected as described in para. 9.

97. The object of this test is to ensure that the receiver remains muted during channel changing and when the equipment on test is being switched between the receive and transmit conditions. The test should extend over a period of five minutes, during which time the oscilloscope should be monitored for any signs of the receiver becoming not muted. Proceed as follows:-

(1) The equipment on test should be operated on 315.5 Mc/s then on 315.6 Mc/s and back to 315.5 Mc/s ten times; this is accomplished by switching the tenths dial (extreme right hand dial) of the control unit from position 5 to 6 and back to 5.

(2) Whilst the equipment is indexed to 315.6 Mc/s the TRANSMIT/RECEIVE switch of the interconnecting box should be switched from RECEIVE to TRANSMIT and then back to the RECEIVE position twice.

(3) The test should be repeated under the lower level of service test conditions and again, with the primary power supplies set to 28.5V d.c. and 118V a.c. (when applicable).

Guard receiver

98. Remove the CT419 from J1402 and connect the CT394A as instructed in para. 11(1). The control unit function switch should be then set to the T/R+G position and the CHAN switch to position 10.

Squelch (TR4/ARC52)

99. The primary power supplies should remain set to 28.5V d.c. and 118V a.c. (as applicable).

100. Set the input carrier (on 234 Mc/s) to a level not greater than 0.1µV open circuit and with the CT429 connected between chassis and test point Y, adjust R1402 for a reading of 1.75V in the multimeter, valve.

101. Increase the carrier level to 1µV open circuit and modulate it to a depth of 30% by 1,000 c/s tone. Then proceed as follows:-

(1) Adjust R1507 for the setting at which the receiver is at the threshold of being muted (para. 19(2)(a)). If it is not possible to mute the receiver in this manner, then R1402 should be rotated in a counter-clockwise direction until it is possible to mute by adjusting R1507. The a.g.c. voltage at test point Y should not be permitted to fall below 1.75V by any readjustment necessary to R1402.

(2) If the receiver remains muted when R1402 is set for a CT429 reading of 1.75V and R1507 is set to the fully clockwise position, then the condition is satisfactory provided that:-

(a) The receiver becomes not muted when the carrier input level is increased to not more than 3µV open circuit.

(b) The a.g.c. characteristics of the receiver conform to the requirements of para. 84.

Squelch (TR5/ARC52)

102. The primary input power should remain as for para. 99.

103. The CT394A carrier should be modulated to a depth of 30% by 1,000 c/s tone and set to a level of 1µV open circuit. Then adjust R1507 so that the receiver is at the threshold of being muted (para. 19(2)(a)).

104. If the receiver will not be muted by adjusting R1507 then adjust R1402 until the receiver can be muted by a setting of R1507.

105. If the receiver is muted when R1507 and R1402 are both set to the fully clockwise position, the condition is satisfactory provided that:-

(1) The receiver becomes not muted when the carrier input level is increased to not more than 3µV open circuit.

(2) The a.g.c. characteristics of the receiver conform to the requirements of para. 84.

Guard gain control

106. Set the CT394A carrier to a level of 1,000µV open circuit and modulated to a depth of 25% by 1,000 c/s tone. Then set R425 for a CT44 reading of 125 mW.

<u>Transmitter</u>

107. Terminate the aerial socket J1402 as described in para. 10. Then switch on the a.f. signal generator and set the carrier output level for 75% of F.S.D. in the microphone simulator meter.

108. Set the control unit function switch to the T/R+G position and position the CHAN switch to 18.

109. The TRANSMIT/RECEIVE switch of the interconnecting box should be set to the TRANSMIT position and the CT394A set to 300 kc/s above or below the transmitter frequency and fine-tuned for a modulation envelope in the oscilloscope.

Modulation control

110. Set R702 for an average depth of modulation of between 80% and 85%.

Sidetone control

111. With R702 set as in para. 108 set R418 for a CT44 reading of 250 mW.

Manipulation of preset controls

112. Due to the mutual interaction of R415, R425 and R418 the adjustment of one may adversely affect the setting of the others. For this reason they should be continually adjusted until the CT44 readings of para. 92, 106 and 111 are maintained simultaneously.

ASSEMBLY AFTER TESTS

113. Switch off the bench power supplies and disconnect the test equipment from the transmitter-receiver.

114. Visually examine the transmitter-receiver and ensure that all the flylead plugs and sockets are securely fitted.

115. Slide the transmitter-receiver into its cover and test for pressurization as detailed in Chap. 17.

TR4/ARC52 EQUIPMENT ILLUSTRATED.
FOR TR5/ARC52 EQUIPMENT NOTE THAT :-
POWER UNIT (AC), RECTIFIER UNIT AND BLOWER ARE
EXCHANGED FOR POWER UNIT (DC). TEST POINTS E AND F
ARE SITUATED IN APPROXIMATELY THE SAME POSITION.

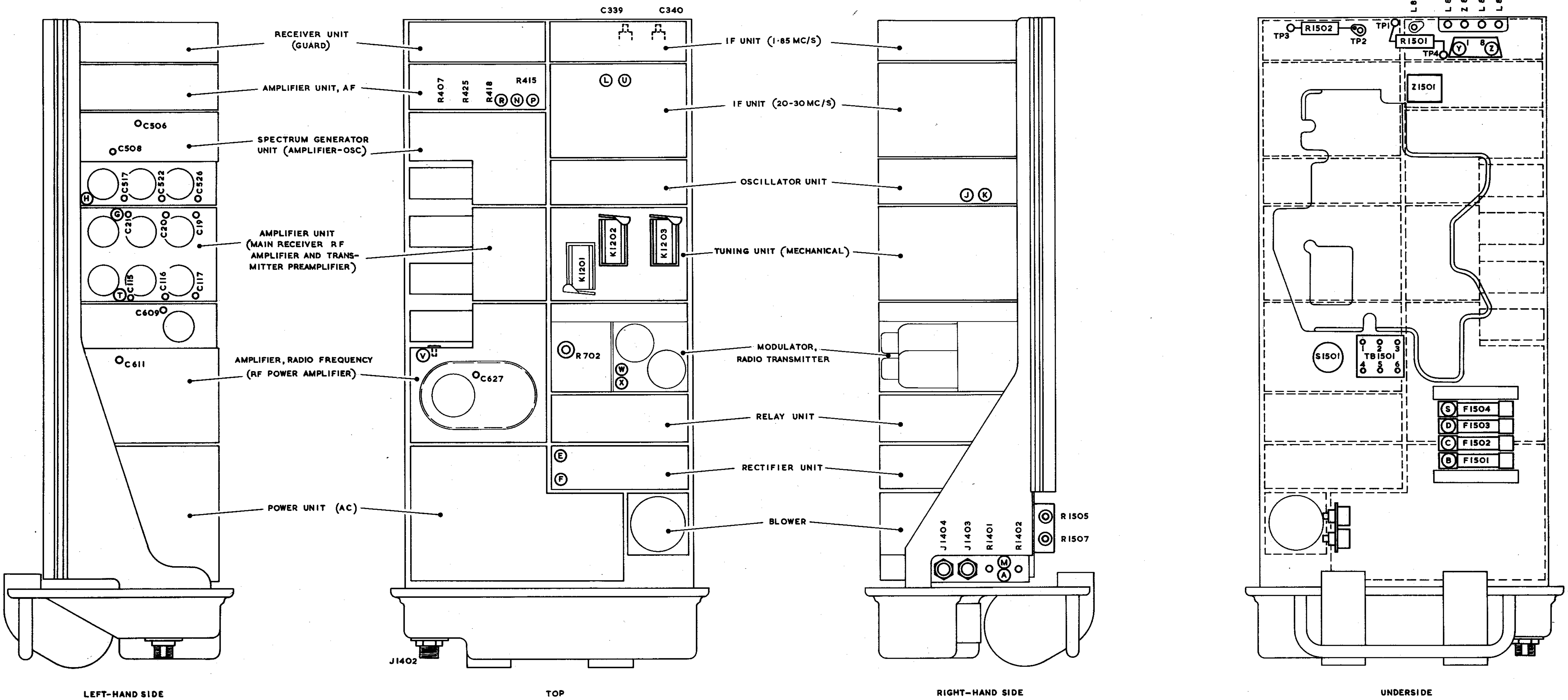

Fig. 1 ARI. 18124/1 and ARI. 18124/2 – transmitter-receiver – test points and preset controls

Chapter 2

INTERCONNECTING BOX

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Introduction

1. The interconnecting box (5821-99-932-6361) is required for use with ARI.18124/1 and ARI.18124/2 in all aircraft where the u.h.f. homing equipment is to be retrospectively fitted. It can be dispensed with if the installation is loom wired. The interconnecting box consists, principally, of a series of multipole connectors and associated wiring. One connector, marked TEST SOCKET, is provided to enable the test set, UHF, Type 15077 (Vol. 1, Part 2, Chap. 6) to be used for pre-flight tests of these installations.

2. The unit is intended for installation on the aircraft equipment shelf or panel without the use of resilient mountings; four fixing holes are provided in the cover for this purpose.

Component inspection

3. Verify that the equipment serial number and modification state entered on the repair card accompanying the unit are correct.

4. Ensure that the captive dust covers for the MUTING UNIT and TEST SOCKET connectors fit correctly and the retaining chains are serviceable.

5. Carefully examine all the connectors to ensure that they are undamaged and that the pins and sockets are clean and free from corrosion. Any loose connectors should be securely fitted.

6. Unscrew the three captive screws on the connector face of the box and remove the cover. Any evidence of moisture should be investigated.

7. Inspect the wiring for any visible signs of broken insulation and see that all sleeving is pulled well down over joints and that the lacing is not damaged.

Test equipment

8. The test equipment required to implement the tests described in this Chapter should be available from Service stores and are as follows:-

(1) Multimeter Type 1 (Ref. No. 10S/16411) A.P.2536C

(2) Tester, insulation, Type C (Ref. No. 5G/152) A.P.4343

Electrical test

9. Using the multimeter (para. 8(1)) a test should be made of all connector outer shells and the metal braiding of screened wiring to establish that good electrical continuity exists between them and the front panel. Probable causes of bad connection are:-

(1) Corrosion, dirt, or paint between the front panel and connectors.

(2) Loose nut, screws or retaining rings of the connectors.

(3) Fractured metal braiding of the screened wiring especially near the soldered pigtails.

10. A point to point test should be made of all the wiring, using the multimeter. Fig. 1, when used in conjunction with Table 1, will be of assistance during this test.

TABLE 1

Wiring key

From	Wire colour	Marker colour	Length (in.)	To	Remarks
SKT1/A	Red		3½	PL1/A	
	Red		4½	SKT/A	
SKT1/B	Blue		3¼	PL1/B	Earth
SKT1/D	Violet	Black	4	SKT6/D	
SKT1/E	Green		5¼	SKT2/E	
SKT3/E	Green		3½		
SKT1/F	Red	Brown	6½	SKT4/D	
SKT1/H	Red/White		4½	SKT6/A	
SKT1/J	Red/orange		5½	SKT2/J	
SKT6/E	- do -		3½		
SKT1/K	Red/green		5¼	SKT2/K	

From	Wire colour	Marker colour	Length (in.)	To	Remarks
SKT1/N	Yellow		-	SKT5/A	Screened
SKT2/M	"		-		
SKT1/P	"		5½	SKT2/F	
SKT5/C	"		3¾		
SKT1/R	Red		-	SKT2/D	Screened
SKT3/D	"		-		
SKT1/S	Blue		-	SKT2/G	Screened
SKT3/C	"		-		
SKT1/T	Grey		5¾	SKT2/C	
SKT4/C	"		4½		
SKT1/U	Red/blue		5	SKT6/U	
SKT1/V	Green	Grey	5¼	SKT6/V	
SKT1/W	Blue	Yellow	4	SKT6/W	
SKT1/X	White		-	PL1/C	Screened
SKT5/B	"		-		
SKT1/Y	Black		-	PL1/D	Screened
SKT2/L	"		-		
SKT1/Z	Brown		-	PL1/E	Screened
SKT1/a	Pink	Violet	5	SKT6/a	
SKT1/b	Green		5½	SKT6/b	
SKT1/c	Green/orange		5¼	SKT6/c	
SKT1/d	Blue/white		4¼	SKT6/d	
SKT1/e	White		4¼	SKT6/T	
SKT1/f	Black		5	SKT6/f	
SKT1/g	Violet		5	SKT6/g	
SKT1/h	Orange		5½	SKT6/h	
SKT1/i	Green/black		5¼	SKT6/i	
SKT1/j	Blue	Black	4¾	SKT6/Y	
SKT1/k	Blue/orange		5	SKT6/K	

From	Wire colour	Marker colour	Length (in.)	To	Remarks
SKT1/m	Brown		5	SKT6/M	
SKT1/n	Green	Yellow	$5\frac{1}{2}$	SKT6/X	
SKT1/p	Green/white		$5\frac{1}{2}$	SKT6/Z	
SKT1/q	Blue	Green	$4\frac{1}{2}$	SKT6/S	
SKT1/r	Blue	Grey	5	SKT6/R	
SKT1/z	Blue		$1\frac{3}{8}$	SKT1/t	Earth
SKT1/u	"		$1\frac{1}{4}$		
	"		$1\frac{3}{8}$	SKT1/w	Earth
Frame of unit	"		$1\frac{1}{2}$		
SKT1/z	"		$3\frac{1}{2}$	PL1/B	Earth
SKT2/H	"		4		
	"		$1\frac{3}{4}$	SKT2/B	Earth
SKT4/B	"		4		
	"		2	SKT5/E	Earth
SKT3/B	"		2		
	"		$4\frac{3}{4}$	SKT6/N	Earth
SKT6/L	"		2		
SKT6/P	Black/orange		$4\frac{1}{2}$	SKT4/A	
SKT6/F	White/orange		$4\frac{1}{2}$	SKT3/A	
SKT5/D	Black	Yellow	2	SKT3/F	

Note...

The screening of all screened leads is connected to earth in each case (a suitable earth testing point is SKT1/w).

11. Finally, an insulation test should be applied between each connector pole and the front panel and also between certain connector poles (Table 2). Using the insulation tester, connect one lead to a good earth point, i.e. a solder tag and connect the other lead to each connector pole in turn. The measured resistance should not be less than 50 megohms at normal room temperature (15° - 25°C). This insulation test should also be applied between the connector poles listed in Table 2.

TABLE 2

Pole to pole insulation test

Connector	Pole and pole
Power supply (PL1)	C and D C and E E and D
Mic/tel (SKT3)	A and D A and C C and D

12. Should it become necessary to change any components which fail to comply with the test limits it is important to ensure that the new items are positioned accurately and connected correctly. Reference to the components layout shown in Vol. 1, Part 1, Chap. 5 of this Air Publication will assist in component identification.

13. In the event of wire replacement becoming necessary, the correct lengths, gauge of wire and colour coding must be respected as in the original or as indicated in Table 1 (unless modification requirements necessitate changes).

Final inspection

14. A final inspection should be made of the unit to ensure that:-

(1) Cablelooms are correctly placed.

(2) All soldering is neat, free from dry and spiky joints.

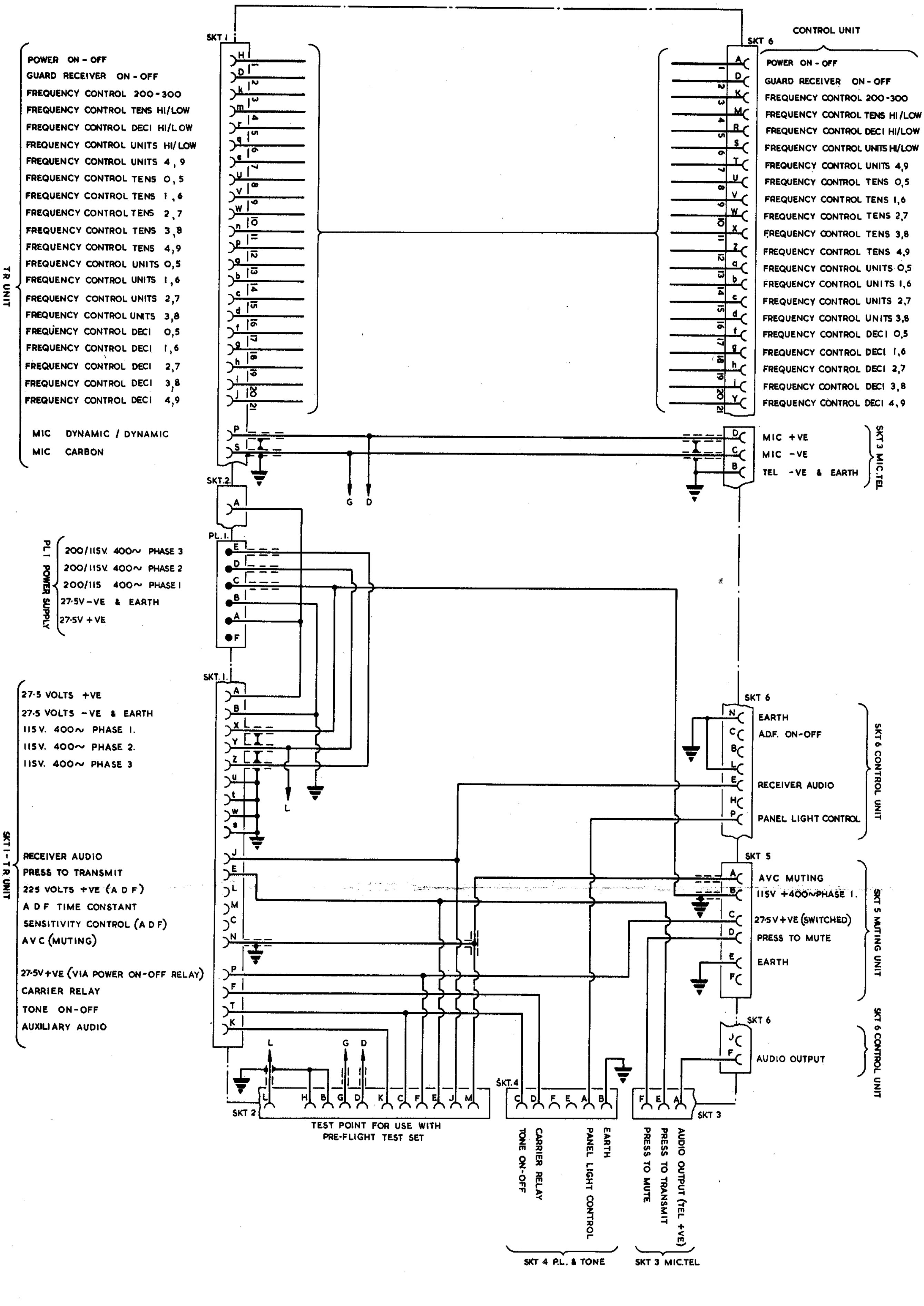
(3) Insulation is close up to the soldered joints and is free from burns or damage sustained during servicing.

(4) Marker sleeves are clearly visible and sleeving is pulled completely over joints.

(5) Connectors are securely fitted.

15. Fit the cover ensuring that the mating edges are not damaged and the three captive screws are tight.

16. For storing and transit purposes the five uncovered connectors should be fitted with the polythene dust covers provided.



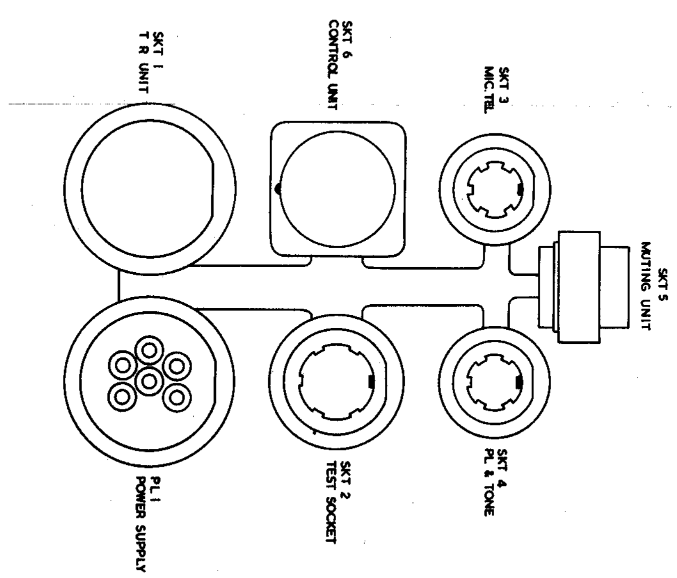


Fig. 1 ARI. 18124/1 and ARI. 18124/2—interconnecting box (5821-99-932-6361)—wiring diagram

Chapter 3

AMPLIFIER UNIT
(MAIN RECEIVER RF AMPLIFIER AND TRANSMITTER PREAMPLIFIER)

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General

1. The amplifier unit comprises two sections mounted on a common base plate; a main receiver r.f. amplifier and a transmitter preamplifier. The receiver r.f. amplifier incorporates two amplifying stages and a mixer stage. Both amplifying stages operate within the signal frequency range of 225.0 Mc/s to 399.9 Mc/s (input at socket J1). The mixer stage combines this r.f. signal with the output from the spectrum generator unit (Chap. 7); the resultant is a frequency of between 20 Mc/s and 30 Mc/s which is then fed to the IF unit (20-30 Mc/s) (Chap. 4). through a flylead connector P3.

2. The transmitter preamplifier embodies a mixer stage which is fed with the combined outputs of the spectrum generator and the IF unit (20-30 Mc/s) via flylead connectors P2 and P4 respectively. The resultant frequency, which is within the range of 225.0 Mc/s to 399.9 Mc/s, is passed through two stages of amplification to socket J101. Each section of this sub-unit employs triple-ganged tuned circuits, the shafts of which are common and rotated by gears driven by the tuning unit (mechanical) (Chap. 15) through an Oldham coupler.

3. The unit is secured to the main chassis assembly by three red-painted Phillips type captive screws, which are accessible from the underside of the chassis when the sealed cover is removed. Details of the method of cover removal from the transmitter-receiver, its replacement and subsequent pressurizing are given in Chap. 17. Details of the procedure for dismantling and assembly of sub-units are given in Vol. 1, Part 1, Chap. 5.

WARNING

> It is essential that the equipment is indexed to 220.0 Mc/s before any attempt is made to remove the unit from the main chassis since, in this position, the frequency selector mechanism is correctly aligned for unit withdrawal and refitting. Immediately upon removal of the unit from the main chassis it is recommended that the Oldham coupler ring be removed to avoid possible damage being sustained to the ring spigot. Gently prise out the O ring with a screwdriver or similar tool, then remove the coupler ring.

Test equipment

4. The equipment required for servicing and testing the amplifier unit is listed in Table 1. Further information on the individual items may be obtained by reference to the publication referred to.

TABLE 1

List of test equipment

Item No.	Reference No.	Nomenclature	Para.	Further details
1	10AG/940	Drill and ream jig	12	Sect. 1
2	10AG/937	Checking fixture	13	"
3	1B/1770	Surface plate	13	"
4	1B/4764	Gauge, dial type	13	"
5	5120-99-943-9324	Torque tester	12	"
6	10AG/955	Height gauge	12	"

7	10AG/959	Height gauge plate	12	Sect. 1
8	9150-99-932-4820	Lubricating oil, gear	6	Aero Shell fluid 3, Shell Petroleum Co.
9	-	Oil, electrical	14	Viscosity Oil Co. (U.S.A.) 7069 (see note)
10	10S/17134	Sig. gen. CT394A - set	15(7)	A.P.2531HA
11	10S/9438384	Multimeter, valve, CT429	15(6)	
12	F19/6625-99-943-0510	Wattmeter, absorption, CT44	15(5)	
13	5120-99-942-1514	Tuning wand	34	Vol.1,Pt.2,Ch.2
14	6625-99-999-7815	Test set, amplifier	15(1)	Sec.1, Chp.15
15	6130-99-999-7312	Power unit	15(8)	" Ch. 2
16	5821-99-932-1806	Cover, r.f. amplifier, test side	15(1)	Vol.1,Pt.2, Ch. 2
17	5821-99-932-1804	Cover, preamplifier, test side	15(1)	- do -

Note...

Possible British equivalents for item (9) are being investigated at time of going to print.

Component inspection

5. Inspect for correctness the details of equipment serial numbers and modification state entered on the repair card accompanying the unit. Unscrew the side covers and, if necessary, thoroughly clean the unit of all dust. This can be done by using a portable blower or other approved supply of dry air under pressure. Since the transmitter-receiver equipment is enclosed within an airtight casing, however, the presence of dust, dirt or moisture should be fully investigated.

6. Carefully examine the unit to ensure that it is free from damage and corrosion, with all components securely retained in position. Any loose components must be securely refitted. During this preliminary visual examination ensure that grub screws on the spur gears are tight and that gears and bearing surfaces are free from dirt. These items may be cleaned with an approved cleaning agent, i.e. carbon tetrachloride, and subsequently lubricated. Apply two drops (only) of oil, (Table 1, item 8) to the idler gear lub and a light coat of grease, DTD.866, to gear teeth. Then rotate the Oldham coupler and remove any excess oil and grease.

7. Screws and nuts removed during inspection or servicing and which are not fitted with locknuts or lockwashers, must be locked with an approved varnish when refitted.

8. Should it be necessary to change any components, it is important to ensure that the items are positioned accurately and correctly connected. Component layouts given in Vol. 1, Part 1, Chap. 5, will assist in item identification.

Wiring

9. The wiring of the unit should be carefully inspected for continuity and conformity with the circuit shown in Vol. 1, Part 2, Chap. 1, fig. 5. This inspection should consist of a point-to-point test or such electrical tests which will confirm the accuracy of the wiring. The equipment should be examined for neatness of soldering, absence of dry joints and a generally satisfactory condition of the wiring and insulation, with particular attention paid to the sleeving covering the connections to the multi-pole plug. No inadvertent interconnections or tracking paths should be permitted due to excess solder, wire clippings or dirty connections.

10. To assist in servicing, a wiring diagram is given at fig. 1. It is important to ensure that any re-wiring is carried out correctly and that lengths, gauge of wire and colour coding are replaced as in the original (unless modification requirements necessitate changes). In Table 2 is listed a wiring key which, when used in conjunction with the wiring diagram, will assist in replacement of any wiring.

TABLE 2

Wiring key

From	Colour	Length (in.)	To
P1/1	Vidaflex, brown	-	R10
P1/3	Pink	$5\frac{1}{4}$	RB1
P1/6	Shielded	$3\frac{1}{2}$	C23
P1/9	Vidaflex, brown	-	L11
P1/11	Light green	$2\frac{3}{4}$	C112
P1/12	Orange	3	TB1
P1/13	Tinned busbar	1	ET1
R10	Vidaflex, brown	-	C23
L11	Vidaflex, brown	-	C16
C18	White	-	ET1
RB2	Brown	3	C111
C111	Brown	$3\frac{1}{2}$	C113
C113	Brown	2	C114
C114	Brown	-	C15
C112	Light green	$2\frac{3}{4}$	C120
RB1	Vidaflex, brown	-	R9
R9	Vidaflex, brown	-	C13
TB1	Orange	2	C102

Servicing

11. The renewal of the majority of components in this unit should be a simple matter of standard procedure, the few cases requiring special procedure are detailed in the following paragraphs.

WARNING

ELECTRICAL SHOCK. It is essential to ensure that before any attempt is made to service or replace any item found defective during any part of the tests, the power supply is switched off or, preferably, entirely disconnected from the instrument.

12. In the event of the Oldham coupler requiring renewal the new coupler plate is drilled and pinned using the drill and ream jig (Table 1, item 1) as follows:-

(1) Fit the coupler plate on to the shaft and slide the G shaped plate of the jig under the coupler plate.

(2) Secure the drill and ream jig on to the bottom of the unit and, at the same time, position the coupler plate into the jig.

(3) Tighten the long knurled screw, which adjusts a slider plate, to lock the coupler plate into the correct position.

(4) Engage the second knurled knob with the coupler plate shaft and rotate the rotor vanes until they are fully meshed and the edges are flush with the stator vanes. Lock the knurled knob in this position.

(5) Drill through the coupler plate and shaft using a No.50 (0.070 in.) drill and ream to suit the taper pin.

(6) Unload the unit from the jig and insert the taper pin trimming any protrusion of the pin flush with the plate.

(7) Remove the G plate and fit the coupler ring and O ring so that the coupler ring spigot is adjacent to the silk screen circle on the base plate when the capacitor vanes are positioned as in (4).

(8) The maximum torque applied to the coupler shaft in a counter-clockwise direction, as measured on the torque gauge, (Table 1, item 5), should not exceed 10 oz in.

(9) Verify the coupler height in relation to the base plate using the coupler height gauge and plate (Table 1, items 6 and 7).

13. The coupler alignment may be verified using the checking fixture (Table 1, item 2) as follows:-

(1) Remove the O ring and the bronze coupler plate.

(2) Load the unit into the fixture and tighten the two knurled captive screws in the fixture.

(3) Lay the fixture on the surface plate (Table 1, item 3) so that the coupler aperture is at 90° with the surface plate.

(4) Rotate the coupler until the long portion of the rotor vanes are fully meshed with the stator vanes. With the vanes in this position use the dial type gauge (Table 1, item 4) to verify that the coupler plate dog, from end to end, is parallel to the surface plate to within ± 0.0045 in.

(5) Unload the unit from the checking fixture and with the vanes still positioned as in (4) refit the bronze coupler and O ring; in this position the coupler ring spigot should be adjacent to the datum ring on the mounting plate.

14. Ensure that the inductance wipers and shaft wipers of the variable tuned circuits are clean and making good contact. Where necessary, clean and lubricate with a mixture of 50% carbon tetrachloride and 50% oil (Table 1, item 9). After lubrication, the shafts should be rotated and any excess oil wiped off.

Arrangement of test equipment

15. The equipment required for testing the amplifier unit, and which is listed in Table 1, should be prepared on the test bench as follows:-

(1) Fit the side test covers (Table 1, items 16 and 17) to the unit to be tested, place it on to the index head of the test rig (Table 1, item 14) and secure the unit by tightening the captive screws on the jig base plate.

(2) Connect the index head and test set together by means of the 10-way Cannon connector provided with the test rig.

(3) Connect the socket J101 of the unit under test to the Microdot socket marked J101 on the front panel of the test set using the connector provided.

(4) Connect the three flyleads P3, P4, P2 to the appropriate Microdot sockets J1518, J1517, J501 on the front panel of the test set.

(5) The a.f. wattmeter CT44 (Table 1, item 12) should be connected to the Belling Lee type terminals, marked AF OUTPUT, on the left of the test set front panel.

(6) Connect the valve voltmeter CT429 (Table 1, item 11) to the Belling Lee type terminals marked V/V on the test set front panel.

(7) The signal generator CT394A (Table 1, item 10) should be connected to the Microdot socket J1 of the unit being tested. A MBC to N plug connector is supplied with the test set for this purpose.

(8) Connect together the power unit (Table 1, item 15) and test set using the connector provided with the power unit.

(9) Connect the test set, using the 4-way connector provided, with the 27.5V d.c. bench supply.

16. Whenever the test set WATTMETER is used the DESENS. WATTMETER switch should be operated in conjunction with it. This switch desensitizes the meter thus avoiding damage to it when large powerreadings are anticipated.

TESTING PROCEDURE

Current consumption

17. Switch on the power supplies to the power unit and test set and allow the equipment to thermally stabilize for a period of at least five minutes.

18. Adjust the bias output of the power unit for a reading in its voltmeter of 15V. At this bias input, the test set will deliver 0.45V bias to the unit under test when the A.V.C./BIAS switch is set to BIAS.

19. Set the test set HT TO MODULE switch to ON and adjust the power unit h.t. output for a reading in its voltmeter of 130V.

20. Set the power unit meter switch to read the current drawn by the unit on test and read the current consumption as follows:-

(1) Receive conditions - set the FUNCTION switch to RX whereupon the current consumption should not exceed 51 mA.

(2) Transmit conditions - set the FUNCTION switch to TX whereupon the current drawn should not exceed 51 mA.

Test point voltage levels

21. Set the equipment to operate on 399.9 Mc/s with the FUNCTION switch to TX and the WATTMETER switch to 20-30 Mc/s. Then adjust the SET 20-30 Mc/s control on the test set for a reading in the WATTMETER of 30 mW.

22. Set the WATTMETER switch to SPEC. GEN. and adjust the SET SPEC. GEN control for a reading of 200 mW in the test set WATTMETER.

23. Transmit conditions - the d.c. voltage at test point T, measured on the CT429, should be not less than 0.95V when the test set switches are set as follows:-

WATTMETER switch	SPEC. GEN.
A.V.C./BIAS	BIAS
FUNCTION switch	TX
VOLTAGE TEST switch	T

24. Receive conditions - the d.c. voltage, measured on the CT429, at test point T should be not less than 2.35V and at test point C, not less than 0.85V when the test set switches are set as follows:-

WATTMETER switch	OUTPUT
A.V.C./BIAS	BIAS
FUNCTION switch	RX
VOLTAGE TEST switch	T or G (depending on the test point voltage to be read).

Tracking possibility

25. Throughout the alignment and trimming of the receiver r.f. amplifier stages, always set the signal generator CT394A accurately to the frequency required by fine-tuning it to obtain maximum reading in the multimeter CT429. The VOLTAGE TEST switch must be set to A.V.C., the A.V.C./BIAS switch to A.V.C. and the signal generator output maintained for approximately -1V of a.v.c.

26. Set the equipment to operate at 399.9 Mc/s with the FUNCTION switch set to RX. The signal generator carrier should be unmodulated.

27. Adjust the trimming capacitors C20 and C21 for maximum a.v.c. voltage in the multimeter CT429.

28. Adjust the trimming capacitor C19 for minimum noise output indicated by the audio wattmeter CT44.

29. Now set the equipment to 355.7 Mc/s and set the signal generator as in para. 25. The trimming capacitors C19, C20, C21 should be adjusted as in para. 27 and para. 28 but it is unlikely that complete tracking will be achieved if more than two turns of the trimming screws are necessary. Under such circumstances the position of components in the unit under test should be investigated.

30. The equipment must now be indexed to 399.9 Mc/s, the FUNCTION switch of the test set switched to TX and the WATTMETER switch set to OUTPUT. Then adjust the trimming capacitors C115, C116, C117 for maximum power dissipation in the WATTMETER.

31. Index the equipment to 355.7 Mc/s and retrim for a maximum reading in the WATTMETER. Again, if more than two turns of the trimming screws are necessary, it is unlikely that complete tracking will be achieved and component positioning should be investigated.

Receiver r.f. amplifier alignment

32. The alignment of the three stages of the receiver r.f. amplifier can be performed concurrently. The method is to first set the trimming capacitors C19, C20, C21 at 399.9 Mc/s, then at certain spot frequencies throughout the range, by bending the winged portions of the top and bottom rotor vanes of the main tuning capacitors; top and bottom being identifed by the way the unit normally stands on the chassis, i.e. bottom nearest the Oldham coupler.

33. It will be noticed that the vanes to be adjusted are not sectorized in the same way, but are staggered. Thus, as alignment progresses the sector to be adjusted is alternately part of the top vane then part of the bottom. Also, the sectors of the vanes vary in size and the first to be adjusted is the smallest. To assist in the identification of the sector to be adjusted, each is colour coded; details of the colour coding and the frequency at which it should be adjusted is given in Table 3.

TABLE 3

Vane and sector adjustments

Stage No.	Signal freq. (Mc/s)	Vane	Sector No.	Sector colour
1	399.9	Neither	None	
2	395.7	Lower	1	Plain
3	385.7	Upper	1	Black
4	375.7	Lower	2	Black
5	365.7	Upper	2	Red
6	355.7	Lower	3	Red
7	345.7	Upper	3	Yellow
8	335.7	Lower	4	Yellow
9	325.7	Upper	4	Blue
10	315.7	Lower	5	Blue
11	305.7	Upper	5	Plain
12	295.7	Lower	6	Plain
13	285.7	Upper	6	Black
14	275.7	Lower	7	Black
15	265.7	Upper	7	Red
16	255.7	Lower	8	Red
17	245.7	Upper	8	Yellow
18	235.7	Lower	9	Yellow
19	225.7	Upper	9	Plain

34. The tuning wand (Table 1, item 13) should be used to determine whether the tuning capacity should be increased or decreased. Insert the wand through the access hole in the side cover of the unit so that its tip enters in the vicinity of the tuning inductance. If the brass end of the wand causes the a.v.c. voltage to decrease negatively, the tuning capacity must be decreased by bending the appropriate sector away from the sector vane. Conversely, if the iron dust end causes an increase in a.v.c. then capacity must be increased. The setting is correct when the a.v.c. voltage falls for both brass and iron dust.

35. The trimming capacitor C19 and assembly Z1 are similarly aligned as are C20 and C21 and Z2 and Z3 except that the noise output indicated in the wattmeter CT44, is used as indicating approach to resonance rather than a.v.c. voltage. Decrease in noise when the iron tip is used

indicates that more capacity is required; a decrease in noise with the brass tip indicates that less capacity is necessary. Resonance is assured when noise increases to both iron and brass insertion.

36. On completion of this procedure the edges of the sectors should be twisted to form a smooth curve. Then repeat the alignment procedure to obtain more precise tracking of the shaft angle to resonance characteristic of the preamplifier but no further twisting of the sectors should be effected.

37. Finally the unit should again be trimmed at 399.9 Mc/s by adjusting the trimming capacitors C19, C20 and C21 for resonance.

Transmitter preamplifier alignment

38. Set the switches of the test set as follows:-

FUNCTION switch	TX
WATTMETER switch	OUTPUT
DESENS. WATTMETER	as required (para. 16)
VOLTAGE TEST switch	T

The procedure adopted for the receiver r.f. amplifier (para. 32, 33) is used to align the transmitter preamplifier with the exception that the test set WATTMETER is used to indicate resonance instead of the multimeter CT429.

39. Index the equipment to 399.9 Mc/s and adjust the trimming capacitors C11, C116, C117 for a maximum reading in the test set WATTMETER.

40. Now repeat the procedure of alignment adopted for the receiver r.f. amplifier (para. 32 and 33) adjusting the tuning assemblies Z101, Z102, Z103 and finally the trimming capacitors C115, C116 and C117 for a maximum reading in the WATTMETER.

41. On completion of this procedure repeat the action detailed in para. 36 and 37 for the tuning assemblies Z101, Z102, Z103 and the trimmers C115, C116, C117.

Initial functional test

Receiver r.f. amplifier

42. Set the switches of the test set as follows:-

FUNCTION switch	RX
A.V.C./BIAS	BIAS
VOLTAGE TEST switch	A.V.C.
WATTMETER switch	SPEC. GEN.

Adjust the SET SPEC. GEN. control for a reading of 200mW in the test set WATTMETER. The carrier of the signal generator should be set to 5 microvolts open circuit and modulated to a depth of 30% by 1,000 c/s tone. The frequency of the signal generator should be set accurately to the test frequencies, as described in para. 25.

43. A test of the d.c. voltage levels at test points T and G together with a signal plus noise-to-noise ratio test should be made at each of the nineteen frequencies listed in Table 3. At each frequency the VOLTAGE

TEST switch should first be set to T for a reading of not less than 2.35V in the multimeter CT429. Then set the VOLTAGE TEST switch to G for a reading of not less than 0.85V.

44. The signal plus noise-to-noise ratio is measured in the wattmeter CT44. When the carrier of the signal generator is switched from modulated (signal plus noise) to unmodulated (noise) the ratio should be not less than 10 dB.

Transmitter preamplifier

45. Adjust the output power of the 20-30 Mc/s IF and spectrum generator sections of the test set as in para. 21 and 22.

46. Set the FUNCTION switch of the test set to TX and the WATTMETER switch to OUTPUT. The equipment should be indexed to the frequencies listed in Table 3 and at each frequency the output power, read in the test set WATTMETER, should be not less than 140 mW.

A.V.C. characteristic

47. Adjust the output of the spectrum generator section as in para. 22, then position the test set switches as follows:-

FUNCTION switch	RX
A.V.C./BIAS	A.V.C.
VOLTAGE TEST switch	A.V.C.
WATTMETER switch	OUTPUT

Index the equipment to 305.7 Mc/s. No adjustment to the tracking should be made.

48. The carrier of the signal generator should be set to 1,000 microvolts open circuit and modulated to a depth of 30% by 1,000 c/s tone; its frequency should be set as described in para. 25.

49. For an input signal level of 1,000 microvolts from the signal generator the audio output power, as measured on the wattmeter CT44, should be 250 mW. Taking this power level as 0 dB, the signal generator carrier voltage level should be varied for a change of output in the wattmeter CT44 as follows:-

Carrier voltage level	Audio output power
1,000μV	0dB (250mW)
10μV	± 3dB
100,000μV	± 3dB
500,000μV	- 7dB maximum

Final functional test

Receiver r.f. amplifier

50. The final tests are similar to those of para. 42 to para. 44 inclusive with the exception that the test equipment frequency is set

0.5 Mc/s in advance or foreshort of the unit being tested.

51. The method is to first set the index head to 399.9 Mc/s with the test set and signal generator set to 399.4 Mc/s and adjust the trimming capacitors C19, C20, C21 as in para. 27 and 28. Then repeat the tests of para. 43 and 44 with the unit being tested set to the frequencies listed in Table 3, whilst the test set and signal generator are set 0.5 Mc/s, foreshort of each test frequency. The trimming capacitors and sectorized vanes of the tuning assemblies should not be adjusted.

52. The procedure of para. 51 is then repeated but with the test set and signal generator set 0.5 Mc/s in advance of the test frequencies (Table 3) to which the unit under test is set. However, since the test set is incapable of operating on a frequency in advance of 399.9 Mc/s this channel must be omitted from the test set and the unit trimmed on the next channel frequency, i.e. 395.7 Mc/s with the test set and signal generator set to 396.2 Mc/s.

Transmitter preamplifier

53. The foreshort and advance procedures used for the receiver r.f. amplifier (para. 51 and 52) are adopted for the transmitter preamplifier with the exception that the requirements of para. 46 should be fulfilled instead of para. 43 and 44. The trimming capacitors C115, C116, C117 are adjusted as in para. 30 with the test set frequency either 0.5 Mc/s foreshort or in advance of the unit setting.

54. When the tests of para. 50 to para. 53 have been completed, the unit under test should be retrimmed as outlined in para. 37 and 39.

Assembly after test

55. Ensure that the test side covers are removed and the original covers are replaced before fitting the unit on to the main chassis assembly. The module is retained in position on the chassis by red-painted captive screws of Phillips pattern.

56. Two dowels are provided in the base of the unit to ensure correct alignment of the multipole plug with the mating socket integral with the main chassis.

57. Ensure that the three flyleads and two plugs to J1, J101 are firmly and correctly fitted.

58. Following the assembly of all components in the chassis and refitting of the cover, full functional tests should be carried out as detailed in Chap. 1 of this Section. Pressurization and leak testing should follow as described in Chap. 17.

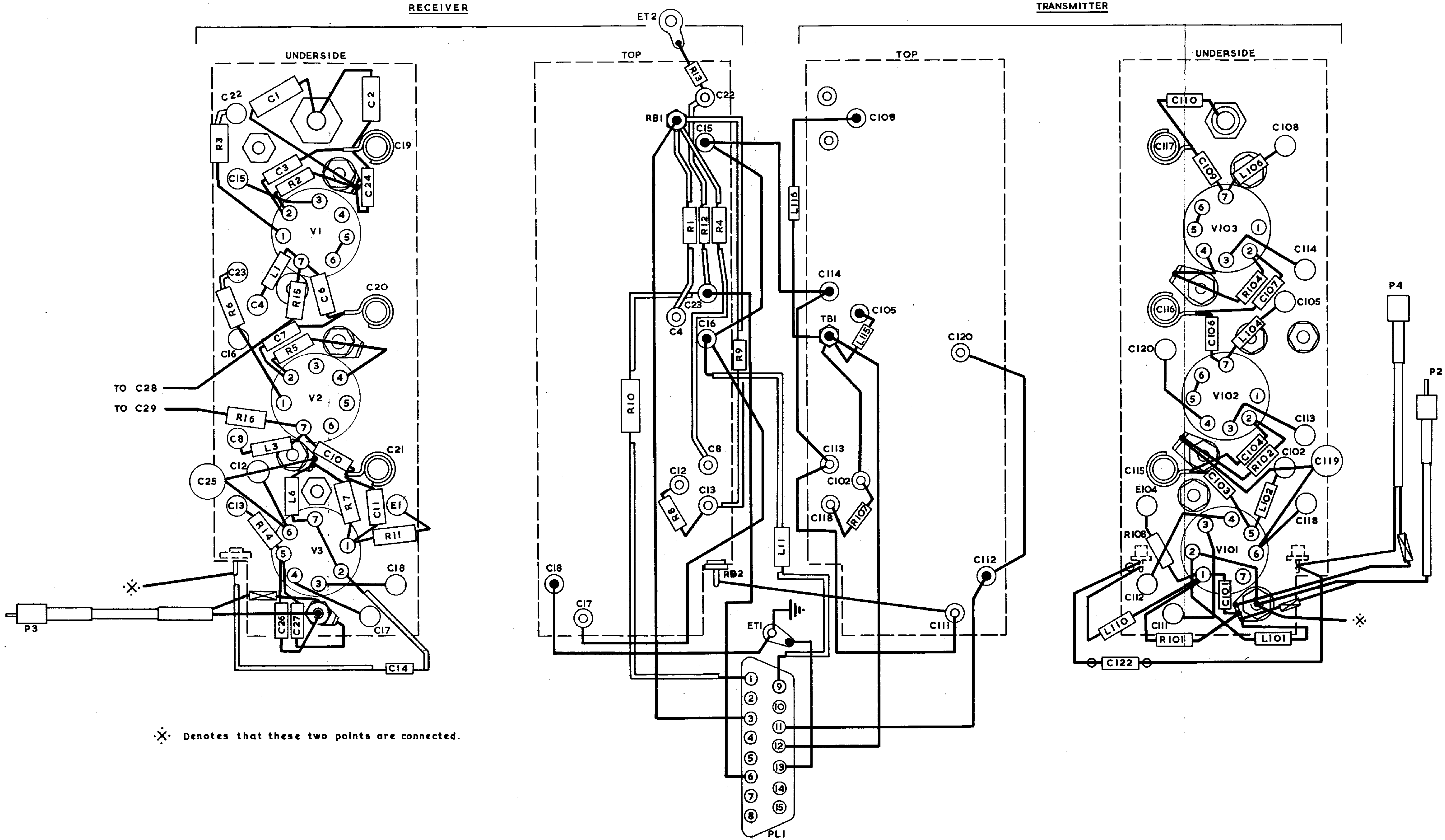

Fig. 1. ARI. 18124/1 and ARI. 18124/2 – amplifier unit (main receiver RF amplifier and transmitter preamplifier)—wiring diagram

Chapter 4

IF UNIT (20-30 MC/S)

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General

1. The IF unit (20-30 Mc/s) is employed during both transmission and reception. In the receive condition, the output of the main receiver r.f. amplifier feeds into the IF unit at P201. This signal is amplified by two stages then mixed with the output of the oscillator unit which is fed in at P208 and amplified by V205. The result of this mixing is an i.f. of 1.85 Mc/s which is fed out at P206. In the transmit condition, the IF unit (20-30 Mc/s) accepts the oscillator unit signal, amplifies it and then mixes it with a 1.85 Mc/s local oscillator signal. The resultant frequency, of between 20.0 Mc/s and 29.9 Mc/s is then passed to the transmitter preamplifier via P205.

2. The unit is gang-tuned by a cam operated carriage which varies iron dust cores of bandpass transformers. The cam assembly is driven by the mechanical tuning unit gear train via two Oldham couplers. Ganging alignment of the tuned circuits is provided by preset variable capacitors situated within the screened covers of the transformers.

3. Test points U and L are accessible at the top of the unit when it is mounted on the main chassis, i.e. on the opposite face to the Oldham couplers.

4. The unit is secured to the main chassis with four Phillips type captive screws. These are painted red and are accessible from underneath the chassis when the sealed cover is removed. The methods of removing the cover, refitting it and subsequent pressurizing are given in Chap. 17, of this Section, whilst details of sub-unit removal are given in Vol. 1, Part 1, Chap. 5.

WARNING

It is essential that the equipment is indexed to 220.0 Mc/s before any attempt is made to remove the unit from the main chassis since, in this position, the frequency selector mechanism is correctly aligned for unit withdrawal and refitting.

Test equipment

5. The equipment required for servicing and testing the i.f. unit (20-30 Mc/s) is listed in Table 1. Further information on individual items may be obtained by reference to the publication listed.

TABLE 1

List of test equipment

Item	Ref. No.	Nomenclature	Para.	Further details
1	10AG/956	Aligning fixture	24	Sect. 1
2	10AR/4892	Setting plate	25	"
3	10AG/957	Drill and ream jig	26	"
4	1B/1770	Surface plate	26	"
5	1B/4764	Gauge, dial, Type A, B.S.907	26	"
6	10AG/958	Checking fixture	27	"
7	10AG/959	Height gauge plate	28	"
8	10AG/961	Depth gauge	28	"
9	5120-99-943-9324	Screwdriver tester	30	"
10	5120-99-120-0868	Bit, screwdriver	30	"
11	6130-99-999-7812	Power unit	32(1)	" , Chap. 2
12	6625-99-943-6537	Test set, amplifier (20-30 Mc/s)	32(1)	" , " 14
13	10S/17134	Signal generator CT394A - set	32(2)	A.P.2531HA
14	F19/6625-99-943-0510	Wattmeter, absorption, AF No. 1, CT44	32(3)	A.P.2536C
15	10AH/14	Headset Type 9	32(4)	A.P.830
16	6625-99-943-8483	Multimeter, valve CT429	32(5)	
17	10S/16823	Signal generator, Type 57A (R.N.)	32(6)	A.P.2538J
		or		
	10S/16822	Signal generator Type 56A (R.A.F.)	32(6)	A.P.2879D

Component inspection

6. Inspect for correctness the details of equipment serial numbers and modification state entered on the repair card accompanying the unit.

7. It is recommended that when the unit is withdrawn from the main chassis, the Oldham coupler rings should be removed to prevent possible damage being sustained during the servicing procedures.

8. Remove the four side covers and thoroughly clean the unit of all dust. Since the transmitter-receiver equipment is enclosed within an airtight casing the presence of dust, dirt or moisture should be fully investigated.

9. Carefully examine the unit to ensure that it is free from damage and corrosion, with all components securely retained in position. Any loose components must be securely refitted. Should it be necessary to change any components, it is important to ensure that the items are positioned accurately and correctly connected. Component layouts given in Vol. 1, Part 1, Chap. 5 will assist in item identification.

10. Screws and nuts removed during inspection or servicing and which are not fitted with locknuts or lockwashers, must be locked with varnish when refitted.

Wiring

11. The wiring of the unit should be carefully inspected for continuity and conformity with the circuit shown in Vol. 1, Part 2, Chap. 1, fig. 6. This inspection should consist of a point-to-point test or such electrical tests which will confirm the accuracy of the wiring. The equipment should be examined for neatness or soldering, absence of dry joints and a general satisfactory condition of the wiring and insulation. No inadvertent interconnections or tracking paths should be permitted due to excess solder, wire clippings or dirty connections.

12. To assist in servicing, a wiring diagram is given at fig. 1. It is important to ensure that any new wiring is correctly connected with respect to length, gauge of wire and colour coding (unless modification requirements necessitate changes). A wiring key is given in Table 2 which, when used in conjunction with the wiring diagram (fig. 1) will assist in the refitting of any wiring.

TABLE 2

Wiring key

From	Wiring colour	To
P207/1	White	LHB/5
" /3	Brown	LHB/8
" /3	Brown	RHB/5
" /5	Light green	LHB/1
" /7	Red	LHB/6
" /7	Red	RHB/3
" /9	Orange	LHB/4
" /10	Green	K201/5

P207/11	Brown	K201/1
" /11	Brown	K202/3
" /13	Pink	RHB/1
" /15	Green	RHB/7
E242	Black	LHB/2
E223	Black	LHB/3
E221	Black	LHB/7
Y201	Black	LHB/9
Y201	Black	ET2
C203	Black	LHB/10
R218	Black	LHB/11
K202/2	Black	L213
K204/4	Black	RHB/6
K202/5	Black	ET3
K202/5	Black	K202/8
K202/6	Green	K201/5
C237	Black	RHB/2
L207	Black	RHB/4
RHB/7	Green	RHB/8

Servicing

13. Certain detailed instructions for the renewal and alignment of mechanical parts are given in subsequent paragraphs but the renewal or refitting of most of the components in this unit will require only the adoption of standard servicing procedure.

14. If it becomes necessary to renew any of the button mica capacitors C203, C213, C223, C237 or C247 they should be fitted in the same manner as the original i.e. with the terminals in the same position as the original capacitor, bend three tabs flat against the inside of the frame and spot solder the capacitor in three places to the outside frame.

15. When removing C204 the lead to the feed-through insulator E213 should be kept to a minimum length with both the lead and capacitor positioned as far as possible from the frame.

16. In order to gain access to the mechanical component parts employed in operating the slug assembly, it will be necessary to dismantle the unit. Dismantling should be done in a clean atmosphere and limited to

the degree of dismantling that is required to effect the particular repair. Assembly instructions are given in para. 27 thus, if only partial dismantling has been done, reassembly may be implemented from that stage of the instructions required.

Dismantling

17. Remove the coupler plates from the shafts by extracting the tapered fixing pins which secure the coupler plates to the shafts. If the coupler plates and shafts are serviceable and are to be refitted, note the shaft from which each coupler is removed and their radial relationship. This precaution is of paramount importance since, on assembly, each coupler plate is jig aligned with the shaft and drilled together; therefore, the fixing pin hole is only in line for the coupler and shaft which have been so drilled. For this reason, if it is necessary to change either a coupler plate or shaft, both must be renewed and the instructions given in para. 28 to 30 complied with.

18. Handle the unit with care and pay particular attention to ensure that the transformer coils are not damaged whilst dismantling. It is recommended that the crystal, situated alongside V204, be removed and placed in a safe place on the bench.

19. The five leads enclosed in sleeving, which pass over the mechanical assembly, should be released. Unsolder these leads from the board to which K202 is secured and withdraw them to gain access to the slug assembly.

20. Do not release the 0.1 Mc/s cam grub screws if this assembly is serviceable because the cams are jig aligned on the shaft.

21. Release and remove the four springs which keep the cam following shaft under compression then tie the rocker arm shaft to the spacer bar. Unscrew and remove the top plate (i.e. opposite end to the P207 plate).

22. Slacken the screws which secure the side panel (that has attached to it the K202 board) to the bottom plate. This should allow sufficient movement to gently ease out the slug rack. If complete removal of this side panel is necessary the leads from the printed circuit board to the transformer assembly must be unsoldered.

23. Ease the shafts from the bottom plate; untie the rocker arm shaft and carefully lift the slug rack assembly, shafts and rocker arms free from the unit, being careful to avoid damaging the slugs.

24. Slide the rocker arms from the 1.0 Mc/s shaft and lift the 0.1 Mc/s shaft free from the slug rack.

25. Inspect the components individually and ensure that they are serviceable before reassembly. Further dismantling involves the unsoldering of leads connected to the transformer assembly and release of the securing screws.

0.1 Mc/s cam alignment

26. In the event of the 0.1 Mc/s cams or shaft being renewed they must be aligned using the aligning fixture (Table 1, item 1). It will be seen that the aligning fixture has two knurl-headed locating pins at each end; these pins ensure that the cams are correctly set, radially, on their shaft. Two smaller pins, one at each end can be engaged in a small hole in each cam thus verifying that the correct cam (i.e. left or right hand) has been fitted. A further pin, with a blade end, is used to engage in the slot at one end of the cam shaft. The cams are aligned as follows:-

(1) Slide the cams on to the shaft and load them into the fixture. Engage the blade end pin with the shaft slot and rotate the pin until the shaft slot lies horizontally. Lock the pin in this position by tightening down the locking screw.

(2) Slide the cams outwards until they are flush with the ends of the fixture. Then rotate them until the small pin at each end engages with the holes in the cams. If the pins do not engage with the holes then the cams have been positioned at the wrong end of the shaft.

(3) Align each cam separately by projecting the two locating pins and rotating the cam until it is again flush with the end face of the fixture.

(4) With the cam in this position apply locking varnish to the cam grub screws and tighten them securely.

(5) Repeat the procedure of (3) and (4) for the remaining cam and remove the assembly from the fixture.

Assembly

27. The unit is assembled in the following manner:-

(1) Gently fit the slug rack assembly into the unit taking great care to avoid damaging the slugs.

(2) With the 0.1 Mc/s cams aligned (para. 26) fit the assembly into the slug assembly with the slotted end of the shaft protruding through the baseplate.

(3) Fit the rocker arms on the shaft and lower the ends of the arms into the slug assembly with the rollers resting on the 0.1 Mc/s cams.

(4) Fit the top plate and ease the 0.1 Mc/s shaft into its bearing.

(5) The 1.0 Mc/s shaft is fitted in the unit by sliding it through the baseplate aperture with the slotted end of the shaft outwards. The shaft should be passed through the bottom rocker arm then the two 1.0 Mc/s cams fitted to the shaft, cam bosses inwards, before inserting it through the top rocker arm.

(6) Tighten the screws of the top and side plates then fit the four retaining springs.

(7) Offer the setting plate (Table 1, item 2) to the baseplate of the unit and rotate the two shafts until the slots engage with the inserts of the setting plate; keep the 1.0 Mc/s shaft pressed firmly against the insert. With the 1.0 Mc/s shaft in this position, set the 1.0 Mc/s cams so that the cam followers are resting and try the shaft for end play which should be between 0.005 in. and 0.020 in. If the end play is not within these limits then the cams should be released, the shaft withdrawn and the shims fitted between the cams and rocker arms as necessary.

(8) Tighten all screws and solder the five leads which were removed during dismantling (para. 19).

Oldham coupler renewal

28. The Oldham couplers are drilled and reamed with the shafts using the special jig (Table 1, item 3) as follows:-

(1) Remove the coupler height plate from the stowage position on the jig and place it on the unit base-plate; this plate ensures that the couplers are situated on the shafts at the correct distance from the baseplate.

(2) Fit the couplers on the shafts and offer the jig to the unit baseplate. Adjust the couplers to fit into the jig recesses and secure the jig to the baseplate with the securing screws.

(3) Place the unit on the surface plate (Table 1, item 4) with the rocker arms to the left (facing the jig). Adjust the dial type gauge (Table 1, item 5) so that its needle rests on a rocker arm.

(4) Engage the blade end pin of the jig with the slot of the 0.1 Mc/s shaft and rotate the shaft in a clockwise direction until the gauge clock shows the lowest reading, i.e. when the cam followers are in the dip of the cams. Now carefully turn the shaft counter-clockwise until the gauge dial rises by 0.0001 in., then lock the blade end pin this position with the knurl-headed screw which protrudes from the side of the jig.

(5) Push the two knurl-headed pins on the jig face well down, so as to position the two coupler plates in the correct position, then lock them by tightening the cap screws.

(6) Drill each coupler and shaft using a No. 50 (0.070 in.) drill and ream to suit the taper pin.

(7) Remove the jig from the unit baseplate and fit the taper pins. Then trim any protrusions of the pins flush with the coupler grooves.

29. The position of the coupler plates in relation to the cam positions should be verified using the checking fixture (Table 1, item 6) as follows:-

(1) Load the unit into the checking fixture and secure it with the two captive screws of the fixture. Place the fixture on the surface plate (Table 1, item 4) so that the baseplate of the unit makes 90° with the surface plate, P207 downwards.

(2) Adjust the dial type gauge (Table 1, item 5) so that its needle rests on one of the rocker arms. Then, keeping the fixture steady on the baseplate, slowly rotate the 0.1 Mc/s coupler in a clockwise direction until the gauge dial stops falling and commences to rise. This indicates that the cam followers have reached the lowest point on the cams. Now carefully turn the 0.1 Mc/s shaft counter-clockwise for a rise in the gauge dial of 0.0001 in. and lock the coupler in this position with the fixture attachment.

(3) Move the dial type gauge and set the needle to rest on the 1.0 Mc/s coupler dogs. Slide the gauge along the length of the coupler dogs, which should be parallel to the surface plate to within ± 0.016 in. from end to end.

(4) Repeat the procedure of sub-para. (3) for the 0.1 Mc/s coupler, the dogs of which should be parallel to the surface plate to within 0.064 in. from end to end.

30. The coupler plate height, with respect to the unit baseplate, should be ascertained using the depth gauge and height plate (Table 1, items 7 and 8). Secure the height plate to the unit baseplate and insert the depth gauge on each coupler in turn. It will be seen that the top surface of the depth gauge is stepped, one side being marked GO and the other NO GO. If the coupler plates have been correctly positioned on the shafts, the GO side of the gauge will not protrude above, or the NO GO side fall below, the surface of the height plate.

Lubrication

31. Using Aero Shell fluid 3 (9150-99-932-4820) apply three or four drops, only, to the porous bronze bearings at each end of the 0.1 Mc/s shaft and one drop to each ball bearing race. Rotate the Oldham couplers then remove any excess oil.

Torque test

32. A torque test should be made at the Oldham couplers after assembly. Using items 9 and 10 of Table 1 set the screwdriver to 16 oz in. and engage the bit in the 1.0 Mc/s shaft. Turn in a counter-clockwise direction when the screwdriver should not slip at any point of rotation. Reset the screwdriver to 9 oz in. and turn the 0.1 Mc/s shaft in a counter-clockwise direction; the screwdriver should not slip at any point of rotation.

33. On completion of the torque test fit the bronze coupler rings so that the locating pins on the rings are adjacent to the datum circle marked on the unit baseplate, when the shafts are positioned as in para. 29 (3) and (4). Ensure that the O rings, which retain the coupler rings in position, are seated correctly in the coupler plate groove.

Arrangement of test equipment

34. The equipment required for testing the IF unit (20-30 Mc/s) should be arranged on the test bench as follows:-

(1) Connect the power unit (Table 1, item 11) to the bench supply source and to the test set amplifier (20-30 Mc/s) (Table 1, item 12), using the two connectors provided with the power unit.

(2) The signal generator CT394A (Table 1, item 13) should be connected to the bulkhead connector on the test set marked 20-30 Mc/s SIG. GEN.

(3) Connect the wattmeter CT44 (Table 1, item 14) to the test set terminals marked A.F. OUTPUT.

(4) The headset (Table 1, item 15) should be plugged into the test set marked PHONES as and when required.

(5) The multimeter valve CT429 (Table 1, item 16) should be connected to the test set terminals marked D.C. V/V, or the test points U and L of the unit under test, as required by the test procedure (para. 35 to 66).

(6) The signal generator (Table 1, item 17) should be connected to the test set connector marked 1.85 Mc/s SIG. GEN. when required (para. 64).

35. The unit under test should be securely fitted to the side of the indexing head on the test set and the flyleads connected to the test set Microdot sockets as follows:-

IF unit		Test set
P201	to	J1518
P205	to	J1517
P206	to	J1516
P208	to	J1515

36. Switch on the power supplies to the test equipment and allow at least five minutes for it to thermally stabilize before switching on the h.t. During this period the heater voltages should be adjusted on the power unit as follows:-

(1) Set the power unit meter switch to the HEATER VOLTS TEST SET position and adjust the SET L.T. TEST SET control for 6.3V in the power unit voltmeter.

(2) Set the power unit meter switch to the HEATER VOLTS UNIT ON TEST position and adjust the SET L.T. UNIT ON TEST control for 6.3V in the power unit voltmeter.

37. Set the H.T. switch on the test set to ON and adjust the h.t. and bias voltages as follows:-

(1) Set the power unit meter switch to H.T. VOLTS and adjust the SET H.T. control for 130V in the power unit voltmeter.

(2) Set the power unit meter switch to BIAS VOLTS and adjust the SET BIAS control for 15V in the power unit voltmeter.

Current consumption

38. To read the h.t. current drawn by the unit on test, set the meter switch of the power unit to H.T. CURRENT UNIT ON TEST. Then with the test set function switch positioned to either REC. or TRANS. the power unit milliammeter reading should not exceed 50 mA.

Transmitter second i.f. oscillator

39. Unplug the flylead P208 from the test set and set the function switch to the TRANS. position. Connect the valve voltmeter between the test point U and frame then read the voltage indicated, which should be not less than 2.8V negative with respect to frame.

40. The frequency of the transmitter second i.f. oscillator should be verified using the beat frequency oscillator and frequency meter of the test set. The frequency meter reading should be not greater than 500 c/s when the test set switches are positioned as follows:-

Function switch to TRANS.
REC. INPUT switch to TRANS. OSC.
B.F.O. to ON

Alignment procedure

41. Whenever the CT394A signal generator is used for alignment, its carrier frequency should be constantly verified using the beat frequency oscillator of the test set. The method is to first adjust the carrier frequency for maximum a.g.c. voltage; then switch the B.F.O. switch on the test set panel to ON and fine-tune the instrument for zero beat in the headset. Switch off the B.F.O.

42. It will be seen that the setting knobs on the indexing head are retained in one of three positions (20.7, 25.7 and 29.7) by spring-loaded keys. To set the couplers of the unit on test first release the knobs by pulling out the key; then turn the knobs a small amount, release the key and continue to rotate the knobs until they click into the desired position.

43. To assist in identifying the inductors and capacitors to be adjusted, it is advisable to lay the unit dustcover on the bench next to the unit on test. With the physical layout of the transformer section facing upwards the component positions are easily located.

Injection amplifier

44. Connect the flylead P208 to the Microdot connector J1515 and set the function switch to REC. The 0.5 BIAS VOLTS switch should be set to the OFF position and the INJ. OSC. switch set to the 20.7 position. Connect the CT429 between the test point L and frame of the unit on test.

45. Index the unit to 20.7 Mc/s and adjust the iron dust cores of the inductors L209, L210, L211, and L212, successively, for a maximum reading in the CT429.

46. Index the unit to 29.7 Mc/s and set the INJ. OSC. switch to the 29.7 position. Then set the trimming capacitors C236, C241, C245 and C250, successively, for a maximum reading in the CT429.

47. Continuous adjustment to these inductors and capacitors should alternate in the manner described (para. 45 and 46) until no further improvement in alignment can be made.

I.F. amplifier

48. Connect the CT429 to the test set terminals marked D.C. V/V and set the voltmeter switch of the test set to the A.G.C. position. Set the INJ. OSC. switch and the indexing head to the 20.7 position. Then connect the test set flylead, which is attached to the 20-30 Mc/s GEN bulkhead connector, to the Microdot connector marked GEN. The REC. INPUT switch should be set to the J1516 position.

49. The CT394A carrier frequency should be tuned to 20.7 Mc/s (para.41) unmodulated and its output voltage level set to maximum. Then adjust the iron dust cores of the inductors L201, L202, L203, L204, L205 and L206, successively, for a maximum a.g.c. voltage level as indicated in the CT429. As alignment progresses the output voltage level of the CT394A should be decreased to levels which provide only sufficient indication in the CT429 of the approach to resonance.

50. Set the indexing head and the INJ. OSC. switch to the 29.7 position and tune the signal generator to the test set (para. 41) with the output voltage at maximum.

51. The trimming capacitors C202, C207, C211, C217, C221 and C226 should be adjusted, successively for a maximum reading in the CT429. As alignment progresses the output voltage level of the signal generator should be decreased as in para. 49.

52. Index the equipment to 20.7 Mc/s and repeat the process described in para. 49.

53. Position the test set voltmeter switch to TRANS. OUTPUT, the function switch to TRANS. and the INJ. OSC. switch to 20.7; the indexing head should be set to the 20.7 position.

54. Adjust the iron dust core of the inductor L206 for a maximum reading in the CT429. Then set the INJ. OSC. switch and the indexing head to the 29.7 position and adjust the trimming capacitor C226 for a maximum reading in the CT429.

55. The adjustments made to the inductors and capacitors in para. 51, 52 and 54 should be repeated until no further improvement in alignment can be made; the final adjustment should be that of para. 54. On completion of the alignment procedure the adjusting screws of the inductors and trimming capacitors should be staked with anti-tracking varnish (Ref. No. 8010-99-942-8917).

Functional tests

56. The following tests should each be carried out at the following frequencies:- 20.7 Mc/s, 25.7 Mc/s and 29.7 Mc/s.

Injection amplifier

57. Disconnect the CT429 from the test set terminals marked D.C. V/V and connect it between the test point L and frame of the unit on test; then position the test set function switch to REC. and the 0.5 VOLT BIAS switch to ON. Disconnect the flylead P208 of the unit on test from the Microdot connector J1515, remove the test set flylead from the Microdot connector marked GEN. and connect it to J1515. The carrier frequency of the signal generator CT394A should be tuned to 1.85 Mc/s above the setting of the indexing head i.e. 22.55 Mc/s, 27.55 Mc/s, 31.55 Mc/s and tuned for a peak reading in the CT429.

58. At each of the three test frequencies the carrier voltage level of the CT394A should be set to 250,000 microvolts open circuit. With this input level to the injection amplifier a reading of not less than 0.6V negative with respect to frame should be indicated in the CT429.

Transmitter second i.f. performance

59. Connect the CT429 to the test set terminals marked D.C. V/V and set the voltmeter switch to the TRANS. OUTPUT position; the 0.5 VOLT BIAS switch should be in the OFF position and the function switch positioned to TRANS.

60. Disconnect the test set flylead from J1515 and reconnect the unit on test flylead P208 to J1515. The INJ. OSC. switch and the indexing head should be set to each of the three test frequencies in turn and a reading taken in the CT429 which should be not less than 1.6 volts negative with respect to frame.

Signal plus noise to noise ratio

61. Set the function switch to REC. and the 0.5 VOLT BIAS to ON then connect the test set flylead to J1518 after first removing the unit flylead P201. Set the REC. INPUT switch to J1516; the indexing head and INJ. OSC.

switch should both be positioned to the three test frequencies in turn.

62. Tune the CT394A to the equipment (para. 41) and set the carrier voltage level to 5 microvolts open circuit, modulated to a depth of 30% by 1000 c/s tone.

63. Note the reading in the wattmeter CT44 then switch off the modulation of the CT394A carrier; the difference in output power should be not less than 12dB.

Insertion gain

64. For this test a calibration voltage level for the 1.85 Mc/s receiver section of the test set should be obtained as follows:-

(1) Connect the 1.85 Mc/s signal generator (para. 34(6))

(2) Set the test set switches as follows:-

Voltmeter switch to REC. REF.
REC. INPUT switch to GEN.
B.F.O. switch to ON
Function switch to REC.

(3) Set the 1.85 Mc/s signal generator signal level to 600µV open circuit and adjust the frequency for a minimum reading in the test set frequency meter; this reading must be below 50 c/s.

(4) Set the B.F.O. switch to the OFF position and reset the carrier output voltage level of the signal generator to 60µV open circuit. The reading in the CT429 constitutes the calibration voltage level and should be noted.

(5) Disconnect the 1.85 Mc/s signal generator and set the REC. INPUT switch to the J1516 position.

63. The equipment should be set up as described in para. 61 and the voltmeter switch set to the REC. REF. position.

66. Tune the CT394A to the equipment (para. 41) and set the carrier output level (unmodulated) to obtain the calibration voltage level (para. 64 (4)); the carrier output voltage should be not more than 20µV open circuit.

67. Switch off the equipment, disconnect the power supplies and remove the unit on test from the indexing hand.

Assembly after test

68. Ensure that the adjusting screws of the inductors L201, L202, L203, L204, L205, L206, L209, L210, L211, L212, and the trimming capacitors C202, C207, C211, C217, C221, C226, C236, C241, C245, C250 have been staked (para. 55).

69. Fit the covers of the unit securely in position. If the unit is to be fitted into the main chassis, full details of assembly will be found in Vol. 1, Part 1, Chap. 5 of this Air Publication.

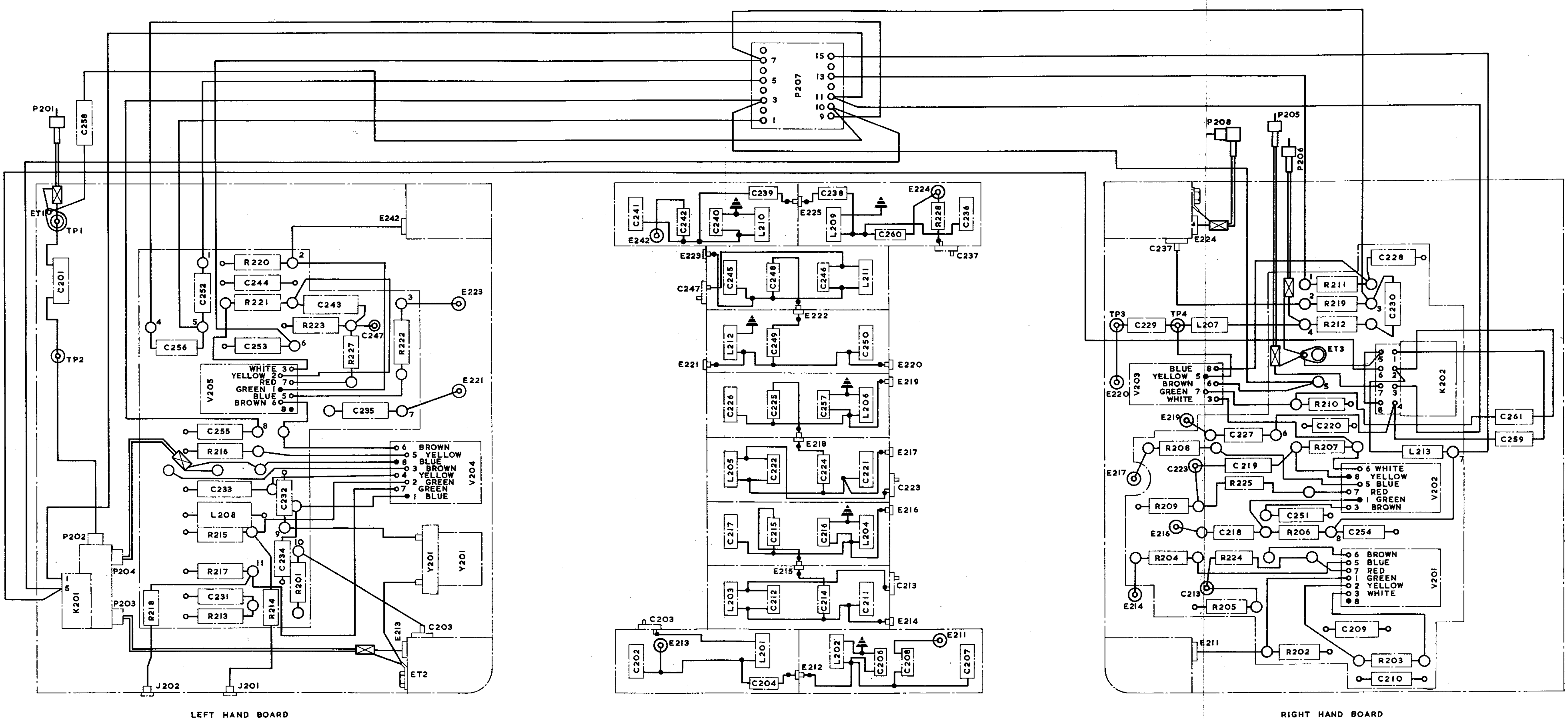

Fig. 1 ARI. 18124/1 and ARI. 18124/2 – i.f. unit (20–30 Mc/s) – wiring diagram

Chapter 5

IF UNIT (1.85 MC/S)

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General

1. The function of this module is principally to amplify the second i.f. of the receiver which is fixed at a frequency of 1.85 Mc/s. The i.f. passband is set by a filter unit situated on the top of the unit, the input of which is fed through plug P301. The unit incorporates an a.f. detector stage together with a noise limiter and a.g.c. voltage source; also provided in this module is a signal for the squelch control associated with the a.f. amplifier unit. Embodied in the rear of the unit, near the top, are two stage gain preset capacitors (C339 and C340). The 1.85 Mc/s selective filter is carefully adjusted to give an

ideally sharp response at 1.85 Mc/s. In order to preserve full operation under service conditions, it is sealed in an epoxy-resin compound to prevent disturbance and the ingress of dust. In the event of failure being attributed to this filter, it must be changed in its entirety.

2. The i.f. unit is secured to the chassis by four red-painted Phillips type captive screws, which are accessible from the underside of the chassis when the sealed cover is removed. Details of the method of cover removal from the transmitter-receiver, its replacement and subsequent pressurizing are given in Chap. 17 of this Section. Details of the procedure for dismantling and assembly given in subsequent paragraphs will be supplementary, only, and limited to requirements for repair or replacement of components.

Test equipment

3. The equipment required for testing the i.f. unit (1.85 Mc/s) is listed in Table 1; further particulars of an individual item may be obtained by reference to the publication listed.

TABLE 1

List of test equipment

Item	Reference No.	Nomenclature	Para.	Further details
1	6625-99-943-6536	Test set, amplifier	13	Sect. 1
2	10S/NIV649	Power unit No. 2	14	Sect. 1
3	10S/16308	Multimeter, electronic CT38	14	A.P.2879AG
4	10S/695	Signal generator, Type 57A (R.N.)	15	A.P.2538J
		or		
	10S/647	Signal generator, Type 56A (R.A.F.)	15	A.P.2879D
5	10S/16344	Signal generator, Type 65	14	A.P.2536C
6	5995-99-932-4021	Connector	15	Vol.1, Part 2, Chap. 2
7	10S/831	Oscilloscope, Type 13A	14	A.P.2879AF
8	10AH/14	Headset Type 9	15	A.P.830

Component inspection

4. Inspect for correctness the details of equipment serial numbers and modification state entered on the repair card accompanying the unit.

5. Unclip the side covers by easing a screwdriver between the mating edges in the slots at the top of the cover. Then, using a portable

blower or other approved supply of dry air under pressure, thoroughly clean the unit of all dust. Where necessary, a soft squirrel-hair brush will assist in this process. Since the transmitter-receiver equipment is enclosed within an airtight casing, however, the presence of dust, dirt or moisture should be fully investigated.

6. Carefully examine the unit to ensure that it is free from damage and corrosion, with all components securely retained in position. Any loose components must be securely refitted. Should it be necessary to change any components, it is important to ensure that the items are positioned accurately and correctly connected. Component layouts given in Vol. 1, Part 1, Chap. 5 will assist in item identification.

7. Screws and nuts removed during inspection or servicing and which are not fitted with locknuts or lockwashers, must be locked with an approved varnish when refitted.

Wiring

8. The wiring of the unit should be carefully inspected for continuity and conformity with the circuit shown in Vol. 1, Part 2, Chap. 1. This inspection should consist of a point-to-point test or such electrical tests which will confirm the accuracy of the wiring. The equipment should be examined for neatness of soldering, absence of dry joints and a generally satisfactory condition of the wiring and insulation, with particular attention paid to the sleeving covering the connections to the multipole plug. No inadvertent interconnections or tracking paths should be permitted due to excess solder, wire clippings or dirty connections.

9. It is important to ensure that the diodes CR301, CR302, CR303 and electrolytic capacitors C330, C331, C332, C335 and C336 have been correctly fitted and wired with respect to polarity and screening. These capacitors are of the tantalum electrolytic type and it is important that, should any be changed, the wire at the positive end of the component must be formed into a swan neck before connection in order to prevent any excessive strain or heat from affecting the weld.

10. To assist in servicing, a wiring diagram is given at fig. 1. It is important to ensure that any rewiring is carried out correctly and that lengths, gauge of wire and colour coding are as in the original unless modification requirements necessitate changes). In Table 2 is listed a wiring key which, when used in conjunction with the wiring diagram, will assist in the replacement of any wiring.

TABLE 2

Wiring key

From	Wire colour	Length (in.)	To
P302/1	Pink	$2\frac{5}{8}$	IFB/7
" /2	Light green	$2\frac{3}{4}$	F/8
" /3	White	$2\frac{1}{8}$	ET2
" /4	Clear	$3\frac{1}{4}$	IFB/5
" /5	Black	$3\frac{1}{4}$	IFB/6
" /6	Brown	$3\frac{1}{2}$	IFB/9
" /7	Red	$3\frac{1}{8}$	IFB/4
" /8	Green	$3\frac{7}{8}$	F312
" /9	Green	$2\frac{3}{4}$	F/6
" /10	Pink	$4\frac{1}{2}$	F/1
" /11	Yellow	$3\frac{1}{2}$	F/3
" /12	Tan	$3\frac{3}{8}$	IFB/3
" /13	Brown	4	F/10
" /14	Grey	$3\frac{1}{2}$	F/5
" /15	Blue	$3\frac{5}{8}$	F/4
F/13	Green	$3\frac{1}{4}$	F/6
F/13	Green	3	IFB/1
F/12	Green	$2\frac{1}{2}$	IFB/2
IFB/8	Red	$2\frac{3}{8}$	F/6
F/8	Red	-	F/6

Servicing

11. In view of the comparative simplicity of this unit, little servicing should be required. Renewal of components and any rewiring necessary should be a matter of standard procedure needing no special instructions.

WARNING

ELECTRIC SHOCK. It is essential to ensure that before any attempt is made to service or replace any item found defective during any part of the tests the power supply is switched off or, preferably, entirely disconnected from the instrument.

12. Printed circuits present special problems with regard to servicing. A printed circuit board may be irreparably damaged by the sustained heat from a soldering iron. The recommended method to be adopted when renewing a component on a printed circuit board is as follows:-

(1) Remove the faulty component by clipping the wires as close to the component as possible. This leaves the wire ends still fastened to the printed board.

(2) Prepare the wire ends of the new component and make a good mechanical joint with the wires attached to the printed board. (Fit the new component so that its value is uppermost and readable).

(3) Solder the connections as quickly as possible using only a light-weight soldering iron.

Arrangement of test equipment

13. Fit the unit under test to the test set, amplifier (Table 1, item 1) ensuring that the multipole plug P302 is correctly mated with the test set socket before tightening the captive screws on the test set.

14. Connect the test set, amplifier to the power unit (Table 1, item 2) using the connectors supplied with the power unit. The voltmeter (Table 1, item 3), oscilloscope (Table 1, item 7) and the a.f. signal generator (Table 1, item 5) are connected to the respective terminals which are appropriately labelled on the test set, amplifier.

15. Plug the headset (Table 1, item 8) into the jack on the test set and, using the connector (Table 1, item 6), couple the i.f. signal generator (Table 1, item 4) to the flylead connector P301 of the unit under test.

16. Ensure that the power unit MAIN switch is switched OFF, then connect the power unit to the bench supply source using the connector provided with the power unit; connect the remaining test equipment to the bench supply source.

Test procedure

17. Whenever the i.f. signal generator (Table 1, item 4) is required for testing an 1.85 Mc/s, it should first be back tuned to the built-in 1.85 Mc/s crystal oscillator of the test set. Set the 1.85 Mc/s oscillator switch to ON, and tune the i.f. signal generator for zero beat in the headset; switch off the 1.85 Mc/s crystal oscillator.

18. Switch on the two signal generators, oscilloscope, CT38 and power unit and allow the test equipment sufficient time to stabilize thermally before proceeding with the test procedure.

Functional test without signal

19. Set fully clockwise the SENSITIVITY control on the test set. The signal source is operated at zero input, with the variable capacitors (C339 and C340) set to minimum capacitance and the power unit and test set meter switches set as required for the following readings:-

(1) H.T. current - the total consumption should not exceed 40mA.

(2) A.G.C. output voltage - must be between +0.05 volt and -0.25 volt with respect to frame.

(3) Squelch output voltage - this voltage should not be less than 13 volts positive with respect to frame.

(4) Auxiliary audio output voltage - the noise level of which should not be more than 1 volt r.m.s. with respect to frame.

(5) Main audio output voltage - a noise level of not more than 0.1 volt r.m.s. should be evident with respect to frame.

Functional tests with signal

Squelch

20. The SENSITIVITY control should be set fully clockwise.

(1) Zero level. Set the variable capacitors (C339 and C340) to minimum capacitance. Then adjust the i.f. signal source to operate at 1.85 Mc/s (para. 17) with the output signal level, unmodulated, set to obtain a squelch output voltage level of zero with respect to frame. Carefully note this signal level, which should not exceed 15 microvolts open-circuit.

(2) Control. Set the variable capacitors (C339 and C340) for maximum capacitance. Readjust the i.f. signal output level again to obtain zero squelch output voltage. This change in signal source level should not be less than 4 dB.

A.G.C. characteristics

21. Ensure that the SENSITIVITY control is set fully clockwise. Set the variable capacitors (C339 and C340) to minimum capacitance and the i.f. signal source to operate at 1.85 Mc/s (para. 17).

(1) The input carrier level should be set to that level which develops an a.g.c. voltage of 1 volt; this input should not exceed 50 microvolts open-circuit.

(2) Using the main audio output voltage obtained as a reference level, set the input carrier level to 1,000 microvolts open-circuit and modulate to a depth of 30% with a tone of 1,000 c/s.

(a) Control above reference - raise the input carrier level to 100,000 microvolts open-circuit, when the main audio output voltage level should not rise more than 10dB above the reference level.

(b) Control below reference - the input carrier level should be lowered to 50 microvolts open-circuit when the main audio output voltage should not fall more than 1dB below the reference level.

Squelch output voltage

22. Set fully clockwise the SENSITIVITY control of the test set; the variable capacitors (C339 and C340) should be set at minimum capacitance.

The i.f. signal source should be set to operate at 1.85 Mc/s (para. 17) with an unmodulated output signal level adjusted to obtain an a.g.c. output voltage of one volt negative with respect to frame. The squelch output voltage should be between 1.5V and 2.5V negative with respect to frame.

Auxiliary characteristics

23. The SENSITIVITY control of the test set should be set fully clockwise; then set the variable capacitors (C339 and C340) to minimum capacitance.

(1) Output voltage - set the i.f. signal source to operate at 1.85 Mc/s (para. 17), the output of which should be modulated to a depth of 30 per cent by a tone of 1,000 c/s. The signal source output level should be set to obtain an a.g.c. output voltage of 1 volt negative with respect to frame. The auxiliary audio output voltage should be between 2.5V and 3.5V r.m.s. with respect to frame.

(2) Frequency response - the i.f. signal source should be set to operate at 1.85 Mc/s (para. 17) with the output modulated to a depth of 30% by a 1,000 c/s tone. Adjust the signal level to obtain an auxiliary audio output voltage of 2.5 volts r.m.s. The modulation frequency alone should be successively varied according to Table 3 and the corresponding changes in the auxiliary audio output should be within the limits shown.

TABLE 3

Auxiliary audio frequency response

Modulation frequency	Limits of deviation from reference audio frequency voltage level (dB)
70	+ 2 to - 3
100	+ 2 to - 3
300	+ 2 to - 3
1,000	reference level (2.5 volts)
4,000	+ 2 to - 3
7,000	+ 2 to - 3
20,000	+ 2 to - 3

Main audio output

24. Set the SENSITIVITY control fully clockwise and the variable capacitors (C339 and C340) to minimum capacitance.

(1) Set the i.f. signal source to 1.85 Mc/s (para. 17) with an output signal level of 50 microvolts open-circuit, modulated to a depth of 30% by 1,000 c/s tone.

(2) Output voltage of the main audio should be not less than 1 volt r.m.s. with respect to frame. Remove the modulation of the signal whereupon the main audio output level should fall by at least 26 dB.

Audio amplitude limiting

25. Turn the SENSITIVITY control fully clockwise and adjust the variable capacitors (C339 and C340) for minimum capacitance.

(1) Set the i.f. signal source to operate at 1.85 Mc/s (para. 17) with an output signal level adjusted to obtain an a.g.c. voltage of 1 volt negative with respect to frame.

(2) The signal should be modulated by a 1,000 c/s tone to the depth at which amplitude limiting of the audio output waveform commences as indicated by the oscilloscope. This depth of modulation should be between 40% and 65%.

Selectivity

26. The SENSITIVITY control should be set fully clockwise and the variable capacitors (C339 and C340) should be adjusted for minimum capacitance.

(1) Set the i.f. signal source to operate at 1.85 Mc/s (para. 17) and an unmodulated output signal set to a level such that an a.g.c. output voltage of 1 volt negative with respect to frame is obtained. At this stage the squelch output voltage should be noted and used as a reference.

(2) Increase the output signal level of the i.f. signal generator by 6 dB and hold it constant throughout this test; then raise the i.f. signal generator frequency until the squelch output voltage has fallen to the reference level.

(3) Set the a.f. signal generator to approximately 1.89 Mc/s with an unmodulated output of 1V. Then tune the a.f. signal generator to beat with the i.f. signal generator by listening for zero beat in the headset. The frequency on the a.f. signal generator should be read off and noted.

(4) Decrease the i.f. signal generator frequency below 1.85 Mc/s until the squelch output voltage again falls to the reference level.

(5) Reset the a.f. signal generator to approximately 1.81 Mc/s with an unmodulated output of 1V. Then again tune it by the beat frequency method as described in para. 26 (3) and note the frequency.

(6) The total bandwidth should not be less than 80 kc/s and each sideband not less than 42 kc/s.

(7) This test should be repeated with the output level of the signal generator set 60 dB above the level required to obtain an a.g.c. voltage of -1 volt (para. 26(1)). With this input the bandwidth should be not more than 100 kc/s.

Passband ripple

27. Set the SENSITIVITY control fully clockwise and adjust the variable capacitors (C339 and C340) for minimum capacitance.

(1) The i.f. signal generator should be tuned to 1.85 Mc/s (para.17) with the output signal level, unmodulated, set to obtain an a.g.c. voltage of 1V negative with respect to frame; then increase the output signal level by 6 dB.

(2) Sweep the i.f. signal generator through a frequency band from 1.78 Mc/s to 1.92 Mc/s and note whether there is more than one frequency of peak response as indicated by the squelch voltage.

(a) If there is only one, then the peak-to-valley ratio of the passband frequency response characteristic can be considered as unity or 0 dB.

(b) Should there be two frequencies of peak response, the signal generator should be tuned to that of greatest response (or, if they are of equal response, to either). This squelch output voltage should be noted and used as a reference. Then tune the signal generator to the frequency of least response, between the two frequencies of peak response, and increase the signal generator output voltage level to produce the reference squelch voltage. The required increase is the peak-to-valley ratio and should not be greater than 2 dB.

Squelch characteristics

28. The SENSITIVITY control should be set fully clockwise and the variable capacitors (C339 and C340) set to minimum capacitance.

(1) The i.f. signal source should be set to operate at 1.85 Mc/s (para. 17) with an unmodulated signal level set to obtain a squelch output voltage level of 6.5V positive with respect to frame. This level of the signal source should not exceed 15 microvolts open-circuit.

(2) The SENSITIVITY control should be reset fully counter-clockwise. Then readjust the output level of the signal source to produce a squelch output voltage level of 6.5V positive with respect to frame. This output level of the signal source should be not less than 25 microvolts.

Assembly after test

29. The 1.85 Mc/s i.f. unit is retained in position on the chassis by four captive screws; these are of Phillips pattern and the heads are painted red for identification purposes. Two dowels are provided in the base of the unit to ensure correct alignment so that the multipole plug in the base of the module will engage correctly with the mating socket integral with the equipment chassis. Following the assembly of all components into the chassis and refitting of the cover, full functional tests should be carried out as detailed in Chap. 1 of this Section. Pressurization and leak testing should follow as described in Chap. 17 of this Section.

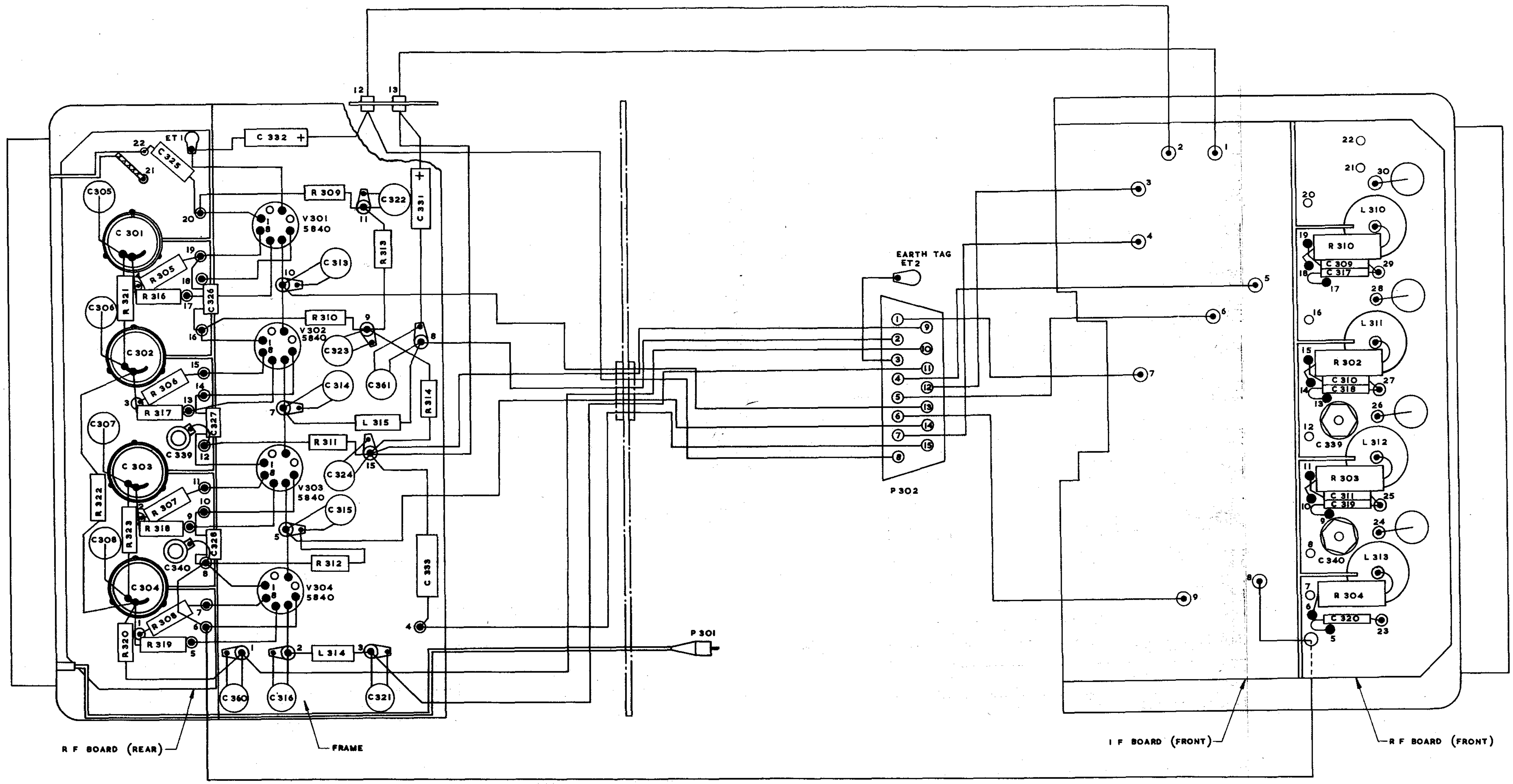

Fig. 1 ARI. 18124/1 and ARI. 18124/2 - I F unit (1·85 Mc/s.) - wiring diagram

Chapter 6

AMPLIFIER UNIT, AF

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General

1. The amplifier unit, AF includes an audio squelch circuit and a signal-to-noise squelch circuit in addition to the audio frequency amplifier. Output from the receiver unit (guard) is fed into the output valve and connection to the main assembly is made by multipole plug (P401). The unit embodies seven soldered wire links which are connected to provide the desired type of squelch control. Control over the performance of the unit is provided by four preset variable resistors accessible from the top of the unit. Three test points are provided at the top of the unit, these are marked R, N and P.

2. The sub-unit is secured to the main transmitter-receiver chassis by four red-painted Phillips-type captive screws which are accessible from the underside of the chassis when the sealed cover is removed. The method of removing the cover for access to individual units, its replacement and subsequent pressurizing are given in Sect. 2, Chap. 17 of this Volume; whilst details of removal of the sub-units are given in Vol. 1, Part 1, Chap. 5. Details of the procedure for dismantling and reassembling given in subsequent paragraphs will be supplementary only and limited to requirements for repair or replacement of components.

3. The inspection procedures and tests outlined in the following paragraphs reveal the salient performance characteristics of the equipment and will indicate whether or not the amplifier unit, AF is operating to the original specification. The tests should follow all repairs and renewal of components, or when specified as routine matters in preventive servicing.

4. Two methods of testing are described in this chapter:-

(1) Using standard equipment normally available at most user units

(2) Using special-to-type test equipment.

Component inspection

5. Inspect for correctness the details of equipment serial numbers and modification state entered on the repair card accompanying the unit.

6. Using a portable air blower or other approved supply of dry air under pressure, thoroughly clean the unit of all dust. Where necessary, a soft squirrel-hair brush will assist in this process. Since the transmitter-receiver equipment is normally enclosed within an airtight casing, the presence of excess dust, dirt or moisture should be fully investigated.

7. Carefully examine the unit to ensure that it is free from damage and corrosion, with all components securely retained in position. Particular attention should be paid to the valve screening cans. Any loose components must be securely refitted. Should it be necessary to change any components, it is important to ensure that the items are positioned accurately and correctly connected. Reference to the component layouts shown in Vol. 1, Part 1, Chap. 5, fig. 21, 22 and 23, will assist in component replacement.

8. All screws and nuts removed during inspection or servicing and which are not fitted with lockwashers must be locked with an approved varnish when refitted.

Wiring

9. The wiring of the unit should be carefully inspected for continuity and conformity with the circuit shown in Vol. 1, Part 2, Chap. 1, fig. 9.

This inspection should consist of a point-to-point test or such electrical test which will confirm the accuracy of the wiring. The equipment should be examined for neatness of soldering, absence of dry joints, and a generally satisfactory condition of the wiring and insulation, with particular attention paid to the sleeving covering the connections to the multipole plug (P401). No inadvertent interconnections or tracking paths should be permitted due to excess solder, wire clippings, or dirty connections.

10. It is important to ensure that the rectifiers (CR401 and CR402) and the electrolytic capacitors (C402, C408 and C405) have been wired correctly with regard to polarity. These capacitors are of the tantalum electrolytic type, and it is important that if renewal is necessary the wire is formed into a swan neck before connection in order to avoid excessive strain or heat which may affect the weld.

11. To assist in servicing, a wiring diagram is given in fig. 1 at the end of the chapter. It is important to ensure that any rewiring is carried out correctly, and that lengths, gauge of wire and colour coding are replaced as in the original (unless modification requirements necessitate changes). A cableform wiring key is listed in Table 1 which, when used in conjunction with the wiring diagram, will assist should any rewiring become necessary. In Table 1, the abbreviations R.B. and F.B., followed by a tag number are used to indicate tags on the rear and front boards respectively, shown in fig. 1.

TABLE 1

Cableform wiring

From	Wire Colour	Marker	Length (in.)	To
P401/1	Pink	-	$5\frac{1}{2}$	R.B./35
" /1	Yellow	-	6	R.B./33
" /3	Tan	-	$4\frac{5}{8}$	F.B./22
" /4	Blue	-	4	F.B./15
" /5	Orange	-	$7\frac{1}{4}$	R425/3
" /6	Maroon	White	$5\frac{1}{8}$	F.B./17
" /7	Green	White	$1\frac{1}{2}$	F.B./54
" /8	Brown	-	$3\frac{3}{4}$	F.B./31
" /9	Yellow	-	$2\frac{3}{4}$	F.B./5
" /10	Black	-	6	R.B./14
" /11	White	-	$2\frac{3}{4}$	F.B./3
" /12	Red	White	6	F.B./37
" /12	Red	-	$7\frac{1}{4}$	R.B./30
" /13	Light Blue	-	$2\frac{1}{2}$	F.B./28

From	Wire Colour	Marker	Length (in.)	To
P401/14	Light Green	Black	$2\frac{1}{8}$	F.B./52
" /15	Grey	-	$3\frac{1}{4}$	F.B./2
F.B./1	Grey	-	$3\frac{3}{4}$	R.B./46
" /4	White	-	6	R.B./1
" /12	Blue	-	3	T401/2
" /16	Pink	-	$5\frac{1}{2}$	J401
" /21	Orange	-	3	T401/3
" /23	White	-	3	T401/6
" /27	Maroon	-	$7\frac{3}{4}$	R.B./26
" /29	Black	-	$2\frac{3}{4}$	K401/8
" /30	Brown	-	$4\frac{1}{2}$	K401/7
" /35	Red	-	3	K401/6
" /36	Red	-	8	R.B./40
" /38	Red	-	4	T401/1
" /39	Blue	-	4	R418/3
" /40	Clear	-	4	R418/1
" /41	Grey	-	4	R425/1
" /41	Grey	-	$2\frac{1}{2}$	J402
" /42	Black	-	4	R415/1
" /43	Brown	-	$4\frac{1}{2}$	R415/2
" /44	Brown	-	$4\frac{1}{2}$	R415/3
R.B./53	Light Green	-	$5\frac{3}{4}$	R.B./41
F.B./55	Green	-	$7\frac{1}{4}$	R.B./11
R.B./4	Blue	-	As reqd.	R.B./13
R.B./10	Blue	-	1	L401/4
" /12	Green	-	$2\frac{3}{4}$	R407/2
" /13	Blue	-	$3\frac{1}{4}$	R407/3
" /15	Clear	-	$3\frac{1}{2}$	K401/4
" /21	White	-	4	K401/3
"/21	White	-	2	R407/1

From	Wire Colour	Marker	Length (in.)	To
R.B./22	White	Black	5	J403
" /27	Yellow	-	4½	K401/2
" /29	Pink	-	4½	K401/1
" /36	Blue	-	6	K401/5
" /42	Pink	-	1	L401/2
" /47	White	-	1	L401/1
R418/2	White	-	1	R415/2
R418/2	White	-	1	R425/2

Servicing

12. In view of the comparative simplicity of this unit, little servicing should be necessary. Renewal of components and any rewiring required should be a simple matter of standard procedure, needing no special instructions.

WARNING

ELECTRIC SHOCK. Before any attempt is made to service or replace any item found defective during any part of the tests the power supply must be switched off, or preferably, entirely disconnected from the equipment.

TESTING USING STANDARD EQUIPMENT

Test equipment

13. The test equipment required for all tests described in this series should be available from Service stores. Electronic characteristics and physical features of this equipment are as follows:-

(1) Audio frequency signal source - A signal generator should be used having an output level adjustable from 70 c/s to 20,000 c/s. The source impedance should not exceed 1,000 ohms and the distortion factor of the output waveform should not exceed 1 per cent with a generator load of 100 milliwatts at 1,000 c/s, e.g. signal generator Type 65B or equivalent.

(2) Carrier squelch signal source - This must be a d.c. generator having an output level adjustable from zero to ten volts with a source impedance of 470,000 ohms ± 10 per cent. An output voltage control should give a zero output level when set fully clockwise. The meter should be calibrated in open-circuit volts.

(3) Wattmeter, absorption, CT44 (Ref. No. 10AF/98).

or

(3A) Output meter Type 2 (Ref. No. 10S/11934).

(4) Indicator, distortion (Ref. No. 10S/17639).

or

(4A) Test set Type 35 (Ref. No. 10S/74).

(5) Multimeter Type 1

(6) Multimeter, electronic, CT38.

14. It is essential to ensure that the test equipment is serviceable before commencing the tests. The simplest way of proving the equipment is by the substitution-test method, whereby a module of known serviceability is coupled correctly into the test equipment and the performance verified. This measure is recommended with either series of tests which may be carried out, i.e. using standard or special-to-type test equipment.

15. In the subsequent test procedures it is assumed that all test equipment will be operated in accordance with the standard instructions given in the appropriate Air Publications.

Power supplies

16. For the series of tests using standard equipment, the module must be supplied with power as specified hereunder:-

(1) A valve heater supply with an on-load voltage of between 6.2V and 6.4V d.c. or 50 c/s a.c.

(2) An h.t. supply having an on-load voltage of between 127V and 132V with a source impedance not greater than 5 ohms and a ripple content not exceeding 50 millivolts r.m.s. when the supply is loaded to 60 milliamps.

(3) A bias supply, the on-load voltage of which must be between 27V and 28V d.c. with the source impedance not greater than 10 ohms and a ripple content not exceeding 20 millivolts r.m.s. when the supply is loaded to 50 milliamps. Two positive supply terminals are necessary; one connected direct to source and the other through a resistor of 380 ohms ± 10% and a switch which, for reference purposes, should be clearly marked AUTO RELAY.

Dummy loads

17. The output of the main audio and sidetone amplifiers should be terminated with a non-inductive load of 300 ohms ± 10%, or 50 ohms ± 10% (according to circuit linkage). Means should be included for measuring the a.f. power output over a range from zero to 1500mW i.e. CT44 and of measuring the distortion factor of an a.f. waveform, i.e. indicator distortion.

18. The auxiliary audio amplifier should be terminated in a resistive load of 20,000 ohms ± 10% and include means for measuring the audio output level from zero to five volts r.m.s. over a frequency range of 70 c/s to 20,000 c/s, i.e. CT38.

Arrangement of test equipment

19. To provide the correct operating conditions, the supplies and loads referred to in para. 13 to 18 should be connected as follows:-

(1) Valve heater supply - poles 9 and 14 of the multipole plug (P401) should be connected together and the 6.3V heater supply (para. 16 (1)) connected between pole 9 and pole 15 of (P401).

(2) H.T. supply - with poles 11 and 14 of the plug connected together, the 130V h.t. supply (para. 16(2)) should be connected with the positive pole to pole 12 and the negative pole to pole 11 of the multipole plug (P401).

(3) Bias supply - the direct positive terminal of the 27.5V d.c. bias supply should be connected to pole 2 and the negative terminal connected to pole 11 of the plug (P401). The AUTO RELAY terminal (para. 16(3)) should then be connected to pole 6.

(4) Carrier squelch signal source - the positive pole of this source (para. 16(3)) should be connected to pole 10 with the negative pole to pole 11 of the plug (P401).

(5) Audio-frequency signal source - one terminal of the source should be connected to pole 11 of the plug and the other terminal connected to the arm of a single-pole, four-way switch. For the purpose of this test the switch should be indexed and connected as follows:-

Index	Plug pin No.
SIDETONE	4
AUXILIARY AUDIO	13
MAIN AUDIO	8
GUARD	5

Note...

Except when the switch is used in the GUARD position, pole 5 of the plug should be connected to pole 11 through a capacitor of 0.01μF ± 20% in series with a resistor of 6,800 ohms ± 10%.

(6) Main audio and sidetone amplifier load - the 50 (or 300) ohm load should be connected between poles 3 and 11 of the plug.

(7) Auxiliary audio amplifier - connect the 20,000 ohm audio load between poles 7 and 11 of the plug.

(8) Test points N, P and R should be unterminated.

20. Observe that the squelch linkages in the amplifier unit, AF are connected for signal-to-noise squelch operation and that the linkage of the secondary windings of the output transformer are connected for a 300-ohm load.

Guard audio amplifier

21. Set the S/N THRESHOLD and GUARD controls fully clockwise and the MAIN and SIDETONE controls to approximately midway. Set the AUTO RELAY switch (para. 16(3)) to the open position, then switch the a.f. signal source to GUARD.

Sensitivity

22. Set the frequency of the a.f. signal source to 1,000 c/s and adjust the output voltage level in order to obtain an audio output level of 250mW. The output voltage level should not exceed 5V open circuit.

(1) Whilst maintaining the level of signal input, change the frequency of the a.f. signal to 3,000 c/s.

(2) Set the GUARD audio control fully counter-clockwise. The output power level should not exceed one milliwatt.

Frequency response

23. Set the GUARD audio gain control fully clockwise and adjust the input signal frequency to 1,000 c/s; then set the input signal level to obtain a main audio output power level of 250 milliwatts.

(1) Holding the level of signal input constant, change the signal frequency from 300 c/s to 3,000 c/s. The output power level of the guard audio amplifier should remain between +1dB and -2.5 dB of 250 milliwatts.

(2) Maximum h.t. current drawn should be 55 milliamps.

Operation of squelch

Tests with signal-to-noise linkages

24. Connect the squelch linkages for signal-to-noise operation and the secondary winding linkage of the output transformer for a 50-ohm load.

(1) Set the MAIN, SIDETONE, GUARD and S/N THRESHOLD controls of the a.f. amplifier unit fully clockwise. Set the AUTO RELAY switch to the open position. Set the carrier squelch signal source to zero level.

(2) A positive d.c. voltage of between 5V and 7V should be evident on pole 1 of the multipole plug with respect to the frame.

(3) Switch the a.f. signal source to AUXILIARY AUDIO and adjust the input signal frequency to 2,000 c/s, the level of which should be set so that the squelch relay just operates as evinced by an aural click. The relay should again operate when the S/N THRESHOLD control is rotated in a counter-clockwise direction.

Tests with carrier squelch linkages

25. Connect squelch linkages in the amplifier unit for carrier squelch operation and the secondary winding linkage of the output transformer for a 50-ohm load.

(1) Set the SIDETONE and GUARD controls to approximately midway, then set the S/N THRESHOLD and MAIN controls fully clockwise and the AUTO RELAY switch to the open position.

(2) Switch the a.f. signal source to MAIN AUDIO and, after setting the operating frequency to 1,000 c/s, adjust the output voltage level to obtain 250 milliwatts of main audio output power.

(3) The carrier squelch signal source output voltage should be adjusted to the level at which the squelch relay is de-energized, as indicated by a sudden fall in audio output power. Such a signal level should not exceed 6.5V open circuit, whilst the main audio output power level falls to not more than 5 mW.

(4) The squelch signal source output voltage is now adjusted to the level at which the squelch relay is energized. This will give rise to a sudden increase in the audio output power level. The source output voltage level should be not less than 4V open circuit whilst the difference between the relay energizing and de-energizing voltage levels should not exceed 0.5V open circuit.

(5) With the a.f. signal source switched to AUXILIARY AUDIO, set the signal frequency at 400 c/s and adjust the signal level to 1V open circuit.

(6) Reset the carrier squelch signal source to zero level and rotate the S/N THRESHOLD control fully clockwise, whereupon the voltage level at test point 'R' should not be less than 5 volts positive with respect to the frame, measured on the CT38.

(7) Increase the a.f. signal frequency to 20,000 c/s then set the signal level to 1V, open circuit. With the S/N THRESHOLD control set fully counter-clockwise, the voltage level at test point 'R' should not be less than 7 volts negative with respect to frame. Now set the squelch signal source to 7 volts, whereupon the potential on test point 'R' should disappear.

Sidetone amplifier

26. Set the S/N THRESHOLD and SIDETONE controls fully clockwise, the MAIN and GUARD controls to approximately midway and the AUTO RELAY switch to the open position. The a.f. signal source should be switched to SIDETONE AUDIO and the carrier squelch signal source set to zero input level.

Sensitivity

27. Set the a.f. signal frequency to 1,000 c/s and adjust the output voltage level to obtain a dissipation of 250 milliwatts in the main audio amplifier load. The voltage level should be not in excess of 1.5V open circuit.

28. Without changing the voltage level, increase the input frequency to 3,000 c/s. Then, with the SIDETONE control set fully counter-clockwise, the output power level should not exceed one milliwatt.

Frequency response

29. Set the SIDETONE control fully clockwise.

(1) Initially, the a.f. signal source should be set to 1,000 c/s with an output voltage level such that 250 milliwatts is produced in the main audio output load. Now, keeping the output voltage constant, set the a.f. signal frequency first to 300 c/s and then to 3,000 c/s.

(2) The sidetone audio output power level should be within 0 dB and -2 dB of 250 milliwatts at 300 c/s and between 0 dB and -5 dB of 250 milliwatts at 3,000 c/s.

Automatic relaying

30. With the SIDETONE control set fully clockwise, adjust the carrier squelch signal source to 7V open circuit.

(1) Set the a.f. signal frequency to 1,000 c/s and adjust the output voltage level to produce 250 milliwatts in the main audio output load.

(2) Close the AUTO RELAY switch and, keeping the output voltage level constant, change the frequency input to 3,000 c/s. The output power level in these conditions should not exceed one milliwatt.

Auxiliary audio amplifier

31. Set the S/N THRESHOLD, MAIN, SIDETONE and GUARD controls fully clockwise and open the AUTO RELAY switch. Additionally, the a.f. signal source should be switched to AUXILIARY AUDIO and the carrier squelch signal source reverted to zero level.

Sensitivity

32. The a.f. signal source should be set to 1,000 c/s with an output voltage level adjusted to 1.5V, open circuit. Under these conditions the auxiliary audio amplifier output voltage should not be less than 900 millivolts.

Frequency response

33. Starting from 70 c/s, increase the signal frequency through 3,000 c/s and 10,000 c/s up to 20,000 c/s maintaining the output voltage level of the amplifier constant by varying the input. It should not be necessary to vary the input by more than 0.5dB on either side of the 1.5V setting (para. 32).

Distortion factor

Note...

The distortion factor is defined as the square root of the sum of the squares of the harmonic voltages expressed as a percentage of the total r.m.s. voltage.

34. When the a.f. signal source is set to 1,000 c/s with an output voltage of 1.5 volts open circuit, the distortion factor of the audio output should then not exceed 1.5%.

Main audio amplifier

35. The S/N THRESHOLD and MAIN controls should be turned fully clockwise; then the SIDETONE and GUARD controls set approximately midway. Switch the a.f. signal source to MAIN AUDIO.

Sensitivity

36. Set the signal frequency to 1,000 c/s and adjust the output voltage level to obtain a dissipation of 250 milliwatts in the main audio amplifier load. This voltage should not exceed 1 volt (open circuit).

37. Keeping the voltage level steady, increase the signal frequency to 3,000 c/s and in turn rotate the MAIN control fully counter-clockwise. The output power level should not exceed one milliwatt.

Frequency response

38. Reset the MAIN control fully clockwise and set the signal frequency to 1,000 c/s. Adjusting the output level to produce 250 milliwatts in the main output load.

39. While maintaining the output voltage level of the signal source constant, vary the frequency from 300 c/s to 3,000 c/s. The main audio output power level should remain within +1 dB and -2.5 dB of 250 milliwatts.

Distortion factor

40. See note in para. 33. The distortion factor should not exceed 6% when the a.f. signal source is set to 1,000 c/s and its output adjusted to produce 250 milliwatts of main audio power output.

TESTING USING SPECIAL-TO-TYPE EQUIPMENT

Special-to-type test equipment

41. The test equipment designed by the manufacturers for the amplifier unit, AF is known as the test set, audio (Ref. No. 6625-99-943-6544). The module under test is secured on the test set with four captive screws and the multipole plug P401 mates with a multipole socket integral with the test set. Connections are provided for an external signal source, a wattmeter, distortion indicator, valve voltmeter and power supplies.

42. The loads referred to in para. 17 and 18 of this chapter are incorporated in the test set and the associated switches are mounted on the front panel. Further details of this test set may be found in Part 2, Sect. 1 of this Volume and a description of the R.N. overall module test kit, which includes a test set for the amplifier unit, AF, is contained in Vol. 1, Part 2, Chap. 2 of this Air Publication.

Test procedure

43. Secure the unit under test on the test set and connect the external test equipment (para. 41) to the appropriate terminations on the set.

44. Observe that the squelch linkages and the output transformer are connected as in para. 20. Then switch on the power supplies and commence the test procedure described in para. 21 to para. 40 inclusive.

Assembly after test

45. Examine the unit and ascertain that any damage, possibly sustained during testing, is made good.

46. Ensure that the seven squelch linkages together with the impedance matching linkages on the output transformer are correctly soldered to provide the desired type of squelch control.

47. The amplifier unit, AF is retained in position on the chassis by four captive screws. Two dowels are provided in the back of the unit to ensure correct alignment so that the multipole plug in the base of the module will engage correctly with the multipole socket in the equipment chassis.

48. Following the assembly of all components into the chassis and refitting of the cover, full functional tests should be carried out as detailed in Sect. 1, Chap. 1 of this volume. Pressurization should follow as described in Sect. 2, Chap. 17.

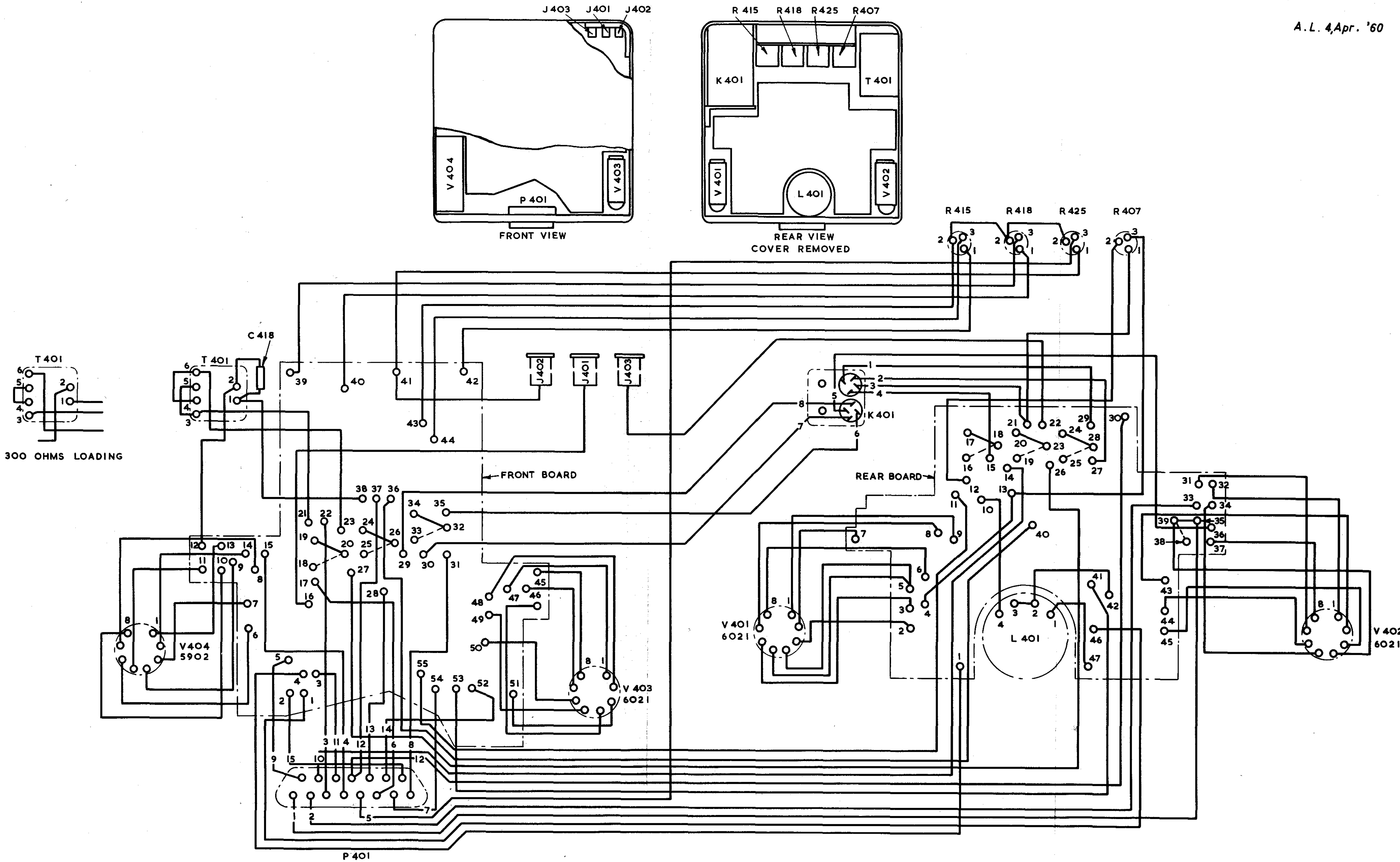

Fig. 1 ARI.18124/1 and ARI.18124/2 — amplifier unit, AF — wiring diagram

Chapter 7

SPECTRUM GENERATOR UNIT (AMPLIFIER - OSCILLATOR)

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General

1. The spectrum generator (amplifier-oscillator) unit comprises essentially two sections; a crystal oscillator whose output is passed to an amplifier; both sections are mounted on a common chassis. The frequency of the crystal oscillator is derived from eighteen inductors and fifteen crystals, three crystals are used twice to give eighteen outputs varying by 10 Mc/s from 200 Mc/s to 370 Mc/s. Frequency stability is maintained by banking the crystals in a thermostatically-controlled oven, whilst frequency selection is made by switching the appropriate crystal and inductor in the circuit through a common switch shaft driven by an Oldham coupler and gearing from the mechanical tuning unit. The oscillator output is doubled or trebled and then trebled again in the amplifier section prior to amplification. Tuning of the amplifier is provided through ganged tuning circuits. The oscillator section and the amplifier gangs are driven from the Oldham coupler via gears; the gear for the amplifier gang having a reduction of drive in the ratio 2 : 1.

2. The sub-unit is secured to the main transmitter-receiver chassis by three captive Phillips-type screws. These are painted red and are accessible from the underside of the unit when the sealed cover is removed. The method of removing the cover for access, its replacement and subsequent pressurizing are given in Chap. 17 of this Section, whilst details of removal of the sub-units are given in Vol. 1, Part 1, Chap. 5 of this Air Publication. Details of the procedure for dismantling and assembly given in subsequent paragraphs will be supplementary and limited to requirements for repair or replacement of components.

WARNING

> It is essential that the equipment is indexed to 220.0 Mc/s before any attempt is made to extract the unit from the main chassis since, in this position, the frequency selector mechanism is correctly aligned for unit withdrawal and refitting.

3. The inspection procedures and tests outlined in the following paragraphs reveal the salient performance characteristics of the equipment and will indicate whether or not the spectrum generator unit is operating to the original specification. The tests should follow all repairs and renewal of components, or when specified as routine matters in preventive servicing.

Test equipment

4. The equipment required for servicing and testing the spectrum generator unit (amplifier-oscillator) is listed in Table 1. Further information on certain items may be obtained by reference to Sect. 1 of this publication.

TABLE 1

List of test equipment

Item	Ref. No.	Nomenclature	Para.	Further details
1	10AG/968	Drill and ream jig	17	Sect. 1
2	10AG/955	Height gauge	17	-do-
3	5120-99-943-9324	Screwdriver torque tester	17	-do-
4	5120-99-120-0868	Screwdriver bit	17	-do-
5	10AG/969	Checking fixture	18	-do-
6	1B/1770	Surface plate	18	-do-
7	1B/5764	Gauge, dial type	18	-do-
8	9150-99-932-4820	Lubricating oil	19	
9	-	Oil, electrical	19	Viscosity Oil Co. (USA) 7069 (See Note)
10	9150-99-942-3152 (34B/304)	Grease XG.295 (4 oz. tube)	19	
11	5821-99-932-2942	Power unit	20	Sect. 1
12	6625-99-999-1046	Test jig, oscillator	20	-do-
13	10S/9438384	Multimeter, valve CT429	21	Marconi TF1041B
14	6625-99-999-3591	Wattmeter, absorption CT443	21	
15	6625-99-943-6879	Monitor, radio frequency	22	Sect. 1
16	6625-99-999-2642	Calibrator, frequency	23	-do-
17	5821-99-932-1916	Test side cover	32	-do-
18	5120-99-942-1514	Tuning wand	33	-do-

<u>Note...</u>

Possible British equivalents are being investigated at the time of print.

<u>Component inspection</u>

5. Inspect for correctness the details of equipment serial numbers and modification state entered on the repair card accompanying the unit.

6. Remove the side covers by unscrewing the retaining screws. Then, using a portable blower or other approved supply of dry air under pressure,

thoroughly clean the unit of all dust. Where necessary, a soft squirrel-hair brush will assist in this process. Since the transmitter-receiver equipment is enclosed within an airtight casing, however, the presence of dust, dirt or moisture should be fully investigated.

7. Carefully examine the unit to ensure that it is free from damage and corrosion, with all components securely retained in position. Any loose components must be securely refitted. Should it be necessary to change any components, it is important to ensure that the items are positioned accurately and correctly connected. Component layouts given in Vol. 1, Part 1, Chap. 5, will assist in item identification.

8. Screws and nuts removed during inspection or servicing and which are not fitted with locknuts or lockwashers, must be locked with an approved varnish when refitted, i.e. blue Glyptol varnish.

Wiring

9. The wiring of the unit should be carefully inspected for continuity and conformity with the circuit shown in Vol. 1, Part 2, Chap. 1. This inspection should consist of a point-to-point test or such electrical tests which will confirm the accuracy of the wiring. The equipment should be examined for neatness of soldering, absence of dry joints and a generally satisfactory condition of the wiring and insulation with particular attention paid to the sleeving covering the connections to the multipole plug. No inadvertent interconnections or tracking paths should be permitted due to excess solder, wire clippings or dirty connections.

10. To assist in servicing, a wiring diagram is given at fig. 1. It is important to ensure that any replacement wiring is done correctly and that lengths, gauge of wire and colour coding are replaced as in the original (unless modification requirements necessitate changes). In Table 2 is listed a wiring key which, when used in conjunction with the wiring diagram, will assist in replacement of any wiring.

TABLE 2

Wiring key

From	Colour	Length (in.)	To
P501/1	Red	$2\frac{7}{8}$	Plate 1/3
" /3	Black	$4\frac{7}{8}$	" 3/2
" /8	White	$2\frac{1}{2}$	ET 1
" /10	Yellow	3	Plate 1/4
" /11	Light green	$2\frac{1}{2}$	" 1/1
" /12	Grey	25/8	" 1/2
ET1	White	$10\frac{1}{8}$	Amp 1
ET1	White	$2\frac{1}{2}$	Plate 1/6
Plate 1/1	Light green	$3\frac{1}{2}$	" 2/1
" 1/1	" "	12	Amp 8
" 1/2	Grey	$3\frac{1}{2}$	Plate 2/2

Plate 1/2	Grey	$12\frac{1}{4}$	Amp 10
" 1/3	Red	$3\frac{1}{2}$	Plate 2/3
" 1/3	"	$12\frac{7}{8}$	Amp 11
" 1/4	Yellow	$11\frac{1}{2}$	Amp 5
" 1/6	White	2	Plate 2/4
" 1/5	-	-	C510
C510	-	-	C506
Plate 1/7	White	$2\frac{3}{4}$	Amp 1
L532	-	2	Amp 2
Plate 2/4	White	$2\frac{1}{2}$	Plate 3/4
" 2/5	Blue	$1\frac{1}{2}$	" 3/1
" 2/6	"	$2\frac{1}{4}$	Xtal busbar
" 2/7	Yellow	3	Plate 3/5
" 2/8	"	3	" 3/3
Amp 3	Red	-	Amp 7
" 7	"	-	" 11
" 4	Grey	-	" 10

WARNING

ELECTRIC SHOCK. The power supply to the spectrum generator unit must be switched off or, preferably, completely disconnected before any attempt is made to service the unit or to renew any of the components.

Servicing

11. The replacement or renewal of most of the components in this unit should be a matter of standard procedure, the few cases requiring special attention are detailed in the following paragraphs.

12. The printed circuit presents special problems with regard to servicing. A printed circuit board may be irreparably damaged by the sustained heat from a soldering iron. The recommended method to be adopted when renewing a component on a printed circuit board is as follows:-

(1) Remove the faulty component from the board by clipping the wires as close to the component as possible. This leaves the wire ends still fastened to the printed board.

(2) Prepare the wire ends of the new component and make a mechanical joint with the wires attached to the printed board. (Fit the new component so that its value is uppermost and readable).

(3) Solder the connections as quickly as possible using only a lightweight soldering iron.

13. When handling the unit with side covers removed, care should be taken to avoid disturbing the inductors L531 and L532 (para. 29(1)).

14. Should it become necessary to renew any part of the gear assembly, first remove the two side covers of the spectrum generator section and slacken the grub screws retaining the switch shaft spur gear to the shaft. Stand the unit on end with the Oldham coupler uppermost and unscrew the six retaining screws. Then place the unit on a bench with the amplifier side underneath and gently lower the base plate, care being taken to avoid damage or strain to the cableform. Plug P501 and its associated cableform may now be released from the base plate.

Switch shaft removal

15. Remove the base plate as described in para. 14 and release the collar grub screw at the oven end of the switch shaft. Then carefully withdraw the shaft. Before sliding in a new shaft first ascertain that the switch arms are correctly aligned, i.e. the arms of the first three switches (S505, S504, S501) above the gear plate should be in line while the arm of switch S502 should be positioned to a further 180° relative to the others. Then, after sliding in the shaft ensure that the shaft collar is positioned so that longitudinal play is between 0.010 in. and 0.020 in.

16. Refitting of the base plate is achieved by adopting the reverse procedure for dismantling; but correct alignment of the switch shaft and amplifier tuning shaft must be observed. With the wiper of switch S501 positioned as shown in fig. 2, the r.f. tuning capacitors of Z501, Z502 and Z503 must be fully meshed. After one complete revolution of the switch wipers, the tuning capacitors should be fully open, i.e. two revolutions of the switch wipers are completed before the tuning capacitors are again fully meshed.

Oldham coupler renewal

17. The method for drilling, reaming and pinning a new Oldham coupler to the unit, using the drill and ream jig (Table 1, item 1) is as follows:-

(1) Fit the coupler plate on to the drive shaft and slide the G shaped plate of the jig under the coupler plate. The G shaped plate ensures that the coupler is positioned to the correct height relative to the unit base plate.

(2) Carefully ease the drill and ream jig on to the bottom of the unit ensuring that the coupler plate and unit base plate dowels fit into the jig recesses. Now tighten the jig captive screws which secure the jig to the unit base plate.

(3) Adjust the centre knurled spindle until the coupler plate is firmly held by the jig and the unit shafts are in the 200 Mc/s position (fig. 2 and 3) then tighten down the locking screw.

(4) Drill through the coupler plate and shaft using a No. 50 (0.070 in.) drill and ream the drilled hole for the taper pin.

(5) Remove the jig from the unit base plate and after aligning the reamed hole in the coupler plate and shaft, insert the taper pin; trim any protrusion of the pin flush with the coupler plate.

(6) Remove the G plate and fit the coupler ring and O ring so that, when the coupler ring spigot is adjacent to the silk screen hole on the base plate, the capacitor vanes and switch rotors are in the 200 Mc/s position.

(7) Using the torque gauge (Table 1, items 3 and 4), measure the coupler shaft torque in a counter-clockwise direction, this torque should not exceed 12 oz in.

(8) Verify the coupler height in relation to the base plate using the height gauge (Table 1, item 2).

18. The coupler alignment, relative to the capacitor and switch shafts, may be verified using the checking fixture (Table 1, item 5) as follows:-

(1) Remove the O ring and coupler ring then fit the checking fixture on to the unit base plate.

(2) Lay the fixture on the surface plate (Table 1, item 6) so that the coupler aperture is at 90° with the surface plate.

(3) Lay a straight edge along the leading ends of a capacitor gang and rotate the coupler plate until the rotor vanes are flush with the stator vanes; the switch shaft should be positioned so that S501 wiper is set as shown in fig. 2. Without disturbing the coupler plate position, use the dial type gauge (Table 1, item 7) to verify that the coupler plate dogs are parallel with the surface plate by taking a reading from end to end on the dogs; this reading should be within ± 0.0015 in.

(4) Unload the checking fixture from the base plate. Refit the coupler ring and O ring so that the coupler ring spigot is adjacent to the silk screen datum ring on the base plate when the unit is in the 200 Mc/s position.

Lubrication

19. Apply a thin film of grease (Table 1, item 10) to the gear teeth and remove any excess after rotating the gear train several times. The shaft bearing should be lightly lubricated with item 8, Table 1, and any excess lubricant removed. Inductance wipers, shaft wipers and switch contacts should be cleaned and lubricated with a composition of 50% carbon tetrachloride and 50% oil (Table 1, item 9).

Arrangement of test equipment

20. Fit the unit under test on the test jig, oscillator (Table 1, item 12) and connect the test jig to the power unit (Table 1, item 11) using the connector supplied with the power unit. Ensure that the mains switch is in the off position then connect the power unit to the bench supply source, i.e. 115V or 230V, 50 c/s.

21. The CT429 (Table 1, item 13) should be connected across test point H and chassis of the unit under test; the output power meter (Table 1, item 14) should be connected to J501.

22. The output level of the unit under test may be measured with the CT443, or alternatively, by the CT429 in conjunction with the monitor, radio frequency (Table 1, item 15). If the CT429 is used to measure the output level then the monitor, radio frequency, should be connected

between the J501 and CT429.

23. The calibrator, frequency (Table 1, item 16) is connected through the coaxial connector to J501, as required, but the instrument should have the heater and oven supplies switched on throughout the testing of the spectrum generator unit.

Test procedure

24. Set the power unit switches as follows:-

BIAS to OFF
HT1 to OFF
HT2 to ON (adjust for 130V)
27.5V D.C. to OFF

Oven operation

25. When the oven has been operating for not more than five minutes (when previously it had been inoperative for at least one hour) it should be determined that the thermostatic switch S503 is functioning as follows:-

(1) Set the voltmeter switch on the power unit to 26.5V.

(2) Set the power unit (MAINS) switch to ON and observe the power unit voltmeter for a rise in voltage as the thermostatic switch opens.

H.T. current

26. When the equipment has been operating for five minutes, set the power unit milliammeter switch to HT2 and ensure that the total h.t. current drawn does not exceed 100mA.

Spectrum generator

Tuning the Butler oscillator

27. Connect the CT429 to test point H and index the unit to the 200 Mc/s position. Then adjust the inductor L501 and the tuning capacitors C506 and C508 in that order to obtain maximum voltage reading in the CT429. Now index the unit successively to the frequencies listed in Table 3 and adjust the corresponding inductors to obtain maximum reading in the CT429.

TABLE 3

Oscillator inductance tuning

Index (Mc/s)	Inductor	Frequency (Mc/s)
200	L501	33.3333
210	L502	35.0000
220	L503	36.6666
230	L504	38.3333
240	L505	40.0000

250	L506	41.6666
260	L507	43.3333
270	L508	45.0000
280	L509	31.1111
290	L510	32.2222
300	L511	33.3333
310	L512	34.4444
320	L513	35.5555
330	L514	36.6666
340	L515	37.7777
350	L516	38.8888
360	L517	40.0000

Inertia

28. Index the equipment to each of the eighteen positions in turn and switch off and on the h.t. supply ten times. On each occasion when the h.t. supply is made, the CT429 meter reading should rise unhesitatingly to the working level obtained in para. 27.

Printed inductance circuits

29. Proceed as follows:-

(1) Tuning - Index the unit to the 280 Mc/s position and adjust the capacitor C506 for maximum voltage level in the CT429 connected to test point H. The unit should next be indexed to the 370 Mc/s position and the inductor L531 adjusted for maximum voltage; the adjustment of this inductor is accomplished by compressing the windings to increase inductance or expanding it to decrease inductance. Next, set the unit to operate on 280 Mc/s and repeat the tuning procedure described until the condition is met whereby further adjustment will not increase the output voltage level. Capacitor C508 and inductor L532 should be tuned in the same manner as C506 and L531.

(2) Activity - The equipment should be indexed to 200 Mc/s and then by 10 Mc/s intervals to 370 Mc/s. In each position, the voltage indicated on the CT429 at the test point H must not be less than 7.0 volts d.c.

Oscillator activity

30. When the spectrum generator has been correctly aligned, the unit should be indexed from 370 Mc/s through 10 Mc/s intervals to 200 Mc/s. At each 10 Mc/s increment the voltage developed at test point H should not be less than 7 volts over the range $\pm$ 2° of arc of the Oldham coupler.

NOTE...

Should adjustment to the switch registration be necessary as the result of this test (para. 30), advantage may be taken of the facility provided by the coupling collet and ring of the switch shaft. If the switch shaft is adjusted at this stage then the test (para. 30) should be repeated in full.

Oscillator inertia

31. At each of the eighteen positions, the h.t. supply to the unit should be switched off and on three times and on each occasion, when the supply is applied, the voltage level at test point H should rise unhesitatingly to the working level.

Amplifier

Alignment

32. The alignment of the three stages of the amplifier section can be performed concurrently. The method is to first set the trimmer capacitors (C517, C522, C526) at 370 Mc/s, then, at certain spot frequencies throughout the range, by bending the winged portions of the upper and lower rotor vanes of the main tuning capacitors; upper and lower being identified by the way the unit normally stands on the chassis, i.e. lower nearest the Oldham coupler.

33. It will be noticed that the vanes to be adjusted are not sectorised in the same way but are staggered. Thus, as alignment progresses the sector to be adjusted is alternately part of the upper vane then part of the lower. Also, the sectors of the vanes vary in size, the first to be adjusted is the second shortest followed by the third shortest, etc. To assist in the identification of the sector to be adjusted, each is colour coded; details of the colour coding and the frequency at which it should be adjusted is given in Table 4. The first sector (shortest) of each vane should not be adjusted in any alignment position.

34. Resonance may be verified by means of the tuning wand (Table 1, item 18). If the power output of the unit rises when the iron dust end of the wand is presented through the access hole of the test side cover, then further capacity is required and the appropriate sector of the vane should be bent nearer to the stator vane. Conversely, if the power rises when the brass end of the tuning wand is used, the appropriate sector of the vane should be bent further from the stator vane. Correct setting is obtained if the power falls when either end of the wand is presented.

35. The procedure is as follows. Remove the amplifier side cover and fit the test side cover (Table 1, item 17). Index the unit to the 370 Mc/s position and adjust the trimming capacitors C517, C522 and C526 for maximum power dissipation in the output power meter (para. 22). Then index the unit to the frequencies listed in Table 4 and adjust the appropriate sector of the vanes as described in para. 33.

TABLE 4

Sectorized colour code

Frequency (Mc/s)	Vane used	Sector coliur
360	Lower	Black
350	Upper	"
340	Lower	Red
330	Upper	"
320	Lower	Yellow
310	Upper	"
300	Lower	Blue
290	Upper	"
280	Lower	None
270	Upper	"
260	Lower	Black
250	Upper	"
240	Lower	Red
230	Upper	"
220	Lower	Yellow
210	Upper	"
200	Lower	None

36. When each tuning assembly has been completely adjusted, the test side cover should be removed and the standard one fitted. Index the equipment to 370 Mc/s and readjust the trimming capacitors C517, C522 and C526 for maximum power dissipation in the output meter.

Power output

37. The unit should now be indexed down through the eighteen positions and at each position the power output should not be less than 180 milliwatts.

Frequency

38. Connect the calibrator, frequency (Table 1, item 16) as in para. 23 with the input to the calibrator, frequency coupled via the attenuator. Set the H.T. switch to ON and set the crystal selector switch to the 10 000 kc/s position.

(1) Index the unit to the eighteen frequencies (Table 5) and measure the frequency error at each 10 Mc/s increment. The maximum permissible error is listed in Table 5.

(2) Should adjustment to frequency be necessary, it may be made by trimming the inductor corresponding to the oscillator frequency in error (Table 3). Any adjustment necessary should not cause the voltage level at test point H to fall below 7.0V or 3dB below the tuned peak level, whichever is the greater. Repeat the procedures of para. 30 to 37 inclusive.

TABLE 5

Oscillator frequency error

Index	Nominal output frequency (Mc/s)	Maximum permissible error (kc/s)
370	370	3.88
360	360	3.78
350	350	3.68
340	340	3.58
330	330	3.48
320	320	3.38
310	310	3.28
300	300	3.07
290	290	3.08
280	280	2.98
270	270	2.82
260	260	2.72
250	250	2.62
240	240	2.58
230	230	2.42
220	220	2.32
210	210	2.22
200	200	2.12

39. On completion of the test procedures described, ensure that the power supplies are switched off before disconnecting the unit from the test equipment.

Assembly after test

40. Ensure that all components are correctly positioned in the unit

and any damage, possibly sustained during the testing, is rectified before fitting the unit on to the main chassis. The module is retained in position on the main chassis by three captive screws. These are of Phillips-pattern and the heads are painted red for identification purposes.

41. Two dowels are provided in the base of the unit to ensure correct alignment of the multipole plug in the base of the unit with the mating socket, thus avoiding damage to the pins of plug P501. Ensure that the Microdot type plug is securely fitted to J501.

42. Following the assembly of all components into the chassis and refitting of the cover, full functional tests should be carried out as detailed in Chap. 1 of this Section. Pressurization and leak testing should follow as described in Chap. 17 of this Section.

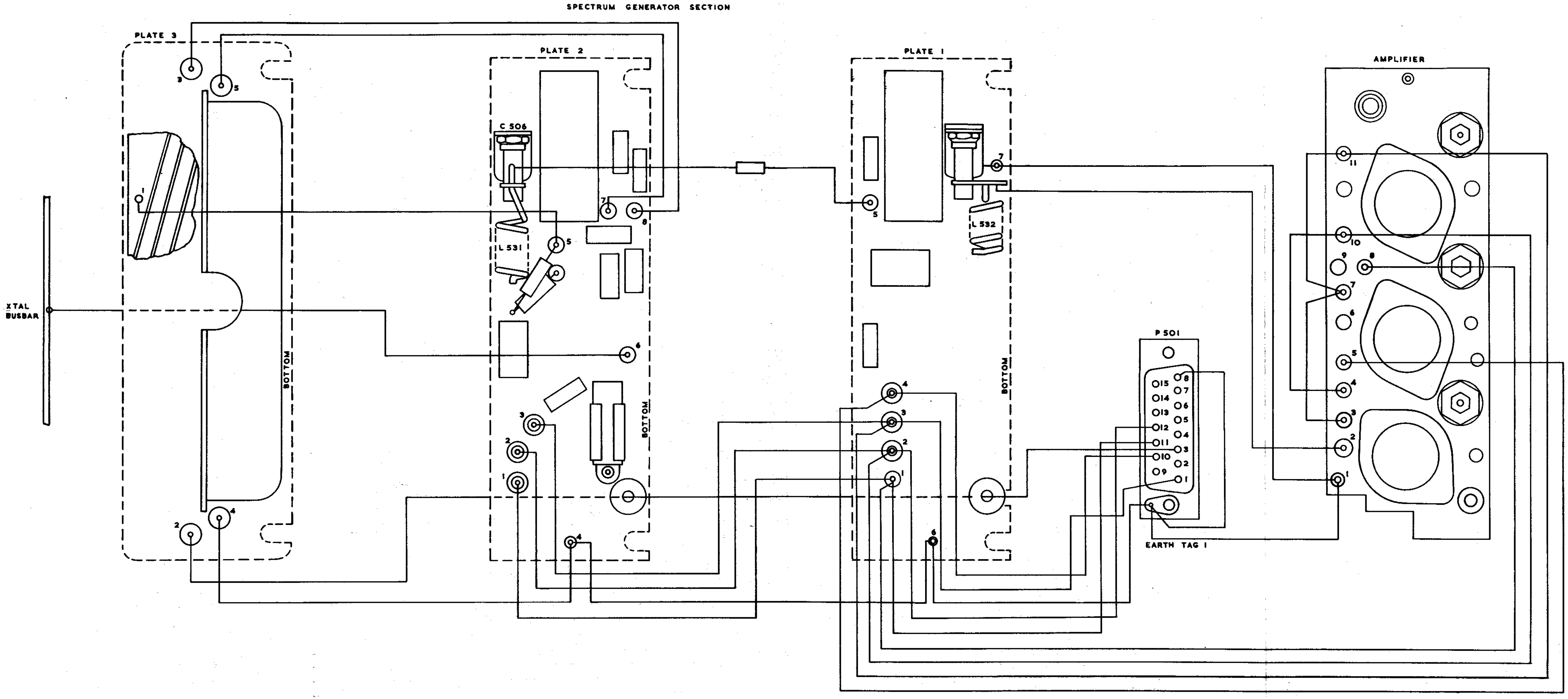

Fig.1 ARI. 18124/1 and ARI. 18124/2 — spectrum generator unit — (amplifier — oscillator) — wiring diagram

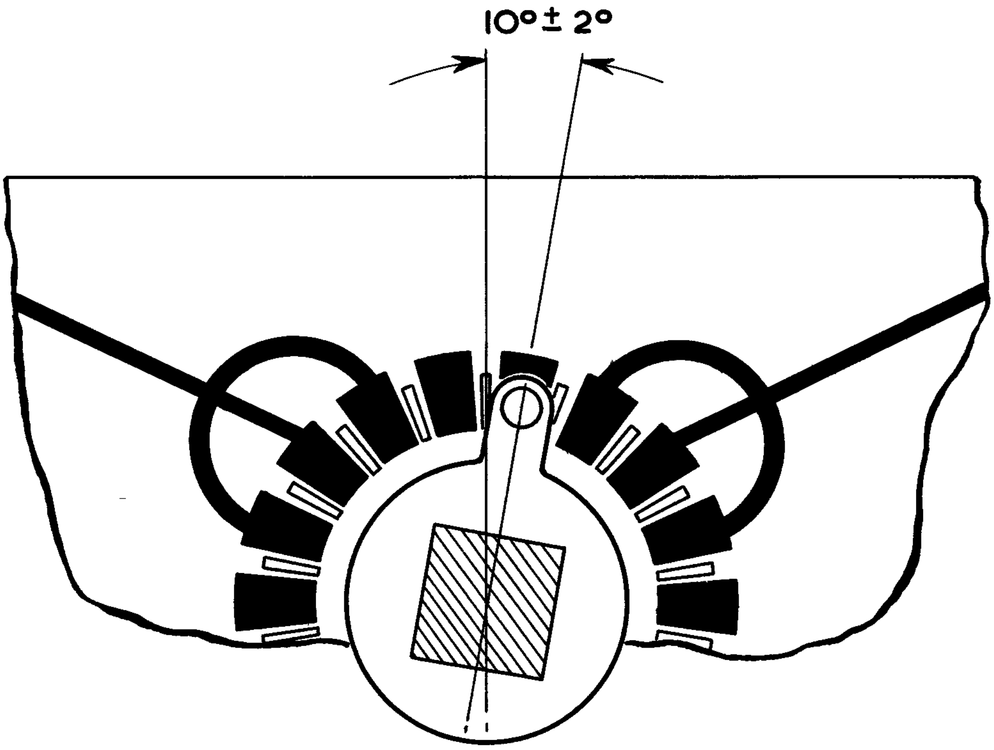

Fig. 2. 200 Mc/s setting for switch S501 wiper.

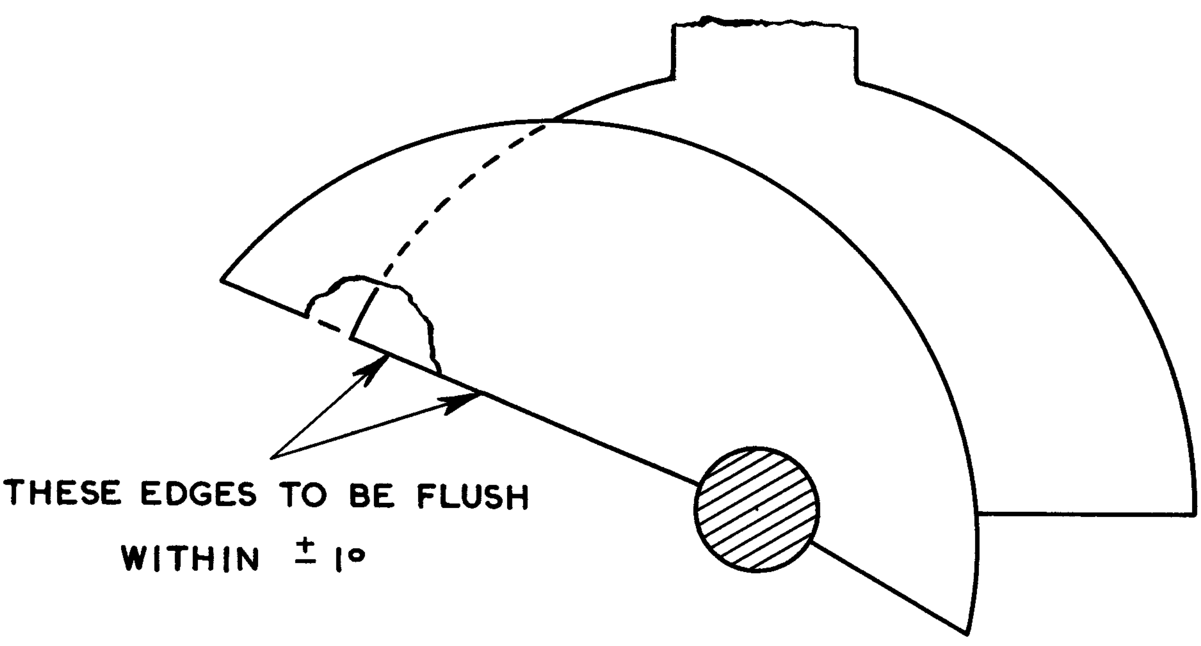

Fig. 3. 200 Mc/s setting for capacitor rotor vanes.

Chapter 8

AMPLIFIER, RADIO FREQUENCY

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General

1. This unit is a three-stage amplifier operating over the frequency range of 225.0 Mc/s to 399.9 Mc/s and it is employed in the transmitter section of TR4/ARC52 and TR5/ARC52 equipments to provide a carrier signal which, after amplitude modulation, is radiated by the aerial.

2. It is a self-contained, compact module secured to the transmitter-receiver chassis by four captive Phillips-type screws. These are painted red and are accessible from the underside of the chassis when the sealed cover is removed. Details of cover removal for access to sub-units, its replacement and subsequent pressurizing are given in Chap. 17 of this Section, whilst the procedure for removal and refitting of the modules (sub-units) making up the transmitter-receiver equipment are given in Vol. 1, Part 1, Chap. 5 of this Air Publication, to which reference should be made. Any dismantling or assembly procedures given in subsequent paragraphs will be supplementary and limited to requirements for repair and refitting of components where these may differ from normal standard practice.

Note...

> It is important to ensure that before this module is removed from the chassis, the 220.0 Mc/s channel is selected in order that the frequency selector mechanism is correctly aligned for sub-unit withdrawal and its subsequent refitting. Immediately upon removal of the amplifier, radio frequency (RF power amplifier) from the main chassis it is advisable to remove the Oldham coupler ring to prevent possible damage. For removal instructions see Chap. 15, para. 17 of this Section.

3. Inspection procedures and tests outlined in this chapter reveal the salient performance characteristics of the equipment and will indicate whether or not the r.f. power amplifier is operating to the original specification. The tests should follow all repairs and refitting of components, or when specified as routine matters in preventive servicing.

Test equipment

4. The test equipment required for servicing and testing the amplifier, radio frequency (RF power amplifier) is given in Table 1; further information on the equipment may be obtained by reference to the publication listed against each item.

TABLE 1

List of test equipment

Item	Ref. No.	Nomenclature	Para.	Further Details
1		Megger 1000V	15(1)	
2	6625-99-943-2442	Universal bridge CT375	15(2)	
3	10AG/944	Drill and ream jig	17(1)	Sect. 1
4	10AG/955	Height gauge	17(7)	"
5	10AG/959	Height gauge plate	17(7)	"
6	10AG/943	Checking jig	18	"
7	1B/1770	Surface plate	18(1)	"
8	1B/4764	Gauge, dial type	18(3)	"
9	1B/4110	Feeler gauges (includes 0.005 in. and 0.010 in.)	19(4) 20	
10	34B/304	Grease, XG295	21	
11		Oil, electrical	21	Viscosity Oil Co. (USA) 7069 (see note)
12	5120-99-943-9323	Screwdriver, tester	22	Sect. 1
13	5120-99-120-0868	Bit, screwdriver	22	"
14	5G/1621	Insulation resistance Tester Type A	23	
15		Test rig, power amplifier	19	Sect. 1
16	5821-99-932-2942	Power unit	24(7)	"
17	6625-99-943-5568	Wattmeter, absorption, CT419	24(6)	"
18	5120-99-942-1514	Tuning wand	31	"
19		Blower, air Type VBM-3, Air Control Institutes Ltd.	24	

Note...

Possible British alternatives for item (9) are being investigated at the time of going to print.

Component inspection

5. Inspect for correctness the details of equipment serial numbers and the modification state entered on the repair card or servicing documents which should accompany the equipment sent for inspection or overhaul.

6. Using a portable blower, or other approved supply of dry air under pressure, thoroughly clean the unit of all dust. Where necessary, a soft squirrel-hair brush will assist in this process. Since the transmitter-receiver equipment is normally enclosed within an airtight casing, however, the presence of dust, dirt or moisture should be fully investigated.

7. Carefully examine the unit to ensure that it is undamaged and free from corrosion, with all components securely retained in position. Any loose connections or components it is important to ensure that the new items are positioned accurately and connected correctly. Reference to the component layouts shown in Vol. 1, Part 1, Chap. 5, will assist in component replacement.

8. Examine the unit under a good light for cracks in all ceramic insulators.

9. Particular care should be taken during this preliminary visual inspection to note that:-

(1) The grub screws on the cam collar and other collars are tight.

(2) The bevel and drive gears are free from foreign matter or excessive amounts of grease which might interfere with smooth rotation - see para. 21 for lubrication instructions.

(3) All wiping contacts make good contact at all positions.

(4) All contacts are clean and not burnt or pitted due to arcing. If they are burnt or pitted action is necessary as described in para. 13.

Wiring

10. The wiring throughout the r.f. power amplifier unit should be carefully inspected for continuity and conformity with the circuit shown in Vol. 1, Part 2, Chap. 1, fig. 18 of this Air Publication. This inspection should consist of point-to-point tests (Table 2) or other such electrical tests which will confirm the accuracy of the wiring. Examination should be made for neatness of soldering, absence of dry joints and a generally satisfactory condition of the wiring and insulation. No inadvertent interconnections or tracking paths should be permitted due to excess solder, wire clippings or dirty connections.

11. To assist in the servicing of this unit, a wiring diagram is given at fig. 1 and component layouts will be found in Vol. 1, Part 1, Chap. 5 of this Air Publication. It is important to ensure that any rewiring is done correctly and that lengths, gauge of wire and colour coding are as in the original (unless modification requirements necessitate changes). A wiring key is listed in Table 2 which, when used in conjunction with the wiring diagram, will assist should any rewiring become necessary.

TABLE 2

Wiring key

From	Wire colour	Length (in.)	To
P601/1	Maroon	$5\frac{1}{4}$	TP1
" /3	Brown	$1\frac{3}{8}$	Z602/2
Z602/4	Brown	$4\frac{1}{2}$	" /2
P601/4	Light green	$2\frac{3}{8}$	" /1
P601/5	Yellow	$5\frac{3}{8}$	Z604/Induct. arm
" /6	Orange	$3\frac{1}{8}$	Z602/3
TP2	Orange	$6\frac{1}{2}$	" /3
P601/8	White	2	ET1
J602	Busbar	-	C613
P602	Braided	-	V601/2

Servicing

12. Certain detailed instructions for the servicing and renewal of purely mechanical parts of this sub-unit will be given in subsequent paragraphs. Renewal of most of the components and any rewiring, however, should be a comparatively simple matter requiring no special instructions.

WARNING

ELECTRIC SHOCK. The power supply to the r.f. power amplifier must be switched off or, preferably, completely disconnected before any attempt is made to service the unit or to renew any of the components.

13. Dirty contacts should be treated with trichlorethylene. Dirt not removable in this way, or slight burning may be cleaned by the use of flour paper. (i.e. a very fine grade of emery paper). Should the burning be too serious to be cleaned by these methods, the appropriate parts should be replaced.

14. When renewing or refitting such components as resistors, inductors or capacitors, their dressing (i.e. physical position) should be kept as near as possible to that of the component removed, particularly C607 and C608.

Tank assemblies Z602, Z603, Z604

15. The tank assemblies Z602, Z603 and Z604, are available as spares and fitting them is a straight-forward operation except for the use of Melinex insulation which may not appear obvious. The grid tank Z603

and anode tank Z604 assemblies are each insulated from the chassis with two Melinex sheets. These sheets are the dielectric for C610, formed with Z603 and chassis and C614, formed with Z604 and chassis. It is important that these insulators are undamaged and that the following tests should be made immediately after fitting and prior to wiring the Z603 and Z604 assemblies:-

(1) Dielelectric strength - using item 1, Table 1 apply 1000V between the anode tank Z604 and chassis and/or grid tank Z603 and chassis; there should be no breakdown during a one minute test.

(2) Capacity measurement - using item 2, Table 1 measure the capacity between chassis and Z604 which should not be less than 350pF. Repeat this test for Z603 which should be not less than 250pF.

Gear train

16. The shaft gears are secured with grub screws only, and therefore, when a new gear is fitted its grub screws should be partially tightened on the shaft and the gear train aligned as follows:-

(1) Set the grid tank, anode tank and preamplifier tank assemblies as shown in fig. 2; the Oldham coupler should be set so that the pin on the bronze coupler ring is in line with the datum circle on the base plate.

(2) Ensure that all gears are free running and the teeth are properly meshed then, with the gear train biased in the clockwise direction (looking at the base of the unit), tighten the grub screws securely and lock them with Glyptol varnish, or its equivalent.

Oldham coupler renewal

17. If a new coupler plate is to be fitted a new drive shaft will also be required since, on manufacture, the two items are drilled and reamed together. The new coupler plate is fitted as follows:-

(1) Slide the new coupler plate on to the shaft and fit the drill and ream jig (Table 1, item 3) on the bottom of the amplifier unit. Remove the distance plate from its stowage position on the jig and slide it in between the coupler plate and unit base; this distance plate ensures that the coupler height is correct with respect to the unit baseplate.

(2) Secure the drill and ream jig to the bottom of the unit using the two captive screws.

(3) Using the shorter of the two vertical knurl-headed screws, tighten it down until the coupler plate is firmly held, then lock in position with the slotted screws.

(4) Engage the second vertical knurl-headed screw with the slot in the coupler shaft and rotate in a clockwise direction until the unit is correctly aligned (fig. 2); bias the shaft clockwise to take up any backlash and lock in this position with the knurl-headed locking screw.

(5) Drill through the coupler plate and shaft using a No. 50 (0.070 in.) drill and ream to suit the taper pin.

(6) Unload the unit from the jig and insert the taper pin; trim any protrusion of the pin flush with the coupler plate groove.

(7) Using the height gauge and plate (Table 1, item 4 and item 5) verify that the coupler height from the unit baseplate lies between 0.070 in. and 0.080 in.

Mechanical alignment

18. When a new Oldham coupler has been fitted its alignment should be verified using the checking jig (Table 1, item 6) as follows:-

(1) Secure the checking jig (Table 1, item 6) to the base of the amplifier unit with the Oldham coupler ring removed. Lay the jig and unit on the surface plate (Table 1, item 7) so that the base of the unit makes 90° with the surface plate.

(2) Rotate the coupler plate so that the tank assemblies Z602, Z603, Z604 are positioned as in fig. 2 and the pin of the cam follower is coincident with the datum line on the cam.

(3) Set the dial gauge (Table 1, item 8) height to obtain a reading when the clock needle is in contact with the coupler dog.

(4) With the unit set as in sub-para. (1), run the dial indicator along the dogs of the coupler and the difference measured should not exceed 0.005 in. from end to end of the dogs.

19. If any gear, tank assembly or cam operated component has been renewed or refitted the following alignment tests should be made with the unit fitted in the test jig of the test rig (Table 1, item 15) and indexed to the 220 Mc/s position:-

(1) Grid tank Z603 - A line through the grid tank inductance contacts should be coincident with the leading edge of the inductance ring; the capacitor vanes should be fully meshed with the straight edges of the rotor blades in line with the straight edge of the stator blade (A of fig. 2).

(2) Anode tank Z604 - the leading contact of the inductance arm should be 5/8 in. ± 1/32 in. beyond the leading edge of the inductance ring; the capacitor vanes should be fully meshed with the straight edges of the rotor blades in line with the straight edge of the stator blade (B of fig. 2).

(3) Preamplifier tank Z602 - the capacitor vanes should be fully meshed with the leading tips of the longer edges of the rotor vanes in line with the edges of the stator blades (C of fig. 2).

(4) Cam assembly C615 - the datum line, marked on the cam should be coincident with the cam follower to within $\frac{1}{2}^{\circ}$. Using the item 9, Table 1 ensure that a gap of 0.010 in. exists between the clamp of valve V603 and the pip of the cam actuated plate of C615. Adjustment to this clearance may be made with an adjusting screw, the head of which is accessible through an aperture marked C615 at the base of valve V601. Lock the adjusting screw with red paint on completion of adjustment.

20. After alignment, remove the amplifier unit from the test rig and, using a 0.005 in. feeler gauge (Table 1, item 9), ensure that a clearance of at least 0.005 in. exists between the preamplifier Z602 capacitor rotor vanes and stator vanes for any position of rotation. It should also be ascertained that the inductance arm wipers of the three tank assemblies make good contact throughout their working range.

Lubrication

21. All gear teeth and idler shafts should be lubricated with a thin film of grease (Table 1, item 10). The trimming capacitor C609, all inductance arm wipers and the shaft wipers of the preamplifier tank assembly should be lubricated with a small amount of a composition consisting of 50% carbon tetrachloride and 50% oil (Table 1, item 11).

Torque test

22. On completion of servicing the unit a torque test should be made at the Oldham coupler using the torque tester and bit (Table 1, items 12 and 13) adjusted to 21 oz. in. Engage the bit into the coupler shaft slot and rotate the shaft in a clockwise direction for one complete revolution. If the torque tester slips in any position then the torque is high and the gear train must be readjusted to reduce it.

Coaxial test

23. The insulation tester Type A (Table 1, item 14) should be used to test the insulation at the centre pin of J602; the coaxial cover above the C615 adjusting screw should be fitted. Connect the tester between the centre pin of J602 and chassis and ensure that there is no sign of insulation breakdown.

Arrangement of test equipment

24. It will be seen that the test rig (Table 1, item 15) comprises a test set and test jig together with an air blower and five connectors. The unit to be tested should be fitted into the test jig and the equipment connected as follows:-

(1) Using the air hose provided, connect the blower (Table 1, item 19) with the test jig.

(2) Connect together the test jig and test set with the 10-way connector provided.

(3) Connect, electrically, the blower and test set with the 3-way connector provided.

(4) J602 of the unit under test should be connected with the coaxial flylead attached to the test jig relay.

(5) P602 of the unit under test should be connected to one end of the $7\frac{3}{4}$ in. coaxial connector provided via the BNC/Microdot adaptor; the other end of this connector should be connected to the test set via the B.N.C. to microdot adaptor, also provided.

(6) Connect the CT419 (Table 1, item 17) to the test jig using the three feet long coaxial connector provided.

(7) The power unit (Table 1, item 16) should be connected to the test set and main power source using its own connectors.

(8) Finally, using the 4-way connector provided, connect the test set with the 28V d.c. bench supply source.

25. The test point V and the junction of R603/C621 of the unit under test should be connected with two lengths of wire to the TEST POINT terminals marked 'V' and 'R603' respectively on the test set front panel.

Testing procedure

26. Set the test set and power unit switches as follows:-

Test set			Power unit		
EHT	to	OFF	27.5V D.C.	to	ON
HT	to	OFF	BIAS	to	OFF
28V D.C.	to	ON	MAINS	to	ON
HEATERS	to	ON			
MAINS	to	ON (blower should operate)			
Meter switch	to	6.3V			

Allow the equipment to thermally stabilize for a period of five minutes, then adjust the test set control, SET 6.3V, for the central calibration mark in the test set meter. Reset the meter switch on the test set to the 26.5V position and adjust the test set control, SET 26.5V, for the central calibration mark on the test set meter.

Current consumption

27. The following tests should be made to verify that the h.t. and e.h.t. current drawn by the unit under test is correct:-

(1) HT current - set the power unit and test set switches as follows:-

Test set			Power unit		
HT	to	ON	HT2	to	ON
Meter switch	to	HTmA	READ RAIL VOLTS	to	HT2

Then set the HT.2.ADJ control on the power unit for 130V in its voltmeter and read the current in the test set meter which should be not more than 125mA.

(2) EHT current - set the power unit and test set switches as follows:-

Test set			Power unit		
HT	to	ON	HT2	to	ON
EHT	to	ON	HT1	to	ON
Meter switch	to	EHTmA	READ RAIL VOLTS	to	HT1

Then set the HT.1.ADJ. control on the power unit for 410V in its voltmeter and read the current in the test set meter which should be not more than 230mA. Set the EHT switch on the test set to OFF.

Alignment of tank circuits Z602, Z603, Z604

28. Whenever the equipment is set to operate on a particular channel frequency, the r.f. drive to the unit under test should be adjusted to 130mW. This is accomplished by setting the test set meter switch to the CHECK RF position and adjusting the SET RF TO PA control for the red line at centre scale of the test set meter; r.f. at this level is then

connected to the unit under test when the switch is in the RF TO PA position.

29. The alignment of the three tank circuits of the amplifier radio frequency (RF power amplifier) should be performed separately. The method is to first set the trimming capacitors C609, C611, C627 at 399.9 Mc/s then, at certain frequencies throughout the frequency range of the unit, by bending the winged portions on the two rotor vanes of the tank capacitors. (The centre vane of the preamplifier tank capacitor is not sectorized).

30. It will be noticed that the vanes to be adjusted are not sectorized in the same way but are staggered. Thus, as alignment progresses the sector to be adjusted is alternately part of one vane then part of the other. The sectors of the vanes also vary in size and the first to be adjusted is the smallest. To assist in the identification of the sector to be adjusted, each sector of the preamplifier tank circuit is colour-coded; details of the colour coding and the frequency at which it should be adjusted are given in Table 3. The upper and lower vanes of the pre-amplifier tank are identified relative to the usual position of the unit, i.e. lower being nearest to the Oldham coupler. The sectors of the grid and anode tank rotor vanes are given numbers in Tables 4 and 5, the smallest sector being number 1 and the remainder are numbered consecutively to number 9; the ninth sector of each rotor vane is that nearest to the inductance arm.

31. The tuning wand (Table 1, item 18) should be used to determine whether the capacity of the tank circuits should be increased or decreased. Insert the wand through the appropriate hole, mentioned in the relative paragraphs (para. 34, 38, 44), so that its tip enters in the vicinity of the tuning inductance. If the iron dust end of the wand causes the d.c. voltage at TEST POINT 'R603' (or TEST POINT 'V') to rise, the tuning capacity must be increased by bending the appropriate sector nearer to the stator vane. Conversely, if the brass end causes an increase in voltage the tuning capacity must be decreased by bending the appropriate sector away from the stator vane. The setting is correct when the voltage falls for both the brass and iron dust ends of the wand.

Preamplifier tank (Z602)

32. Index the unit to 399.9 Mc/s and adjust the test set r.f. drive (para. 28), then switch OFF the e.h.t. from the power supply unit. Set the test set meter switch to 'R603' TP and adjust C609 for a maximum reading in the test set meter.

33. Index the jig and test set to the frequencies listed in Table 3, and adjust the tuning capacitor vanes (Table 3) using the method explained in para. 30.

34. Insert the tuning wand through the round hole marked Z602 and ascertain that the correct setting of the tuning capacitor has been made (para. 31).

TABLE 3

Preamplifier tank (Z602) sectorized vane details

Index position (Mc/s)	Rotor vane used	Sector colour
395.0	Lower	Plain
385.0	Upper	Black
375.0	Lower	"
365.0	Upper	Red
355.0	Lower	"
345.0	Upper	Yellow
335.0	Lower	"
325.0	Upper	Blue
315.0	Lower	"
305.0	Upper	Plain
295.0	Lower	"
285.0	Upper	Black
275.0	Lower	"
265.0	Upper	Red
255.0	Lower	"
245.0	Upper	Yellow
235.0	Lower	"
225.0	Upper	Plain

35. When the sectorized vanes have been correctly adjusted the steps in their peripheries should be eliminated by twisting the sectors to form a smooth curve. The alignment procedure must then be repeated (para. 33) to correct any misalignment due to the twisting and should be corrected by the resetting only (not further twisting) of the vanes.

Grid task (Z603) initial adjustment

36. Index the test set and jig to 399.9 Mc/s and adjust the r.f. drive (para. 28), then switch OFF the e.h.t. from the power supply unit. Set the meter switch of the test set to 'V' TP and adjust C611 for maximum reading in the test set meter.

37. Index the test set and jig to the frequencies listed in Table 4 and at each indexed position adjust the sectorized vanes, as listed in Table 4, using the method outlined in para. 30.

38. The tuning wand should be inserted in the square dished hole of the side cover and the correct sector setting ascertained from the reading of the test set meter (para. 31).

39. If a large change in capacity appears to be required, it is recommended that a thorough examination be made of the indexing frequency and any previous adjustments.

TABLE 4

Grid tank (Z603) sectorized vane details

Nominal frequency and index position	Sector to be used of each rotor vane
395.0	1
385.0	1
375.0	2
365.0	2
355.0	3
345.0	3
335.0	4
325.0	4
315.0	5
305.0	5
295.0	6
285.0	6
275.0	7
265.0	7
255.0	8
245.0	8
235.0	9
225.0	9

WARNING

The h.t. supply to the unit should be switched off whilst adjustments are made to the capacitor vanes.

40. Throughout the capacitor vane adjustments the test point V voltage, as measured by the test set meter, should be maintained at not more than 25 volts by adjusting the SET RF TO PA control on the test set.

Anode tank (Z604)

41. Index the test set and jig to 399.9 Mc/s and adjust the r.f. drive

(para. 28). Set the meter switch of the test set to 'V' TP, switch on the e.h.t. to the unit and adjust C627 for maximum power dissipation in the CT419.

42. The grid tank trimming capacitor C611 should now be adjusted for a maximum reading in the test set meter.

43. Index the unit, successively, to the frequencies listed in Table 5. At each position, adjust the sectorized vanes listed in Table 5 using the method described in para. 30.

44. Ascertain in the correct setting of the sectorized vane at each frequency (para. 31) by inserting the tuning wand through the round hole, normally covered with a cover plate, in the same side cover as the square dished hole.

45. Should a large change of capacity appear necessary, it is recommended that a thorough examination be made on the indexing and previous adjustments.

TABLE 5

Anode tank (Z604) sectorized vane details

Nominal frequency and index position	Sector to be used of each rotor vane
395.0	1
385.0	1
375.0	2
365.0	2
355.0	3
345.0	3
335.0	4
325.0	4
315.0	5
305.0	5
295.0	6
285.0	6
275.0	7
265.0	7
255.0	8
245.0	8
235.0	9
225.0	9

WARNING

E.H.T. to the unit should be switched off whilst adjustments to the tank capacitor are made.

46. On completion of the correct setting of the anode tank capacitor vanes, the procedure for setting the capacitor C627 (para. 41) should be repeated.

Final adjustments to grid tank (Z603)

47. Allow the e.h.t. to remain on, then repeat the procedure detailed in para. 36 to 40 adjusting the sectorized vanes as necessary. Continue this procedure successively and repeatedly, finishing with the 399.9 Mc/s position, until no further improvement can be obtained in the 'V' TP voltage level.

Functional tests

48. Set the E.H.T. switch to ON and index the equipment to 399.9 Mc/s with the r.f. drive adjusted as in para. 28.

(1) H.T. current - set the test set meter switch to HTmA and ensure that the current drawn by the unit does not exceed 80mA.

(2) E.H.T. current - set the test set meter switch to EHTmA and ensure that the current drawn by the unit does not exceed 200mA.

49. The equipment should be indexed to 399.9 Mc/s and then successively to the frequencies listed in Table 5 for the following tests:-

(1) Power amplifier grid drive - set the r.f. drive as in para. 28 and test set meter switch to 'V' TP. At each test frequency, the voltage shown on the test set meter should be not less than 24 volts.

(2) R.F. power output - at each test frequency the power output should be not less than 16 watts as measured by the CT419.

220.0 Mc/s performance test

50. Index the equipment to 220.0 Mc/s. With the r.f. drive set as in para. 28, the test point V voltage, measured by the test set meter, should be not less than 15V and the power measured by the CT419 should be not less than 10 watts.

51. Switch off all power supplies and remove the unit from the test jig.

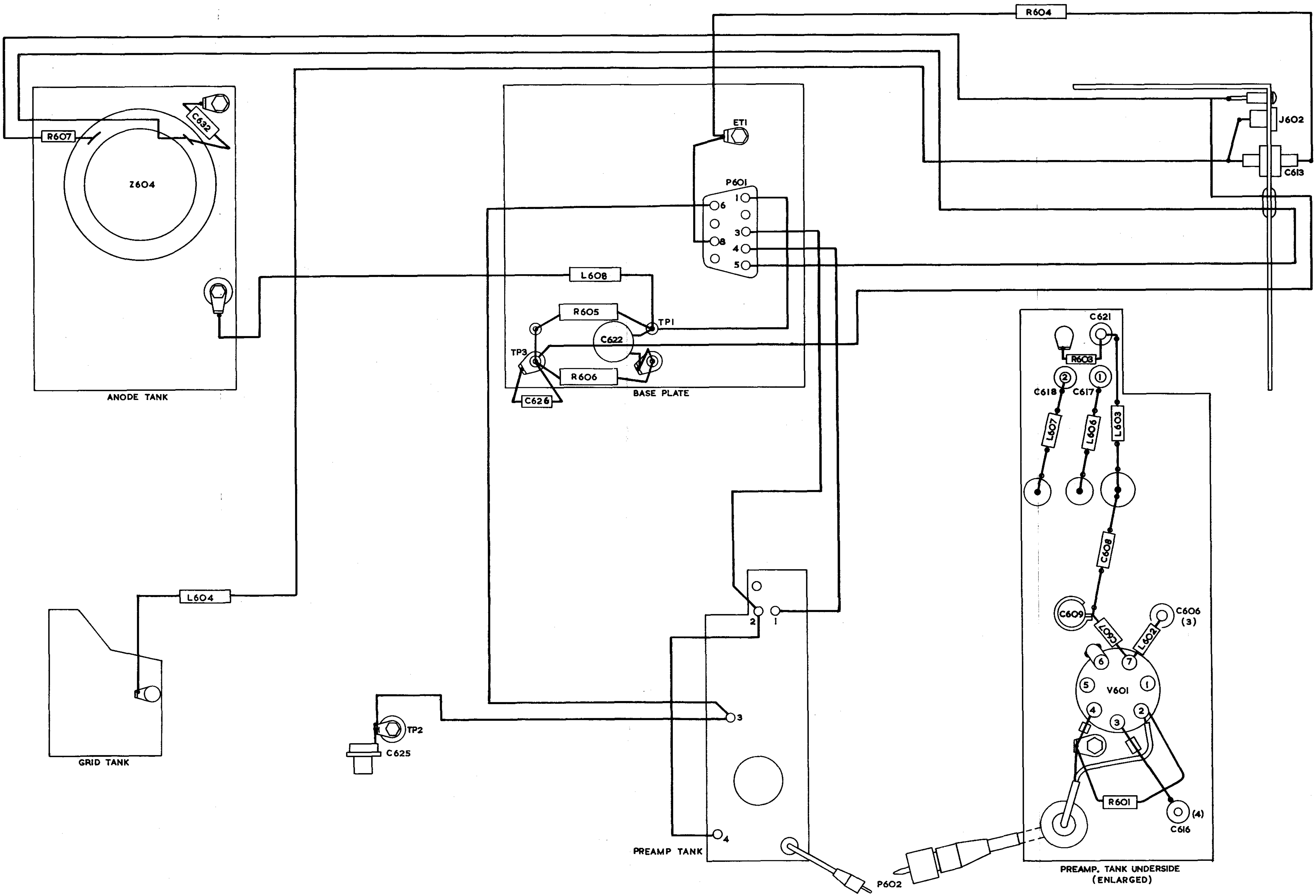
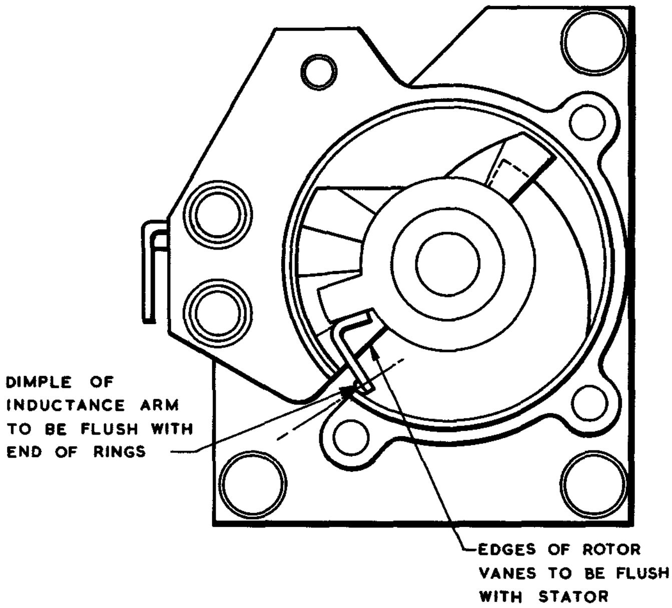
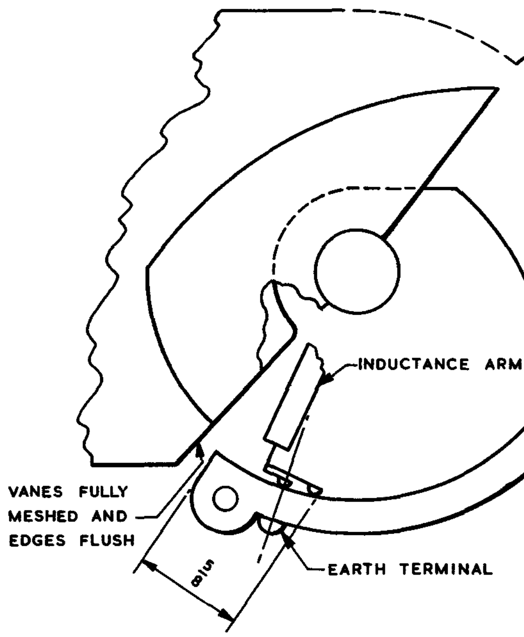


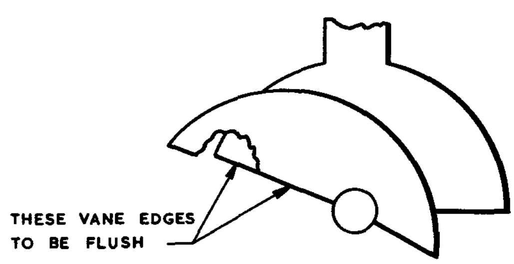
Fig. 1 ARI. 18124/1 and ARI. 18124/2 — amplifier, radio frequency (RF power amplifier) — wiring diagram



(A) Grid tank (Z603)



(B) Anode tank (Z604)



(C) Preamp. tank (Z602)

Fig. 2 Alignment of tank assemblies Z602, Z603, Z604

Chapter 9

MODULATOR, RADIO TRANSMITTER

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General

1. This modulator unit is a push-pull amplifier for amplitude modulation of the r.f. carrier produced by the amplifier, radio frequency (RF power amplifier) prior to radiation by the aerial. Input to the modulator is from either a carbon microphone or a dynamic microphone and provision is made so that, by simple adjustment of links, microphones of differing sensitivity and either high or low impedance may be matched to the modulator (Vol. 1, Part 2, Chap. 1 of this Air Publication).

2. The unit is a self-contained, compact module secured to the transmitter-receiver chassis by seven captive Phillips-type screws. These are painted red and are accessible from the underside of the chassis when the sealed cover is removed. Details of cover removal for access to sub-units, its replacement and subsequent pressurizing are given in Chap. 17 of this Section, whilst the procedure for removal and refitting of the modules (sub-units) making up the transmitter-receiver equipment are given in Vol. 1, Part 1, Chap. 5 of this Air Publication, to which reference should

be made. Any dismantling or assembly procedures given in subsequent paragraphs will be supplementary and limited to requirements for repair and renewal of components where these may differ from normal standard practice.

3. Inspection procedures and tests outlined in the following paragraphs reveal the salient performance characteristics of the equipment and will indicate whether or not the modulator is operating to the original specification. The tests should follow all repairs and renewal of components, or when specified as routine matters in preventive servicing.

Test equipment

4. The test equipment required for servicing and testing the modulator unit is listed in Table 1; further details of the individual items may be obtained from the publication referred to against each item.

TABLE 1

List of test equipment

Item	Ref. No.	Nomenclature	Para.	Further details
1	10AG/971	Assembly base	12	Sect. 1
2	6625-99-943-8384	Multimeter, valve CT429	17	Marconi TF1041B
3	10S/16499	Sig. Gen. Type 65B	16	A.P.2879AD
4	6940-99-943-6545	Simulator, microphone	16	Vol. 1, Part 2, Chap. 2 & 7
5	10S/831	Oscilloscope Type 13A	18	A.P.2879AF
6	10S/17639	Indicator, distortion	18	Marconi TF142F
7	5821-99-932-2942	Power unit	15	Sect. 1
8	5P/2341	Fan, circulation, desk	20	G.E.C. 8 in.
9	6625-99-943-6546	Test set, amplifier	15	Sect. 1

Component inspection

5. Inspect for correctness the details of equipment serial numbers and the modification state entered on the repair card or servicing documents which should accompany the equipment sent for inspection or overhaul.

6. Using a portable blower, or other approved supply of dry air under pressure, thoroughly clean the unit of all dust. Where necessary, a soft squirrel-hair brush will assist in this process. Since the transmitter-receiver equipment is normally enclosed within an airtight casing, however, the presence of dust, dirt or moisture should be fully investigated.

7. Carefully examine the unit to ensure that it is undamaged and free from corrosion, with all components securely retained in position. Any loose connections or components must be refitted. Should it become necessary to change any components it is important to ensure that the new

items are positioned accurately and connected correctly. Reference to the component layouts shown in Vol. 1, Part 1, Chap. 5 will assist in component renewal.

8. Screws and nuts removed during inspection or servicing and which are not fitted with locknuts or lockwashers must be locked with an approved varnish after being refitted.

9. Whenever electrolytic capacitors of the tantulum type (C701, C705, C706, C715) are changed, the wire at the positive end of the component must be formed into a swan-neck before connection in order to prevent any excessive strain or heat from affecting the weld.

Wiring

10. The wiring throughout the modulator unit should be carefully inspected for continuity and conformity with the circuit shown in Vol. 1 Part 2, Chap. 1 of this Air Publication. This inspection should comprise point-to-point tests or other such electrical tests which will confirm the accuracy of the wiring. Examination should be made for neatness of soldering, absence of dry joints and a generally satisfactory condition of the wiring and insulation. No inadvertent interconnections or tracking paths should be permitted due to excess solder, wire clippings or dirty connections.

11. To assist in the servicing of this unit, a wiring diagram is given at fig. 1 and component layouts will be found in Vol. 1, Part 1, Chap. 5. It is important to ensure that any rewiring is done correctly and that lengths, gauge of wire and colour coding are as in the original (unless modification requirements necessitate changes). A wiring key is listed in Table 2 which, when used in conjunction with the wiring diagram, will assist should any rewiring become necessary.

TABLE 2

Wiring key

From	Wire colour	Length (in.)	To
R702/1	White	2	Earth tag 1
" /1	"	$3\frac{1}{2}$	T701/5
R702/2		$5\frac{1}{2}$	TB701/1
Earth tag 2	Screen for above cable	-	Earth tag 3
R702/3	White/black	$3\frac{5}{8}$	T701/4
T701/2	White	$7\frac{1}{2}$	TB701/30
" /3		$8\frac{5}{8}$	TP5
	Screen for above cable		Earth tag 6
TP2	White	$6\frac{1}{2}$	TB701/26
T703/1	White/orange/blue	$3\frac{7}{8}$	" /19

T703/2	White/orange	$9\frac{1}{2}$	TP7
T703/3	White/orange/green	$5\frac{3}{4}$	XV703/5
" /4	White/green	$5\frac{3}{4}$	TB701/25
" /5	White/orange/green	$7\frac{7}{8}$	XV704/5
T702/1	White	4	V704/CAP
P701/1	White/red/orange	-	T702/2
T702/3	White	$5\frac{1}{8}$	V703/CAP
" /3	White/red	-	P701/9
P701/2	White/orange	-	XV703/3
" /3	White/orange	2	TP7
" /4	White/orange/green	$5\frac{3}{4}$	TB701/23
" /5	White/green	-	" /25
" /5	White/green	-	J701
" /6	White/red/blue	-	TB701/22
" /7		8	T701/1
	Screen for above cable		Earth tag 5
" /8	White	-	TB701/26
" /10	White/blue	-	XV703/2
" /11	White/black/green	-	X704/2
" /12	White/brown	-	TP4
" /13	White/brown	-	XV703/7
" /15	White/black	-	TP5
XV703/2	White/red	25/8	XV704/7
" /3	White/orange	$3\frac{1}{2}$	" /3
" /4	White/brown/blue	$2\frac{1}{4}$	" /6
" /7	White/black	$6\frac{1}{2}$	TB701/30
" /8	White	$2\frac{7}{8}$	XV704/8
XV704/8	White	$2\frac{3}{4}$	Earth tag 7
" /2	White/black/green	$8\frac{1}{8}$	TB701/29
" /4	White/red/blue	$7\frac{1}{2}$	J702
" /7	White/blue	$6\frac{7}{8}$	TB701/24
TP6	White/red	$4\frac{1}{4}$	" /26
TB701/32		$3\frac{3}{4}$	TP5

	Screen for above cable	-	Earth tag 6
TB701/28	White/brown	$3\frac{3}{4}$	TP3
R702/3	Busbar		TP1

Servicing

12. In view of the comparative simplicity of this unit, little servicing should be necessary. Renewal of components and any rewiring, should be a matter requiring no special instructions with the exception of transformer T702. Since four of the seven unit securing holes are in the base of T702 it will be necessary to ensure their correct alignment when renewing or refitting the transformer. Alignment is accomplished by fitting the assembly base plate (Table 1, item 1) to the unit being repaired with the three captive screws of the plate. Then screw the transformer to the assembly base plate and bolt the transformer securely into position before removing the assembly base plate.

13. Printed circuits present special problems with regard to servicing. A printed circuit board may be irreparably damaged by the sustained heat from a soldering iron. The recommended method to be adopted when renewing a component on a printed circuit board is as follows:-

(1) Remove the faulty component by clipping the wires as close to the component as possible. This leaves the wire ends still fastened to the printed board.

(2) Prepare the wire ends of the new component and make a good mechanical joint with the wires attached to the printed board. (Fit the new component so that its value is uppermost and readable).

(3) Solder the connections as quickly as possible using only a lightweight soldering iron.

WARNING

ELECTRIC SHOCK. The power supply to the modulator unit must be switched off or, preferably, completely disconnected before any attempt is made to service the unit or to renew any of the components.

Testing

Definitions

14. For the purpose of the tests described in this chapter the following definitions of terms are included:-

(1) Distortion factor - the ratio between the square root of the sum of the harmonics and the total voltage. All measurements are r.m.s. and the result is expressed as a percentage. This may be read directly using the distortion indicator (Table 1).

(2) Amplitude limiting - that capacity of the modulator to limit the peak level of the a.c. component of the output voltage, when a prescribed depth of modulation has been achieved, even though the input signal level may continue to rise. When this is displayed on an oscilloscope it will show as a distinct horizontal flattening of the audio voltage.

(3) Modulating capability - the a.f. output voltage obtained for a specified audio input.

Arrangement of test equipment

15. Connect the power unit (Table 1, item 7) to the test set, amplifier (Table 1, item 9) and the bench supply source using the connectors provided with the power unit.

16. The OUTPUT and EARTH terminals of the microphone simulator (Table 1, item 4) should be connected to the test set terminals marked MIC(A), MIC(B) and E respectively. The INPUT terminals of the microphone simulator should be connected to the signal generator (Table 1, item 3) output i.e. 0 and 600Ω or 0 and 1,000Ω depending on the signal generator used.

17. The CT429 (Table 1, item 2) should be connected to the voltage test points of the test set, MODULATOR LOAD and SIDETONE, or the modulator unit test points X and W as required by the test procedure.

18. The oscilloscope (Table 1, item 5) and the distortion indicator (Table 1, item 6) should be connected to the test set terminals marked DFM.

19. Fit the modulator unit to be tested into the test set fixture and secure the four captive screws.

20. The CT429, oscilloscope, signal generator, distortion indicator and the fan (Table 1, item 8) should be connected to the bench supply source. The fan (Table 1, item 8) should be positioned so that the airflow is directed at the base of the unit under test.

21. In the subsequent test procedure it is assumed that all test equipment will be operated in accordance with standard instructions given in the appropriate Air Publications.

22. The nature of the tests given in the test procedure is that recommended by the manufacturer of the equipment.

Endurance rating

23. With forced draught cooling, using the table fan (Table 1, item 8) directed at the unit base, the modulator unit is rated to work continuously. Without forced draught cooling the modulator unit is rated to work as follows:-

(1) The e.h.t. should only/applied for periods not exceeding five minutes and this should be followed by ten minutes with the e.h.t. off.

(2) For shorter periods the e.h.t. should only be applied for one third of the total time.

E.H.T. and h.t. current consumption

24. Set the modulation control (R702) to the fully counter-clockwise position. Set the TONE switch on the test set and the READ RAIL CURRENT meter switch on the power unit as follows and note that the meter on the power unit does not exceed the following figures:-

TONE switch	Meter switch	Meter reading
OFF	HT2 (h.t.)	Not greater than 12mA
OFF	HT1 (e.h.t.)	- do - 210mA
ON	HT2 (h.t.)	- do - 40mA
ON	HT1 (e.h.t.)	- do - 280mA

Bias voltage

25. Use the multimeter and measure the bias voltage at test point X. This should be not less than 13.5V or more than 15.0V negative with respect to frame.

Functional tests

26. The tests which should be conducted are:-

(1) modulating capability

(2) distortion factor

(3) audio frequency response

(4) carbon microphone current

(5) sidetone output

(6) tone operation

The first three of these tests should be conducted separately with each of the three types of microphone input. The changing of microphone involves the changing over of the links and resetting of the test set and microphone simulator switches. Since it is unimportant in which order the tests are conducted, it will be found easier to set the links and switches for one type of microphone and conduct all three tests, then change the links and repeat. The final link setting should be for the type of microphone with which the equipment is expected to operate.

27. The carbon microphone current test is only applicable when the links are set for that type of microphone, while the sidetone test need only be conducted once. Tone operation must be conducted separately (para. 35) but since the linkage arrangement for this test is the same as for the 200Ω dynamic microphone, for convenience, both of these tests should be conducted consecutively.

28. The link positions, the test set and microphone simulator switch settings for the three different types of microphone are as follows:-

(1) 82 ohms carbon microphone:-

(a) Links - A and B linked; terminals 1 and 4, 5 and 6, 7 and 8, 9 and 10 linked as pairs and the linkage on pairs 2 and 3, 6 and 7, 8 and 9, 10 and 5 removed.

(b) Test set - MIC. SELECTOR switch to UNBALANCED and TONE switch to OFF.

(c) Microphone simulator - set the MICROPHONE SELECTOR switch to 82Ω UNBAL. MIC.

(2) 82Ω dynamic microphone

(a) Links - A and B linked; terminals 2 and 3, 6 and 7, 8 and 9, 10 and 5 linked as pairs and the linkage on pairs 1 and 4, 5 and 6, 7 and 8, 9 and 10 removed.

(b) Test set - MIC. SELECTOR switch to BALANCED and TONE SWITCH to OFF.

(c) Microphone simulator - set the MICROPHONE SELECTOR switch to 82Ω BAL. MIC.

(3) 200Ω dynamic microphone:-

(a) Links - A and B opened; terminals 2 and 3, 6 and 7, 8 and 9, 10 and 5 linked as pairs and the linkage on pairs 1 and 4, 5 and 6, 7 and 8, 9 and 10 removed.

(b) Test set - MIC. SELECTOR switch to BALANCED and TONE switch to OFF.

(c) Microphone simulator - MICROPHONE SELECTOR switch to 200Ω DYNAMIC MIC.

29. With the signal generator connected as in para. 16 set it for 1000 c/s operation at an output sufficient to make the meter on the microphone simulator read to 0.75 of full scale deflection. The MICROPHONE SELECTOR switch on the microphone simulator brings into circuit certain resistors so that with an input of 0.75 of the meter full scale deflection the simulator output on open circuit becomes:-

82Ω carbon mic.	=	0.1V
82Ω dynamic "	=	25mV
200Ω " "	=	10mV

30. Switch on the bench fan, CT429, oscilloscope, distortion indicator and the power unit, then allow the equipment to stabilize thermally.

Testing procedure

31. Modulating capability - adjust the modulation control (R702) to the point at which amplitude limiting (para. 14 (2)) first commences on the output voltage modulation waveform. At this point the audio output voltage measured on the CT429 should be between 220V and 265V r.m.s.

<u>Note</u>...

There should be only slight difference between the two settings of R702 at which clipping commences on the positive and negative peaks; if the difference is large, then a fault is to be expected in the unit.

32. Audio output distortion factor - adjust the modulation control (R702) to the point at which amplitude limiting first commences on the modulation output waveform. Reduce the input signal level by 2.5 dB ± 1 dB. At this level, the distortion factor of the audio frequency component of the modulator output waveform should not exceed 10% as measured on the distortion indicator.

33. Audio frequency response - reset the input signal level of the microphone simulator to 0.75 of full scale deflection (para. 29) and adjust the modulation control (R702) to the point at which amplitude limiting first commences on the modulation output waveform. The input signal level should be reduced by 2.5 dB ± 1 dB and held constant, whereas the input signal frequency should be changed according to Table 3. The corresponding variations in the audio frequency component of the modulator output voltage, measured at the modulator load test point, should remain within the limits set. These limits are relative to the modulator output level obtaining for a 1,000 c/s input signal.

TABLE 3

Audio frequency response

Signal frequency	A.F. output voltage level relative to that at 1,000 c/s
c/s	dB
150	-7 or lower
300	-2 to -7
600	+1 to -2
1000	0dB (reference level)
3000	+2 to -2
6000	+2 to -2
10000	+1 to -3
20000	0 to -10

34. Carbon microphone current - the microphone polarizing current reading should be taken by substituting the CT429 (set at the appropriate current range) for the link across the MIC. CURRENT terminals of the microphone simulator. This reading should be between 43mA and 57mA.

Tone operation

35. Set the equipment as in para. 28 (3) except that the test set TONE switch should be set to the ON position. Then set the modulation control R702 to approximately mid-track and reduce the input signal level to zero.

36. Modulating capability - the output voltage should be at least 220V r.m.s. and amplitude limiting of either or both of the positive and negative peaks of the output voltage waveform should have commenced.

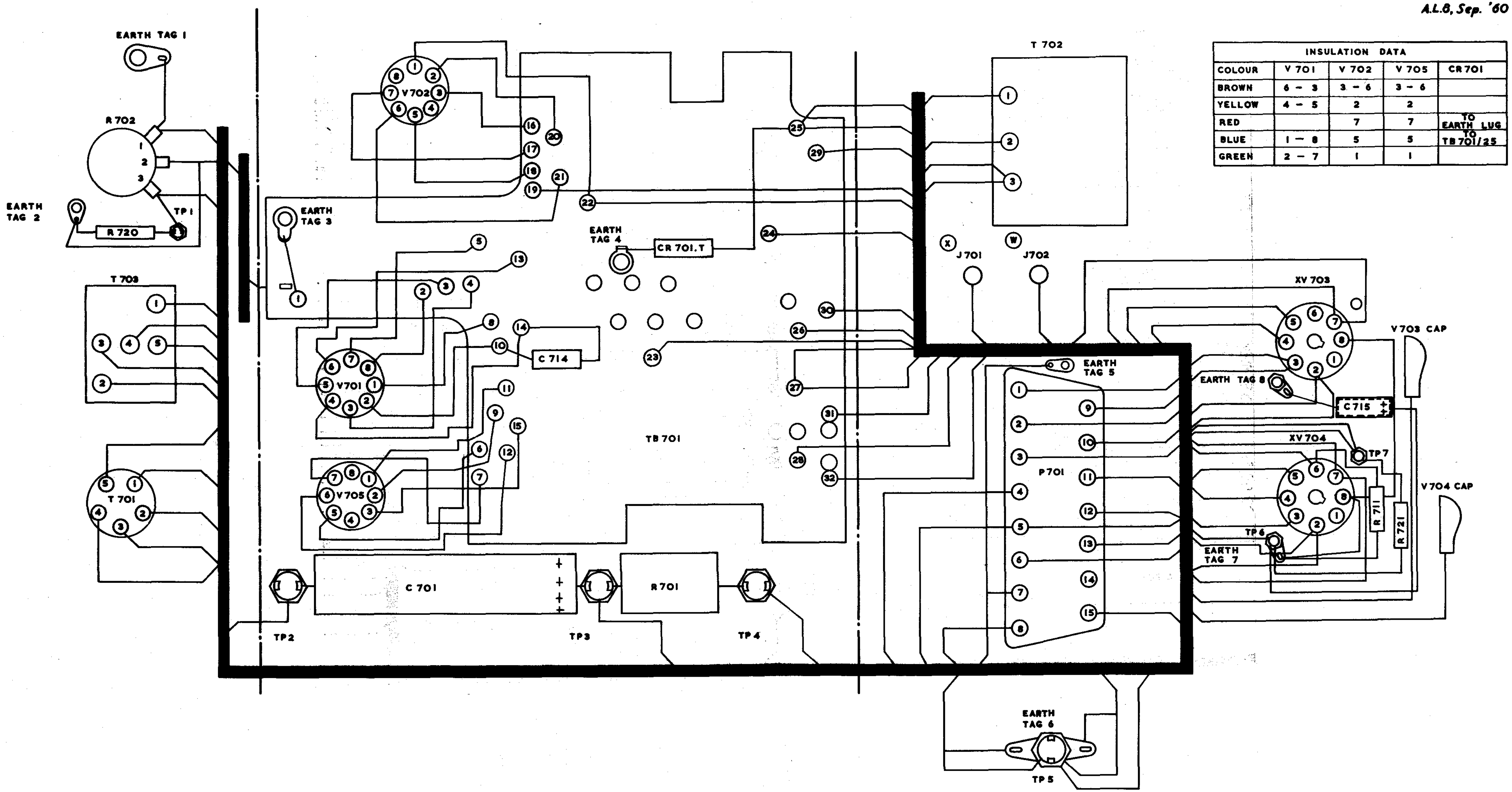
37. Tone frequency - the frequency of the tone oscillator should be measured as follows:-

(1) Disconnect the signal generator from the microphone simulator and connect the signal generator to the X INPUT of the oscilloscope.

(2) The oscilloscope Y INPUT should be connected to the test set DFM terminals

(3) Switch ON the TONE switch and set the signal generator to approx. 1,000 c/s.

(4) Adjust the X GAIN control on the oscilloscope to obtain a complete trace then adjust the signal generator frequency to obtain a steady loop trace on the screen. When this is achieved the signal generator frequency will be the same as that of the tone oscillator which should be within 100 c/s of 1020 c/s.



INSULATION DATA				
COLOUR	V 701	V 702	V 705	CR 701
BROWN	6 – 3	3 – 6	3 – 6	
YELLOW	4 – 5	2	2	
RED		7	7	TO EARTH LUG
BLUE	1 – 8	5	5	TO TB 701/25
GREEN	2 – 7	1	1	

Fig.1 ARI.18124/1 and ARI.18124/2 – modulator, radio transmitter – wiring diagram

Appendix 1

MODULATOR, RADIO TRANSMITTER - REBUILDING

LIST OF ILLUSTRATIONS

1. To facilitate rebuilding of the modulator unit after overhaul or renewal of components, an assembly base is provided under Ref.No. 10AG/971. This is principally a flat steel plate provided with a cutout portion to accommodate the module plug (P701) which protrudes from the base of the sub-chassis and with holes for the locating pegs adjacent to the plug. In addition, there are seven captive knurled-head screws for engagement into the base of the module in similar manner to those provided in the chassis, main assembly.

2. In use, the chassis of the modulator unit is fitted to the assembly base with the plug P701 and locating pegs correctly engaged in the cutout. The two knurled-head screws adjacent to the plug are then engaged into the tapped holes in the module sub-chassis and screwed finger tight (over-tightening of any of these screws should be avoided). The lower screw of the remaining five (fig. 1) should then be engaged into the tapped hole provided in the module side cover.

3. The transformer T702 may then be placed in position so that the remaining four finger screws can be engaged into the tapped holes in the base of the transformer. This action will positively locate the transformer in relation with the module sub-chassis and, further, ensures that all seven of the module securing screws of the chassis, main assembly will engage correctly when the modulator unit is fitted in position. The transformer T702 is then secured firmly in the module sub-chasis by means of the cross-head screws and the transformer mounting bracket.

4. The remainder of the components incorporated in the modulator unit can then be assembled without any difficulty or special precautions.

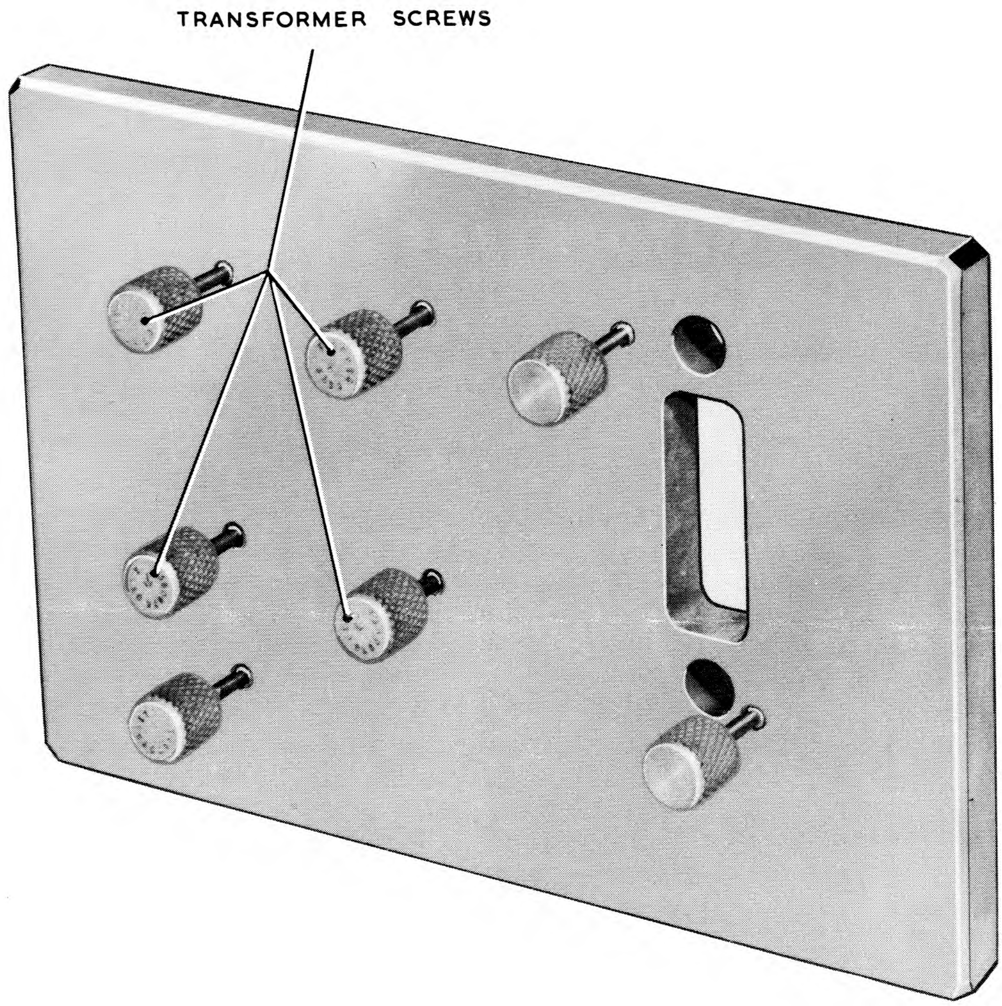


Fig. 1. Assembly base for modulator

Chapter 10

RECEIVER UNIT (GUARD)

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General

1. The guard receiver unit is a single-channel receiver operating normally on a frequency of 243.0 Mc/s. The receiver is of the double conversion type, employing a first i.f. of 36.3 Mc/s and a second of 1.85 Mc/s. A.G.C. is incorporated, together with a noise limiter, and the receiver is gated by a carrier-operated squelch device which is adjustable by a preset potentiometer situated on the main chassis assembly.

2. The guard receiver is secured to the chassis by four red-painted Phillips-type captive screws accessible from the underside of the chassis when the sealed cover is removed. Details of cover removal, replacement and subsequent pressurizing are given in Chap. 17 of this Section. Details of procedure for dismantling and assembly given in subsequent paragraphs will be supplementary, only, and limited to requirements for repair or renewal.

Component inspection

3. Examine for correctness the details of equipment serial numbers and modification state entered on the repair card accompanying the unit.

4. Unclip the side covers by easing a screwdriver between the mating edges, then, using a portable blower or other approved supply of dry air under pressure, thoroughly clean the unit of all dust. Where necessary, a soft squirrel hair brush will assist in this process. Since the transmitter-receiver is enclosed within an airtight casing, the presence of dust, dirt or moisture should be fully investigated.

5. Carefully examine the unit to ensure that it is free from damage and corrosion, with all components securely retained in position. Any loose components must be securely refitted. Should it be necessary to change any components, it is important to ensure that the items positioned accurately and correctly connected.

6. Screws and nuts removed during inspection or servicing and which are not fitted with locknuts or lockwashers, must be locked with an approved varnish when refitted.

Wiring

7. The wiring of the unit should be carefully inspected for continuity and conformity with the circuit shown in Vol. 1, Part 2, Chap. 1. This inspection should consist of a point-to-point test or such electrical test which will confirm the accuracy of the wiring. The equipment should be examined for neatness of soldering, absence of dry joints and a generally satisfactory condition of the wiring and insulation, with particular attention paid to the sleeving covering the connections to the multipole plug. No inadvertent interconnections or tracking paths should be permitted due to excess solder, wire clippings or dirty connectioon.

8. It is important to ensure that the rectifier units (CR801, CR802 and CR803) and the electrolytic capacitor C841 have been correctly fitted and wired with respect to polarity. This capacitor is of the electrolytic tantalum type and it is important that if it is to be changed the wire at the positive end of the component must be formed into a swan neck before connection, in order to prevent any excessive strain or heat from affecting the weld.

9. To assist in servicing, component layouts are given in Vol. 1, Part 1, Chap. 5; in addition, a wiring diagram is included in this chapter at fig. 1. It is important to ensure that any renewal of the wiring is carried out correctly and that lengths, gauge of wire and colour coding are as

in the original (unless modification requirements necessitate changes). In Table 1 is listed a wiring key which, when used in conjunction with fig. 1 will assist in the replacement of any wiring.

TABLE 1

Wiring key

From	Wiring colour	Length (in.)	To
P801/1	Green	$4\frac{3}{8}$	AFB/14
" /2	Tan	$3\frac{1}{2}$	AFB/28
" /3	Green	2	AFB/20
" /6	Light blue	$3\frac{1}{4}$	AFB/6
" /8	Grey	$2\frac{1}{2}$	AFB/26
" /9	Pink	$4\frac{1}{2}$	RFB/25
" /10	Slate grey	6	RFB/8
" /11	Brown	$3\frac{7}{8}$	AFB/4
" /12	Green	$2\frac{1}{8}$	AFB/30
" /13	Light green	5	RFB/28
" /14	White	2	ET 2
" /15	Yellow	$2\frac{1}{8}$	AFB/24
ET 2	White	$2\frac{1}{2}$	AFB/21
RFB/30	Green	7	AFB/16
"/20	Red	$6\frac{1}{2}$	AFB/18
"/43	White	5	AFB/5
"/33	Brown	$6\frac{1}{4}$	AFB/9
"/18	Red	-	R843
R843	Red	-	AFB/15
RFB/13	Blue	-	T803/2
T803/4	Red	-	AFB/17
T803/3	Black	-	AFB/14
T804/4	Red	-	AFB/10
T804/3	White	-	AFB/5
T805/4	Red	-	AFB/7
T805/3	Black	-	AFB/1
T805/1	Green	-	AFB/2

Servicing

10. In view of the comparative simplicity of this unit, little servicing should be required. Renewal of components and any rewiring necessary should be a simple matter of standard procedure and needing no special instructions.

11. The printed circuits present special problems with regard to servicing. A printed circuit board may be irreparably damaged by the sustained heat from a soldering iron. The recommended method to be adopted when renewing a component on a printed circuit board is as follows:-

(1) Remove the faulty component from the board by clipping the wires as close to the component as possible. This leaves the wire ends still fastened to the printed board.

(2) Prepare the wire ends of the new component and make a mechanical joint with the wires attached to the printed board. (Fit the new component so that its valve is uppermost and readable).

(3) Solder the connections as quickly as possible using only a lightweight soldering iron.

WARNING

ELECTRIC SHOCK. It is essential to ensure that before any attempt is made to service or replace any item found defective during any part of the tests the power supply is switched off or, preferably, entirely disconnected from the unit.

Test equipment

12. The equipment required for testing the receiver unit (guard) is listed in Table 2. Further information on the individual items may be obtained by reference to the publication listed.

TABLE 2

List of test equipment

Item	Reference number	Nomenclature	Para.	Further details
1	6625-99-943-1911	U.H.F. signal generator CT394	15	A.P.2531H
2	10S/695	Signal generator Type 57 (R.N.) or	17	A.P.2538J
	10S/647	Type 56 (R.A.F.)	17	A.P.2879D
3	10S/16308	Multimeter CT38	17	A.P.2879AG
4	10S/17639	Indicator, distortion	17	
5	10S/831	Oscilloscope Type 13A	17	A.P.2879AF
6	6625-99-943-7328	Monitor, audio/radio frequency	17	Vol.1, Part 2, Chap.2
7	5995-99-932-1907	Connector	15	- do -

Item	Reference number	Nomenclature	Para.	Further details
8	5821-99-932-2388	Cover, guard receiver, test side	17	Sect. 1
9	5821-99-932-8542	Transmitter-receiver TR5/ARC52	15	A.P.2531J
10	6625-99-943-7031	Test kit (R.N.) or	16	Vol.1, Part 2, Chap.
	6625-99-943-7032	Test kit (R.A.F.)	16	- do -
11	5821-99-942-8543	Control unit Type C1607/ARC52	16	Sect. 2, Chap.18
12	5995-99-932-1910	Connector	15	Vol.1, Pt.2, Ch.2
13	6625-99-943-6886	Test set, radio	20	Sect. 1
14	10S/NIV/649	Power unit	20	- do -

13. A requirement for aligning the r.f. transformers is a damping network comprising a 1000 ohms ± 10% resistor in series with a 1000 picofarad ± 20% capacitor and suitably terminated with crocodile type terminals.

TESTING THE RECEIVER UNIT (GUARD)

General

14. The receiver unit (guard) may be tested by employing a serviceable transmitter-receiver with the receiver unit (guard) removed.

15. Remove the transmitter-receiver from the cover, details of cover removal are given in Chap. 17 of this Section. Then remove the receiver unit (guard) from the chassis and plug the connector (Table 2, item 12) into J1508. The junction of the aerial cable P1502/P1402 should be disconnected and P1502 connected with item 7 in Table 2 to the U.H.F. signal generator, when required, as described in the testing procedure (para.22).

16. Connect together the transmitter-receiver, control unit (Table 2, item 9 and item 11) and the bench supply source using the test kit (Table 2, item 10). Remove the sidecovers of the receiver unit (guard) to be tested and plug the connector (Table 2, item 12) into P801 then the aerial plug P802 into J1501 underneath the chassis assembly (main).

17. The indicator, distortion and the oscilloscope (Table 2, item 4 and item 5) should be suitably connected between the frame and the P801 pole 6 end of C843, via the audio/radio frequency monitor (Table 2, item 6). The signal generators (Table 2, item 1 and item 2), the d.c. voltmeter (Table 2, item 3), the damping network (para. 13) and the test sidecover (Table 2, item 8) are connected and fitted as described in the test procedure (para. 22).

18. The output terminals of the i.f. signal generator should be supplied with a d.c. blocking capacitor of not less than 100pF. When operated on the 36.3 Mc/s intermediate frequency an auxiliary signal of 1.85 Mc/s should be available at a coaxial socket.

19. Set the function selector switch on the control unit (Table 2, item 11) to T/R + G and the channel selector switch to any channel other than G.

20. Alternatively, the receiver unit (guard) may be tested using the test set, radio (Table 2, item 13). This test set has been designed by the equipment manufacturer and is capable of testing the receiver unit (guard) to the standard required by their production test specification. The test set is a compact module which provides a rigid mounting for the unit under test and connections to external signal sources and power supplies. The required power supplies for the test set and the unit under test are provided by an external power unit (Table 2, item 14). Two built-in crystal oscillators, resonant at 1.85 Mc/s and 34.45 Mc/s, provide accurate setting facilities for the external signal generators and the receiver unit local oscillators. In addition to these oscillators a low frequency generator is embodied which is employed for testing the selectivity characteristic of the receiver unit at the 6dB and 60dB response levels (para. 26) using the beat frequency method. Full details of this test set will be found in Section 1 of this part.

Definitions

21. For the purpose of tests described in this chapter the following definitions of terms are included:-

(1) Distortion factor - the ratio between the square root of the sum of the harmonics and the total voltage. All measurements are r.m.s. and the result is expressed as a percentage.

(2) Blocking is considered to have commenced when due to an increase in the input signal level, the audio output falls by a specified amount.

(3) Selectivity - the relative input signal level required to maintain the detector test point voltage level constant, as the frequency of the input signal is varied.

(4) A.G.C. characteristic - is the ability to hold the audio output power level within specified limits whilst the signal input level is varied over relatively wide specified limits.

(5) Amplitude limiting - that capacitor of the equipment to limit the peak level of the audio output voltage for a constant level of the input carrier wave, even though the depth of modulation of the carrier may be further increased. It is manifest as a distinct horizontal flattening of the audio frequency output voltage waveform peaks when displayed on an oscilloscope.

(6) Muting threshold

(a) Threshold of being not muted, i.e. when the input carrier voltage is raised from zero to that level obtaining at completion of the abrupt rise in the audio output voltage level.

(b) Threshold of being muted i.e. when the input carrier voltage is reduced to that level obtaining at the completion of the abrupt fall in the audio output voltage level.

Test procedure

22. The following test procedure fulfils the requirements of the manufacturer's production test specification and may be adopted for either method of testing with the following exceptions:-

(1) When using the complete transmitter-receiver method of testing, the peak-to-valley ratio test (para. 25) is not possible using a Type 56 or Type 57 signal generator since the incremental scale readings are unsuitable. This test, however, has been included for completeness and is accomplished by the beat frequency principle when using the test set, radio method of testing.

(2) Where reference has been made to controls and test points in the complete equipment these have been simulated in the test set, radio.

NOTE...

When adjustments and measurements are made at u.h.f., the signal generator should be tuned to the resonant frequency (nominally 243.0 Mc/s) by adjusting the operating frequency for maximum response at the detector test point or, at the a.f. output load. When response is taken from the detector test point the voltage presented should be maintained below 10V and when taken from the a.f. load the input carrier level should be the least practicable.

Current consumption

23. After the equipment has been operating for five minutes the maximum current drawn should not exceed 85 milliamps.

1.85 Mc/s i.f. amplifier alignment

24. Set the r.f. gain control (R1402, chassis assembly (main) side panel) and the squelch control (R1507, chassis assembly (main) underside) to their fully clockwise position.

(1) Disable the 34.45 Mc/s oscillator, either by mistuning the inductance (L807) or by short-circuiting the 34.45 Mc/s crystal (Y801).

(2) Tune the signal generator (Table 2, item 2), unmodulated, accurately to 1.85 Mc/s. This setting should be carefully done and all efforts made to be within 100 c/s of the figure. The test set, radio incorporates a 1.85 Mc/s crystal oscillator; by the heterodyne method, the signal generator can be accurately set. The output level of the signal generator should be set and constantly reset, so that the reading on the voltmeter connected to the detector does not exceed 10V.

(3) Connect the signal generator output between the control grid (pin 1) of valve V807 and the chassis. Tune the primary and secondary of the transformer T805 for approximate peak response as indicated by the detector voltmeter. Repeat this procedure for valves V806 and V805 and associated transformers T804 and T803 with the exception that for valve V805 the signal generator must be connected between the cathode (pin 2, 4 or 8) and the frame.

(4) With the signal generator still connected across the cathode of valve V805 and frame, shunt the primary of transformer T805 with the damping network described in para. 13. Now accurately tune the secondary for maximum response in the detector voltmeter, adjusting the input voltage as necessary to ensure a reading between 5V and 10V on the detector voltmeter.

(5) Connect the damping network across the secondary of transformer T805 and adjust the primary for maximum response in the detector voltmeter. Adjust the input as necessary to ensure a reading between 5V and 10V on the detector voltmeter.

(6) The alignment procedure for the transformer T805 should be repeated successively for the transformers T804 and T803 with the signal generator remaining connected to valve V805. Repeat the alignment procedure until no improvement in response can be effected, after which the damping network may be disconnected.

Peak-to-valley ratio

25. With the signal generator tuned to 1.85 Mc/s as in para. 24(2) and connected to the cathode of V805, adjust the output level to obtain a reference voltage of between 6.65V and 7.35V in the voltmeter connected to the detector test point; note the actual output level of the signal generator. The operating frequency of the signal generator should be swept, first through the lower frequency band of 1.78 Mc/s to 1.85 Mc/s, and then through the upper band of 1.85 Mc/s to 1.92 Mc/s. The frequency at which response peaks occur at the detector test point must be noted.

(1) If there is only one frequency of peak response and that frequency is 1.85 Mc/s then the peak-to-valley ratio should be taken as 0dB.

(2) When there is only one frequency of peak response present in either the upper or lower sideband, the signal generator should be tuned to it and the output level adjusted until the reference voltage (6.65V to 7.35V) is obtained in the detector test point voltmeter; note the actual output level of the signal generator. The difference between the output level at 1.85 Mc/s and the output level at the frequency of peak response should not exceed 1.25dB. If it does so the amplifier must be realigned.

(3) When there is one frequency of peak response in each sideband the signal generator should be tuned to each in turn and then to the frequency of minimum response between these two peaks. In each case adjust the output signal level to obtain the reference voltage at the detector test point. These output signal levels must be noted.

(a) The difference between the output signal levels of the two peak response frequencies should not exceed 1.25dB. If this ratio is exceeded the amplifier must be realigned.

(b) The difference between the output signal levels of the side-band frequency of greatest response and the inner frequency of minimum response must not exceed 3.25dB. If this ratio is exceeded the amplifier should be realigned.

Selectivity

26. With the signal generator tuned to 1.85 Mc/s as in para. 24(2) and connected to the cathode of V805 adjust the output level to obtain a reference voltage of between 6.65V and 7.35V in the voltmeter connected to the detector test point.

(1) 6dB response level - The output level of the signal generator should be increased by a nominal 6dB (5.75dB to 6.25dB). Now lower the frequency of the signal generator until the voltage at the detector test point falls to the reference voltage i.e. 6.65V to 7.35V. This change in frequency should not be less than 45 kc/s. The

signal frequency should now be raised until the detector test point voltage has again fallen to the reference voltage. Again, this change in frequency should be not less than 45 kc/s above 1.85 Mc/s.

(2) 60dB response level - Further increase the signal generator output level by a nominal 54dB (53.75dB to 54.25dB) to a total of 60dB. Then lower and raise the frequency of the signal generator to the frequencies at which the detector test point voltage falls to the reference voltage. The total bandwidth between these frequencies should not exceed 400 kc/s.

Sensitivity

27. The signal generator should remain connected as for the selectivity test and tuned to 1.85 Mc/s as in para. 24(2). Adjust the output level of the signal generator until the voltmeter at the detector test point shows not more than 10.5V. The output level of the signal generator should not exceed 55 microvolts open circuit.

28. Remove the signal generator and render the 34.45 Mc/s oscillator active by removing the means adopted for disablement (para. 24 (1)).

36.3 Mc/s i.f. amplifier alignment

29.

(1) Set the r.f. gain control and the squelch control fully clockwise and fit the test sidecover (Table 2, item 8) to the side of the guard receiver. The signal generator (Table 2, item 1) should be connected between the cathode (pin 2) of the valve V805 and the frame and tuned to 36.3 Mc/s (with the output signal level adjusted, initially, to 50 microvolts open circuit. Tune the inductor L807 for peak response in the voltmeter connected to the detector test point; the level of this response must be kept between 5V and 10V by readjusting the output signal level of the generator.

(2) Remove the sidecover on the a.f. side of the unit and loosely couple the 1.85 Mc/s signal generator (Table 2, item 2), set to 1.85 Mc/s as in para. 24(2), to the control grid (pin 1) of valve V806. Finally adjust the inductor L807 until the audio heterodyne is reduced to zero. Disconnect the 1.85 Mc/s signal generator from the unit and refit the sidecover previously removed. The signal generator (Table 2, item 1) is next transferred from valve V805 to the grid (pin 2) of valve V802A and an unmodulated output signal, set at a level which produce 7 volts (or the maximum voltage possible if below 7 volts), at the detector test point.

(3) First the secondary (L810B) and the primary (L810A) of the transformer T802 must be accurately tuned for maximum response at the detector test point; this voltage level being maintained below 7 volts, during this process, by adjustment to the output level of the signal generator. Then L809B and L809A of the transformer T801 should be tuned in a similar manner to transformer T802.

Selectivity, 36.3 Mc/s i.f. with 1.85 Mc/s i.f.

30. With the signal generator (Table 2, item 1) still connected to the grid of valve V802A, tune it to 36.3 Mc/s using an unmodulated carrier level

set to produce a reference voltage of between 9V and 11V at the detector test point. Increase the signal generator output level between 5.75dB and 6.25 dB and lower the signal frequency until the detector test point voltage has fallen to the reference voltage; the difference between this point and the 36.3 Mc/s position should be noted. Now raise the signal frequency until the detector test point voltage, having passed through a peak of response, has again fallen to the reference voltage; the difference between this point and the 36.3 Mc/s setting should be noted. The total bandwidth contained between the two 6dB response levels thus obtained should be not less than 90 kc/s and they should be equi-spaced, within 15 kc/s, on each side of 36.3 Mc/s. Disconnect the i.f. signal generator from valve V802A.

U.H.F. amplifier alignment

31. With the test sidecover remaining in position, set the r.f. gain control and squelch control fully clockwise. Connect the d.c. valve voltmeter between the grid of valve V802B and the frame. Now adjust the inductors L806 and L805 for maximum response as indicated by the voltmeter. The valve voltmeter is then disconnected from the valve V802B and the test side cover replaced by the regular unit cover.

32. The u.h.f. signal generator (Table 2, item 1) should be coupled to the aerial plug P1502 (underneath the chassis assembly (main)) and tuned to the resonant frequency of the receiver (nominally 243.0 Mc/s) by adjusting the injected frequency for maximum response at the detector test point. An unmodulated output carrier level should next be set to produce a detector test point voltage of between 5V and 10V. Then tune the inductors L803, L802 and L801 for maximum response, at the same time keeping the level of the test point voltage below 10V by adjusting the input signal level.

A.G.C. characteristic and blocking

33. Remove the sidecover on the a.f. side of the unit and loosely couple the 1.85 Mc/s signal generator (Table 2, item 2), set to 1.85 Mc/s as in para. 24(2) to the control grid (pin 1) of valve V906. With the u.h.f. signal generator (Table 2, item 1) connected as for para. 32 set it, unmodulated, to within ± 2dB of 1000 microvolts open circuit then tune it to 243.0 Mc/s by zero audio heterodyne as displayed on the oscilloscope (para. 17). The 1.85 Mc/s signal generator can now be removed, the side cover refitted and the u.h.f. signal carrier modulated to a depth of between 25% and 35% by a tone of 1000 c/s. Connect the CT38 (Table 2, item 3) with the oscilloscope and indicator distortion (para. 17) between C843 and the frame. For an input carrier level of 1 microvolt the receiver should be adjusted to the threshold of not being muted (para. 21(6)) by manipulating the squelch control and, if necessary, the r.f. gain control; the latter should be set as close to the fully clockwise position as is practicable.

(1) Sensitivity - the audio output voltage level should be not less than 5.25V r.m.s., as measured on the a.f. voltmeter, for a signal level of 1000 microvolts open circuit.

(2) Control characteristic - the audio output voltage obtained for the input signal level of 1000 microvolts open circuit should be used as the reference level. Reduce the input signal level by between 39.75dB and 40.25dB, the audio output voltage should fall by not more than 3dB. Raise the input signal level by between 39.75dB and 40.25dB, the audio output voltage should rise by not more than 3dB.

(3) Blocking - set the input carrier level to within 2dB of 500 000 microvolts open circuit; the audio output voltage level should not fall below 5.25V r.m.s.

Audio frequency response

34. The u.h.f. signal generator should remain connected and tuned as for para. 33. The receiver is then adjusted to the threshold of not being muted for an input signal level of 1 microvolt open circuit, again following the instructions of para. 33.

(1) Response at 1000 c/s - the audio open output voltage obtained for an input carrier level of 1000 microvolts open circuit, modulated to 30% by a 1000 c/s tone should be used as a reference level.

(2) Response at 300 c/s - reset the modulating frequency of the test carrier to 300 c/s, to within 6 c/s, when the audio output voltage level should not rise by more than 1dB or fall by more than 3dB relative to the reference level obtained in (1).

(3) Response at 3000 c/s - reset the modulating frequency of the test carrier to 3000 c/s, to within 60 c/s, when the audio output voltage level should not rise by more than 1dB or fall by more than 4dB relative to the reference level obtained in (1).

Distortion

35. The side covers of the equipment should remain in position and the u.h.f. signal generator connected and tuned as described in para. 33. The receiver should again be adjusted to the threshold of being not muted for an input carrier level of 1 microvolt open circuit (para. 33).

(1) 1000 microvolt level. The distortion factor of the audio output waveform must not exceed 12%, as measured on the indicator, distortion.

(2) 100 microvolt level. The input carrier level should be reduced by between 19.75dB and 20.25dB when the distortion factor of the audio output waveform should be not in excess of 12% as measured on the indicator, distortion.

Noise limiter characteristic

36. The side covers should remain in position with the signal generator still connected as in para. 33 and tuned to the resonant frequency of the receiver. The receiver is then adjusted to the threshold of being not muted for an input carrier level of one microvolt open circuit. Then the output carrier level of the signal generator should be set to within 2dB of 1000 microvolts open circuit and modulated by 1000 c/s ± 20 c/s tone to the depth at which amplitude limiting of the audio output waveform commences. Amplitude limiting of the audio output waveform should not commence until the depth of modulation is 40% and should have commenced at depths beyond 65%.

Sensitivity

37. The u.h.f. signal generator should remain connected as in para. 33 and

the receiver adjusted to the threshold of being not muted for an input carrier level of one microvolt open circuit. The auxiliary 1.85 Mc/s signal should be injected into the first i.f. amplifier. Then the u.h.f. signal level, which should be unmodulated, is set to within ± 2dB of 5 microvolts open circuit and tuned to 243.0 Mc/s by obtaining zero audio heterodyne (para. 33). The 1.85 Mc/s auxiliary signal should then be removed and the side cover refitted. The signal carrier is then modulated to a depth between 25% and 35% by a 1000 c/s ± 20 c/s tone.

(1) Audio output level - should be not less than 2.25V r.m.s.

(2) Signal plus noise-to-noise ratio - note the audio output voltage. Now remove the modulation of the signal carrier whereupon the audio output level should fall by at least 5.8dB.

38. With the sidecovers fitted the signal generator should be connected and tuned to the equipment as specified in para. 37.

(1) Muting capability - the squelch control and r.f. gain control should be set fully clockwise. The receiver should not be muted and the input carrier level is to be set to one microvolt open circuit. It should now be possible for the receiver to be set to the threshold of being muted by adjusting the squelch control or, if necessary, by adjusting the r.f. gain control and final adjustment made to the squelch control.

(2) Muting range - the receiver should be adjusted to the threshold of being not muted for an input carrier level of one microvolt open circuit. The r.f. gain control should then be rotated to the fully counter-clockwise position and the input carrier level raised until the receiver is at the threshold of being not muted. This input signal level should be not less than 10 microvolts open circuit.

39. On completion of alignment the tuning slug threads of transformers T801, T802, T803, T804, T805 and inductors L801, L802, L803, L805, L806 and L807 should be staked with an approved anti-tracking compound i.e. I.C.I. Type Dulux red.

Assembly after test

40. The receiver unit (guard) is retained in position on the chassis by four red-painted captive screws of Phillips-type. Two dowels are provided in the base of the unit to ensure correct alignment so that the multipole plug in the base of the module will engage correctly with the mating socket integral with the equipment chassis. The aerial plug (P802) should be firmly connected to the aerial socket underneath the chassis assembly (main), care being taken to avoid strain or damage to the cable.

41. Following the assembly of all components into the chassis and refitting of the cover, full functional tests should be carried out as detailed in Chap. 2 of this Section. Pressurization and leak testing should follow as in Chap. 17.

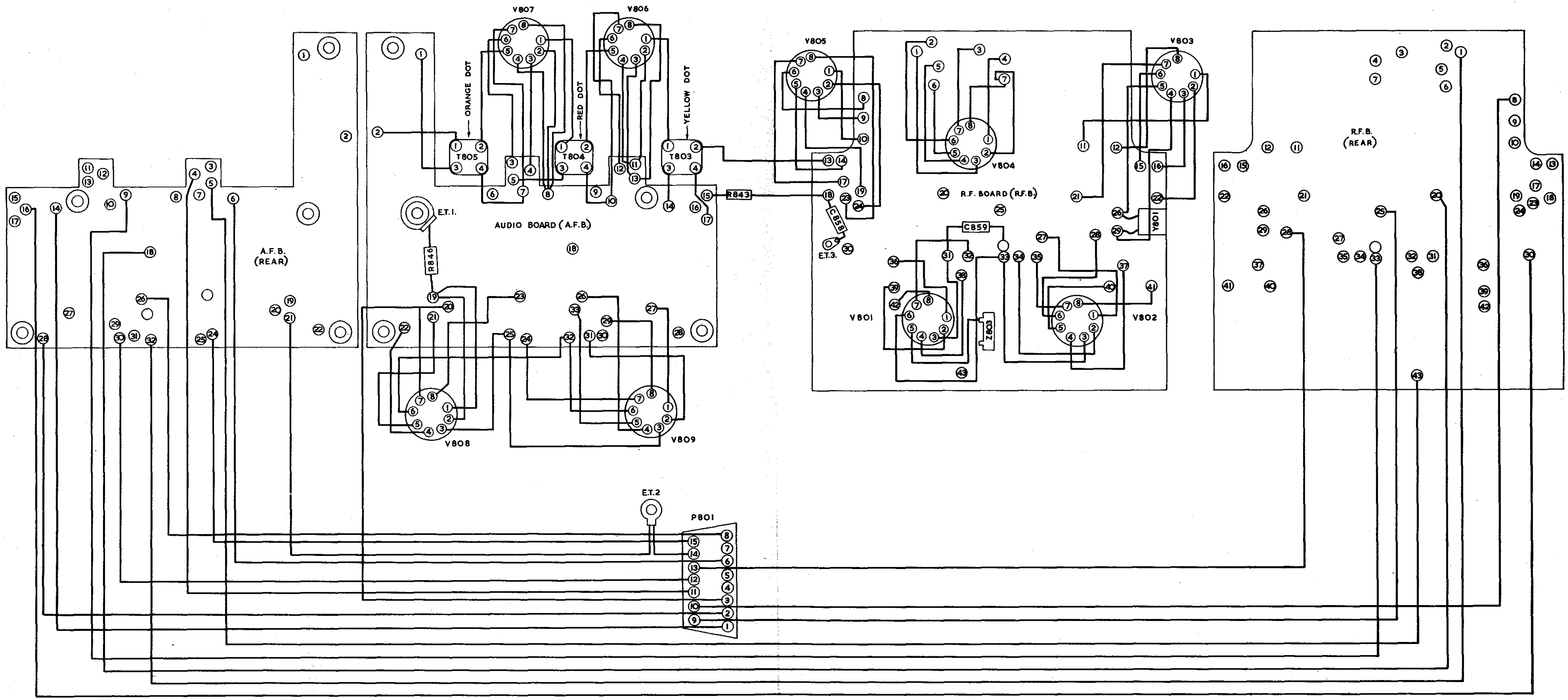

Fig. 1. ARI. 18124/1 and ARI. 18124/2 — receiver unit (guard) — wiring diagram

Chapter 11

RELAY UNIT

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General

1. The relay unit is a component part of both the TR4/ARC52 and the TR5/ARC52 equipments and is incorporated to facilitate remote control of various functions of these transmitter-receivers. These functions are, principally, transmit-receive, tone modulation and guard receiver operation as follows:-

(1) The T/R relay (K901), when operated by the external PRESS-TO-TRANSMIT switch, causes the equipment to function as a transmitter. Contacts 2 and 3 switch the modulator h.t. supply and contacts 5 and 7 switch the h.t. to the transmitter section of the IF unit (20-30 Mc/s) and the amplifier unit (main receiver RF amplifier and transmitter pre-amplifier). In addition it has the function of removing h.t. from the receiver sections of these same modules and from the guard receiver.

(2) The tone relay (K904), when operated by the external TONE switch, actuates the T/R relay (K901) and in addition supplies h.t. to the tone oscillator in the modulator unit, thereby causing the equipment to transmit a signal modulated at approximately 1 kc/s.

(3) The guard relay (K903), when operated from the control unit Type C1607/ARC52, supplies h.t. to the guard receiver, thereby making it operative.

(4) The disable relay (K902) operates when any shaft of the mechanical tuning unit is in motion. This relay causes the relays K901, K903 and K904 to relax, thereby putting the equipment into a passive state and also suppressing any noise in the headset.

2. The relay unit is secured to the main chassis by four captive Phillips-type screws, painted red for identification, which are accessible from the underside of the chassis when the sealed cover is removed. Details of cover removal, replacement and subsequent pressurizing are given in Sect. 2, Chap. 17, of this Volume. Details of procedure for the removal and refitting of this unit are given in Vol. 1, Part 1, Chap. 5 of this Air Publication, to which reference should be made when required; any dismantling or assembly procedures given in subsequent paragraphs will be supplementary, and limited to requirements for repair and replacement of components.

3. The test equipment required for the tests described in para. 13-17 is the test set, relay 6625-99-943-6538 which is used in conjunction with the power unit (AC) 5821-99-943-7136 and a multimeter and capacitance bridge. Full details of the test set, relay and associated equipment are given in Sect. 1, Chap. 8 of this Part.

Component inspection

4. Inspect to ensure that the details of equipment serial numbers and modifications state, entered on the repair card accompanying the unit, are correct.

5. Using a portable blower, or other approved supply of dry air pressure, thoroughly clean all dust from the unit. The equipment is normally enclosed in a sealed casing which is pressurized and the presence of dust, dirt or moisture should be fully investigated.

6. Carefully examine the relay unit to ensure that it is undamaged and free from corrosion, with all components securely retained in position. Any loose connections or components must be refitted before proceeding with examination or testing. Should it be necessary to renew any components, it is important to ensure that the new items are positioned accurately and connected correctly.

7. Any screws or nuts removed during inspection or servicing, which are not fitted with either locknuts or lockwashers, must be locked with an approved varnish when refitted.

8. It is important to ascertain that the capacitor C902 has been correctly connected with regard to polarity. Since this is a tantulum electrolytic, the wire at the positive end of the component must be formed into a swan neck before connection in order to avoid excessive strain or heat which may affect the weld.

Wiring

9. The wiring should be carefully inspected for continuity and conformity with the circuit shown in fig. 1 at the end of this chapter. This inspection should consist of point-to-point tests or such electrical tests which will confirm the accuracy of the wiring.

10. The equipment should be examined for neatness of soldering, absence of dry joints, and a generally satisfactory condition of the wiring and insulation. No inadvertent interconnections or tracking paths should be permitted due to excess solder, wire clippings or dirty connections.

11. To assist in the servicing of this unit, a wiring diagram is given at fig. 2 and the cableform wiring key is shown in Table 1. It is important to ensure that any rewiring is done correctly, and that lengths, gauge of wire and colour coding are replaced as in the original (unless modification requirements necessitate changes).

TABLE 1

Cableform wiring key

From	Colour	Breakout	To
P901/15	Yellow	B1	K901/5
" /1	Clear	"	" /4
" /16	Green	"	" /3
" /4	Maroon	"	" /2
" /21	Pink	B2	" /9
" /6	Red	"	"//8
" /18	Orange	""	" /7
" /2	Yellow	"	" /6
" /9	Black	"	K902/3
" /14	Clear	B3	" /8
K901/22	Tan	B3	K902/6
" /24	Blue	"	K903/5
" /25	White	B4	Earth tag
" /12	Grey	"	K903/8
" /11	Brown	"	K904/3
" /10	Green	"	" /1
" /13	Light green	B5	" /8
" /20	Red	"	" /5
" /3	White/Black	B6	C902
" /3	Green	B1-B6	R902(A)
K901/1	Busbar	-	K902/2
" /1	-	-	V901
" /10	-	-	"
" /10	Brown	B2-B4	K904/3
" /9	Pink	"	K903/6
" /7	Orange	B2-B5	K904/6
K902/3	Busbar	-	K902/1
" /2	"	-	K903/1
" /4	White/Black	B3-B6	R901
" /5	White	B3-B4	Earth tag
" /5	White	B3-B6	C901
K904/4	Busbar	-	Earth tag
C901	Green	-	R902(A)
C903	Busbar		K901/8

Servicing

12. In view of the comparative simplicity of this unit, little servicing should be required. Renewal of components, when this becomes necessary, should be quite straight-forward involving only standard practice and requiring no special instructions. Reference to Vol. 1, Part 2, Chap. 5, fig. 45 will assist in component identification.

WARNING

ELECTRIC SHOCK. It is essential to ensure that before any attempt is made to service or renew components found defective during any part of the tests, the power supply is switched off or, preferably, entirely disconnected from the equipment.

Testing

13. Fit the relay unit to be tested to the test set, relay, and connect the test set to the supply.

Functions

14. To test the functioning of the relays in the relay unit, set the RES & CAP and the TEST switches of the test set, relay to FUNCT and the FUNCTIONS switch to each of its positions in turn (the setting of the SHORT-CIRCUITS switch is immaterial). The indicator lamps should operate as shown in Table 2. The reason for incorrect indications may be diagnosed from the information in the details column of the Table in conjunction with the circuit (fig. 1). Throughout the function tests the positive side of the supply is connected to pole 9 of the relay unit and the negative side to the chassis (earth). The CORRECT and FAULT lamps have one connection permanently to the positive of the supply and the other to the pole given in the Table.

TABLE 2

Functions tests

FUNCTIONS switch position	Lamps On	Lamps Off	Details of test set connections
A		DISABLE	No connection to pole 14
		T/R	No connection to pole 11
		TONE	No connection to pole 13
	GUARD		Pole 12 to earth, lamp between poles 10 and 12
	CORRECT		Lamp to pole 2, earth on pole 1
		FAULT	Lamp to pole 24 (K903/2 closed), no connection to poles 6 or 24.
B		DISABLE	No connection to pole 14
		T/R	No connection to pole 11
		TONE	No connection to pole 13
	GUARD		Pole 12 to earth, lamp between poles 10 and 12
	CORRECT		Lamp to pole 24, earth on pole 21 (K903/2 closed). No connection to pole 6
		FAULT	Lamp to pole 2, no connection to poles 1, 7 or 15 (K903/1 closed)

Table 2 (Continued)

FUNCTIONS switch position	Lamps On	Lamps Off	Details of test set connections
C		DISABLE	No connection to pole 14
	T/R		Pole 11 to earth, lamp between poles 10 and 11
		TONE	No connection to pole 13
		GUARD	No connection to pol3 12
	CORRECT		Lamp to pole 15, earth on pole 1
		FAULT	Lamp to pole 2, carth on pole 1
D		DISABLE	No connection to pole 14.
		T/R	No connection to pole 11
		TONE	No connection to pole 13
	GUARD		Pole 12 to earth, lamp between poles 10 and 12.
	CORRECT		Lamp to pole 2, earth on pole 7
		FAULT	Lamp to pole 15, earth on pole 1
E		DISABLE	No connection to pole 14
		T/R	No connection to pole 11
		TONE	No connection to pole 13
	GUARD		Pole 12 to earth
	CORRECT		Lamp to pole 24, earth on pole 6 (K903/2 closed), no connection to pole 21.
		FAULT	Lamp to pole 20 (K904/2 open)
F		DISABLE	No connection to pole 14
	T/R		No connection to pole 11 (K904/1 closed)
	TONE		Pole 13 to earth
		GUARD	No connection to pole 13
	CORRECT		Lamp to pole 20, earth on pole 18
		FAULT	Lamp to pole 6 (K901/1 and K901/2 closed), no connection to pole 4.

Table 2 (Continued)

FUNCTIONS switch position	Lamps On	Lamps Off	Details of test set connections
G		DISABLE	No connection to pole 14.
	T/R		No connection to pole 11 (K904/1 closed)
	TONE		Pole 13 to earth
		GUARD	No connection to pole 12
	CORRECT		Lamp to pole 16, earth on pole 4
		FAULT	Lamp to pole 20 (K904/2 closed), no connection to pole 18.
H		DISABLE	No connection to pole 14
	T/R		No connection to pole 11 (K904/1 closed)
	TONE		Pole 13 to earth
		GUARD	No connection to pole 12
	CORRECT		Lamp to pole 20, earth on pole 6, no connection to pole 18
		FAULT	Lamp to pole 22
I	DISABLE		Pole 14 to earth
		T/R	No connection to pole 11
		TONE	No connection to pole 13
		GUARD	No connection to pole 12
	CORRECT		Lamp to pole 22, pole 25 permanently earthed.
		FAULT	Lamp to pole 24, earth on pole 21
J		DISABLE	No connection to pole 14
		T/R	No connection to pole 11
		TONE	No connection to pole 13
		GUARD	No connection to pole 12
	CORRECT		Lamp to earth for test only
		FAULT	Lamp to pole 20 (K904/2 open)

Table 2 (Continued)

FUNCTIONS switch position	Lamps On	Lamps Off	Details of test set connections
K		DISABLE	No connection to pole 14
		T/R	No connection to pole 11
		TONE	No connection to pole 13
		GUARD	No connection to pole 12
	CORRECT		Lamps to earth for test only
	GUARD		

Short-circuit tests

15. These tests are to establish that no inadvertent short-circuits exist either to earth or to other circuits in the relay unit. This is done by connecting to earth most of the poles of SKT1 of the relay unit and testing for an earth on one isolated pole. The FAULT (red) lamp will light if a short-circuit is present. For these tests none of the relays are energized and the CORRECT (green) lamp remains alight all the time and is not part of the test.

16. The FUNCTIONS switch should be set to K, the RES & CAP switch at FUNCT, and the TEST switch at SHORTS. Set the SHORT-CIRCUITS switch to each of its eleven positions in turn. The pole selected for short-circuit test is as follows:-

N.	Pole 2	T.	Pole 21
O.	" 22	U.	Poles 11, 12, 13 and 14
P.	" 20	V.	Pole 3
Q.	" 16	W.	" 24
R.	" 14	X.	" 15
S.	" 18		

Resistance and capacitance tests

17. For these tests an external ohmeter and capacitance meter are required, they should be connected to the appropriate terminals on the front panel of the test set. The TEST switch (S4) should be set to R & C, the settings of the FUNCTIONS (S1) and the SHORT-CIRCUITS (S3) switches are immaterial. The RES & CAP switch (S2) has nine test positions (Sect. 1, Chap. 8) thus:-

DISABLE The resistance of the DISABLE relay winding which should be 280 ohms ± 10%

TONE The resistance of the TONE relay winding which should be 280 ohms ± 10%.

GUARD	The resistance of the GUARD relay winding which should be 280 ohms ± 10%
T/R	The resistance of the T/R relay winding which should be 280 ohms ± 10%
R901	The resistance of R901 which should be 68 kilohms ± 10%
R902	The resistance of R902 with R902A in parallel which should be 340 kilohms ± 10%
C901	The capacitance of C901 which should be between 1.6 microfarads and 2.4 microfarads.
C902	The capacitance of C902 which should be between 1.25 microfarads and 2.0 microfarads.
C903	The capacitance of C903 which should be between 21.25 microfarads and 31.25 microfarads.

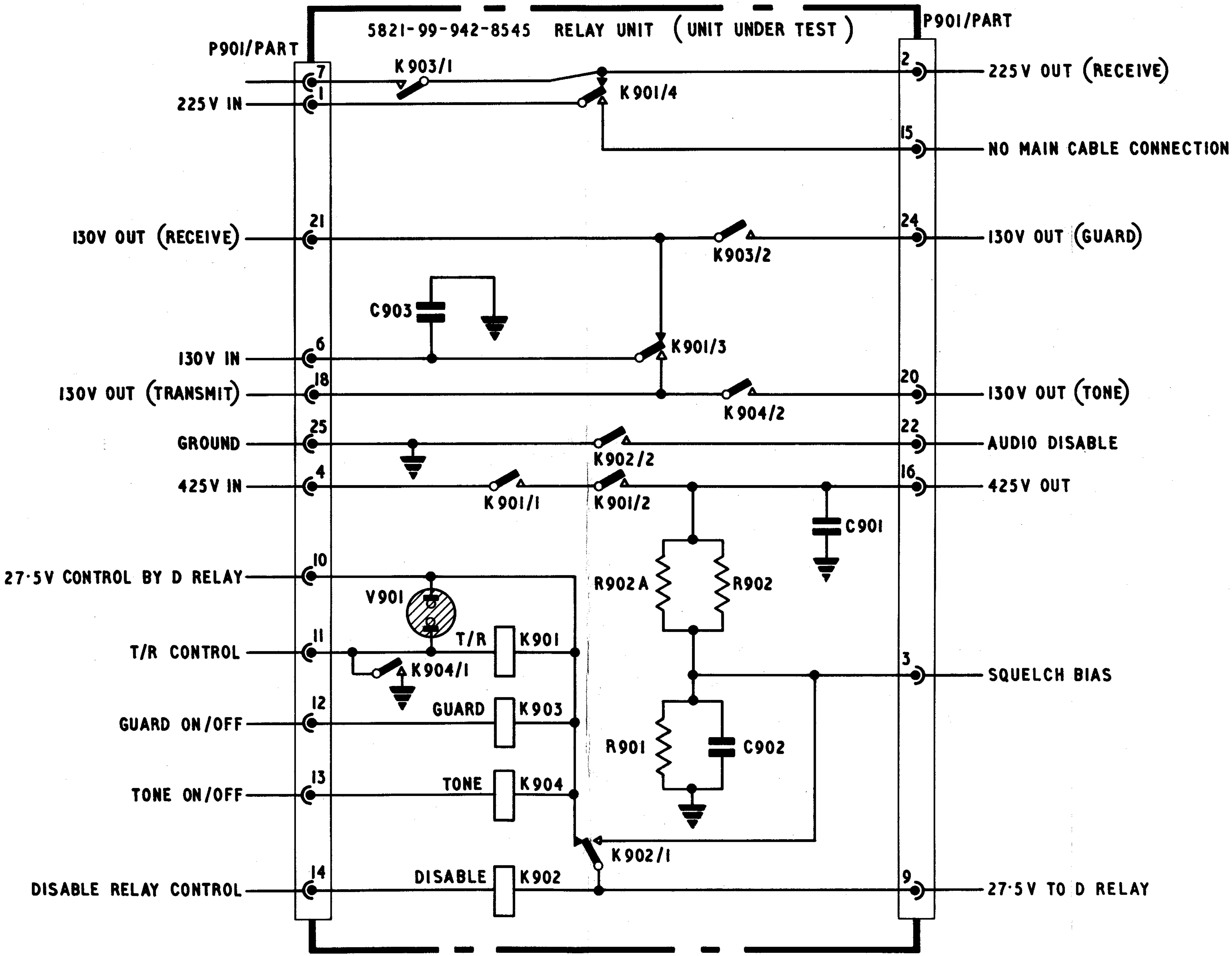

Fig.1 Transmitter-receiver ARC 52 - relay unit : circuit

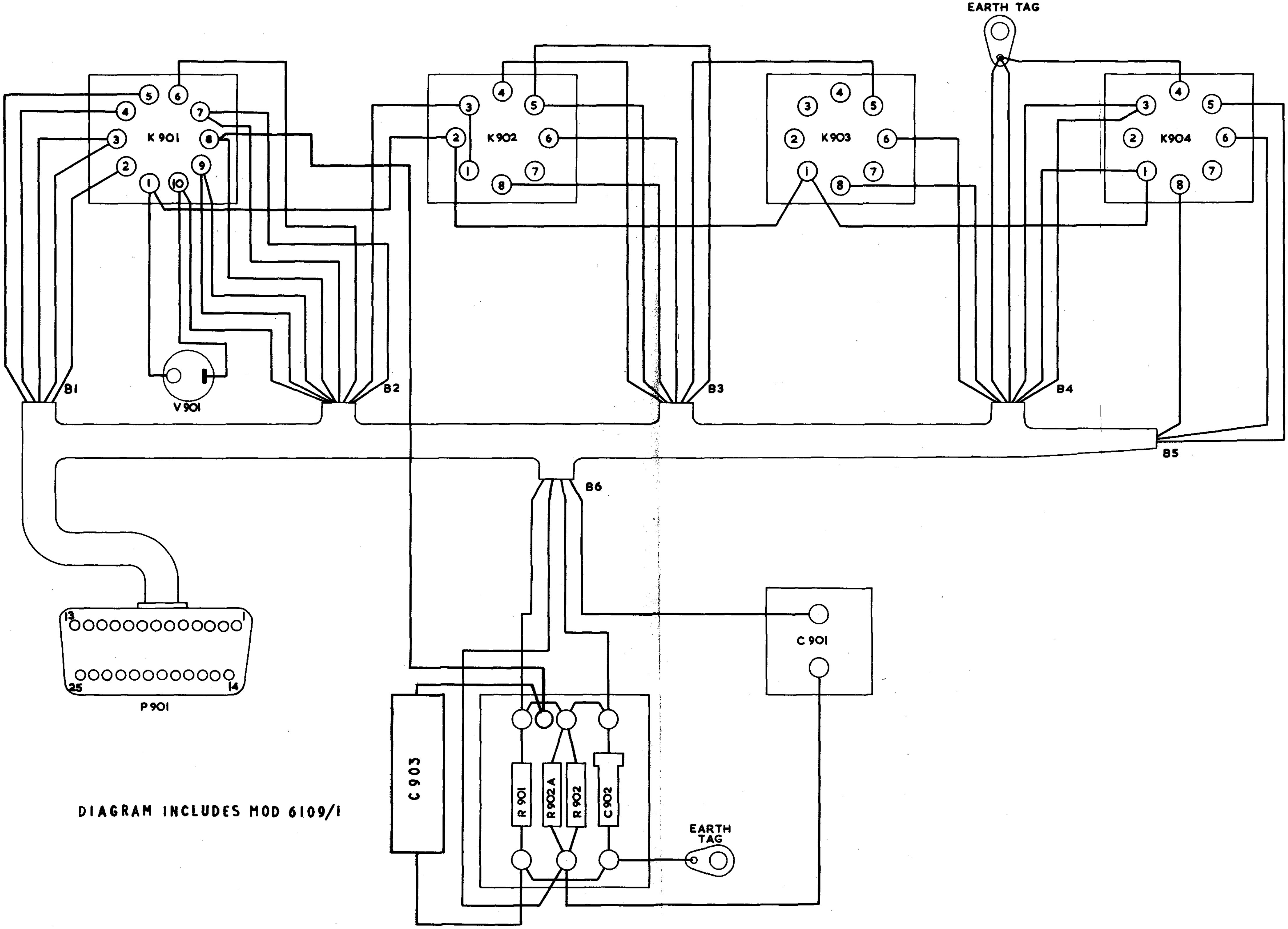

Fig. 2 Transmitter receiver ARC52 — relay unit: wiring diagram.

Chapter 12

RECTIFIER UNIT

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General

1. The purpose of the rectifier unit is to provide main h.t., a.d.f. h.t. and negative bias for the operation of the transmitter-receiver Type TR4/ARC52, which is used in ARI.18124/2. The input supply of 115V 3-phase, 400 c/s, is routed via the a.c. power unit (Chap. 13) to the rectifier unit. The outputs of the rectifier unit are as follows:-

(1) 130V h.t. for sub-units throughout the transmitter-receiver.

(2) 225V h.t. for automatic direction finding and other navigational aids when required.

(3) Approximately 40V negative bias to the receiver unit (guard), the IF unit (1.85 Mc/s) and to the modulator, radio transmitter.

2. The unit is a self-contained, compact module, secured to the transmitter-receiver chassis base by four captive Phillips-type screws. These are painted red and are accessible from the underside of the chassis when the

sealed cover is removed. The method of removing the cover of the transmitter-receiver for access, its refitting and subsequent pressurizing are given in Chap. 17 of this Volume. Details of the procedure for removal and refitting of the sub-units (modules) making up the transmitter receiver equipment are given in Vol. 1, Part 1, Chap. 5 of this Air Publication to which reference should be made before proceeding. Any dismantling or assembly procedures given in subsequent paragraphs will be supplementary and limited to requirements for repair or renewal of components.

3. The inspection procedures and tests outlined in the following paragraphs reveal the salient performance characteristics of the equipment and will indicate whether or not the rectifier unit is operating to the original specification. The tests should follow all repairs and renewal of components, or when specified as routine matters in preventive servicing.

4. Two methods of testing the rectifier unit are described in this chapter:-

(1) Using standard equipment normally available at most user units.

(2) Using special-to-type equipment.

Note...

At the time of going to press this special-to-type test equipment had not received full approval; details must, therefore, follow at a later date.

Component inspection

5. Inspect for correctness the details of equipment serial numbers and the modification state entered on the repair card or servicing documents which should accompany the equipment sent for inspection or overhaul.

6. Using a portable blower, or other approved supply of dry air under pressure, thoroughly clean the unit of all dust. Where necessary, a soft squirrel-hair brush will assist in this process. Since the transmitter-receiver equipment is normally enclosed within an air-tight casing, however, the presence of dust, dirt or moisture should be fully investigated.

7. Carefully examine the unit to ensure that it is undamaged and free from corrosion, with all components securely retained in position. Any loose connections or components must be refitted. Should it become necessary to change any components it is important to ensure that the new items are positioned accurately and connected correctly. Reference to the component layouts shown in Vol. 1, Part 1, Chap. 5, figs. 46 and 47 of this Air Publication will assist in component replacement.

8. Screws and nuts removed during inspection or servicing and which are not fitted with locknuts or lockwashers must be locked with an approved varnish after being refitted.

9. Whenever capacitors of electrolytic tantalum type (C1001, C1002, C1005, C1006, C1007 and C1008) are changed, the wire at the positive end of the component must be formed into a swan-neck before connection in order to prevent any excessive strain or heat from affecting the weld.

Wiring

10. The wiring throughout the rectifier unit should be carefully inspected for continuity and conformity with the circuit shown in Vol. 1, Part 2, Chap. 1, fig. 26 of this publication. This inspection should consist of point-to-point tests or other such electrical tests which will confirm the accuracy of the wiring.

Examination should be made for neatness of soldering, absence of dry joints and a generally satisfactory condition of the wiring and insulation. No inadvertent interconnections or tracking paths should be permitted due to excess solder, wire clippings or dirty connections.

11. It is important to ensure that the rectifiers (CR1001, CR1002, CR1003 and CR1004) and the electrolytic capacitors (C1001, C1002, C1003, C1005, C1006, C1007 and C1008) have been wired correctly with respect to polarity.

12. To assist in the servicing of this unit, a wiring diagram is given in fig. 1. It is important to ensure that any rewiring is done correctly and that lengths, gauge of wire and colour coding are as in the original (unless modification requirements necessitate changes). A cableform wiring key is listed in Table 1 which, when used in conjunction with the wiring diagram (fig. 1), will assist should any rewiring become necessary.

TABLE 1

Cableform wiring

From	Reference (fig.1)	Wire Colour	Length (in.)	To
P1001/4	4	Orange	$6\frac{1}{2}$	CR1001
" /5	5	Yellow	$5\frac{1}{2}$	R1006
" /6	6	Blue	$3\frac{1}{2}$	C1004
" /8	8	Red	$3\frac{5}{8}$	L1001
" /9	9	Maroon	$3\frac{3}{4}$	CR1004
" /10	10	Light blue	$5\frac{1}{2}$	C1005(+)
" /12	12	Green	$4\frac{3}{8}$	R1008
" /15	15	White	$2\frac{1}{2}$	Earth tag
R1002	20	White	$4\frac{3}{8}$	Earth tag
J1001	21	Red	$4\frac{3}{4}$	L1001
C1001(+)	22	Red	$3\frac{1}{4}$	L1001
CR1001	23	Red	$3\frac{7}{8}$	R1001
CR1001	24	Yellow	$5\frac{1}{8}$	R1006
CR1001	25	Blue	$8\frac{1}{4}$	C1004

Servicing

13. In view of the comparative simplicity of this unit, little servicing should be necessary. Renewal of components and any rewiring required should be a simple matter of standard procedure, needing no special instructions.

WARNING

> ELECTRIC SHOCK. The power supply to the rectifier unit MUST be switched off or, preferably, the unit completely dismantled from the test bench before any attempt is made to service the unit or to renew any of the components.

TESTING USING STANDARD EQUIPMENT

Test equipment

14. The test equipment required for all tests described in this series should be available from Service stores. Electronic characteristics and physical features of this equipment are as follows:-

(1) D.C. voltmeter - This should have an accuracy of within ± 1% over the ranges 35V to 50V, 125V to 145V and 220V to 250V; e.g. multimeter Type 1, or equivalent. This requirement is in order to facilitate measurement of the d.c. output voltage levels.

(2) Ripple voltmeter - For the measurement of r.m.s. value of a.c. voltages within the range 0 to 5V with an accuracy within ± 5% ; e.g. CT38 or equivalent.

(3) A.C. voltmeter - To measure the a.c. power input voltage level. A tolerance of less than ± 1% is required over the range 110V to 120V; e.g. multimeter Type 1, or equivalent.

15. It is essential to ensure that test equipment is serviceable before conducting the tests. The simplest way of proving the equipment, is by the substitution-test method, whereby a module of known serviceability is coupled correctly into the test equipment and the performace varied. This measure is recommended for both series of tests i.e. using standard or special-to-type test equipment.

16. In the subsequent test procedures it is assumed that all test equipment will be operated in accordance with the standard instructions given in the appropriate Air Publications.

Power supplies

17. A three-phase a.c. power supply having the following characteristics is required to provide an input to the rectifier unit under test:-

(1) Three-phase, star connected, i.e. four wires, three phases plus neutral. Each of the three phase lines should be switched and fused.

(2) Voltage (line to neutral) nominally 115V r.m.s., but adjustable over the range 110V to 120V r.m.s. when on load. The maximum allowable voltage difference between the phases is 2.5V r.m.s. The reference phase, referred to in the text, is that phase having a voltage intermediate between that of the other two phases; where the voltage of two phases are the same, they shall both be regarded as the reference phase.

(3) Frequency, fixed within the range 380 c/s to 420 c/s.

(4) Distortion factor, for each phase, not greater than 5%. The depth of modulation by an frequency other than the fundamental should be not greater than 2%.

18. Connect the a.c. power supply to the rectifier unit under test as follows:-

A.C. power supply	Plug P1001 of rectifier unit
phase 1	pole 4
phase 2	pole 5
phase 3	pole 6
neutral	pole 15

Dummy loads

19. The output of the rectifier unit must, in addition, be terminated with the following loads:-

(1) Main h.t. supply load - A resistive load of 450 ohms ± 1% rated continuously at 40 watts, connected between poles 8 and 15 of the multipole plug (P1001).

(2) A.D.F. h.t. supply load - A resistive load of 15 000 ohms ± 1%, rated continuously at 4 watts, connected between poles 10 and 15 of the multipole plug (P1001).

(3) Bias supply load - A resistive load of 45 000 ohms ± 1%, rated continuously at 1 watt, connected between poles 9 and 15 of the multipole plug (P1001).

Testing procedure

20. With the rectifier unit supplied and loaded as specified in para. 17 and 18, the potentials and values enumerated against each test must be assured. The sequence of testing given in the following paragraphs is that recommended by the manufacturers of the equipment.

21. Primary input power supply; the reference phase (para. 17) should be set to between 114V and 116V.

22. Main h.t. supply: A positive d.c. potential of between 128·25V and 141·75V should be present at pole 8 relative to pole 15 of the multipole plug (P1001). This d.c. voltage level must not contain a ripple voltage greater than 225 millivolts r.m.s.

23. A.D.F. h.t. supply: the positive potential at pole 10 relative to pole 15 of the multipole plug (P1001) should not be less than 225V. The r.m.s. value of ripple voltage on the d.c. voltage level must not exceed 4V r.m.s.

24. Bias supply: A negative potential of between 39·375V and 50·625V should be present at pole 9, relative to pole 15, of the multipole plug (P1001).

The r.m.s. value of ripple voltage on the d.c. voltage level must not exceed 500 millivolts. A negative potential of approximately half of that obtained at pole 9 should be present at pole 12, relative to pole 15, of the multipole connector (P1001).

25. A quick-reference schedule of the values and potentials required to satisfy the foregoing tests is given in Table 2.

TABLE 2

Test voltages

Circuit	Limits	
	Lower	Upper
Primary input supply	114	116
Main h.t. supply;		
(a) d.c. voltage	130	140
(b) ripple content (mV)	-	225
A.D.F. h.t. supply;		
(a) d.c. voltage	225	-
(b) ripple content (V)	-	4
Bias supply;		
(a) d.c. voltage	40	50
(b) ripple content (mV)	-	500

26. On completion of the tests, switch off all power supplies and disconnect the equipment.

TESTING USING SPECIAL-TO-TYPE EQUIPMENT

Test equipment

27. Details of this equipment are not available at the time of going to press and must follow at a later date. Similarly, description of the test procedure to be adopted using this equipment cannot be provided at this stage.

Assembly after test

28. The rectifier unit is retained in position on the chassis by four captive screws. These are of Phillips-pattern and the heads are painted red for identification purposes. Two dowels are provided in the base of the unit to ensure correct alignment so that the multipole plug in the base of the module will engage correctly with the mating socket integral with the equipment chassis.

29. Following the assembly of all components into the chassis and refitting of the cover, full functional tests should be made as detailed in Chap. 1 of this Volume. Pressurization and leak testing should follow as described in Chap. 17.

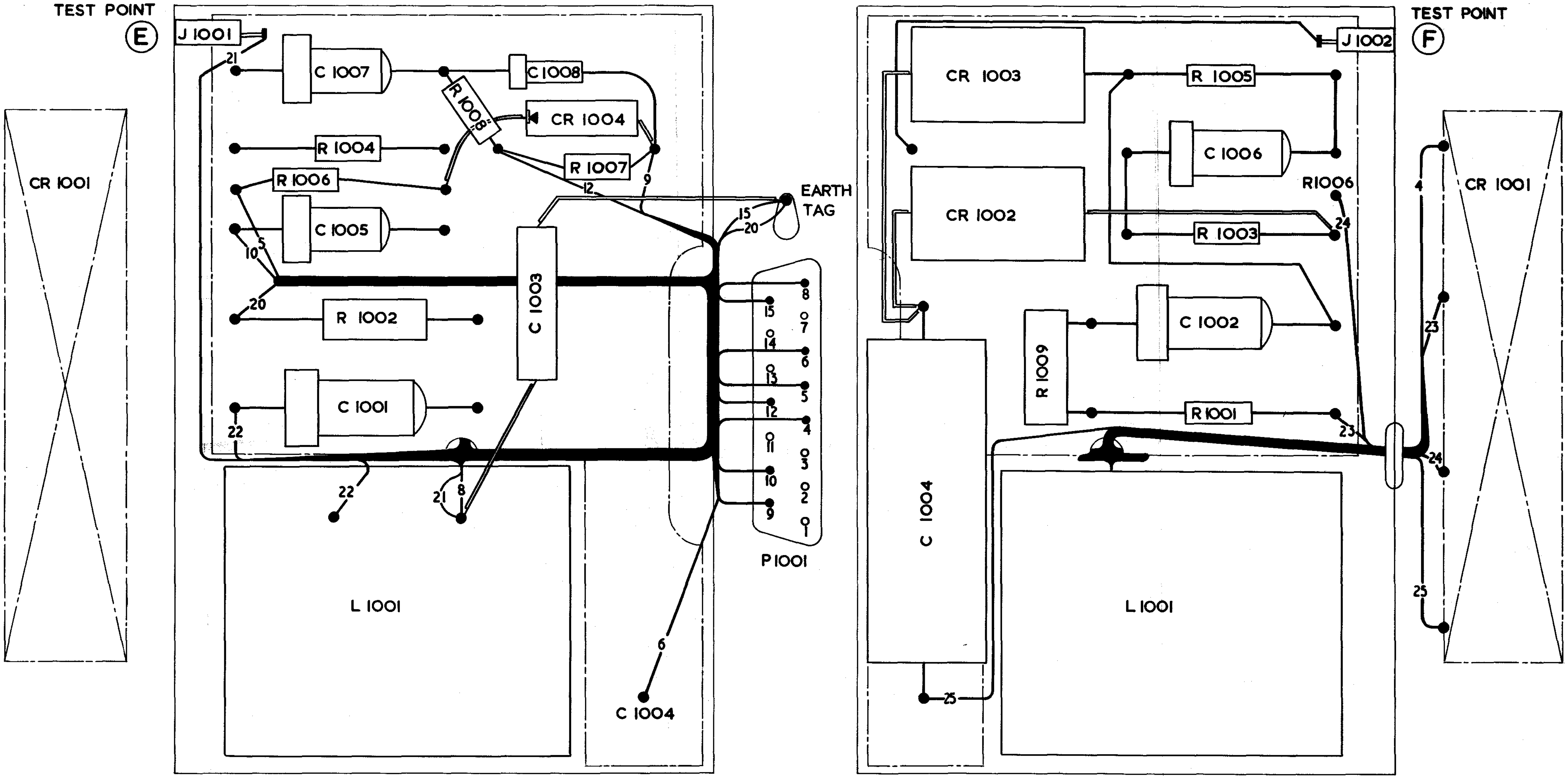

Fig.1 ARI. 18124/2 - rectifier unit - wiring diagram

Chapter 13

POWER UNIT (AC)

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General

1. Input power supplies to the a.c. power unit are connected at a 20-pole (P1101) as shown in Vol. 1, Part 2, Chap. 1, fig. 25 and are fed to the contacts of the on-off relay K1101). When the relay coil is energized from the 27.5V d.c. supply by operation of the function switch on the control unit Type C1607/ARC52, the a.c. supply at 115V is fed as follows:-

(1) To the motor blower via relay contacts 7 and 12 from phase 2.

(2) To the primary winding of the three phase heater transformer via relay contacts 5 and 6, 7 and 12 and 8 and 9 from phases 1, 2 and 3 respectively.

(3) To the primary winding of the h.t. transformer (T1102) by a parallel 3-phase supply from the transformer (T1101).

2. The a.c. power unit is secured to the main chassis base by four

captive Phillips-type screws which are painted red; these are accessible from the underside of the chassis when the sealed cover is removed. The method of removing the cover of the transmitter-receiver for access, its refitting and subsequent pressurizing are given in Sect. 2, Chap. 17 of this Volume. Details of the procedure for removal and refitting of the sub-units making up the transmitter-receiver equipment are given in Vol.1, Part 1, Chap. 5, of this Air Publication, to which reference should be made before proceeding. Any dismantling and assembly procedures given in subsequent paragraphs will be supplementary, only, and limited to requirements for repair or replacement of components.

3. Inspection procedures and tests outlined in the following paragraphs reveal the salient performance characteristics of the equipment and will indicate whether or not the transmitter-receiver is operating to the original specifications. The tests should follow all repairs and renewal of components or when specified as routine matters in preventive servicing.

4. Two methods of testing are described in this chapter:-

(1) Using standard equipment normally available at most user units and described in para. 14 to 21.

(2) Using special-to-type equipment (para. 22).

Component inspection

5. Inspect to ensure that the details of equipment serial numbers and modification state entered on the repair card or servicing documents, which should accompany the equipment sent for inspection or overhaul, are correct.

6. Using a portable blower, or other approved supply of air pressure, thoroughly clean the unit of all dust. Where necessary, a soft squirrel-hair brush will assist in this process. The transmitter-receiver equipment is normally enclosed within an air-tight casing and the presence of dust, dirt or moisture should be fully investigated.

7. Carefully examine the power unit to ensure that it is undamaged and free from corrosion, with all components securely retained in position. Any loose connections or components must be refitted. Should it be necessary to change any components, it is important to ensure that the new items are positioned accurately and connected correctly. Reference to the component layouts shown in Vol. 1, Part 1, Chap. 5, fig. 48 and 49 of this Air Publication will assist in component replacement.

8. Screws and nuts removed during inspection or servicing, which are not fitted with locknuts or lockwashers, must be locked with an approved varnish when refitted.

Wiring

9. The wiring of the power unit (AC) should be carefully inspected for continuity and conformity with the circuit shown in Vol. 1, Part 2, Chap. 1 fig. 25. This inspection should consist of a point-to-point test or such electrical tests which will confirm the accuracy of the wiring.

10. The unit should be examined for neatness of soldering, absence of dry joints, and a generally satisfactory condition of the wiring and insulation. No inadvertent interconnections or tracking paths should be permitted due to excess solder, wire clippings or dirty connections.

11. It is important to ensure that the rectifiers (CR1101 to CR1109, inclusive) have been wired correctly with respect to polarity. In addition,

verify that poles 8, 15 and 20 of the plug (P1101) are properly connected with the main chassis of the unit. Poles 12 and 19 must be connected together, also poles 17 and 18.

12. To assist in the servicing of this unit, a wiring diagram is given in fig. 1. A wiring key is listed in Table 1 for use in conjunction with the wiring diagram should any rewiring become necessary. It is important to ensure that any rewiring is done correctly, and that lengths, gauge of wire and colour coding are replaced as in the original (unless modification requirements necessitate changes).

TABLE 1

Wiring key

From	Wire colour	Marker	Length (in)	To
P1101/1	White/black/orange		$7\frac{1}{8}$	K1101/5
P1101/3	Black/red/green		$7\frac{5}{8}$	" /7
" /5	Black/red/blue		$7\frac{5}{8}$	" /8
" /7	White/brown		$6\frac{1}{4}$	" /3
" /9	White/red/orange		$6\frac{7}{8}$	" /10
" /13	White/brown/red		$9\frac{7}{8}$	L1101/1
" /2	White/brown/blue		$8\frac{1}{2}$	T1101/1
" /17	White/black		$5\frac{1}{4}$	K1101/1
" /4	White/brown/orange		$8\frac{3}{4}$	T1101/2
" /6	White/brown/green		$8\frac{1}{4}$	T1101/3
" /8	White		$7\frac{1}{8}$	Earth tag
" /12	White/black/blue		$8\frac{1}{4}$	T1101/6
" /14	White/black/red		$8\frac{1}{4}$	T1101/5
" /16	White/black/green		$8\frac{3}{8}$	T1101/4
" /15	Busbar		As required	P1101/13
" /15	Busbar		As required	" /20
" /8	Busbar		As required	" /20
" /8	Busbar		As required	" /12
" /17	Busbar		As required	" /18
K1101/1	White/black		$2\frac{1}{4}$	K1101/4
" /6	White/brown/blue		$8\frac{7}{8}$	T1102/1

K1101/9	White/brown/green		$8\frac{3}{4}$	T1102/3
" /12	White/brown/orange		$8\frac{1}{2}$	" /2
" /12	White/brown/orange		$9\frac{1}{8}$	C1103/2
T1101/1	White/brown/blue		$7\frac{1}{8}$	T1102/1
" /2	White/brown/orange		$7\frac{3}{4}$	" /2
" /3	White/brown/green		$7\frac{7}{8}$	" /3
T1102/4	White/brown/orange	Black	$9\frac{3}{4}$	CR1101
" /5	White/brown/blue	Green	$10\frac{1}{4}$	CR1104
" /6	White/brown/green	Red	$9\frac{1}{4}$	CR1107
B1001/1	Green		7	C1102/1
B1101/2	Orange		6	C1103
B1101/3	Black		5	C1103/2
L1101/2	White/brown/red	Black	$8\frac{1}{2}$	C1101/2
C1102/2	White/brown/red		2	C1101/2
C1102/2	White/brown/red		3	CR1106
CR1103	White/brown/red		2	CR1106
CR1109	White/brown/red		2	CR1106
C1102/1	White		2	C1101/1
Earth tag	White		6	C1101/1
T1102/N	Busbar		1	Earth tag

Servicing

13. In view of the simplicity of this unit, little servicing should be required. Renewal of components and any rewiring should be a simple matter requiring no special instructions.

WARNING

In order to prevent electric shock it is essential to ensure that before any attempt is made to service or replace any item found defective during any part of the tests the power is switched off, or preferably, entirely disconnected from the unit.

TESTING USING STANDARD EQUIPMENT

Test equipment

14. The test equipment required for the series of tests described in para. 18 to 21 should be available from Service stores. Electronic

characteristics and features of the equipment are as follows:-

(1) D.C. voltmeter for h.t. and l.t. measurements. This instrument should be capable of measuring both voltages, over the ranges 20V to 30V and 400V to 500V, with an accuracy not worse than ± 2 per cent. Over the range of 26V to 29V the accuracy of measurement between two levels differing by 1V should be not worse than ± 0.1V. Resistance of the meter should be not less than 20,000 ohms/volt e.g. Multimeter Type 1 or equivalent.

(2) Ripple voltmeter. Should be capable of measuring the ripple voltage to an accuracy not worse than ± 10 per cent. The d.c. resistance should be not less than one megohm and impedance to 1000 c/s not less than 1000 ohms; e.g. CT38 or equivalent.

(3) A.C. voltmeter. Should measure the l.t. voltage levels together with the a.c. power supply input voltages, to an accuracy of not worse than ± 1 per cent within the levels 115V, 26.5V and 6.3V; e.g. CT38 or equivalent.

Dummy loads

15. The unit must be connected to the following dummy loads in place of the normal circuit loading which is present when the module is connected into the transmitter-receiver equipment:-

(1) H.T. supply load - this must comprise a resistor of value between 1500 ohms and 1530 ohms, continuously rated for not less than 120 watts, in parallel connection with a paper capacitor of 2 microfarads ± 20 per cent, having a dielectric strength not less than 1,000V d.c. and connected in series with an isolating switch of suitable capacity and electrical strength between poles 13 and 20 of the plug (P1101) on the module.

(2) Supply load, 26.5V a.c. - a resistive load of 39 ohms ± 1 per cent, rated continuously for not less than 20 watts, to be connected between poles 12 and 15.

(3) Supply load, 6.3V a.c. - a resistive load of 1 ohm ± 1 per cent rated continuously for not less than 40 watts, connected between poles 8 and 16.

(4) Relay contact load - a resistive load of 5.5 ohms ± 1 per cent, rated continuously at not less than 140 watts, connected between poles 7 and 20.

(5) In addition a relay switch, a suitably approved single pole type should be provided; this is to be wired in series with a 100 ohms ± 10 per cent, 1 watt resistor and connected between poles 9 and 20.

Power supplies

16. The unit under test should be connected with the following power supplies:-

Note...

The reference phase of the three-phase supply system, referred to in the text, shall be that which is working at a voltage level intermediate between the other two phases.

(1) Primary power source, a.c. - shall be star connected, three-phase, four wires (3 phase lines and neutral). The nominal line to neutral voltage must be 115V r.m.s. and frequency within the range 380 c/s to 420 c/s. The actual on-load line to neutral voltage must be adjustable over the range 110V to 120V. The voltage of each phase should not differ from the remainder by more than 2.5 volts. The distortion factor of each phase shall not exceed 5 per cent and the depth of modulation by any frequency other than the fundamental shall not exceed 2 per cent. Amplitude factor of the phase voltage waveform must be within 1.41 $\pm$ 0.14.

(2) The phase lines should be connected through a suitable isolating switch and fuses to poles 1, 3 and 5, with the neutral line to pole 20 of the multipole plug (P1101) of the unit undergoing test.

(3) Primary power source d.c. - shall be capable of being set to on-load terminal voltages within the range 20V to 30V. The positive lead must be connected to pole 17 and the negative lead to pole 20 of the plug (P1101). The source must be connected to the equipment through a suitably approved isolating switch and fuse.

Endurance ratings

17. With no load connected between poles 13 and 20 (h.t. load) of the multipole plug, the equipment is rated for continuous operation. But, when the h.t. is applied, the equipment is rated to operate for a period not longer than five minutes and, subsequently, for not less than ten minutes with this load isolated.

Testing procedure

18. Blower, - the h.t. load must be isolated and the applied d.c. power should be set with the voltage level between 21V and 22V. The reference phase of the primary a.c. power must be set to 115V $\pm$ 5 volts. The blower should then operate when the relay (K1101) is energized and a.c. power applied. When a.c. power is applied without the relay being energized, however, the blower should not operate.

19. Relay - the h.t. load must be isolated, both a.c. and d.c. primary power should be applied and the relay (K1101) energized. The d.c. primary power must be set between 27V and 28V and the reference phase of the a.c. primary power between 110V and 120V. With these conditions:-

(1) The d.c. potential measured between poles 7 and 20 of the multipole plug must not be more than 0.6 volt greater than that measured between poles 17 and 20. The relay should then be operated for twenty times and these tests repeated.

(2) With the relay energized, the a.c. potentials between pairs of poles, 1 and 20, 2 and 20, 3 and 20, 4 and 20, 5 and 20 and 6 and 20, must indicate that the relay contact pairs 5 and 6, 7 and 12, 8 and 9 have closed.

(3) With the relay not energized, there must be no a.c. potential between poles, 2 and 20, 4 and 20, 6 and 20; and no d.c. potential between poles 7 and 20 of the unit plug (P1101).

20. H.T. supply - both a.c. and d.c. primary power should be applied; in addition, the h.t. load must be connected and the relay energized. The d.c. primary power must be set between 27V and 28V and the reference

phase to between 114V and 116V. The positive d.c. potential on pole 13 of the module plug, relative to pole 20, should then be between 404.8V and 475.2V. Ripple potential between poles 13 and 20 must not exceed 2.0 volts r.m.s.

21. L.T. supplies - the h.t. load must be isolated; both a.c. and d.c. primary power must then be applied and the relay energized. The d.c. primary power should be set between 27V and 28V. Now the a.c. potential between poles 1 and 20 of the plug should be set to between 114V and 116V, and the a.c. potential between poles 12 and 20 must be between 25.5V and 27.5V r.m.s. The a.c. potential between poles 3 and 20 must then be set to between 114V and 116V; the a.c. potential between poles 14 and 20 must be between 6.05V and 6.55V r.m.s. and a similar a.c. potential must also be obtained between poles 16 and 20.

TESTING USING SPECIAL-TO-TYPE EQUIPMENT

Special-to-type test equipment

22. The equipment designed for third and fourth line servicing, test set, electrical power (AC) Plessey Part No. CP.241640, (10S/NIV788) provides facilities for testing the power unit (AC) together with the rectifier unit (Sect. 2, Chap. 12). The test equipment is capable of testing the power unit (AC) and rectifier unit to a similar standard demanded by the manufacturer's production test specification. An interconnecting box is provided with multipole connectors for connection to the units under test, to d.c. and a.c. power supplies and a dummy load unit. Mounted on the front panel are supply switches, indicating lamps, a unit ON/OFF switch, an H.T. load switch and a number of test points. These test points, and the input supplies may be monitored with an external voltmeter, the readings thus obtained being true "on-load" values.

23. The load unit contains wire-wound resistors which simulate the loads imposed on the power unit (AC) and rectifier unit under normal operating conditions in the TR4/ARC52 equipment. These resistors are housed in a convection-cooled box which is connected to the test set with a 25-way connector.

24. Further details of the test set, and method of use will be published when they become available.

Assembly after test

25. The power unit is retained in position in the chassis by four red-painted captive screws. Two dowels are provided in the base of the unit to ensure correct alignment so that the multipole plug in the base of the unit will engage correctly with its socket in the equipment chassis.

26. Following the assembly of all components into the main chassis and refitting of the cover, full functional tests should be carried out as detailed in Sect. 2, Chap. 1 of this Volume. Pressurization should follow as described in Chapter 17.

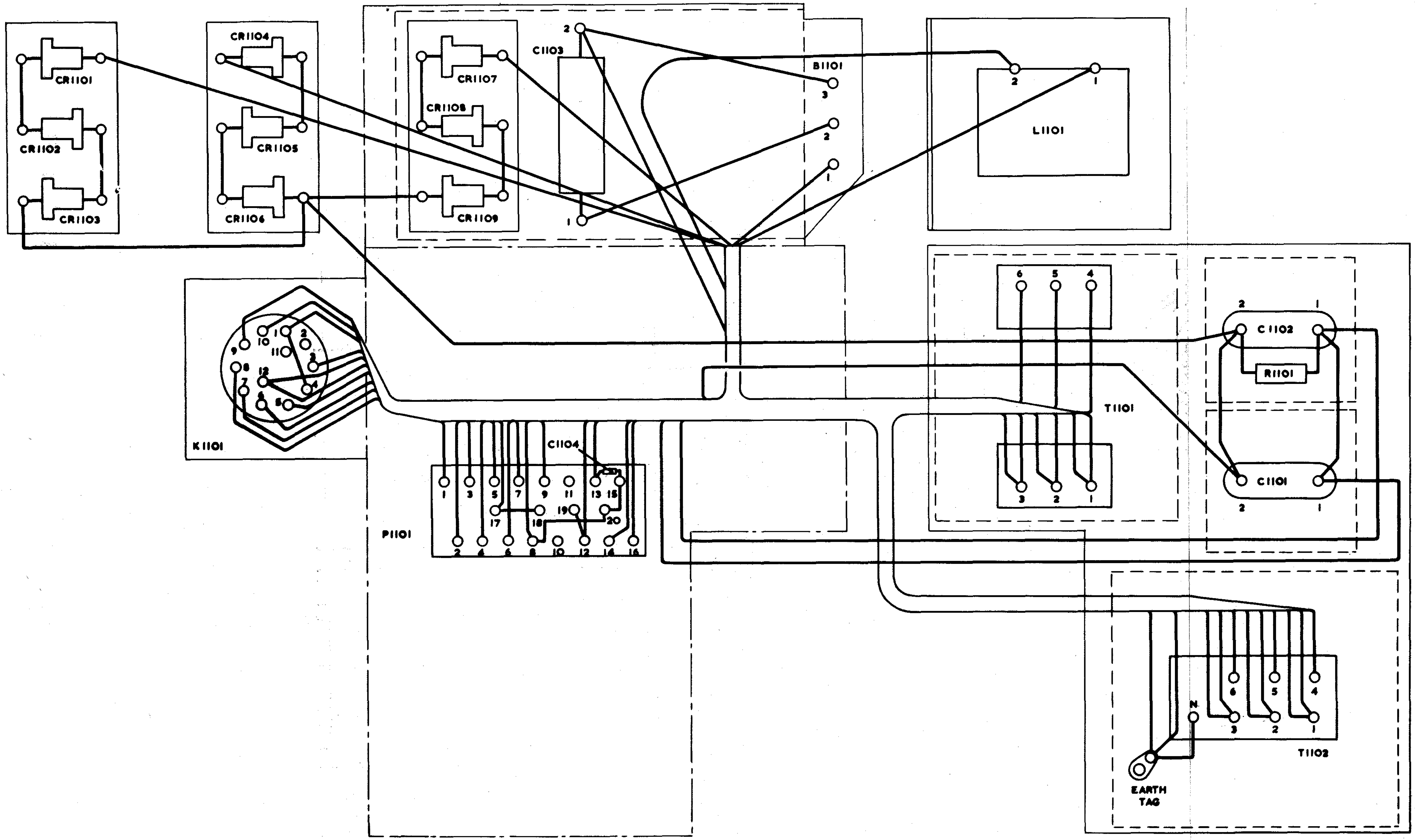

Fig. 1 ARI.18124/2 — power unit (A.C.) — wiring diagram

Chapter 14

POWER UNIT (DC)

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General

1. The d.c. power unit comprises, principally, a rotary transformer (dynamotor unit) which, operating solely from the aircraft power supply of 27.5V d.c., provides output voltages for the supply of h.t. for the transmitter-receiver Type TR5/ARC52. The valve heaters are supplied from the 27.5V d.c. which is routed via the d.c. power unit. Details of the supplies and outputs for the appropriate sub-units are given in Vol. 1, Part 2, Chap. 1 and in the circuit diagram fig. 27 of that chapter.

2. This unit is provided with two multipole connectors (P1101 and P1102) which correspond with similar connectors used for the alternative power unit (AC), and rectifier unit in the transmitter-receiver Type TR4/ARC52.

3. A double-ended air impeller system is provided as an integral part of the dynamotor unit. One side of the impeller system cools the transmitter power amplifier and the other side provides the air circulation for cooling the remaining sub-units mounted on the main chassis.

4. The complete unit is secured to the main chassis by four captive Phillips type screws. These are painted red and are accessible from the underside of the chassis when the sealed cover is removed. Details of cover removal for access, its replacement and subsequent pressurizing are given in Chapter 17 of this Volume. Details of the procedure for removal and assembly refitting of the sub-units (modules) of the transmitter-receiver are given in Vol. 1, Part 1, Chap. 5 of this Air Publication, to which reference should be made when required. Any dismantling or assembly procedures given in subsequent paragraphs will be supplementary only and limited to requirements for repair or renewal of components.

5. The inspection procedures and tests outlined in the following paragraphs reveal the salient performance characteristics of the equipment and will indicate whether or not the transmitter-receiver is operating to the original specifications. The tests should follow all repairs and renewal of components, or when specified as routine matters in preventive servicing.

6. Two methods of testing are described in this chapter:-

(1) Using standard equipment normally available at most user units and described in para. 74 and 86 to 96.

(2) Using special-to-type equipment (para. 97).

Component inspection

7. Inspect to ensure that the details of equipment serial numbers and

the modification state entered on the repair card or servicing documents, which should accompany the equipment sent for inspection or overhaul, are correct.

8. Using a portable blower, or other approved supply of dry air under pressure, thoroughly clean all dust from the unit. If necessary, a squirrel-hair brush may be used to assist this process. Since the equipment is normally enclosed within an airtight casing which is pressurized, the presence of dust, or moisture should be fully investigated.

9. Carefully examine the power unit and dynamotor to ensure that they are undamaged and free from corrosion, with all components securely retained in position. Any loose connections or components must be refitted. Should it become necessary to renew any components, it is important to ensure that the new items are positioned accurately and connected correctly. Reference to the component layout shown in Vol.1, Part 1, Chap. 5, fig. 50 will assist when renewing components.

10. Any screws or nuts removed during inspection or servicing must be locked on reassembly with an approved varnish, unless fitted with lock-nuts or lockwashers.

11. There is only one fuse incorporated in this unit, a cartridge-type, 400mA rating (F1101) in the 130V d.c. output from the dynamotor which, ultimately, is the filtered 120V h.t. supply for the sub-units. It is housed in a fuse holder at the top of the chassis and removal for changing or inspection is accomplished by unscrewing the cap of the fuse holder and simply withdrawing the fuse. The correct type is fuse link, 400mA cartridge type, (Ref. No. 5920-99-059-0108).

12. Whenever the tantalum electrolytic capacitor C1106 is changed, the wire at the positive end must be formed into a swan-neck before soldering in order to prevent excessive strain or heat from affecting the weld.

Wiring

13. The wiring of the power unit components should be carefully inspected for continuity and conformity with the circuit shown in Vol.1, Part 2, Chap. 1, fig. 27 of this Air Publication. This inspection should consist of point-to-point tests or such electrical tests which will confirm the accuracy of the wiring. Examination should be made for neatness of soldering, absence of dry joints and a generally satisfactory condition of the wiring and insulation. Ensure that there are no erroneous interconnections or tracking paths due to excess solder, wire clippings or dirty connections.

14. It is important to ensure that the rectifier CR1101 and capacitors C1101 and C1106 have been wired correctly with respect to polarity.

15. To assist in the servicing of this unit a wiring diagram is given in fig. 1. It is important to ensure that any rewiring is carried out correctly, and that lengths, gauge of wire and colour coding are as in the original (unless modification requirements necessitate changes). A wiring key is given in Table 1, and when used in conjunction with the wiring diagram will assist should any rewiring become necessary.

TABLE 1

Wiring key

From	Colour	Length (in.)	To
P1101/2	-	1	P1101/7
" /7	-	1	" /19
" /7	Black	4	R1101
" /7	Black	3	K1101
" /8	-	1	P1101/12
" /8	Yellow	2	R1101
" /9	Pink	3	K1101
" /13	Red	2	R1102
" /14	Yellow	2	V1101/3
" /15	Brown	2	V1101/6
" /17	-	1	P1101/18
" /17	Red	3	K1101
" /20	White	2	Earth tag
P1102/8	Red	3	R1103
" /9	Maroon	3	L1104 (A)
" /10	Red	2	R1102
" /11	Clear	3	V1102/1
" /12	Green	3	R1107
" /15	White	2	Earth tag (to C1107)
V1102/2	-	-	Terminal board (B)
" /4	-	-	" " "
" /8	-	-	" " "
J1101	Red	6	" " "
J1102	Maroon	6	L1104 (A)
L1104 (A)	Maroon	2	R1106
L1104	Red	3	C1105
L1103/1	Red	6	C1103
" /2	Clear	6	C1102

L1103/3	Blue	6	C1105
C1108	-	-	Earth tag
C1108	-	-	R1102
L1101	-	-	C1107 (+)
L1101	Black	4	D1101 (2)
L1101	Black	8	K1101
D1101 (3)	Black	4	R1102
D1101 (1)	Green	$5\frac{1}{2}$	F1101
D1101 (4)	White	3	Earth tag
F1101	Green	3	L1102
L1102	-	-	C1109 (+)
L1102	-	-	C1101 (+)
L1102	Red	5	R1103
K1101	Busbar	$1\frac{1}{2}$	K1101
V1101/1	-	-	R1108
V1101/5	-	-	C1103
V1101/7	-	-	C1103
V1101/4	-	-	R1105
C1102	White	5	Earth tag

Introduction

16. This machine converts a d.c. input of 27.5V to d.c. outputs of 440V at 280mA and 137V at 225mA. The component parts can be seen in fig. 2, 3 and 4. It has a two-pole magnetic system, compound wound and an armature incorporating three sets of windings terminated at separate commutators. A centrifugal blower mounted at one extremity provides cooling air for other equipment whilst a smaller blower mounted at the other extremity draws cooling air through the machine itself.

Note...

General information on the servicing of motor generators is given in A.P.1186D.

Description

17. The principal sub-assemblies of the machine are the yoke assembly (1) which accommodates the field coils and pole shoes and the end housing components (3) and (4) in which are mounted the ball bearings, brush gear and smoothing capacitors.

18. The end housings and yoke are held together by a pair of tie bolts, nuts and washers. Correct radial location of the housing spigots in the yoke is ensured by short pins, one of which projects inwards at each mating bore on the yoke. The input end housing (3) has a semi-circular slot (11) cut in the periphery to accept the pin. The output end housing (4) has a short elongated slot (12) to accommodate the pin and to permit restricted rotation of the housing relative to the yoke in order to achieve correct commutation. Tie-bolt holes (13) on this housing are elongated for the same reason. The end housings are die-castings, the bearing bores being provided with steel liners.

19. The input end housing (3) accommodates the input brush gear and smoothing capacitor (14) which is suspended between the two brush terminals (15). Carbon brushes (16) are rectangular in section and are retained in the brush boxes under pressure from coil springs by insulated screw-on caps (17). Brush terminal screws (19) thread into the brush terminals (15) which project from the end of the brush boxes. The input brush gear is enclosed by a cover which is integral with the blower housing assembly (9).

20. The output end housing (4) accommodates the medium and high voltage brushes (24) and (25), the latter being located nearer the yoke. Both the high and medium voltage brushes are rectangular in section and of the same size, but they are much smaller than the input brushes. The brush boxes, springs and terminals are similar to those in the input end housing and all are placed on the longitudinal centre line. Smoothing capacitors (26) are secured by clamps (27) to the housing. One lead from each is soldered to a projection on the high voltage brush terminal, the other lead being soldered to a tag which is anchored under the clamp fixing screw. A cover strap (5), which is perforated to permit cooling is clamped around the end housing and baffle plate (6) by two screws.

21. The armature (2) has three separate windings, which terminate at their respective commutators. The armature shaft projects at each end of the assembly and flats thereon provide for securing the blower rotors (7) and (8) with grub screws. The armature is supported on ball bearings at each end, these being of the same size and shielded on one side. Grease slingers are fitted between the bearings and the adjacent commutator.

22. The armature end float and the relative positions of the brushes and commutators longitudinally are controlled by shims (31), (32) and (33) (para. 61). These are positioned in the end housings against the outer faces of the bearings and retained by bearing covers (28) which are secured to the end housings by screws (29) locked by spring washers.

23. The blower assembly (7) and (9), mounted at the input end of the machine, provides cooling air for the machine itself, air being drawn in through the cover strap (5) and exhausted at the blower nozzle. The blower housing is integral with the input brush gear cover and is secured to the end housing (3) by four screws (22) locked by spring washers. The blower rotor (7) is secured to the armature shaft by two socket headed grub screws.

24. The blower assembly which provides cooling air for other equipment is mounted at the output end of the machine. The blower housing (10) is secured, with baffle plate (6), to the face of the end housing (4) by two screws (23) which are locked by spring washers. Inlet plate (20) is secured to housing (10) by two screws (21), which are locked with varnish, and completes the enclosure of the rotor (8). The latter is secured to the armature shaft by a pair of socket headed grub screws.

25. Internal connections are made with flexible insulated conductors fitted with solder type terminal tags. Leads passing through the yoke are prevented from coming into contact with the armature by a rigid sheet of insulating material which spans the adjacent pole shoes. Four leads for its external connections are brought out through a grommet (18); these are coloured black, red, white and green respectively. Internal connections are shown in fig. 5, which also identifies the coloured leads.

Installation

26. Before installing the machine, inspect it visually for damage and test its functioning (para. 77).

27. Installation of the machine into the power unit (DC) is straightforward and entails securing it by means of the four tapped holes and terminating the four flexible leads at the appropriate connections. Fig. 6 shows the overall dimensions of the dynamotor and fixing details.

Servicing

28. Routine servicing between overhauls at 1,000 hourly intervals is unnecessary. For these overhauls, the machine should be removed from the power unit (DC).

29. For greasing the ball bearings, a suitable hypodermic syringe will be required.

30. The grub screws securing the fan motors have Bristow socket heads. A Bristow wrench, which is provided in the tool kit, radio adjustment, (Ref. No. 5180-99-943-1512), is required to turn them.

31. A suitable gauge (or gauges) for testing the brush force will be required. Minimum brush forces are 8 oz. and 2.25 oz.

Dismantling

32. Remove the cover strap (5). Unscrew the medium voltage and high voltage brush caps and withdraw the brushes identifying each one so that they can be refitted the same way round and in the same holder on assembly.

33. Remove the inlet plate (20). Rotate the armature until the grub screws in the motor hub are in turn accessible through the blower nozzle and slacken them using the appropriate Bristow wrench. Pull the blower rotor (8) off the shaft.

34. Remove the screws and spring washers (23) and remove the housing (10) and baffle plate (6).

35. Remove the blower rotor (7) adopting the same procedure as for rotor (8) (para. 33).

36. Remove the screws and spring washers (22) and slide off the blower housing assembly (9) easing the grommet (18) from its slot.

37. Remove the input brushes, identifying them so that they can be refitted the same way round and in the same holders on assembly,

38. Remove the wiring tags from both input and output brush terminals but leave the green wire attached to the medium voltage brush terminal to prevent its loss. The input smoothing capacitor (14) will become detached.

39. Mark the two end housing castings and yoke so that they may be assembled in the same relative radial pssitions. Remove the two tie bolts. The earthing link (30) will become detached.

40. Grasp the end housing (4) and, pulling steadily, remove it from the yoke (1). It may carry the armature with it, in which event avoid straining the bearing by supporting the weight of the armature whilst withdrawing it from the yoke.

41. Similarly, part the input end housing from the yoke. Remove the armature from the remaining housing. If either bearing has remained on the shaft, remove it carefully, using an extractor if necessary. Discard the grease slinger, and refit a new one on reassembly.

42. Remove the bearing covers (28) from the housings (3) and (4), marking them so that they may be assembled to the same housing. Make a note of the shimming arrangement at each housing so that the shimming dimensions may be maintained on assembly. Remove the bearings from the housings, pressing only on the outer race.

43. Do not attempt to dismantle the machine further.

Cleaning and inspection

44. Loosen and remove all carbon dust and other dirt/using clean, dry compressed air. Clean the commutators with a rag moistened with white spirit. Remove grease from the bearing housings in the same manner. Clean all grease from the bearing covers and shims. These may be immersed in white spirit, if necessary.

45. Clean the bearings thoroughly by rotating them whilst immersed in white spirit. Use several batches of clean spirit progressively and proceed until a fresh batch of spirit shows no further dirt or grease emerging from the bearing. Dry off with clean, dry, compressed air but do not rotate the races with the jet.

TABLE 2

Dynamotor fits and clearances

DESCRIPTION		DIM. NEW (INCHES)	MAX. PER-MISSIBLE WORN DIM (INCHES)	FIT NEW (INCHES)	MAX. PER-MISSIBLE WORN CLEAR-ANCE (INCHES)	REMARKS
Bearing on armature shaft	(Bearing bore	0.3147 - 0.3150		) between 0.0002 clearance and 0.0004 interference	0.0002	
	(Shaft journal	0.3148 - 0.3151		)		
Bearing in end housing	(Bearing O/D	0.8657 - 0.8661		) between 0.0008 clearance and 0.0001 interference	0.0008	
	(Housing bore	0.8660 - 0.8665		)		
Input commutator diameter		0.957 - 0.947	0.934			Minimum permissible diam. after skimming 0.937 in.
M.V. Commutator diameter		0.930 - 0.920	0.901			- do - 0.904 in.
H.V. commutator diameter		1.427 - 1.447	1.395			- do - 1.398 in.
Input brush length		0.485 - 0.500	0.285			(Brushes may wear 0.080 in (during an overall life (of 1000 hours
M.V. & H.V. brush length		0.297 - 0.312	0.147			
Armature end float		-	-	0.002 - 0.004		

46. When clean, inspect all parts for signs of obvious damage, i.e. cracks, distortion, burring, scoring, deterioration of insulation. Verify the dimensions of relevant parts against the list of fits and clearances given in Table 2 and discard any which do not comply.

47. Bearings may be expected to survive not less than two overhaul periods. Inspect for excessive wear and renew if there is any doubt about suitability for further use. Re-lubricate bearings which are to be used again immediately after inspection (para. 54).

48. Inspect the commutators for proud mica and wear. If a track of 0.005 in. or more is present, skim to remove the track. Skimming is subject to the minimum dimensions shown in Table 2. The finished surface must be concentric with the shaft journals and the use of a special commutator finishing tool is recommended. After skimming, undercut the micas 0.029 in. to 0.040 in. deep.

49. Test the brush force with each brush in its appropriate holder using a suitable gauge. Measure the force acting at the working face of the brush when it is flush with the race of the brush holder. The force must be 8 oz. minimum for the input brushes and 2.25 oz. minimum for all output brushes. The brushes must slide freely in their holders. The insulated cap must be refitted to the brush holder.

50. Renew any faulty wiring.

51. Test the resistance of the field windings. The value measured between the black field coil lead and the brown lead which connects to the negative input brush must be between 32.4 ohms and 39.6 ohms. Test the insulation resistance of the field windings using a 500V megger. The minimum acceptable value is 100 megohms.

52. Measure the resistance between segments 1 and 7 of each commutator. The values must be 0.155 ohm $\pm$ 10% for the input commutator, 10.0 ohms $\pm$ 10% for the medium voltage commutator and 57 ohms $\pm$ 10% for the high voltage commutator. Measure the insulation resistance of each armature winding to the core and to each other winding using a 500V megger. The minimum acceptable value is 100 megohms.

53. Disconnect the earthed end of the two smoothing capacitors on the output end housing. Test the insulation resistance of each insulated brush holder to the casting using a 500V megger. The minimum acceptable value is 200 megohms. (The negative input brush holder is earthed to the casting). Reconnect the smoothing capacitors.

Lubrication

54. The only parts requiring lubrication are the ball bearings. After thorough cleaning, lubricate with Andok C grease or an approved equivalent. Since one side of the bearing is fitted with a shield, it will be necessary to employ a suitable hypodermic syringe to insert the grease. After greasing, rotate the bearing at approximately 6,000 r.p.m. by pressing it against a turning lathe spindle or wheel to expel surplus grease and remove this with a good quality tissue paper. Carefully protect the bearings from all forms of dirt until required for assembly.

Assembly

55. Place a grease slinger over the armature shaft output end with its periphery nearest the commutator. Fit the ball bearing, with its shielded side to the commutator, by pressing only on the inner race. Ensure that the bearing being fitted provides the necessary fit on the shaft and in the housing bore.

56. Assemble the input end grease slinger and ball bearing in like manner, observing the same precautions.

57. Fit the cover (28) and shims, if any, to the input end housing (3) and secure with four screws (29) and spring washers. Support the housing (3) and insert the armature input end bearing into the housing.

Note...

If either the yoke, armature, or end housings being assembled are not the original parts, do not fit any shims to the input end housing (3) but press the bearing hard against the cover (28).

58. Place the yoke (1) in position on the input end housing (3), locating the yoke pin in the housing slot (11).

59. Place the output end housing (4) in position on yoke (1). Ensure that the yoke pin locates in slot (12) and press the housing fully home. Pass the tie bolts through the housings and yoke from the output end and apply the nuts and washers to the threaded ends, securing the earthing link (30) under the nut nearest the brush terminals. Line up the index marks on the yoke and housings and tighten the nuts. Inspect the armature for free rotation.

60. Assemble the appropriate shims into the output end housing (4) and fit the cover (28) securing it with screws (29) and spring washers. Examine again for free armature rotation. If necessary, tap the housings with a light plastic headed mallet to settle the bearings in the housings. Insert a brush at each pair of brush holders to ensure that it rides within the width of the commutator. It is especially important, if any wear has occurred in the commutator, to ensure that the shimming arrangement keeps the brush within the commutator track.

61. When the yoke, armature and end housings have been assembled, tighten the tie bolts and position the armature so that each pair of brushes rises entirely within the width of its commutator by positioning the bearings in the housings. Insert shims at each end to take up the gap between the bearings and bearing covers, allowing for an end float of between 0.002 in. and 0.004 in. Refit the bearing covers and secure with screws (29) and spring washers.

62. Connect the cable tags to the output brush terminals and to the positive input brush terminal in accordance with the wiring diagram (fig. 5). Do not fit the capacitor (14) at this stage.

Note...

The positive input brush holder is the one which is insulated from the housing casting.

63. Fit the baffle plate (6) and blower housing (10) with screws (23) and spring washers. Align the blower outlet as indicated in fig. 2. Fit the blower rotor (8) on to the shaft, align the grub screws with the flats on the shaft and tighten.

64. Fit the inlet plate (20) to the housing (10) with screws (21), locking these with varnish (Kearsley's VX 1360, non-fungicidal) or an approved equivalent.

65. Insert all brushes except the negative input and fit the retaining caps. Disconnect the earthed ends of the capacitors (27). Connect the field lead and white lead, which normally terminate at the negative input brush, and the black lead together. Perform the insulatkon resistance test (para. 82).

66. Connect the appropriate cable tags to the negative input brush terminal. Fit the capacitor (14) to the input brush terminals and secure the earthing link (30) to the negative input terminal. Fit the negative input brush and the retaining cap. Reconnect the capacitors (27).

67. If new brushes are to be fitted, or if the commutator has been skimmed, pre-bed the brushes at this stage (para. 72).

68. Fit the blower housing assembly (9), locating the grommet (18) in the slot. Secure the cover with four screws (22) and spring washers.

69. Fit the blower rotor (7) on to the shaft and secure it in position, locating the grub screws on the shaft flats.

70. Fit the cover strap (5) with its fixing screws and lockwashers.

Bedding of brushes

71. It is important that the brushes should be bedded in if new ones have been fitted or if the commutator has been skimmed.

72. Pre-bedding is very desirable and will reduce the time for which the machine must be run on load. Pre-bedding can be executed by running a thin strip of fine glasspaper (not emery) back and forth under the brushes, taking care to keep the paper completely in contact with the commutator in the region of the brushes. Remove the dust so formed with clean, dry, compressed air.

73. Bedding of brushes is completed by operating the machine on load. Use 50 per cent full load until the whole of the arc and 50 per cent of the area is bedded; then use 75 per cent full load until 80 per cent of the area is bedded. Remove all carbon dust after bedding.

TESTING THE DYNAMOTOR

Test equipment

74. The following equipment is required for testing the machine:-

(1)	Ammeter, d.c. 15A (1% accuracy) (Ref. No. 5Q/25489)							
(2)	Milliammeter, d.c. 500mA (1% accuracy) (Ref. No. 5Q/25060)							
(3)	"	"	300mA	"	"	("	" 5Q/12)	
(4)	Voltmeter	"	40V, 1,000 ohms/V.	(1% accuracy)				(Ref. No. 5Q/25426)
(5)	"	"	200V	"	"	"	"	(Ref. No. 5Q/17587)
(6)	"	"	600V	"	"	"	"	(Ref. No. 5Q/25033)
(7)	Resistance, adjustable, 750 ohms, 100 watts							
(8)	"	"	1,800 ohms, 150 watts					

(9) Switch or link for shorting the ammeter

(10) Power supply, 18-40V d.c. (without ripple voltage)

The connection of this test equipment to the machine is shown in fig. 7.

Rotation

75. Apply 18V d.c. to the input leads (negative polarity to white lead) and see that the armature rotation is counter-clockwise as viewed from the input end.

Brush setting

76. Operate the machine at full load with the minimum input voltage (18V). Slacken the tie bolt nuts and adjust the position of the input end housing (3) to eliminate or minimize sparking at the input brushes. The act of movement is not more than 3.5 degrees. Ensure that the housing does not move relative to the yoke and adjust the output end housing (4) to eliminate or minimize sparking at the high voltage brushes. Tighten the tie bolts.

Functioning

77. Apply loads across the medium and high voltage outputs such that 225mA and 280mA respectively will be drawn with an input voltage of 27.5V d.c. Ensure that the output voltages are 135V $\pm$ 5 per cent and 440V $\pm$ 5 per cent respectively.

Heating

78. All covers must be in position. With the machine connected into the test circuit (fig. 7), operate it for two hours with an input voltage of 27.5V and medium high voltage outputs of 137V at 225mA and 440V at 280mA respectively. At the end of the run, take readings of all voltage and current values. Calculate the electrical efficiency using these values. The minimum acceptable figure is 50 per cent.

Regulation

79. While the machine is still hot from the previous test, measure the no load and full voltages and calculate the regulation from the following formula:-

$$\frac{(V\ \text{no load}) - (V - \text{full load})}{(V\ \text{full load})} \times 100 \quad \%$$

This figure should not exceed 20 per cent.

Insulation

80. With the machine still hot, measure the insulation resistance between all live parts and the frame and also between the three armature windings using a 500V megger.

81. Disconnect the white lead and the field lead from the negative input brush terminal and join them together with the black lead. Remove the input negative brush. Disconnect the output and smoothing capacitor from the frame.

82. Apply the megger between the three joined leads and the frame. The minimum acceptable insulation resistance value is 50 megohms. Remove the medium voltage output brushes and measure the insulation resistance between each commutator and the other two commutators. The minimum acceptable value is 100 megohms. Fit all brushes and reconnect the leads and smoothing capacitor.

Overspeed

83. Operate the machine on no load for three minutes at 10,000 r.p.m. (38V d.c. input, approximately). No excessive noise or vibration must be detected.

84. Disconnect the machine from the test equipment and refit it to the power unit (DC).

Ripple voltages

85. To confirm that any ripple voltages present are not excessive, it is advisable to fit the machine to an ARC52 and check aurally.

TESTING THE POWER UNIT (DC) USING STANDARD EQUIPMENT

Standard test equipment

86. The test equipment required for all tests described in this series (para. 90 to 96) should be available from Service Stores. Electronic characteristics and physical features of this equipment are as follows:-

(1) D.C. voltmeter - this instrument should be capable of measuring the on load output potentials of the equipment to within 2 per cent of absolute; the resistance of the voltmeter should be not less than 20,000 ohms per volt, e.g. Multimeter Type 1 or equivalent.

(2) A.C. voltmeter - required for measuring the ripple voltage components; it should be accurate to within 3 per cent of absolute. The d.c. resistance should be not less than one megohm and the impedance at 1000 c/s not less than 1000 ohms, e.g. CT38 or equivalent.

87. In the subsequent test procedures it is assumed that all test equipment will be operated in accordance with the standard instructions given in the appropriate Air Publications.

Power supplies

88. For the series of tests using standard service equipment, the module must be supplied with power as specified in the following sub-paragraphs:-

(1) Valve heater primary power supply - this supply, which is required for valve V1101, must be connected between poles 14 and 15 of the plug (P1101). Due regard must be taken of mutual chassis potentials. The supply may be either d.c. or 50 c/s to 400 c/s a.c. The on load terminal voltage is to be between 6.18V and 6.42V.

(2) D.C. primary power supply - the source is to be capable of maintaining an on load terminal voltage of between 27.22V and 27.77V between poles 17 and 20 of the plug (P1101), the positive pole being connected to the equipment under test via a suitable isolating switch and fuse.

Dummy loads

89. A schematic diagram for a load unit appropriate to this series of tests is shown in fig. 8. A list of components showing values, tolerances and ratings is given in Table 3.

(1) Transmitter h.t. supply load (R1) - a load should be connected between poles 13 and 20 of the plug (P1101) comprising a resistor of between 1500 ohms and 1530 ohms, continuously rated for not less than 120 watts, connected in parallel with a paper capacitor (C1) of 2 microfarads ± 20 per cent, 1000 volts d.c. working. The load is to be provided through a suitable double pole, changeover, isolating switch, marked for convenience, H.T. LOAD.

(2) Main h.t. supply load (R8 and R9) - to be connected between poles 8 and 15 of the multipole plug (P1102). When the transmitter h.t. load (para. 89 (1)) is applied, the resistance of the main h.t. load must be 425 ohms ± 1 per cent, but when the transmitter h.t. supply load is isolated, the resistance must be 600 ohms ± 1 per cent. This change in h.t. loading is to be made automatically as the H.T. LOAD switch is operated. The load is to be rated aontinuously at not less than 50 watts.

(3) A.D.F. h.t. supply load (R10) - a resistive load of 15,000 ohms ± 1 per cent, rated continuously at not less than 4 watts, to be connected between poles 10 and 15 of the multipole plug (P1102).

(4) Bias supply load (R11 and R12) - alternative loads are to be provided (45,000 ohms ± 1 per cent and 11,000 ohms ± 1 per cent) each rated continuously for not less than one watt. The loads should be selected by means of a single pole, changeover switch marked, for convenience, BIAS SUPPLY LOAD. Connection should be made between poles 9 and 15 of the multipole plug (P1102).

(5) Valve-heater supply loads (R2 and R3) - a resistive load of 45 ohms ± 1 per cent, rated continuously at not less than 15 watts, is to be connected between poles 12 and 20 of the multipole plug (P1101), whilst another resistive load of 8.2 ohms ± 1 per cent, rated continuously at not less than 80 watts, to be connected between poles 8 and 20.

(6) In addition, the following resistive loads should be provided:-

(a) 6 ohms ± 10 per cent (R4) rated at not less than 120 watts, connected between poles 7 and 20 of the multipole plug (P1101).

(b) 27 ohms ± 10 per cent (R5), rated at not less than 27 watts, connected between poles 19 and 20 of the plug (P1101).

(c) 50 ohms ± 10 per cent (R6), rated at not less than 15 watts, connected between poles 2 and 20 of the plug (P1101).

(7) Other switches should be provided as follows:-

(a) A single-pole, on-off switch (SW2), marked for convenience, RELAY in series with a 100 ohms ± 10 per cent resistor (R7), rated at 1 watt, connected between poles 9 and 20 of the plug (P1101).

(b) A single-pole, on-off switch (SW4) marked A.D.F. H.T., for convenience, connected between poles 10 and 11 of the plug (P1102).

(c) In addition, during the tests poles 14 and 20 of the plug (P1101) are to be linked.

TABLE 3

Load unit components

Item	Ref. No. or Cat. No.	Value	Tolerance	Minimum rating
R1		1515 ohms	± 15 ohms	120W
R2		45 ohms	± 1%	15W
R3		8.2 ohms	± 1%	80W
R4		6 ohms	± 10%	120W
R5	5905-99-024-1063	27 ohms	± 10%	27W
R6	P200927/1	50 ohms	± 10%	15W
R7		100 ohms	± 10%	1W
R8		600 ohms	± 1%	50W
R9		425 ohms	± 1%	50W
R10	P200929/1	15000 ohms	± 1%	4W
R11	P200928/1	45000 ohms	± 1%	1W
R12		11000 ohms	± 1%	1W
C1	5910-99-011-2359	2 mfd	± 20%	1000V d.c.

SKT1101	5935-99-932-1028	Socket, electrical, 20-pole
SKT1102	" "-940-2180	" " 15-pole
SW1	5930-99-051-0554	Switch, double-pole, changeover
SW2	" "-951-0551	" single-pole, on-off
SW3	" "-051-0578	" " " changeover
SW4	" "-951-0551	" " " on-off

Testing procedure

90. Relay - Close the d.c. power on-off switch; the dynamotor should operate when the RELAY switch is closed, and cease to operate when it is opened. The RELAY switch should be operated for twenty times to ascertain satisfactory operation of the relay.

91. Transmitter h.t. supply - The A.D.F. H.T. switch should first be opened and the H.T. LOAD isolating switch and RELAY switch both closed. A d.c. positive potential of between 406.13V and 448.87V relative to the chassis should be present at pole 13 of the multipole plug (01101).

92. Main h.t. supply - with the switches operated as in para. 91 a d.c. positive potential of between 131.18V and 133.82V relative to the chassis should be present at test point E on the power unit (DC).

93. A.D.F. h.t. supply - first isolate the transmitter h.t. supply load, then close the A.D.F. H.T. and RELAY switches, and test as follows:-

(1) The d.c. positive potential, relative to the chassis at pole 11 of the plug (P1102) should be between 210V and 260V; and the stabilizer (V1102) should glow.

(2) Open the A.D.F. H.T. switch, whereupon the potential on pole 11 should fall to not more than 70V positive with respect to the chassis.

94. Bias supply - again set the switches as described in para. 91 and proceed as follows:-

(1) Set the BIAS SUPPLY LOAD switch to 45,000 ohms whereupon full bias, a d.c. negative potential of 38V to 52V, should be present at test point F on the power unit (DC).

(2) Reset the BIAS SUPPLY LOAD switch to 11,000 ohms and the d.c. negative potential at test point F should be not less than 20V.

(3) With the BIAS SUPPLY LOAD switch still at 11,000 ohms, verify that the ripple voltage at test point F, relative to the chassis, does not exceed 40mV r.m.s.

(4) Now set the BIAS SUPPLY LOAD switch back to 45,000 ohms and a half-bias d.c. negative potential between 18V and 32V, relative to the chassis, should be present at pole 12 of the plug (P1102).

95. Valve heater supply - with the switches again set as in para. 91 the d.c. positive potential on poles 8 and 12 of the plug (P1101), relative to the chassis, should be 24.7V to 25.7V.

96. Miscellaneous supplies - with the switches set as in para. 91, the d.c. potentials measured at poles 2, 7 and 19 of the plug (P1101) should each be not more than 0.2V lower than the primary supply voltage (para.88 (2)).

TESTING THE POWER UNIT (DC) USING SPECIAL-TO-TYPE EQUIPMENT

Special-to-type test equipment

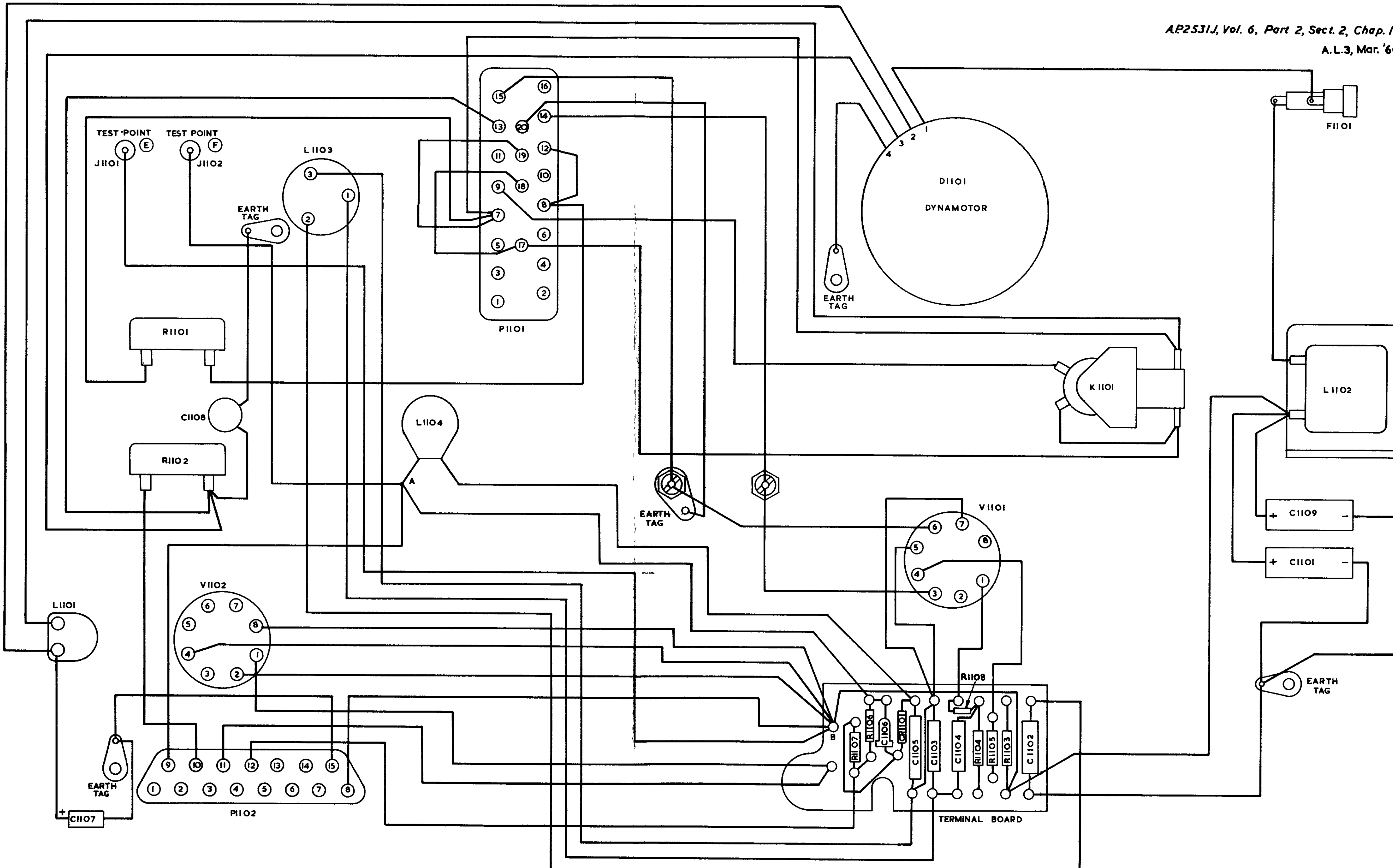
97. Details of this equipment are not available at the time of going to press and must follow at a later date. Similarly, description of the testing procedure to be adopted using this equipment cannot be provided at this stage.

Assembly after testing

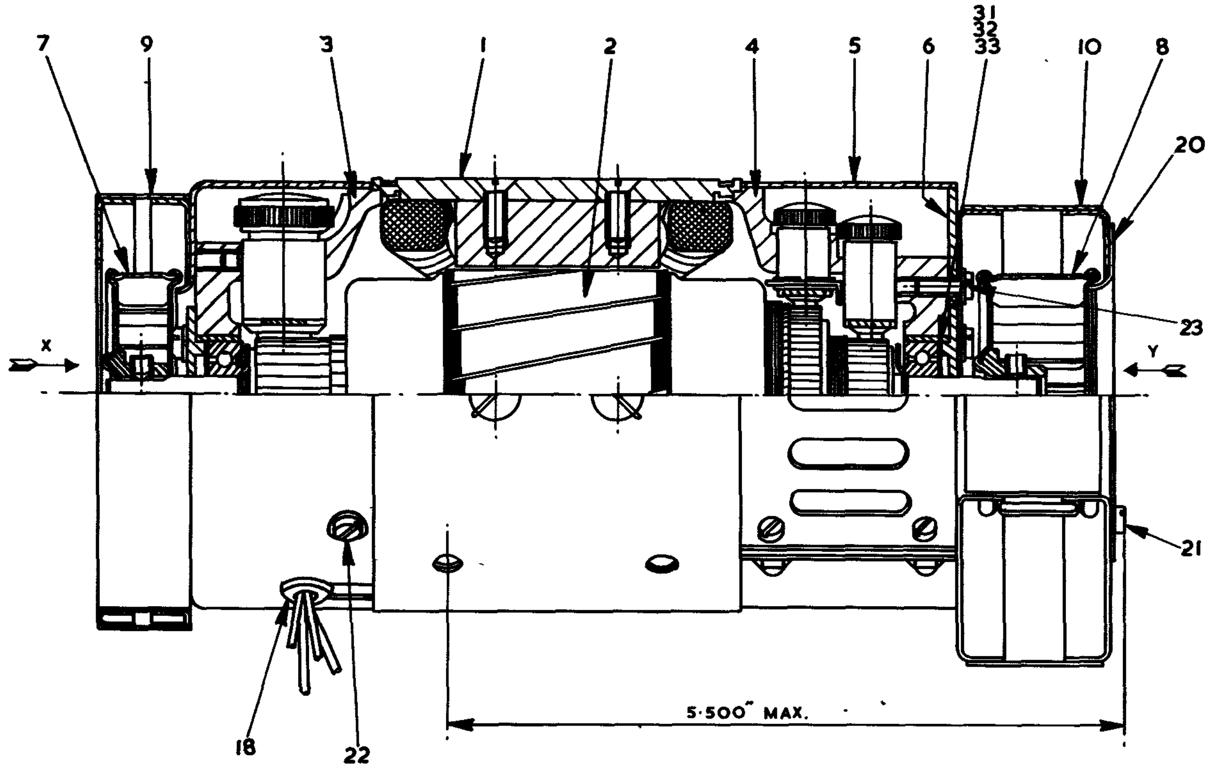
98. The complete unit is retained in position on the main chassis by

Phillips screws, which are accessible from the underside of the chassis. Dowels are provided in the base of the unit to ensure correct alignment so that the multipole plug in the base of the unit will engage correctly with the equipment chassis.

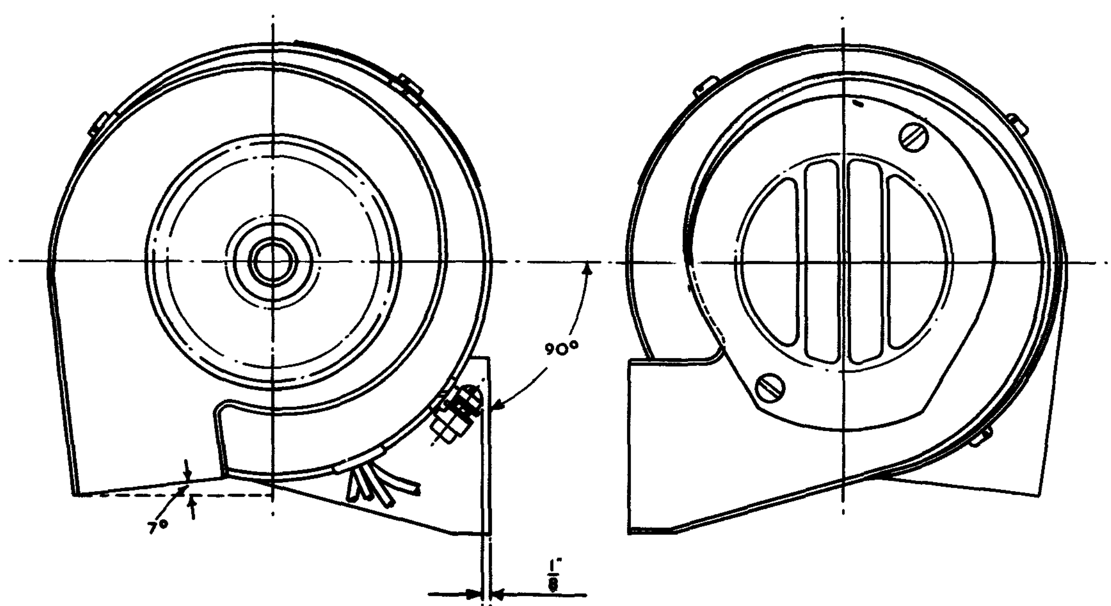
99. Following the assembly of all components into the main chassis and refitting of the cover, full functional tests should be carried out as detailed in Sect. 2, Chap. 1 of this Volume. Pressurization should follow as described in Chap. 17.



ARI. 18124/1 — power unit (DC) — wiring diagram Fig. 1.



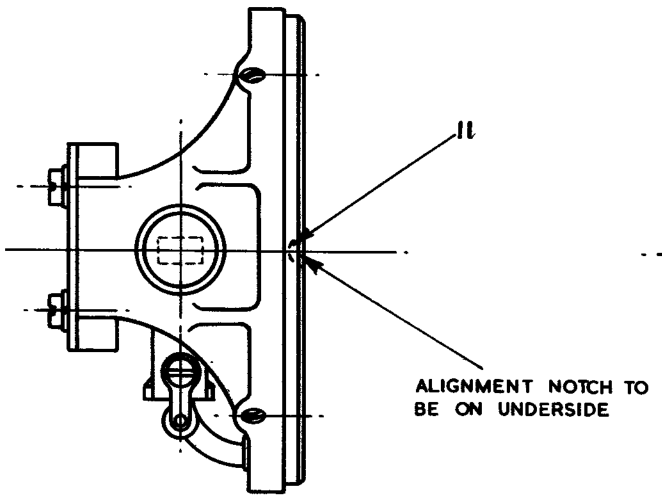
NOTE:
SEE FIG. 4 FOR LIST OF ITEMS.



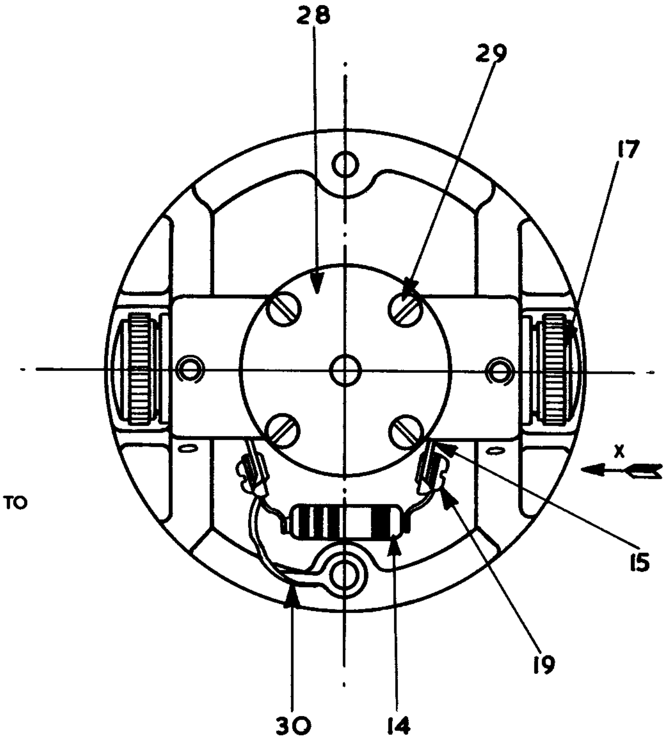
VIEW IN DIRECTION OF ARROW X

VIEW IN DIRECTION OF ARROW Y

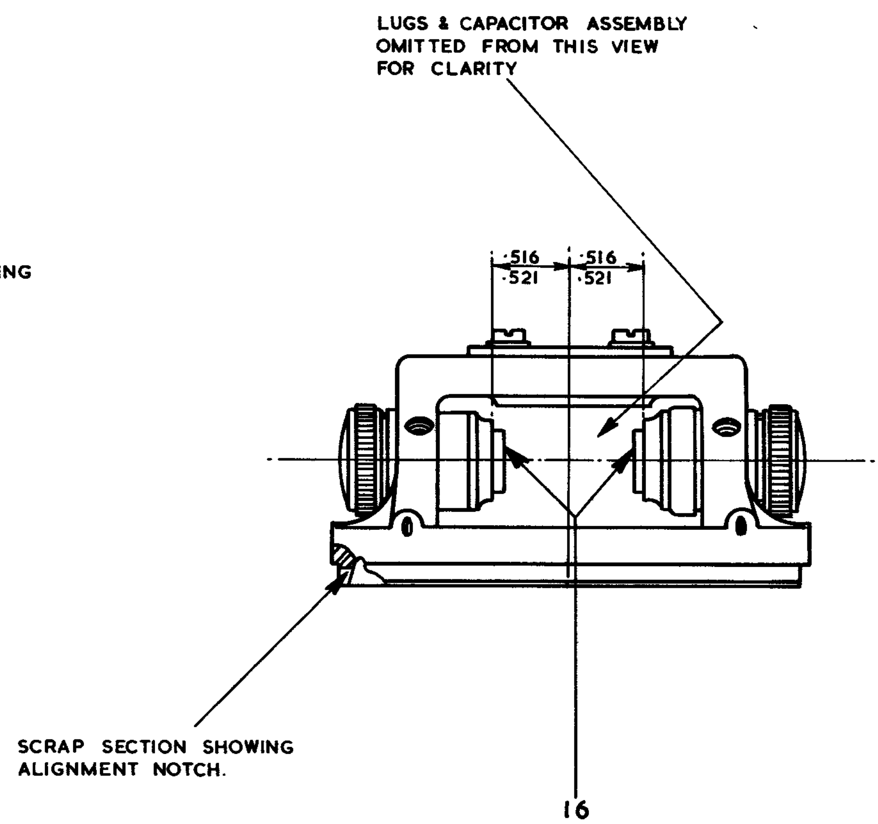
ARI.18124/1 – power unit (DC) – part sectioned view of dynamotor **Fig. 2**



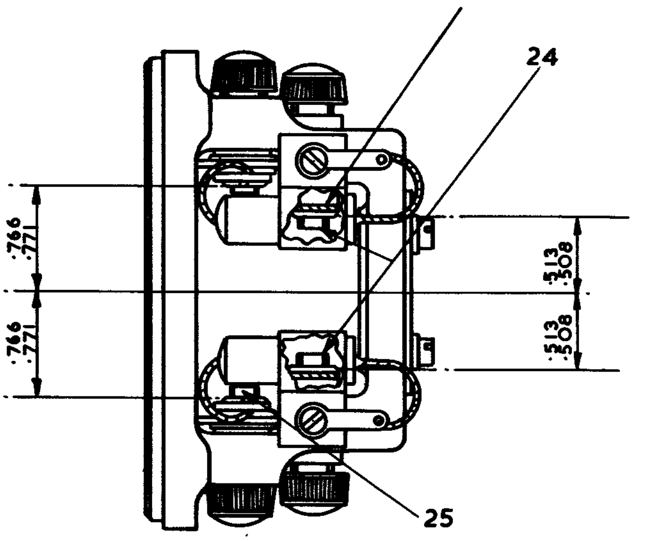
VIEW IN DIRECTION OF ARROW X

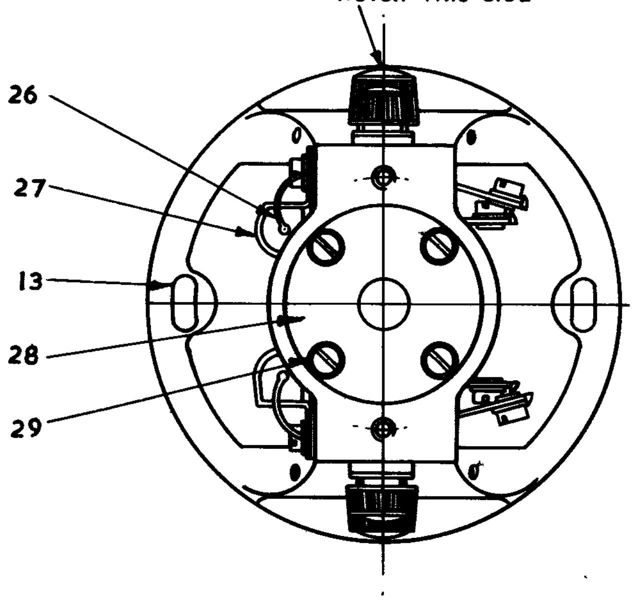


NOTES
1. INSTALL BRUSH HOLDERS IN HOUSING SO THAT THE BRUSH TRACKS ARE HORIZONTAL AND PARALLEL.
2. SEE Fig.4 FOR LIST OF ITEMS.

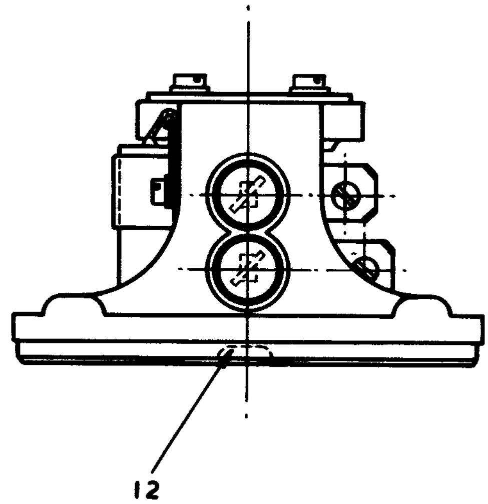


ARI.18124/1 – power unit (DC) – dynamotor input end housing Fig.3.



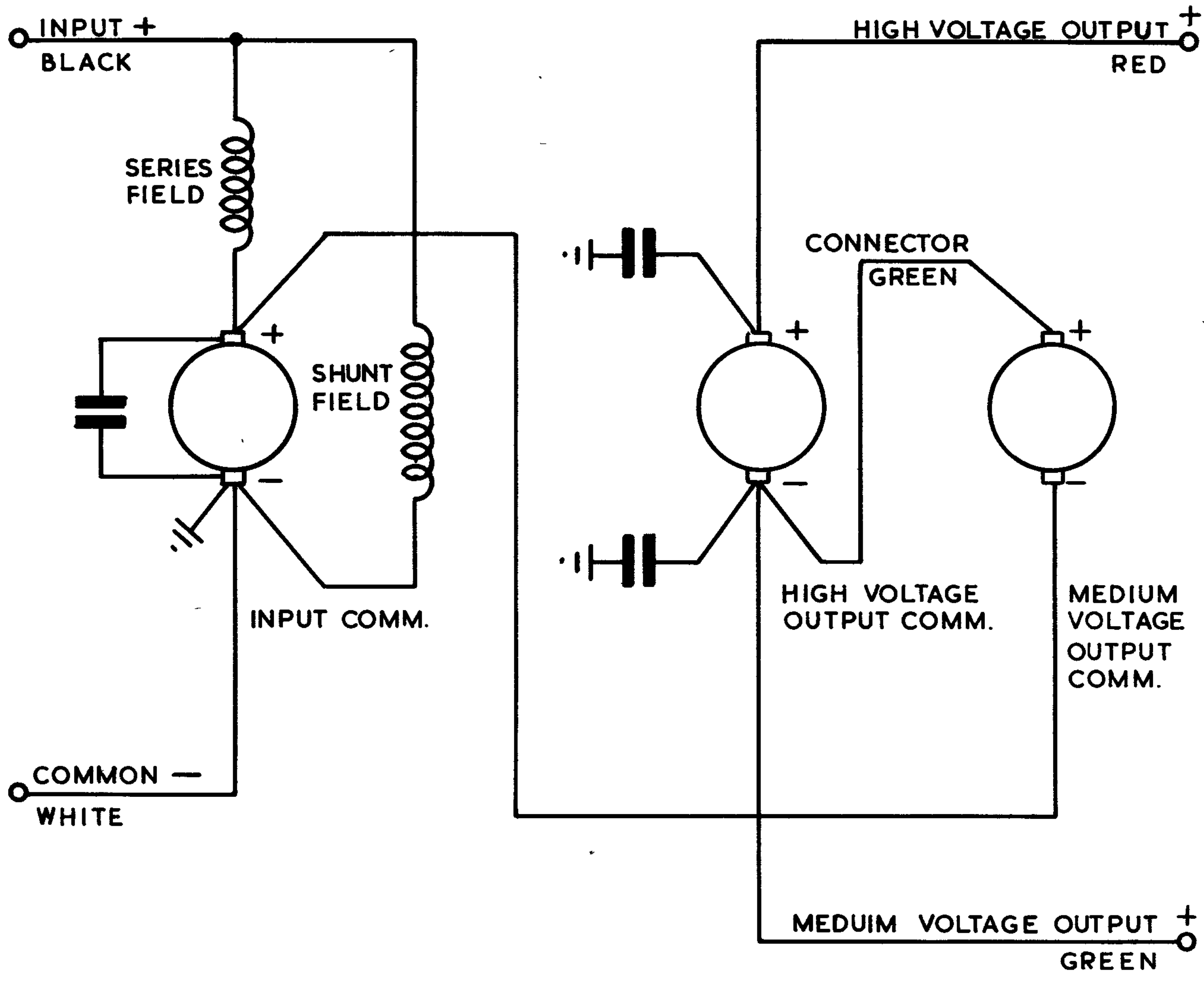


NOTE
INSTALL BRUSH HOLDERS IN HOUSING SO THE BRUSH TRACKS ARE HORIZONTAL AND PARALLEL.

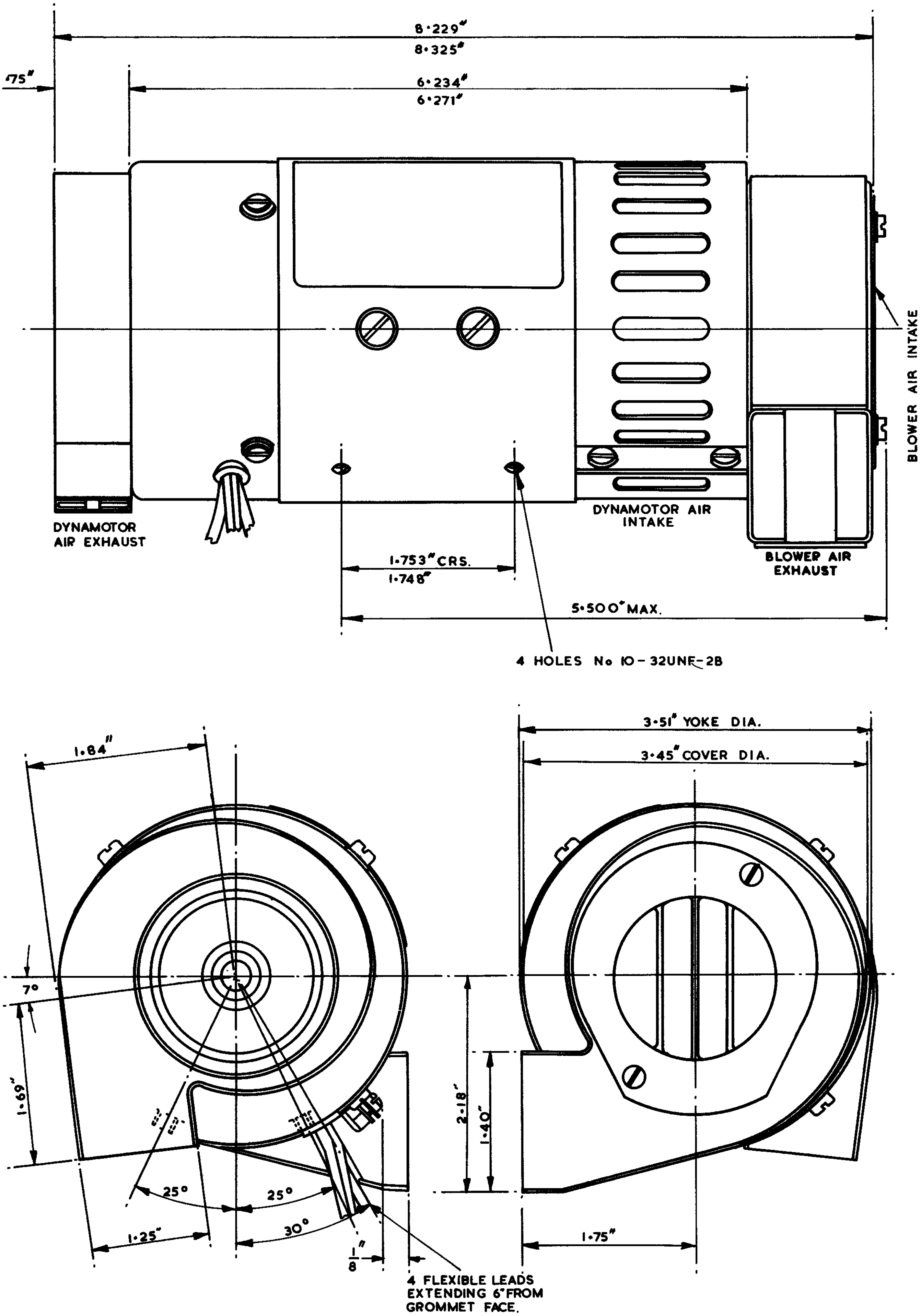


ITEM	DESCRIPTION	Fig.
1	YOKE ASSEMBLY	2
2	ARMATURE	2
3	INPUT END HOUSING	2
4	OUTPUT END HOUSING	2
5	COVER STRAP	2
6	BAFFLE PLATE	2
7	BLOWER ROTOR	2
8	BLOWER ROTOR	2
9	BLOWER HOUSING ASSEMBLY	2
10	HOUSING	2
11	SEMI-CIRCULAR SLOT	3
12	SHORT ELONGATED SLOT	4
13	TIE BOLT HOLES	4
14	SMOOTHING CAPACITOR	3
15	BRUSH TERMINALS	3
16	BRUSHES	3
17	SCREW-ON CAPS	3
18	GROMMET	2
19	BRUSH TERMINAL SCREWS	3
20	INLET PLATE	2
21	SCREWS	2
22	SCREWS & SPRING WASHERS	2
23	SCREWS & SPRING WASHERS	2
24	MEDIUM VOLTAGE BRUSHES	4
25	HIGH VOLTAGE BRUSHES	4
26	SMOOTHING CAPACITORS	4
27	CAPACITOR CLAMPS	4
28	BEARING COVERS	3 & 4
29	SCREWS & SPRING WASHERS	3 & 4
30	EARTHING LINK	3
31	SHIM	2
32	SHIM	2
33	SHIM	2

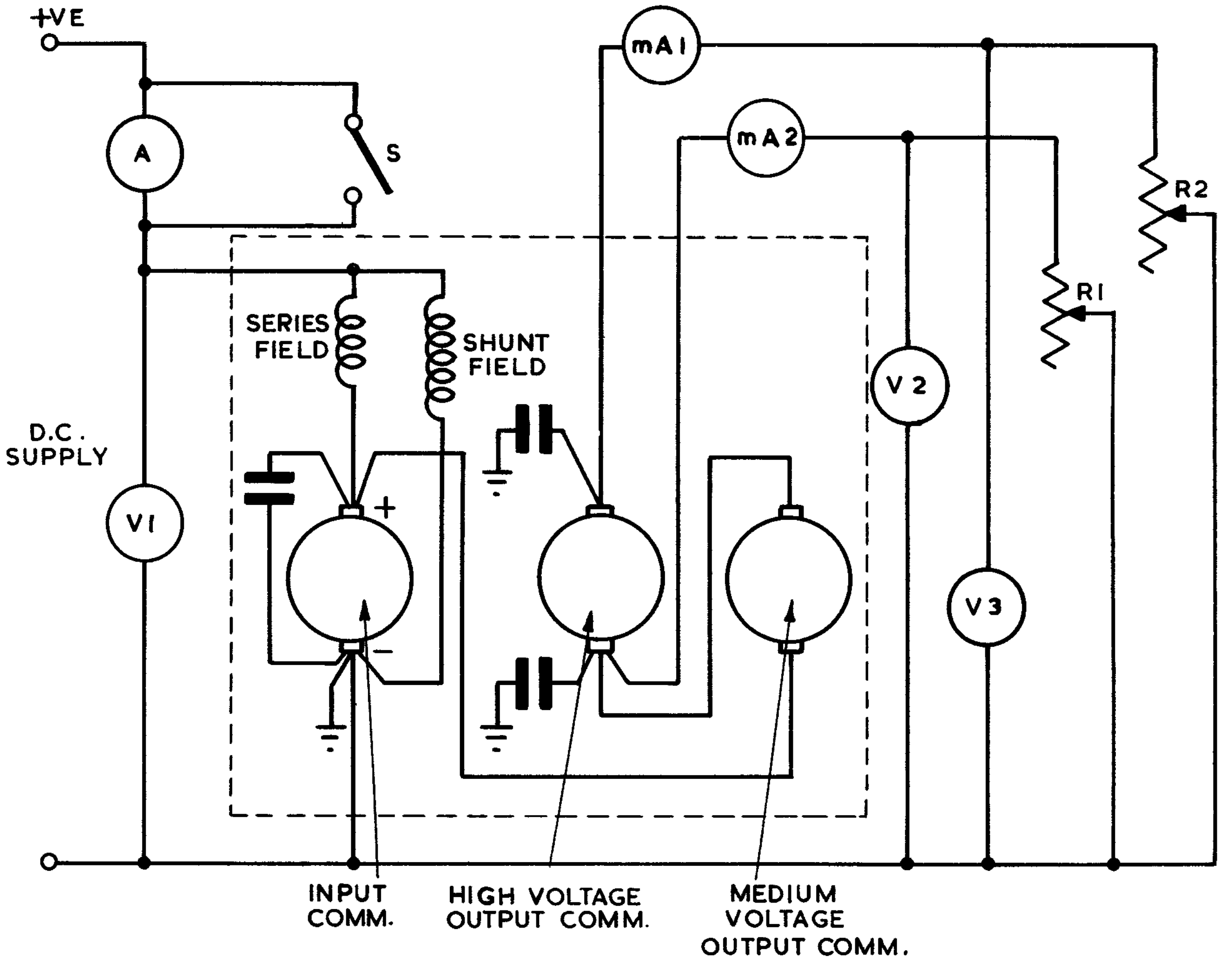
ARI.18124/1 – power unit (DC) – dynamotor output end housing Fig.



ARI.18124/1 — power unit (DC)—dynamotor wiring diagram Fig.5.



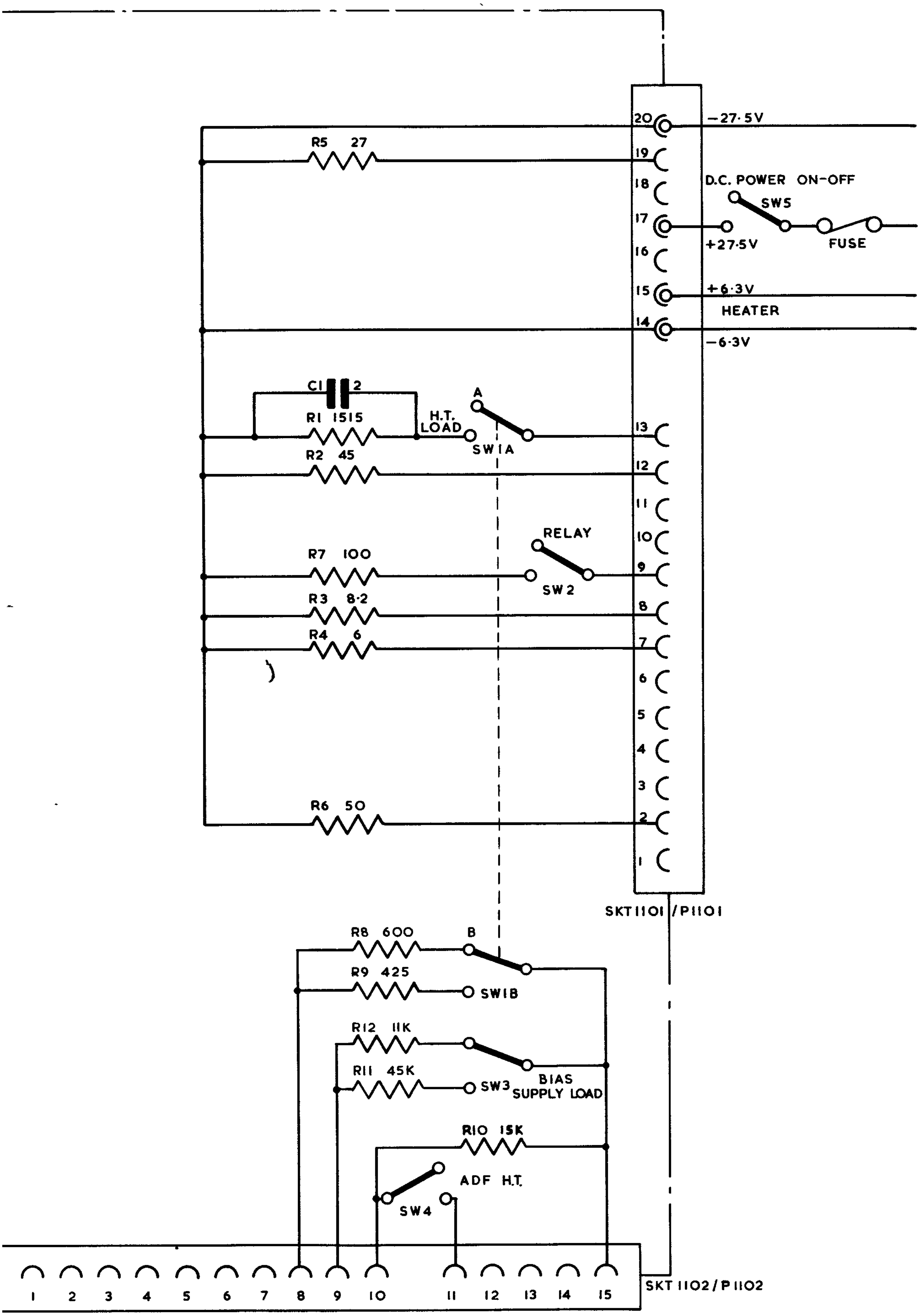
ARI.18124/1 — power unit (DC) — dynamotor installation details. Fig.6



TEST CIRCUIT

A	AMMETER	0–15A
mA1	MILLIAMETER	0–500 mA
mA2	MILLIAMETER	0–300 mA
V1	VOLTMETER	0–40V
V2	VOLTMETER	0–200V
V3	VOLTMETER	0–600V
R1	VARIABLE RESISTOR 750 OHMS 100 WATTS	
R2	VARIABLE RESISTOR 1800 OHMS 150 WATTS	
S	SHORTING KEY (FOR STARTING ONLY)	

ARI.18124/1 — power unit (DC) — dynamotor test circuit Fig. 7



ARI. 18124/1—power unit (DC)—schematic of test load unit Fig. 8

Chapter 15

(completely revised)

TUNING UNIT (MECHANICAL)

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INTRODUCTION

General

1. The mechanical tuning unit is an electromechanical rotary positioning device for the selection of tuned circuits and appropriate crystals; this it accomplishes by the combination of switch contacts. It comprises a motor, gear trains, couplers, and the associated rotary switches and relays. Details of the operation and the power supply requirements of this sub-unit are given in Vol. 1, Part 1, Chap. 2 of this publication.

WARNING

> The tuning unit (mechanical) used in the ARC52 is a similar mechanism to the tuning unit Type 11683 used in the homing installation ARI.18120. Most of the jigs and tools have a common application to both units and it will probably be found convenient to test and service both units on the same test bench. However, great care must be taken not to confuse the two units; they are not fitted with the same type of motor nor are the friction linings of the clutches the same, consequently the torque figures are different. Also, it should be noted that the switch wafers are different; fibreglass switches are used in the tuning unit Type 11683 because this equipment has been designed to operate over a higher temperature range. The appropriate Volume 3 should always be consulted if in doubt regarding spare parts.

2. The tuning unit (mechanical) is secured to the main chassis of the ARC52 by three, captive, Phillips-type screws. These screws are accessible from the underside of the chassis and are painted red for ease of recognition. The method of removing the cover of the ARC52, its refitting and pressurizing is given in Chap. 17 of this Section.

3. Before attempting to remove any of the mechanically coupled sub-units from the chassis, it is important to set the tuning to a frequency of 220.0 Mc/s. This will make things easier when refitting the sub-units to the chassis.

Test equipment

4. The test equipment required for testing and servicing the mechanical tuning unit is given in the following list. Further details of these items is given in Part 2, Sect. 1 Chap. 5 of this Volume.

(1)	Tool kit special (Ref. No. 10AG/9431512)	
(2)	Screwdriver crosstip (Ref. No. 1C/6410)	
(3)	Multimeter Type 1 (Ref. No. 10S/16411)	
(4)	Roll pin applicator (Ref. No. 10AG/945)	(para. 19)
(5)	Bearing support tool - drive end (Plessey No. T.336939)	(para.33)
(6)	Bearing press tool - drive end (Plessey No. T.336906)	(para.33)
(7)	Housing support tool - commutator end (Plessey No. T.336947)	(para.33)
(8)	Bearing press tool - commutator end (Plessey No. T.336916)	(para.33)
(9)	Bearing and shaft ejector (Plessey No. T.336945)	(para.33)
(10)	Torque test rig (Plessey No. 4CZ94028)	(para.40)
(11)	Support jig and pin punch (Plessey No. T.336948)	(para.43)
(12)	Clutch spring assembly tool (Ref. No. 10AG/949)	(para.46)
(13)	Assembly fixture (Ref. No. 10AG/951)	(para.47 & 51)
(14)	Special spanner Type 550 (Ref. No. 10AG/950)	(para.47 & 54)
(15)	Torque testing tool (Ref. No. 10AG/946)	(para.54)
(16)	Torque testing and running in fixture (Ref.No.10AG/948)	(para.59)
(17)	Torque gauge (Ref. No. 10AG/947)	(para.60)
(18)	Feeler gauge (Ref. No. 1B/4110)	(para.65)
(19)	Cam setting plate (Ref. No. 10AG/962)	(para.79)
(20)	Cam setting gauge (Ref. No. 10AR/953)	(para.79)
(21)	Drill and ream jig (Ref. No. 10AG/952)	(para.81)
(22)	Test set, tuning unit 6625-99-943-6906	(para.82 & 83)
(23)	Torque test fixture (Ref. No. 10AG/938)	(para.82 & 91)
(24)	Height gauge - .070 / .080 (Ref. No. 10AG/955)	(para.82 & 101)
(25)	Checking fixture (Ref. No. 10AG/954)	(para.82 & 104)
(26)	Surface plate (Ref. No. 1B/1770)	(para.82 & 106)
(27)	Tial test indicator (Compac type PARVUS P3GA)	(para.82 & 108)

Components

5. Examine for correctness, the details of equipment serial numbers and modification state entered on the repair card accompanying the unit. Using a portable blower, or other approved supply of air pressure, thoroughly clean all dust from the unit. If necessary, a squirrel-hair brush may be used to assist this process. Since the tuning unit is normally enclosed within an airtight casing, the presence of dust, dirt or moisture should be investigated.

6. Carefully examine the tuning unit to ensure that it is undamaged, free from corrosion and with all components securely in position. Any loose connections or components must be refitted. Particular care should be taken during this preliminary visual inspection to note that:-

(1) The grub screws on the cam collar and other collars are tight.

(2) The differential gears and drive gears are free from grease and foreign matter.

(3) All ball races are clean and intact.

(4) The pawls move freely under the action of the relay and that the pawl return springs are unbroken.

(5) The cover of the motor is not dented since damage may be done to the capacitors or wiring under it.

(6) The relay contact points are not dirty, pitted or burnt due to arcing.

(7) The switch contacts and rotor surfaces are clean and not burnt due to arcing caused by dirt or excessive wear.

Wiring

7. The wiring should be carefully inspected for continuity and conformity with the circuit shown at Vol. 1, Part 2, Chap. 5, fig. 8 of this Air Publication and wiring diagram (fig. 15 at the end of this chapter). This inspection should consist of point-to-point tests (Table 1) or such electrical tests which will confirm the accuracy of the wiring. Visual examination should be made at the same time for frayed or broken insulation and also to ensure that cableforms are intact and have not been crushed or pinched during assembly. This applies particularly to the cableform from the neon tagboard (TB1201) to the motor tag board (TB1202) where it passes through the apertures in the relay mounting plate and motor plate, since, if untied or out of position, the cableform can easily be caught between the cover and the relay mounting plate and be damaged, or have the insulation frayed by rubbing on the gears (fig. 1).

8. The equipment should be examined for neatness of soldering, absence of dry joints and a generally satisfactory condition of the wiring and insulation. No inadvertent interconnections or tracking paths should be permitted due to excess solder, wire clippings or dirty connections.

TABLE 1

Wiring key

From	Wire colour	Length (in.)	To
P1201/1	White/brown/red	$3\frac{7}{8}$	S1201/2
" /2	White/brown/orange	$3\frac{3}{8}$	" /5
" /3	White/brown/green	$4\frac{1}{8}$	S1202/4
" /4	White/brown/blue	$3\frac{3}{8}$	" /5
" /5	White/red/orange	$3\frac{5}{8}$	" /6
" /6	White/red/green	$3\frac{5}{8}$	" /7
" /7	White/red/blue	$3\frac{7}{8}$	" /8
" /8	White/orange/green	$6\frac{3}{4}$	S1206/10
" /9	White/orange/blue	$4\frac{1}{8}$	S1205/1
" /10	White/green/blue	$3\frac{7}{8}$	" /2
" /11	Black/red/orange	$3\frac{1}{2}$	" /3
" /12	Black/red/green	$3\frac{1}{4}$	" /4
" /13	Black/red/blue	$3\frac{1}{2}$	" /5
" /14	Red/orange/blue	$7\frac{3}{8}$	S1207/2
" /15	Red/green/blue	$7\frac{3}{8}$	" /1
P1202/1	Brown/red/green	$8\frac{1}{8}$	" /5
" /2	Brown/red/blue	$7\frac{3}{8}$	" /4
" /3	Red/orange/green	$7\frac{1}{8}$	" /3
" /4	White/black	$2\frac{1}{2}$	TB1202/5
" /5	White/black	$2\frac{5}{8}$	" /5
" /6	White/blue	$2\frac{1}{2}$	" /4
" /7	White	$6\frac{5}{8}$	S1206/8
" /8	White	3	TB1202/6
" /9	Brown/red/orange	$7\frac{5}{8}$	S1207/2A
S1206/3A	White/red/green	7	S1208/2
" /2	White/red/orange	$6\frac{5}{8}$	" /1

S1201/1	White/brown	$6\frac{1}{4}$	TB1201/1
S1205/12	White/red	$6\frac{5}{8}$	TB1202/2
S1206/8	White	$9\frac{1}{8}$	S1201/14
TB1201/4	White/blue	$8\frac{1}{2}$	TB1202/4
" /5	White/black	$8\frac{1}{2}$	" /5
" /2	White/red	$8\frac{1}{4}$	" /2
" /1	White/brown	$6\frac{3}{4}$	S1204/2
TB1202/1	White/brown	$5\frac{1}{4}$	" /2
TB1201/3	White/orange	8	TB1202/3
S1207/6	White/orange	$6\frac{1}{2}$	" /3
" /6A	White	$6\frac{5}{8}$	" /6
Earth tag	White	7	" /6
S1204/3	White	$5\frac{5}{8}$	" /6
S1203/6	White/brown/green	3	S1202/2
" /2	White/brown/blue	$2\frac{5}{8}$	" /1
" /1	White/brown/green	3	" /4
S1201/9	White/brown	4	" /3
S1203/8	White/brown/blue	$3\frac{1}{4}$	" /5
S1201/14	White	$4\frac{1}{2}$	TB1202/6
S1205/12	White/red	2	S1206/11
TB1201/1	White/brown	$5\frac{1}{4}$	K1201/3
" /1	Brown	$5\frac{1}{4}$	K1202/2
" /2	White/red	4	" /3
" /3	White/orange	$4\frac{1}{2}$	K1203/3
" /4	White/blue	$6\frac{1}{2}$	" /1
" /4	White/blue	$5\frac{1}{4}$	K1202/1
" /4	White/blue	$5\frac{3}{4}$	K1201/1
" /5	White/black	$4\frac{1}{2}$	K1203/2
" /5	White/black	$3\frac{1}{4}$	K1202/4
K1201/2	White/black	$5\frac{3}{4}$	" /4
B1201	Red tracer	As required	TB1202/5

B1201	-	As required	TB1202/4
S1201/1	Busbar	- do -	S1201/4
" /6	Busbar	- do -	" /4
" /6	Busbar	- do -	" /9
S1206/1	Busbar	- do -	S1206/11
S1207/6	Busbar	- do -	S1207/1A
" /6A	Busbar	- do -	S1208/7
S1208/6	Busbar	- do -	" /7

SERVICING

General

9. To assist in the servicing of this unit, component layout diagrams are given in fig. 1, 2, 3 and 4. The wiring key in Table 1, when used in conjunction with the wiring diagram (fig. 15 at the end of the chapter) will be useful should any repairing become necessary.

Note...

Before attempting any servicing of the unit, ensure that it is entirely disconnected from the power supply.

10. In the event of replacement of wiring becoming necessary, the correct lengths, gauge of wire and colour coding used must be as in the original (unless modification requirements necessitate changes).

11. Dirty contacts, points or switches and relays should be cleaned with trichlorethylene. Dirt not removable in this way or slight burning of the contacts may be cleaned by the use of flour paper, i.e. a very fine grade of emery paper. If any contact is too badly burnt to be cleaned by these methods, the appropriate switch wafer or relay contact must be renewed.

Dismantling the tuning unit

12. In order to gain access to most of the component parts of the tuning unit it will be necessary to dismantle it. This should be done very carefully, in a clean, dust free atmosphere. Do not dismantle the unit further than is necessary for the particular repair to be carried out. The full re-assembling instructions are given in para. 49 to 81 ; if the tuning unit is only partly dismantled, re-assembly can be implemented from that point. All tests described in the re-assembling instructions must be done; it is advisable therefore, to first read the instructions, and ensure that all test equipment required is available.

13. If it is necessary to dismantle as far as separating the gearing, first set the mechanism to a frequency of 220•0 Mc/s using either the test set tuning unit or by hand manipulation of the gearing. Access to certain grub screws is easier with the mechanism at this frequency.

Motor servicing without removal

14. If the motor requires extensive servicing then it will be necessary to completely remove it from the tuning unit. However, some maintenance can be carried out without this being necessary. Remove the circlip which retains the motor end cover and then the cover itself. This exposes the suppression capacitors, the bearing protection cap and its retaining circlip, and two nuts. These nuts fit on to the T-head bolts which hold the three main motor parts together. If the brushes are to be renewed, refer to para. 34 and 35.

15. Only replacement of the motor cover, capacitors, brushes and brush assemblies should be attempted without the removal of the motor from the frame. The four leads passing through the grommet in the motor cover are soldered to the motor terminals and are thus renewable.

16. The brush spring pressures are not adjustable but must be between $3\frac{1}{2}$ oz and $4\frac{1}{2}$ oz (para. 35).

Drive coupling

17. The spring dowel fitted to the phosphor bronze coupling ring may easily become damaged during servicing; it is advisable therefore to first remove the coupling ring. It is held in place by a plastic "O" ring (fig. 9), which may be removed by gently prising it with a screwdriver or similar tool.

18. The "O" ring should be examined and if it shows signs of damage or if it is becoming perished, it should be discarded and a new one fitted when re-assembling (para. 81 (11)).

19. The coupling ring should also be examined for damage, particularly the spring dowel. If it is decided to renew the spring dowel, remove the old one by a straight pull with a pair of pliers. To fit a new spring dowel, use the roll pin applicator (para. 4(4)). The roll pin should be fitted to the applicator which should be fitted in the chuck of a vertical bench drill. Do not start the drill but use it only as a means of applying vertical pressure.

Coupler plate

20. Should it be necessary to remove a coupler plate, make note of the way it was fitted and of the shaft from which it is removed. Ensure that it is refitted to the same shaft and in the same way. This is essential since the hole for the fixing pin is drilled through the coupler plate and the shaft after assembly, while both are held in their correct settings, they are not therefore reversible or interchangeable.

21. If it is necessary to change either a shaft, or a coupler plate, then both must be changed. The method of fitting, drilling and reaming is described in para. 81.

Relays

22. Each of the three relays are secured to the relay plate by two screws and it is a relatively easy matter to remove them should they need renewing. It should be noted, however, that one of the securing screws on the relay K.1202 is shorter than any of the others. If the wrong screw is used in this position it will jam the gearing under the relay plate.

23. The d.c. resistance of the relay windings should be between 17 ohms and 23 ohms. These may be measured at the terminal board TB1201 (or TB1202) between tags 1 and 5 for relay K1201; tags 2 and 5 for relay K1202 and tags 3 and 5 for relay K1203.

24. If the tuning unit is being dismantled in order to service the clutches, then the relays will have to be removed, and it will be found easier to do so at this stage. If dismantling for any other reason then the relays may be left in place.

Removing the relay plate

25. Remove the larger of the two side covers; this is secured by eight countersunk Phillips-type screws. Release the two screws which hold the neon board in place. Release the four screws which secure the relay panel; three of these screw into the spacing pillars while the fourth screws into the bearing shaft of an idler wheel situated in the corner between the tens and units clutch drums (fig. 3).

26. Using the appropriate Bristow wrench (part of tool kit) release the grub screws which secure the differential cam and the switch collar on the units shaft. Also with the Bristow wrench release the grub screws which secure the drive gear on the hundreds/tens shaft; remove carefully the taper pin which secures the drive gear to the differential which is also on the hundreds/tens shaft.

27. Unhook the spiral spring, which tensions the differential arm, from the inside of the smaller side cover. Gently ease the relay plate from the assembly; the clutches and shafts come away still attached to the relay plate.

Removing the motor

28. The motor can be removed at this stage. Unsolder the electrical connections at the tagboard and release the three screws which secure the motor to the motor plate. Details of motor servicing are given in para. 29 to 45.

Servicing the motor

29. The operating details of the motor are as follows:-

Voltage - Nominal 25V d.c.; range 18V to 29V

Output - Nominal 0.032 h.p. at 6900 rev/min on intermittent duty cycle of 6 secs on and 9 secs off, repeat.

Current - Nominal 2.8A

30. An exploded view of the motor is given in fig. 5 and the circuit in fig. 6. To dismantle it, first remove the circlip which holds the end cover in place and remove the end cover. Unscrew and remove the nuts from the two T-head bolts, this will allow the three main parts of the motor to be separated. Care must be taken at this stage as the shaft of the armature must be withdrawn from the end bearings which should remain in the end housing.

31. If it is necessary to remove the brush holders, unsolder the leads (taking note of the connections so that they may be resoldered correctly) and then unscrew the two screws which secure each holder to the brush gear assembly. When re-assembling the brush holders they must be carefully aligned by passing a 0.125 in. diameter bar through both holders (fig.7)

Coat the exposed threads of the brush holder retaining screws with staking varnish (8010-99-943-3454) and tighten the screws fully to maintain the brush holder alignment. The recess around the head of each screw, on the back of the mounting plate, should then be filled with varnish and, with the assembly complete, the junction between brush holders and mounting should also be brushed over with two coats of varnish.

32. Do not remove the bearings from the end housings unless this is essential because in doing so the bearing will most likely be damaged. However, the bearings will have to be removed if they are faulty, or if the armature is to be changed; bearings must be selected for fit on the armature (Table 2). The procedure for fitting bearings is given in para. 33.

TABLE 2

Motor bearings fits and clearances

Component		Fit/clearance (in.)
Commutator end	bearing housing (inside diam.)	between .3742 and .3747
	bearing (outside diam.)	between .3743 and .3747
	Armature shaft (outside diam.)	between .1252 and .1248
	bearing (inside diam.)	Selected to be between ± .0001 of armature shaft
Drive end	bearing housing (inside diam.)	between .4992 and .4997
	bearing (outside diam.)	between .4993 and .4997
	Armature shaft (outside diam.)	between .1873 and .1877
	Bearing (inside diam.)	selected to be between ± .0001 of armature shaft

33. The order of assembly given below is for the full re-assembly of a motor. In the event of only part-dismantling of a motor for repair, the relevant re-assembly instructions should be selected.

(1) Cut leads to the correct length, strip one end of each, solder to the field coil after removing any excess solder from the field coil tags.

(2) Select the new bearings to be fitted using the dimensions of Table 2, then heat the housings, on an electrical hotplate, to 80°C.

The bearings must now be pressed into the housings using the fitting tools (para. 4 (5)(6)(7)(8) and (9)) and a bench press. On cooling, the housings will shrink and firmly hold the bearings in place. Fit the drive end bearing retaining clip.

(3) Fit the armature to the drive end bearing, supporting the armature on the special sleeve provided whilst pressing the shaft home against the shoulder.

(4) Next slip the field coil assembly over the armature and ensure that the locating pips seat in the appropriate cut-outs. Slide the two T-head bolts through both the end housings and the field coil assembly, locating the head in the slot on the housing. Slip the lengths of Vidaflex sleeving down over the bolts.

(5) Tie the leads securely to the sleeving covering the T-head bolts.

(6) The brush gear assembly should be fitted to the commutator end housing by two screws. The brushes should be withdrawn halfway and the spring arm allowed to press on the side of the brush thus retaining it in the halfway position. Any bedding-in of brushes should next be carried out (para. 34).

(7) Fit the commutator end housing and bearing over the bolts, Vidaflex sleeving and armature and ensure location of the pip in the housing cut-out before securing the fixing nuts to the bolts. Thread the leads through the grommet and fit tags on the red and blue leads to the brush assembly.

(8) Fit the motor end cover and secure with a circlip.

(9) Fit the commutator end bearing cover and circlip.

(10) Drill and pin the spur gear as described in para.42 and 43.

(11) Ensure that the radial movement of the shaft extension just outside the end housing does not exceed 0.0023 in.

(12) Examine the label for engraving and amend where necessary.

(13) Apply the tests outlined in para. 36 and 41.

34. New brushes must be bedded in first by using flour or crocus paper passed around the commutator and turned in the normal direction of rotation (counter-clockwise when viewed from the drive end) and then by running the motor on a reduced voltage, so that it rotates at no more than 2000 r.p.m., until the brushes are bedded over the complete arc and at least 80% of their area.

35. The correct brush spring pressure is between $3\frac{1}{2}$ oz and $4\frac{1}{2}$ oz (100 gm and 130 gm). This measurement should be made as the spring is just leaving the brush.

Testing the motor

36. Before running the motor, lift the brushes off the commutator and measure the resistance of the field and armature windings; when measuring the armature winding, connect between diametrically opposite commutator segments. The resistances at 15 deg. C should be:-

(1) Field winding resistance between 19 and 21 ohms

(2) Armature resistance - between 2.15 and 2.5 ohms

37. During the following running tests the motor should not be allowed to overheat. If the motor does become hot, carefully examine the motor to find the cause.

38. Connect the motor to a d.c. supply of about 24V; the red lead to the positive and the blue lead to the negative. The rotor should rotate in a counter-clockwise direction as viewed from the drive end.

39. Run the motor on no load at 12000 rev/min for one minute; about 32V will be required to do this. During this overrunning, the vibration and noise should not be excessive, if it is, one of the bearings may be faulty or the armature unbalanced.

40. If facilities are available, such as provided by the torque test rig (para. 4(10)) conduct torque/speed/current tests. Typical figures for three voltages are given in Table 3.

TABLE 3

Motor torque

Applied volts	Torque (oz in.)	Speed (rev/min.) Max.	Speed (rev/min.) Min.	Max current (amps)
18	No load	-	6000	1.20
18	5.0	-	4300	2.95
18	8.0	-	3000	4.15
25	No load	-	7800	1.45
25	5.0	-	6400	3.20
25	8.0	-	5500	4.30
29	No load	10500	-	1.65
29	5.0	9000	-	3.25
29	8.0	8000	-	4.20

41. Directly after the running tests, and while the motor is still warm, measure the insulation resistance between the leads and the frame of the motor using a 500V megger. The insulation resistance should not be less than 50 megohms.

42. New motors may not be supplied with the spur gear fitted. If this is so the following items will also be required:-

(1) Gear, spur (Ref. No. 6105-99-9434118)

(2) Pin, tapered, solid (Ref. No. 5315-99-9433920)

43. A new spur gear may be fitted to the motor shaft with the motor otherwise fully assembled. Use the support jig (para. 4(11)) while drilling and reaming (fig.8). The correct drill is No.53 (0.0595) and the

reamer a 1/16th in. The support slot in the jig is shaped and elongated to permit the gear to pass through the top portion whilst the shaft boss rests on an anvil at the bottom of the slot. Both spur gear and shaft must be drilled together. The motor may, for convenience, be clamped in position using vee-blocks and wood packing during the drilling. This will help to ensure that the drill is applied practically at right angles to the centre line of the shaft.

44. If a new spur gear is to be fitted to a motor shaft which is already drilled, the support jig may be used for the gear alone. Hold the gear in position on the anvil with the fingers, taking care to keep the fingers clear of the drill, yet still retaining sufficient pressure to clamp the gear squarely in contact with the anvil. All swarf must be removed from the spur gear and any drilling flash at the break through points of the drill must be removed before fitting the gear to the motor shaft. Reaming should follow to align the holes in both the gear and shaft and to permit the fitting of a taper pin.

45. A pin punch is supplied with the jig for use when removing or fitting a taper pin. After tapping the taper pin right home, any projecting part of the pin should be filed off flush with the gear boss. Thoroughly clean the motor and gear of any filings or lubricant used when drilling and reaming and during the fitting of the spur gear.

46. All three clutches are of similar construction, they differ only in the number of springs that they may have fitted. An exploded view of the clutch assembly is given in fig. 9. To dismantle a clutch, release the circlip which retains the gear and bearing assembly; removal of this assembly exposes the friction lining and springs. Using the clutch spring assembly tool (para. 4(12)), close the lining against the spring and withdraw it; the springs may be removed from inside the lining in a similar manner. The spacer from behind the lining can now be removed.

47. A circlip must be removed from the shaft before the nut, which retains the clutch drum, can be removed. To remove the clutch drum, place the assembly on the assembly fixture (para. 4 (13)) with the detent wheels engaged with the projections, and release the securing nuts using the special spanner Type 550 (para. 4 (14)). The upper clutch flange can now be removed followed by the clutch drum and lower clutch flange. The detent wheel and shaft can then be withdrawn through the relay plate.

Servicing the clutches

48. If the clutch drums are heavily scored they should be discarded and new ones fitted. Light scoring can be removed by rubbing with crocus paper. Remove all traces of grease with trichlorethlene.

Re-assembling the tuning unit

49. Use only new or serviced parts when assembling the tuning unit. Be sure to conduct the tests described at the various stages of assembly.

Clutches

50. Insert the shafts of the detent wheels into their bearings in the relay plate. The wheel of the hundreds/tens shaft has 18 detents and the bearing for this shaft is in the corner of the relay plate. The wheel of the units shaft has 20 detents and the bearing for the shaft is halfway along one side. The wheel of the decimals shaft has 10 detents and its bearing is in the corner of the relay plate next to the motor.

51. Fit the lower flange, clutch drum and upper flange in that order, to the shafts centring the clutch drum on the shoulder of the lower flange. Start the nuts on the threads of the shaft, then place the assembly on the assembly fixture (para. 4 (13)) so that the indent wheels engage with the projections on the assembly fixture and the flats on the ends of the hundreds/tens and the decimals shafts are facing away from the centre line of the plate and parallel with the lines scribed on the base of the assembly fixture.

52. Fit the brass inserts into the clutch drums. These inserts are supplied with the assembly fixture and are to prevent the clamps from damaging the drums. Turn the drums to the position where they are indicating a frequency of 220.0 Mc/s, and tighten the clamps on to the hundreds/tens and the decimals drums with the projecting part of the clamp arm engaged with the hole on the assembly fixture.

53. Place the top of the assembly fixture in position with its projections engaging with the holes in the base of the assembly fixture. The hundreds/tens, units and decimals shafts should be centrally positioned in their appropriate holes.

54. Using the special spanner Type 550 (para. 4 (14)), tighten the nuts of the hundreds/tens and the decimals shafts. This spanner is a torque spanner and must be set up to a torque of·75 lb in. by means of the torque testing tool (para. 4(15)).

55. Remove the top of the assembly fixture and the clamps from the drum. Fit one of the clamps to the units drum, put the top of the assembly fixture back in place and tighten the nut of the units drum in the same way as the others. It is not possible to tighten the nuts of both the units and the decimals drums in one operation because the drums are too close together to fit clamps to both drums at the same time.

56. Before removing the assembly from the assembly fixture, ensure that the drums are still set at 220.0 Mc/s.

57. The next part of the assembly procedure is to fit the clutch linings and springs into the drums. Fit the first circlip to each shaft so that the sharp edges will be away from the gear and bearing assembly, and place the spacers in the drums. Fit the clutch springs into the friction linings, the hundreds/tens clutch will require three springs while the units and decimals clutches will require only two springs.

58. Place the gear and bearing assemblies on the shafts, engaging the ends of the friction linings in the forks of the gear and bearing assemblies. Fit the second circlip to each shaft with the sharp edges away from the gear and bearing assemblies.

59. Fit the assembly to the torque testing and running in fixture (para. 4 (16)) using the special running in plate. Connect the supply to the drive motor and run-in clutches for three minutes. Switch off the motor.

60. Remove the running-in plate from the fixture and in its place fit the torque gauge plate. Slip the torque gauge (para. 4 (17)) into the appropriate hole in the torque gauge plate so that the torque gauge drive shaft engages with the clutch, and the torque gauge arm can press against its stop post. Switch on the drive motor and note the torque gauge readings. These should be as in Table 4.

TABLE 4

Torque of clutches

Clutch	Number of detents on wheel	Torque (lb. in.)	Gauge reading (grams)
Hundreds/tons	18	4 - 7	726 - 834
Units	24	2 - 4.5	437 - 543
Decimals	10	2 - 4.5	437 - 543

61. In the event of the torque transference being too low or too high, the faulty clutch should be dismantled and the clutch springs expanded or compressed slightly as required and the tests repeated. It may be necessary to renew the clutch springs or to add or remove one or more in order to obtain the correct torque.

Pawl arms

62. On the outside face of the relay plate are three short pins (approx. $\frac{3}{8}$ in. high), one adjacent to each detent wheel. On these should be fitted the pawl arms. The bush of each pawl arm is eccentric to allow fine adjustment of the stop positions of the shafts; the eccentric bush is locked in position by a small hexagon headed screw. The pawl arm is held on the pin by a circlip.

63. When the pawl arms are fitted into place, set the eccentric bush to its central position to allow for adjustment in either direction later. The pawl arms should be free to move when the unit is tilted slightly in either direction.

Relays

64. The three relays are each held in position on the plate by two screws. When fitting these screws it is important to ensure that a special short screw is fitted to the mounting bracket remote from the armature of relay K1202 otherwise the gearing under the plate will be jammed.

65. Ensure that the following clearances are obtained after the relays are in place:-

(1) A clearance of .005 in. or more between the pawl arm and the relay when the pawl arm is fully engaged with the detent wheel (fig. 6).

(2) A clearance of .005 in. or more between the pawl and the detent wheel when the relay is energized (fig. 10).

66. If the clearances in either case are not obtained, adjustment of the relay setting screws should be made.

67. Ensure that the post on the pawl arm fits between the spring and the relay actuating arm.

68. Care must be taken to ensure that the relay contacts open when the pawl engages the detent and that they close on energizing the relay coil. If this is not so in either case the contact arm may be bent slightly to correct the fault.

Motor and gearing

69. Ensure that the motor is secured in position and refit the gearing to their appropriate shafts. Seven of the gears, mounted between the relay plate and motor plate, are secured by circlips and care should be exercised to ensure that all of them are refitted after dismantling. Discard any damaged circlips and fit new ones.

Switch wafers

70. Should any servicing have been carried out which has affected the setting of switch wafers or rotors, the following visual examinations can be made to verify their correct positioning.

Note...

Ensure that the tuning unit is indexed to 220.0 Mc/s.

71. Stand the unit so that the relays are uppermost and the switch (S1204) is immediately in front - the dimples on the switch rotors (S1201, S1202 and S1203) should face the corner of the plate (A of fig. 11). Also, with the unit in the same position the dimple on S1204 switch rotor should face the back left corner of the plate (A of fig. 11).

72. With the hundreds drum indexed at 22, the D-shaped rotor on the top side of switch S1204 should be on the motor side of the switch shaft (A of fig.11). The clearance between the trailing edge of the rotor and the fixed contact with two white/brown leads should be between 1/64 in. and 1/32 in. This can only be ascertained visually, there being no room for a feeler gauge or other measuring device.

73. Rotate the hundreds drum by means of the registration test set so that it rotates through all numbers from 22 to 39. The D-shaped rotor should now be on the side of the switch shaft remote from the motor (B of fig.11). The clearance between the leading edge of the rotor and the fixed contact (as in para. 72) should be between 1/64 in. and 1/32 in.

74. Any necessary adjustment may be carried out by releasing the pinion on shaft S1201/2/3, and manually turning the shaft of S1204 until the clearances are correct. Tighten the pinion grub screws.

75. With the relays uppermost, position the unit so that the differential is at the front and to the right of the unit; with the unit drum at 0, the rotor dimples of switches S1205 and S1206 should be towards the front. (C of fig. 11).

76. At the same time, ensure that the contacts on the upper sides of S1206 lie between the segments of their respective rotors; this can be seen in the inset at C of fig. 11.

77. Invert the unit so that the relays are underneath; and with the differential on the left the dimples on S1207 and S1208 rotors should be at a position corresponding to 11 o'clock, when looking at the top of the wafers (D of fig. 11).

Differential cam and roller

78. Rollers are available in six sizes of outside diameter (Table 5), this allows slight variation of the stop position of the coupler. Therefore if the same shaft and coupler are being refitted, it is important to ensure that the original roller is also fitted. On the other hand, if a new shaft and coupler are being fitted, continue assembling the unit using a medium sized roller. After the coupler is pinned to the shaft (para. 81) it may be found necessary to change the roller for one slightly larger or smaller in order to correct for any slight inaccuracy of the coupler position.

TABLE 5

Cam roller sizes

Plessey Part No.	Outside diameter (in.) Min.	Max.
P.191628/1	0.165	0.169
" /2	0.173	0.177
" /3	0.181	0.185
" /4	0.189	0.193
" /5	0.197	0.201
" /6	0.205	0.209

79. The differential cam is locked to the shaft by two grub screws. The cam setting plate (para. 4 (19)) is a tool which should be used to set the cam to its correct radial position before tightening the screws. The cam setting gauge (para. 4 (20)) is a similar tool but is employed to verify the setting of the cam during subsequent inspection after assembly of the tuning unit. The pin of the cam setting gauge is made of smaller diameter to permit a tolerance of ± 3 deg. from the reference position specified for the differential cam.

Note...

Both the cam setting gauge and cam setting plate are for use on tuning units fitted with the nominal size roller, only. Other rollers may have been fitted during assembly, however, so that it is important to ensure that a roller of .184/.190 in diameter is fitted for these tests. The original roller, if other than nominal in size, must be refitted before proceeding with other tests.

80. The use of both tools will be apparent in the following explanation of the use of the cam setting gauge and also by reference to fig. 12.

(1) Ensure that the units shaft is set at 0, and that the spring which holds the roller in contact with the cam is disconnected. Loosen the two grub screws on the cam collar and fit the cam setting plate over the cam shaft and engage the differential arm roller in the slot provided (fig. 12).

(2) Rotate the cam setting plate around the cam shaft until the roller is pressed against the end of the slot. Turn the cam until the hole in the plate lines up with the hole in the cam.

(3) Pass the gauge pin through both these holes and, with the Bristow key, tighten both grub screws on the cam collar.

(4) Refit the retaining spring.

Fitting the coupler plates

81. The coupler plates are drilled, reamed and pinned to their respective shafts after assembly; thus, should either need renewing, both must be renewed. Before proceeding with the drilling operation, it is advisable to first set the eccentric cams of the pawl arms to a position where it will be possible afterwards to have a measure of adjustment on either side of the drilled position to allow for small inaccuracies. To drill, ream and pin the couplers, proceed as follows:-

(1) Set the mechanism to 220 Mc/s.

(2) Place the two spacer plates (which are normally secured to the side of the drill and ream jig (para. 4 (21)), above the projecting T-piece, by a knurled screw) in position about the four projecting ends of the shafts. This is to ensure the correct height of the coupler plates above the base plates of the unit.

(3) Slip the coupler plates in position on their shafts ensuring that the flat on the boss of each coupler plate is suitably placed for drilling.

(4) The unit should next be placed in the drill and ream jig with the locating dowels adjacent to the multipole connector firmly seated in their respective locating holes in the jig; ensure that the coupler plates do not rotate whilst doing this.

(5) Secure the unit in the jig by tightening the three larger knurled handscrews. Clip the brass catch on the underside of the jig into the gear of the differential train to clamp the differential, then adjust the knurled screw of the Tee-piece and panel (fitted to the side of the jig) to clamp the unit against the milled faces of two locating dowels within the jig and to eliminate backlash in the gearing. Finger tightness of the screw, only, is required.

(6) Gently tighten the four knurled screws (each situated between a pair of holes through which the abutment faces of the couplers can be seen) which take up the backlash of the shafts in the tuning unit. Tighten the three remaining knurled screws (which are in line with each other on the jig) causing the locating V pieces to seat on the driving abutment faces of each coupler, thus ensuring correct alignment for the drilling operation. Some practice may be necessary in the manipulation of the screws to avoid binding. Should any screw tighten prematurely or become unreasonably stiff to turn, slacken off all screws and again offer up the tuning unit into the jig and recommence the screw tightening sequence. Do not force any of the screws or damage may result.

(7) Thoroughly clean the slip bush and press it securely into the appropriate slot in the base plate. Then with a clean, sharp No.5 drill commence drilling using only a light pressure with high drill revolutions.

(8) Carefully remove the unit taking care not to allow the couplers to fall from their shafts. Remove the two spacer plates.

(9) Hand-ream the drilled holes to suit the solid taper pins. Fit the pins and file off any projecting part of the pins.

(10) Apply the tests outlined in para. 102 to 101.

(11) Refit the phosphor bronze coupling ring using a serviceable "O" ring (para. 17 and 18).

TESTING

82. The tests which should be conducted on the complete tuning unit are:-

(1) Correct frequency selection

(2) Torque of the shafts

(3) Correct operation of the motor and relays on normal and on reduced voltages.

(4) Alignment of the couplers.

Of these, (1) can be done by using the test set tuning unit (para. 4(22)) while the torque test fixture (para. 4(23)) is necessary for (2) and (3). For test (4) a height gauge, a checking fixture, surface plate and dial test indr. (para. 4 (24), (25), (26) and (27) are required.

Frequency selection

83. Connect the source of d.c. power to the test set tuning unit and connect this in turn to the equipment. Set the power source to 27.5V ± 0.5V. Proceed as follows:-

(1) Upper end

Set the switches of the test set to 380.0 Mc/s and observe that the clutch housing labels register the same number. Reset the tens switch to 9 (390.0 Mc/s) and ensure that the tens/hundreds detent wheel has moved one position (to 39) but not through a complete revolution.

(2) Lower end

Repeat the test in sub-para. (1) above for values of 220.0 Mc/s and 230.0 Mc/s respectively.

84. Progressively index the tester from 399.0 Mc/s to 299.0 Mc/s in intervals of 10.0 Mc/s and ensure that the clutch housing labels agree, at each interval, with the tester index.

85. Progressively index the tester from 229.0 Mc/s to 22.0 Mc/s in increments of 1.0 Mc/s and again ensure agreement between the clutch housing labels and the tester index.

86. Repeat the progressive indexing tests from 229.9 Mc/s to 220.9 Mc/s in intervals of 1.0 Mc/s and ensure agreement as with whole units except that the clutch housing label of the units shaft should be advanced one half position above the unit index, i.e. to the intermediate mark.

87. Repeat the progressive indexising from 220.9 Mc/s to 220.0 Mc/s in intervals of 0.1 Mc/s and ensure agreement as before except that for

positions 220.9 Mc/s to 220.5 Mc/s inclusive the clutch housing label of the units shaft shall be advanced one half position above the unit indexed, i.e. to the intermediate mark.

88. When the armature of any of three relays is operated during any of the tests, described in para. 83 to 87 inclusive, ensure that the DISABLE lamp on the test set lights up for the duration of the test.

89. When the armature of any of the three relays is released during any of the tests (para. 83 to 87 inclusive), ensure that the neon lamp associated with it (situated on terminal board TB1201) does flash momentarily.

90. Table 6 gives the terminal number to which one of the wires of each neon lamp is connected and its associated relay.

TABLE 6

Neon lamp wiring connections

Relay	Terminal No. on TB1201
K1201	1
K1202	2
K1203	3

Torque and motor tests

91. For torque tests, use the torque test fixture (para. 4(23)). First examine the tuning unit (mechanical) to be tested for obvious defects or damage which may lead to further damage during test. Units which have been serviced or rebuilt should have been inspected and passed as complete and ready for testing before attempting to apply power.

92. Before securing the tuning unit to the mounting plate, switch off or disconnect the power supply. Then offer the tuning unit into position on the back of the mounting plate and engage the securing screws by just a few threads only. Ensure that the locating dowels on the base of the tuning unit are engaged correctly into the clearance holes drilled into the mounting plate; the dowels in engagement will ensure that the tuning unit is correctly positioned on the mounting plate in the same way that they prevent mis-matching when the tuning unit is fitted into the chassis assembly (main).

93. Release the distance plate on the front of the mounting plate and allow it to fall to the right, freeing the fulcrum rods which pass through the mounting plate. This will enable the fulcrum rods with the coupler plate terminations to be manipulated by the fingers to engage the couplers of the tuning unit on test.

94. With the couplers correctly engaged, carefully tighten the two securing screws until the tuning unit is firmly held in position against the back of the mounting plate. Overtightening of these screws is not necessary.

95. The distance plate may now be swung back to the vertical position and clamped by means of its securing screw. The operating levers on the fulcrum rods should now be engaged with the levers of each dial indicator; the tip of each indicator lever lodging centrally on the cam-formed tip of the operating levers.

96. The terminal block may now be released, by tripping the hand lever, to make contact with the tagboard immediately below the motor of the unit under test. A good electrical contact must be assured between each of the plungers and the relevant test point on the tagboard. Failure of the unit to operate during testing can sometimes be traced to dirty contacts, so that it is essential to wipe clean the terminal block and to remove any preservative which may have been applied to the tagboard test points.

97. The fixture may now be connected to a 28V d.c. supply which must be variable to provide outputs between 16V and 26V. A suitable source of power is the power unit, a.c. (ground); 5821-99-943-1736 the variation in output voltages is obtainable by use of a variable auto-transformer, such as a variac transformer Type 200 (Ref. No. 5P/2491).

98. The first test should be made at a nominal 16V to confirm that the relays will engage and that the motor will operate. This is primarily a safety measure, to be taken before applying the full test voltage. The input should then be adjusted to 27.5V and the torque of each shaft measured, these should be:-

(1) Tens shaft.

The torque shall be between 4 and 7 lb in. on this shaft.

(2) Units shaft.

The torque shall be between 2 and 4.5 lb in. on this shaft.

(3) Decimals shaft.

The torque shall be between 2 and 4.5 lb in. on this shaft.

Note...

The torque test fixture incorporates a safety switch which breaks the supply after the motor has been running for approximately 20 seconds and does not reconnect the supply until 1 minute later. This is to prevent overrunning and damage to the motor.

Current consumption

99. With a voltage of 27.5V ± 0.5V applied to the unit, ensure that the current drawn does not exceed 6.5A.

Low voltage operation

100. Reset the d.c. power source to 16V ± 0.5V and apply it to the equipment. Ensure that the motor rotates and that all pawls disengage and are completely free from the detent wheels.

Coupler alignment

101. Ensure that the height of the coupler plates above the switch plate is within the limits 0.070 in. and 0.080 in. This can be done by using the height gauge (para. 4(24)) in the method shown in fig. 13. The height gauge is a "Go/No Go" tester, if the coupler is correctly set between the limits quoted, only one end of the height gauge will pass over the top of the coupler.

102. A slight adjustment of the stop positions of the hundreds/tens, units and decimals shafts can be obtained by means of the eccentric cams on which the pawl arms hinge (para. 62). Adjustment of the

differential shaft can be obtained by changing the cam roller for one of slightly larger or smaller outside diameter, six different sizes are available (para. 78 and Table 5).

103. In order to check the stop positions of shafts, set the mechanism of the tuning unit to a frequency of 220.0 Mc/s and manually rotate the motor pinion to take up the backlash in the gear train throughout the unit.

104. The tuning unit should then be clamped into position in the checking fixture (para. 4 (25)) by means of the hand screws protruding through the front plate. These engage with the threaded holes in the base of the tuning unit and with finger tightness, only, provide sufficient security throughout the test.

105. Engagement of the brass pawl on the underside of the fixture with the differential gear will hold the unit at the 220.0 Mc/s (start) position and enable any further adjustment required for the elimination of backlash to be made by the knurled screw and finger pawl on the side of the fixture. The pawl engages with the adjacent detent wheel and the action should rotate the detents in the direction of normal rotation. Take care when eliminating backlash, however, as strain imposed upon the adjustment may lead to errors in alignment testing. If any strain is suspected, release the pawls and recommence the procedure for positioning of the tuning unit into the future.

106. The fixture may now be placed on a surface plate for alignment testing. The surface plate should be clean and it is advisable to carefully wipe clean the undersurface of the fixture to prevent errors due to rocking of the jig, which may arise during the test.

107. The Oldham coupler plates can be seen through a series of elongated slots in the base plate of the fixture, as shown in fig. 14. The two dogs on each doupler plate should appear horizontal if the tuning unit has been correctly indexed before commencement of the test.

108. A dial indicator which has been fitted to a height gauge, as shown in fig.14 , should then be brought into position and the horizontal alignment verified at each of the two driving dogs on each coupler plate. The difference in dial readings between the highest and lowest dog should not exceed 0.00175 in.

109. Slight inaccuracies, probably the result of discrepancies during pinning of the coupler plates, can be compensated for, or corrected by, the limited adjustment made available by the eccentric bush of each pawl arm adjacent to the detent wheels on the relay plate and the varied sizes of rollers available (para. 78).

110. Where inaccuracies are caused by wear or errors in the setting of the differential gear, however, the extreme accuracy required in the replacement of component parts can be verified only by the use of expensive optical test equipment. It is recommended, therefore, that in such circumstances the tuning unit (mechanical) is returned through stores to the manufacturer for overhaul.

FINAL INSPECTION

111. Upon completion of servicing and adjustments it will be necessary to inspect the unit, to ensure full serviceability as follows:-

(1) Ensure that any cableforms which have been released in any way are re-tied to their supports.

(2) Ensure that any screws released during maintenance have been tightened down and locked with approved varnish, where these are not fitted with lockwashers.

(3) Re-examine any new soldered joints as described in para. 9 and 10.

(4) Ensure that the covers have been replaced correctly, i.e. with the indentations firmly located in the grooves on the edges of the motor plate and the switch plate. Failure to ensure correct location may cause binding between the bearings in the switch plate and the shoulders on the shafts, or allow longitudinal shaft movement with possible disengagement of gearing or heavy wear resulting.

(5) Visually examine to ensure that the locating dowels are free from any damage caused during the foregoing servicing or inspection procedures.

112. In the event of other modules being removed for servicing from the main chassis, in addition to the mechanical tuning unit, note that this unit should always be replaced first.

FIG. 1 & 2

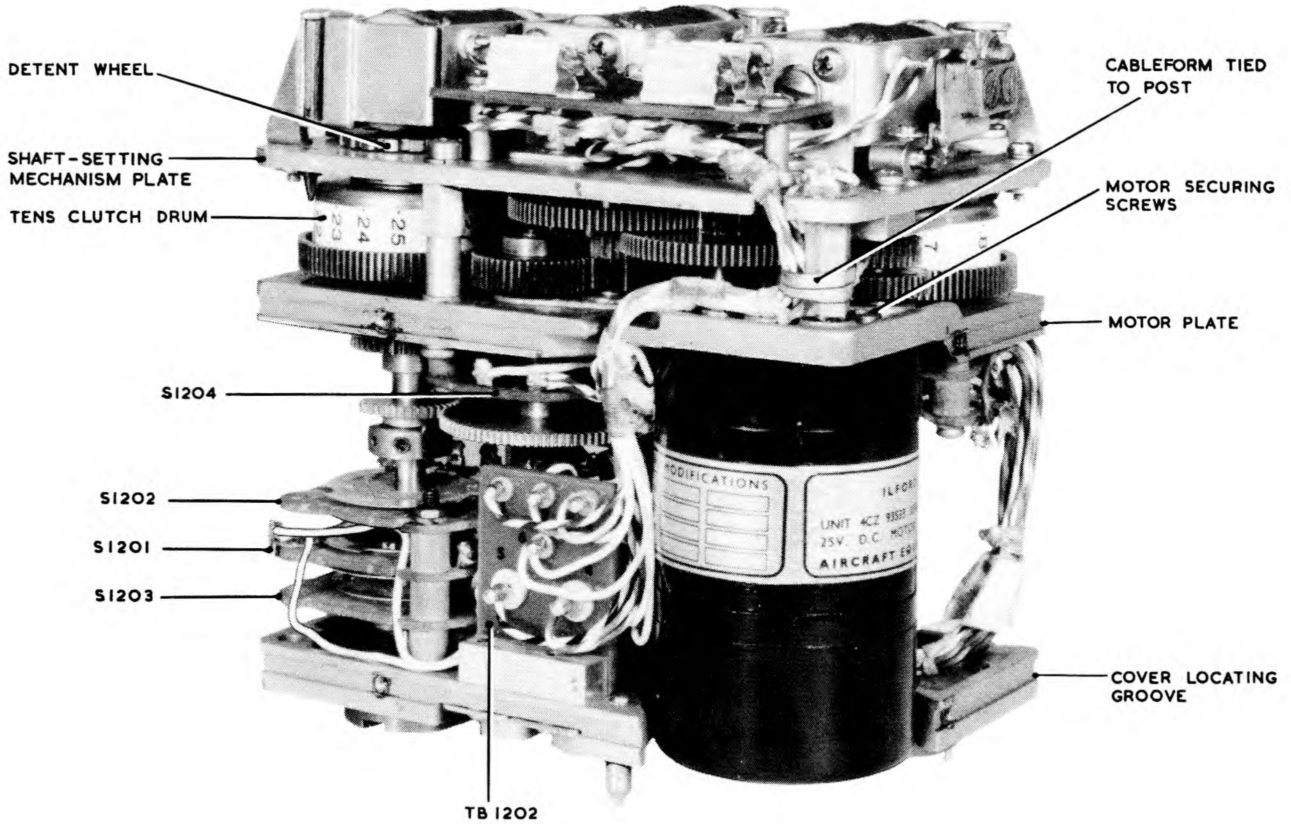

Fig. 1. Component layout-front

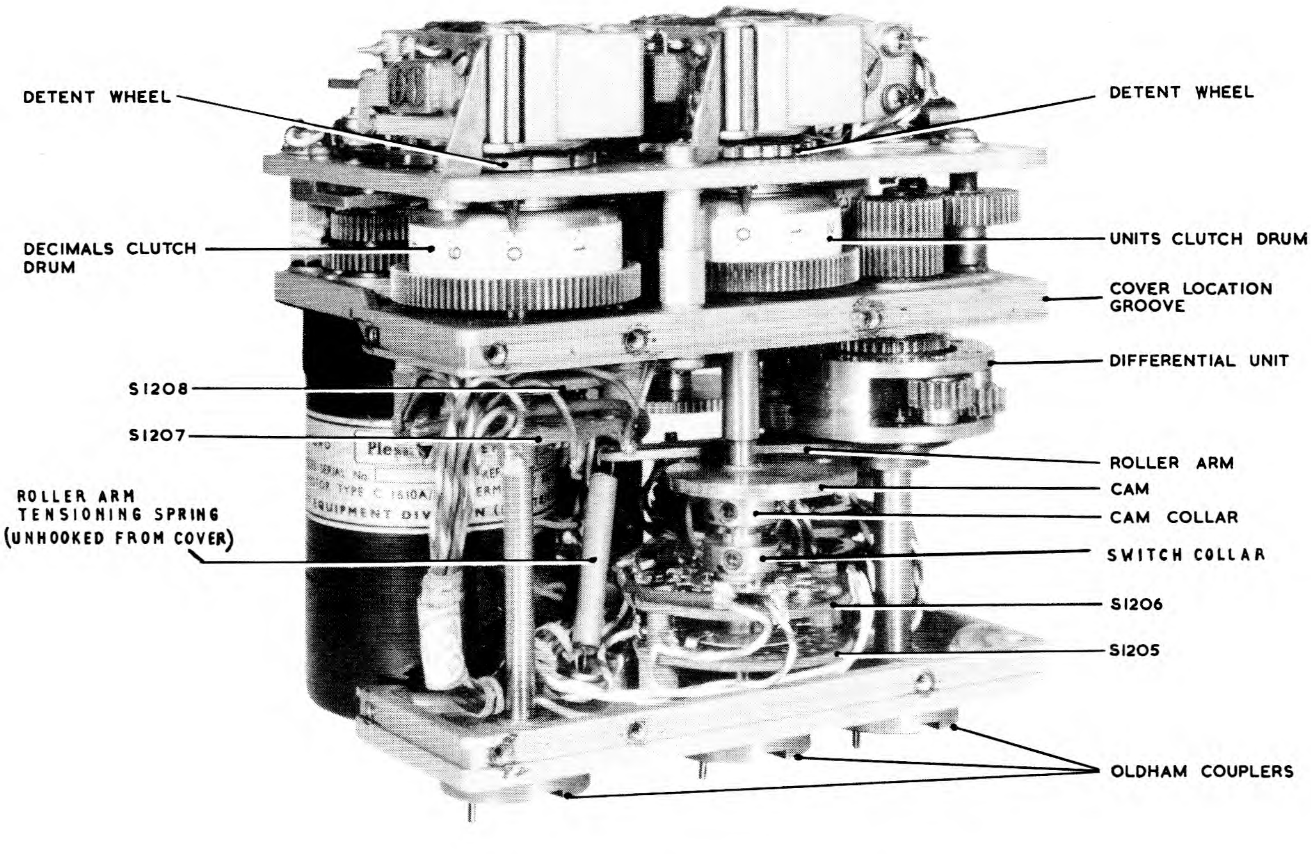

Fig. 2. Component layout - rear

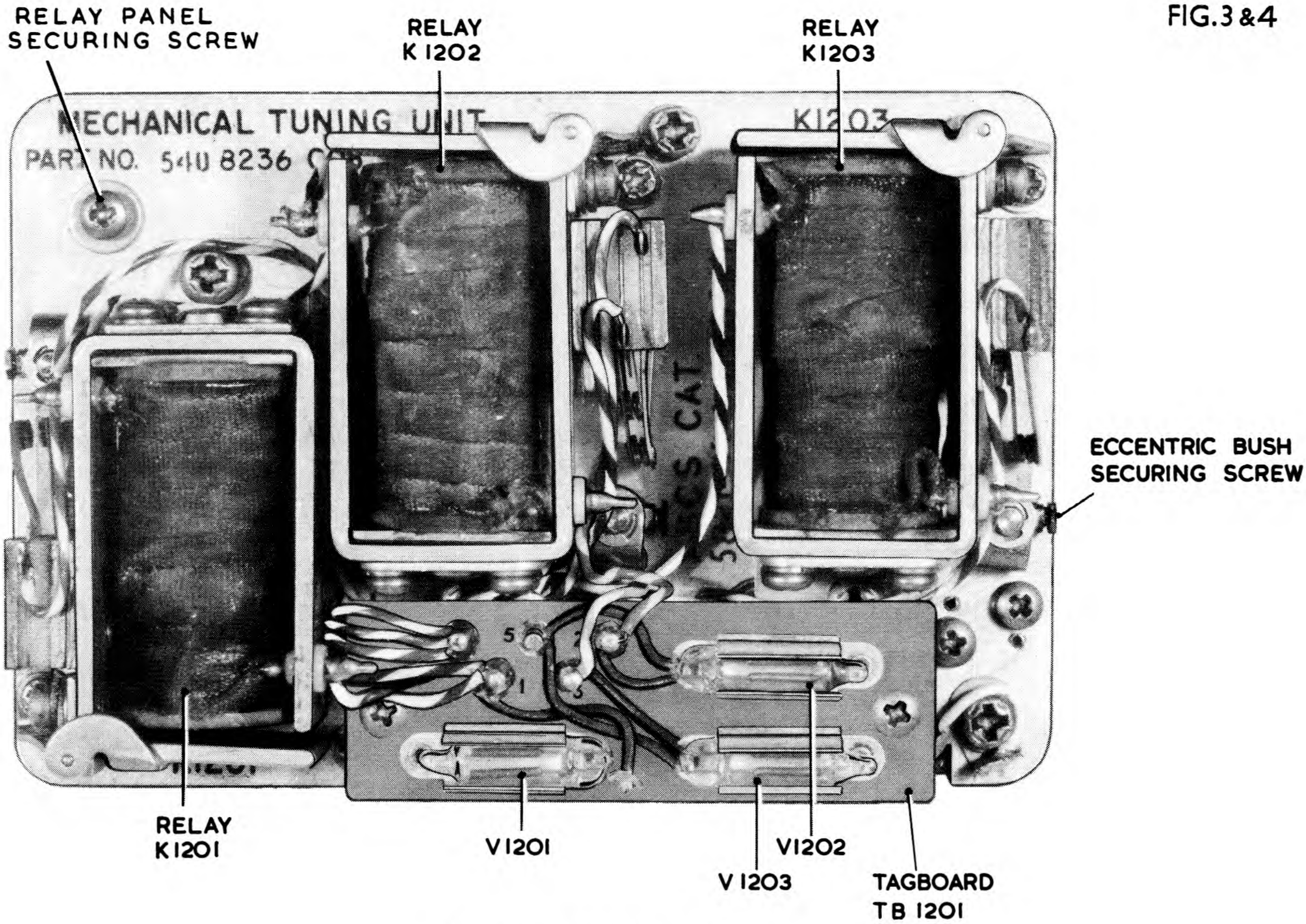

Fig. 3. Component layout-top

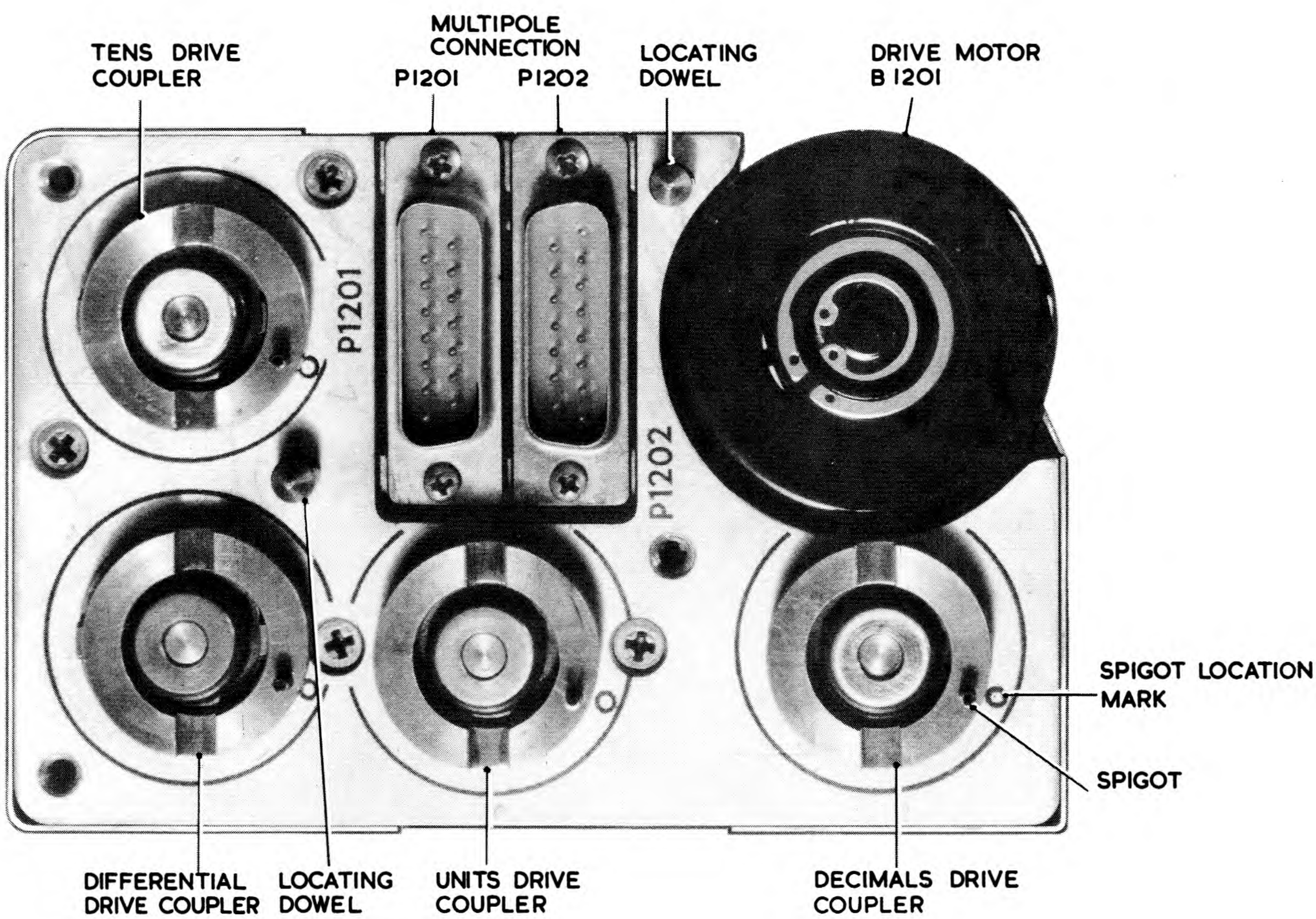

Fig. 4. Component layout-underside

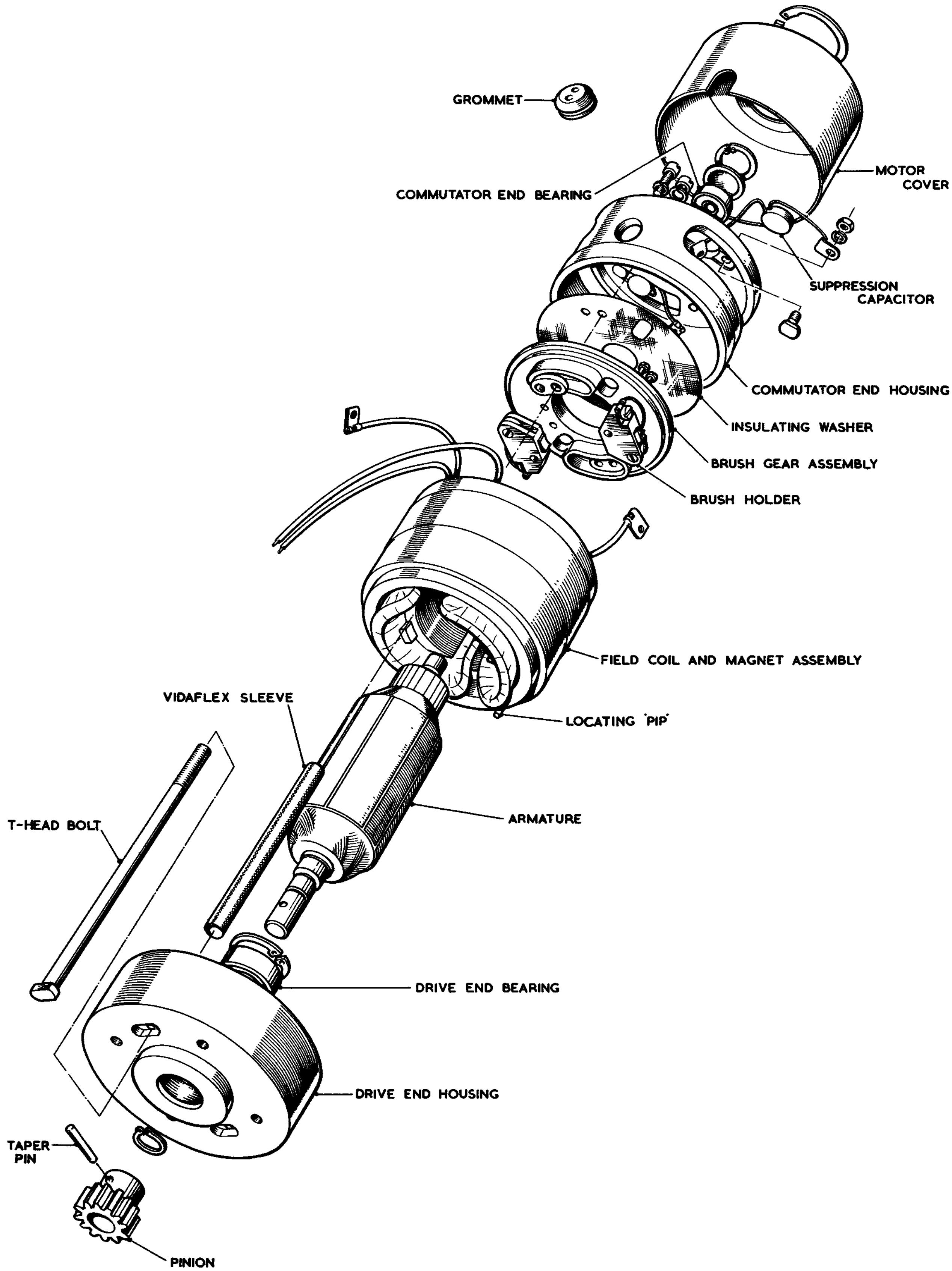

Fig.5. Motor – exploded view.

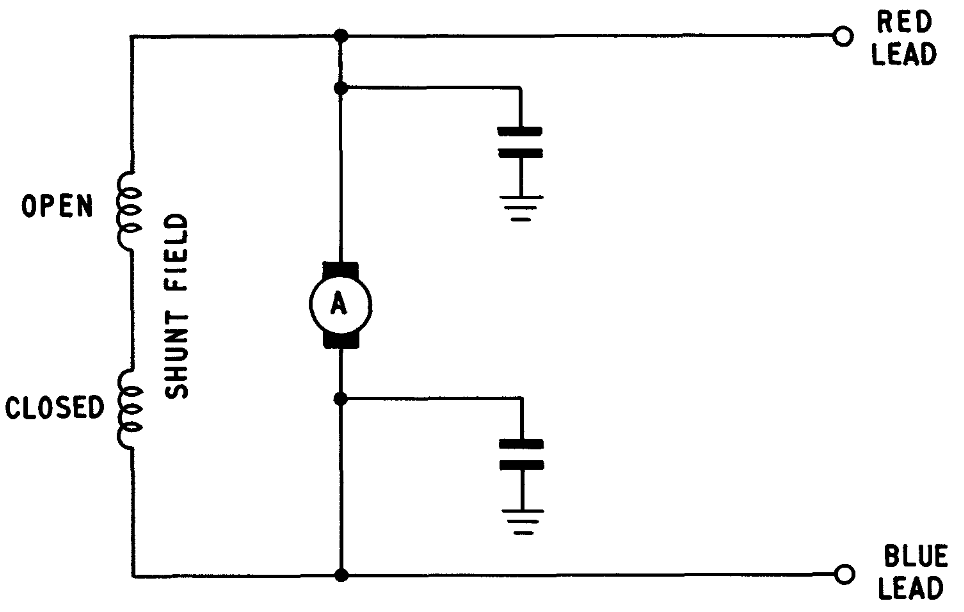

Fig. 6, Motor–circuit diagram.

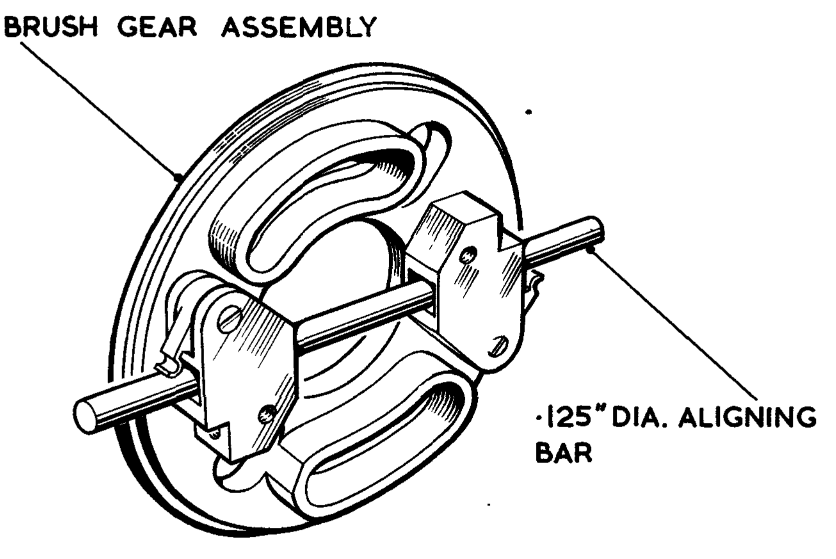

Fig 7 Brush assembly alignment

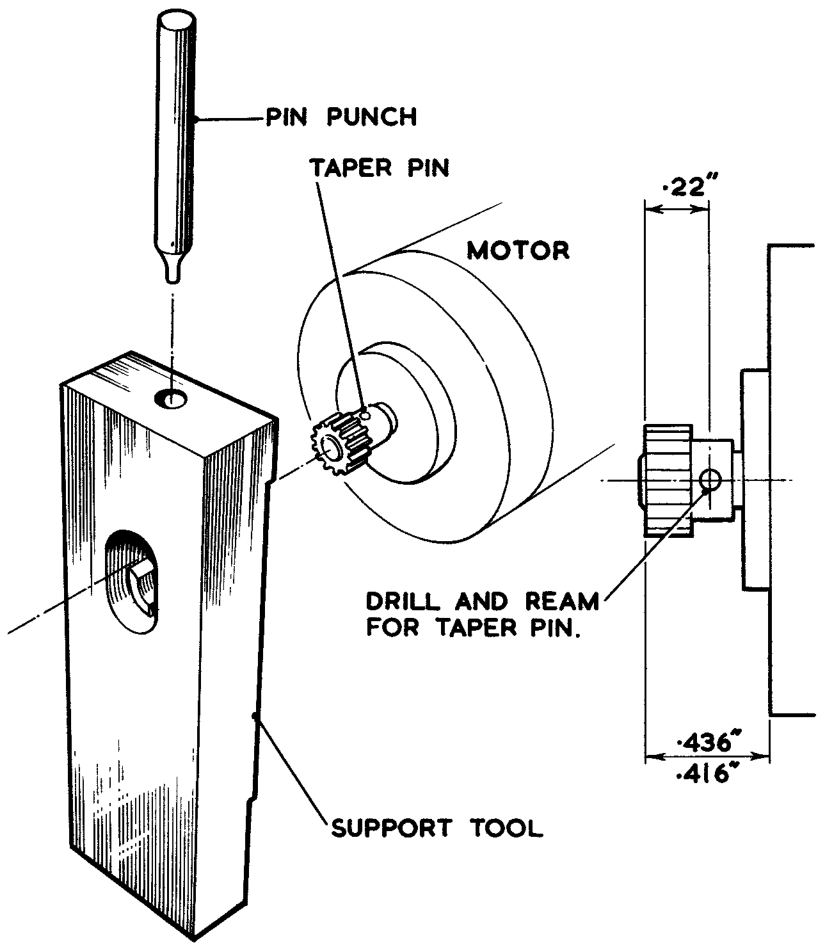

Fig.8. Motor pinion drilling tool

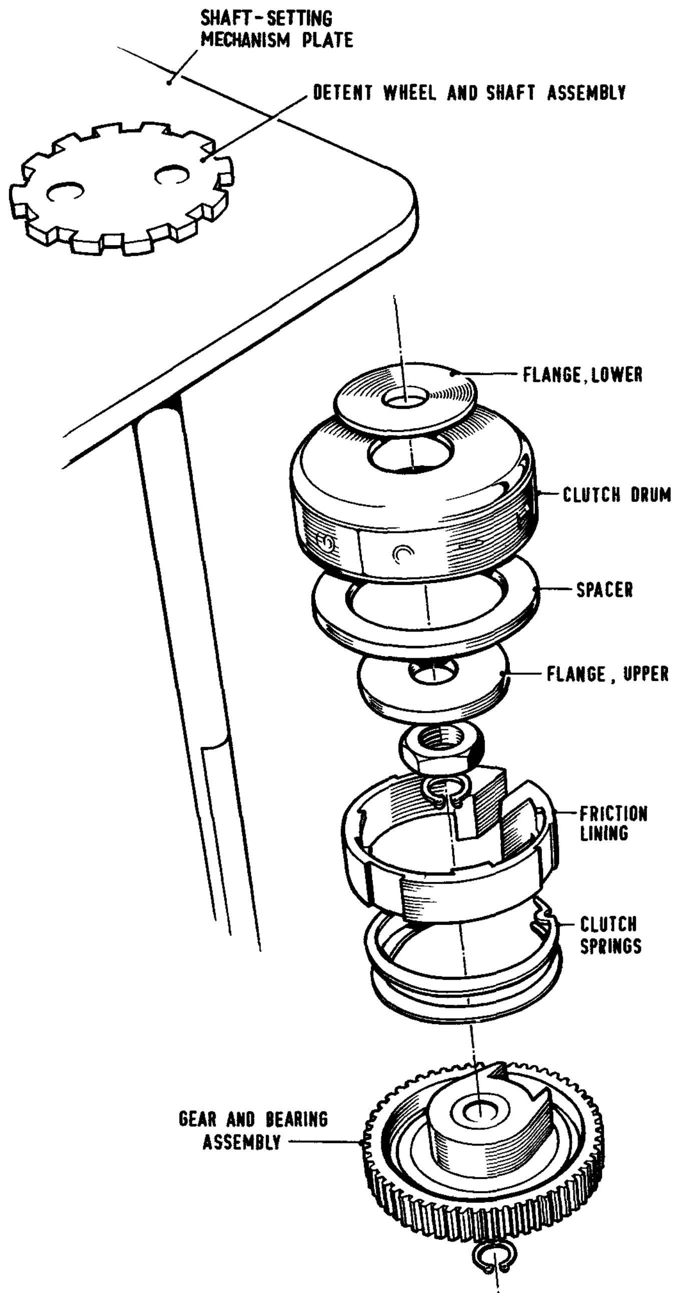

Fig. 9. Clutch-exploded view

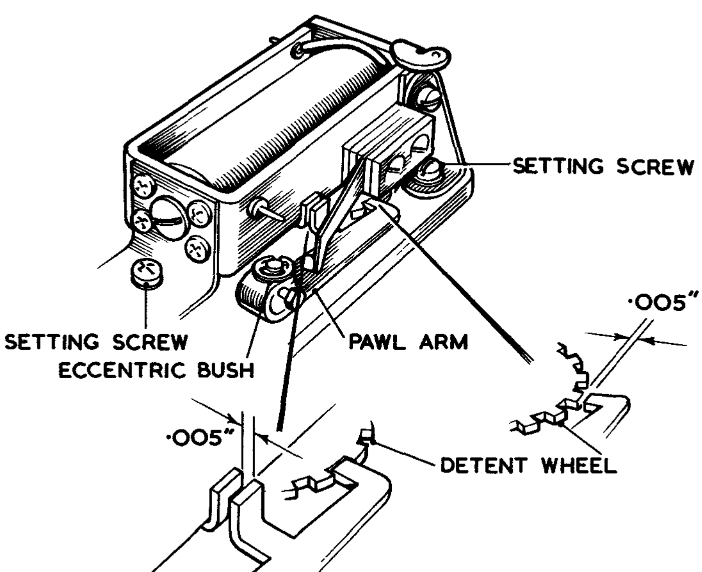

Fig. 10 Relay-setting up

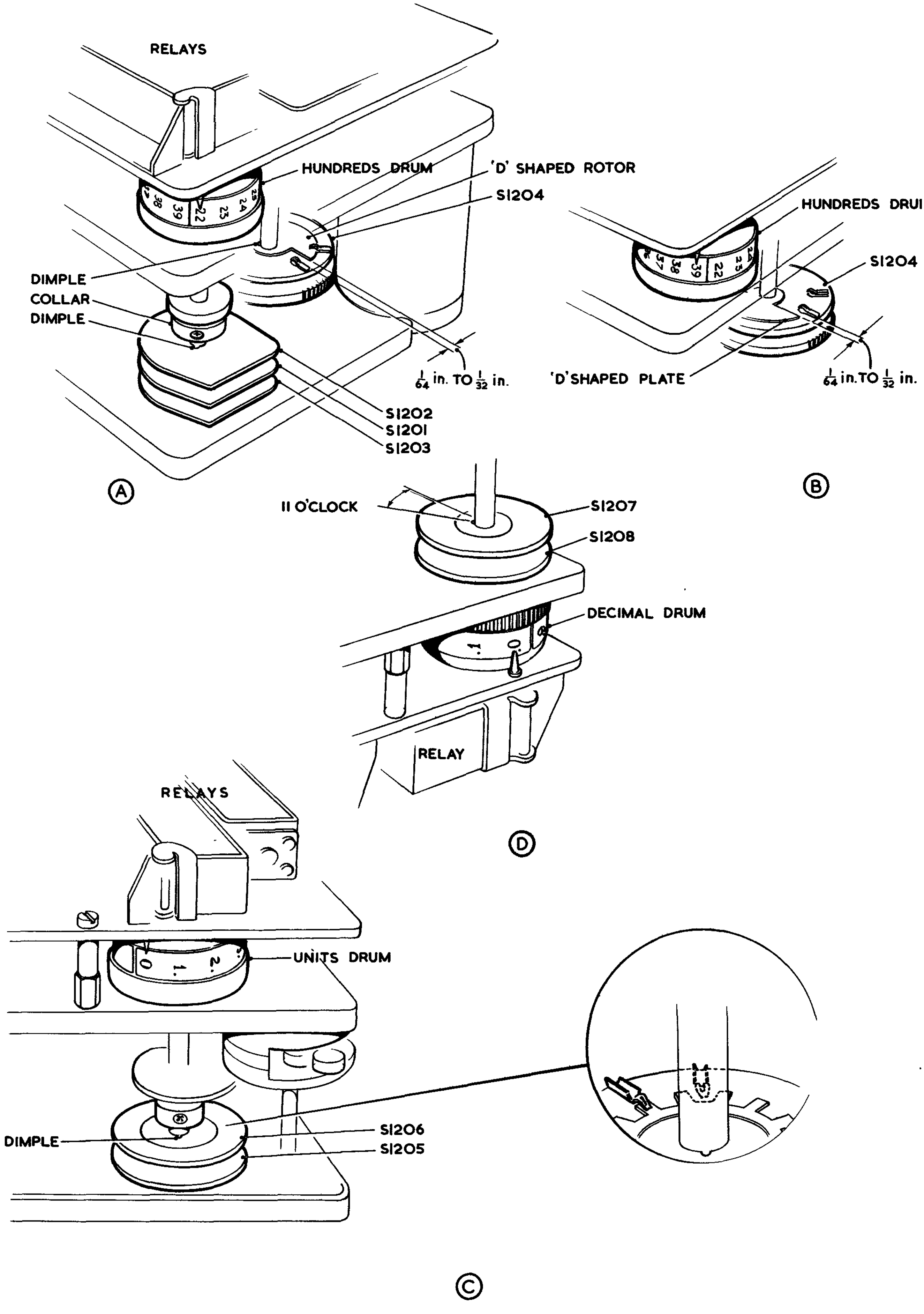

Fig. 11 Switch wafer positioning

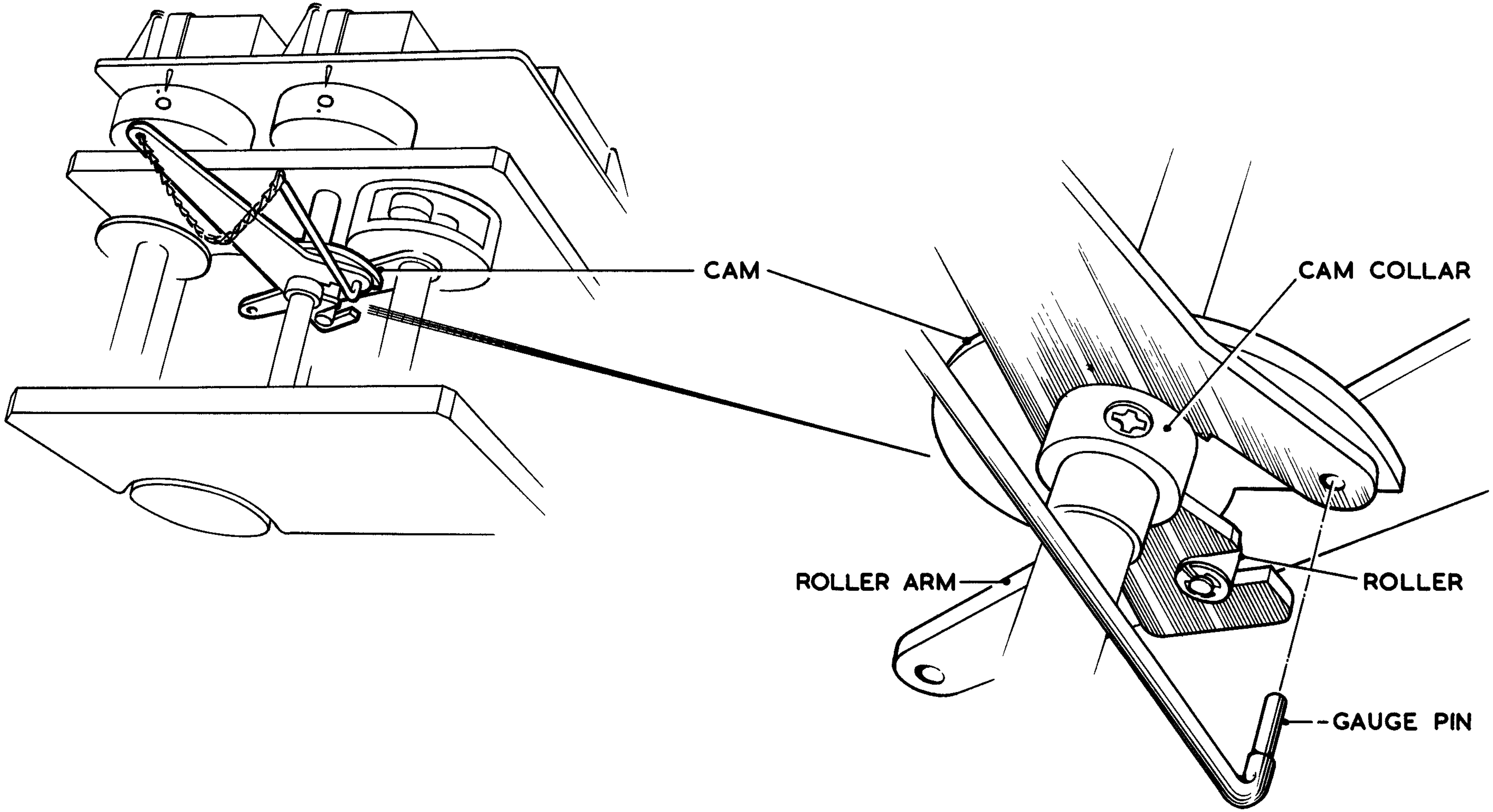

Fig.12. Differential cam

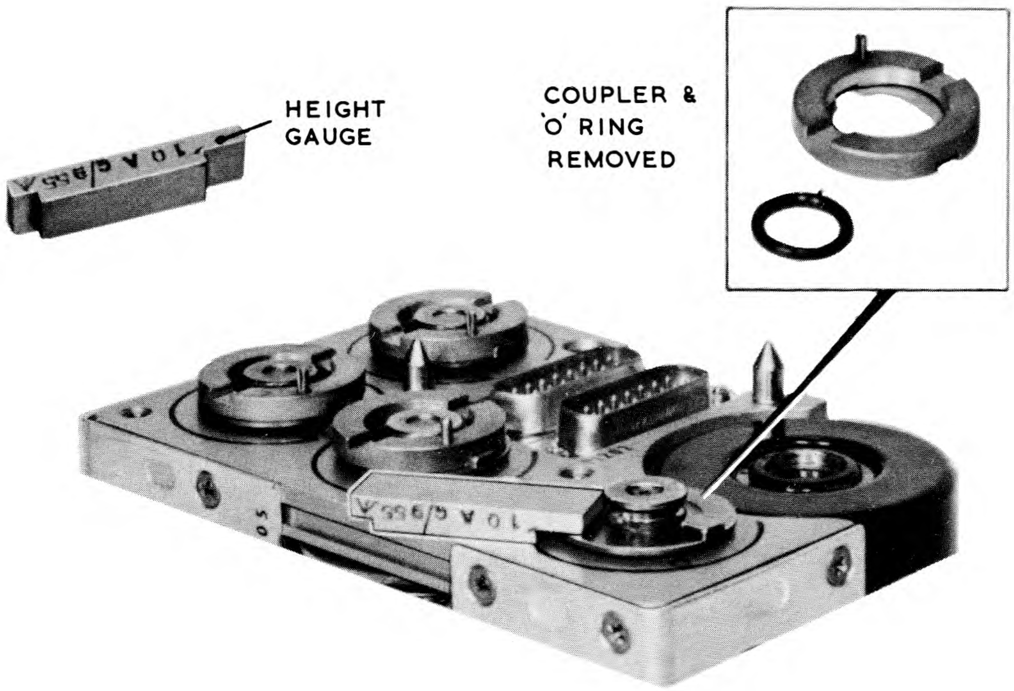

Fig.13. Height gauge, shown in use

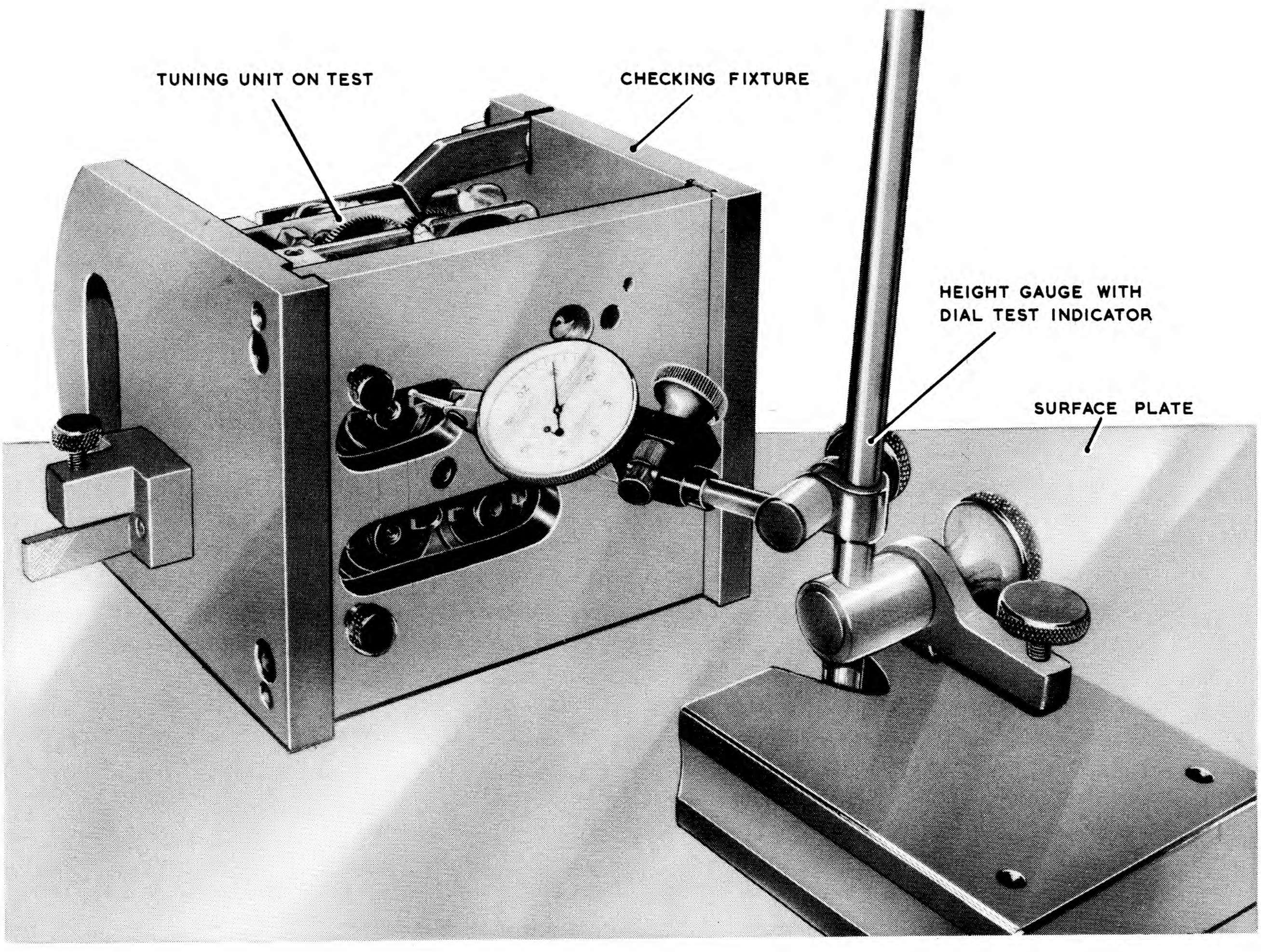

Fig. 14. Method of testing coupler alignment

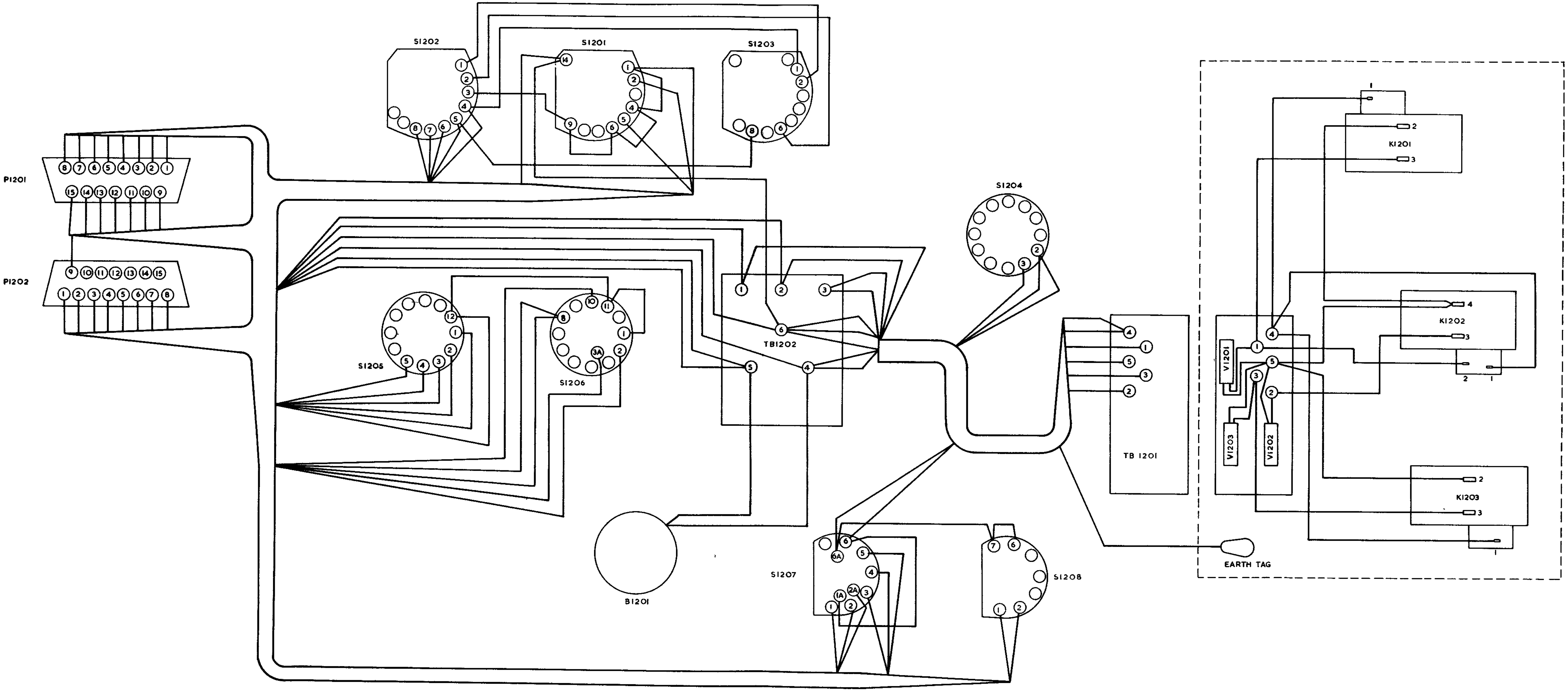

Fig. 15 ARI. 18124/1 & ARI. 18124/2 — tuning unit (mechanical) — wiring diagram

Chapter 16

CHASSIS ASSEMBLY (MAIN)

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General

1. The main chassis assembly comprises a fabricated aluminium base plate, to which is attached the front panel assembly. This component has the principal function of providing a mounting base for the plug-in type sub-units making up the transmitter-receiver equipment. In addition, however, the chassis carries the gear plate assembly and other components such as the axial flow blower and thermostatic switch, fuse box and power supplies filter for the spectrum generator unit (amplifier-oscillator); each one of which is dealt with separately in subsequent paragraphs.

2. With the exception of the axial flow blower, all major items and the associated wiring and connector sockets are fitted to the underside of the chassis assembly and are completely accessible for servicing. The axial flow air blower is not included in the chassis assembly for the transmitter-receiver TR5/ARC52 because air circulation in this equipment is provided by impellers incorporated in the dynamotor of the power unit (DC).

Test equipment

3. The equipment required for servicing and testing the chassis is listed in Table 1. Further information on the individual items may be obtained by reference to the publication listed in the table.

TABLE 1

List of test equipment

Reference No.	Nomenclature	Para.	Further details
5821-99-943-6854	Fixture, gear plate alignment	32	Sect. 1
1B/4764	Dial test indicator	32	-do-
1B/1771	Surface plate	32	-do-
10AG/974	Backlash bias tool	32	-do-
10AG/942	Gear plate checking gauge	33	-do-
10AG/939	Checking gauge	33	-do-
10AG/941	Preload tool	33	-do-
5821-99-942-8549	Tuning unit (mechanical)	33	Sect. 2, Chap.15
10AG/934	Acceptance gauge	35	Sect. 1
10AG/933	Plug gauge	35	-do-
10S/16411	Multimeter Type 1	13	A.P.2536C
	A.C. and d.c. power supplies	47	From station resources

Component inspection

4. Inspect the unit serial numbers and verify that the modification state of the equipment is up to date.

5. Thoroughly clean the chassis assembly before commencing any servicing. A portable blower, or other approved supply of dry air under pressure will assist in removing any dust. As the unit is normally housed within a sealed casing, however, the presence of dust, dirt or moisture should be fully investigated.

6. Carefully examine the assembly visually to ensure that it is undamaged and free from corrosion, with all components securely retained in position. Any loose components or connections should be at once refitted. Should it become necessary, because of obvious damage or failure, to change any of the components it is important to ensure that the new items are positioned accurately and correctly connected. Reference to the component layouts shown in Vol. 1, Part 1, Chap. 5, fig. 6 and 7, will assist.

7. Any screws or nuts removed during servicing and which are not fitted with lockwashers must be locked with an approved varnish (liquid staking) when refitted.

Wiring

8. The wiring throughout the chassis assembly should be carefully inspected for continuity and conformity with the circuit shown in Vol. 1, Part 2, Chap. 1, fig. 28 of this Air Publication. This inspection should consist of point-to-point tests or other electrical tests which will confirm the accuracy of the wiring.

9. Examination should be made for neatness of soldering, absence of dry joints and a generally satisfactory condition of the wiring and insulation. No inadvertent interconnections or tracking paths should be permitted due to excess solder, wire clippings or dirty connections. Cableforms should be correctly banded and routed clear of the gear plate without sharp bends or kinks which may adversely affect the life of the cable during service.

10. To assist in the tracing and servicing of the wiring of this assembly, a wiring diagram is given at fig. 1. It is important that any rewiring is made correctly and that lengths, gauge of wire and colour coding are as in the original (unless modification requirements necessitate changes). This information is given in Table 2. The conductors of the cableforms carry all power supplies and signals at audio frequencies. For feeding signals at u.h.f. between sub-units and relays, miniature coaxial connectors are employed.

Note...

> In this table, the term breakout point is used to describe the point of exit from the cableform of certain leads and wires; these points are generally adjacent to the component items enumerated in the last column and are marked on the wiring diagram, fig. 1. The term free is applied to denote a wire or lead which is not part of a cableform.

11. The terminations of cables and wiring should be carefully examined for sound connection; this applies particularly to the coaxial cables having screwed connectors. Care should be taken to tighten the ferrules firmly when reconnecting the cables, but avoid over-tightening to the extent where damage may occur. Earth tags should be carefully cleaned and a good contact with the chassis assured before refitting.

12. Care must be taken to ensure that pole B of J1401 is earthed and the 42-way connector is fully engaged when the equipment is connected up. Failure to do this may result in damage to one of certain filter chokes in the front panel assembly, when the system finds an alternative earth return through a filter choke; the choke which suffers depends upon the frequency to which the transmitter-receiver is channelled.

TABLE 2

Wiring key

From	Wire colour	Breakout point	Length (in.)	To
CHASSIS CABLE				
J1514/1	White/black/orange	B23	$11\frac{3}{8}$	TP2
" /3	White/black/red	B22	11	TP3
" /6	White/red/orange	B4	$12\frac{1}{4}$	J1502/7
" /6	White/red/green	B4	10	L1507
" /8	White	Free	$4\frac{7}{8}$	Earth
J1509/1	White/orange	B11	$5\frac{1}{4}$	J1510/10
" /2	White/red	B17	$26\frac{3}{8}$	Z1401/L
" /2	White/red	B11	$5\frac{1}{2}$	J1510/11
" /3	White/brown/orange	B7	20	J1504/1
" /4	White/brown/red	B15	165/8	E1501/S
" /6	White/red/orange	Bq1	6	J1510/8
" /6	White/red/orange	B29	$8\frac{3}{8}$	TD1501/6
" /9	White/black	B10	$9\frac{3}{4}$	J1507/12
" /9	White/black	B12	10	J1511/7
" /10	White/green	B12	$9\frac{1}{4}$	" /10
" /10	White/green	B4	$25\frac{1}{8}$	J1502/10
" /11	White/brown	B4	$25\frac{1}{2}$	" /11
" /11	White/brown	B12	$9\frac{3}{4}$	J1511/11
" /12	White/black/orange	B17	$28\frac{7}{8}$	Z1401/D
" /13	White/blue	B17	-	" /T
" /14	Wgite/orange/blue	B13	16	J1513/6
" /16	White/brown/red	B10	$8\frac{3}{4}$	J1507/1
" /18	White/red/blue	B29	$8\frac{3}{4}$	TB1501/4
" /18	White/red/blue	B10	$9\frac{1}{4}$	J1507/2

TABLE 2 contd.

J1509/20	White/green/blue	B10	$8\frac{1}{2}$	J1507/4
" /21	White/red/green	B8	13	J1501/3
" /22	White/black/green	B7	$19\frac{3}{4}$	J1504/3
" /22	White/black/green	B19	$19\frac{3}{8}$	J1403/1
" /24	White/orange/green	B6	20	J1508/9
" /25	White	Free	$3\frac{7}{8}$	Earth
J1503/1	White/red/green	B4	-	L1507/ C1507
" /2	White/black/orange	B4	$4\frac{3}{4}$	J1502/5
" /3	White	Free	$2\frac{7}{8}$	Earth
" /4	White/black	B7	-	J1504/13
" /5	White/red	B7	$10\frac{1}{2}$	" /10
" /6	White/blue	B7	-	" /8
" /7	White/black/blue	B19	$40\frac{3}{8}$	R1401/1
" /9	White/brown/blue	B4	$5\frac{1}{4}$	J1502/15
" /9	White/brown/blue	B8	$17\frac{1}{4}$	J1501/6
" /10	White/red/green	Free	$4\frac{7}{8}$	C1501
" /11	White/black/blue	B27	10	Z1501/3
" /12	White/orange/green	B6	$10\frac{3}{4}$	J1508/12
" /13	White/black/red	B22	$6\frac{7}{8}$	TP3
" /14	White/black/green	B7	$11\frac{1}{2}$	J1504/15
J1502/13	White/red/green	B4	$4\frac{7}{8}$	L1501
" /1	White	Free	$4\frac{7}{8}$	Earth
" /3	White/black/red	B22	$9\frac{1}{8}$	TP3
" /5	White/black/orange	B23	$7\frac{3}{8}$	TP2
" /7	White/red/orange	B27	$8\frac{7}{8}$	Z1501/1
" /9	White/red/blue	B8	$16\frac{1}{2}$	J1501/12
" /13	White/red/green	B8	$17\frac{1}{4}$	" /3
J1505/1	White/red/orange	B28	$5\frac{1}{8}$	Z1501/6
" /3	White/black	B28	$5\frac{1}{8}$	" /7
" /8	White	Free	$5\frac{1}{8}$	Earth

TABLE 2 contd.

J1505/10	White/black/blue	B28	$5\frac{1}{8}$
" /11	White/black/orange	B28	$5\frac{1}{8}$
" /12	White/black/green	B28	$5\frac{1}{8}$
J1508/2	White/brown/green	B19	$34\frac{3}{8}$
" /3	Green	B32	24
" /6	White/green/blue	B7	$3\frac{1}{4}$
" /10	White/black/green	B25	$11\frac{7}{8}$
" /11	White/black/red	B22	$10\frac{7}{8}$
" /12	White/orange/green	B30	$22\frac{3}{8}$
" /13	White/black/orange	B24	55/8
" /14	White	Free	55/8
" /15	White/black/blue	B26	$5\frac{7}{8}$
" /15	White/black/blue	B7	$3\frac{3}{4}$
J1504/2	White/black	B12	$23\frac{3}{4}$
" /4	White/brown	B29	-
" /6	White/orange	B17	$32\frac{3}{8}$
" /7	White/brown/green	B32	$24\frac{3}{8}$
" /11	White	Free	$3\frac{3}{8}$
" /12	White/red/orange	B11	20
" /12	White/red/orange	B27	$8\frac{1}{2}$
" /14	White/black/orange	B24	35/8
" /15	White/black/green	B12	$23\frac{3}{4}$
J1501/1	White/brown/blue	B17	$23\frac{7}{8}$
" /9	White/black/red	B12	$17\frac{1}{4}$
" /11	White/black/orange	B9	$9\frac{1}{4}$
" /12	White/red/blue	B9	$9\frac{1}{4}$
" /13	White	Free	$4\frac{7}{8}$
J1506/1	White/brown	B10	-
" /3	White/black/red	B12	$13\frac{1}{4}$
" /4	White/black/orange	B12	$13\frac{1}{4}$
" /5	White/black/blue	B12	$13\frac{1}{4}$
" /6	White/red/blue	B29	$8\frac{7}{8}$

TABLE 2 contd.

J1506/8	White	Free	$4\frac{7}{8}$	Earth
J1507/3	White/brown/blue	B29	$7\frac{7}{8}$	TB1501/5
" /5	White/orange/blue	B11	$10\frac{3}{4}$	TP5
" /6	White/orange	B29	-	TB1501/3
" /8	White	Free	$3\frac{7}{8}$	Earth
" /10	White/black/green	B12	12	J1511/16
" /10	White/black/green	B12	12	" /16
" /11	White/black/orange	B12	12	" /15
" /13	White/black/blue	B12	12	" /8
J1510/4	White/brown/orange	B12	$9\frac{1}{4}$	" /2
" /5	White/brown/green	B12	$9\frac{1}{4}$	" /4
" /6	White/brown/blue	B12	$9\frac{1}{4}$	" /6
" /15	White	Free	$3\frac{7}{8}$	Earth
" /9	White/orange/green	B30	75/8	TP6
J1511/1	Black/red/orange	B18	$16\frac{7}{8}$	E1501/B1
" /2	Brown/red/orange	B14	$11\frac{7}{8}$	" /1
" /3	Black/red/green	B18	$10\frac{7}{8}$	" /C1
" /5	Black/red/blue	B18	$10\frac{7}{8}$	" /D1
" /7	White/black	B13	$15\frac{3}{4}$	J1513/4
" /7	White/black	B17	$27\frac{7}{8}$	Z1401/P
" /7	White/black	B13	$15\frac{3}{4}$	J1513/5
" /8	White/black/blue	B26	255/8	TP4
" /9	White/black/red	B17	$27\frac{3}{8}$	Z1401/H
" /10	White/green	B20	$24\frac{7}{8}$	TB1401/1
" /11	White/brown	B19	$16\frac{3}{8}$	J1404/1
" /13	White/brown/red	B18	$10\frac{3}{8}$	E1501/S1
" /14	White/black/red	B22	$31\frac{3}{8}$	TP3
" /14	White/black/red	B22	$31\frac{3}{8}$	TP3
" /15	White/black/orange	B23	$30\frac{3}{8}$	TP2
" /15	White/black/orange	B24	$25\frac{3}{8}$	C1508

TABLE 2 contd.

J1511/16	White/black/green	B25	$28\frac{7}{8}$
" /17	White/black	B21	$18\frac{3}{8}$
" /17	White/black	B12	6
" /19	White/black/blue	B27	27
" /20	White	Free	$3\frac{7}{8}$
J1512/1	White/brown/red	B16	$21\frac{7}{8}$
" /2	White/brown/orange	B16	$22\frac{7}{8}$
" /3	White/brown/green	B17	$37\frac{7}{8}$
" /4	White/brown/blue	B17	$37\frac{7}{8}$
" /5	White/red/orange	B17	$37\frac{3}{8}$
" /6	White/red/green	B16	$22\frac{3}{8}$
" /7	White/red/blue	B16	$23\frac{7}{8}$
" /8	White/orange/green	B16	$23\frac{7}{8}$
" /9	White/orange/blue	B16	$21\frac{7}{8}$
" /10	White/green/blue	B16	$22\frac{3}{8}$
" /11	Black/red/orange	B16	$22\frac{3}{8}$
" /12	Black/red/green	B16	$22\frac{3}{8}$
" /13	Black/red/blue	B16	$23\frac{7}{8}$
" /14	Red/orange/blue	B16	$24\frac{3}{8}$
" /15	Red/green/blue	B16	$21\frac{7}{8}$
J1513/1	Brown/red/green	B16	$22\frac{7}{8}$
" /2	Brown/red/blue	B16	$23\frac{3}{8}$
" /3	Red/orange/green	B16	$25\frac{7}{8}$
" /7	White	Free	$4\frac{7}{8}$
" /8	White	Free	$4\frac{7}{8}$
" /9	Brown/red/orange (blue marker)	B16	$22\frac{7}{8}$
S1501/2	Brown/red/orange (green marker)	B16	$21\frac{1}{4}$
E1501/D	Black/red/blue	B17	16
" /B	Black/red/orange	B17	$15\frac{1}{2}$
" /C	Black/red/green	B17	$15\frac{1}{4}$

TABLE 2 contd.

Z1401/P	White/brown/blue	B19	$35\frac{1}{4}$	J1405
" /N	White/black	B19	$38\frac{1}{2}$	J1406
" /E	White/brown	B20	$13\frac{1}{2}$	TB1401/2
" /K	White/brown/red	B32	$25\frac{1}{4}$	R1505/2
" /C	White/black/blue	B21	9	R1401/1
" /S	Black)Screened	B31	-	J1507/15
" /R	Red)twin lead	B21	-	J1404/3
J1404/3	Red	B31	-	J1507/7
Z1401/E	White/brown	B21	$8\frac{1}{4}$	J1404/1
" /J	White/black/green	B21	10	J1403
TP2	White/black/orange	B27	$9\frac{1}{2}$	Z1501/4
TP1	White/black/green	B27	$11\frac{1}{8}$	" /5
TP4	White/black/blue	B27	16	" /3
TB1501/1	White/blue	B33	-	TB1401/3
FILTER PLATE CABLE				
E1401/A	Brown/red/orange	B43	$7\frac{3}{4}$	Z1401/A
" /B	White	B42	7	C1478 clamp
" /C	Black/red/orange	B44	$8\frac{1}{4}$	C1478
C1478	Brown/red/orange	B44	$5\frac{1}{2}$	Z1401/A
FILTER (Z1401) INPUT CABLE				
J1401/A	White/black		$3\frac{3}{4}$	Z1401/A
" /B	White		$3\frac{3}{4}$	" /B
" /C	White/black/blue		$4\frac{1}{2}$	" /C
" /D	White/black/orange		$4\frac{1}{2}$	" /D
" /E	White/brown		$4\frac{3}{4}$	" /E
" /F	White/orange		$5\frac{1}{8}$	" /F
" /H	White/black/red		$5\frac{3}{8}$	" /H
" /J	White/black/green		6	" /J
" /K	White/brown/green		$6\frac{3}{8}$	" /K
" /L	White/red		$6\frac{3}{4}$	" /L

TABLE 2 contd.

J1401/M	White/brown/orange	$6\frac{1}{2}$
" /N	White/brown/blue	$7\frac{1}{8}$
" /P	White/black/orange	$4\frac{1}{4}$
" /R	Red	-
" /S	Black	-
" /T	White/blue	$5\frac{3}{8}$
" /U	White/brown/green	$5\frac{3}{4}$
" /V	White/brown/blue	$6\frac{1}{8}$
" /W	White/red/orange	$6\frac{3}{8}$
" /X	Brown/red/orange	$6\frac{3}{8}$
" /Y	Brown/red/green	$6\frac{7}{8}$
" /Z	Brown/red/blue	$7\frac{1}{4}$
" /a	White/orange/blue	$4\frac{1}{4}$
" /b	White/green/blue	$4\frac{7}{8}$
" /c	Black/red/orange	$5\frac{1}{4}$
" /d	Black/red/green	$5\frac{1}{4}$
" /e	Black/red/blue	$5\frac{1}{2}$
" /f	Brown/red/green	6
" /g	Brown/red/blue	$6\frac{3}{4}$
" /h	Red/orange/green	$6\frac{7}{8}$
" /i	Red/orange/blue	$7\frac{1}{8}$
" /j	Red/green/blue	$4\frac{1}{2}$
" /k	White/brown/red	$4\frac{7}{8}$
" /m	White/brown/orange	$5\frac{1}{8}$
" /n	White/red/green	$5\frac{1}{2}$
" /p	White/red/blue	$5\frac{7}{8}$
" /q	White/orange/green	6
" /r	Brown/red/orange	$6\frac{1}{2}$

Fuses

13. Access to the four fuses (F1501, F1502, F1503, F1504) is gained by removing three screws securing the fuse box cover. All fuses are of the cartridge type and, therefore, easily removable for changing. Three of the four fuses are for use in the transmitter-receiver Type TR4/ARC52 only, whilst the fourth is common to both the TR4/ARC52 and TR5/ARC52 equipments. Care should be taken to ensure that the fuse contacts are undamaged, clean and making good clip-contact with the metal ferrules of the fuses. Fuses should be removed for a serviceability test which may be made using either the multimeter Type 1 or a simple lamp and battery test gear.

14. Full details of fuse replacements are given in Table 3. Spare fuses are positioned adjacent to the fuse box, one of each value being provided. It is important to ensure that a full complement of spare fuses is provided before returning the unit into service.

TABLE 3

Fuse details

Fuse	Rating	Circuit
F1501	2A	115V 400 c/s phase 1 a.c. input
F1502	2A	- do - 2 a.c. input
F1503	2A	- do - 3 a.c. input
F1504	0.5A	425V h.t. supply

Cooling arrangements

15. The TR4/ARC52 (a.c. operation) is cooled by two air blowers; one fitted externally, the other internally. The external air blower (B1401) is secured to the front panel of the transmitter-receiver by four Phillips screws. The blower unit is a Plannair type (4140-99-943-2427) and will operate from a three-phase supply of between 380 c/s and 1000 c/s at 115V. With this input it rotates at 9000 rev/min providing 1/50 h.p. The power is supplied to this motor via the connector plug E1401. An impeller is fitted at each end of the motor and these force air into the square section ducts on the front panel which communicate with similar ducts on the cover assembly when this is in place.

16. The internal blower of the TR4/ARC52 is retained in position on the chassis assembly by four Phillips screws fitted with nuts and lockwashers. The screws are accessible from the underside of the chassis and no difficulty should be experienced in removing this blower. The unit is an axial flow type and operates from a single phase supply of 115V at 400 c/s.

17. The TR5/ARC52 (d.c. operation) has only one blower and this is fitted externally in a similar way to the external blower of the TR4/ARC52 (para. 15). The motor employed in this case is also a Plannair type (4140-99-943-2428) and develops 1/50 h.p. at 10 000 rev/min. It operates from a nominal 27.5V d.c. supply.

18. The dynamotor of the TR5/ARC52 is fitted at each end with an air impeller and these provide similar cooling facilities to the internal air blower of the TR4/ARC52 (para. 16).

19. The blower motors should be serviced in a similar way to all small motors of this type. Units requiring extensive servicing should be returned to the manufacturer for repair.

Thermostatic switch

20. The a.c. supply to the two blower motors of the TR4/ARC52, and the d.c. supply to the external blower motor of the TR5/ARC52 is controlled by a thermostatic switch (S1501). This switch is situated to the front of the gear plate assembly, and its purpose is to delay the switching-on of the blowers until the operating temperature of the equipment has been reached, this permits the transmitter-receiver to warm up more rapidly.

21. The thermostatic switch should, for ambient temperatures, remain open. In order to test its operation, it is necessary to apply black heat to the cover of the switch and note that it closes when warmed to about 40° C. The heat from a soldering iron should be sufficient to make the switch close, do not play a naked flame or glowing element on the switch.

22. The switch is hermetically sealed so that adjustment is not possible. A faulty switch must be renewed.

Link board

23. Sidetone facilities for obtaining intercom. from the modulator or aerial are provided through a link board (TB1501). This link board is attached to the underside of the chassis adjacent to the thermostatic switch, and six positions or terminals are provided with wire links soldered between appropriate points. Should this board be removed for any purpose, care must be taken on reassembly to ensure that the linking remains unaltered unless a change of facility is to be brought about.

Filter unit

24. The power supplies filter (Z1501) for the spectrum generator unit (amplifier-oscillator) is mounted towards the back on the underside of the chassis. It contains five separate choke-capacitor circuits through which pass all the power inputs to the spectrum generator. This filter unit is supplied as a sealed assembly; no individual servicing is possible or desirable. The unit must be changed complete in the event of possible failure.

Gear plate

25. This assembly comprises a cast-alloy plate complete with all driving and idler gear wheels and Oldham couplers. The complete assembly is located by means of two dowels and secured to the underside of the chassis by nine Phillips-type screws fitted with star locking washers. Component layouts of the gear plate are given in Vol. 1, Part 2, Chap. 4, fig. 1 and 2.

26. The driving gears of this assembly are manufactured from stainless steel, and mesh with brass idlers. Driving gears are adjustable on their shafts in order to obtain correct alignment of the Oldham couplers; the idler gears are mounted on shafts which, because of a small calculated disparity in diameter with the screw fixing holes, permit slight adjustment of position in order to reduce backlash throughout the gear trains to a minimum. The small amount of backlash remaining after adjustment is relatively unimportant, since the gear trains rotate always in the same direction.

27. Individual components may be changed should any of the driving or idler gears become damaged. Care must be taken with the re-alignment of the Oldham coupler, however, and with the elimination of backlash consistent with smooth operation throughout the gear train. Where damage is encountered through jamming of gear wheels or by the shearing of gear teeth, it is highly probable that other gears or shafts have been over stressed; it is recommended in such events that the gear plate assembly be changed complete.

28. Complete gear plate assemblies (5821-99-943-7805) are available, and these are aligned and set correctly (with the exception of the amplifier r.f. coupler - (para. 33)) to provide smooth operation without further attention before installation.

29. When changing individual gears, or if the original gear plate alignment is lost, the assembly may be reset by the use of special equipment supplied for this operation. This equipment comprises a setting jig which clamps the assembled gear plate securely in a vertical position whilst allowing access to the back of the plate for adjustments to the gear wheels. A dial test indicator is then used to align the flats on the dogs of the Oldham couplers. Reference should be made to Sect. 1 of this Part, which contains an illustration showing the special-to-type equipment in use. No alignment should be made to the coupler for the r.f. power amplifier at this stage since this operation requires individual attention, including special adjustment with jigs and fixtures having means for eliminating backlash and providing a torque test.

30. With the gear plate assembly clamped in position on the fixture (5821-99-943-6854) the whole is placed on a surface plate and a dial test indicator attached to a height gauge preparatory to alignment of the couplers, as follows:-

(1) Loosen off the clamping screw at the boss of each driving gear wheel sufficiently to enable the coupler to be rotated without operating the gear train.

(2) Align the flats of the couplers for the tuning unit (mechanical) output. These should be horizontal within ± 0.0015 in. Then securely clamp the couplers using the clamps provided at the rear of the fixture.

(3) Rotate the flats of the dogs on all couplers to the horizontal position. Then, working through each gear train in turn, ensure that the dogs of each coupler are truly aligned horizontally to within ± 0.0015 in. measured at the extreme ends of the dogs.

(4) Insert the backlash bias tool (10AG/974) into the drive gear of each gear train and, after the elimination of backlash, tighten the clamping screws on each gear boss. Reaffirm the alignment as in (3) to ascertain that the couplers have not shifted during the tightening of the clamps.

(5) The couplers should now be aligned to the position which is appropriate to the 220.0 Mc/s setting required for sub-unit insertion into the chassis. At this stage, a torque test at 25 lb. in. should be made at the couplers to verify that the clamps have been sufficiently tightened.

(6) Lubricate all gear shafts with two drops of lubricating oil (9150-99-932-4820) and apply a very thin film of grease to the adjustable gear posts and gear teeth. Avoid overlubrication. The gear plate assembly is now ready for fitting into the main chassis.

31. The coupler for the amplifier, radio frequency (RF power amplifier) is not aligned to the 220.0 Mc/s reference position, even on renewal assemblies issued as spares. Alignment of this coupler is made using a gear plate checking gauge (10AG/942) in conjunction with a checking gauge (10AG/939) and pre-load tool (10AG/941) in the following manner:-

(1) Fit a tuning unit (mechanical) which has previously been indexed to the 220.0 Mc/s position into the chassis.

(2) Assemble the gauge 10AG/939 on the top of gauge 10AG/942 and securely fit them into the r.f. amplifier position on the main chassis, ensuring that the Oldham couplers are correctly mated.

(3) Slacken the clamping screw on the r.f. amplifier gear boss just sufficiently to allow the coupler to rotate freely. Then rotate the large knurled knob of the checking gauge, in a clockwise direction.

(4) Fit the pre-load tool 10AG/941 into the gear hub (r.f. amplifier) so that the gear train is biased against the direction of rotation; the torque applied by the pre-load tool should be 21 oz in.

(5) Now adjust the coupler until the vernier head of the checking gauge reads 0 deg.; this will align the coupler to the 220.0 Mc/s position. Before attempting to revolve the gear train ensure that the worm drive of the checking gauge is released.

(6) Tighten the clamping screw of the gear hub and torque-test the coupler to a turning force of 25 lb in. to ensure that the clamp has been tightened sufficiently.

(7) Verify the correct alignment of this component by applying the positive pole of a 275 V d.c. supply to J1401/P, and the negative pole to J1401/B. Depress the relays K1202 and K1203 on the tuning unit (mechanical) and allow the gear train to complete one revolution. Ascertain that the tuning unit has returned to the 220.0 Mc/s position by reading the clutch scales. If the coupler has been correctly aligned the vernier head of the checking gauge should read 0 deg.

Front cover

32. The front cover houses the supplies filter unit (Z1401) and the transmitter-receiver relay (K1401). On the front of the cover is carried the external air blower (para. 15 and 17) and the supplies connection and aerial plug.

33. If the front panel assembly has been removed from the chassis plate, then upon reassembling, the 90° angle that is made between the front panel assembly and the chassis plate should be verified with an acceptance gauge (10AG/934) and plug gauge (10AG/933) as follows:-

(1) Assemble the front panel assembly to the main chassis plate but leaving the securing screws slack.

(2) Secure the equipment into the acceptance gauge and insert the plug gauge between the top inner face of the front assembly and the top outer face of the acceptance gauge.

(3) Tighten the securing screws until the gap between the faces mentioned in sub-para. (2) is within the GO and NO GO limits of the plug gauge.

34. The filter (Z1401) comprises a sealed, fabricated panel containing an assembly of 37 filter units which are interposed between the input leads to the transmitter-receiver and other sections of the circuits. Each filter comprises a small r.f. choke in conjunction with feed-through capacitors and little trouble is normally met with in service. In addition, the filter unit incorporates three externally-mounted capacitors (C1477, C1478, C1479). Should any failure be attributed to the filter unit, a single continuity test will confirm any fault. Each pole of the supplies plug and each filter can be readily found by reference to coding letters engraved adjacent to each pole on both the plug and the filter chassis.

35. Failure of any component necessitates the removal of the complete filter unit, as follows:-

(1) Slacken the four chassis fixing screws and remove the two screws which secure the side flanges to the chassis.

(2) Remove the D handle on the front panel.

(3) Release the unions of the 42-way connector (J1401).

(4) Unfasten the filter unit retaining screws and withdraw the unit and connector from the equipment.

36. The method of assembly for the filter unit is in reverse order to that given in para. 37 for removal. After assembly, a leak test should be made of the complete equipment; details of the method and equipment required are given in Chap. 17 of this Section.

37. Points of possible gas leakage are limited normally to the plug unions at the entry apertures. Careful tightening of the unions may eliminate small troubles, but persistent leakage suggests that another plug be tried with careful attention paid to the sealing washers during assembly into the cover.

Component panel

38. A component panel is located at the rear of the front panel assembly adjacent to the filter unit. This panel is let into a cut-out in the right-hand side bracket, and is secured at the top to the side bracket by a countersunk-head screw fitted with a stand-off sleeve and locknut. The panel comprises test jacks and sockets as follows:- microphone socket (J1404), head-phone socket (J1403), main receiver sensitivity control (R1401), guard receiver sensitivity control (R1402), and the test points A and M (J1405 and J1406).

Electrical testing

Component tests - passive

39. R.F. chokes should be tested for resistance values as follows:-

(1) L1501 - between pole 10 of multipole socket J1503 and pole 21 of multipole socket J1509 to be between 2.5 ohms and 5.5. ohms.

(2) L1507 - between pole 1 of multipole socket J1503 and pole 8 of multipole socket J1510 to be between 2.5 ohms and 5.5 ohms.

40. Fixed resistors should be tested for resistance values as shown:-

(1) R1501 - between poles 10 and 15 of multipole socket J1508 to be between 59 ohms and 77 ohms.

(2) R1502 - between poles 11 and 14 of multipole socket J1508 to be between 41 ohms and 53 ohms.

(3) R1506 - between terminal 3 of terminal board TB1501 and pole 6 of multipole socket J1507 to be 470K ohms ± 70K ohms.

(4) R1509 - between pole 5 of multipole socket J1507 and pole 9 of the multipole socket J1510 to be 4.7K ohms ± 600 ohms.

41. Variable resistors should be tested for resistance values as follows:-

(1) MAIN SENS. (R1401). The resistance included in the circuit by the variable resistor R1401 is to be measured between pole 7 of the multipole socket J1503 and the frame at two settings; first, fully clockwise - the resistance should not be greater than 26 ohms and second, fully counter-clockwise - when the resistance should be 5K ohms ± 1200 ohms.

(2) GUARD SENS. (R1402, R1404). The resistance included in the circuit by the variable resistor R1402 in series with the fixed resistor R1404 is to be measured between pole 2 of the multipole socket J1508 and the frame at two positions; first, fully clockwise - the resistance is to be 8.2K ohms ± 1K ohms, and second, fully counter-clockwise - when the resistance is to be 33.2K ohms ± 6.6K ohms.

(3) AUX. AUDIO (R1504, R1505). The resistance is measured at two positions; first, fully clockwise - the resistance between pole K of the multipole plug J1401 and pole 7 of the multipole socket J1504 must be not greater than 30 ohms and the resistance between pole K and the frame is to be 6K ohms ± 1300 ohms, second, fully counter-clockwise - when the resistance between pole K of plug J1401 and the frame is to be 1010 ohms ± 140 ohms.

(4) GUARD SQUELCH (R1507, R1508). The resistance is measured at two positions; first, fully clockwise - the resistance between poles 3 and 14 of the socket J1508 is to be 2.8 megohms ± 800K ohms, second, fully counter-clockwise - when the resistance between poles 3 and 14 of socket J1508 is now to be 220K ohms ± 30K ohms.

42. The thermal switch (S1501) should, for ambient temperatures, remain open; upon the application of black heat from a heated soldering iron to the cover, the switch should close, (para. 21).

43. Aerial relay and sidetone circuit resistances should be verified as follows:-

(1) Relay coil (K1401). The resistance in circuit between poles 10 and 11 of the multipole socket J1502 should be between 220 ohms and 340 ohms.

(2) Sidetone circuit. The ohmmeter should next be connected between terminal 1 of the terminal board TB1501 and the frame, then:-

(a) With the negative pole of the ohmmeter operating potential connected to terminal 1, the resistance should be 15K ohms ± 2K ohms.

(b) With the positive pole connected to terminal 1, the resistance should be not greater than 1K ohms (L1401 and CR1401).

44. The motor resistance, measured between terminal A' of the filter Z1401) and the frame, should be as follows:-

(1) TR4/ARC52 equipment - 30 ohms to 50 ohms.

(2) TR5/ARC52 equipment - 5 ohms to 15 ohms.

Functional tests

Primary power source

45. The undermentioned primary power source, a.c. and d.c., should be available from station resources:-

(1) A.C. - 3-phase 380 c/s to 420 c/s, 115V nominal, line to neutral supply; the power to be delivered through a suitable isolating switch and fuses.

(2) D.C. - to be capable of maintaining an on-load terminal voltage of 28V nominal when delivering one ampere. It must be supplied via a suitable isolating switch and fuse.

46. The sources of power, a.c. and/or d.c., should be connected to the main chassis of the equipment in the following manner:-

(1) A.C. source - (TR4/ARC52) - one phase to be connected to terminal A' of the distribution panel of the filter Z1401 and neutral to the chassis via pole B of the multipole plug J1401. This source is not required for TR5/ARC52 equipments.

(2) D.C. source - for TR4/ARC52 equipments, the positive side is to be connected to pole E of the multipole plug J1401 and the negative to pole 10 of the socket J1502 or J1509 or J1511. For TR5/ARC52 equipments the positive pole is to be connected to pole E of plug J1401 and terminal A' of the distribution panel of filter Z1401. The negative pole is to be connected to the chassis and pole 10 of the socket J1502 or J1509 or J1511.

Relay operation

47. With the relay in the de-energized condition, continuity should be obtained between J1402 and P1401. This condition should be reversed when d.c. is applied to the coil of the relay.

Blower motor operation

48.
(1) TR4/ARC52 equipment - with the a.c. power applied, both the external blower (B1401) and the internal, axial flow blower (B1501) should operate.

(2) TR5/ARC52 equipment - with the d.c. power applied, the external blower should operate. The internal blower is not fitted to this equipment.

Assembly of sub-units

49. The fourteen sub-units served by multipole connector sockets are provided with dowels which have the function of correctly aligning each sub-unit into the correct position before engagement of the pins of the multipole plugs. In addition, the upper part of each socket is mounted through integral bushes which permits a float of approximately 1/32 in. These measures ensure positive connection and lessen the possibility of damage caused by forceful fitting.

50. A number of the sub-units are mechanically-coupled to the gear plate assembly, mounted on the underside of the chassis. It is essential before fitting these units into the chassis to register the couplers at the 220.0 Mc/s setting in order to ensure correct alignment and subsequent operation. In the event that the precaution of selecting the 220.0 Mc/s frequency channel has not been made, the mechanical tuning unit must be removed from the chassis before the couplers can be reset by hand to the correct positions, as indicated in Vol. 1, Part 2, Chap. 5, fig. 2. When all the mechanically driven sub-units are to be replaced on the chassis, it is advisable to fit the mechanical tuning unit first.

51. The sub-units should then be examined for damage, particular attention being paid to the connector pins and flanges. Flexible leads, where fitted, should be fed carefully through the respective apertures in the chassis and attention given to the avoidance of sharp bends, kinks and twisting of the cableforms. With the sub-unit locating dowels carefully engaged, the fixing screws may be partly tightened. Care is needed at this stage, since, if the Oldham couplers are not exactly aligned, excessive pressure may cause damage. Precise alignment of the couplers can be made with the aid of a screwdriver, the blade being passed through the hollow shaft of the gear plate coupler in contact with the shaft of the sub-unit. The shafts and couplers are then rocked slightly until complete engagement is achieved. When fitting the tuning unit (mechanical) it is essential to rock the gears of the gear plate assembly since the gear plate couplers for this unit are not provided with hollow shafts and the coupler shafts of this unit are locked by the indent wheels.

52. Attached to the sides of the main chassis assembly, along the entire length, are two specially-shaped brackets of hardened aluminium containing grooves for the location of runner bars within the cover assembly. These must be undamaged and a good sliding fit when assembled. All old grease or dirt should be cleaned off and the runner brackets lightly lubricated with a thin film of grease before finally assembling into the cover.

53. When refitting the main chassis assembly into the cover, it is important to ensure that a serviceable aluminium-rubber gasket is inserted between the mating faces of the chassis front cover and the main cover. It is advisable to discard the old gasket removed at each servicing and, as a precaution, to fit a new one. The twelve cover fixing screws should be tightened securely in cylinder-head fashion to provide a completely airtight seal between the cover and front panel (Chap. 17, fig. 1 of this Section).

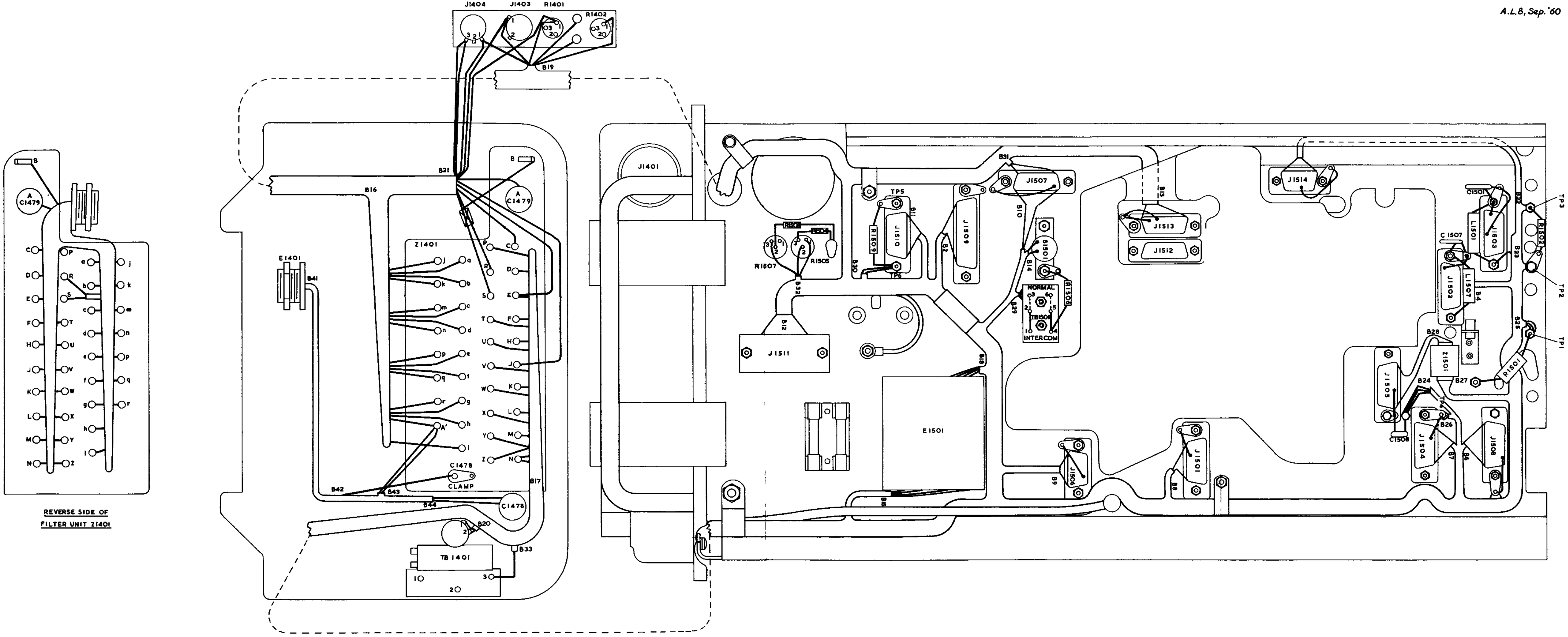

Fig. 1 ARI. 18124/1 and ARI. 18124/2 – chassis assembly (main) – wiring diagram

Chapter 17

COVER (TRANSMITTER-RECEIVER) AND TRAY, MOUNTING, TYPE MT1477/ARC52

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COVER (TRANSMITTER-RECEIVER)

Introduction

1. The cover assembly for the TR4/ARC52 and TR5/ARC52 transmitter-receivers comprises a fabricated aluminium case which, in service, is pressurized with air. Vol. 1, Part 1, Chap. 1, fig. 1 of this Air Publication shows the cover fitted to the transmitter-receiver; an illustration of the cover assembly alone is given in Vol. 1, Part 1, Chap. 5, fig. 2.

2. The construction is designed to provide a cooling air stream over the inner walls of the cover. Air circulation through a duct on the front face is directed by means of transverse corrugations up the sides and across the top surface. Overall dimensions are $18\frac{1}{4}$ in. x $10\frac{1}{8}$ in. x $7\frac{3}{4}$ in. deep.

3. Finish is black lustreless paint on internal surfaces and black crackle enamel externally.

Dismantling

4. The complete unit is retained in the aircraft upon a mounting tray (para. 26). Full details for removal are given in Vol. 1, Part 1, Chap. 5 of this Air Publication.

5. With a standard hexagon key (No. 8 in the tool kit, radio adjustment 5180-99-943-1512) unscrew the twelve socket-head captive screws securing the front panel to the cover. The screws should be released in the order shown in fig. 1. Each screw should be loosened only half a turn at a time until all are only finger tight. The front panel or cover may be distorted if this procedure is not adopted.

6. With the cover fixing screws completely loosened off, stand the transmitter-receiver unit upright on its front panel and lift off the cover. Alternatively, the cover may be removed by laying the assembly on a bench and withdrawing the unit by means of the handle. In this case, assistance is required to provide support and prevent damage during removal.

Cleaning

7. Clean the cover thoroughly inside and out, paying particular attention to the air ducts. Using a portable blower or other approved supply of dry air under pressure, clean all dust from the unit.

8. Ensure that all air ducts are clear and unobstructed.

Inspection

9. Examine the cover carefully for dents or other mechanical damage, which may cause fouling of the chassis or give rise to air leaks. Particular attention should be given to welded seams and corners.

10. Inspect for evidence of corrosion. Any damaged paint must be repaired at once.

11. Examine the joint face at the front of the cover for damage which may spoil the essential air seal within this unit. The face should be undistorted and any scores or burrs carefully filed flat and level. Cover screws fit into wire-thread inserts in the joint face and to ensure an air-tight seal on reassembly the inserts must be undamaged. Replacement thread inserts must be carefully fitted with the coils 1/16 in. ± 1/32 in. below the surface of the flange.

12. The flange at the rear of the cover carrying the locating dowel holes should be undamaged.

13. Ensure that the internal runner bars are true and undamaged. The chassis assembly should move freely on the runner bars.

14. To preserve an airtight joint between the cover assembly and the front panel of the chassis, a gasket of aluminium and beaded rubber (A.B.C.S. Cat. No. 5330-99-942-9472) is fitted on assembly. Careful examination should be made to ensure the efficiency of this gasket, Any evidence of perishing or splitting entails renewal.

Reassembly

15. Stand the transmitter-receiver unit upright upon its front panel.

16. Carefully place a serviceable aluminium-rubber gasket into position on the mating face of the front panel. Four small pins engage in holes in the gasket to prevent misalignment.

17. Lower the cover into position over the chassis and engage several of the screws, finger tight.

18. With the assembly placed on the bench the securing screws can be tightened. Tighten each screw a little at a time, in the order shown in fig. 1, until all are tight.

Pressure testing

19. With the unit completely assembled and the front panel screws correctly tightened, pressure testing and leak location tests should be conducted. A general description of these tests and the test equipment are given in A.P.2563BZ, Vol. 1.

20. The test equipment required will comprise Service stores held items, as follows:-

(1) Leak locator CT105

(2) Leak indicator kit CT106

(3) Capsules, Arcton

(4) Pump pressurizing, Kismet

21. The equipment to be tested must first be charged to a pressure of 15 p.s.i. with a gas containing halogen compound vapour, the most suitable being Arcton 6 since it is non-corrosive, non-inflammable and non-explosive - all properties essential for gases used with the leak locator CT105.

22. When the leak locator has warmed up (ten minutes should be allowed), the search probe should be moved over the points where leakage is likely to occur. Within one second of passing over a leak the buzzer will sound and continue to sound whilst the probe is held close to the leak. The buzzer sound does not vary with the halogen content, thus no indication of the magnitude of the leak is given.

Note...

Since carbon-tetrachloride and trichlorethylene (both of which may be used for cleaning purposes) are effective halogen compounds, the leak locator must never be used near cleaning bays or where these chemicals may be present. Prolonged exposure to these vapours may cause the sensitive element to become permanently de-sensitized.

23. Probable sources of leakage following reassembly of the cover to the equipment are as follows:-

(1) Around the plug P1401 - which must be changed completely if any leakage is found.

(2) Mating faces between the front panel and the main casing.

(3) Aerial relay lead J1402.

24. Following leak detection tests, the casing must be cleared of all vapour and flushed with warm dry air. The flushing bung on the front cover should be removed during this process and replaced immediately afterwards.

25. Finally, the casing must be pressurized, using the Schrader valve connection on the front cover, with dry air to a pressure of 5 p.s.i. before putting the transmitter-receiver into service.

Introduction

26. The tray, mounting, Type MT1477/ARC52, shown in fig. 1, is a resiliently mounted carrier for the transmitter-receiver unit.

27. The tray is of riveted construction and carried on four resilient mounts each secured to the tray by one bolt. Attachment to the airframe is by four bolts through each resilient mount. Silver-plated beryllium-copper earthing straps bond the tray to the airframe; one is fitted adjacent to each resilient mount.

28. Two clamping screw assemblies at the front of the tray, pivoted on pins, clamp the transmitter-receiver against two spring-loaded locating dowels at the rear of the tray.

Mechanical examination

29. The tray is mounted on the airframe. Full details for installation and removal are given in Vol. 1, Part 1, Chap. 3 of this Air Publication.

30. Examine the tray thoroughly to ensure that it is clean, free from corrosion and structurally sound.

31. Examine the resilient mounts for deterioration. Renew if necessary. Care must be taken to ensure that when renewing or refitting mounts the specified items are correctly positioned. Front mounts (A.B.C.S. Cat. No. 5340-99-943-2038) have a load range of 10-20 lb and rear mounts (A.B.C.S. Cat. No. 5340-99-943-2039) have a load range of 8-16 lb. The mounts are each secured to the tray by one screw.

32. Examine the spring-loaded dowels at the rear of the tray for damage and broken or weak springs. Renew if necessary. Reference should be made to fig. 2 which gives a dimension to the centre line of the dowel, which must be set on reassembly. As a means of doing this, shims (A.B.C.S. Cat. No. 5821-99-943-1890) may be used. The spring-loaded dowels are each secured by four Phillips recessed head screws.

33. Examine the four earthing straps for damage or corrosion. Renew if necessary. One Phillips recessed head screw, nut and washer are used to secure each strap to the mounting tray.

34. Ensure that the clamping screw assemblies are free from damage or corros on. To dismantle the clamping screw assembly first remove the split pin securing the headed pivot pin. Then, whilst holding the clamping screw assembly with one hand, withdraw the headed pin. Reassemble the new parts in the reverse order.

35. Examine the two brackets to which the clamping screws are secured. Should these be damaged and preventing free operation of the clamping screws it may be necessary to renew either or both of the brackets. Replacement of a bracket will necessitate the removal of the rivets securing the existing bracket and re-riveting the new bracket in place. Any damaged surfaces should be repaired with a suitable varnish.

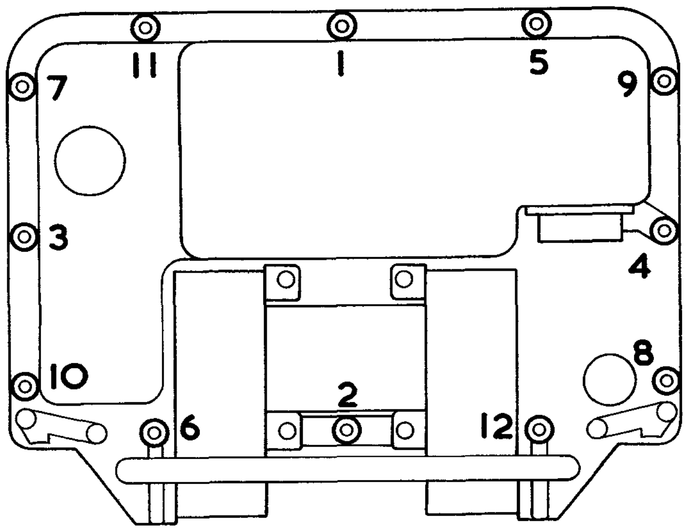

Fig.1. Order of loosening and tightening cover securing nuts

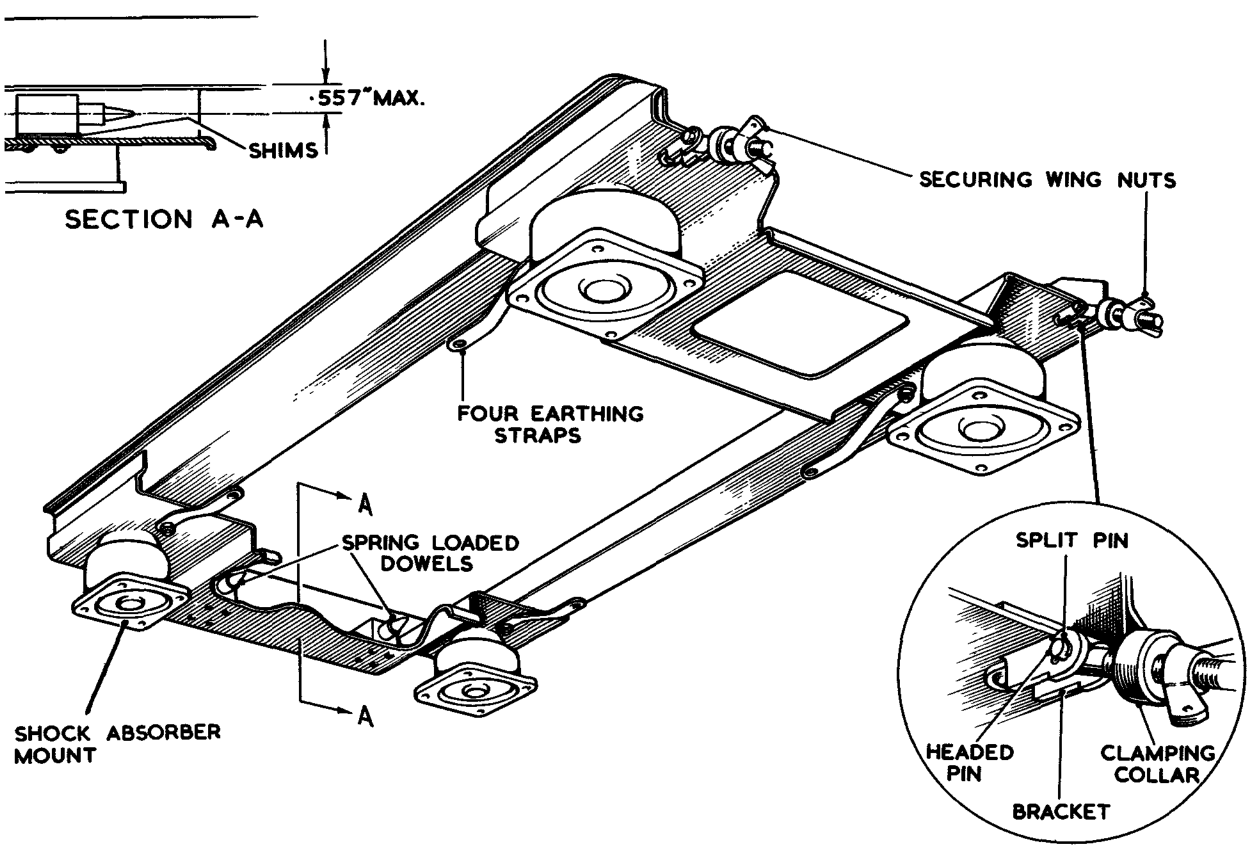

Fig. 2. Mounting tray

Chapter 18

CONTROL UNIT TYPE C1607/ARC52

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Introduction

1. The control unit Type C1607/ARC52 contains all the operational controls for the TR4/ARC52 or TR5/ARC52 transmitter-receiver. It consists essentially of manually operated wafer switches, a memory drum of preset studs and switch contacts with the associated channel selector switch and wiring, a function switch and a volume control.

2. Details of supplies for this sub-unit are given in Vol. 1, Chap. 1 of this Air Publication.

3. The unit is intended for installation near the operator and is secured in position by four Dzus fasteners in the front panel. Details and illustrations showing the construction of this control unit are given in Vol. 1, Part 2, Chap. 5 of this Air Publication to which reference should be made when it is required to dismantle or assemble the unit. Any dismantling or assembly procedures given in subsequent paragraphs will be supplementary only and limited to requirements for repair or renewal of components.

Test equipment

4. The following test equipment will be required to implement the tests described in this chapter:-

(1)	Multimeter Type 1 (or alternative)		(para. 9)
(2)	Test set, control unit	(6625-99-943-6905)	(para. 5)
(3)	Connector, 30 way		(para.33)
(4)	Connector, 3 way		(para.33)
(5)	Feeler gauge 0.002 in.	(Ref. No. 1B/4110)	(para.26)
(6)	Feeler gauge 0.025 in.	(Ref. No. 1B/4110)	(para.26)
(7)	Roll pin application 3/32 in. dia.	(Ref. No. 10AG/970)	(para.29)
(8)	Roll pin applicator 1/16 in. dia.	(Ref. No. 10AG/945)	(para.19)
(9)	Gauge, G.E.C. style, contact tensiometer, 10-80 gm.	(Ref. No. 1H/57)	(para.23)

5. The test set, control unit (6625-99-943-6905) facilitates the testing of the control unit Type C1607/ARC52 to a standard comparable with that of the manufacturer's test specification. Mounted on the front panel of the test unit are eleven indicating lamps, three of which indicate the operation of the function selector switch of the control unit. Seven lamps are used in conjunction with the DENARY selector switch, also mounted on the front panel, these light up to indicate the channel selected. A panel mounted meter and METER switch are incorporated for testing the VOL control of the control unit; when switched to RES position the meter indicates the resistance of the VOL control, when switched to the ATT position the meter is used in conjunction with the dB RANGE switch and indicates the attenuation range. The test set incorporates an internal power supply unit which has a fuse, switch and indicating lamp which are also on the front panel of the test set. Situated at the rear of the test set are two multipole connectors, viz., a 30-way socket for connection with the control unit and a 3-way plug for the a.c. mains supply source.

MECHANICAL EXAMINATION

Component inspection

6. Inspect for correctness the details of equipment serial numbers and modification state entered on the repair card accompanying the unit.

7. Using a portable blower, or other approved supply of air pressure, thoroughly clean all dust from the unit. If necessary, a squirrel-hair brush may be used to assist in this process.

8. Carefully examine the control unit to ensure that it is undamaged, free from corrosion and with all components securely in position. Any loose connections or components must be be refitted. Particular care should be taken during this preliminary visual examination to note that:-

(1) The grub screws on the bevel gears and control knobs are tight.

(2) The gears are free from dirty grease and foreign matter which might prevent rotation.

(3) The contacts on the memory drum contact assembly are not dirty, pitted or burnt due to arcing, or have become out of alignment with their mating contacts.

(4) All switch contacts and rotor points are clean and not burnt due to arcing caused by dirt or excessive wear.

9. The wiring should be carefully inspected for continuity and conformity with the circuit shown at Vol. 1, Part 2, Chap. 5 of this Air Publication. This inspection should consist of point-to-point tests or such electrical tests which will confirm the accuracy of the wiring. The multimeter Type 1 (or alternative) can be used for these tests. Visual examination should be made at the same time for frayed or broken insulation and to ensure that the cableform lacing is intact.

10. The equipment should be examined for neatness of soldering, absence of dry joints and a generally satisfactory condition of the wiring and insulation. No inadvertent interconnections or tracking paths should be permitted due to excess solder, wire clippings or dirty connections.

TABLE 1

Wiring key

From	Wire colour	Length (in.)	To
J1801/A	White/black/red	$6\frac{1}{2}$	S1801/5
" /C	White/black/blue	$5\frac{3}{4}$	S1801/3
" /D	White/black/orange	$5\frac{1}{2}$	S1801/2
" /E	White/black/green	$5\frac{1}{2}$	R1803/IN
" /F	White/red	$5\frac{1}{8}$	R1803/OUT
" /K	White/brown/red	$5\frac{1}{4}$	S1807A/16

From	Wire colour	Length (in.)	To
J1801/L	White/green	$6\frac{7}{8}$	S1801/10
" /M	White/brown/orange	12	S1802/D2
" /N	White	$4\frac{7}{8}$	EARTH TAG
" /P	White/black	$9\frac{1}{4}$	X1 1802
" /R	Brown/red/orange	10	S1802/S2
" /S	White/orange/green	11	S1802/K2
" /T	Black/red/blue	11	S1805A/5
" /U	White/brown/green	$10\frac{3}{4}$	S1804A/1
" /V	White/brown/blue	11	S1804A/2
" /W	White/red/orange	$11\frac{1}{4}$	S1804A/3
" /X	White/red/green	$11\frac{1}{2}$	S1804A/4
" /Z	Wh te/red/blue	$11\frac{3}{4}$	S1804A/5
" /a	White/orange/blue	$11\frac{3}{4}$	S1805A/1
" /b	White/green/blue	10	S1805A/2
" /c	Black/red/orange	$10\frac{1}{4}$	S1805A/3
" /d	Black/red/green	$11\frac{1}{2}$	S1805A/4
" /f	Brown/red/green	9	S1806/A1
" /g	Brown/red/blue	$9\frac{1}{8}$	S1806A/2
" /h	Red/orange/green	$9\frac{3}{4}$	S1806A/3
" /i	Red/orange/blue	$9\frac{3}{4}$	S1806A/4
" /y	Red/green/blue	10	S1806A/5
S1802/A2	Busbar	As required	S1802/C2
" /B2	White/black/red	$16\frac{1}{2}$	S1807A/9
" /B3	Busbar	As required	S1802/D3
" /F1	Busbar	As required	S1802/D3
" /C2	Busbar	As required	S1802/F3
" /D1	White/black/blue	$15\frac{1}{2}$	S1807A/6
" /E2	White/brown/green	$16\frac{1}{8}$	S1804A/1
" /F2	White/brown/blue	16	S1804A/2
" /G2	White/red/orange	$16\frac{1}{8}$	S1804A/3
" /H2	White/red/green	16	S1804A/4

From	Wire colour	Length (in.)	To
S1802/J2	White/red/blue	$16\frac{3}{8}$	S1804A/5
" /J3	White/black/orange	16	S1807B/9
" /K1	White/black/green	$14\frac{3}{8}$	S1807B/6
" /K3	Busbar	As required	S1802/M1
" /L2	White/orange/blue	$13\frac{3}{8}$	S1805A/1
" /M2	White/green/blue	$13\frac{3}{8}$	S1805A/2
" /N2	Black/red/orange	$13\frac{5}{8}$	S1805A/3
" /P2	Black/red/green	$13\frac{3}{8}$	S1805A/4
" /R2	Black/red/blue	$14\frac{1}{4}$	S1805A/5
" /R3	White/red	15	S1807C/9
" /S1	White/brown	$13\frac{1}{2}$	S1807C/6
" /S3	Busbar	As required	S1802/U1
" /T2	Brown/red/green	$11\frac{3}{8}$	S1806A/1
" /U2	Brown/red/blue	$11\frac{1}{2}$	S1806A/2
" /V2	Red/orange/Green	$11\frac{5}{8}$	S1806A/3
" /W2	Red/orange/blue	$11\frac{3}{4}$	S1806A/4
" /X2	Red/green/blue	$12\frac{3}{8}$	S1806A/5
" /X3	White/orange	$14\frac{1}{2}$	S1807D/9
R1803/C	White	$6\frac{3}{4}$	S1807B/19
S1807B/16	Busbar	As required	S1807B/19
" /16	Busbar	As required	S1807B/14
S1807C/14	Busbar	As required	S1807B/14
" /14	Busbar	As required	S1807C/16
" /19	Busbar	As required	S1807C/16
" /19	White	$11\frac{1}{2}$	S1806B/7
" /14	Busbar	As required	S1807D/14
S1807D/16	Busbar	As required	S1807D/14
S1807A/19	Busbar	As required	S1807B/16
S1807A/19	White	$5\frac{3}{8}$	EARTH TAG

From	Wire colour	Length (in.)	To
S1803/3	Busbar	As required	S1804B/1
S1804B/12	Busbar	As required	S1804B/1
" /12	Busbar	As required	S1804A/12
S1803/1	Busbar	As required	S1804B/4
" /2	Brown/red/green	$2\frac{1}{2}$	S1804A/8
S1807B/11	Brown/red/green	$17\frac{5}{8}$	S1804A/8
S1804A/11	Busbar	As required	S1804A/4
S1805A/4	Busbar	As required	S1805A/11
S1805B/12	Busbar	As required	S1805A/12
S1806A/11	Busbar	As required	S1806A/4
S1806A/12	Busbar	As required	S1806B/12
S1806B/7	Busbar	As required	S1805B/7
S1804B/7	Busbar	As required	S1805B/7
S1806A/8	White/brown/green	$15\frac{3}{4}$	S1807D/11
S1805A/8	White/brown/orange	$16\frac{3}{4}$	S1807C/11
S1806B/5	Brown/red/orange	$12\frac{1}{4}$	S1807C/1
S1805B/5	White/orange/green	$12\frac{1}{4}$	S1807B/1
S1804B/5	Red/orange/green	$14\frac{1}{4}$	S1807A/1
S1804B/2	Brown/red/green	As required	S1807A/11
S1801/4	Busbar	As required	R1803/C
X11802	White/black	As required	X11801

SERVICING

General

11. To assist in the servicing of this unit, reference should be made to the component layouts in Vol. 1, Part 2, Chap. 5 of this Air Publication and the wiring diagram (fig. 1) at the end of this chapter. A cableform wiring key is listed in Table 1 which, when used in conjunction with the wiring diagram, will assist should any rewiring become necessary.

WARNING

Before attempting to dismantle the unit ensure that it is not connected to the power supply or other units.

12. In the event of wire renewal becoming necessary, the correct lengths, gauge of wire and colour coding must be used as in the original (unless modification requirements necessitate changes).

13. Trichlorethylene should be used to clean dirty contacts, points or switches. Dirt not removable in this way, or slight burning of the contacts, may be cleaned by the use of flour paper (i.e. a very fine grade of emery paper).

14. If any contact is too badly burnt to be cleaned by these methods, the appropriate switch wafer or contact set must be replaced.

15. Should it be necessary to change any components the instructions given in para. 16 to 32 will be of assistance.

Memory drum

16. Should it become necessary to remove the memory drum, it should be noted that these drums, when fitted with a driving gear, are NOT interchangeable between different units as the gear pinning is carried out on assembly and is not standard.

17. The drum is removed by releasing the two countersunk Phillips-type screws which secure each bearing to the two side plates. The bearings can then be removed and, thus, the memory drum also, (fig. 2).

18. When renewing the drum, collar and gear assembly, fit them together and assemble into the unit by first refitting the bearing remote from the gear, partly tightening the Phillips screws and then fitting the wave washer into place at the gear end (D of fig. 2). Ensure that the number indexed by the channel selector knob is the same as that adjacent to the set of pins on the memory drum, which locate in the indent on the arms of the contact assembly, (A and B of fig. 2). Then fit the gear end bearing into place and tighten the screws at both ends.

19. Tighten the set screw and drill through the gear, collar and shaft using a 1/16 in. drill; then fit the pins using the appropriate roll pin applicator (para. 4, item 8).

NOTE...

It should be ensure that the location of switch S1807 relative to the memory drum conforms to the instructions given in para. 27.

Switch S1802

20. This assembly is not normally serviced other than by the cleaning of dirty contacts. This is carried out as described in para. 12. If during wiring up any contacts are pulled out of alignment with their respective mating contacts, for example, by a wire being drawn too tightly before soldering, this wire should be renewed and the contact element carefully straightened.

21. If any contact arm becomes too badly burnt or pitted or is bent out of alignment, the complete switch contact assembly must be renewed.

22. To remove the assembly, unsolder all connecting wires, remove both Phillips type screws from each side plate securing the assembly and withdraw it from the unit. When renewing an unserviceable item, care must

be taken to ensure that the upper contacts are closed and the lower contacts are open when actuated by a pin on the memory drum. These contacts must then be opened and closed, respectively, when the memory drum pin is moved out of the indentation (A and B of fig. 2).

23. When the contact operating arm is raised by a memory drum stud the pressure between the upper closed contacts should be measured as follows:-

(1) Set the tensiometer (para. 4, item 9) to release at 15 grams.

(2) With the memory drum stud engaged in the indent of the switch segment under test, hook the tensiometer under the free end of the top spring contact. A force of at least 15 grams should exist between the top segments.

(3) To ensure correct alignment of S1802 this test should be made of all the upper closed contacts before the four securing screws are finally tightened.

Switches S1803, S1804, S1805 and S1806

24. If it is necessary to remove any of the shafts of switches S1803/4/5/6, all four channel selecting knobs must be removed by tapping out the spring dowels and releasing the grub screws. The face plate must next be removed by undoing the four instrument head screws. The appropriate numbered disc may now be removed, exposing the switch shaft securing nut.

25. With the wires to the switch wafers unsoldered and the wafers released, the shaft may now be removed.

26. Special action must be taken when repinning the knob as follows:-

(1) Turn the switches to the fully clockwise position when viewed from the front.

(2) Fit the knobs and tighten the grub screw, ensuring that the unit is indexed to 399.9 and that the flats on the knobs are horizontal when the unit is standing normally (horizontally).

(3) With the unit standing normally, index to 300.0 or 366.6. Use items 5 and 6, para. 4 to ensure that a gap of 0.002 in. minimum is allowed between the knobs and the face plate, also ensure that a gap of 0.002 in. minimum to 0.025 in. maximum is allowed between the numbered disc and the front plate, then drill the three right-hand side knobs (those indexed to 0 or 6) with a 1/16 in. drill. Press the spring dowels into place with the roll pin applicator (para. 4, item 8).

(4) Turn the unit on its side (vertically), with the switch S1803 indexed to 3 uppermost. Drill and pin this knob as the others (para. 26 (3)).

Switch S1807

27. Renewal of wafers for switch S1807 is accomplished by first removing the socket plate; the wafers are then readily accessible.

Bevel gear

28. Renewal of a bevel gear on the shaft for switch S1807 can be accomplished only by first removing the shaft. To remove this shaft, it is

necessary to remove the socket plate, release the channel selector knob, function switch knob and the volume control knob.

29. Release the spring which holds the roller in contact with the actuator plate, then release the actuator plate. The switch plate, complete with the wafers of switches S1807 and S1801 and the volume control, can then be removed by releasing the four Phillips-type screws which are fitted through the side plates. On releasing the bevel gear grub screw and extracting the spring rowel the gear is free to move on the shaft. The switch shaft can then be released from the front panel. Line up the 3/32 in. hole in the gear with that in the shaft and replace the spring dowel using item 7, para. 4. The order of reassembly is the reverse of the above instructions but it will be necessary to locate the switch S1807 relative to the memory drum before pinning the shaft bevel gear. The correct condition is obtained when the memory drum and channel selector knob are set to M and S1807 is positioned as shown in C of fig. 2. The manual position of S1807 may be verified electrically as follows:-

S1807A	J1801/K	connected to S1804B (front rotor)
S1807B	EARTH	connected to S1804A (front rotor)
S1807C	EARTH	connected to S1805A (front rotor)
S1807D	EARTH	connected to S1806A (front rotor)

Duplex gear

30. This gear, which connects the S1807 shaft drive to the memory drum gear train, necessitates removal of the left-hand side plate for its removal. It is necessary to ensure that the channel selected by the channel selector switch is the same as that selected on the memory drum before fitting the new gear. The manufacturing method of these duplex gears is such that the bevel gear teeth and spur gear teeth are cut in two separate operations, therefore the relationship between spur gear and bevel gear teeth are not necessarily the same for any two duplex gears. For this reason, when a duplex gear is renewed, it will usually be necessary to renew the S1807 shaft and bevel gear (para. 29).

Idler gear

31. The idler gear is secured on a post fitted to the left-hand side plate by a self-locking nut. Removal of this plate is necessary for renewal of the idler gear.

Order of assembly

32. An outline of the order of assembly for the control unit is as follows:-

(1) Fit cross plates with switches S1801, S1807 and variable resistor R1801.

(2) Slip the bevel gear over S1807 switch shaft.

(3) Fit the idler gear to the left-hand side plate.

(4) Slip the duplex gear on to its post on the left-hand side plate, then fit this plate and the right-hand plate to the cross plate by means of two screws through each.

(5) Fit the S1807 switch actuator arm and spring to the cross plate and ensure that they align with the actuator plate.

(6) Fit the memory drum to the unit as described in para. 17.

(7) Fit the contact assembly and adjust it to suit the memory drum pins as in para. 22 and 23.

(8) Fit the socket panel complete with the cross wires for the Dzus labels and fasteners.

(9) Fit the four switches, dial lamps and cable loom (including the socket) to the front panel. Secure the looms in the appropriate clamp.

(10) Secure the socket to the socket panel, ensuring socket orientation as originally.

(11) Slip the numbered discs over the appropriate switch shafts S1803/4/5/6. Screw the cover in place over these discs with the four instrument head screws.

(12) Fit the knobs as described in para. 25.

(13) Fit the channel selector control knob, volume control knob and function switch knob.

(14) Fit the secure the panel covering the preset frequency controls.

(15) Replace the cover.

<u>Test procedure</u>

TEST PROCEDURE

33. Using the two connectors (para. 4(3) and (4)) connect the control unit to be tested to the test set and the test set to the 230V a.c. supply.

34. Set the switches of the test set as follows:-

METER switch to OFF
SUPPLY switch to ON
DENARY and CHECK RE-ENTRANT EARTH switches as required by the test being conducted.

35. The panel lamps of the control unit should become illuminated when the SUPPLY switch is set to ON.

36. To test that the function switch of the control unit is operating correctly, set it to each position in turn and note that the lamps of the test set become illuminated as follows:-

Function switch position	Test set lamps illuminated
OFF	None
T/R	T/R
T/R + G	T/R and +G
ADF	T/R and ADF

37. To test the volume control on the control unit, set the METER switch on the test set firstly to its RES position and rotate the VOL control knob over its full range. The meter on the test set should move between the two calibration marks on the dial. Secondly, set the METER switch to its ATT position and the dB RANGE switch to its .5 dB position; with the VOL control knob set fully clockwise the meter of the test set should read 0.5 dB. Reset the dB RANGE switch to its 35 dB.

38. To test the operation of the MANUAL frequency selector switches of the control unit, set the CHAN switch to M and operate the MANUAL switches and the switches of the test set in accordance with Table 2, the lamps of the test set should become illuminated as indicated in the Table. The position of the VOL control and the function switch do not affect the results of this test.

39. To test the operation of the CHAN switch and the preset memory drum switches, first set up the control unit to the frequencies and channels shown in the first two columns of Table 3 (setting up instructions are given in Vol. 1, Part 1, Chap. 4 of this publication), then select these channels one at a time using the CHAN switch, the lamps of the test set should become illuminated as indicated in Table 3.

TABLE 2

MANUAL frequency selection

Control unit MANUAL switches: Huns	Tens	Units	Dec	Test Set Switches: DENARY	CHECK RE-ENTRANT EARTH	200 GP SELECTED	0 TO 4GP SELECTED	Test set Lamps: 0 OR 5	1 OR 6	2 OR 7	3 OR 8	4 OR 9
2	0	0	Blank	DEC	Up							
2	0	0	.0	"	"		X	X				
2	0	0	.1	"	"		X		X			
2	0	0	.2	"	"		X			X		
2	0	0	.3	"	"		X				X	
2	0	0	.4	"	"		X					X
2	0	0	.5	"	"			X				
2	0	0	.6	"	"				X			
2	0	0	.7	"	"					X		
2	0	0	.8	"	"						X	
2	0	0	.9	"	"							X
2	0	0	Blank	"	Down							
2	0	0	.0	"	"			X				
2	0	0	.1	"	"				X			
2	0	0	.2	"	"					X		
2	0	0	.3	"	"						X	
2	0	0	.4	"	"							X
2	0	0	.5	"	"		X	X				
2	0	0	.6	"	"				X	X		
2	0	0	.7	"	"					X	X	
2	0	0	.8	"	"						X	X
2	0	0	[illegible]	"	"							

2	0	Blank	.0	UNITS	Up							
2	0	0	.0	"	"		X	X				
2	0	1	.0	"	"		X		X			
2	0	2	.0	"	"		X			X		
2	0	3	.0	"	"		X				X	
2	0	4	.0	"	"		X					X
2	0	5	.0	"	"			X				
2	0	6	.0	"	"				X			
2	0	7	.0	"	"					X		
2	0	8	.0	"	"						X	
2	0	9	.0	"	"							X
2	0	Blank	.0	"	Down							
2	0	0	.0	"	"			X				
2	0	1	.0	"	"				X			
2	0	2	.0	"	"					X		
2	0	3	.0	"	"						X	
2	0	4	.0	"	"							X
2	0	5	.0	"	"			X	X			
2	0	6	.0	"	"				X	X		
2	0	7	.0	"	"					X	X	
2	0	8	.0	"	"						X	X
2	0	9	.0	"	"						X	X

Control unit MANUAL switches				Test Set Switches				Test set Lamps				
Huns	Tens	Units	Dec	DENARY	CHECK RE-ENTRANT EARTH	200 GP SELECTED	0 TO 4GP SELECTED	0 OR 5	1 OR 6	2 OR 7	3 OR 8	4 OR 9
Blank	Blank	0	.0	TENS	Up							
Blank	0	0	0	"	"		X	X				
2	0	0	.0	"	"		X	X				
2	1	0	.0	"	"		X		X			
2	2	0	.0	"	"	X	X			X		
2	3	0	.0	"	"	X	X				X	
2	4	0	.0	"	"	X	X					X
2	5	0	.0	"	"	X		X				
2	6	0	.0	"	"	X			X			
2	7	0	.0	"	"	X				X		
2	8	0	.0	"	"	X					X	
2	9	0	.0	"	"	X						X
3	0	0	.0	"	"		X	X				
3	1	0	.0	"	"		X		X			
3	2	0	.0	"	"		X			X		
3	3	0	.0	"	"		X				X	X
3	4	0	.0	"	"		X					X
3	5	0	.0	"	"			X				
3	6	0	.0	"	"				X			
3	7	0	.0	"	"					X		
3	8	0	.0	"	"						X	
3	9	0	.0	"	"							X

Blank	Blank	0	.0	TENS	Down							
Blank	0	0	.0	"	"			X	X			
2	0	0	.0	"	"			X	X			
2	1	0	.0	"	"				X	X		
2	2	0	.0	"	"					X		
2	3	0	.0	"	"						X	
2	4	0	.0	"	"							X
2	5	0	.0	"	"			X	X			
2	6	0	.0	"	"				X	X		
2	7	0	.0	"	"					X	X	
2	8	0	.0	"	"						X	X
2	9	0	.0	"	"						X	X
3	0	0	.0	"	"			X	X			
3	1	0	.0	"	"				X	X		
3	2	0	.0	"	"					X	X	
3	3	0	.0	"	"						X	X
3	4	0	.0	"	"			X				X
3	5	0	.0	"	"			X	X			
3	6	0	.0	"	"				X	X		
3	7	0	.0	"	"					X	X	
3	8	0	.0	"	"						X	X
3	9	0	.0	"	"						X	X

TABLE 3

Preset frequency selection

Control unit		Test Set Switches				Test set Lamps				
CHAN	Frequency	DENARY	CHECK RE ENTRANT EARTH	200 GP SELECTED	0 TO 4GP SELECTED	0 OR 5	1 OR 6	2 OR 7	3 OR 8	4 OR 9
1	225.5	TENS	Up	X	X			X		
2	236.6	"	"	X	X				X	
3	247.7	"	"	X	X					X
4	258.8	"	"	X		X				
5	269.9	"	"	X			X			
6	270.0	"	"	X				X		
7	281.1	"	"	X					X	
8	292.2	"	"	X						X
9	303.3	"	"		X	X				
10	314.4	"	"		X		X			
11	325.5	"	"		X			X		
12	336.6	"	"		X				X	
13	347.7	"	"		X					X
14	358.8	"	"			X				
15	369.9	"	"				X			
16	370.0	"	"					X		
17	381.1	"	"						X	
18	392.2	"	"							X

1	225.5	TENS	Down					X		
2	236.6	"	"						X	
3	247.7	"	"							X
4	258.8	"	"			X	X			
5	269.9	"	"			X	X			
6	270.0	"	"			X	X	X		
7	281.1	"	"			X	X		X	
8	292.2	"	"			X	X			X
9	303.3	"	"			X	X			
10	314.4	"	"			X	X			
11	325.5	"	"			X	X	X		
12	336.6	"	"			X	X		X	
13	347.7	"	"			X	X			X
14	358.8	"	"			X	X			
15	369.9	"	"			X	X			
16	370.0	"	"			X	X	X		
17	381.1	"	"			X	X		X	
18	392.2	"	"			X	X			X

Control unit		Test Set Switches								
CHAN	Frequency	DENARY	CHECK RE-ENTRANT EARTH	200 GP SELECTED	0 TO 4GP SELECTED	0 OR 5	1 OR 6	2 OR 7	3 OR 8	4 OR 9
1	225.5	UNITS	Up			X				
2	236.6	"	"				X			
3	247.7	"	"					X		
4	258.8	"	"						X	
5	269.9	"	"							X
6	270.0	"	"		X	X				
7	281.1	"	"		X		X			
8	292.2	"	"		X			X		
9	303.3	"	"		X				X	
10	314.4	"	"		X					X
1	225.5	"	Down			X	X			
2	236.6	"	"			X	X			
3	247.7	"	"			X	X	X		
4	258.8	"	"			X	X		X	
5	269.9	"	"			X	X			X
6	270.0	"	"			X				
7	281.1	"	"				X			
8	292.2	"	"					X		
9	303.3	"	"						X	
10	314.4	"	"							X

1	225.5	DEC	Up			X				
2	236.6	"	"				X			
3	247.7	"	"					X		
4	258.8	"	"						X	
5	269.9	"	"							X
6	270.0	"	"		X	X				
7	281.1	"	"		X		X			
8	292.2	"	"		X			X		
9	303.3	"	"		X				X	
10	314.4	"	"		X					X
1	225.5	"	Down			X	X			
2	236.6	"	"			X	X			
3	247.7	"	"			X	X	X		
4	258.8	"	"			X	X		X	
5	269.9	"	"			X	X			X
6	270.0	"	"			X				
7	281.1	"	"				X			
8	292.2	"	"					X		
9	303.3	"	"						X	
10	314.4	"	"							X

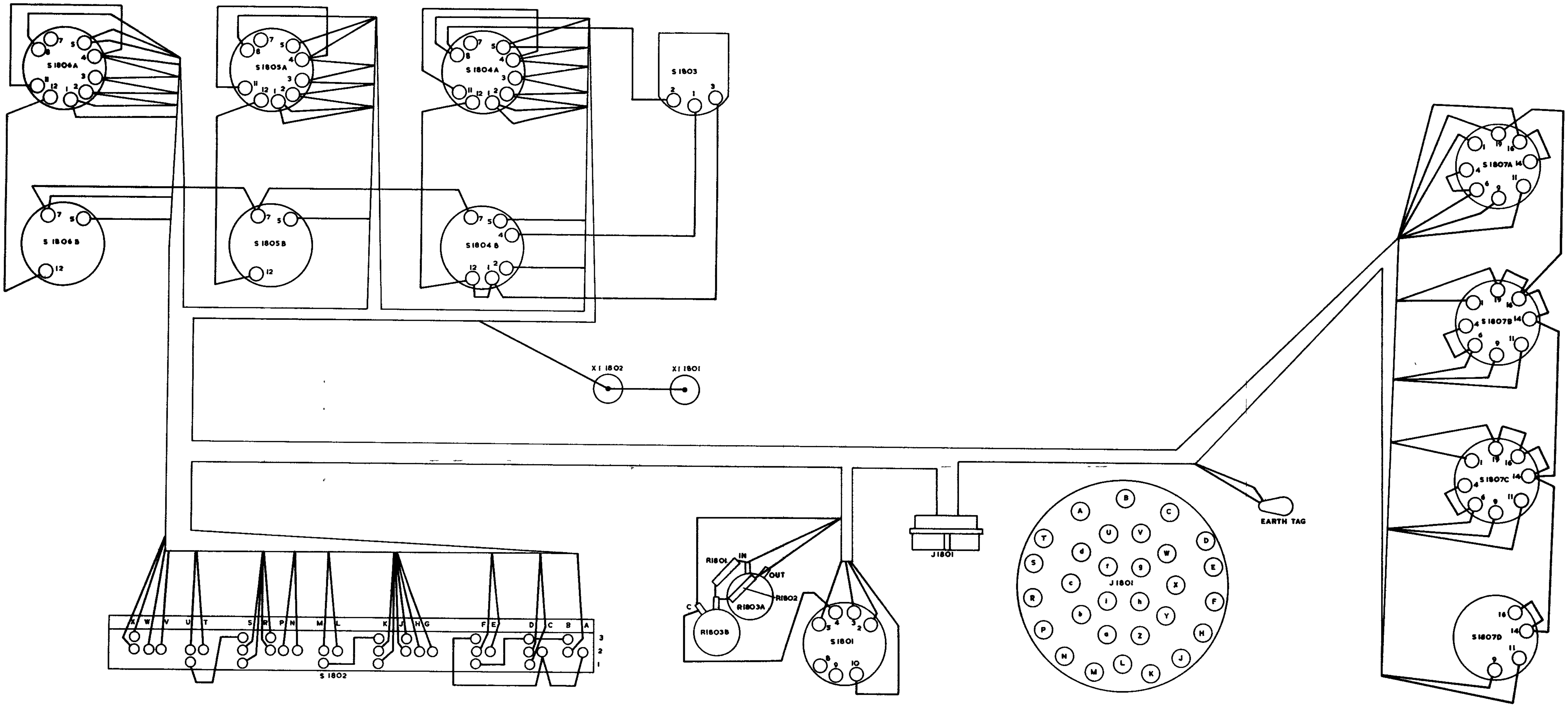

Fig. 1. ARI. 18124 and ARI. 18124/2 — control unit Type C1607/ARC52 — wiring diagram

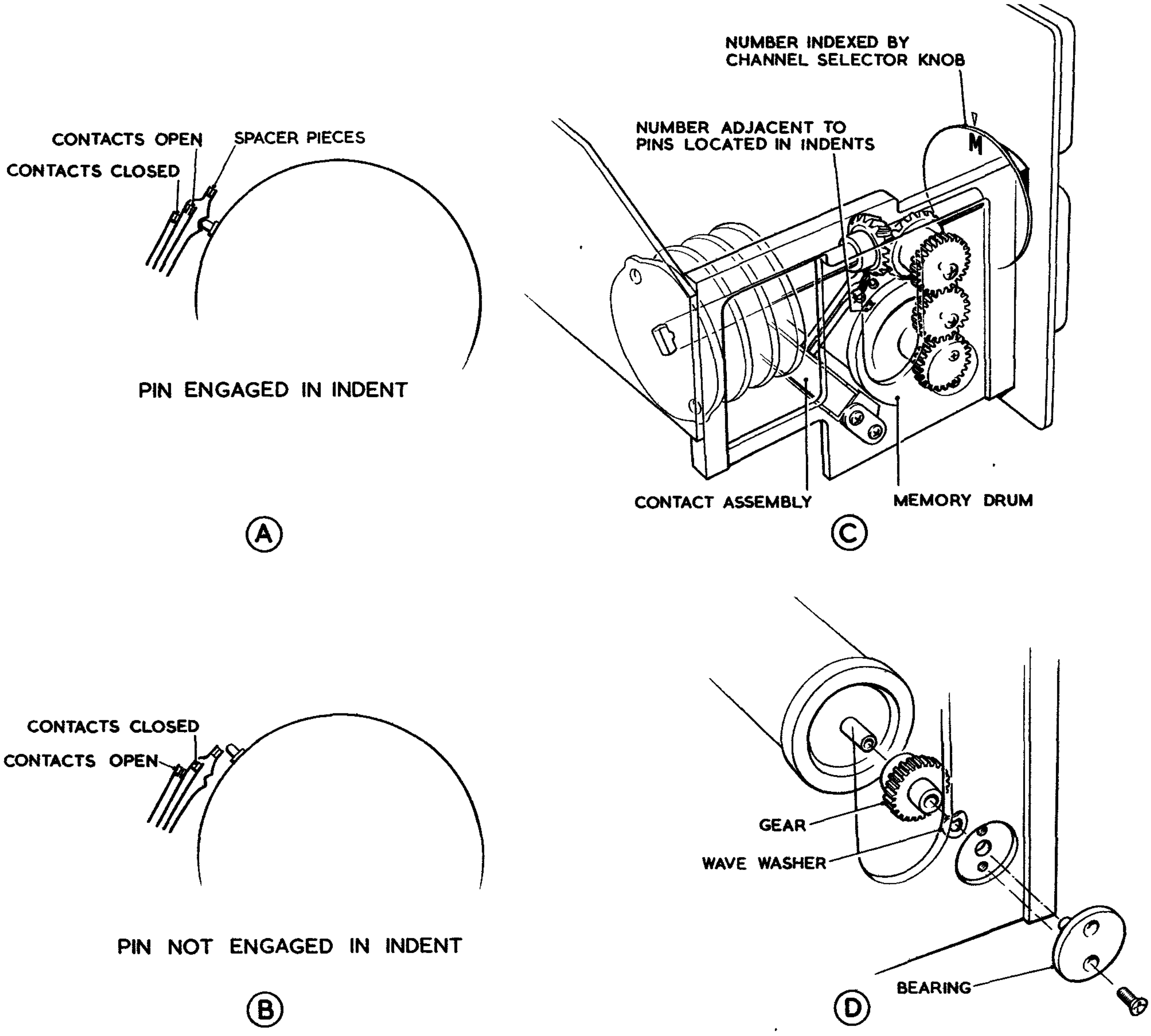

Fig. 2 Memory drum assembly conditions

Chapter 19

OSCILLATOR UNIT

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General

1. The oscillator unit provides crystal-controlled outputs in the intermediate frequency range of 21.85 Mc/s to 31.75 Mc/s for both the receiver and transmitter. Outputs are fed to the amplifier valve (V205) in the 20 - 30 Mc/s IF unit.

2. The unit is a self-contained, compact module which is secured to the transmitter-receiver chassis base by four captive Phillips-type screws. These screws are painted red and are accessible from the

underside of the chassis when the sealed cover is removed. Details of cover removal, its refitting and the method for pressurizing the complete unit are given in Part 2, Sect. 2, Chap. 17 of this Volume. Details of the removal and refitting of the sub-units (modules) making up the transmitter-receiver equipment are given in Vol. 1, Part 1, to which reference should be made. Any dismantling or assembly procedures given in subsequent paragraphs will be supplementary and limited to requirements for repair or the renewal of components.

Note...

It is important that before this module is removed from the chassis the 220.0 Mc/s channel is selected. This ensures that the frequency selector mechanism is correctly aligned for sub-unit withdrawal and subsequent refitting.

3. The inspection procedures and tests outlined in the following paragraphs reveal the salient performance characteristics of the equipment and will indicate whether or not the oscillator unit is operating to the original specifications. The tests should follow all repairs and renewal of components or when specified as routine in the matter of preventive servicing.

Test equipment

4. The equipment required for servicing and testing the oscillator unit is listed in Table 1. Further information on the individual item may be obtained by reference to the publication listed.

TABLE 1

List of Test Equipment

Item	Ref. No.	Nomenclature	Para.	Further details
1	10AG/964	Drill and ream jig	25	Sect. 1
2	10AG/965	Assembly fixture	25	Sect. 1
3	10AG/967	Switch setting piece	21	Sect. 1
4	10AG/966	Checking fixture	21	Sect. 1
5	10AG/960	Height gauge plate	25	Sect. 1
6	10AG/961	Depth gauge	25	Sect. 1
7	6625-99-943-66547	Test set, oscillator	29	Sect. 1, Chap.10
8	6130-99-999-7812	Power supply (130V)	28	Sect. 1, Chap.2
9	10S/16308	Multimeter, electronic CT38.	30	A.P.2879 AC.

Component inspection

5. Inspect for correctness the details of equipment serial numbers and the modification state entered on the repair card or servicing documents accompanying the equipment.

6. Using a portable blower or other suitable supply of dry air under pressure, thoroughly clean the unit of all dust. Where necessary, a soft squirrel-hair brush will assist in this process. Since the transmitter-receiver equipment is enclosed within an air-tight casing, however, the presence of dust, dirt or moisture should be fully investigated.

7. Carefully examine the unit to ensure that it is undamaged and free from corrosion with all components securely retained in position. Any loose connections or components must be refitted. Should it become necessary to renew any components it is important to ensure that the new items are positioned accurately and connected correctly. Reference to the component layouts shown in Vol. 1, Part 1, Chap. 5, will assist in component replacement.

8. All screws and nuts removed during inspection or servicing and which are not fitted with locknuts or lockwashers must be locked with an approved varnish after they are refitted.

Wiring

9. The wiring throughout the oscillator unit should be carefully inspected for continuity and conformity with the circuit shown in Vol. 1, Part 4, of this Air Publication. This inspection should consist of point-to-point tests or such electrical tests which will confirm the accuracy of the wiring. Examination should be made for neatness of soldering, absence of dry joints and a generally satisfactory condition of the wiring and insulation. No inadvertent interconnections or tracking paths should be permitted due to excess solder, wire clippings or dirty connections.

10. To assist in the servicing of this unit a wiring diagram is given in fig. 3 at the end of this chapter. It is important to ensure that any replacement wiring is carried out correctly and that lengths, gauge of wire and colour coding are replaced as in the original (unless modification requirements necessitate changes). In Table 2 is listed a wiring key which when used in conjunction with the wiring diagram, will assist in the replacement of any wiring.

WARNING

ELECTRIC SHOCK: The power supply to the oscillator unit must be switched off, or, preferably, the unit completely disconnected from the test bench before any attempt is made to service the unit or to renew any of the components.

TABLE 2

Wiring Key

From	Wire Colour	To
P1901/8	White	ET/1
TB1902/1	Violet	TB1901/1
" /2	Blue	" /2
" /3	Green	" /3
" /4	Yellow	" /4
" /5	Orange	" /5
" /6	Red	" /6
" /7	Brown	" /7
TB1901/9	Green	J1902
TB1902/16	Black	J1901

Table 2 (Continued)

From	Wire Colour	To
TB1901/2	Green	S1903/H
TB1902/11	Red	L1901/1
L1904/1	Busbar	L1901/1
L1904/1	"	L1903/1
L1902/1	"	L1903/1
L1902/1	"	L1905/1
L1906/1	"	L1905/1
L1906/1	"	L1907/1
L1910/1	"	L1907/1
L1910/1	"	L1909/1
L1908/1	"	L1909/1
S1901/1	Black	L1901/2
S1901/2	Brown	L1902/2
S1901/3	Red	L1903/2
S1901/4	Orange	L1904/2
" /5	Yellow	L1905/2
" /6	Green	L1906/2
" /7	Blue	L1907/2
" /8	Violet	L1908/2
" /9	Grey	L1909/2
" /10	White	L1910/2
" /11	Clear	TB1902/9
S1902/11	Pink	TB1902/13
Xtal bank A/1	Tan	TB1902/12
P1902	-	TB1901/4
Xtal bank B/1	White	ET2
Xtal bank B/1	Busbar	S1903/5
" " B/6	"	Xtal bank B/4
" " B/4	"	" " B/2
" " B/2	"	" " B/8
" " B/8	"	" " B/10
" " B/10	"	" " B/12
" " B/12	"	" " B/19
" " B/19	"	" " B/17
" " B/17	"	" " B/15
" " B/15	"	" " B/14
" " B/3	"	S1903/3
" " B/5	" sleeved black	" /2
" " B/7	do.	" /1
" " B/9	Busbar	" /4
" " B/11	"	" /10

Table 2 (Continued)

From	Wire Colour	To
Xtal bank B/13	Busbar	S1903/9
" " B/16	"	" /6
" " B/18	" sleeved black	" /7
" " B/20	do.	" /8

Servicing

11. The renewal of the majority of the components in this unit should be a simple matter of standard procedure, the few special cases and procedures will be detailed in the following paragraphs.

12. The printed circuits present special problems with regard to servicing. A printed circuit board may be irreparably damaged by the sustained heat from a soldering iron. The recommended method to be adopted when renewing a component on a printed circuit board is as follows:-

(1) Remove the faulty component from the board by clipping the wires as close to the component as possible. This leaves the wire ends still fastened to the printed board.

(2) Prepare the wire-ends of the new component and make a mechanical joint with the wires attached to the printed board. (Fit the new component so that its value is uppermost and readable).

(3) Solder the connections as quickly as possible using only a light-weight soldering iron.

Crystal bank A and switches

13. The ten crystals (Y1901 and Y1910) are of the Type 10XBF; these are soldered as a pack into an insulated baseboard which carries a common earth plate. If it is required to change any of the crystals the complete pack must be removed as follows:-

(1) Unscrew the four Phillips-type screws and carefully lift off the cover, together with the screws and spacers.

(2) The baseboard may then be lifted clear, for a limited distance in order to gain access to the soldered connections.

14. Carefully examine the switch wafers S1901 and S1902. The contacts should be clean and undamaged; evidence of burning at the contacts or wipers necessitates changing the switch and investigation into the probable causes of the damage. Removal of the switch for renewal of damaged wafers is quite straightforward, entailing only the unscrewing of clamping nuts on each of the four studs.

15. When refitting the switch, care should be taken to ensure that the insulating washers are replaced in the correct order (fig. 1). It is important to note that when rebuilding the switch unit, the wafers are assembled with the soldering tags towards the crystal pack in order to provide sufficient access for soldering. The wafers should be assembled parallel and square with the coupler shaft; limited amount of adjustment can be obtained by means of the clamping screws.

Crystal bank B and switch

16. The ten crystals (Y1911 to Y1920) are Type 10XCM. These crystals are of the pin connection type, and may be removed for renewal or servicing simply by withdrawing them from the insulated mounting block.

17. Carefully examine the single wafer switch (S1903). The contacts should be clean and undamaged. Should there be any evidence of burning of the switch contacts, the component should be changed and the causes of the damage fully investigated.

18. Removal of the switch (S1903) for servicing (fig. 1) should proceed as follows:-

(1) Note the position of the crystals, then withdraw them and store in a safe place.

(2) Remove the insulated mounting block by first unscrewing the counter-sunk head screws in the side plate of the oscillator chassis. Unscrew the two round-head screws which pass through the mounting block, insulating distance pieces and the switch wafer, into the chassis. A spanner will be required to prevent the nut from turning on the inside of the chassis.

(3) The crystal mounting block may then be placed to one side to give access to the remaining two screws securing the switch wafer to the chassis.

Note...

The wiring to the crystal mounting block will permit only a limited amount of movement of the block, but this should be quite sufficient for the access required.

(4) The switch wafer may then be withdrawn from the coupler shaft.

19. When refitting the switch wafer after servicing, care must be taken to correctly replace all the insulated spacers (fig. 1). It is important also to ensure that the switch wafer is positioned squarely in relation to the coupler shaft and with the soldering tags towards the crystal bank.

Switch rebuilding

20. The double wafer switch S1901 and S1902 of the oscillator unit can be rebuilt for further service after repair or renewal of component parts. For the purpose of rebuilding this type of switch, the special tool (Ref. No. 10AG/967) is available (fig. 4). The method of switch rebuilding is quite simple and is carried out as follows:-

(1) Into the base plate insert the four threaded corner posts of the double switch. These should be complete with the bottom nut which is retained in the recesses cut into the face of the base plate. Screw down the corner posts until flush with the bottom face of the base plate; this will ensure sufficient extension of threaded portion to enable the complete switch to be secured into the oscillator unit. Fit plain washers and insulated spacers on to each post.

(2) Now load the bottom switch wafer into the base plate, with the terminals uppermost. Two small holes are drilled into the base plate close to the right-hand pillar and one hole near the left-hand pillar; these are provided as a guide to correct loading of the switch wafer since on one side of the wafer are two terminals and on the opposite side is one terminal. These should coincide with the small drilled holes adjacent to the pillars. The switch rotor should be positioned on the machined spigot so that the

rotor contact points towards the left as shown in fig. 4.

(3) Nuts and spacer washers should next be fitted to each post prior to the fitting of the top wafer switch. This switch wafer is best assembled first into the top plate of the setting piece; the two plates subsequently being assembled to match one with the other. As with the bottom plate, holes are drilled to indicate the coincident positions for the switch terminal lugs.

(4) The top plate may then be carefully placed in position over the two pillars and the thumb nuts tightened to clamp the two plates securely together. The nuts between wafers on the corner posts should then be firmly tightened to correctly space the switch wafers. Take care not to overtighten the nuts in order to avoid splitting the insulating washers or distorting the wafers. The long hexagon nuts, with their insulating washers, may then be fitted through the cut-out portions of the top plate.

(5) Release the thumb nuts and remove the complete switch assembly from the setting piece to enable the wiring of the switch terminals to be made.

(6) When installing the switch into the oscillator unit, ensure that the rotors are centrally disposed about the shaft and centred within the wafers. In addition, test that both rotors operate simultaneously over the complete range. Slight adjustment may be obtained by releasing the top wafer securing nuts and using the limited clearance of the four corner post holes in the wafer to bias the switch in the required direction.

(7) With the switch assembled in position on the oscillator unit, a torque test can be made using a standard Minor Acratork wrench; the switch operation should need a load not greater than 8 oz. in.

(8) The crystal bank may now be fitted and secured by screws passing into the long hexagon nuts on the upper portion of the switch corner posts.

Alignment of switches

21. After replacing or adjusting any wafers the switches must be aligned as follows:-

(1) Ensure their correct position; i.e. configuration of switch segments, as shown in fig. 2.

(2) Rotate the couplers until the spigots line up with the small printed 0 datum rings on the base of the unit.

(3) Inspect all the switches to ensure that the rotor contacts are positioned as shown in fig. 2. Slight adjustment may be made by loosening off the fixing screws and taking advantage of the movement permitted by the clearance of the fixing holes in the switch wafers.

22. Alignment of the switches may be simplified by using the checking fixture 10AG/966. This fixture will verify that the switch wipers remain in electrical contact with each segment when the shaft is rocked $2\frac{1}{2}^{\circ}$ either side of the nominal position. The fixture tests alignment at four nominal positions spaced 90° apart and each position has two dowel holes (fig. 4). The checking fixture is used as follows:-

(1) Remove the bronze coupler rings and secure the checking fixture to the base of the oscillator unit.

(2) Using two continuity testers (i.e. ohmmeter, buzzer, lamp etc.) connect one between pin 1 and pin 8 of V1901 and the other between pin 5 of V1901 and a segment of S1902. The segment chosen should correspond radially, to the segment of S1901 being tested.

(3) Insert the dowel pin into hole 1 of the checking fixture and rotate the 1 Mc/s shaft counter-clockwise with a screwdriver until the continuity testers show a closed circuit condition.

(4) Ensure that the shaft is not moved and carefully withdraw the dowel from hole 1 and insert it in hole 2. Rotate the shaft counter-clockwise until the dowel halts rotation whereupon the continuity testers should still show a closed circuit condition.

(5) Continue the test until the dowel pin has been inserted in all the four pairs of holes. Should the switches fail to make contact on any segment the wafers should be adjusted as described in para. 21 (3).

(6) It will be sufficient to test the alignment of S1903 on one position only and the dowel should be used to stop the coupler on one position of the switch as already described. Then visually ensure that the wiper of S1903 is truly situated on a segment.

Shaft replacement

23. The special-to-type equipment developed for the oscillator unit includes a drill and ream jig 10AG/964 (fig. 4) and a clamp assembly fixture 10AG/965 (fig. 5) (see also Part 2, Sect. 1, Chap. 10 of this Volume) for the renewal of shafts and coupler plates. The shafts are rotated to allow the switch rotors to be correctly positioned and the shafts are then clamped with the assembly fixture 10AG/965. When the coupler plates have been positioned on the shafts, the drill and ream jig 10AG/964 is secured to the oscillator unit to allow accurate drilling and reaming to be accomplished.

24. Damage to a coupler plate or shaft will necessitate the renewal of both items. Removal of either of the shafts should be carried out in the following order:-

(1) Remove the coupler ring.

(2) Extract the top circlip and carefully withdraw the shaft a small amount; this will facilitate extraction of the power circlip.

(3) Extract the lower circlip.

25. The shaft may now be withdrawn but care must be taken to prevent damage to the switch rotors.

26. Shaft replacement for switch S1901 - S1902 is carried out in the following manner:-

(1) Slide the new shaft carefully through its bearing and into the two switch wafers, care must be taken to ensure correct alignment of both rotors (fig. 2).

(2) Insert a new lower circlip.

(3) Insert a new top circlip.

(4) Rotate the shaft to position the rotor between switch segments as shown in fig. 2. Remove any backlash by rotating the shaft in the direction of operation and, at the same time, push the shaft into the unit to remove end-play.

(5) Using the assembly fixture 10AG/965, clamp the shaft securely with the switch rotor positioned as shown in fig. 2.

(6) Assemble the coupler plate so that the centre lines of the driving dogs are horizontal (fig. 1 and 2) and the flat on the boss of the coupler plate is uppermost on that side from which it is intended to drill. Insert the coupler distance plate between the coupler and baseplate, then fit the drill and ream jig 10AG/964 as shown in fig. 4.

(7) Drill through the coupler plate boss and shaft with a No.50 (0.070 in. dia.) drill and ream for the taper pin. Verify that the face of the coupler plate projects between 0.070 in. and 0.080 in. from the base of the unit using the height and depth gauges 10AG/960 and 10AG/961 (fig. 6).

(8) The torque required to turn the shaft must not exceed 8 oz. in., using a screwdriver, tester (L.H.) 5120-99-943-9324 or Minor Acratork tool.

27. Shaft replacement for switch S1903 is carried out in the following manner:-

(1) Insert the new shaft carefully through its bearings and the switch wafer; care must be taken to ensure correct alignment of the rotor (fig. 2).

(2) Insert a new lower circlip.

(3) Insert a new top circlip.

(4) Rotate the shaft to position the rotor as shown in fig. 1 and push the shaft into the unit to remove end-play.

(5) Assemble the coupler plate so that the centre lines of the driving dogs are $7\frac{1}{2}^{\circ}$ off the horizontal (fig. 2) and the flat on the boss of the coupler plate is uppermost on that side from which it is intended to drill. Insert the coupler distance plate of the drill jig between the baseplate and coupler, then fit the drill jig item 2, Table 1 to the base of the unit.

(6) Drill through the coupler plate boss and shaft using a sharp No. 50 drill (0.070 in. dia.) and ream for the taper pin. Verify that the face of the coupler plate projects between 0.070 in. and 0.080 in. above the base of the unit using the height and depth gauges 10AG/960 and 10AG/961 (fig. 6).

(7) The torque required to turn this shaft must not exceed 12 oz. in. using the screwdriver, tester or Minor Acratork tool.

Inductors, r.f.

28. Should any variable inductors have become damaged or faulty they must be changed. This is a simple matter requiring only unsoldering and the removal of a retaining nut and washer.

Testing the oscillator unit

29. The oscillator unit may be tested by means of the test set, oscillator 6625-99-943-6547 in conjunction with the power unit (130V). This test set forms a mounting for the oscillator unit under test and provides facilities for indexing the rotary crystal switches incorporated so that the operation of all crystals may be verified. Since the oscillator unit contains two crystal oscillator circuits which combine to give one output, means are provided (DISABLE OSC. switch) for disabling either oscillator. In the test set, within a temperature controlled oven, is a comparator oscillator which is basically a standard ARC52 oscillator modified by the fitting of crystals having a temperature range coincident with the working temperature of the test oven. The crystal switches of this comparator oscillator are linked with the indexing system provided on the test set which provides means for comparison of the outputs from the two oscillator units and displaying the frequency difference on the incorporated meter. Terminals on the front panel of the test set provide for the connection of a multimeter to the test points J and K of the oscillator unit on test. Measurements at these points given an indication of the activity of the units and decimals crystals. Provision is also made to enable the output of the unit on test to be applied to the mixer circuit of the test set and simultaneously to monitor this signal on the multimeter. An r.f. test load (10 Kohms) for the oscillator on test is incorporated in the test set.

30. Power supplies for the test set are provided by the power supply (130V), issued under A.B.C.S. Cat. No. 6130-99-999-7812, which is connected into the appropriately marked socket on the test set central panel.

Testing procedure

31. The oscillator unit for test should first be located correctly on the test pedestal of the test set then clamped firmly in position by means of the finger screws which engage with the tapped holes in the base of the unit by which it is secured into the chassis, main assembly. Be sure to engage the switch driving couplers correctly, and align the dowels of the module with the locating holes provided in the test pedestal platform which is designed as a facsimile of the appropriate section of the chassis, main assembly. Then connect the microdot lead from the module on test to the uppermost socket (SKT2) of the connector block just to the left of the test pedestal. Secure flyleads between the test points J and K of the oscillator unit on test and the terminals marked J and K on the front of the test set. These two leads are provided for the application of bias by operation of the DISABLE OSC. switch, which disables the oscillator selected for test. Thus, turning the switch to the position J disables the units oscillator permitting measurements and comparison of the decimals oscillator; similarly, turning this switch to position K disables the decimals oscillator, by application of bias, permitting measurements of the units oscillator to be made.

32. Switch on the power supply unit and set the h.t. supply to +130V and bias supply to -12V. Switch on the test set H.T. ON switch. The test equipment should then be allowed a thermal stabilization period of 60 minutes. After a period not exceeding 45 minutes after switching on, the red OVEN pilot lamp on the front of the test set should light up to indicate that oven cycling has commenced.

33. Index the unit on test, by means of the finger wheels on the test pedestal to the reference position 0.0. Then in this position, isolate the bias supply either by removing the flyleads to terminals J and K of the test set or by adjustment at the power supply unit. This permits an h.t. current test to be made; h.t. current drawn by the unit when ready for testing should not exceed 25 milliamps.

Decimals oscillator tests

34. Connect the multimeter to the terminals of the lead from socket SKT4 on the test set. Turn the DISABLE OSC. switch to the position marked J then index the equipment progressively as in Table 3, taking note of the voltage readings for each selection. These readings indicate the r.f. voltage level at the anode (pin 8) of the valve V1902A; in all instances this value should be not less than 0.5V r.m.s.

35. For testing the activity, the multimeter should be connected between the left-hand pair of terminals on the test set marked D.C. and E. The d.c. voltage level at each position of indexing should be not less than 0.7V.

36. In frequency comparison tests, the operating frequency of the decimals oscillator at each position of indexing should not differ from the correct frequency (Table 3) by more than 400 c/s. This measurement is shown as the difference frequency on the test set meter. Note that a meter range switch (RANGE) is provided to enable coarse and fine readings to be determined accurately.

TABLE 3

Decimals oscillator test frequencies

Index freq. (Mc/s).	Dec. osc. freq. (Mc/s)	Crystal
0.0	3.05	Y1911
0.1	2.95	Y1912
0.2	2.85	Y1913
0.3	2.75	Y1914
0.4	2.65	Y1915
0.5	2.55	Y1916
0.6	2.45	Y1917
0.7	2.35	Y1918
0.8	2.25	Y1919
0.9	2.15	Y1920

Units oscillator tests

37. The tests described in para. 34 - 36 should then be repeated, but with the DISABLE OSC. switch set to the position marked K.

38. At each position of the units oscillator indexing wheel (Table 4), the d.c. level should be not less than 0.9V.

39. At each position of indexing, the r.f. voltage level should be not less than 0.18V r.m.s.

40. At each indexing position the h.t. voltage of the unit should be alternately disconnected and applied (by means of the H.T. ON switch) three times. On each occasion when the h.t. is applied the voltage level at test point J should unhesitatingly rise to the correct working level.

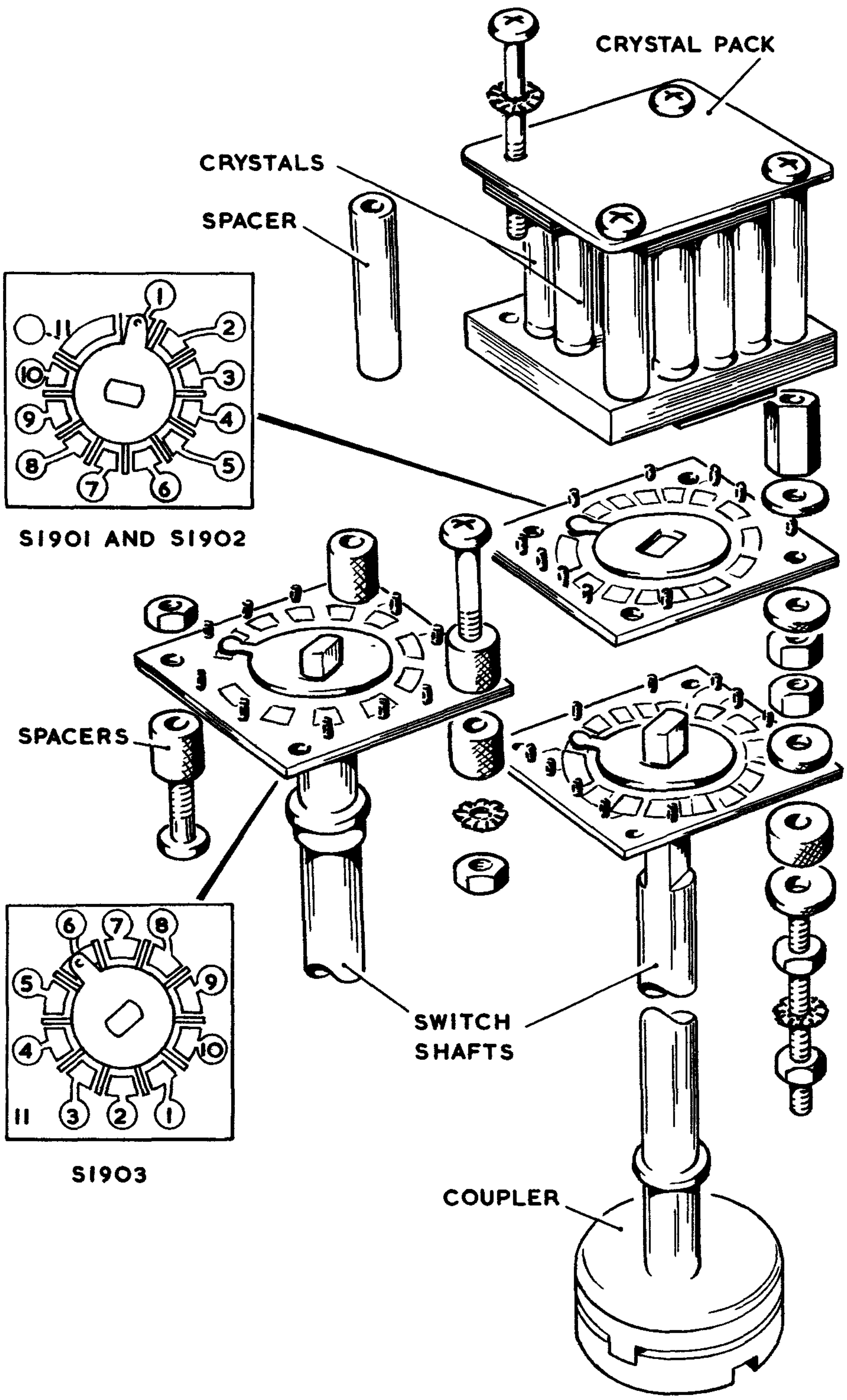


Fig. 1. Exploded view of switches S1901, S1902 and S1903

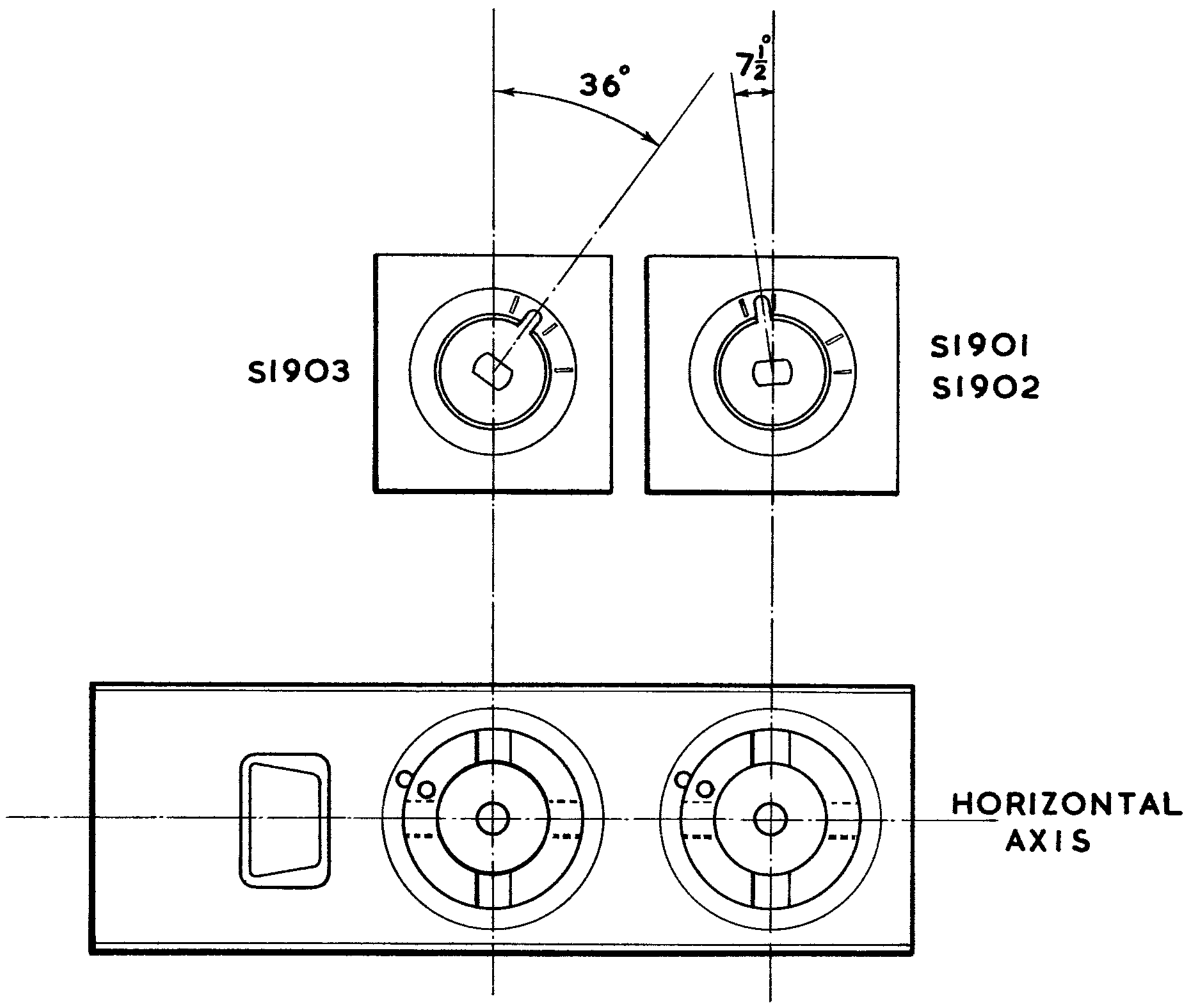
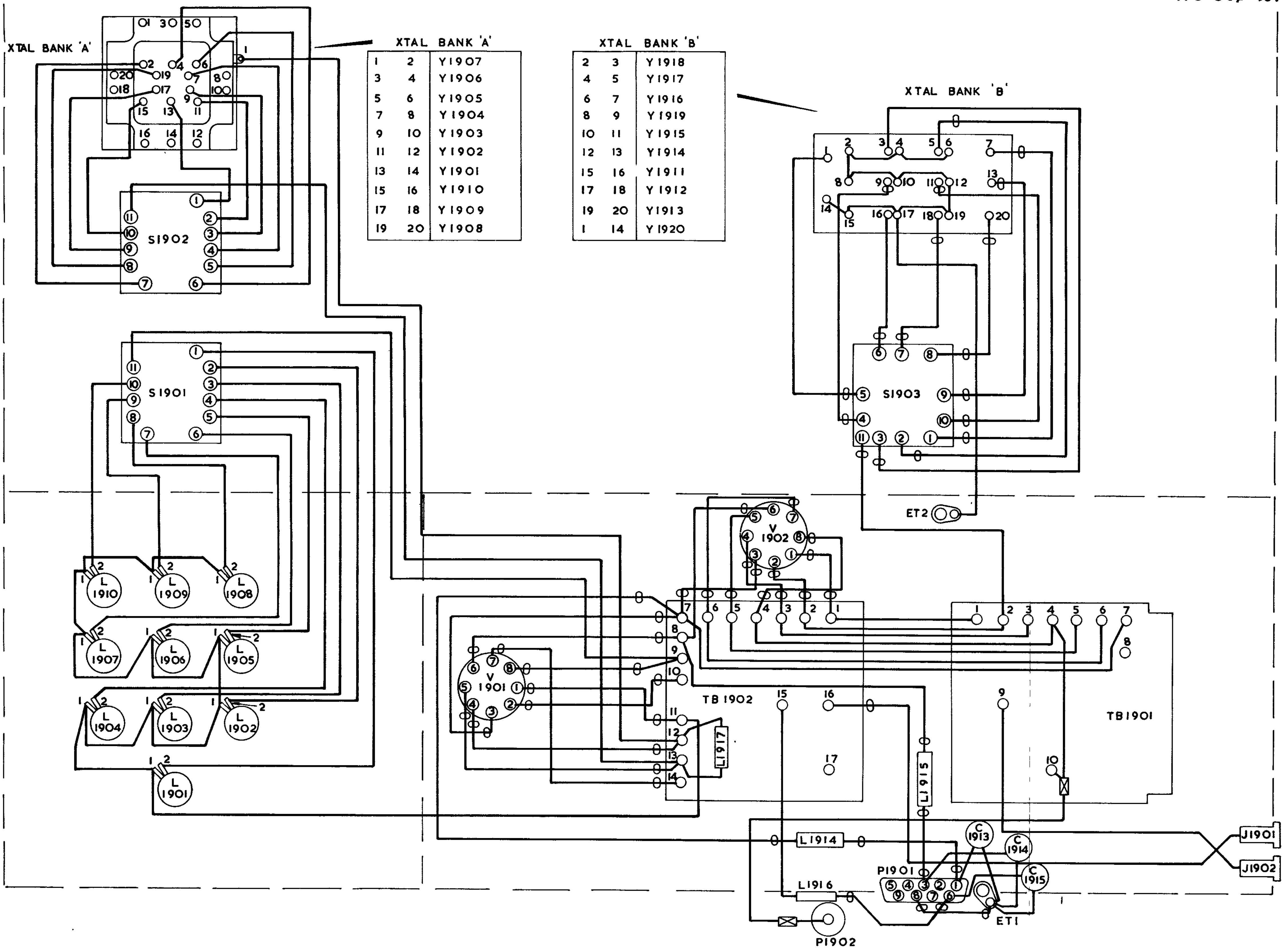


Fig. 2. Oscillator unit — coupler and switch alignment details



XTAL BANK 'A'

1	2	Y1907
3	4	Y1906
5	6	Y1905
7	8	Y1904
9	10	Y1903
11	12	Y1902
13	14	Y1901
15	16	Y1910
17	18	Y1909
19	20	Y1908

XTAL BANK 'B'

2	3	Y1918
4	5	Y1917
6	7	Y1916
8	9	Y1919
10	11	Y1915
12	13	Y1914
15	16	Y1911
17	18	Y1912
19	20	Y1913
1	14	Y1920

Fig. 3 Transmitter-receiver ARC52 : - oscillator unit - wiring diagram

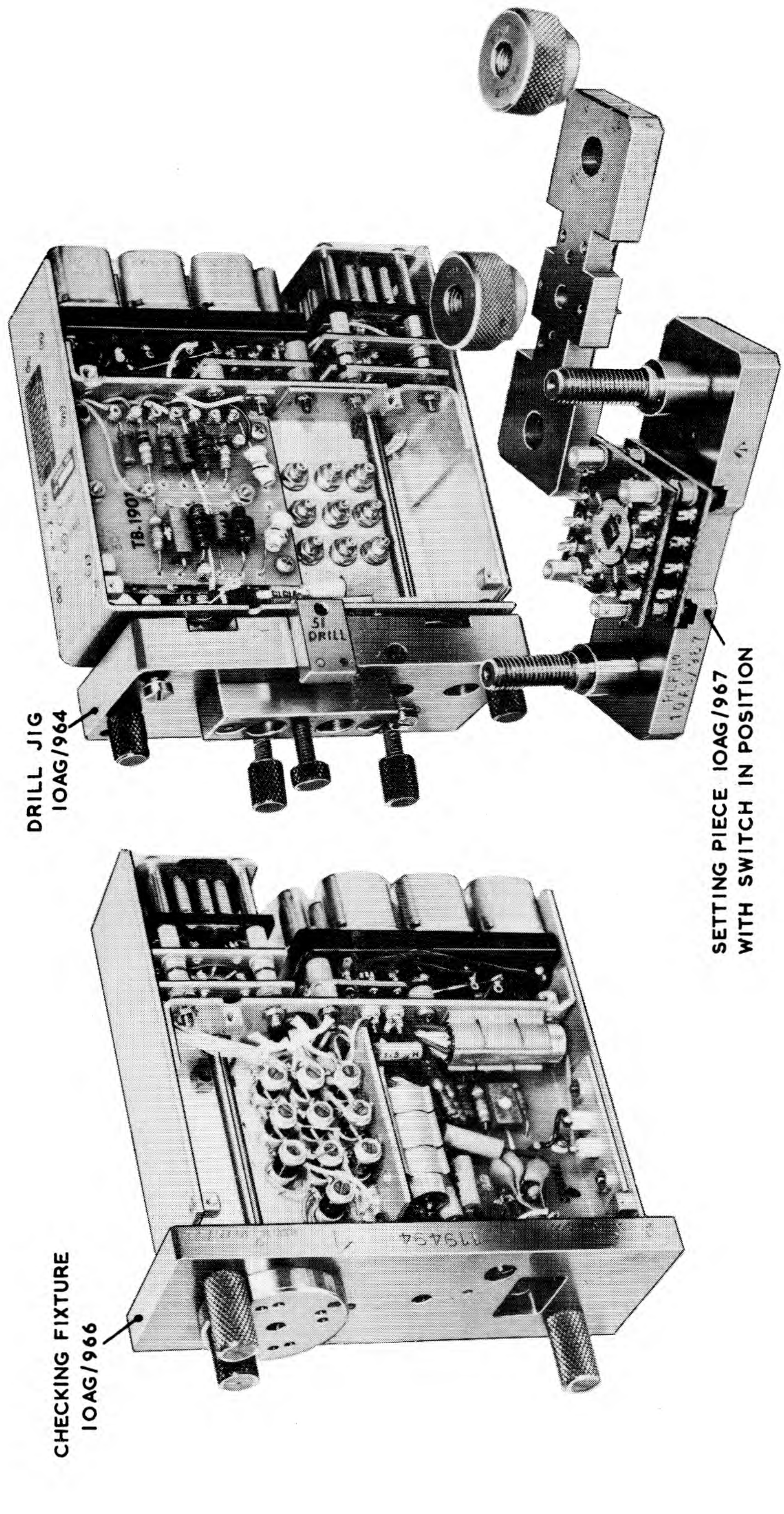


Fig. 4. Tools and fixtures mounted on oscillator unit

Fig. 5. Assembly fixture Ref. No. 10AG/965 with oscillator unit in position

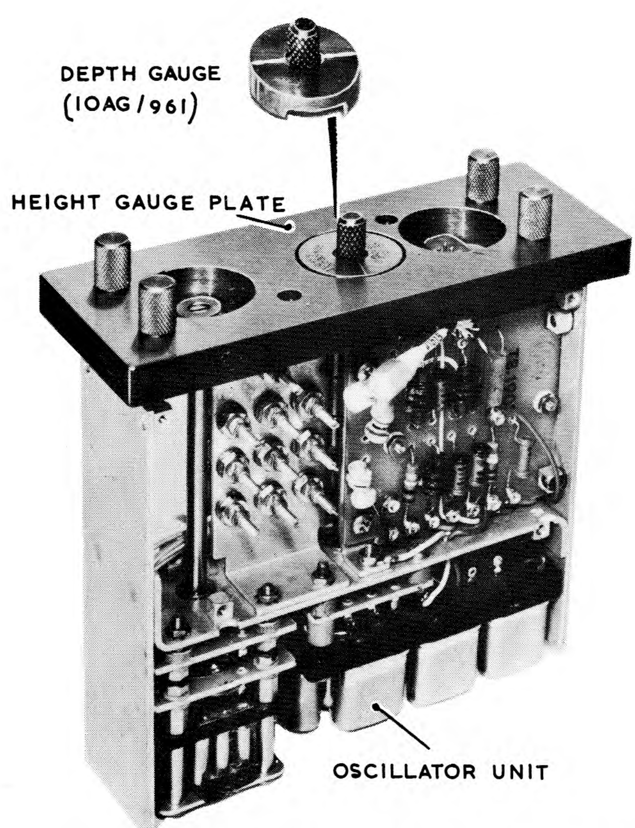


Fig. 6. Height gauge plate Ref. No. 10AG/960 in position

Chapter 20

CONTROL, RECEIVER MUTING

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Introduction

1. The function of the control, receiver muting (5821-99-943-3247) is to provide a negative d.c. bias which, when applied to the main receiver a.v.c. line, mutes any incoming signals when the intercommunication facility is urgently required. The bias output produced by this unit is controlled by a press-to-mute switch, situated in the vicinity of the operator, which energizes a relay (RL1) in the unit. When this relay is made the bias is applied, through the interconnecting box, to the transmitter-receiver (J1401/N). The control, receiver muting may be used with either ARI.18124/1 or ARI.18124/2 and a label on the front of the unit indicates for which equipment the unit is wired (para. 2, 3 and 4).

2. For operation with the aircraft 27.5V d.c. supply, the control, receiver muting derives the negative bias potential from the rectified

output of an r.f. oscillator, operated from a 27.5V d.c. h.t. at a frequency between 350 kc/s and 500 kc/s.

3. For operation with the aircraft 115V, 400 c/s a.c. supply a conventional rectifier circuit is used to derive the bias potential.

4. Links are incorporated in the unit which are wired for the mode of operation required.

Note...

Pre-stage B versions of the control, receiver muting can be identified from the production versions since the latter have been allocated serial numbers from 0500 onwards. The differences between them are of a minor mechanical nature.

SERVICING

WARNING

ELECTRIC SHOCK. The power supplies to this unit must be switched off or, preferably, completely disconnected before any attempt is made to service the unit.

Component inspection

5. Inspect for correctness the details of equipment serial numbers and modification state entered on the repair card accompanying the unit.

6. Remove the cover by releasing the four 2 B.A. captive screws, which are symmetrically positioned on the front panel, and unclip the side covers of the oscillator power supply group.

7. Using a portable blower, or other approved supply of dry air under pressure, thoroughly clean the unit of all dust. Where necessary, a soft squirrel hair brush will assist in this process.

8. Carefully examine the unit to ensure that it is undamaged and free from corrosion, with all components securely retained in position. Any loose connections or components should be refitted. Should it become necessary to change any components it is important to ensure that the new items are positioned accurately and connected correctly.

9. The recommended method to be adopted when renewing a component on a printed circuit board is as follows:-

(1) Remove the faulty component from the board by clipping the wires as close to the component as possible. This leaves the wire ends still fastened to the printed board.

(2) Prepare the wire ends of the new component and make a mechanical joint with the wires attached to the printed board. (Fit the new component so that its value is uppermost and readable).

(3) Solder the connections as quickly as possible using only a lightweight soldering iron.

10. When renewing the tantalum type electrolytic capacitors (C16, C17) it is important to ensure that they are correctly connected with respect to polarity.

11. Inspect the lead from the positive end of the capacitor C18 and ensure that it is not possible for this to touch the casing of the unit. Implement the instructions of STI/Radio/144 if this has not been done.

12. Inspect the four resilient mounts on the relay mounting plate for signs of perishing and renew if necessary.

Renewal of diodes

13. The three diodes (MR1, MR2, MR3) are secured to the printed circuit boards with Araldite. In the event of these components becoming unserviceable they should be carefully removed by scraping away as much adhesive as possible with a sharp instrument. Prising the component off the board should not be attempted since damage to the printed circuit board would almost certainly result. The replacement component should be secured to the board with Araldite using only sufficient adhesive to effect a secure bonding.

14. A thermal shunt should always be used to protect the diodes when soldering. Grip the diode wire to be soldered with a pair of pliers and apply only sufficient heat to effect a good joint. It is important that the correct polarity is observed when connecting these components into circuit. The red dot on the body indicates the lead which corresponds to the cathode lead of a thermionic diode; for correct positioning reference should be made to fig. 1.

Wiring

15. The wiring should be inspected for continuity and conformity with the wiring diagram shown in fig. 1 and the circuit diagram (fig. 2). To confirm the accuracy of the wiring this inspection should consist of a point to point test using item 1, para. 17.

TABLE 1

Wiring key

From	Wire colour	Length (in.)	To
TP6(b)	Black	$8\frac{1}{2}$	PLA/E
TP4(b)	Grey	$3\frac{3}{4}$	Link A/2
TP5(b)	Violet	$3\frac{1}{2}$	Link B/1
Link A/1	Blue	$6\frac{1}{4}$	PLA/B
Link B/2	Pink	$6\frac{3}{4}$	RL1/23
Link C/1	Orange	$6\frac{1}{2}$	TP3(b)
R9	Light blue	$4\frac{1}{2}$	TP1(b)
Link E/2	Brown	$4\frac{3}{4}$	RO1/2
Link E/2	Yellow	$4\frac{1}{2}$	PLA/C
Link D/2	White	$5\frac{1}{4}$	RL1/3
PLA/D	Red	$4\frac{1}{2}$	RL1/C2

From	Wire colour	Length (in.)	To
RL1/2	Brown	1	RL1/C1
PLA/C	White/grey	-	C18
C18	White/black	-	ET2
PLA/E	White/black	-	ET2
Link D/1	Light green	$2\frac{1}{4}$	TP2(b)
RL1/22	Green	$4\frac{1}{4}$	PLA/A
TP3(a)	Black	-	TB1/2
TP1(a)	Orange	$4\frac{3}{4}$	C7(a)
TP2(a)	Grey	$5\frac{1}{2}$	C8(a)
TP6(a)	Busbar	$\frac{3}{8}$	ET1
TP4(a)	Grey	-	TB1/4
TP5(a)	White	-	TB1/3
TB1/1	Pink	-	TB2/2
C9(a)	Blue	-	TB2/1
C7(b)	Black	-	TB3/11
C8(b)	Black	-	TB3/12
C9(b)	Black	-	TB3/13
V1/1	Natural	$5\frac{1}{2}$	TB3/1
V1/3	Natural	$5\frac{1}{2}$	TB3/3
V1/5	Natural	$5\frac{1}{2}$	TB3/5
V1/6	Natural	$5\frac{1}{2}$	TB3/6
V1/7	Natural	$5\frac{1}{2}$	TB3/7
V1/8	Natural	$5\frac{1}{2}$	TB3/8
T1/1	Yellow	-	TB3/10
T1/2	Brown	-	TB3/2
T1/3	Red	-	TB3/9
T1/4	Violet	-	TB3/4

16. In the event of the necessity to renew any of the wiring the correct lengths, gauge of wire and colour coding must be used as in the original (Table 1), unless modification requirements necessitate changes.

FUNCTIONAL TEST

Test equipment

17. The test equipment required to implement the following tests should be available from Service stores; further information on these items may be obtained from the publication listed. The items are as follows:-

(1)	Multimeter Type 1	10S/16411	A.P.2536C
(2)	Multimeter, electronic, CT38	10S/16308	A.P.2869AG
(3)	Bench power supply, nominal 27.5V d.c.	-	-
(4)	Bench power supply, nominal 115V a.c. 400 c/s	-	-

Testing procedure

D.C. operation

18. Ensure that the unit is wired for d.c. operation, that is with the links C, D, E made and A and B broken.

19. A 500K ohms ± 10% $\frac{1}{2}$W resistor should be connected between PLA/A and PLA/E.

20. Connect the positive pole of the nominal 27.5V d.c. bench supply (para. 17, item 3) to pole C of PLA and the negative pole to PLA/E.

21. Connect the CT38 (para. 17 (2)) with the positive lead to PLA/E and the negative lead to PLA/A. Then with PLA/D connected to frame the negative bias should vary with the supply voltage as follows:-

Supply voltage	Negative bias voltage Max.	Min.
27.5V d.c.	32.5V	20.0V
22V d.c.	24.75V	15.0V
29V d.c.	35.25V	21.5V

A.C. operation

22. Adjust the links for a.c. operation, i.e. with links A and B made and C, D, E broken.

23. Connect the nominal 115V a.c. 400 c/s bench supply (para. 17, item 4) to PLA/B and PLA/E; the CT38 (para. 17 (2)) should be connected as in para. 21.

24. With PLA/D connected to the chassis the negative bias voltage, as indicated by the CT38, should conform to the following readings when the power supply voltage is adjusted as follows:-

Supply voltage	Negative bias voltage Min.	Max.
102V a.c.	32.5V	20.0V
115V a.c.	24.75V	15.0V
124V a.c.	35.25V	21.5V

Ripple voltage

25. The r.m.s. ripple voltage as measured on the CT38 at pole A of FLA should not exceed 10 millivolts.

FINAL INSPECTION

26. Upon completion of servicing it will be necessary to inspect the units to ensure full serviceability, as follows:-

(1) Ensure that any cablelooms which have been released are relaced and the lacing varnished.

(2) All screws that are not fitted with lock washers, which have been released, should be locked with varnish after tightening down.

(3) Examine the unit for neatness of soldering, absence of dry and unsoldered joints and a generally satisfactory condition of the wiring and insulation. No inadvertant connections or tracking paths should be permitted due to excess solder, wire clippings or dirty connections.

(4) Generally examine the unit and ascertain that any damage, possibly sustained during servicing, has been made good.

(5) Finally replace the side covers of the oscillator power supply group and the unit cover. Tighten the 2 B.A. captive screws on the unit front panel.

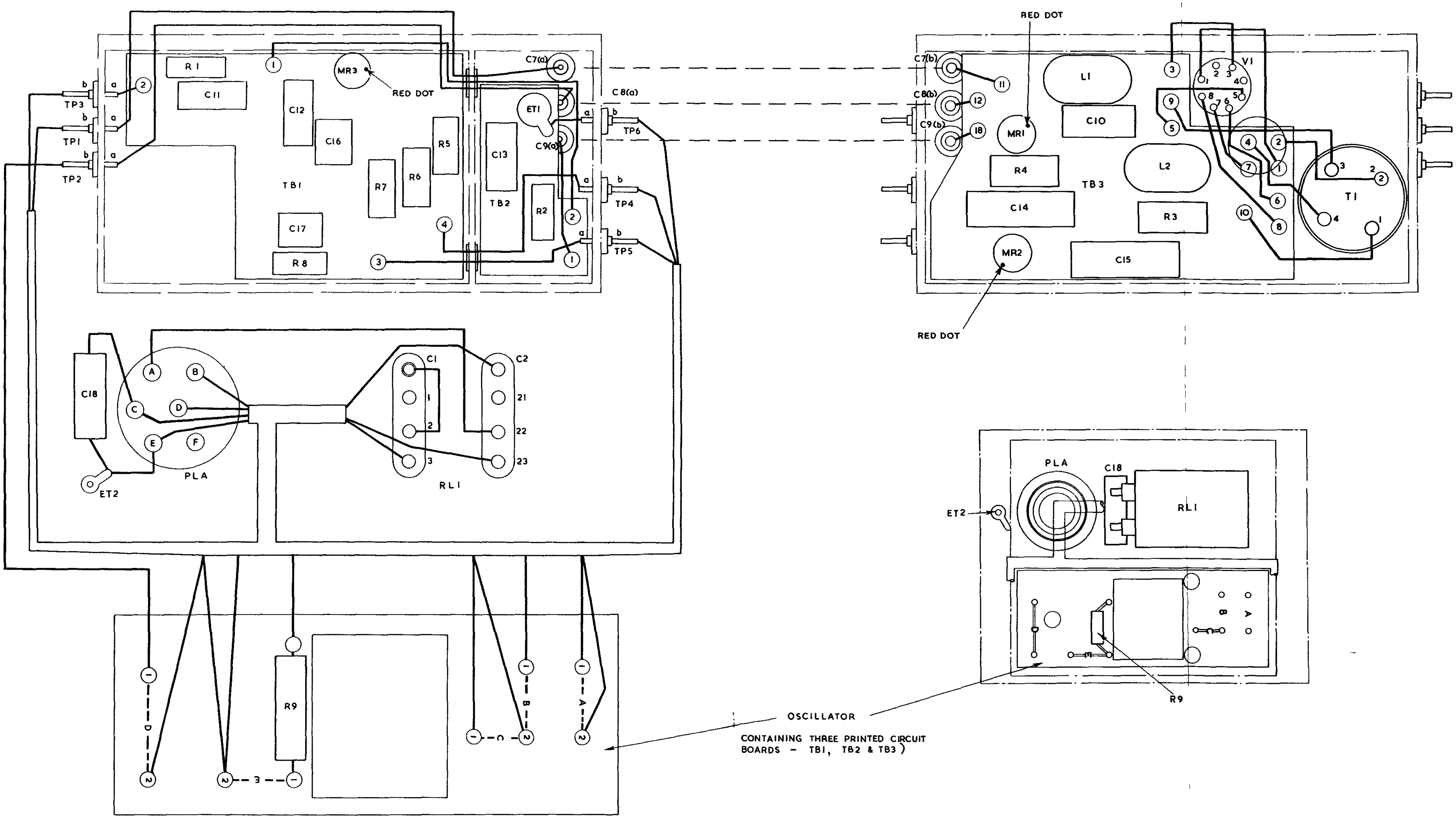

Fig. 1 ARI. 18124/1 and ARI. 18124/2— receiver muting control—wiring diagram

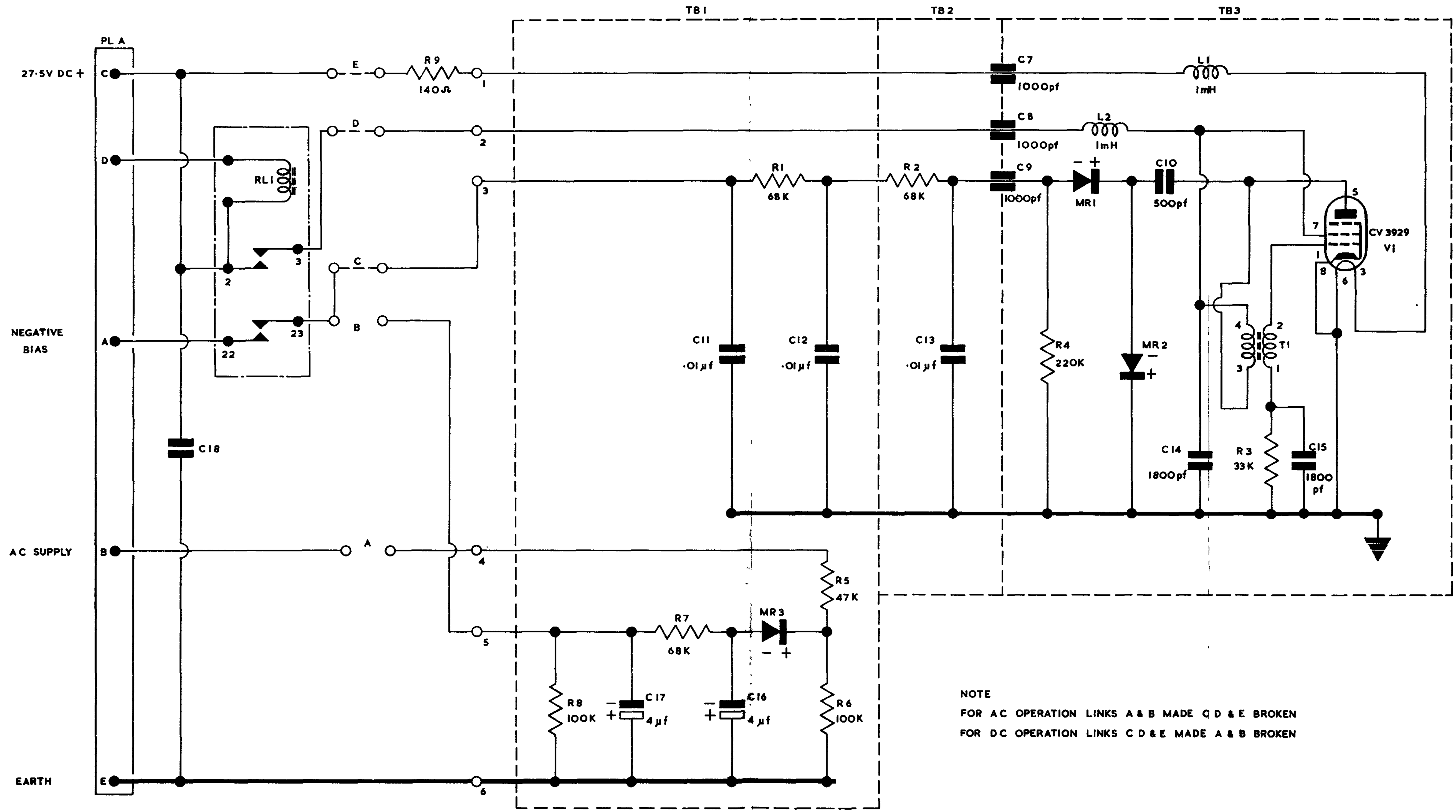

Fig.2 ARI. 18124/1 and ARI. 18124/2 — receiver muting control — circuit diagram

SECTION 3

GROUND POWER UNITS

Chapter 1

POWER UNIT (AC)
5821-99-943-7136

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Fig.

General

1. The power unit (AC) 5821-99-943-7136 provides the power requirements of the transmitter-receiver Type TR5/ARC52 when operated from an a.c. mains supply, principally when incorporated in fixed ground installations such as FGRI.23065.

2. The unit operates from a single phase a.c. source in the voltage range of 100V to 125V or 200V to 250V at a frequency between 45 c/s and 65 c/s to provide a nominal 27.5V d.c. output at up to 15A. This output is regulated to within the range 26.5V to 29V irrespective of variations in the input voltage and load.

3. Basically, the unit comprises a step-down mains transformer with two primary windings and a centre-tapped secondary winding feeding a full wave silicon diode rectifier circuit. The transformer primary is tapped to provide for supply voltage increments of 5V on the 100V to 125V range and 10V increments on the 200V to 250V range. A micro-switch

safety device is incorporated to break the supply circuit when selecting the voltage range and tap position. The inclusion of a saturable reactor, with its two reactance windings connected in the input supply circuit and the voltage and current windings connected into the d.c. output circuit, provides a degree of stabilization for changes in output current with receive and transmit conditions of the Type TR5/ARC52 and for changes in unit temperature. A detailed circuit description together with a circuit diagram for this unit is included in Vol. 1, Part 4, Chap.4 of this Air Publication.

5. When in service use with the FGRI.23065, the power unit is fitted in a mounting 5821-99-932-6394 for installation in a rack, mounting, Type 2; details of installation are provided in Vol. 1, Part 1, Sect. 2, Chap.2 of this Air Publication.

Visual examination

6. To avoid injury, the power unit should be disconnected from the mains supply before attempting any servicing.

Note...

> This equipment contains electrolytic capacitors (C1, C2, C3 and C4). Full precautions, such as discharging the capacitors, should be taken before handling any internal component of this equipment. These capacitors are grouped in a clip on the top of the unit toward the rear. Further details are included in A.P.3158, Vol. 2 which also describes the procedure for recharging the capacitors periodically when the equipment is not in use.

7. With a soft cloth or brush, clean off all dust from the exterior of the unit. Although the case is practically dustproof under normal circumstances, thorough cleaning is recommended as a matter of good practice before any servicing or dismantling is done. Cleaning will also reveal more readily any damage to the casing which may require investigation internally, or show if damage to the crackle finish enamel has been incurred.

8. Damage, such as dents in the casing, may usually be restored by careful plannishing using a hide-faced mallet or boxwood tool. Avoid the use of a steel hammer as this may stretch the metal causing distortion of the casing and subsequent loss of dustproof qualities.

Dismantling for servicing

9. The unit is enclosed within a rectangular aluminium box which is attached simply by countersunk head screws to a steel frame or chassis to which is secured the front panel. No difficulty should be met with in removing the casing when the complete unit is stood on the bench upon the protective 'D' handles fitted through the front panel. Access to all components is quite free with the casing lifted off.

10. Should further dismantling be required (for example, when renewing faulty components) it will be found that ample accessibility is provided and the method to be adopted will be self-evident from an examination of the unit. The unit is built on to a pressed steel frame and comprises four light alloy castings which are bolted together by means of high tensile steel bolts with hexagon socket heads. The bolts engage into steel wire thread inserts in the light alloy castings in order to avoid damage or wear of the softer casting alloy. These castings hold the transformer (T1) and the smoothing choke (L1) and support the saturable reactor on a bracket fixed to the castings by cheese head screws. Above the rear castings (over L1) the bank of electrolytic capacitors (C1-C4) are mounted on a laminated fibreglass tagboard.

Further forward is mounted the potentiometer RV1 upon a light metal bracket; and alongside, a stand-off tagboard carrying the neon surge limiters V1 and V2 together with other small components such as the resistors R1, R2 and R3 and capacitor C5.

11. The windings of the transformer, smoothing choke and saturable reactor are encased in epoxy resin compound mouldings as a protection against mechanical damage and the ingress of moisture or dust which would adversely affect performance.

12. Other components, such as the fuses, meter, input and output supply terminations and switches are mounted through the front (control) panel and become accessible when the panel is removed, without the necessity for removal of the main casing. The front panel can be detached from the unit frame by unscrewing eight cheese head screws accessible from the front of the unit. Behind the front panel can be seen the micro-switch, which is actuated by the fixing screw of the SUPPLY TAPPINGS cover, and also the heat sink for the two silicon diode rectifiers.

Wiring

13. A careful examination of all wiring throughout the unit should be made and any wiring which has become damaged or broken, or which shows signs of deterioration through overheating, should be renewed. Test all terminations to ensure that they are sound and securely fastened. Screw-fastened tags must be tight and clean; soldered terminations should be inspected for neatness of soldering and for evidence of tracking paths provided by excess solder or wire clippings. Make a careful examination of the lead, in the main cableform, which is fitted to permanently connect the front panel to the chassis, thus providing an earth for the front panel when this is detached from the main unit for servicing. This earth (para. 19) is essential, since an unearthed chassis is potentially dangerous during servicing with the power supply connected. Also ensure that R6 (introduced by Modification No.6256) is connected across the coil of the relay RLA.

14. Any rewiring found to be necessary must be made in wire of the same gauge and type as in the original, unless modification requirements have dictated changes. Terminations should be as in the original, also. All soldering should be made as neatly as possible; test all terminations subsequently for absence of dry joints. When renewing the neon valves, remember that irreparable damage can be caused by excessive heat; thermal shunts must always be used during soldering.

15. All wiring and terminations are accessible with the unit removed from the casing and all cables carry identification sleeves so that by reference to the wiring key (Table 1) and the wiring diagram (fig. 3 at the end of this chapter) a continuity test can be readily carried out.

TABLE 1

Power unit (AC) - wiring key

From	Colour	To	Cableform
C1/1	Blue	RV1/3	2 - 2
C1/2	Yellow/slate	X1/2	2 - 3
X1/3	Yellow/white	RV1/1	3 - 2
X1/5	Green/brown	S2-1/3	3 - 11

TABLE 1 (Contd.)

From	Colour	To	Cableform
X1/5	Blue/brown	TS1/8	3 - 4
X1/6	Black/white	S2-2/3	3 - 11
X1/7	Black/green	S1-1/1	3 - 14
X1/8	Black/red	S2-1/5	3 - 11
X1/4	Brown/violet	MR1, MR2/Neg.	3 - 6
X1/1	Brown/slate	SKT1/B	3 - 13
L1/1	Brown/red	T1/17	1 - 18
L1/2	Brown/yellow	SKT1/A	1 - 13
RV1/2	Blue/black	S3/No.	2 - 8
RLA/b	Orange/slate	S4/3	17 - 12
RLA/1	Yellow/violet	S3/COM	17 - 8
RLA/a	Black/violet	S4/5	17 - 12
RLA/22	Brown/black	S4/4	17 - 12
RLA/23	Blue/green	S2-2/11	17 - 16
PL2/A	Yellow/black	S4/4	13 - 12
PL2/B	Yellow/orange	FS2/1	13 - 10
PL2/C	Black	T1/15	13 - 5
E3	Brown	E4	13 - 5
SKT1/A	Black/yellow	M1/1	13 - 7
SKT1/B	Black/slate	M1/2	13 - 7
FS2/1	Green/white	S2-2/7	10 - 11
FS2/2	Orange/yellow	T1/1	10 - 5
FS1/1	Brown/white	T1/8	9 - 5
FS1/2	Orange	S2-1/9	9 - 11
M1/1	Yellow	S3/NO	7 - 8
M1/2	Red/slate	ILP1/1	7 - 9
ILP1/1	Green	S4/3	9 - 12
T1/2	Orange/green	S1-2/9	18 - 15
T1/3	Orange/violet	S1-2/8	5 - 15
T1/4	Brown/blue	S1-2/7	18 - 15
T1/5	Red/brown	S1-2/6	18 - 14
T1/6	Yellow/red	S1-2/5	5 - 14
T1/7	Black/blue	S1-2/4	18 - 14
T1/9	Red/black	S1-1/9	18 - 15
T1/10	Yellow/brown	S1-1/8	18 - 15
T1/11	Red/orange	S1-1/7	18 - 15
T1/12	Red/green	S1-1/6	5 - 14
T1/13	Red/violet	S1-1/5	5 - 14
T1/14	Green/yellow	S1-1/4	5 - 14
TS1/4	Green/violet	S4/6	4 - 12

TABLE 1 (Contd.)

From	Colour	To	Cableform
TS1/12	Orange/black	S4/2	4 - 12
TS1/6	Blue/red	S2-2/1	4 - 16
S2-1/1	Red/white	S1-2/1	16 - 14
S2-1/11	Yellow/green	S1-1/1	16 - 14
ILP1/2	-	R5	NOT
M1/1	-	R5	NOT
TS1/1	Brown	T1/16	NOT
TS1/2	Brown	T1/18	NOT
TS1/13	Brown	X1/4	NOT
X1/1	Brown	E2	NOT

Note...

To locate components, read the columns headed 'From' and 'To'. The cableform breakout points are shown respectively for these points in the column headed 'Cableform'. Where connections are made by single wire and not through the cableform this is indicated by the word 'NOT' in the column headed 'Cableform'.

Fuses

16. Two fuses are incorporated in this unit, both of 5A rating and on the input circuit. Both are accessible from the front panel and are of the Belling Lee Type L693/5(Ref. No. 5920-99-059-0112).

Shorting link

17. A shorting link enables the d.c. output to be connected with either the positive pole or negative pole earthed. Before connection to an external load, on completion of servicing, the link LKA must be correctly positioned to provide a positive or negative earth as required by the installation. FGRI.23065 requires the negative pole to be earthed.

ELECTRICAL TESTING

Test equipment

18. For the tests, subsequently described, which constitute a thorough examination of the power unit (AC) under varying conditions of input voltage and output current load, the test equipment listed in Table 2 will be required. Each item is standard equipment which should be available at all installations.

TABLE 2

Voltage and current test equipment

Item	Description	Reference details
1	Auto-transformer (power supply)	Variac Type 100R or equivalent (Ref. No. 5P/2493)
2	Rheostat (load) 0-5 ohms, 15A d.c.	Berco Type DE or Rheostat (Ref.No. 5P/60)
3	*Ammeter, 0-15A d.c.	Multimeter Type 1 (Avo 8)
4	Ammeter, 0-10A a.c.	Multimeter Type 1 (Avo 8)
5	Voltmeter, 0-250V a.c.	Multimeter Type 1 (Avo 8)
6	Voltmeter, 0-100V a.c.	Multimeter Type 1 (Avo 8)
7	Voltmeter, 0-100V d.c.	Multimeter Type 1 (Avo 8)
8	Oscilloscope	Cossor Model 1035 or Oscilloscope Type 13A (Ref. No.10S/831)
9	Insulation tester 500V (to measure 40 megohms)	Evershed megger Type 70013 or Insulation resistance tester Type E (Ref.No. 5G/427) or Bridge megger Type B.

Note...

*Multimeter Type 1 (Avo 8) with shunt or ammeter, m.c. 0-20A d.c. (Ref. No. 5Q/25093)

Chassis earth

19. The addition of a lead in the main cableform (modification No. 6161) to permanently connect the front panel electrically to the chassis, ensures satisfactory earthing when the panel is detached. This is an important addition to the circuit as an unearthed chassis is potentially dangerous when the unit is supplied with power and the front panel is removed during servicing. Ensure that this brown cable is complete and undamaged. Then with the front panel clear of contact with the chassis, test for a good earth continuity (using the multimeter Type 1) between the chassis and the front panel. The lead is made in wire, electrical equipment 70/0.0076 PVC, (brown) and is routed with the main cable form down the centre of the front panel and along the upper left side of the unit. Approximately one inch below this cableform is located a knurled socket headed bolt in the top left-hand corner at the far end of the space behind the front panel; this is the chassis earth point (E4). The other end of the wire (E3) terminates at the lower innermost screw of the SUPPLY plug (PL2).

Insulation test

20. Proceed with an insulation test as follows; disconnect the rectifiers MR1 and MR2 from the tagboard terminations and disconnect the earth link LKA from whichever position it may be set by removal from pin 1 of the saturable reactor. Then connect the insulation tester (Table 2, item 9) between the power unit chassis and the negative terminal of the rectifier block. The insulation resistance should be greater than 40 megohms.

21. Now connect the insulation tester between the chassis and the retaining clip holding the capacitors C1, C2, C3 and C4; the insulation resistance must again be greater than 40 megohms.

22. Test all other parts of the unit which are not intended to be connected electrically, using the insulation tester. The insulation resistance should be in all instances greater than 40 megohms.

23. Reconnect the rectifiers MR1 and MR2 and also the link LKA.

Voltage and current tests

24. Connect up the test equipment (Table 2, items 1 to 8) as shown in fig. 1. The meters shown as A1 and A2 are, respectively, ammeters 0 to 10A a.c. (input) and 0 to 15A d.c. (output); the voltmeters shown as V1 and V2 are, respectively, Variac output voltage meter 0 to 250V a.c. and unit output voltage meter 0 to 100V d.c.

25. Set the range switch (S2) of the power unit (AC) to the 200-250V (upper) position and the tapping switch S1 to the 250V position. Now set the rheostat load to maximum resistance and the Variac output voltage (as measured on V1) to 245V.

26. Switch on the power unit (AC) at the ON/OFF SUPPLY switch and adjust the load, by means of the rheostat, to draw 7A output current as measured on the d.c. ammeter A2. Reset the Variac if necessary to maintain the input voltage level at 245V. The output voltage, as shown on V2, should read 28V ± 1V. Record the reading.

27. Now decrease the load resistance until the output current measured on meter A2 is 15A. The output voltage should not fall by more than 1V on that obtained in para. 26. Read the ammeter A1 in the input circuit; this reading should not exceed 3.5A.

28. Reduce the output voltage from the Variac to 235V, as indicated in the meter V1, and repeat the operations described in para. 26 and 27. The output voltage, as measured on the meter V2, should be 27V ± 1V.

29. The oscilloscope (Table 2, item 8) should now be connected across the rheostat load as shown in fig. 1 whilst the procedure given in para. 26 and 27 is again repeated. The output ripple as observed on the oscilloscope for 7A and 15A loads should not exceed 2V peak to peak.

30. Switch off the power unit ON/OFF SUPPLY switch and reduce the Variac output voltage (meter V1) to 107.5V. Set the range switch S2 of the power unit (AC) now to the 100-125V position and the tapping switch S1 to the position marked 105V.

31. Now switch on the power unit (AC) and measure the output voltage, on meter V2, with both a 7A and a 15A current drain as indicated on meter A2. The output voltage should be 28V ± 1V in each test.

32. Measure the input current (meter A1) with the load resistance set to give an output current of 15A (meter A2); the input current should not exceed 7A.

33. Reduce the Variac output voltage to 102.5V (meter V1) and repeat the test described in para. 31. The output voltage from the power unit (shown on meter V2) should be 27V ± 1V. Note that the meter (M1) on the front panel of the power unit should read the same, subject to a variation limit of ± 1.25V.

34. Switch off the power unit (AC). Now with the range switch S2 set to the 100-125V range and the tapping switch set to the position marked 100V, switch on the power unit and adjust the Variac and rheostat load resistance to give a 7A current drain (as shown on meter A2) with a voltage input (meter V1) of 100V. The output voltage shown on meter V2 should read 28V ± 1V.

35. Repeat the test described in para. 34, but this time with the tapping switch set to the 105V position and the Variac set to produce a reading of 105V on meter V1. The output voltage (meter V2) should again be 28V ± 1V. This test may then be repeated with the tapping switch set successively to 110V, 115V, 120V and 125V and with the Variac set for a corresponding input voltage (shown on meter V1). In all tests the output voltage as shown on meter V2 should be 28V ± 1V.

36. Set the range switch of the power unit (AC) to the 200-250V position and repeat the tests in para. 35 for tapping switch settings of 200V, 210V, 220V, 230V, 240V and 250V successively, with the Variac adjusted for corresponding input voltages. The output voltage readings (meter V2) for all tests should be 28V ± 1V.

37. The complete series of tests described in para. 30-36 should now be repeated but with the load current, as shown on meter A2, set to 15A by adjustment of the rheostat. In all these tests, the output voltages should be 27.5 ± 1.5V (shown on meter V2).

Safety micro-switch testing

38. The input range and tapping setting switches are located on the front panel beneath a hinged cover which is secured by a single screw engaging with a micro-switch. Loosening the screw to unlock the cover also releases the micro-switch, thereby shutting off the power unit circuit and protecting the switches from heavy surge current effects when adjustments are made to the input supply voltage with the power unit connected to the mains supply.

39. The correct operation of the micro-switch can be tested by first unscrewing the SUPPLY TAPPINGS panel cover screw, opening the panel and verifying that the switches S2 and S1 (range and tapping respectively) are set for the local mains supply. Then close the cover and secure the screw. Connect the unit input at PL2 (INPUT) to the mains source and the unit output to SKT1 (D.C. OUTPUT) via the terminations of the front panel of the power unit. Now operate the centre biased ON/OFF SUPPLY switch to the ON position and hold it there until the D.C. OUTPUT lamp lights and the D.C. OUTPUT meter indicates a full reading. Unscrew the cover retaining screw until the micro-switch operates; the D.C. OUTPUT lamp goes out and the D.C. OUTPUT meter reading falls to a minimum. Close the panel cover and secure the screw.

Neon surge limiter tests

40. The resistors R1 and R2 limit the surge current to the transformer T1 when the unit is switched on; a further protective circuit is provided, however, consisting of the two neons V1 and V2 (CV2213) which are connected across the transformer secondary winding. The running voltage of these two neons in series is slightly in excess of the peak to peak voltage developed across the transformer secondary. A large voltage surge, due to single energy transients when the unit is switched on, would cause the neons to strike and thus dissipate the energy of the voltage peak. This surge could be as high as 800V, which would cause a large inverse current in the silicon rectifiers MR1 and MR2 thereby resulting in junction breakdown.

41. The neons can be tested by setting the ON/OFF SUPPLY switch to the ON position and holding it there until the D.C. OUTPUT lamp lights. At

this point verify that the surge voltage causes the neons to strike.

Balancing of potentiometer RV1

42. The correct functioning of the saturable reactor (X1) depends upon the correct setting of the potentiometer RV1. This potentiometer is preset at the factory and locked in position; it should not require adjustment except after changing a major component.

43. The test equipment required for resetting this potentiometer is listed in Table 3 and is arranged as shown in fig. 2.

TABLE 3

Potentiometer balancing test equipment

Item	Description	Ref. details
1	Rheostat, 0-5 ohms, 15A d.c.	Berco Type DE or Rheostat (Ref. No. 5P/60)
2	Ammeter, m.c. 0-20A d.c.	5Q/25093
3	Multimeter Type 12889	10S/17447
	or	
	Multimeter Type 9980	10S/17001
4	Plug, free 2-pole, 19A	10H/9403239
5	Socket, free 4-pole, 19A	10H/9408648
6	Cable, electric, 4-core 19A (as required)	
7	Toggle switch (15A)	5A/4304

WARNING

The electrolytic capacitors (C1, C2, C3 and C4) must be discharged before handling or servicing any component within the unit.

44. Proceed by setting up the input supply. Unscrew the SUPPLY TAPPINGS panel cover screw, open the cover and set the switches to provide 200V input. Relock the cover in position, then verify that the mains supply voltage is at 200V a.c. using the multimeter, on the 250V a.c. range, as shown at V1 (fig. 2).

45. Reset the multimeter to the 25V a.c. range and connect it between the tags 5 and 7 of the saturable reactor (X1) as shown at V2. Operate the power supply unit ON/OFF SUPPLY switch to ON. Set the rheostat load to draw 7A as indicated on the ammeter A1 (Table 3, item 2).

46. Release the locking plate to permit adjustment of the potentiometer RV1 (located on a bracket on top of the unit when withdrawn from the casing). This adjustment should be made to give a maximum reading on the multimeter (V2) that is, 24V $\pm$ 2V.

47. Now turn the potentiometer spindle counter-clockwise to decrease the reading (para. 46) by 2V. Decrease the rheostat load resistance until the reading on ammeter A1 is 15A. The reading of the multimeter at V2 should then fall to less than 10V.

48. Should the reading of the multimeter (para. 47) be greater than 10V, continue with the counter-clockwise adjustment of the potentiometer until the reading does become 10V.

49. Adjust the rheostat load to produce a reading of 7A in the ammeter (A1). The multimeter reading (V2) should now be greater than 20V.

50. Lock the potentiometer adjuster carefully, by means of the locking plate, taking care to avoid altering the setting. If any doubt exists, verify the setting by repeating the test. Operate the unit ON/OFF SUPPLY switch to OFF, then disconnect the multimeter.

51. Make an output test by first connecting the multimeter across the unit output, as shown at V3 of fig. 2., then operate the unit ON/OFF SUPPLY switch to ON. The ammeter A1 should read 7A (as adjusted in para. 49) and the output voltage reading (meter V3) should be 28V $\pm$ 1V. Now increase the load resistance to 15A, as shown on the ammeter A1. The output voltage reading should fall by not more than 1V.

52. Operate the unit ON/OFF SUPPLY switch to OFF and switch off the mains supply before disconnecting the test equipment. Fit the power supply unit into the outer casing and securely tighten the retaining screws.

Setting up for service use

53. Full details of the procedure for setting up the power unit (AC) for operation in the FGRI.23065 are included in Vol. 1, Part 1, Sect. 2, Chap. 2 of this Air Publication. Additional information, covering the treatment of equipment containing electrolytic capacitors before reissue to service use, is given in A.P.3158 Vol. 2, Leaflet H13.

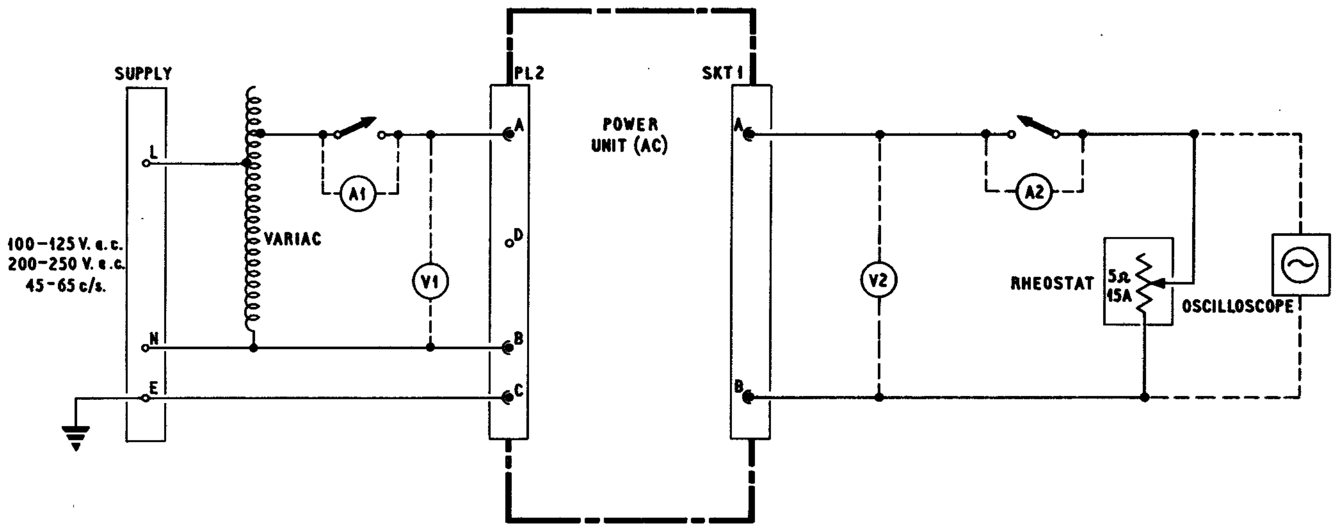


Fig. 1. Arrangement of voltage and current test equipment

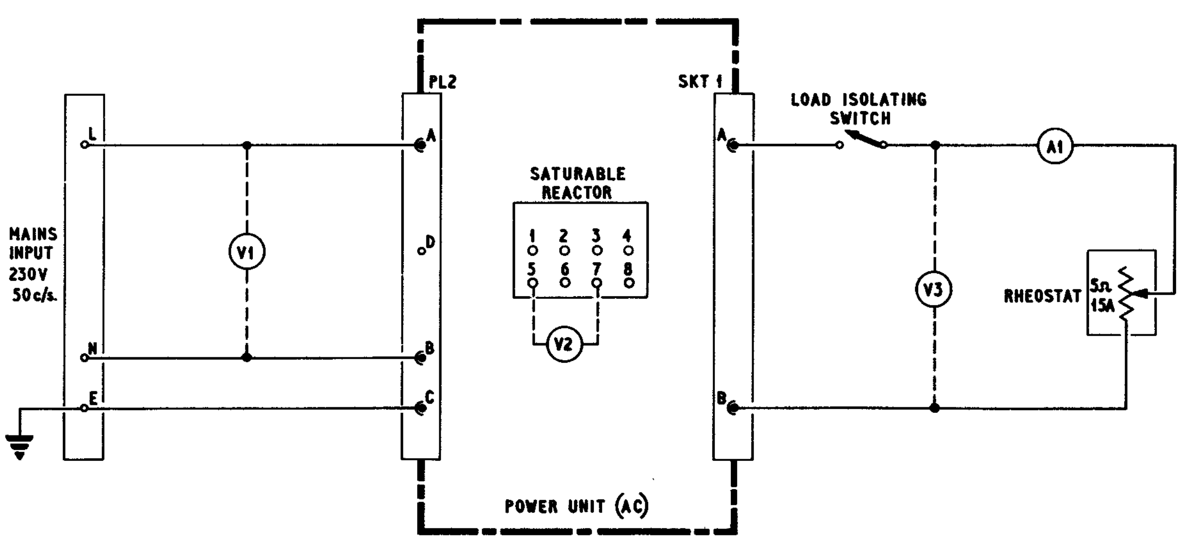
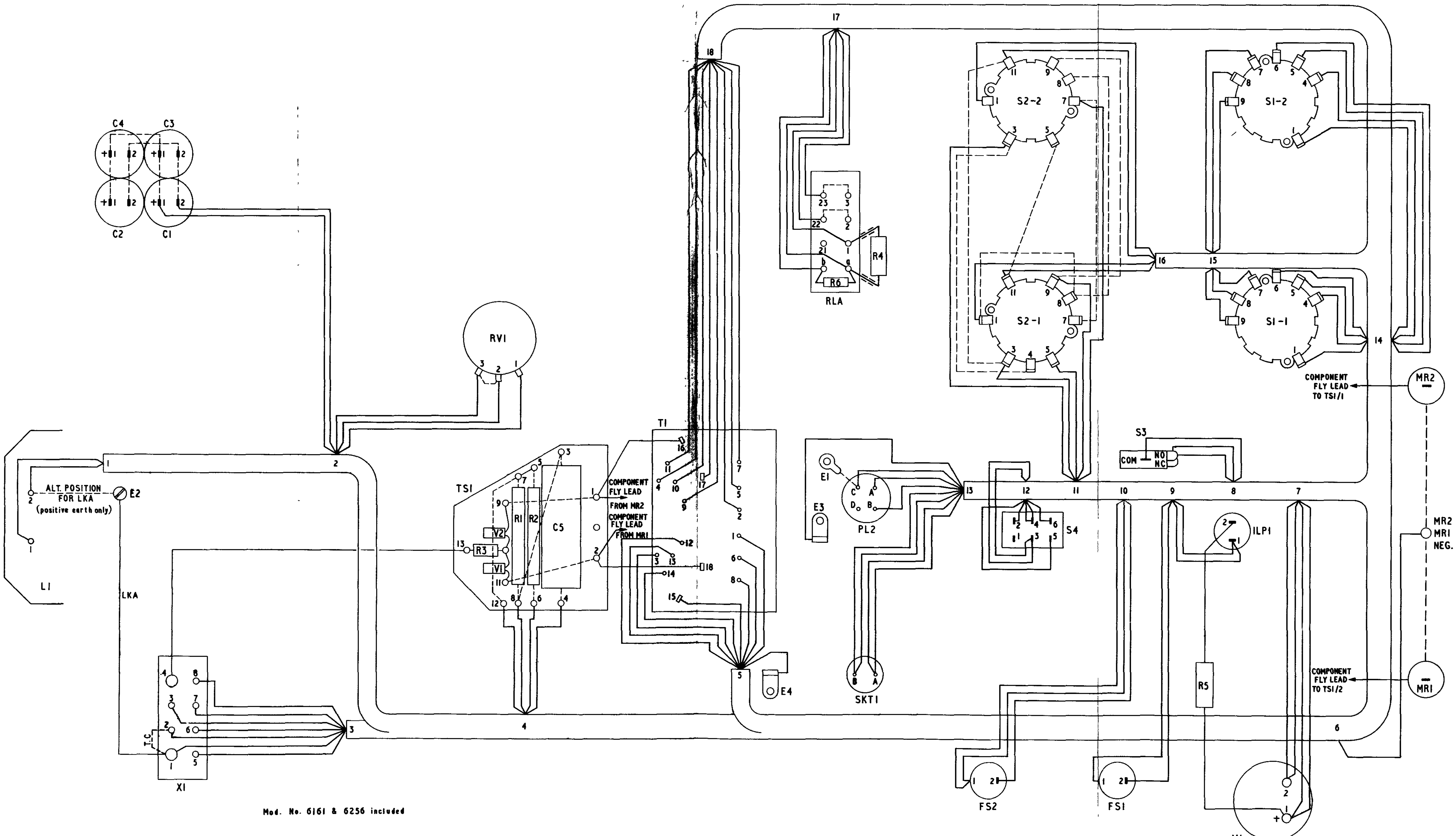


Fig. 2. Potentiometer balancing test equipment arrangement



Mod. No. 6161 & 6256 included

Fig. 3 Power unit (AC) 5821-99-943-7136 : wiring diagram

Chapter 2

DYNAMOTOR POWER SUPPLY

6125-99-999-1276

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General

1. The dynamotor power supply 6125-99-999-1276 operates from a battery source and will function correctly with input variations between 20.6V and 31.6V to provide the power requirements of the transmitter-receiver Type TR5/ARC52 when incorporated in mobile or transportable installations such as the MGRI.23073.

2. The unit comprises a differential compound wound d.c. motor driving a d.c. generator, which is connected in series with the battery supply, and a 400 c/s single phase alternator. The output of the alternator provides a supply for an incorporated magnetic amplifier which, in turn, controls the field current of the d.c. generator. The alternator out-

put is also rectified and stabilized by means of a saturable reactor, neon and Zener diodes to provide a reference voltage for control of the output. Incorporated in the unit are surge protection devices, a meter to monitor both the input and output voltages, and indicator lamps. A description of this power supply unit is given in Vol. 1, Part 1, Sect. 2, Chap. 3 of this Air Publication and a circuit description and diagram are included in Vol. 1, Part 4, Chap. 5.

3. In service use, this power supply is supported in its own mounting tray (5821-99-999-1583) and usually located remote from the transmitter-receiver. Details of mounting and location are provided in Vol. 1, Part 1, Sect. 2, Chap. 3.

Visual inspection

4. Before any attempt is made to dismantle or service this unit, switch off the main equipment (transmitter-receiver) and then set the power supply unit DC INPUT switch to the OFF position; in addition, disconnect the input and output connectors from the power supply unit. This course of action is essential before the unit may be removed to the bench, but it is also a safety precaution advised before any servicing is undertaken since up to 400V a.c. is present in the unit when power is applied.

Note ...

This equipment contains electrolytic capacitors (C2, C3 and C4). Full precautions such as discharging these capacitors, as detailed in A.P.3158, Vol. 2, should be taken before handling any internal component or attempting any servicing of the circuit.

5. Using a soft cloth or brush clean off all dust or mud from the exterior of the unit. Although the construction renders the case virtually dust-proof, thorough cleaning before commencement of dismantlung is a practice to be recommended; further, a clean unit may more readily be inspected for damage to the casing or finish and will obviate possible troubles arising from contamination of internal components.

6. Evidence of corrosion requires that the unit is cleaned of all traces of aluminium oxide and the black crackle enamel finish restored at once. Damage to the casing which has resulted in dents may usually be restored. by gentle plannishing using a hide-face mallet or boxwood plannishing tool. Avoid the use of a metal hammer which may cause distortion of the casing. Distortion of the aluminium casing can mean that the unit will be no longer dustproof when reassembled.

7. Examine the equipment with regard to its modification state and incorporate any that may be outstanding. Full details of modifications are given in Volume 2 of this Air Publication, but brief details of those modifications in existence at the time of going to print are given at the end of this chapter (para. 53).

Overheating

8. The machine becomes warm and even slightly hot if run for any length of time, despite the induced airflow provided by the integral fan. This is quite normal, but the unit should not become so hot that it begins to smoke or smell or to become too hot to touch with the bare hand. A burned out motor is usually the result of overheating caused by the effects of moisture on the windings or by an overload, either mechanical or electrical.

Dismantling

9. The unit may be dismantled on the bench by first unscrewing the four captive bolts from the rear end of the outer casing, then removing the exhaust filter housing. With the unit now standing upright upon the protective D-handles which are fitted into the front panel, the outer casing may then be drawn off in an upward direction. Take care during this dismantling to avoid tilting the unit forward on the base of the front panel; in this attitude the D-handles do not protect the MOTOR 30A fuse holder which may become damaged through contact with the bench. The interior of the power supply unit is now accessible from all sides.

10. The front panel is made in heavy gauge aluminium plate and is fixed to the box shaped filter housing by seven 4BA cheese head screws, accessible from the front of the panel. The connecting leads from all components mounted through the panel are sufficiently long to enable the panel to be moved away from the unit for access to the panel mounted components such as the Zener diodes (MR3), capacitors (C1, C11, C12 and C13) and the meter, lamp and switch terminals.

11. If it is necessary further to dismantle the unit by removing the back plate, take great care to avoid damaging the exposed alternator windings.

Wiring

12. The wiring of the dismantled power supply unit should be carefully inspected for soundness and continuity. This inspection should consist of careful visual examination for damage caused by pinching of wiring leads against sharp edges of component mountings, for deterioration of the covering due to overheating or other causes and for loose terminations, followed by point-to-point tests or such electrical tests which will confirm the accuracy of the wiring to the wiring diagram (fig. 3) and to the wiring key (Table 1). All wiring and terminations are accessible without dismantling further than the stages described in para. 9 and 10, and all wires carry identification sleeves.

TABLE 1

Wiring key

From	Colour	To	Cableform
SW2/6	Yellow/black	SKT3/A	A1 - A2
LP2/2	Yellow/violet	FS1/2	A1 - A2
LP1/1	Yellow/orange	RLD/3	A1 - A5
FS3/1	Blue/white	L2/1	A2 - A6
FS3/1	Blue/red	C3/-	A2 - A15
FS3/2	Black/brown	TB3/GEN+	B28 - B30
FS1/1	Black/red	RLE/4	B28 - B30
FS1/1	Blue/slate	RLD/1	A2 - A5
FS1/2	Black/orange	TB3/GEN-	B28 - B30

TABLE 1 (continued)

From	Colour	To	Cableform
RLD/6	Blue/orange	TB2/11	A5 - A19
L2/2	Yellow/red	MR3/2	A6 - A1
L2/4	Blue/brown	C2/-	A6 - A15
L2/7	Blue/green	TB3/F1-	A6 - A12
L2/3	Blue/violet	RV1/3	A6 - A17
L2/10	Green/slate	MR1/4	A6 - A31
L2/9	Blue/black	TB3/AC	A6 - A16
PL4/E1	Yellow/green	LP2/1	A4 - A1
PL4/E1	Yellow/blue	RLC/X1	A4 - A3
MR3/+	Yellow/slate	TB2/9	A1 - A19
SKT3/A	Black/violet	RLA/2	B28 - B30
PL4/E2	Black/blue (two)	TB3/COM-	B28 - B30
RLE/3	Black/green	TB3/INP+	B28 - B30
ELC/X2	Yellow/white	RLB/3	A3 - A23
RLC/A2	Black/yellow	RLA/1	B29 - B30
RLA/3	Green/white	C4/+	A9 - A10
RLA/3	Green/red	RLB/a	A9 - A23
C4/-	Red	TB2/6	A19 - A22
C3/+	Brown/orange	TB2/4	A11 - A26
C3/-	Red/slate	MR2/8	A15 - A27
C2/-	Orange/violet	MR1/7	A15 - A25
C2/+	Green/violet	TB3/F1+	A18 - A13
C2/+	Green/black	MR1/6	A18 - A25
C15/1	Black	TB2/8	A18 - A19
C15/2	Black	L1/4	A18 - A20
L1/1	Orange/slate	MR2/1	A21 - A27
L1/2	Brown/violet	TB2/8	A21 - A19
L1/3	Brown	TB2/2	A20 - A27
L1/3	Brown/black	TB2/7	A20 - A19
L1/4	Orange/white	V1/1	A20 - A19
L1/5	Brown/white	TB3/AC	A20 - A16
RLB/b	Orange/red	TB2/6	A23 - A22
RV1/1	Brown/red	TB2/1	A17 - A27
TB3/COM-	Green/orange	TB2/1	A10 - A27
TB3/ALT.F+	Red/white	MR2/8	A14 - A27
TB3/AC	Brown/slate	MR1/3	A16 - A31
TB3/ALT.F-	Green/brown	TB2/10	A14 - A19

TABLE 1 (continued)

From	Colour	To	Cableform
TB3/F2-	Green	TB2/12	A14 - A19
V1/2	Red/violet	TB2/4	A19 - A26
MR2/6	Orange	TB2/4	A27 - A26
MR2/7	Red/black	TB2/5	A27 - A24
TB2/5	Orange/black	RLB/2	A24 - A23
LP2/2	Yellow/brown	RLD/2	A1 - A5
LP2/1	Brown	M1/2	Not
LP2/1	Orange	MR3/1	Not
FS2/2	Green	SW2/4	Not
FS2/2	-	RLC/A3	Not
FS2/1	-	TB4/3	Not
SW2/5	Red	M1/1	Not
LP1/2	Green	MR3/1	Not
FS1/2	-	SW1/1	Not
FS1/2	-	SW1/M	Not
SW1/2	-	FS2/1	Not
SW1/L	-	FS2/1	Not
FS2/1	-	PL4/A	Not
FS2/1	-	PL4/B	Not
RLE/2	Red/blue	RLB/3	Not
RLE/1	Red/green	TB2/3	Not
RLE/4	Brown/green	TB5/2	Not
RLE/3	Brown/blue	TB5/1	Not
RLA/4	Yellow	MR2/5	Not
L3/1	Yellow	TB3/AC	Not
L3/2	Brown	TB3/AC	Not
TB6/2	Red/brown	MR1/8	Not
TB6/4	Red/orange	TB3/F1-	Not

Note ...

In order to locate the connected components, use the columns headed 'From' and 'To'. The route including entry and exit points (breakouts) from the cableforms A or B, is shown in the last column to the right. Use in conjunction with the associated wiring diagram (fig.3).

13. It is important to ensure that any rewiring found to be necessary is made in wire of the correct gauge and type as in the original, unless modification requirements dictate changes. New wiring, or any disturbed wiring, should be refitted using the correct type of termination. Most of the wiring is terminated in tags which are fitted to terminal boards by cheese head screws and washers and which must be securely tightened before assembly of the power supply unit.

14. All soldering should be done as neatly as possible, with no inadvertent tracking paths provided by tails of excess solder or wire clippings. Test all terminations to ensure the absence of dry joints. When renewing the silicon diodes, use a thermal shunt to avoid irreparable damage caused by excessive heat.

Fuses

15. Examine the fuse units to ensure they are securely fitted into the holders which, in turn, must be secured into the front panel. The values for replacement fuses are as follows:-

(a) Generator - Fuse link, cartridge type, 15A (FS3) (5920-99-058-0147)

(b) Motor - Fuse link, cartridge type, 30A (FS1) (5920-99-059-0151)

(c) Load starting - Fuse link, cartridge type, 40A (FS2) (5920-99-999-2251)

MOTOR AND GENERATOR SERVICING

Commutator attentions

16. Clean the motor and generator commutators of all traces of carbon deposit. Access can be gained for this operation by first removing the brush cover plates from the housing, then carefully lifting the brush retaining springs to permit the brushes to be withdrawn. A piece of stiff wire bent into a hook or L-shape will facilitate lifting of the brush springs without damage. The springs may be lodged on the lip of the brush holders.

17. Commutators should ideally be perfectly clean and free from uneven discolouration of the smooth, bright copper surface, with each segment fully insulated from adjacent ones. Any deposits of brush carbon, dust or moisture is detrimental to trouble-free operation and full performance from the machine. If the surface is dulled by carbon or light discolouration, the commutators may be adequately cleaned by means of a soft, fluff-free cloth which can, if necessary, be moistened with lead-free gasoline. Never use water or kerosine for cleaning purposes. The cloth can be wrapped around the finger or a thin strip of wood or plastic and pressed against the commutator surface whilst the armature is rotated by hand from the alternator end. Always allow a period of time (5 to 10 min.) to elapse between cleaning using gasoline and any subsequent electrical testing. Evaporation of gasoline and elimination of fire risk can be accelerated by subjecting the internal cavities of the machine to a prolonged blast of clean, dry air.

18. Light marking, scoring or pitting of the commutator surface can usually be remedied by means of very fine grade sandpaper (never metallic emery cloth). The paper should be cut into narrow strips and wrapped diabolo fashion around the commutator so as to cover the complete width of copper surface. The ends of the sandpaper strips can be passed through the

brush apertures and held between the fingers whilst the commutator is rotated. For best results the armature spindle should be rotated at high speed, with only gentle tension applied to the abrasive strip. This will avoid the formation of flats on the commutator surface which may give rise to sparking when the machine is put into service. Cease operations just as soon as the copper surface is smooth and bright, then clean all dust and debris from between the copper segments.

19. The remedy for scored, pitted, ellipitcal or eccentrically worn commutator is to dismantle the machine further and set up the armature in a lathe for skimming of the commutator. The motor and generator share a common armature spindle and both are housed within an aluminium casting which is bolted, at the forward end, to the box chassis associated with the filter housing and front panel bracket. At the rear end of the casting is secured the alternator unit which can be detached following removal of the steel backplate (para. 9) and four hexagon socket head bolts. The sub-chassis which carries the relays RLB and RLA, neon stablizer and rectifiers, is secured to the top of the casting by four 4BA screws and four 6BA screws; also on the top face of the sub-chassis is mounted the saturable reactor which is held in position by two 4BA screws. This chassis should be removed and all components carefully stowed away from the working area of the bench before lifting the motor and generator casting clear of the unit frame.

20. After carefully setting up the armature in the lathe, that is to run as truly concentric as possible, skimming of the commutator can be effected. Only the lightest possible cut should be made, just sufficient to remove the defect. Constant measurements must he taken to ensure that skimming to remove pitting does not reduce the diameter of the commutator beyond the permissible worn dimension as defined in Table 2. In order to achieve the desired fine finish, a diamond-tipped tool is to be preferred; the feed should be set as fine as possible and speed to high. With experience, this method should be all that is necessary, although in some establishments it is standard practice to finish commutators by polishing with finest grade sandpaper using tallow as a polishing compound.

21. After commutator skimming, the mica insulation between segments should be undercut to a depth of approximately 0.025 in., in order to prevent troubles attendant upon arcing and brush wear caused by proud mica. The correct tool for this purpose comprises a short saw-toothed blade with a rigid back set into a handle. The blade should be the same thickness as the mica and worked back and forth in the slot between segments to restore the correct undercut of the mica insulation. Take care to avoid unsteadiness during undercutting; a slip of the tool may lead to scoring of the finely finished soft copper commutator which would thus require further treatment before being fit for service.

22. Finally, thoroughly clean the commutator with a clean rag; this should be moistened with lead-free gasoline if a polishing compound is used. The gaps between segments can be cleaned using a small brush. Further particulars of overhaul procedure for small electrical machines can be obtained by reference to A.P.1186D or A.P.4343.

TABLE 2

Motor and generator servicing details

Commutators

Diameter:	Nominally 1.875 in; worn dimension 1.687 in;
Mica recess:	0.025 in. deep.

Brushes

Type:	Mortley, Sprague grade EGO (motor); Mortley, Sprague grade CM5H (generator)
Dimensions:	New 1 in. x 5/8 in. x 5/16 in; worn (max.) 23/32 in. long.
Spring pressure:	12 oz.

Bearings

Type:	Hoffman BRL.012 single row, ball journal 12 mm. x 32 mm. x 10 mm. (two per machine) Hoffman No. 112, 0.0 fit (or equivalent).
Lubricant:	Grease to DTD.825A. The correct quantity is that required to fill one-third of the space in the bearing (only); excessive grease may cause overheating.

Windings

Average values of resistance at 20°C.

Motor:	Armature, between commutator bars 90° apart	0.055 ohms
	Interpoles, two coils in series, machine serial numbers below 84394, (40 machines)	0.023 ohms.
	Interpoles, two coils in series, machine serial numbers 84394 and above	0.029 ohms.
	Series field, four coils in series	0.019 ohms
	Shunt field, four coils in series	84 ohms.
Generator:	Armature, between commutator bars 90° apart	0.026 ohms.
	Interpoles, two coils, per coil	0.013 ohms.
	F1 field, four coils in series	170 ohms.
	F2 field, four coils in series	90 ohms.

TABLE 2 (continued)

Motor and generator servicing details		
Alternator:	A.C. winding, four coils in series	46 ohms.
	Shunt field winding	49 ohms.
	Series field winding	0.03 ohms

Brushes

23. Worn brushes tend to cause faulty or erratic running, usually with attendant sparking. Sticking brushes cause sparking as also does a dirty, rough or worn commutator; and it is important to remember in this connection that sparking quickly wears and roughens the commutator surface to cause further excessive sparking.

24. All carbon brushes should be examined, therefore, after each 1,000 hours of running time. Renew worn, chipped or cracked brushes; and treat them as sets per machine, renewing all brushes even if only one is unserviceable to ensure an even brush pressure and equal load on the commutator. In general, brushes which are worn for more than one-third of the original length should be renewed as a matter of course. If one brush is worn more than another on the same machine, investigation should be made to find the cause. This may be due to carbon accumulations, spring failure or because the wrong grade of brush has been fitted earlier.

25. Only the correct replacement brushes should be fitted in this machine. These are ready-bedded and suitable for immediate use without further attention. The use of square-ended brushes should be avoided as this may result in blown unit fuses and possible extensive damage to the machine. Although the brushes for both motor and generator are identical in size they are not interchangeable as they are of different grades, as detailed in Table 2.

26. When refitting brushes, ensure that they slide freely within the holders to rest squarely upon the commutator surface; accumulations of carbon dust may prevent a smooth action if allowed to remain in the brush holders. Verify that the flexible brush leads are secure and sound, and do not become clamped by the brush retaining springs when these are re-engaged. If brushes are replaced (without renewal), be sure they are refitted in exactly the same way as they were before renewal in order to retain the original seating. Brush springs should engage with the centre of the top face of the brushes; with brushes which are worn to any extent there is the danger that the spring will rest on the holder and not bear correctly upon the brush.

27. Brush spring pressures should be matched throughout the machine, and should conform to the recommended limits. A small spring balance can be used to determine the force exerted on each brush (Table 2). Brush springs which are broken or damaged are normally easy to see, but it must be remembered that springs may individually lose temper resulting in uneven brush pressures and consequent unequal loading upon the commutator.

28. The brush apertures in the motor/generator housing are fitted with aluminium plates, each secured by two 4BA screws. These plates not only protect the brush gear but also close the aperture against escape of the induced cooling airstream through the machine. Bent or distorted cover plates must be carefully restored to the original contour in order to provide a close seal at the apertures.

Bearings

29. All bearings are packed with suitable lubricant on assembly at the factory and then sealed. No further lubrication should be needed until the bearings require renewal.

Field coil testing

30. Short-circuits between the turns of wire forming a coil cause the resistance to become lower than that in a perfect coil. Tests for internal short circuits can be made by connecting two or more similar coils in series with the battery test supply and measuring the voltage across each coil with a voltmeter. The voltage of a coil having some of its turns short circuited will be lower than that in one in good condition; the resistance of each coil in a set of field coils should be matched to within ± 5% of each other. Discrepancies outside this limit should be remedied by renewing the faulty coil(s).

Armature windings tests

31. To diagnose and locate faults in armature windings, a d.c. voltage drop test can be applied. This test is applied to discover short circuits or breaks in the coils. The test gear required comprises the battery test supply, a variable resistance and millivoltmeter.

32. The armature under investigation is supported by the spindle in an insulated frame (i.e. wooden jig) on the bench, with two fixed contacts (A and B, fig. 1) placed at a contact angle of 90 deg. to contact two segments of the commutator. Two leads from the millivoltmeter are fitted with test prods which are then spaced to contact two adjacent commutator segments. The variable resistance is set to give a mid-scale reading on the millivoltmeter and, providing that the armature is sound, the meter readings will be practically identical for each pair of segments on the commutator. The same relative position between the fixed contacts and the test prods should be maintained throughout the test, by rotating the armature by one segment at a time without moving any other test equipment.

33. With the armature in position on the test frame and the two contacts (A and B) in the battery circuit connected to those coils which lie between an angle of 90 deg., the current from A to B is opposed by the resistance of those coils. The voltage drop in overcoming this resistance should be approximately equal for each coil or group of coils between adjacent commutator bars. The two test prods are connected through the millivoltmeter to record this voltage drop. If the voltage drop between adjacent bars all round the commutator is equal then the resistance must also be equal and the windings, thus, free from shorts or open circuits. At inset (a) of fig. 1 is shown an open circuit on the centre coil; the current from the test battery is interrupted at this point until the commutators bars b and c are connected via the millivoltmeter. Full voltage is thus applied and the meter registers a dull scale reading. At inset (B) the two commutator bars (b and c) are shown short-circuited, with a meter reading at zero. Any sizeable discrepancy between meter readings indicates a defect in the armature winding.

Filter cleaning

34. The forced air cooling system incorporated in this unit is inducted by a fan on the motor armature spindle, drawing air through the side filters at the front end of the unit frame and exhausting through a filter in the backplate. Depending upon the location of the power supply unit in the installation and the amount of running time and prevailing climatic conditions, a regular periodicity for cleaning of the filters should be established.

35. Access to the filters can be gained when the outer unit casing has been removed. The intake filters may be detached from the box chassis after unscrewing the countersunk screws which pass through four lugs on each filter casing into the box chassis; the exhaust filter can be shaken out of the rear filter housing. To clean off dust from the filter packs, place each filter face downwards on a hard, flat surface (the direction of flow arrow then pointing upwards) and tap the sides and upper surface lightly with the fingers to dislodge accumulated dust. If necessary, the filters may be cleaned by use of a vacuum cleaner applied to the outer surfaces. If damp, the packs should be allowed to dry to room temperature before cleaning takes place. No oiling or treatment other than periodic cleaning is necessary. When refitting the filters ensure that they are fitted the right way round, with the direction of flow arrows pointing in the appropriate direction.

36. Replacement filters should be fitted if the cleaning reveals damage to the filtering element, or if dust is found inside the unit. These are supplied under the following A.B.C.S. Cat. Nos.:-

Side filters (intake) - 4130-99-999-2646
Rear filters (exhaust) - 4130-99-999-2645

ELECTRICAL TESTING

Test equipment

37. To implement the functional tests and potentiometer balancing described in subsequent paragraphs, the test equipment listed in Table 3 is required. All items are standard service equipment which should be available at any installation.

TABLE 3

Dynamotor power supply - test equipment

Item	Description	Ref. No.
1	Batteries (3) 12V, 100AH	5J/2379
2	Ammeter, moving coil, 0-20A	5Q/25093
3	Ammeter, moving coil, 0-50A	5Q/1632
4	Multimeter, Type 12889	10S/17447
5	Switch, toggle, 15A	5A/4304
6	Plug, free, 2-pole, 19A	10H/9403239
7	Socket, free, 4-pole	10H/9408648
8	Cable, Quadrasheathround 19	5E/2985

TABLE 3 (continued)

Item	Description	Ref. No.
9	Clip, crocodile	5K/9400856
10	Rheostat, 0-7 ohms, 15A or Rheostat	Berco Type DE 5P/60
11	Insulation resistance tester Type E	5G/407
12	Multimeter Type 1 or Multimeter Type 9980	5QP/16411 6625-99-943-1524

Insulation test

38. The insulation resistance measured between any two parts of the unit not intended to be connected electrically should be not less than 40 megohms when tested with the insulation resistance tester (Table 3, item 11) at 500V.

Voltage and current tests

39. The equipment listed in Table 3 (items 1 to 10 inclusive) should be made up into a test set as shown in fig. 2. The socket (item 7) and crocodile clip (item 9) should be made up as a test input connector, using two pieces of the cable (item 8). One piece of the same type cable is sufficient for connecting voltmeter V1 (Table 3, item 4) and one piece is also sufficient for making up each pole of a test output connector using the plug (item 6). Both connectors should be kept as short as practicable to minimize voltage drop. Throughout all testing operations, the batteries (item 1) should be kept on trickle charge.

40. Remove the dynamotor power supply to the servicing bench and take off the outer casing (para. 9), then settle the unit firmly in a clear working space.

WARNING ...

When the input supply is connected to the unit, voltage will be present at the output socket even though the unit ON/OFF D.C. INPUT switch is set to OFF. Make all connections on the output side before coupling the input supply to the unit and proceeding with the following tests.

41. Measure the regulated output voltage, as indicated on meter V2 (Table 3, item 4), with the input voltage set successively to 22V, 26V and 30V; these three points are arbitrarily chosen to represent the approximate low, middle and high levels of the normal input voltage range. They may be selected by tapping the battery supply and by means of the crocodile clip and test input cable (para. 39.) For each input voltage tapping, the rheostat load should be adjusted to give a reading of 15A on meter A2. In all cases the output voltage indicated on meter V2 should be 27.5V ± 0.5V. Repeat the tests with the rheostat load now set to give readings of 7A on meter A2; the output voltage readings should remain at 27.5V ± 0.5V.

42. With an input voltage on 22V (as shown on meter VL) and the rheostat set to give an output current reading on A2 of 15A, use the multimeter (Table 3, item 12) to measure the voltage between pole 4 of the saturable reactor (L1) and the chassis. This voltage should be 108V $^{+4.0V}_{-3.0V}$. This test should then be repeated at an input voltage tapping of 30V and load current of 7A; the output voltage shown on the multimeter should again be 108V $^{+4.0V}_{-3.0V}$.

43. At input voltage and output current conditions as in para. 42, the voltage between positive and negative connections to the diodes of MR3 should be between 29.1V and 32.1V and should not vary by more than ± 0.6V for the two input voltages and load settings.

44. Now switch off both the input supply and the dynamotor unit and connect the 0-50mA meter (Table 3, item 3) in series with the orange/white lead connected to terminal 4 of the saturable reactor. Switch on the input supply and dynamotor unit and record the reading of the milliameter with an applied input voltage of 22V (as shown on V1) and an output current of 15A (meter A2). Obtain a second reading with an input voltage of 30V and output current of 7A. The milliameter reading in both instances should read between 5 mA and 30 mA. Switch off and disconnect the supply and reconnect the orange/white lead to terminal 4 of the saturable reactor.

45. With the supply connected again, adjust the input connector to the dynamotor unit to tap 22V as indicated on meter V1. When the rheostat load is adjusted to a reading of 15A on meter A2 the input ammeter (A1) reading should be not greater than 40A.

46. A feature of the dynamotor supply unit is the incorporation of an INPUT LOW lamp (ILP1) which provides visual warning should the input voltage fall below 21V. The functioning of this lamp can be verified by setting the rheostat load to 7A (meter A2) then connecting the input supply clip in turn to the battery terminals which will show readings of 24V and 20V on meter V1. The lamp should light with a 20V supply but remain extinguished with 24V input.

47. With the input supply connected and the dynamotor unit switched on, disconnect the load by opening switch S1 (fig. 2). The current sensitive relay RLA should then be observed to release. Then when the switch is closed again a delay of approximately 1-2 seconds should elapse before the relay energizes.

<u>Balancing of potentiometers RV1 and RV2</u>

48. The correct functioning of the magnetic amplifier (which controls the output of the d.c. generator) is dependent upon the amount of feedback obtained from the feedback windings. Feedback is adjusted by selection of a suitable tapping on the windings and by adjustment of the potentiometers RV1 and RV2. These potentiometers are carefully preset at the factory; they should not normally require altering except where renewal of a major component has become necessary. When this occurs, proceed by first setting up the test equipment as shown in fig. 2, then set the dynamotor unit ON/OFF switch to ON and close the load isolating switch S.1. The rheostat should then be adjusted to give a reading of 7A on meter A2.

49. The potentiometers RV1 and RV2 are located on the saddle bracket at the rear of the unit, when the outer casing is removed. Release the locking plate fitted over RV1 adjusting screw and set both potentiometers fully counter-clockwise. The blue/green lead should, at this stage, be connected to terminal 7 of the magnetic amplifier, (L2).

50. Connect the input supply from the batteries to give a reading of 22V on meter V1 then adjust potentiometer RV1, by clockwise rotation, until the output reading (meter V2) is exactly 27.5V. Record the output voltages at inputs of 22V, 24V, 26V, 28V and 30V with a load of 7A.

51. Repeat the test (para. 50) and record the output voltages with a new load of 15A. Then, according to the results obtained in the two series of tests, proceed with balancing as follows:-

(1) If the maximum difference between any two recorded results is less than 0.5V, reset potentiometer RV1 so that the nominal voltage of the readings is 27.5V. But if the readings obtained are not more than 0.5V higher than nominal at low inputs, adjust potentiometer RV2 to bring the output variation to within as close a limit as possible (resetting the output voltage to 27.5V with RV1, as necessary).

(2) If the readings (para. 50 and 51) are low at low inputs, move the blue/green lead from pin 7 to pin 8 of the magnetic amplifier. Turn RV2 fully counter-clockwise and repeat the two series of tests. If these new readings are within 0.5V of nominal, reset RV1 to make 27.5V the nominal and verify satisfactory results by a further repetition of the tests (para. 50 and 51). Should the readings be not more than 0.5V higher than nominal at low inputs, turn RV2 clockwise and repeat the test series to obtain a set of readings within as close a limit as possible.

(3) Should the readings (para. 50 and 51) be high at low inputs, move the blue/green lead from pin 7 to pin 6 of the magnetic amplifier. Then turn RV2 fully counter-clockwise and repeat the test series. If these readings are within 0.5V of nominal, reset RV1 to make 27.5V the nominal and repeat the tests. If the new readings are not more than 0.5V higher than nominal at low inputs, adjust RV2 in a clockwise direction; repeat the test series and reset RV1 to make 27.5V the nominal until the readings obtained are within as close a limit as possible.

(4) When the readings obtained in (3) are still low at low inputs, move the link joining pins 5 and 8 of the magnetic amplifier to connect between pins 5 and 6 then move the blue/green lead back to pin 7. Repeat the test series, resetting RV1 to give a nominal of 27.5V. Set RV2 to give a result to as close a limit as possible, repeating the setting of RV1 to keep the nominal at 27.5V.

NOTE ...

The terminals of the magnetic amplifier can be exposed for alterations after removing the front panel screws and easing the panel forward to provide access. The cableform is of sufficient length to permit adequate movement of the front panel to provide working space.

Setting up for service use

52. Full details for the procedure to be adopted in setting up and operating this equipment are given in Vol. 1, Part 1, Sect. 1, Chap. 5 of this Air Publication.

Modifications

53. Modifications No. 5973 (strike off No. 1) provides for the addition of a 180 ohms resistor (R12) across the magnetic amplifier bias winding, and a 270 ohms resistor (R11) across the main feedback winding, in order to retain the potentiometers RV1 and RV2 well within the limits of adjustment for all tolerance conditions.

54. Modification No. 6348 (strike off No. 2) provides for the addition of a 1uF capacitor (C15) across the saturable reactor bias and control winding, in order to minimize the alternating current component contained in the neon current.

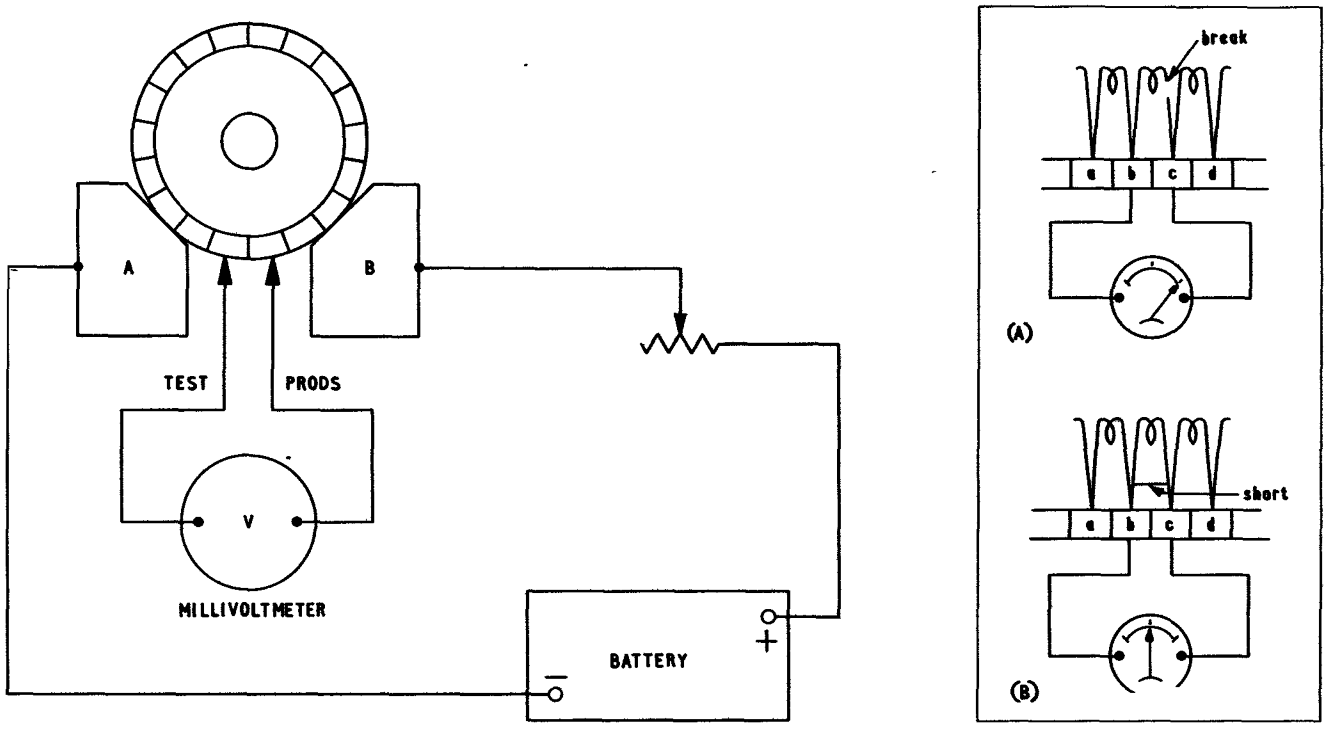


Fig. 1. Armature windings tests and fault location

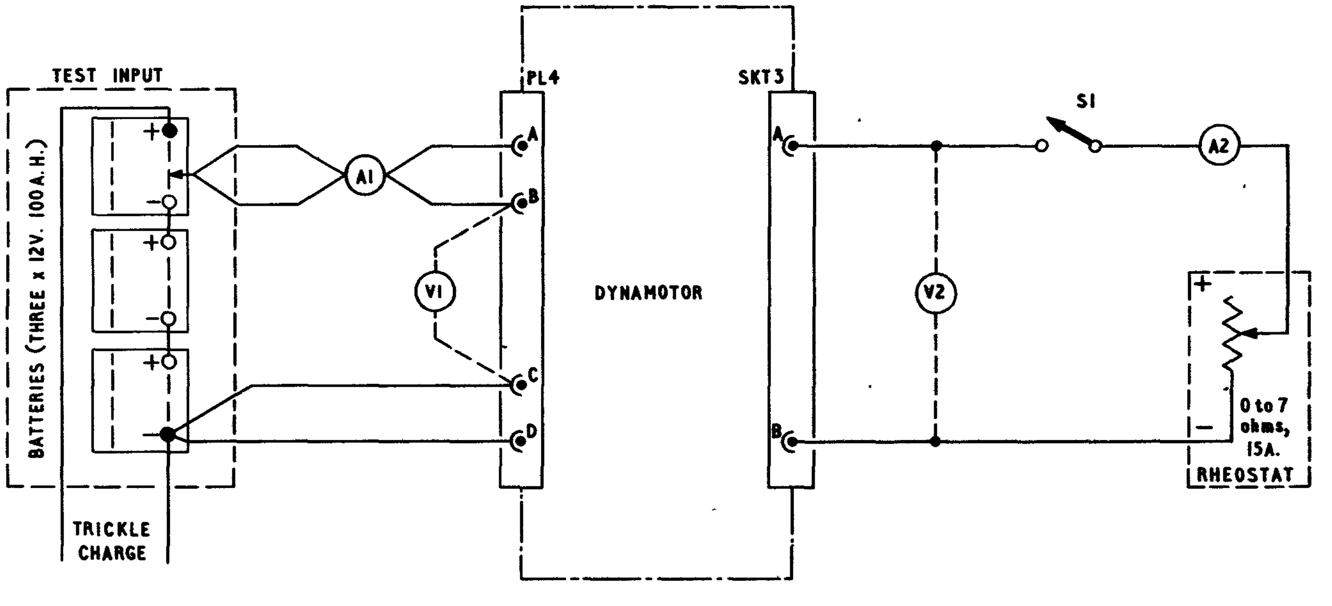
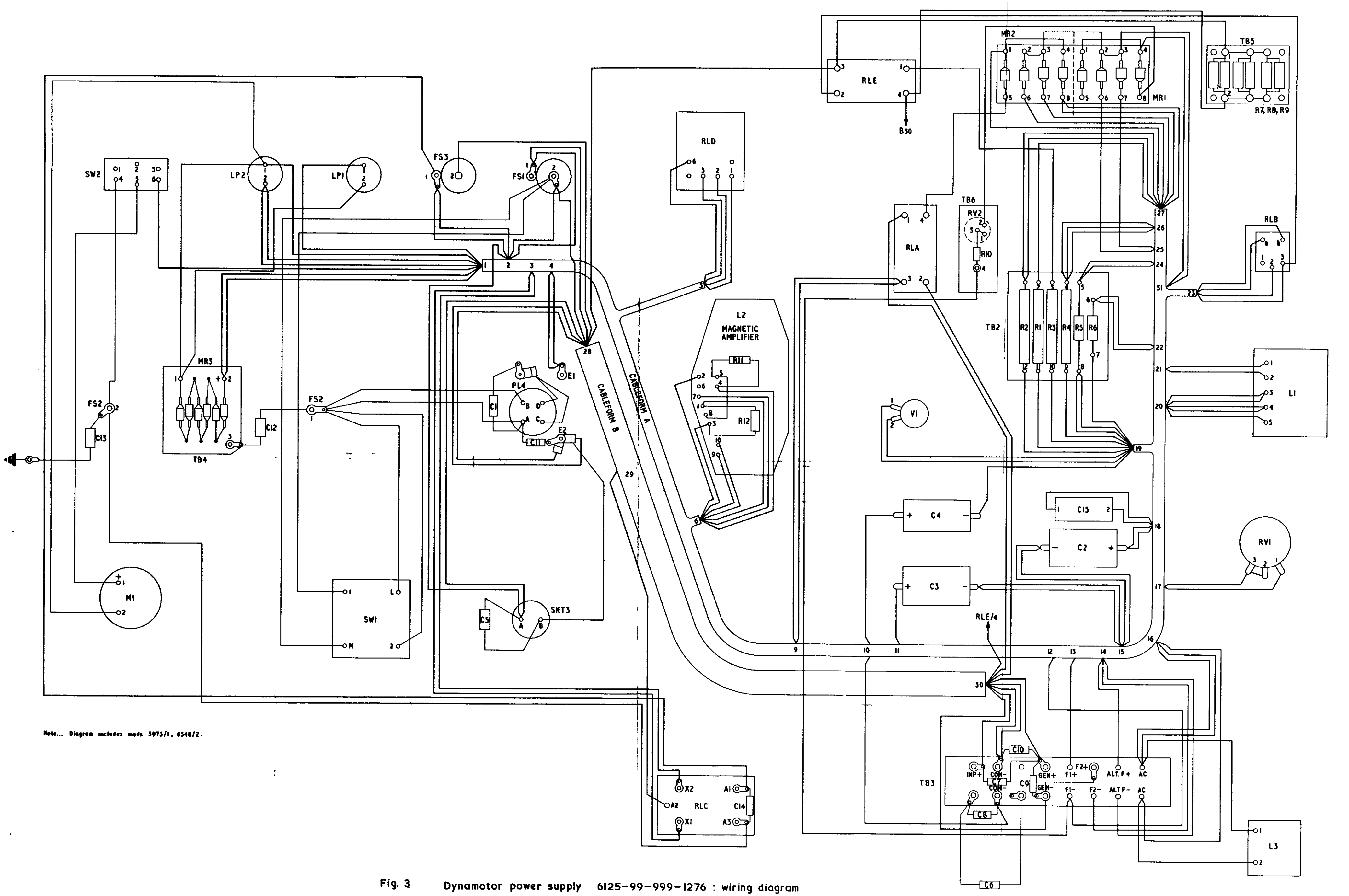


Fig. 2. Arrangement of test equipment



Note... Diagram includes mods 5973/1, 6348/2.

Fig. 3 Dynamotor power supply 6125-99-999-1276 : wiring diagram