STATION, RADIO, A41, NO 1 AND 2

TECHNICAL HANDBOOK - TECHNICAL DESCRIPTION

Note: This Issue 3, Pages 1-2, supersedes Issue 2, Pages 1-2 dated 16 Oct 64. Detail covering the Rebroadcast unit and Relay unit has been added.

This EMER must be read in conjunction with Tels F 482 Part 2 which contains figures and tables to which reference is made

SUBJECT INDEX

INDEX TO FIGURES - (cont)

TRANSMITTER/RECEIVER, RADIO, A41, NO 1

INTRODUCTION

1. The radio set A41, No 1 is a manpack set intended for infantry use in forward areas. It is a v.h.f., f.m. transceiver, continuously tunable over the frequency range from 38-55Mc/s, with 171 channels spaced at 100kc/s intervals. The set is similar to the US AN/PRC 10A and Canadian AN/PRC 510.

2. A superheterodyne receiver is used, and a 2.15Mc/s crystal controlled oscillator provides check points for dial calibration. The r.f. power output is about 750mW and provides a nominal range of about five miles.

3. The following antenna systems may be used:-

(a) 4 ft whip type sectional rod.

(b) 10 ft whip type sectional rod.

(c) 4 ft vertical rod, with a counterpoise earth wire.

(d) Remote half-wave antenna which includes a matching unit.

(e) Portable homing loop.

4. The audio equipment normally used with the set is:-

(a) Officer's headset: Telephone, hand, SI, No 4G

(b) Operator's headset: Microphone and receiver headgear assembly, SI, No 1A.

BRIEF TECHNICAL DESCRIPTION

5. A complete block diagram is given in Fig 1.

Principles of operation

6. The headset pressel switch carries out the send-receive switching by connecting the l.t. to the required valve filaments. The mixer (V5), oscillator (V12), i.f. stages (V6, 7, 8, 9) and a.f. amplifier (V10) filaments are in use on both receive and send.

Receiver

7. The receiver is a single superheterodyne with an intermediate frequency of 4.3Mc/s and is fed by a common antenna circuit used for both send and receive conditions. The receiver has two stages of r.f. amplification (V3 and V4) with accompanying tuned circuits feeding a mixer (V5). These tuned circuits together with

the sender tuned circuits and mixer oscillator circuit are ganged; a special five section capacitor being used for this purpose. The local oscillator (V12), which operates at 4.3Mc/s above the signal frequency, is mixed with the signal in the mixer (V5). The resulting 4.3Mc/s is then applied to V6 which is the first stage of i.f. amplification.

8. The amplifier V6 is followed by three further stages of amplification (V7, V8, V9). Limiting of the signal takes place in these circuits by increasing self bias of each stage and the output is then fed to the discriminator, employing two germanium diodes (MR1, MR2). The output from the discriminator is applied to an a.f. amplifier (V10) thence via a transformer coupling to the headgear.

9. When the set is in the receive condition the filament circuits of V1, V2, V11 and V13 (the modulator, m.o./p.a., crystal calibrator oscillator and sweep oscillator respectively) and the h.t. supply to V1 and V2 (the modulator and m.o./p.a. respectively) are broken.

Calibrator

10. A crystal calibrator operating at 2.15Mc/s, when on the switch position CAL (S-A), feeds harmonics into the second r.f. stage, and the second harmonic into the first i.f. stage of the set. In this way the r.f. signal is converted by the mixer and local oscillator (V5, V12) to 4.3Mc/s, and beats with the second harmonic from the calibrator oscillator (V11) in the i.f. stages of the set. Calibration points are marked on the dial every 2.15Mc/s, and thus by listening to audible beat notes and zeroing, calibration can be carried out accurately every 2.15Mc/s at the points mentioned. In the CAL position of S-A, the dial is illuminated by lamp ILP1.

Sender

11. The sender consists of a crash limiter or speech clipper (MR3, MR4) fed from the microphone output. A high frequency pre-emphasis network is also included in this circuit. The output from the crash limiter is then fed to the modulator (V1) and is frequency modulated by a ferrite reactor (X1) in the anode of the modulator. The output from the ferrite reactor is then fed via a tuned circuit to the m.o./p.a. (V2) and hence to the antenna circuit.

12. When the set is in the send condition the supply to the filaments of the two r.f. stages (V3, V4) is removed. Sufficient r.f. coupling, however, exists to allow for sidetone to be delivered at the output of the receiver.

13. Automatic frequency control is obtained in two ways:-

(a) When the sender oscillator drift is within the limits of control of the receiver discriminator (approximately 80kc/s deviation) a frequency control voltage is developed in the discriminator (MR1, MR2) which changes the bias of the modulator (V1). The current of the modulator, therefore, changes and causes the transmitter oscillator (V2) to change in a direction opposite to the drift by virtue of the ferrite reactor (X1).

(b) When the sender oscillator drift is outside the limits of control of the receiver discriminator, the pulse generator or sweep oscillator (V13) operates with the 4th i.f. (V9) as a multivibrator. The output from the multivibrator is applied to the modulator (V1) and sweeps the sender oscillator through ±1Mc/s until the discriminator can take control, as in sub-para (a), when the multivibrator action ceases.

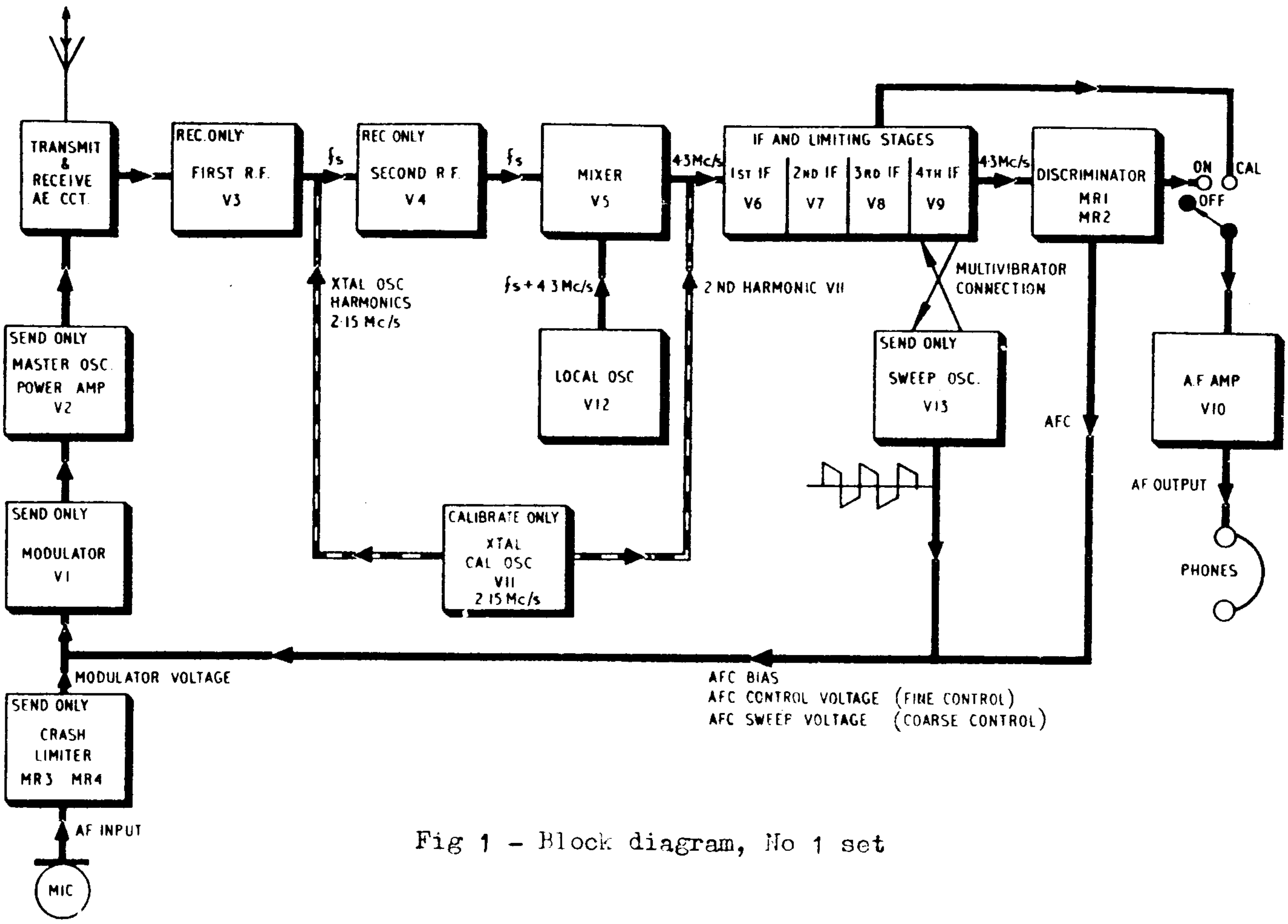

Fig 1 - Block diagram, No 1 set

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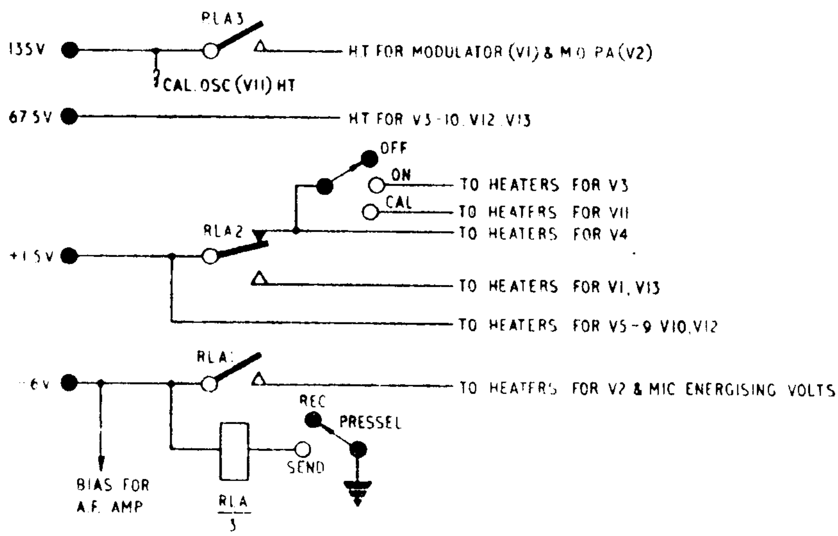

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Fig 2 - Power supplies, No 1 set

Power supplies

14. The set operates from a dry battery having a life of approximately 20 hours and giving the following nominal voltages:-

L.T.	1.5V
H.T.1	67.5V
H.T.2	135V
G.B.	-6V

BRIEF MECHANICAL DESCRIPTION
(Fig 3 and 4)

15. The set consists of a main chassis and several sub-chassis and panels. The plug-in units (Fig 4) are situated on one of these sub-chassis and can be removed easily on undoing the plug-in unit panel cover. The wired-in units are situated on another chassis and are removed by screws. The adjoining valves, V12, V5, V4 and V3, plug into the wired-in units and are held by a cover panel screwed to the main chassis. The other main components (main tuning capacitor, valves V1, V10, V11 and crystal) are situated in the main chassis. The set is contained in an aluminium alloy case. The battery is contained in an aluminium battery box which attaches to the set case by means of spring loaded clamps. The set is approximately 17.7/8 in. high, 2.15/16 in. deep and 9.3/4 in. wide. The weight of the wireless set and battery case (with no battery) is approximately 10.1/2 lb. The set is fully sealed and can be used anywhere in the world.

16. The equipment, when mounted on its appropriate harness, is capable of being operated in wheeled and tracked vehicles at altitudes up to 10,000 ft. The equipment may be transported by air at altitudes up to 25,000 ft and parachute dropped, using standard dropping equipment.

17. A short 8-wire cable and plug (PL2) connects the battery to the set power socket, when it is assembled into its case.

18. Plug-in units are employed for the 1st i.f., 2nd i.f., 3rd i.f., 4th i.f., discriminator and sweep oscillator (see Fig 4). Each of these stages is built into a can 2 in. x 3/4 in. x 3/4 in., containing a subminiature valve with its associated wiring and components. These units are fitted with B7G valve bases which locate in a main chassis.

19. Wired-in units are employed for the receiver oscillator, mixer, 1st r.f., 2nd r.f. and transmitter oscillator (see Fig 4). The first four have their associated miniature valves connected by miniature plugs and sockets, and held by a retaining plate. Each of these stages is built into a can approximately 2.4 in. x 1.3 in. x 0.5 in. The receiver oscillator, mixer, 1st r.f. and 2nd r.f. units have a socket for miniature plug-in valves V12, V5, V3 and V4 respectively.

20. The remaining three miniature valves are held in position by plugs and sockets, and a metal retaining plate. The m.o./p.a. valve (V2) is situated on a sub-chassis next to the main tuning capacitor.

21. The 5-gang tuning capacitor and dial are driven by a set of brass anti-backlash gears.

22. The desiccator is situated on the base of the chassis nearest the battery plug.

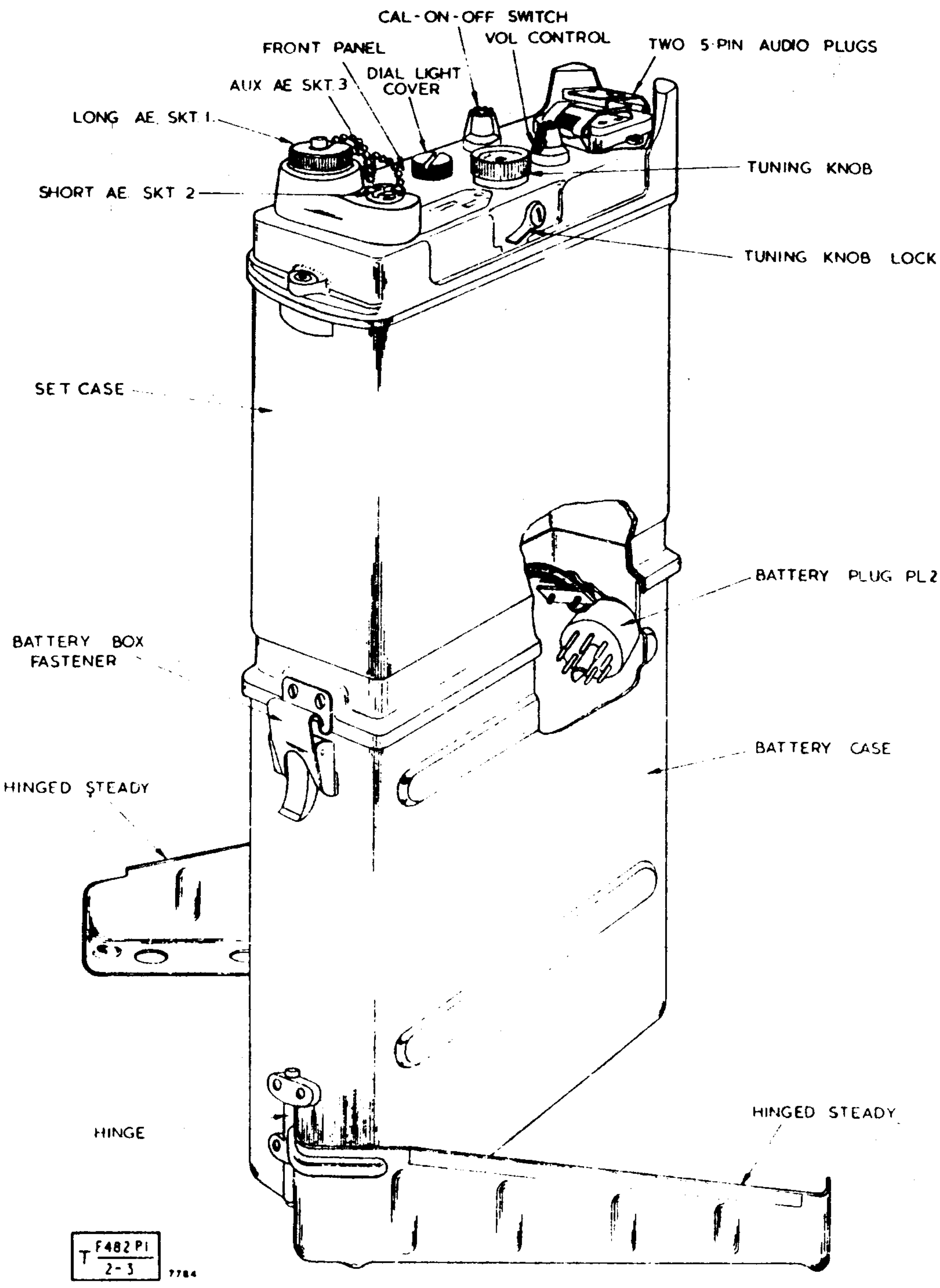


Fig 3 - General view of set and battery case

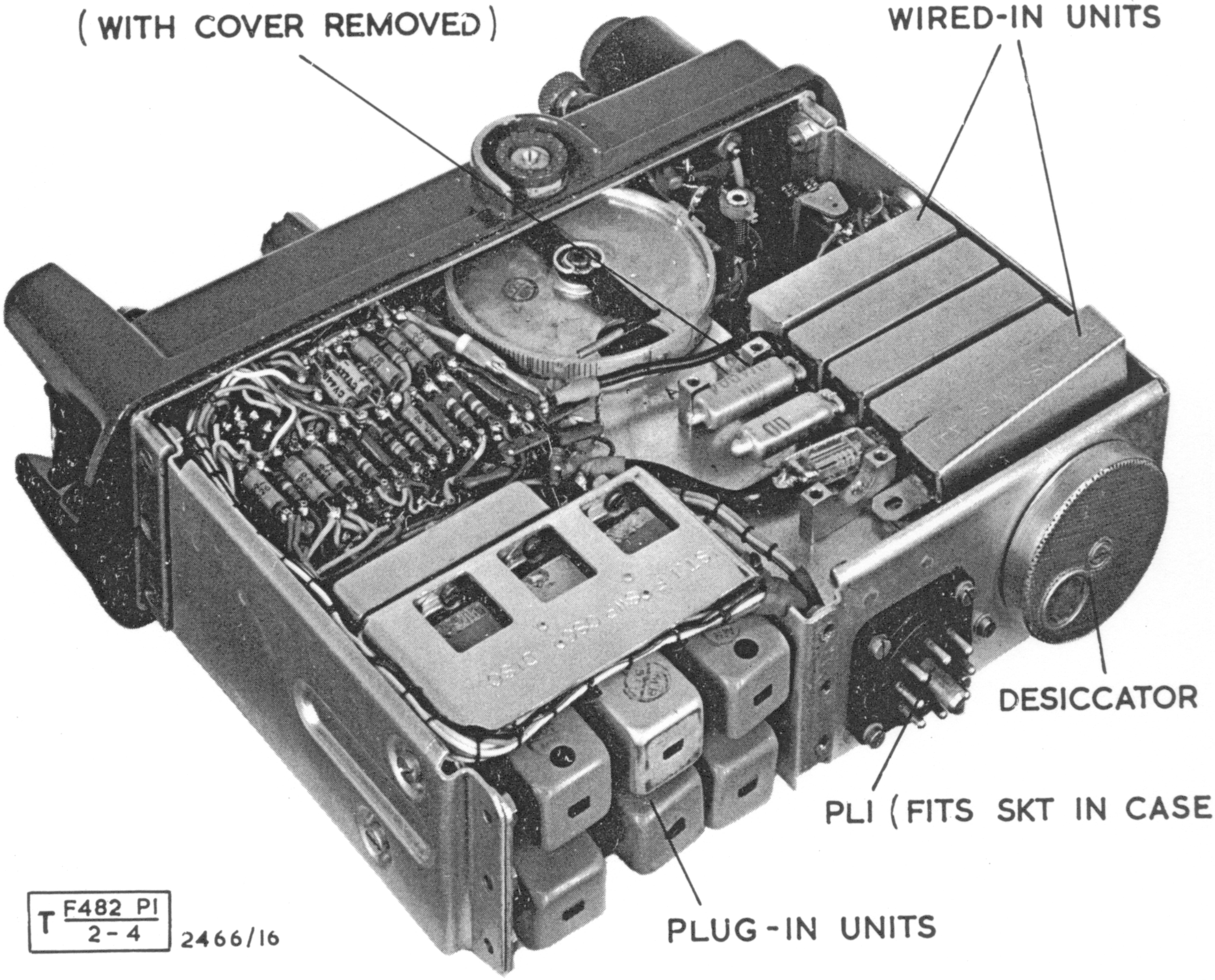


Fig 4 - Construction of set

23. Retaining plates over the plug-in units and the wired-in units and valves are all clearly marked showing the stage covered by them.

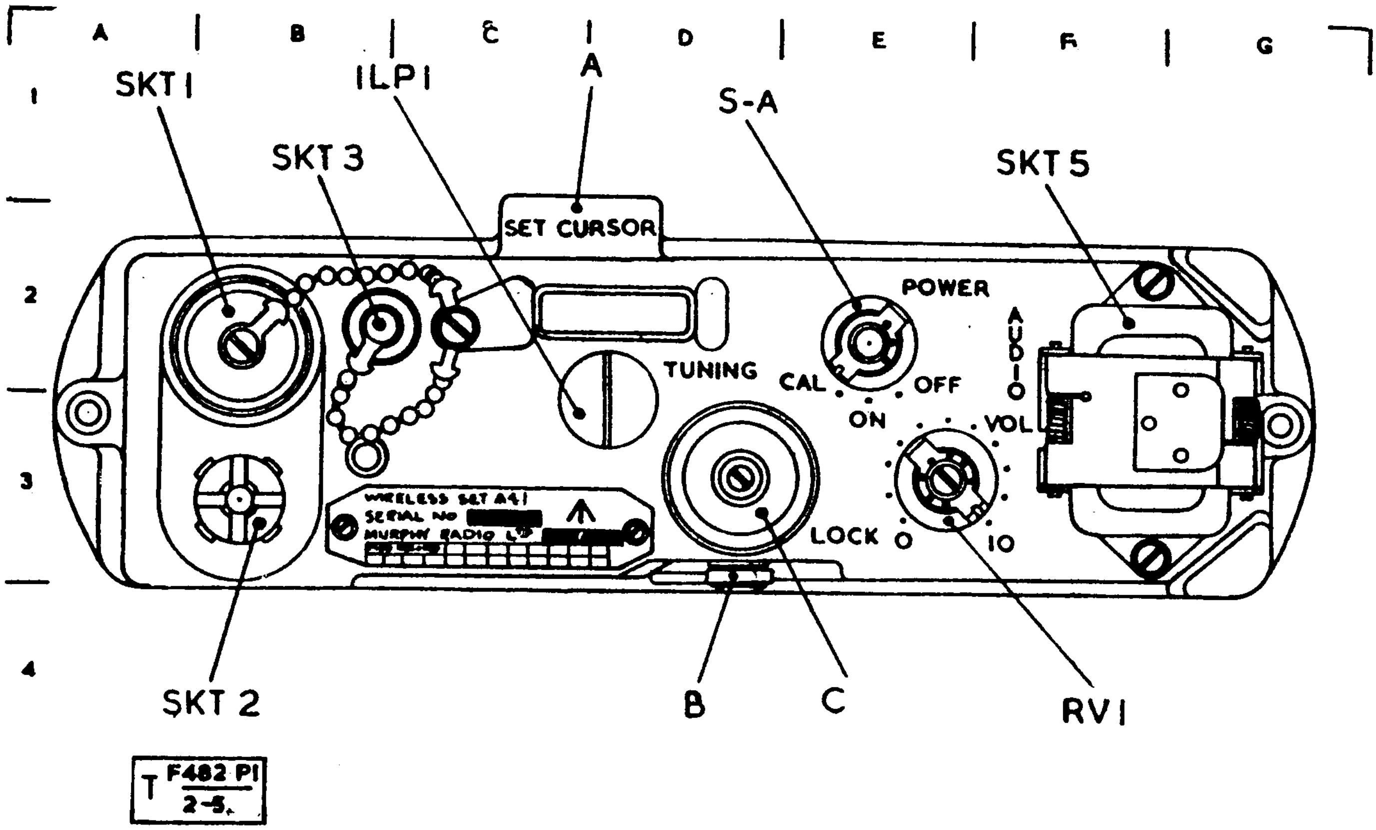


Fig 5 - Front panel layout, No 1 set

Controls and connections etc
(Fig 5)

24. The controls and connections etc mounted on the front panel are as follows:-

S-A	CAL-ON-OFF switch. (Set on, off or for calibration)
SKT1	Antenna socket for use with long antenna
SKT2	Antenna socket for use with short antenna
SKT3	Antenna socket for use with coaxial cable and auxiliary antenna
SKT5	AUDIO socket for connection of microphone and headgear
RV1	VOL - controls set audio output
ILP1	Cap covering dial light

A SET CURSOR - cursor adjustment

B LOCK - locks tuning knob in any position

C TUNING - main tuning capacitor

Interchangeability with US or Canadian sets and the TR A40

25. The British TR A41 can be worked with, and is physically similar to the Canadian AN/PRC 510 and US AN/PRC 10A. Physical dimensions are all identical. The headgear, antennae and batteries can be used with any of these sets.

26. The TR A41 uses the same headgear and antennae as those for the TR A40 (Tels F 460). The TR A41 uses the same i.f. amplifier plug-in units as the TR A42.

DETAILED TECHNICAL DESCRIPTION
(Fig 6 to 13 and Fig 2501a and b)

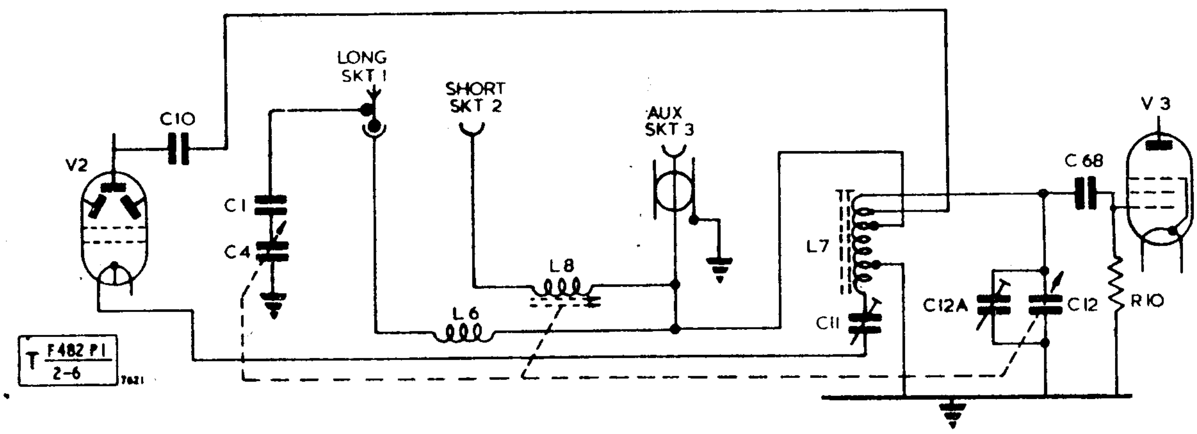


Fig 6 - Antenna tuning circuit

Antenna circuit
(Fig 6)

27. The antenna circuit is used for both sending and receiving. Any one of three antennae may be used. The long 10 ft antenna plugs into SKT1 (Fig 3) and brings C1 and C4 (the latter driven mechanically from the main tuning shaft) into circuit with L6, for tuning the antenna circuit. The short 4 ft battle antenna plugs into SKT2 (Fig 3) and is tuned by L8, which is ganged to the main tuning control. An auxiliary coaxial socket SKT3 (Fig 3) is provided and can be used for an auxiliary antenna.

28. The antenna coil L7 is the anode coil of the sender m.o./p.a. (V2) and the grid coil for the first r.f. stage, and is tuned by capacitor C12, a section of the main tuning gang. C12A in parallel with C12 is a trimmer for high frequency tracking. The r.f. signal is capacitance coupled from the antenna coil L7 to the grid of the first r.f. amplifier stage (V3) by C68.

Receive

1st and 2nd r.f. amplifiers

29. The input tuned circuit to the first r.f. amplifier (V3) is shown in Fig 6. C68 is the coupling capacitor and R10 provides a d.c. path to earth. The tuned anode circuit consists of L10 in parallel with C18, which is a section of the main tuning gang, and trimmer C18A. L10 is adjustable for low frequency alignment. C16 is a fixed trimmer setting the upper resonant frequency.

30. The screen grid is connected to the end of coil L10 remote from the anode, to give some measure of negative feedback, and prevent oscillation of the amplifier.

31. The h.t. is supplied from the 67.5V line via R11 and L10 to the anode of V3, and, via R11 and a small portion of L10, to the screen. C17 in conjunction with R11 decouples the h.t. supply from r.f., and is tapped off coil L10.

32. The heater of V3 is supplied with 1.5V via switch SAc and RLA2 contact 21 and 22, the CAL-ON-OFF switch and send-receive relay respectively. L9 in the filament circuit acts as an r.f. choke, and C15 as an r.f. bypass for the filament. In the send condition RLA2 contacts 21 and 22 are open, breaking the heater circuit of V3 and rendering the stage inoperative. Consequently the first r.f. stage as well as the second stage (V4) operates only when the radio set is in the receive condition.

33. The r.f. signal, amplified by V3, is then fed from a tapping on L10 through C14 to the grid of the second r.f. amplifier (V4). This stage is similar to the first r.f. stage described in para 29-32. The amplified signal from V4 is then fed from a tapping on L13 through C20 to the grid of the mixer stage (V5).

Local oscillator

34. The receiver local oscillator (V12) supplies a signal 4.3Mc/s above the incoming signal, and beats with the latter to produce the i.f. frequency. When sending, the oscillator beats with a portion of the transmitter oscillator signal which is capacitance coupled to the mixer by C68 and the inoperative r.f. stages. This produces a frequency control signal from the discriminator.

35. The oscillator is an inverted Hartley circuit in which anode to grid feedback occurs across L14, the tuned circuit being C50 and L14 in parallel; C50 being a section of the main tuning gang. C51 is a padder in series with C50, and C52 (in parallel with C51 and C50) has a negative temperature coefficient to give the required temperature compensation. C50A is a trimmer for adjusting the high frequency ranges while the core of L14 is adjustable for low frequency alignment.

36. The r.f. feedback path is from the anode of V12 through C56 to earth and the lower portion of L14 to the cathode. Voltages in the anode section of L14 are induced into the grid section of L14. The grid circuit is via C54 and R39 in parallel and through the upper section of L14 to the cathode.

37. A portion of the oscillator voltage is transferred from the filament of V12 to the mixer stage. The filament of V12 is supplied with 1.5V from the mixer filament circuit. H.T. of 67.5V is supplied to the anode of V12 via R41. R40 and C55 form a decoupling filter between the grid and test socket (SKT4 - Pin 7).

Mixer

38. The incoming signal from the second r.f. stage is coupled to the grid of the mixer stage (V5) via C20, at the same time the local oscillator produces a signal, 4.3Mc/s higher than the incoming signal at the filament of V5. These two signals beat to produce an i.f. of 4.3Mc/s. R14 is a grid leak for the pentode V5. The oscillator signal across L15 is decoupled to earth by C27.

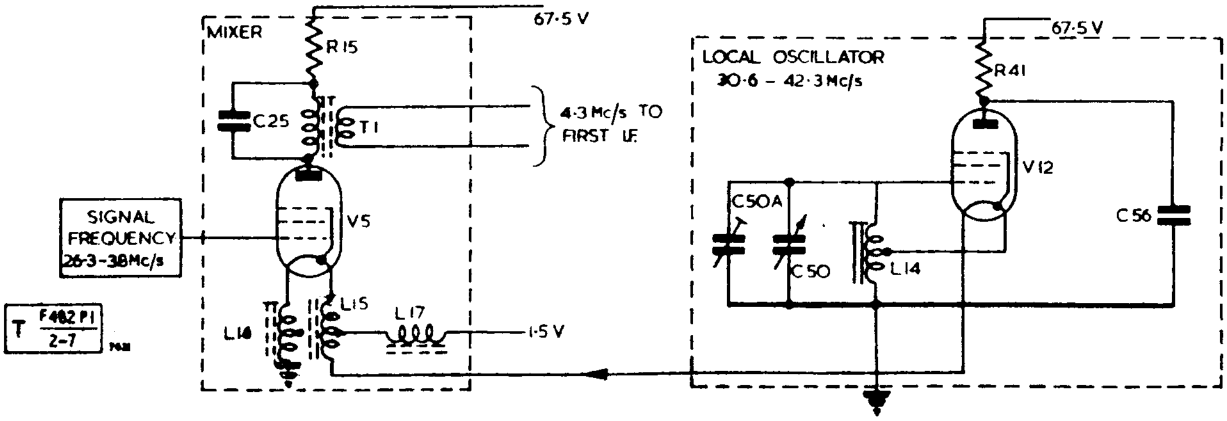


Fig 7 - Mixer and local oscillator circuits - simplified

39. The i.f. signal of 4.3Mc/s appears in the anode of V5 and is passed through the tuned circuit C25 and the transformer T1, to the grid circuit of the first i.f. amplifier V6.

40. The filament voltage of 1.5V is applied to V5 via L17 and portion of L15, while C27 and L17 decouple the heater line from r.f., L16 keeps the filament from r.f. earth. H.T. voltage of 67.5V is supplied via R15 to the screen of V5 and through the primary of T1 to the anode. C28 decouples the main supply from r.f.; C24 in conjunction with R15, decouples the screen and C26 provides the required neutralizing between grid and cathode.

I.F. amplifiers V6, 7, 8, 9

41. There are four i.f. stages, all identical. The signal from the secondary of T1 in the anode circuit of the mixer, resonates at 4.3Mc/s in the series tuned circuit T1, L18, C30A and the voltage is transferred to the grid of V6. R16A and C31A provide self bias for the stage, and in each succeeding stage the bias becomes greater. This, coupled with the lower anode voltage of V9, produced by additional decoupling resistor R22, provides the required limiting action for the discriminator. No external decoupling resistor is used in the case of V7. In the anode circuit of V6, C32A and the primary of T2 resonate at 4.3Mc/s, and R18A broadens the response to the desired bandwidth. The output signal is passed from the secondary of T2 to the next i.f. stage.

42. The h.t. supply of 67.5V is applied through R20, R19A and T2 to the anode and, via R20, R19A and R17A, to the screen. The latter is decoupled by C33A and the former by C29A. The l.t. of 1.5V is supplied via L19. C34A and L19 form an r.f. filter for the filament. Inductor L20 prevents unfiltered r.f. in the 3rd and 4th i.f. stages from getting into the supply circuit. C60 prevents regeneration.

43. The 2nd, 3rd and 4th i.f. stages are all exactly similar to the 1st i.f. stage with the exception of the decoupling resistor to the 4th stage (Para 41). In the 4th i.f. stage R23 shunts the grid resistor R16D and permits this stage to operate as a multivibrator in conjunction with the sweep oscillator stage V13. Test socket pin 3 (SKT4) is connected via R24 to the grid of the 4th i.f. stage V9. R48 in conjunction with C63 provides a filter for the beat note appearing at the control grid of V9 as a result of crystal calibrator harmonics fed into the 2nd r.f. and 1st i.f. stages, on calibration. The signal is then passed via SAb4, R49, C64 and RV1 to the a.f. amplifier.

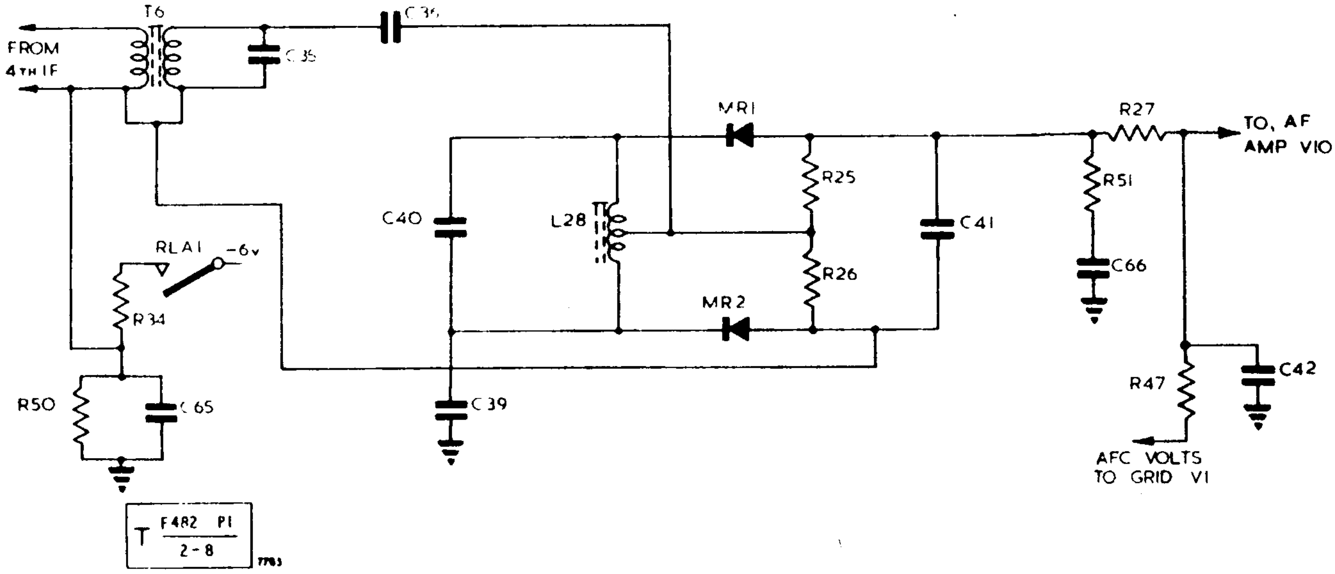


Fig 8 - Discriminator

Discriminator
(Fig 8)

44. The discriminator converts f.m. signals into audio signals. When the i.f. centre frequency (4.3Mc/s) voltage is applied, there is no output from the discriminator. The amount of frequency deviation determines the magnitude of the discriminator output voltage and since these deviations occur at a.f. then the output voltage varies similarly.

45. The input from the 4th i.f. is applied across T6 and appears in the tuned circuit, T6 secondary and C35. The voltage developed across C35 is applied to the centre tap of coil L28 and tuned circuit L28, C40. C39 unbalances the network for frequencies above and below the centre i.f. and crystals MR1 and MR2 rectify the voltages developed in R25 and R26. C41 bypasses the i.f. across these resistors and C65 decouples to earth. R51 and C66 form a de-emphasis network and the signal is fed via R27, switch SAb, R49, C64 and RV1 to the grid of the a.f. amplifier V10. (For further details of the Bond discriminator see Tels A 013).

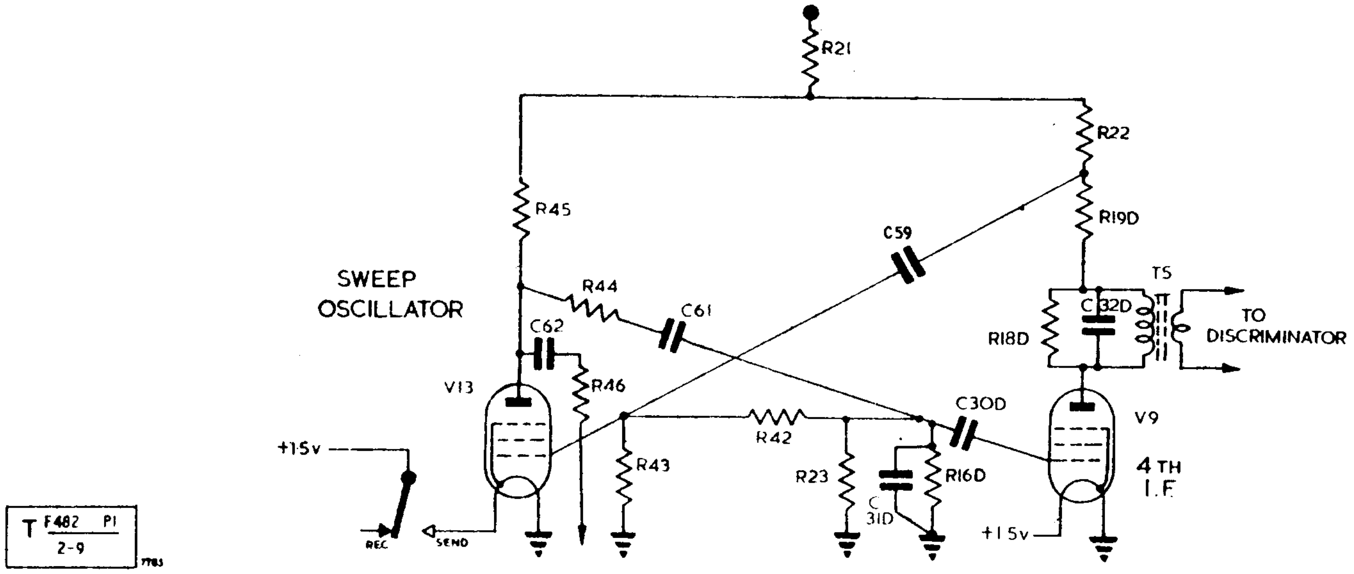


Fig 9 - A.F.C. sweep oscillator

Automatic frequency control - sweep oscillator
(Fig 9 and 11)

46. The sweep oscillator circuit V13 operates with the 4th i.f. stage V9 as a multivibrator to provide a.f.c. and bring the modulator within the range of the discriminator a.f.c. circuit (para 49). This oscillator then becomes inoperative. It only works when on send because the filament is fed via the send/receive relay.

47. On send, V13 conducts and the voltage drop in the anode circuit is coupled via R44 and C61 to the grid circuit of the 4th i.f. (V9) and cuts off this stage. The charge leaks from C61 via R16D and R23, and V9 conducts. The voltage drop at the anode of V9 is coupled back via C59 to the grid of V13 and cuts off this valve. The charge leaks from C59 via R43, R42, R23 and R16D, and V13 again begins to conduct, thus completing the multivibrator cycle. R42 couples the negative bias developed by the signal in the grid of V9 to cut off V13 and stop multivibrator action.

48. The multivibrator has a rectangular voltage waveform at the anode of V13, which is coupled via C62, R46 and R5 to V1 grid. The resultant output waveform is a voltage of slowly varying amplitude, and continuously varies the modulator bias to sweep the transmitter oscillator over a wide frequency range. After a second or two the transmitter oscillator is sufficiently stabilized and operating at its correct centre frequency. An a.f.c. signal then coming through the i.f. stages will be of sufficient strength to produce enough bias on the grid of V9 to cut off the sweep oscillator V13. The multivibrator action can only resume when the a.f.c. signal at the 3rd i.f. output falls enough to remove the cut off bias from V13. Resistor R23 shunts the grid resistor (R16D) of the 4th i.f. stage V9, and permits the multivibrator action with V13.

Automatic frequency control - discriminator
(Fig 8 and 11)

49. The discriminator also provides an a.f.c. voltage for the transmitter. On send RLA1 operates and a negative bias voltage is developed at the junction of R34, R50 and fed to the low side of R26. On send the i.f. coming through the receiver, as a result of the send signal being picked up in the receiver, is fed into the discriminator. The f.m. deviation of this signal develops a discriminator output voltage, centred about the negative bias voltage. This bias voltage is fed via R27, R47, decoupled by C42, to the grid of the modulator (V1). When the transmitter frequency is beyond the control range of the discriminator, then the 4th i.f. (V9) operates in conjunction with the sweep oscillator (V13) as a slow cycling multivibrator (see para 46 - 48).

Audio amplifier

50. The audio signal from the discriminator is fed via R27, switch SAb, R49, C64 and RV1, the volume control, to the grid of V10. Grid bias of -6V is applied via RV1 and decoupled by C58. The output appears across T7 and through SKT5, pins 4 and 5, to the headset. C43 flattens the response curve.

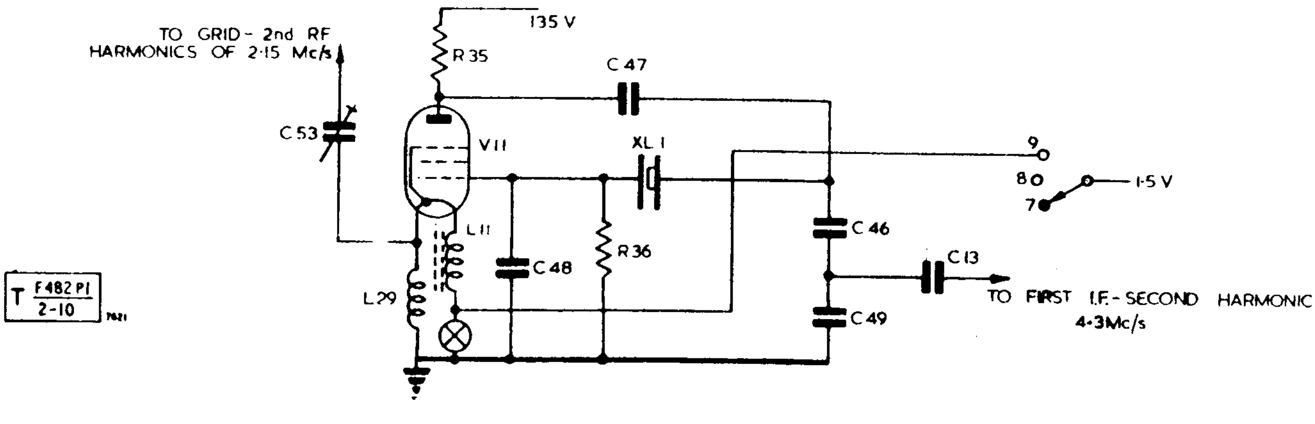


Fig 10 - Crystal calibrator, No 1 set - simplified circuit

Crystal calibrator (Fig 10)

51. 135V h.t. is applied to V11, the crystal calibrator oscillator (2.15Mc/s), through the anode load R35. C47 couples feedback to the crystal, maintaining oscillation. C46, C49, C48 provide for proper loading of the crystal and C13 couples the 2nd harmonic output for the first i.f. stage. R36 is the grid leak and L11 acts as an r.f. choke. A 2.15Mc/s signal developed across L29 in the filament of V11 is also fed to the grid of V4 by C53 and C71, C53 being variable to give a good audible beat note. The dial lamp ILP1 illuminates the dial for tuning during calibration.

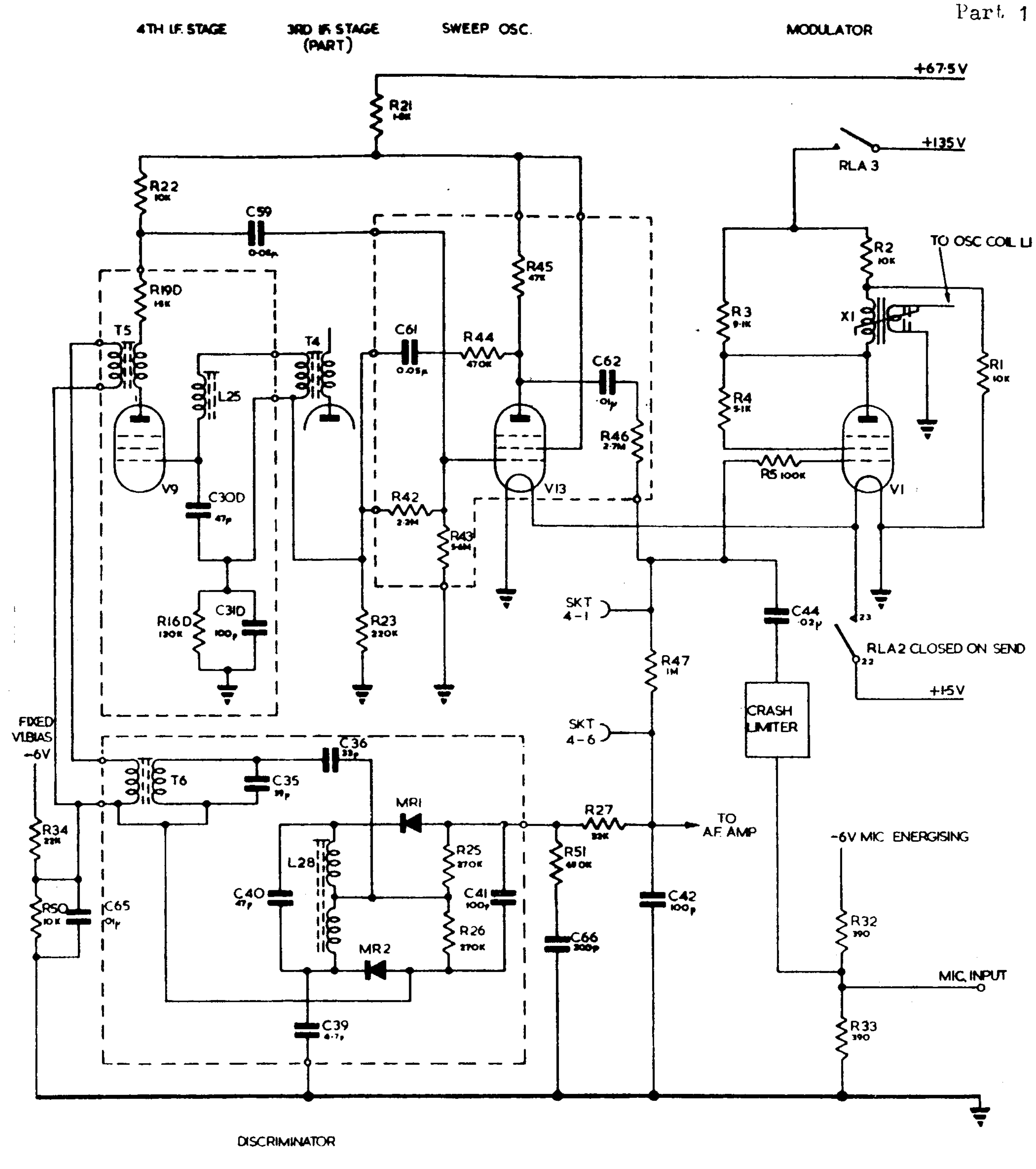


Fig 11 - A.F.C. by discriminator and sweep oscillator - simplified circuit

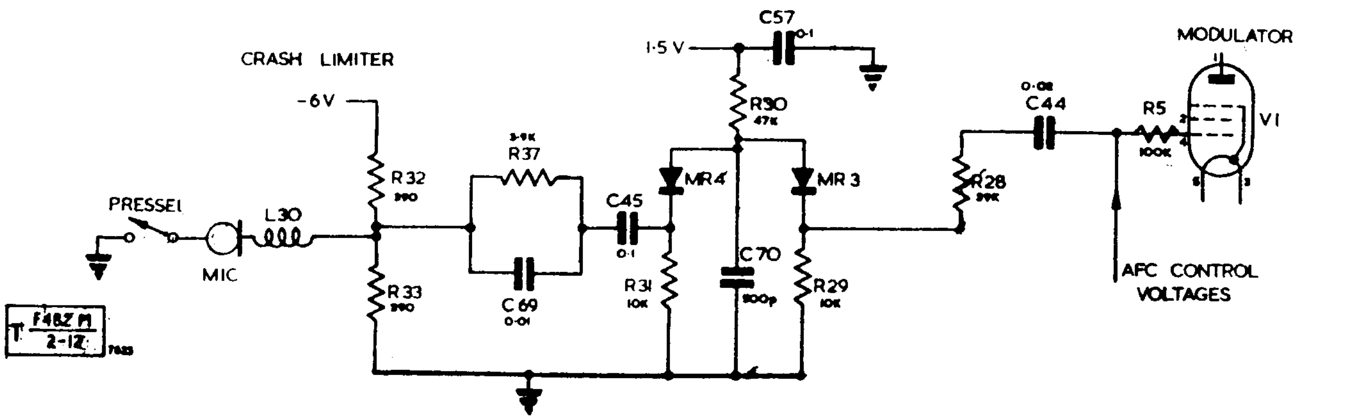


Fig 12 - Crash limiter

Send

Crash limiter
(Fig 12)

52. On send the input from the microphone is fed via L30 to the crash limiter. R32 and R33 act as a potential divider and are fed by -6V. The microphone is thus energized and the a.f. is fed across the frequency equalizing network R37, C69 and C45 to the rectifiers MR3 and MR4 which act as speech modulation clippers. 1.5V is fed via R30 across the rectifiers and through R29 and R31, thus each rectifier is positively biased between the load R30 and the rectifier. Negative and positive modulation voltage peaks greater than this bias voltage are prevented from passing through the rectifiers, and the clipped modulation is fed via matching impedance R28, C44 and R5, an r.f. stopper, to the grid of the modulator (V1). C70 acts as a storing capacitor and C57 decouples the 1.5V line to the rectifiers.

Modulator
(Fig 11)

53. The modulator (V1) frequency modulates the transmitter oscillator (V2) and controls its centre frequency. These functions are accomplished by the reactor X1 which changes its inductance inversely as the current (or flux) passing through it. An increase in flux decreases the inductance and vice versa.

54. Reactor X1 primary is directly connected to the anode of V1. Resistors R1, R2 and R3, with the anode resistance of V1, form a bridge network with the primary of X1 across it, in an unbalanced state. With an increase in the anode current of V1, ie when the grid becomes more positive, the current in X1 decreases and this increases its inductance. Similarly the inductance of X1 decreases when the grid of V1 becomes more negative. The control grid of V1 is kept biased on send by the voltage from the resistors R34, R50 across -6V through the discriminator and via R27 and R47, decoupled by C42 (see para 49).

55. On send speech is fed from the crash limiter to the grid of V1. This a.f. voltage produces changes of inductance in the secondary of X1 (para 53, 54) and hence in the tuned circuit of the transmitter oscillator. These changes of inductance in turn produce changes in transmitter frequency at audio rate.

56. Anode voltage of 135V is fed via RLA3 and R3, and R4 supplies the screen. Filament voltage of 1.5V is supplied via RLA2.

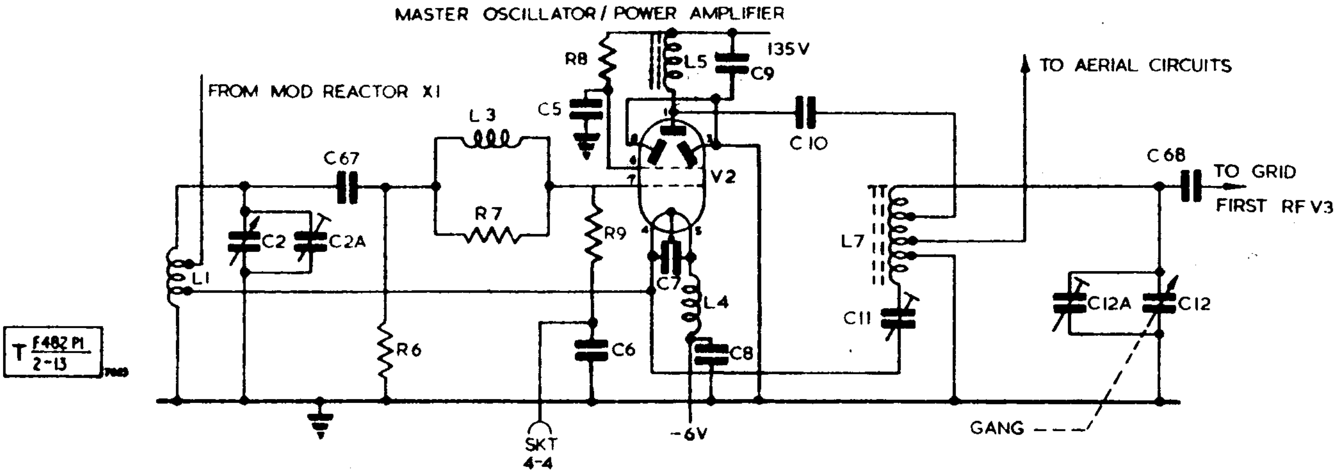


Fig 13 - Master oscillator/power amplifier - simplified circuit

Transmitter oscillator
(Fig 13)

57. The oscillator section of V2 consists of its filament, control grid and screen grid. The tuned circuit is C2, L1, and reactor X1 secondary is connected to a tap on L1. Therefore, changes in inductance of X1 produce changes in transmitter frequency. C2A is a trimmer and L1 is adjustable for low frequency alignment. C67 couples the signal from this circuit through the filter L3, R7 to the grid of V2. R9 and C6 form a decoupling filter for test socket SKT4, pin 4. R6 is the grid leak and C8 and L4 form an r.f. filter for the -6V filament supply while C7 is an r.f. bypass. The h.t. supply is fed to the screen via R8 and is decoupled by C5. The anode is fed via L5 and C9 decouples the h.t. line.

58. The signal developed across L5 is coupled by C10 to the tuned circuit L7, C12 by a tap on L7. C12A is a trimmer and L7 is adjustable for low frequency alignment. C11 provides partial neutralization and a tap on L7 couples the signal from the tank circuit to the antenna sockets.

59. The long antenna is tuned by L6, C1 and C4; the latter being mechanically connected to the main tuning shaft. The short antenna is tuned by L8, its slug connected to a gear on the main tuning assembly. The auxiliary socket is not tunable (see Fig 6).

60. The voltage across L7 is coupled by C68 to the grid of the first r.f. amplifier V3.

Automatic frequency control and sidetone
(Fig 8)

61. The transmitter oscillator circuit is controlled by two circuits so that its centre frequency is constantly 4.3Mc/s below that of the receiver oscillator. These two circuits are fully described in para 46 - 49 (Fig 8, 9 and 11).

62. The sweep oscillator operates when the transmitter oscillator is relatively far off centre frequency. The varying voltage is applied to the grid of the modulator in turn varying the transmitter frequency. When the centre frequency is found, the i.f. signal developed stops the multivibrator operation. The discriminator a.f.c. circuit then takes over.

63. This latter circuit uses the discriminator to provide an a.f.c. voltage compensating for small transmitter frequency deviations. On send the discriminator is biased negatively, and the correction voltages are centred on this bias and applied to the grid of the modulator (V1). This bias is still present on operation of the sweep oscillator.

64. On send the output from the transmitter is coupled to the r.f. stages, which although not operating, allow for sufficient coupling to the mixer and i.f. stages, to be demodulated and fed as sidetone to the output and headphone.

TRANSMITTER/RECEIVER, RADIO, A41, NO 2

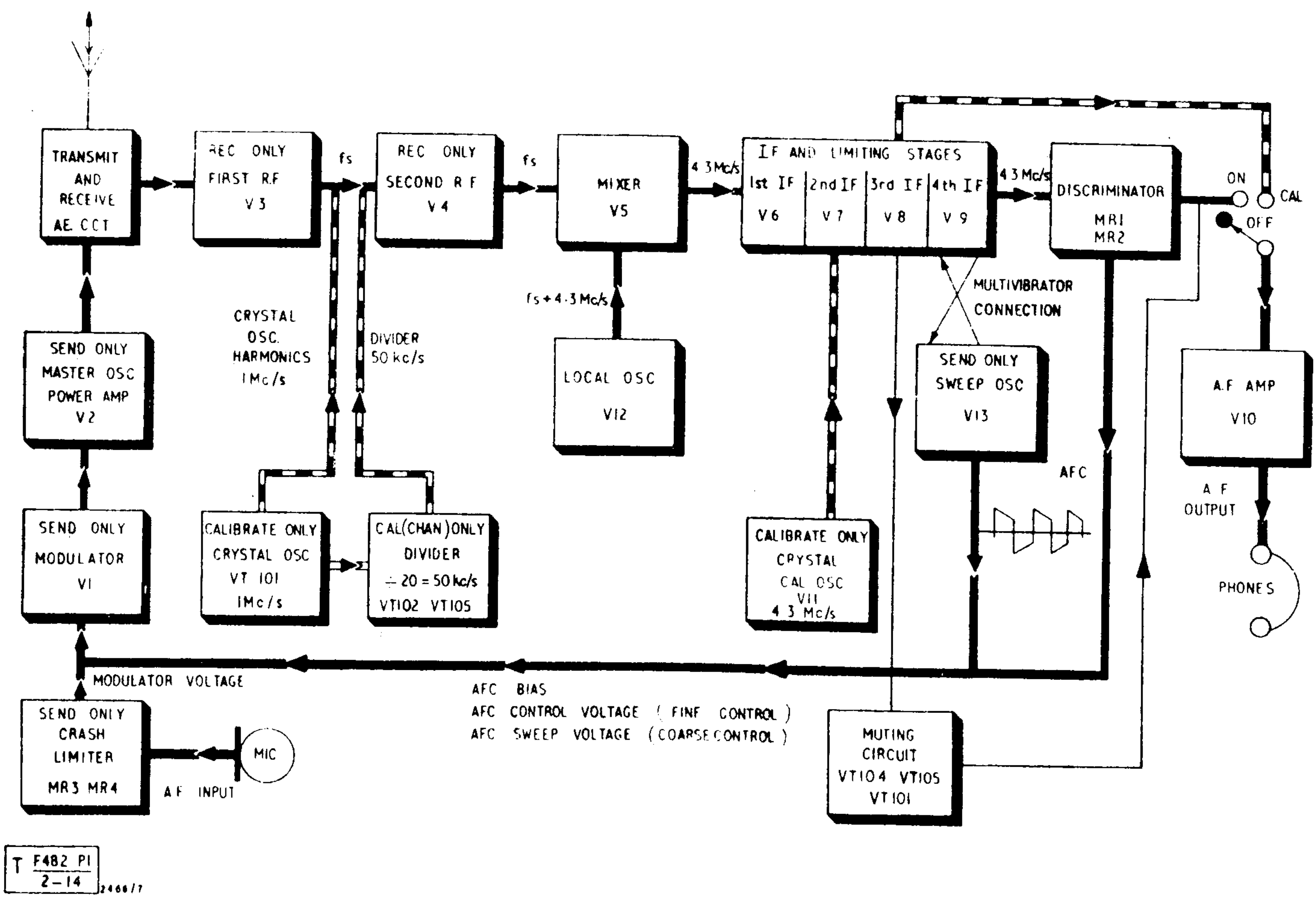


Fig 14 - Block diagram, No 2 set

INTRODUCTION

65. The radio set A41, No 2 is basically the same as the No 1 with the addition of a muting facility and the provision of 50kc/s calibration points. Handset and headset terminations have been changed.

66. In the description that follows, the differences are described and the relevant paragraphs relating to the No 1 set are given in brackets. Component changes and additions can be identified by the fact that they have had 100 added to the original number eg C47 becomes C147 on change of value and R161 is additional.

67. The number of channels is increased to 341 spaced at 50kc/s intervals (para 1). Check points are provided every 50kc/s. The dial is marked at 50kc/s intervals and dial reading is assisted by the provision of a magnifying lens.

68. The audio equipment normally used is similar to that used with the No 1 set (para 4) but the terminations have been changed to 6-pin type 105 (Bendix Thorn).

MECHANICAL DESCRIPTION

69. The test socket SKT104 is a miniature 7-pin type mounted approximately in the same place as SKT2. The adjacent component board has been enlarged to accommodate the muting circuit. The component board on the reverse side of the chassis has also been changed. The calibrator panel, mounted in place of the desiccator, has a removable cover through which access can be gained to RV102 and RV103. These boards now contain printed wiring. The desiccator has been removed from the chassis and replaced in a similar position inside the case.

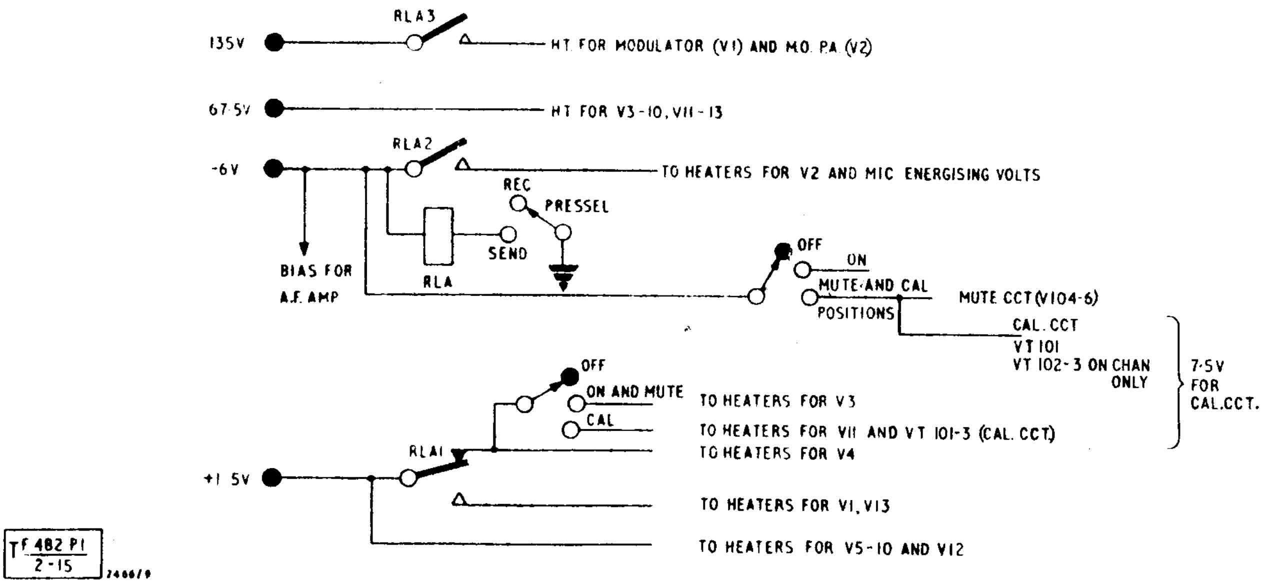


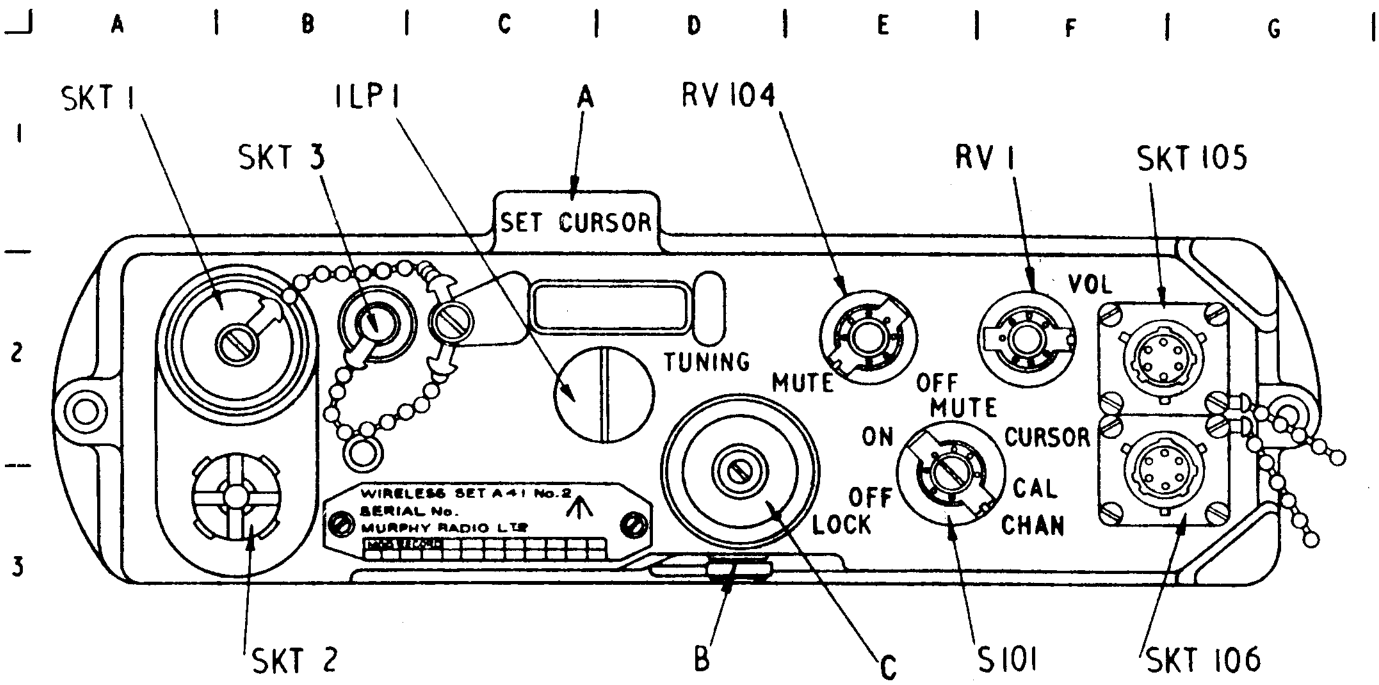
Fig 15 - Power supplies, No 2 set

70. The main function switch S101 is a miniature wafer type in which switching is effected between two adjacent wafers by shorting contacts. An exploded view of the switch is shown in Fig 2519.

Controls and connections
(Fig 16)

71. The controls and connections etc, mounted on the front panel are as follows:-

S101	OFF-ON-MUTE-CURSOR CAL-CHAN switch
SKT1	Antenna socket for use with long antenna
SKT2	Antenna socket for use with short antenna
SKT3	Antenna socket for use with coaxial cable and auxiliary antenna
SKT105	Audio socket for connection of microphone and headgear
SKT106	Audio socket for connection of microphone and headgear
RV1	VOL-controls set audio output
RV104	MUTE-controls muting threshold
ILP1	Cap covering dial light
A	SET CURSOR-cursor adjustment
B	LOCK - locks tuning knob in any position
C	TUNING - main tuning capacitor



T F482 P1 2-16 2466/5

Fig 16 - Front panel layout, No 2 set

TECHNICAL DESCRIPTION

General

72. The working of the No 2 set receiver is the same as described in para 27-50 except that, in the 4th i.f. stage (para 43) R23 shunts the grid resistor R160 in the ON position of S101 only. This also renders the MUTE circuit inoperative.

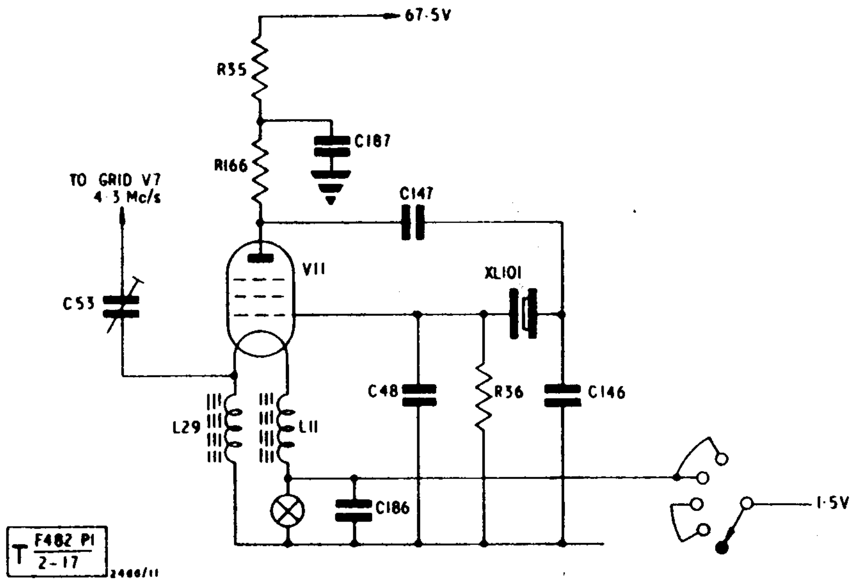


Fig 17 - I.F. calibrator - simplified circuit

I.F. Crystal calibrator
(Fig 17)

73. 67.5V h.t. is applied through R35 and R166 to V11, acting now only as a 4.3Mc/s crystal oscillator. C147 couples feedback to the crystal, maintaining oscillation. Feedback and anode load are reduced to lessen the harmonic content. C146 and C48 provide appropriate loading of the crystal (XL101). R36 is the grid leak and L11 acts as an r.f. choke decoupled by C186. A 4.3Mc/s signal developed across L29 in the filament of V11 is fed to the grid of V7 by C53 which is variable to give a good audible beat note. The dial lamp (ILP1) illuminates the dial, which is no longer marked at every 2.15Mc/s calibration point.

Crash limiter or a.m.c. control

74. This circuit is similar to the No 1 set but the storage capacitor is larger (now C170) and the capacitor C57 decoupling the 1.5V line is reduced (now C60). C192 has been added to provide r.f. decoupling for stray signals picked up in the set wiring.

Send

75. On send, the operation of the No 2 transmitter is the same as described in para 53-64.

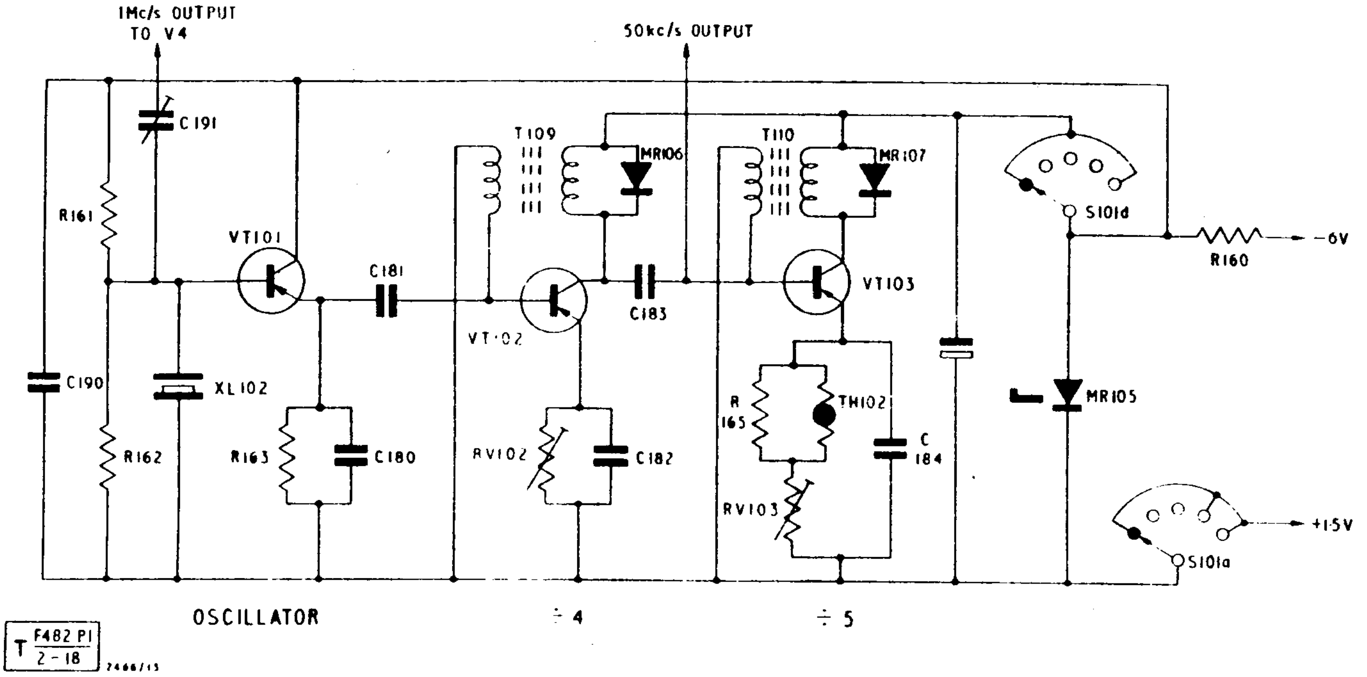


Fig 18 - 1Mc/s and 50kc/s calibrator - simplified circuit

Channel calibration
(Fig 18)

76. Transistor VT101 is a crystal controlled transistor oscillator with a 1Mc/s crystal (XL102). The -6V and 1.5V supplies are added, stabilized by Zener diode MR105 and applied to VT101.

77. On CURSOR CAL position of S101, harmonics of the 1Mc/s generator are fed via C191 to the grid of the second r.f. valve (V4).

78. On CHAN CAL position of S101, transistors VT102 and VT103 are blocking oscillators with 7.5V supplied via S101d. VT102 is triggered by the 1Mc/s pulses via C181 so that the blocking occurs every 4th pulse. The output of VT102 (adjustable in frequency by RV102) is applied to the base of VT103 via C183. The blocking of VT103 occurs every 5th pulse from VT102 (adjusted by RV103) and as a result pulses appear at the base of VT103 every 20 µS and are fed via C173 and/or C171 to the grid of V4. MR106 across T109 absorbs the overshoot when VT102 cuts off and MR107 across T110 carries out a similar function for VT103. Thermistor TH102 compensates for temperature changes.

Muting circuit
(Fig 19)

79. VT106, in common base mode, acts as a constant current source in the emitter circuits of VT104 and VT105. When no signal is present, VT105 is conducting and the output signal is partially bypassed to earth, giving approximately 20dB reduction in output.

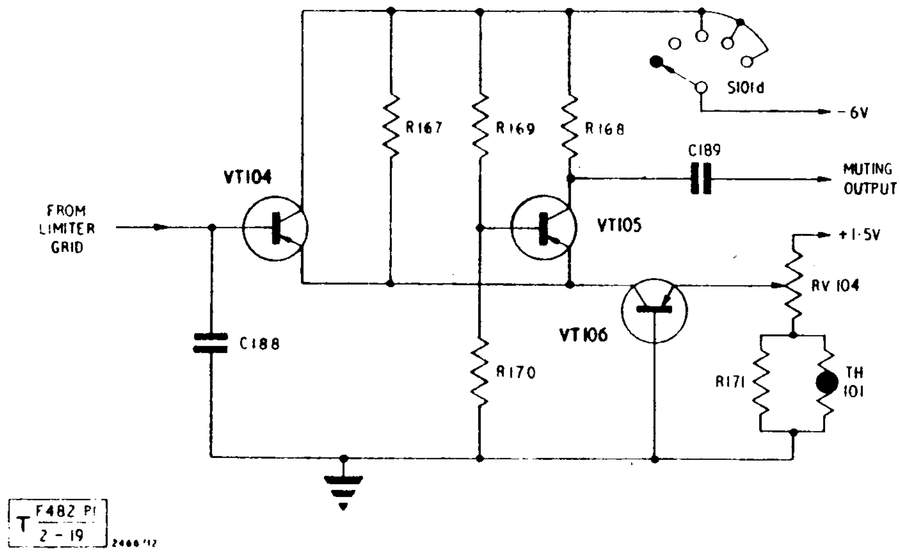


Fig 19 - Muting - simplified circuit

80. An incoming signal produces a negative voltage on the limiter grid and this voltage, fed to the base of VT104 via R23 with S101d to MUTE, causes the emitters of VT104 and VT105 to go negative, thereby transferring the current from VT105 to VT104 and removing the partial a.c. short-circuit from across the audio output.

81. The potentiometer in the emitter circuit of VT106 (the threshold control RV104) sets the circuit to the most sensitive point.

82. If the gain of the set is reduced due to falling battery voltage, the fall in limiter grid voltage is more than counter-balanced by the change in VT106 current caused by falling 1.5 volt supply. VT105 will eventually switch off and will draw attention to this by the increase in noise level, ie, the muting will be less effective.

83. Temperature compensation is provided by thermistor TH101 which is inserted across R171 to control the emitter voltage of VT106. When the temperature rises, R171 and TH101 will provide a change in bias to offset the change in current due to temperature increase.

84. The thermistor will have little effect below normal temperature as its resistance will be too high to make any significant change in the resistance of the parallel combination. At lower temperatures, below the effective region of TH101, the base-emitter voltage characteristic which falls with falling temperature will cause an overall reduction in current throughout the circuit. The fall of current in VT104 and VT105 caused by the drop in current supplied by VT106 will again unmute the circuit.

EME8c/1039

(Note: These Pages 24-30, Issue 2 contain additional information.
Delete "End of Part 1" from bottom of page 23.

REBROADCAST AND RELAY UNITS

INTRODUCTION

Role and purpose of equipment

85. The equipment is used to permit voice signals received by one TR, radio, A41 or A42 to be rebroadcast by a second TR, radio, A41 or A42 and vice versa when a reply is given. The range of communication of a radio net can thus be extended. Direct communication with other nets working on different frequencies can also be made.

Main Parameters

Operational

86. (a) Rebroadcast by one set, of signals received by a second set; and by the second set, of those received by the first set, the direction of transmission being controlled automatically.

(b) Rebroadcast as (a) but with a local operator controlling the direction of transmission.

(c) Use of the first set by a local operator for normal transmission.

(d) Use of the second set by a local operator for normal transmission.

(e) Monitoring by the local operator of the receivers of the two sets separately and simultaneously, one in each earphone of his headset.

(f) The rebroadcast unit is located with one set. A relay unit, connected by a suitable length of cable to the rebroadcast unit, is located with the other set.

Physical

87. Dimensions etc:-

	Rebroadcast unit	Relay unit
Height	4.9/16 in.	-
Width	8.3/4 in.	3.3/4 in. dia.
Depth	6.5/16 in.	4.1/4 in.
Weight	7.3/4 lb. (excluding batteries)	1.1/2 lb.
Case	Sealed aluminium alloy Batteries in splash proof cavity	Sealed aluminium alloy
Desiccator	One silica gel 3/4 in. 20UNS-2B	None

Electrical

88.	Automatic switching	- Both sets are in the receive condition in the absence of a signal. When one set receives a signal of at least 3µV the other set switches to send.
	Manual switching	- Operation of the pressel switch by the local operator will cause A or B set to send (selector switch to WORK A or WORK B). Operation of the MAN RB switch also puts sets to send.
	A.F. performance	- 5mW 1kc/s input (from a receiver) AUTO RB or manual min. output 5mW:- in l.h. phone for operation in A - B direction in r.h. phone for operation B - A direction
	Volume controls	- Range 29dB
89.	Power supply	- 2.8V - maximum continuous consumption - 15mA (AUTO RB with both sets receiving) - maximum intermittent consumption - 116mA (local operator sending via set B) - Dry battery - two unit cells:- Battery dry 1.1/2V No 1 - Y3/6135-99-910-1101

Repair Policy

90. The relay and rebroadcast units are both fully sealed and no spares are carried. Unit repairs are confined to replacement of damaged knobs.

BRIEF DESCRIPTION

Construction

91. The front panel of the rebroadcast (RB) unit is secured to the case by six No 2 BA socket-head screws. A splash-proof compartment in the case holds the batteries, connection from them being taken to an 8-pole socket SKTC. When the front panel is removed from the case the power connection to SKTC is broken.

92. All components are mounted on the front panel or on a sub panel secured to it. On this sub panel are the microphone amplifier printed panel and transformers below, and the relays and noise amplifier printed panels above. These latter items are mounted back to back at right angles to the sub panel.

93. The relay unit is housed in a cylindrical sealed box. All components are mounted on the front panel.

Setting up

94. The two radio sets (set A and set B) may be situated up to 150 yd apart.

95. The audio gear is removed from the sockets on both radio sets and the special headset microphone is fitted to the RB unit. One of the audio sockets on set A is connected to the set A socket on the RB unit. D10 cable is then connected between the set B terminals on the RB unit and those on the relay unit. The socket on the relay unit is then connected to one of the set B audio sockets.

96. As the audio sockets on the No 1 version of the sets differ from those of the No 2 sets, alternative type connectors are provided.

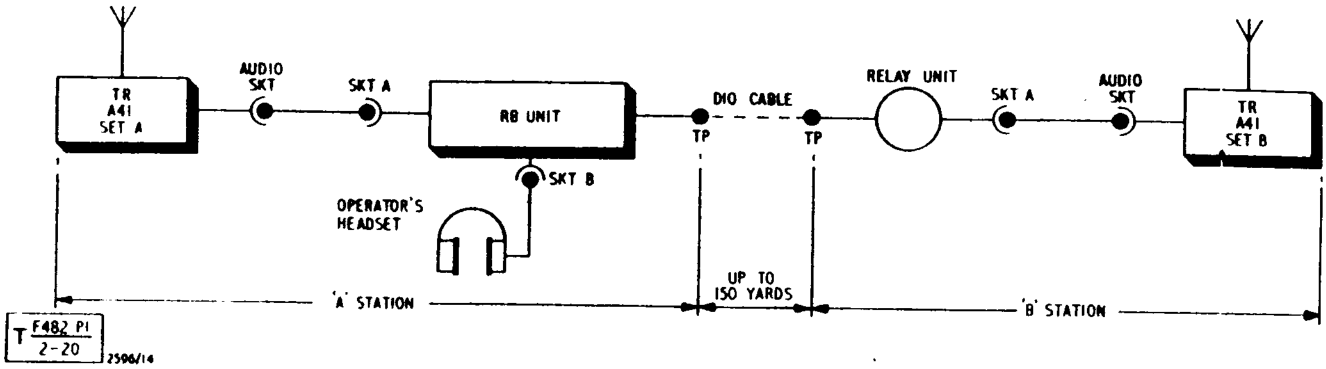


Fig 20 - Block diagram of rebroadcast station

Operation
(Fig 20)

97. In the absence of signals both sets are in the receive condition.

98. In the AUTO RB position of the selector switch, SA, a signal received by set A will automatically cause set B to be switched to send and the signal will be transmitted by set B.

99. In the WORK A or MAN position, the local operator stationed at the RB unit can break-in on the A channel by using his pressel switch. In the WORK B or MAN position, the local operator can similarly break-in on the B channel. With the switch in either position he can establish rebroadcasting in either direction by putting the MAN RB switch to A-B or B-A.

100. Prior to using the automatic facility and in the absence of signals, two controls, ADJUST B-A and ADJUST A-B, used in conjunction with two positions similarly marked on the selector switch, are used to adjust the level of the noise outputs from set A and set B to suit the operation of the switching circuits in the RB unit. With these two controls correctly set, the two sets are held in the receive condition as long as no signal is received. Reduction of the noise output of one receiver due to an incoming signal then causes the other set to be switched to send.

101. The local operator's headset has the l.h. earpiece connected to set A and the r.h. one to set B. The two controls, VOL A and VOL B, separately control the level of the voice signals from each receiver.

102. The volume control on each set must be turned to maximum output when rebroadcasting and the MUTE facility of the No 2 sets must not be used.

DETAILED DESCRIPTION

Automatic RB
(Fig 21, 2523, 2525)

103. With SA set to AUTO RB and in the absence of a signal, noise from set A is fed into the noise amplifier A-B (NA1), at a suitable level set by the ADJUST A-B control RV1. The noise passes through a high-pass filter, C3-6 and L1, and is amplified by VT1 and VT2. The output voltage from VT2 developed across T2 is rectified by MR1. C10 charges and maintains a mean voltage on the base of VT3 cutting off the transistor. No current flows through the relay RLA and the rebroadcast link is quiescent.

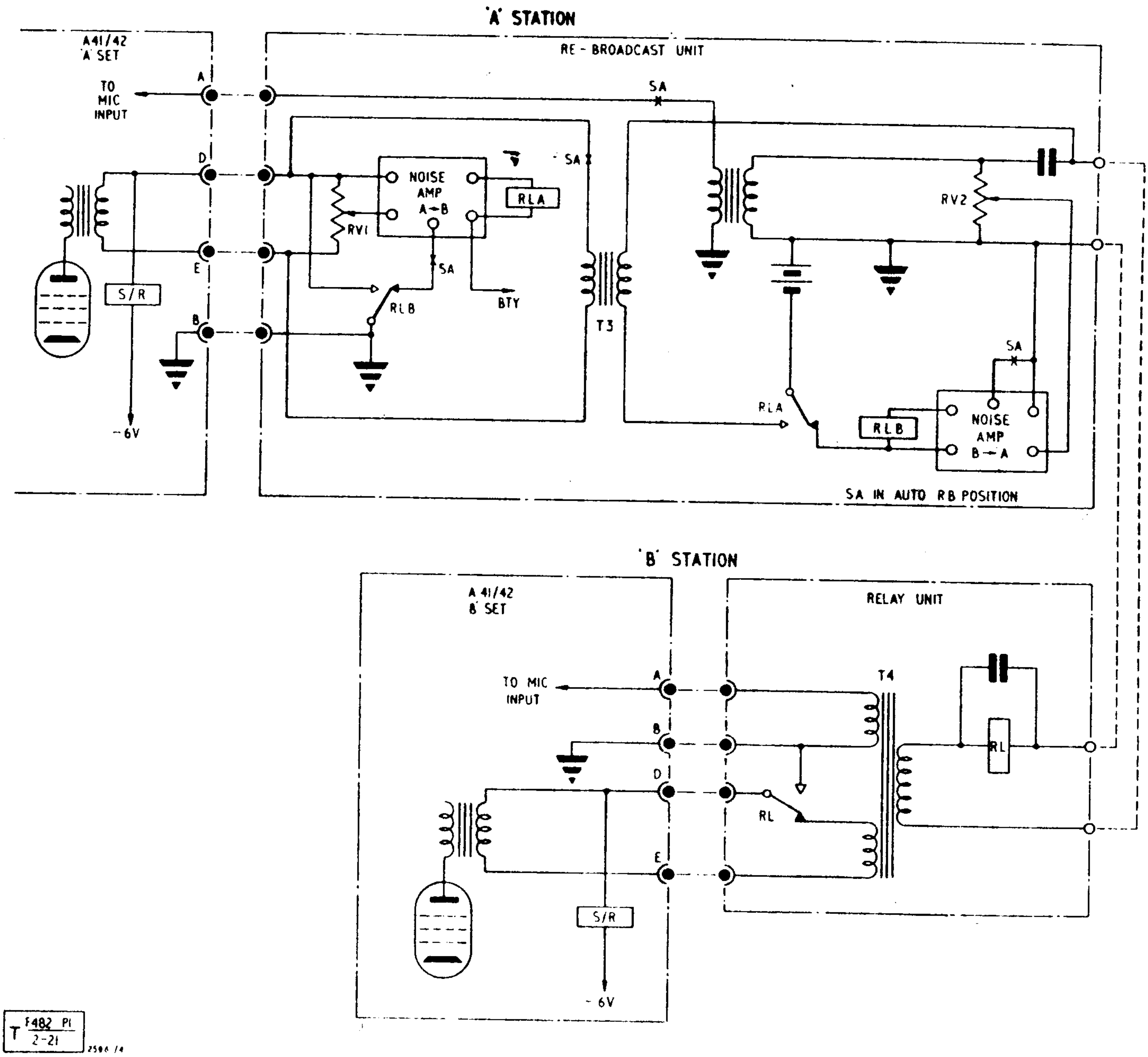


Fig 21 - Simplified diagram of automatic operation

104. Similarly the noise from set B is fed into the noise amplifier B-A (NA2 identical with NA1) at a suitable level set by the ADJUST B-A control RV2. Thus no current flows through the relay RLB and the link is quiescent.

105. Reception by set A of an adequate signal will cause quieting of the set. The consequent reduction of the noise level into the RB unit will remove the charge on C10 which leaks away through R12, and VT3 conducts. The collector now rises rapidly towards earth potential so that the relay operates. C11 is inserted to provide feed-back to maintain the relay current. When the signal ceases and noise is restored, VT3 again cuts off. The relay field will decrease rapidly but the back e.m.f. is prevented from damaging VT3 by the insertion of MR2 across the relay. MR2 conducts when the collector potential exceeds the supply voltage.

106. When relay RLA operates on receipt of a signal, contact RLA will apply the battery potential to the relay unit to operate its relay RLA. Contact RLA will earth the send/receive relay in set B and cause this set to transmit the original message, speech being passed via T3 in the RB unit and T1 in the relay unit to the microphone input of set B. When the signal ceases from set A, relay RLA in the relay unit releases and set B returns to the receive condition.

107. When set B receives a reply, quieting of the signal from set A takes place; relay RLB operates and contact RLB earths the send/receive relay in set A and causes this set to transmit the reply, speech being passed via T1 in the relay unit and T4 in the RB unit to the microphone input of set A.

Level adjustment

108. The input level from set A or set B is set for optimum performance of the RB unit.

109. To set the level for set A the selector switch is set under no signal conditions for ADJUST A-B with the control, RV1, set to '0'. The control is then turned slowly clockwise until the noise in the r.h. earphone suddenly increases.

110. With RV1 at zero, no noise is applied to the noise amplifier and the relay RLA is operated putting set B to send. The noise amplifier is made less sensitive by shunting the collector load of VT1.

111. When RV1 is increased, the noise input increases until RLA is de-energized. Set B then goes to receive and the noise in the r.h. phones increases.

112. Similarly, the level for set B is made by adjusting RV2 for a sudden noise increase in the l.h. phones, with the selector switch in the ADJUST B-A position.

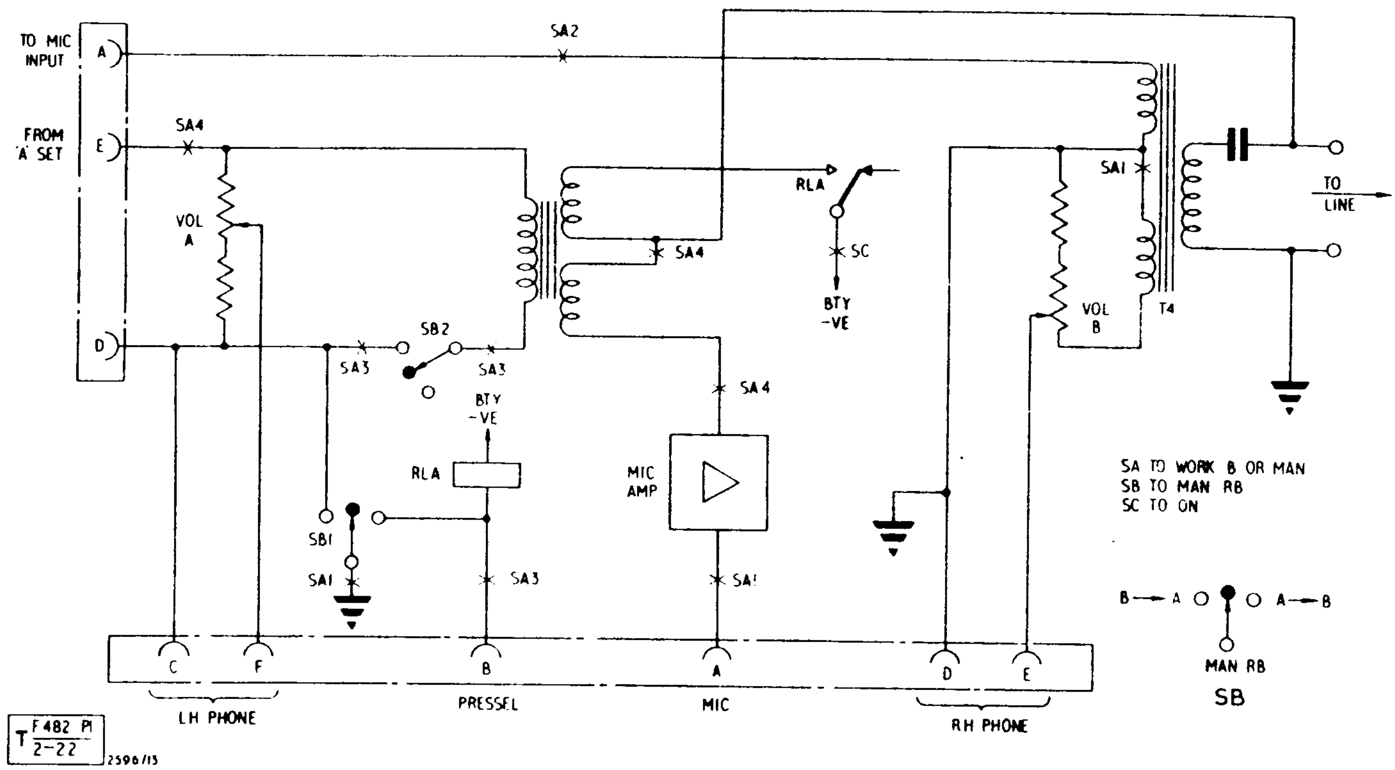


Fig 22 - Simplified WORK B OR MAN condition

Manual RB

113. Manual operation can be carried out in either the WORK B OR MAN or the WORK A OR MAN positions of the selector switch SA but the circuit set up differs. The position of the MAN RB switch, SB, also changes the circuits.

WORK B OR MAN
(Fig 22)

114. In the first position of the selector switch, a call received from set A is heard in the l.h. earpiece of the operator's headset. The signal level is controlled by the VOL A control, RV3, on the front panel.

115. The operator can connect set A to set B by setting SB to A-B. When the pressel switch is operated, speech is amplified by the microphone amplifier. The speech path from set A to set B is via SA3 and SB to T3, then via RLA and the relay unit to Set B. The coil of relay RLA is earthed via SB1 and SA1, and RLA1 connects the battery to the relay unit via T3. This operates relay RLA in the relay unit and RLA contact applies an earth to set B to operate the send/receive relay and switch set B to send.

116. A call received from set B is heard on the r.h. earpiece, the signal level being controlled by the VOL B control, RV4, on the front panel.

117. The operator can also connect set B to set A by setting SB to B-A. Speech is fed from set B to set A via the relay unit and T4, thence via SA2 and pin A of SKTA, to set A. The send/receive relay of set A is operated by the earth on pin D of SKTA from SB1 and SA1.

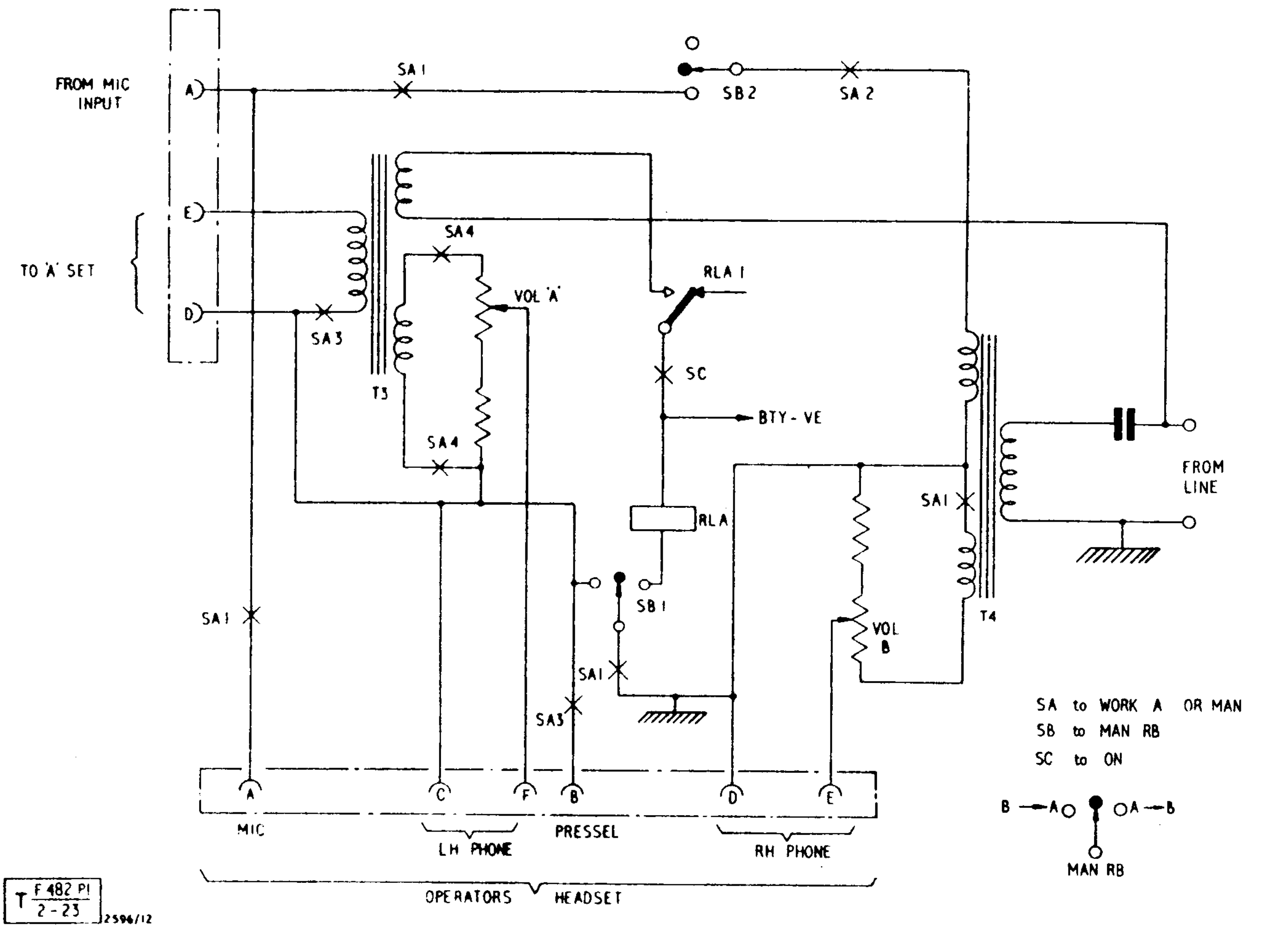


Fig 23 - Simplified WORK A OR MAN condition

WORK A OR MAN
(Fig 23)

118. In the second position of the selector switch the operator can connect set A to set B as before by setting SB to A-B. When the pressel switch is operated, speech is now fed directly to the microphone input of set A. The switching of set B to send, and the speech path from set A to set B are the same as with the selector switch at WORK B OR MAN (para 115).

119. The operator can also connect set B to set A by setting SB to B-A. The switching of set A to send is the same as with the selector switch at WORK B OR MAN (para 117). Speech is passed from set B to set A via the relay unit to T4, thence via SA2 and SB2 to socket A, to set A.

Break-in

120. To break-in on set A channel, the selector switch is set to the WORK A position and the microphone and pressel switch on the operator's headset is used for communication. The reply is heard on the l.h. earphone.

121. To break-in on set B channel, the WORK B position of the selector switch is used. Speech is passed through the microphone amplifier and the pressel switch operates relay RLA to put set B to send. The reply is heard on the right-hand earphone.

EME8c/2596/TELS

END of Part 1