CHAPTER 10

TRANSMITTER-RECEIVER T.R.9H

1. **Requirements.**—A lightweight, low power, crystal controlled R/T set for use in aircraft.

2. **Frequency Range.**—4·3 to 6·6 Mc/s.

3. **Communication Range.**—At least 35 miles air to ground and 5 miles air to air.

4. **Valves.**—(i) Transmitter, three;—oscillator, triode V.T.50; power amplifier, pentode V.T.51; modulator, pentode V.T.51.

(ii) Receiver, six;—R.F. amplifiers, two, V.R.18; detector, V.R.21; A.F. amplifiers, two, V.R.21; output, triode, V.R.22 or pentode, V.R.118.

5. **Power Supplies.**—(i) L.T., 2 volt, 20 A.H. accumulator. Current, 2 amps. on "transmit", 1·15 amps. on "receive".

(ii) H.T., 120-volt dry battery or power unit, type 173. This is a vibrator unit comprising a vibrator, transformer, metal rectifier, filter units and stabiliser (V.S.110). The unit takes 1 amp. (approx.) from the aircraft 24-volt supply. No adjustment is possible; change the stabiliser valve after 500 hours and the vibrator after 1,000 hours. Current, approx., 28 mA on "transmit" and 18 mA on "receive."

(iii) *Grid bias.*—(*a*) Transmitter; 15-volt dry battery, tapped at 10·5 volts for modulator stage.

(*b*) Receiver; 4·5-volt dry battery.

Note.—H.T. and G.B. batteries are fitted internally in the set.

6. **Aerial System.**—A small fixed aerial, type depending on aircraft. When necessary the aerial may be connected via a co-axial cable; this may necessitate a matching unit at the transmitter.

7. **Transmitter Circuit** (fig. 71).—(i) A crystal controlled oscillator drives an anode modulated, class C, R.F. power amplifier.

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

(iii) No neutralising is required for the P.A.

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

(v) The P.A. is tuned by a continuously variable inductance, which is part of the aerial circuit for both transmitter and receiver.

(vi) The output from the microphone is amplified by a sub-modulator, consisting of the external amplifier A.1134, before application to the input of the modulator valve.

8. **Receiver Circuit** (fig. 72).—(i) As the aerial circuit of the receiver is tuned when tuning the transmitter, the two main 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; this is not used in the air, and is normally locked.

(ii) The volume control is external to the set, and is a potentiometer which adjusts the potential on the screen grid of both R.F. valves; it is normally remotely controlled by the pilot.

(iii) Regeneration is provided by a 10 $\mu\mu$F condenser between the two tuned circuits.

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

9. **Control of T.R.9H.**—(i) *General.*—There are three methods of control :—

(*a*) For local control, the Yaxley pattern " send-receive " switch is used.

(*b*) By leaving Yaxley S/R switch at " receive ", " push to talk " operation is available.

(*c*) By leaving Yaxley S/R switch at " off ", complete electrical remote control is available at one point and " push to talk " operation at several others, providing the set has been switched on.

(ii) *Action of remote switching.*—When the remote " on-off " switch is closed, the winding of Relay 1 (fig. 71) is energised by the 2-volt L.T. battery and the following circuits completed :—

(*a*) L.T. + to receiver.

(*b*) L.T. + to C.O. valve in transmitter.

(*c*) L.T. + to winding of relay 2 via " P.T.T." switch.

(*d*) L.T. + to moving contact of relay 2.

(*e*) H.T. + to receiver via relay 2.

Thus at this stage the receiver is switched on, and the filament of C.O. valve heated. On pressing the " P.T.T." switch relay 2 is energised completing the following circuits.

(*f*) L.T. + to P.A. and modulator valves.

(*g*) H.T. + to transmitter, breaking H.T. + to receiver. There is a time delay of about ·75 seconds between switching to " transmit " and availability of the transmitter. This is the time taken for filaments of P.A. and modulator to heat.

VALUES

Condensers		Resistances in Kilohms	
1	50 $\mu\mu$ F	1	20
2	10 $\mu\mu$ F	2	30
3	500 $\mu\mu$ F	3	20
4	·01 μ F		
5	·001 μ F		
6	·002 μ F		

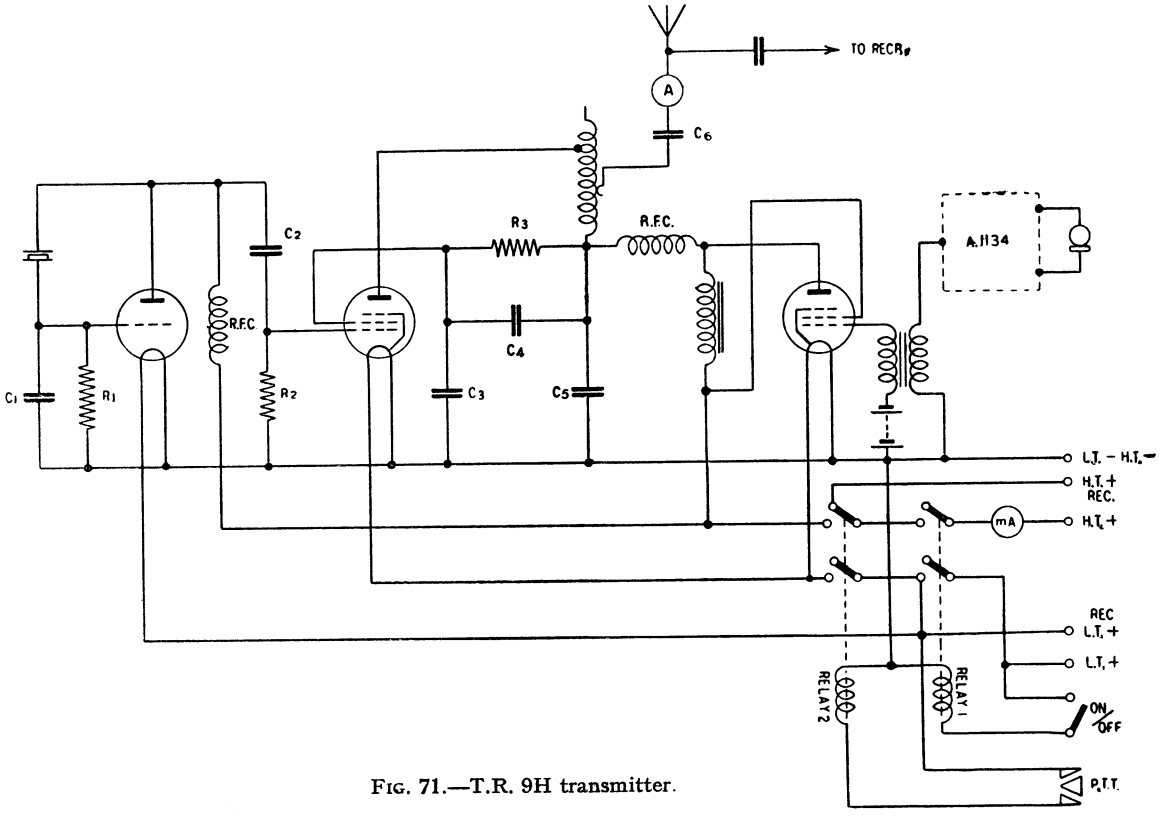

FIG. 71.—T.R. 9H transmitter.

VALUES

Condensers		Resistances	
1	50 μμ F	1	50 K Ω
2	·1 μ F	2	20 K Ω
3	·5 μ F	3	10 K Ω
4	·5 μ F	4	·5 M Ω
5	·5 μ F	5	1·5 Ω
6	230 μμ F	6	20 K Ω
7	48 μμ F	7	1 M Ω
8	20 μμ F	8	1·5 Ω
9	·01 μ F	9	20 K Ω
10	10 μμ F	10	2 K Ω
11	300 μμ F	11	·25 M Ω
12	·5 μ F	12	20 K Ω
13	·5 μ F	13	·5 M Ω
14	230 μμ F	14	250 K Ω
15	48 μμ F	15	2 M Ω
16	20 μμ F	16	1 M Ω
17	·01 μ F	17	20 K Ω
18	100 μμ F	18	50 K Ω
19	·5 μ F	19	·2 M Ω
20	·001 μ F	20	1 M Ω
21	·001 μ F	21	1 M Ω
22	50 μμ F		
23	·5 μ F		
24	·001 μ F		
25	·001 μ F		
26	·5 μ F		
27	2 μ F		
28	·01 μ F		

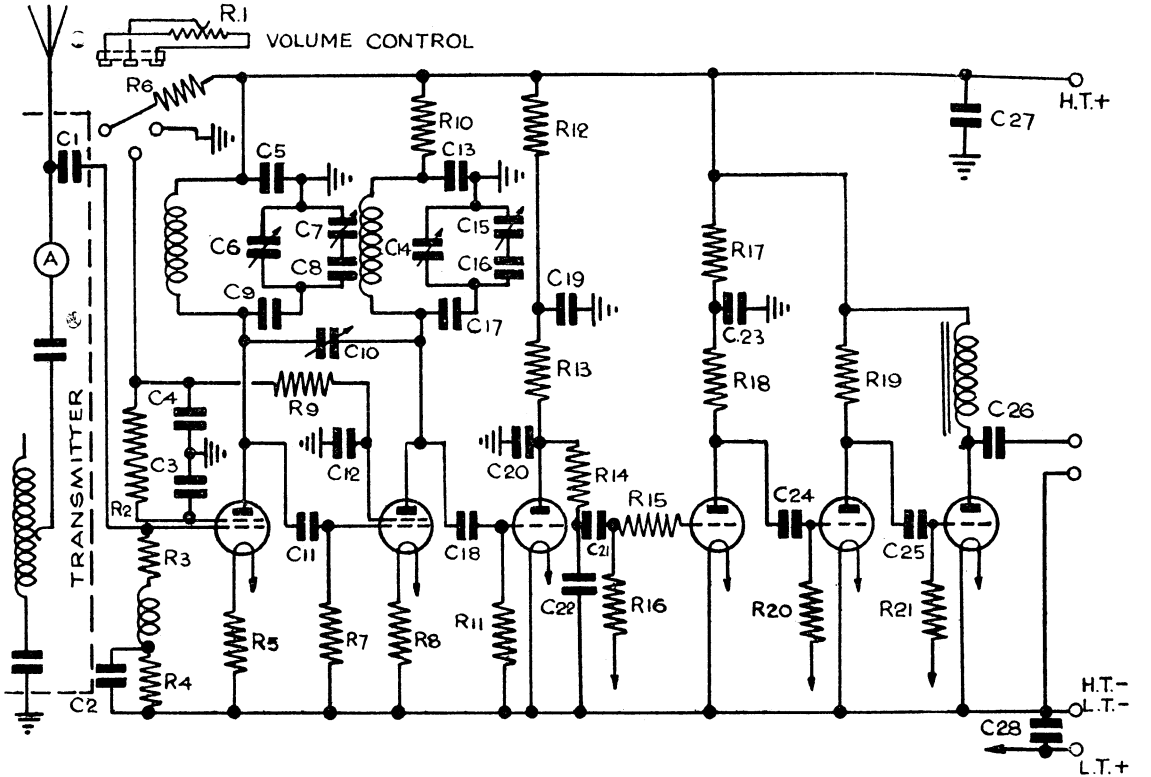

FIG. 72.—T.R. 9H receiver.

10. **Tuning** (N.B.—The transmitter must be tuned first).—(i) *Transmitter :—*

(*a*) Set the normal aerial tuning inductance to O if frequency required is greater than 5 Mc/s, or to 16 if it is less.

(*b*) Switch on set, and switch on supply to power unit if fitted.

(*c*) Press " P.T.T." switch and tune A.T.I. until a dip is noticed in input milliamps ; set to greatest dip and switch off P.T.T. switch.

(ii) *Receiver.*—(*a*) Ensure that the transmitter is correctly tuned.

(*b*) Set volume control to maximum and leave it there during the whole process of tuning.

(*c*) Ensure that set is switched on, and power unit, if fitted, is " on ".

(*d*) Switch on and adjust R/T tester to frequency required.

(*e*) Adjust the two main tuning condensers carefully (keeping them in step) until the modulated signal is heard at full strength.

(*f*) When correctly tuned in, attenuate the signal input until the note is barely audible. This is done by moving the R/T tester, closing the lid, or both.

(*g*) Tune again very carefully, attenuating the signal to ensure absolute accuracy in tuning.

(*h*) Turn the regeneration control up until the receiver commences to oscillate, then turn it back one complete turn.

(*j*) Re-adjust main tuning condensers slightly for maximum signal.

(*k*) Lock receiver tuning.

Note.—Fine and accurate tuning of the T.R.9 receiver is a vital factor in the success of air operations.

11. **Amplifier A.1134** (fig. 73).—(i) *Power supplies.*—(*a*) L.T. 2-volt 14 A.H. accumulator.

(*b*) H.T. 120-volt dry battery.

(*c*) G.B. 6-volt dry battery—tapped at 3 volts and 6 volts.

(ii) *Circuit.*—The A.1134 consists of a two-stage A.F. amplifier. The first stage is a V.R.21 voltage amplifier, transformer coupled to the output stage, which is a V.R.35 quiescent push-pull amplifier. This stage is also transformer coupled to the telephones.

(iii) *General.*—(*a*) The amplifier is used for inter-communication purposes between members of the aircraft crew up to seven in number, in addition to acting as a sub-modulator for the transmitter portion of the T.R.9F.

(*b*) The A.1134 may also be used as a microphone amplifier when it is desired to transmit R/T on the aircraft's normal long distance C.W. transmitter (T.1083 or T.1154).

(*c*) Switching of the amplifier is arranged so that whilst normal inter-communication is possible between other members of the crew, the W/T operator is left connected to his C.W. receiver, but he may be brought into the I/C circuit at will, or may use the amplifier to modulate his transmitter at will.

(*d*) In addition, the pilot has a switch which enables him to switch on the T.R.9H and communicate with his base.

VALUES

Resistances		Condensers	
1	75 Ω	1	100 μμ F
2	75 Ω	2	100 μμ F
3	50 Ω	3	500 μμ F
4	1 M Ω	4	50 μμ F
5	1 M Ω	5	50 μμ F
6	15 K Ω		
7	5 K Ω		
8	500 Ω		
9	500 Ω		
10	·5 M Ω		
11	150 K Ω		
12	15 K Ω		
13	50 K Ω		
14	2 K Ω		

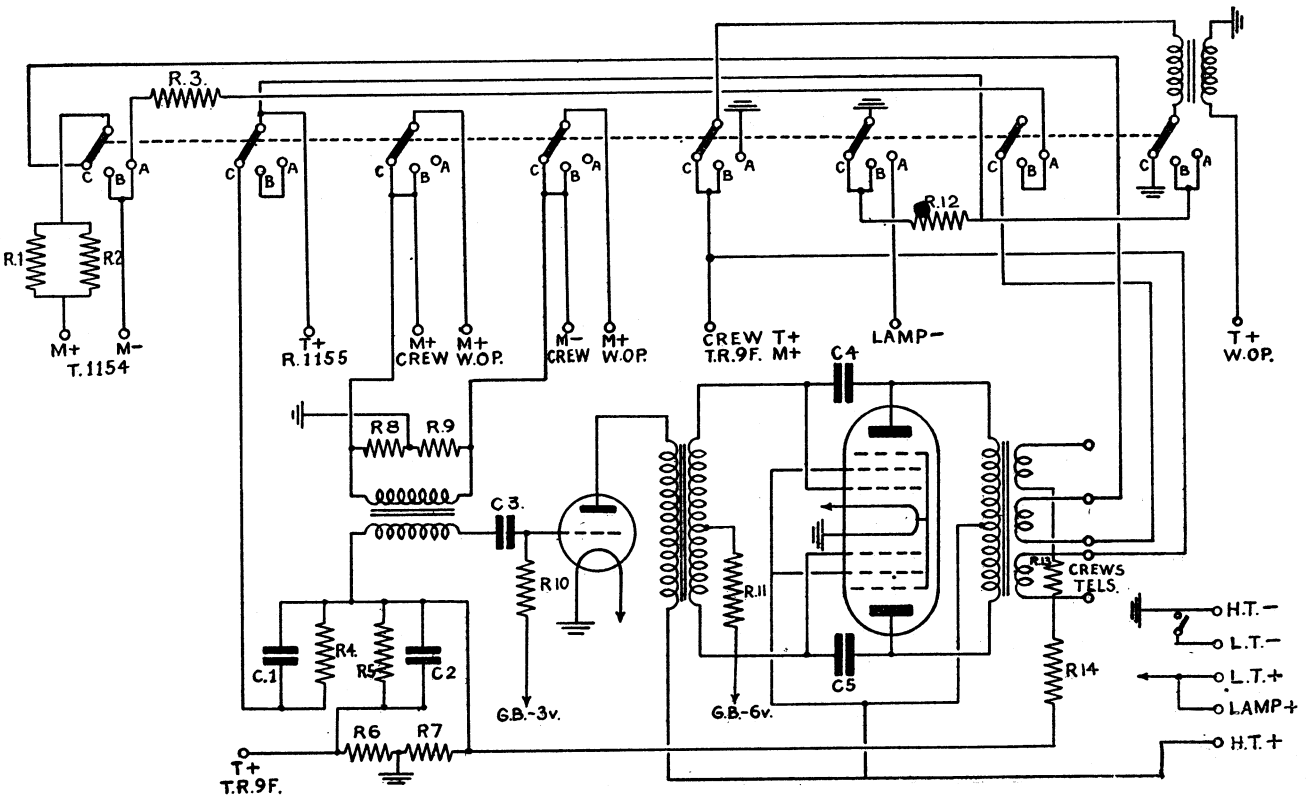

FIG. 73.—Amplifier, A.1134.

(*e*) Fig. 73 shows the complete circuit diagram of the A.1134, and fig. 73A shows the operation of the "A B C" switch.

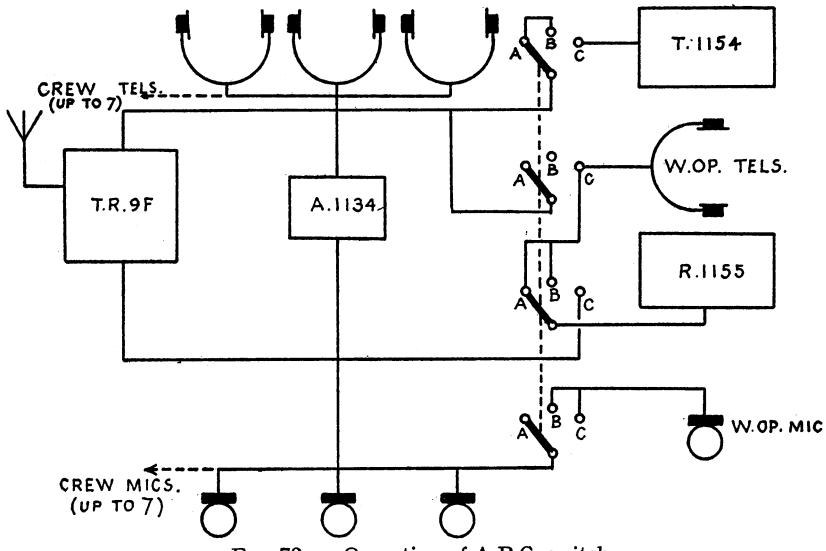

FIG. 73A.—Operation of A.B.C. switch.

(*f*) The connections to the various plugs and sockets are as follows :—

(i) 10-pin plug—

1. Lamp+
2. Lamp−
3. W/T operator T+
4. Crew T+ and T.R.9H M+
5. T.R.9H T+
6. C.W. receiver T+
7. T.R.9H M−, T−, and earth.
8. C.W. transmitter M−
9. C.W. transmitter M+
10. Earth

(ii) 4-pin plug—

1. Crew M+
2. W/T operator M+
3. Crew M−
4. W/T operator M−

(iii) 3-pin plug—
Red—T.R.9H receiver output.
Blue—earth.
Yellow—microphone input to T.R.9H transmitter.

12. **Panel, Type 192.**—This is a junction box fitted in the aircraft, accommodating the microphone and telephone leads from the T.R.9.H and the R.1155, and also the 10-pin and 4-pin plugs from the A.1134. From this panel, microphone and telephone leads go out to the W/T operator and the various crew positions. A switch on the panel provides an additional intercommunication facility, i.e. the use of the A.F. stages of the T.R.9.H receiver as an intercommunication amplifier. This is useful if the A.1134 becomes unserviceable or is damaged in action, although the output is only sufficient for two or three pairs of telephones.

13. **Low Impedance Intercommunication System.**—This consists of :—

(i) *A.1134A.*—This is an intercommunication amplifier, exactly similar to the A.1134, but having an output winding, connected to the crew telephones, which is such as to match the amplifier to an impedance of about 150 ohms, instead of the 20,000 ohms impedance of the A.1134.

(ii) *Microphone Assembly, Type 35.*—This consists of a pair of high impedance (type 16) telephones, an ordinary E.M. microphone, and a cord fitted with the usual plug and a small unit containing a transformer and switch. By means of the switch the transformer can be brought into circuit, or cut out. When the transformer is in

circuit, the microphone assembly can be used with A.1134A (i.e. in a " low-impedance " aircraft). When transformer is out, the helmet is suitable for use with A.1134 (i.e. in a " high impedance " aircraft). When low impedance telephones (type 32) are fitted to this assembly, one lead is changed over, and the turns ratio of the transformer is thus reversed, permitting the use of low impedance telephones with either A.1134 or A.1134A. The assembly is thus universal, enabling air crews to operate in any aircraft with any telephones. Low impedance telephones may be recognised by a white square painted on the rear of the case of the earpiece.

(iii) *Junction Box, Type 9.*—This is a junction box containing a transformer, fitted in the telephone circuit of the R.1125 (S.B.A. receiver), and which matches the high impedance output of the R.1125A to the low impedance pilot's telephone.

(iv) *Matching Unit, Type 111.*—This is a transformer unit, included in the telephones circuit wiring of any other receiver (e.g. a navigator's R.1155, if fitted), whose impedance it is desired to reduce.

14. **Servicing of T.R.9H.**—(i) Change the L.T. battery after every flight.

(ii) Test the H.T. battery on load before every flight by inserting a voltmeter between lower crystal socket and earth terminal with switch at " send ". Battery must be changed when reading is 100 volts or less.

(iii) Before tuning a new transmitter for the first time or when changing the V.T.50 valve, plug in crystals and oscillator valve only, and check that the anode current does not exceed 5 mA.

(iv) Servicing of the intercommunication apparatus is extremely important and great attention is to be given to the following points :—

(*a*) Test the helmets of all members of the crew before each flight. Apart from testing the sensitivity with the tester provided, see that the insulation resistance between microphone and telephone leads, and to the earthed screen, is greater than 10 megohms and that the screening is serviceable and correctly connected to the microphone and telephone negative.

(*b*) Ensure that all telephone-microphone sockets are correctly anchored, clean and lightly smeared internally with petroleum jelly.

(*c*) The insulation resistance to all I/C wiring to be greater than 10 megohms (or as specified for a particular aircraft).

Note.—Ask the crew to refrain from swinging helmets and plugs idly about, whilst walking about the aerodrome, etc.