TRANSMITTER-RECEIVER TR9D AND TR9F

1. TR9D

(a) Requirements- A lightweight, low power, crystal controlled R/T set for use as a "command" set in aircraft. Two crystals are incorporated in the transmitter; one controlling the "normal" frequency for R/T communication, the other controlling the "special" frequency for D/F purposes. The frequency is automatically switched from "normal" to "special" at regular intervals, unless the pilot prevents this by a separate switch.

(b) Frequency range- 4.3 to 6.6 Hz.

(c) Communication range- At least 35 miles air to ground and 5 miles air to air.

(d) Valves

(i) Transmitter: three; oscillator, triode, VT50; power amplifier, pentode, VT51.

(ii) Receiver: six; RF amplifiers, 2, VR18; detector, VR27; AF amplifiers, 2, VR21; output, VR22.

(e) Power supplies

(i) *LT:* 2V, 20AH accumulator. Current, 1.25A on "normal" frequency, 1.6A on "special" frequency.

(ii) *HT:* 120V dry battery. Current, approximately 28mA on "transmit", 18mA on "receive".

(iii) *Grid bias (transmitter):* 15V dry battery, tapped at 10.5V for modulator stage.

(iv) *Grid bias (receiver):* 4.5V dry battery.

Note- HT and GB batteries are fitted internally in the set.

(f) Aerial system- A small fixed aerial, usually from a stub mast to tail fin. In some aircraft the mast is retractable.

(g) Transmitter circuit, general(see fig.)

(i) A crystal controlled oscillator drives an anode modulated, class C, RF power amplifier.

(ii) Oscillator and power amplifier use grid leak and condenser bias.

(iii) No neutralising is required for the PA.

(iv) A "Pierce" circuit is employed, and so the oscillator requires no tuning.

(v) The PA is tuned for "normal" frequency by a continuously variable inductance, which is part of the aerial circuit for both transmitter and receiver. For the "special" frequency this aerial coil is tapped for coarse tuning, and a variable condenser provides the fine tuning.

(vi) The output from the microphone is amplified by a sub-modulator, consisting of the AF stages of the receiver, before application to the input of the modulator valve.

Note- Either an electromagnetic or a carbon granule microphone may be used, but before using the latter the 30pF attenuating condenser must be brought into circuit by removing shorting link "A" (see fig.).

(h) "Special" frequency operation(see fig)

(i) Two relays, energised from the LT accumulator via the "remote contactor", controlling the switching from "normal" to "special" frequency whether the S/R switch is on "send" or "receive".
When the contactor closes the relay circuit, the relays operate the spring loaded switches, and the frequency is changed to "special"; when the contactor breaks the circuit, the frequency reverts to "normal". Te contactor is so arranged that "special" frequency is transmitted for 14 seconds in each minute.

(ii) The remote contactor is an electrically-driven "repeater" of the movements of the "master contactor", which in effect is a spring-controlled clock. Movement of the clock "escapement" opens and closes contact points, thus allowing pulses of current to pass from the general service accumulator to the solenoid of the remote contactor. Each pulse causes the remote contactor "motor" to move one tooth; the number of teeth is such that the motor makes one revolution per minute.

(iii) An index set to one of four positions allows four aircraft to use the same "special" frequency in any one minute, the transmissions following each other at one second intervals.

(iv) The pilot may suspend the transmission of the "special" frequency without stopping the remote contactor, thus preserving synchronisation.

(v) When switched to "special" the HT connection to sub-modulator is broken so that only a carrier wave is transmitted for D/F purposes.

(j) Receiver circuit(see fig)

(i) As the aerial circuit of the receiver is tuned when tuning the transmitter, the two main receiver tuning controls are the variable condensers in the two tuned anode circuits. Connected in parallel with these are two smaller condensers which are ganged together, and form the fine tuning control.

(ii) The volume control is external to the set, and is a potentiometer which adjusts the potential on the screen grids of both RF valves.

(iii) Regeneration is provided by a 10pF condenser between the two tuned circuits.

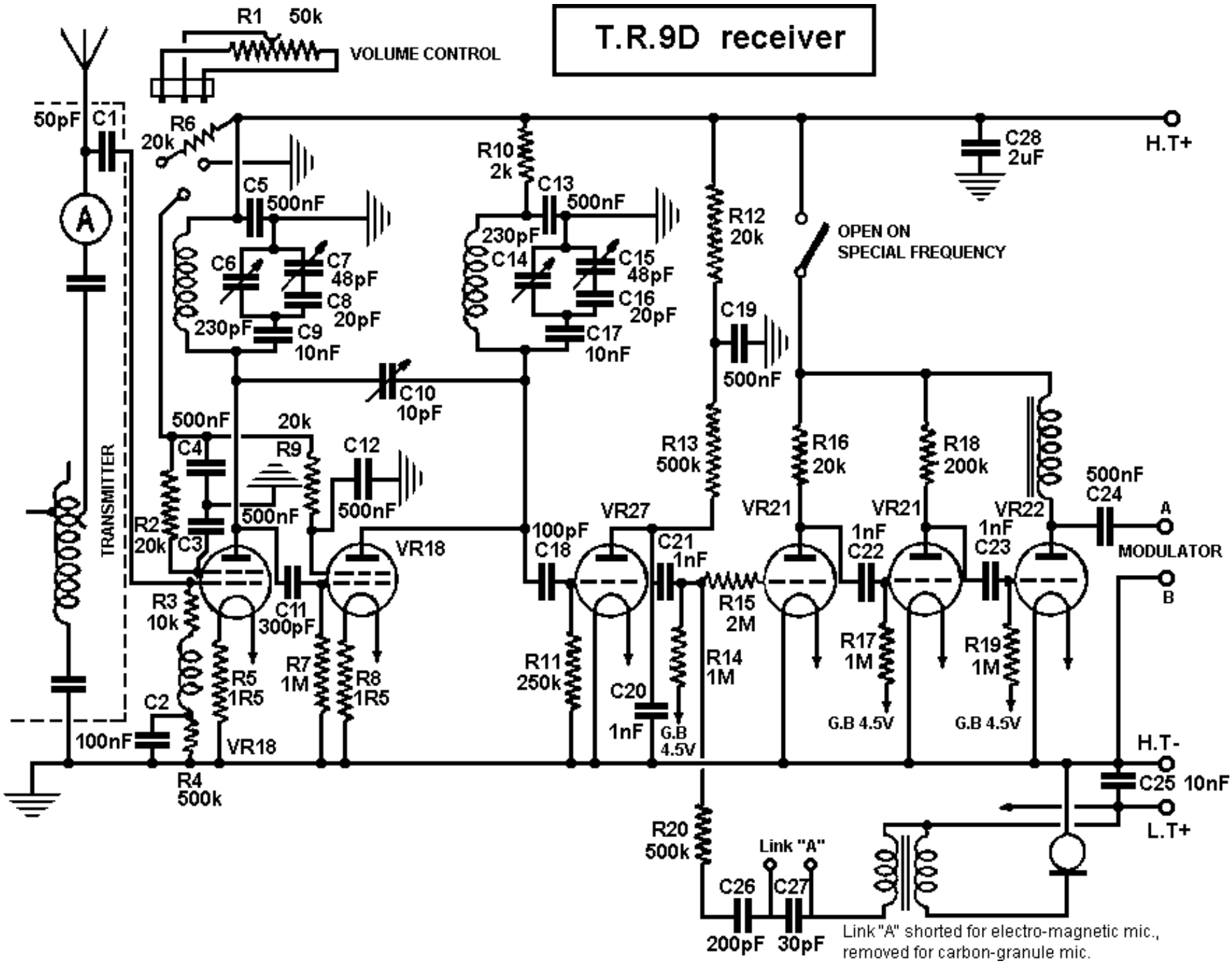
(iv) Battery bias is used on the AF and output stages.

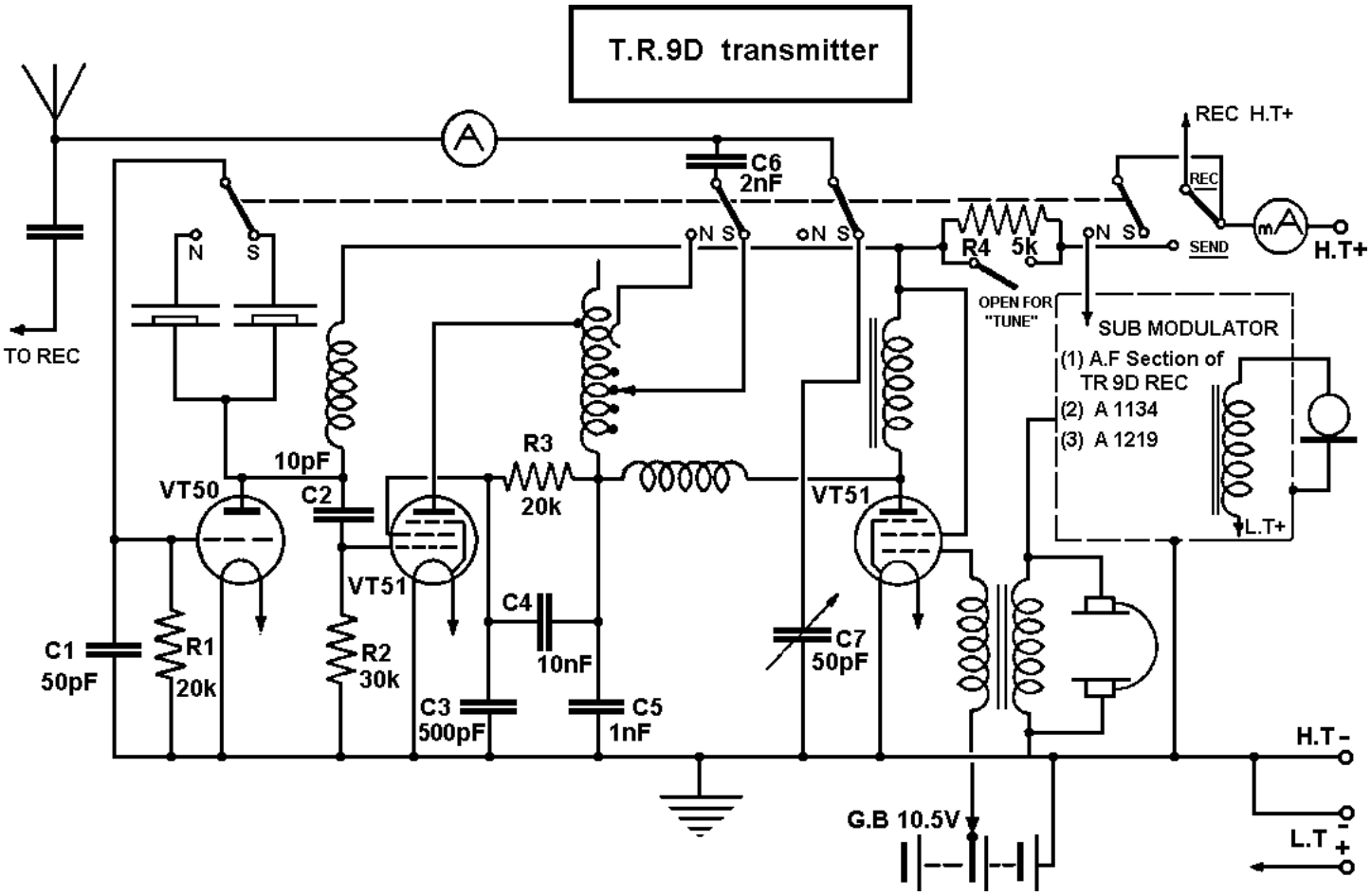
(k) Tuning

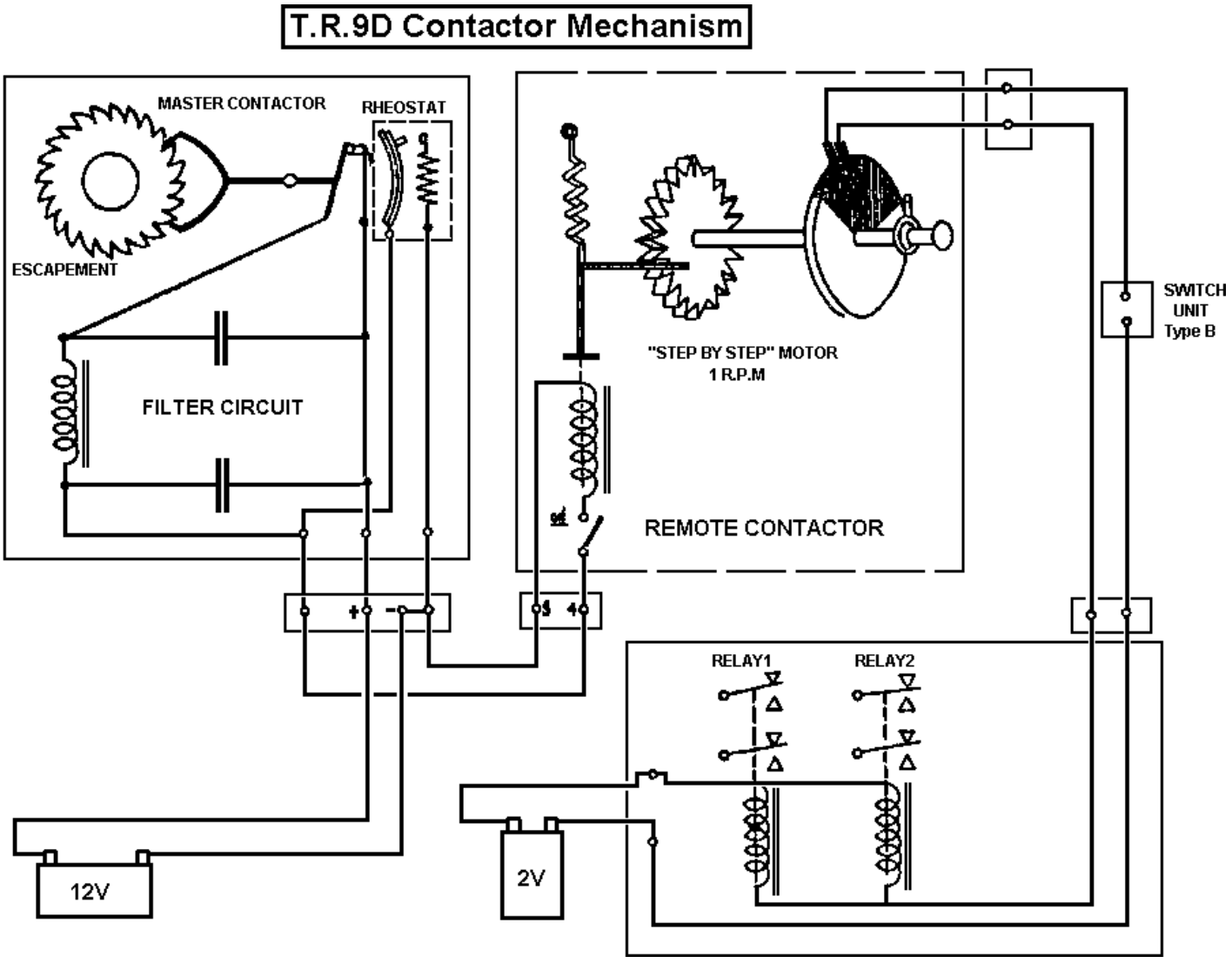
(i) As the crystal oscillator does not require tuning, the setting up of the transmitter is very simple.

(ii) A limiting resistance in the HT positive lead reduces DC surges of current when tuning.

(iii) The receiver is usually tuned to an R/T tester, but a W39A crystal controlled wavemeter may be used.


T.R.9D receiver
R1 50k
VOLUME CONTROL
50pF C1
R6 20k
C5 500nF
C6
C7 48pF
C8 20pF
230pF C9 10nF
C10 10pF
500nF C4
20k R9
C12 500nF
R2 20k
C3
500nF
R3 10k
C11 300pF
R5 1R5
R7 1M
R8 1R5
C2
100nF
R4 500k
VR18
TRANSMITTER
R10 2k
C13 500nF
230pF C14
C15 48pF
C16 20pF
C17 10nF
R12 20k
C19 500nF
OPEN ON SPECIAL FREQUENCY
C28 2uF
H.T+
R13 500k
100pF C18
VR27
C21 1nF
R15 2M
R14 1M
C20 1nF
G.B 4.5V
R11 250k
VR21
R16 20k
VR21
R18 200k
VR22
500nF C24
A
MODULATOR
B
1nF C22
1nF C23
R17 1M
R19 1M
G.B 4.5V
G.B 4.5V
H.T-
C25 10nF
L.T+
R20 500k
Link "A"
C26
C27
200pF
30pF
Link "A" shorted for electro-magnetic mic., removed for carbon-granule mic.


T.R.9D transmitter
REC H.T+
REC
C6
2nF
N S
N S
N S
R4 5k
N S
SEND
H.T+
TO REC
N
S
OPEN FOR
"TUNE"
SUB MODULATOR
(1) A.F Section of
TR 9D REC
(2) A 1134
(3) A 1219
L.T+
10pF
C2
R3
20k
VT50
VT51
VT51
C4
10nF
C1
50pF
R1
20k
R2
30k
C3
500pF
C5
1nF
C7
50pF
H.T -
G.B 10.5V
L.T +


T.R.9D Contactor Mechanism
MASTER CONTACTOR
RHEOSTAT
ESCAPEMENT
FILTER CIRCUIT
"STEP BY STEP" MOTOR
1 R.P.M
SWITCH
UNIT
Type B
REMOTE CONTACTOR
RELAY1
RELAY2
12V
2V

(iv) When tuning -

(a) always tune the transmitter first,
(b) have volume control at maximum, and
(c) have the regeneration control turned back one and a half turns from the point of oscillation.

(l) General notes

(i) The transmitter-receiver is invariably mounted in a position inaccessible to the pilot; a special controller in the cockpit gives him remote control over the S/R switch, the fine tuning and volume control of the receiver. The S/R switch remote control is mechanical, as is the fine tuning control; the volume control is by an extension lead from a three-way socket on the receiver to a potentiometer in the controller.

(ii) Inter-communication is possible in two-seater aircraft, by a slight modification to the wiring of the S/R switch.

(m) Maintenance

(i) The LT battery must be changed after every flight whose duration is nearly the endurance of the aircraft.

(ii) The HT battery must be tested daily. Insert a voltmeter between lower crystal socket and earth terminal, with switch at "send". Change battery if reading is 100V or less.

(iii) Before tuning a new transmitter for the first time, or when changing the VT50 valve, plug in crystals and oscillator valve only, and check that the anode current does not exceed 4.5mA at "tune".

(iv) Good screening and insulation resistance of all microphone and telephone wiring is essential. Insulation resistance must be more than 10M ? and the telephone plugs are to be smeared lightly with mineral jelly.

2. TR9F

(a) General

(i) This set is similar to the TR9D in circuit layout and operation, and is used in addition to GP equipment in bomber aircraft. In the TR9F the "special" frequency may be used as a second channel for communication, because, due to use of a separate sub-modulator (see below), switching from "normal" to "special" frequency has no effect on the microphone circuit. Thus R/T may be transmitted on both "normal" and "special" frequencies.

(ii) There is no remote or master contactor equipment, and the necessary changes from "normal" to "special" are completed by a manually-operated switch which completes the LT relay system.

(iii) A separate amplifier (A1134) serves as the sub-modulator when using an electromagnetic microphone; it also acts as an inter-communication amplifier.

(b) A1134

(i) *Power supplies - LT:* 2V, 14AH accumulator; *HT:* 120V dry battery; *GB:* 6V dry battery - tapped at 3V and 6V.

(ii) *Circuit* - The amplifier consists of a two-stage AF amplifier. The first stage is a VR21 voltage amplifier, transformer coupled to the output stage, which is a VR35 quiescent push-pull amplifier. This stage is also transformer coupled to the telephones. A separate on-off switch is fitted to the amplifier, and another multi-contact switch marked "A", "B" and "C" allows the amplifier to be used with GP equipment, if necessary. For use with TR9F the switch is locked at "B".