2.6. TYPE 86M

DATE OF DESIGN. 1940

HANDBOOK. B.R. 1401

ESTABLISHMENT LIST. E604

FREQUENCY RANGE. 100-156 Mc/s

FREQUENCY DETERMINATION. Crystal Oscillator

EMISSION AND POWER OUTPUT.
Voice – 6 to 8 W

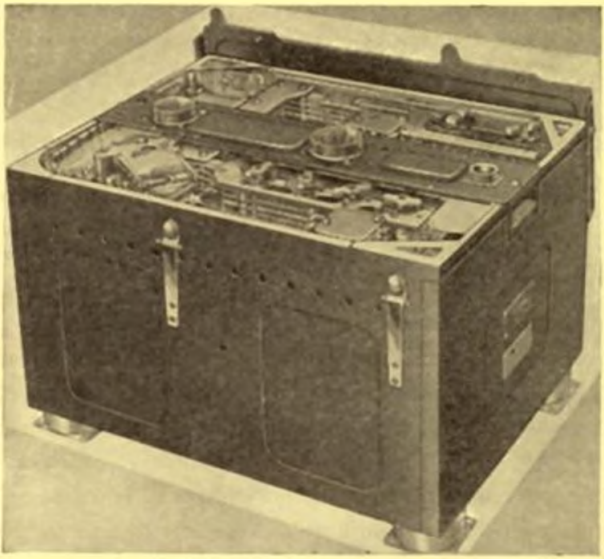


FIG. 1

GENERAL

1. A VHF Transmitter Receiver of U.S. design originally fitted in aircraft. It was fitted in nearly all ships and submarines as the standard emergency VHF set. There are four pre-set automatically tuned frequency channels.

2. **Power Supplies.** The transceiver may operate from:
   a. 230 V, 50 c/s a.c. supply which feeds rectifier unit SE8, or
   b. 24 V d.c. battery supply which feeds a dynamotor unit

TRANSMITTER

3. **Frequency Build-up**

a. Crystal frequency $= \frac{\text{Signal frequency}}{18}$

b. Crystal Grid	Oscillator Anode	1st Harm. Amp.	2nd Harm. Amp.	P.A.
1	×2	×3	×3	
e.g. 8·040 Mc/s	16·08 Mc/s	48·24 Mc/s	144·72 Mc/s	144·72 Mc/s

4. **Crystal Oscillator.** A pentode with 4 separate crystal grid circuits. The anode circuit is tuned by a coil and variable capacitor to the crystal's 2nd harmonic and is capacity coupled to the 1st harmonic amplifier.

5. **1st Harmonic Amplifier.** Trebles. A beam tetrode with the output circuit tuned by a coil and variable capacitor to the crystal's 6th harmonic and capacity coupled to the 2nd harmonic amplifier.

6. **2nd Harmonic Amplifier.** Trebles. A double beam tetrode in push-pull with the output tuned to the crystal's 18th harmonic by a coil and variable capacitor, and capacity coupled to the P.A.

7. **Power Amplifier.** A double beam tetrode in push pull, anode modulated, with output tuned to the crystal's 18th harmonic by a coil and variable capacitor, it is coupled to the aerial circuit by a variable transformer.

8. **Voice Input Circuit.** The microphone feeds into the primary of the microphone input transformer, the secondary being coupled to the speech amplifier via a potentiometer.

9. **Speech Amplifier.** A pentode transformer coupled to the modulator.

10. **Modulator.** Two beam tetrodes in push-pull with the output circuit transformer coupled to the P.A. H.T.

11. **Transmitter Controls**

CRYSTAL OSCILLATOR. The left hand of four controls. Varies a capacitor.

1ST HARMONIC AMPLIFIER. Control second from the left. Varies a capacitor.

2ND HARMONIC AMPLIFIER. Control third from the left. Varies a capacitor.

POWER AMPLIFIER. The right hand control. Varies a capacitor.

ANTENNA COUPLING. A screwdriver control or milled knob on the right of the set. A variable transformer.

GAIN. A screwdriver control which varies a potentiometer adjusting the input to the speech amplifier.

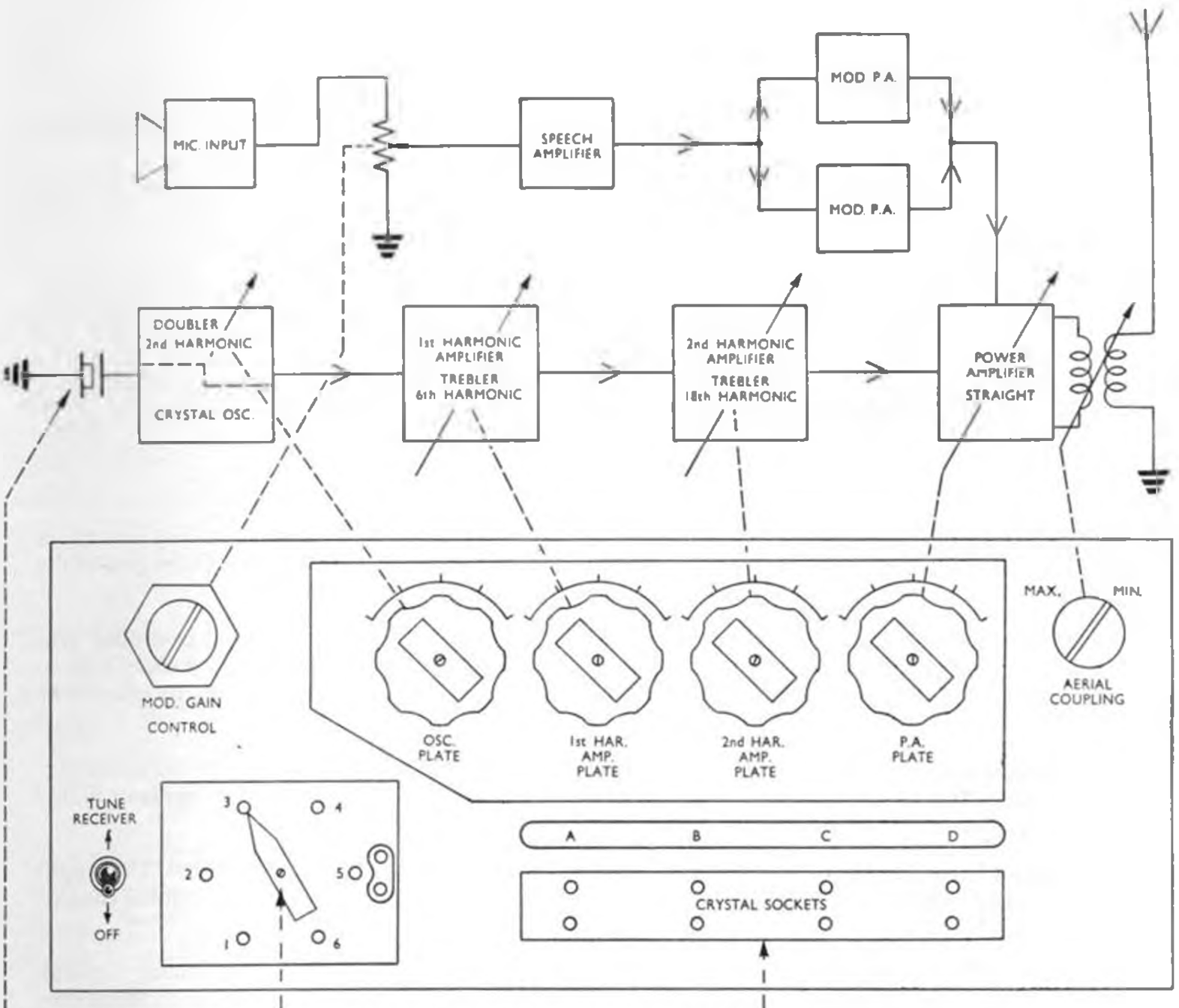
METER SWITCH. Has 6 positions:

a. 1st Harmonic Amp. Anode current
b. 2nd Harmonic Amp. Anode current
c. P.A. Anode current
d. Aerial Current – an indication only – not used
e. P.A. Grid Current
f. Blank.

TUNE-RECEIVER switch. In the Tune-Receiver position, applies H.T. to the crystal oscillator valve only. Used when tuning the receiver.

12. **Tuning Instructions for Transmitter**

a. The transmitter must be tuned before the receiver.
b. Insert the appropriate crystals ($\frac{1}{18}$ of signal frequency).
c. Check TUNE REC switch is off.
d. Plug meter into socket adjacent to meter switch.
e. Make mains switch, press button D, channel release button (in receiver section), loosen locking nuts, and press button A.
f. Set tuning controls to approximate frequency.
g. With meter switch in position 1, tune first tuning control for maximum reading in meter (using T on auto. controller or pressel switch to key transmitter).
h. With meter switch in position 2, tune 2nd tuning control for maximum.
i. With meter switch in position 3, tune 3rd tuning control for maximum, and without delay tune 4th tuning control for minimum (note meter reading) and partially lock all tuning controls, being careful not to upset tuning adjustments.
j. Tune remaining channels as for A, pressing appropriate buttons B, C and D in that order.



SWITCH POSITION	TUNE FOR	NORMAL READING	TROUBLE
1. (1st HAR. AMP PLATE)	MAX	0·4	MORE THAN 0·75
2. (2nd HAR. AMP PLATE)	MAX	0·5	MORE THAN 0·75
3 (P.A PLATE)	3rd CONTROL MAX 4th CONTROL MIN	0·63	MORE THAN 0·75
4 (R.F. INDICATOR)	NOT USED FOR TUNING	FULL SCALE	LESS THAN 0·5
5. (P.A. GRID)		OFF	——
6 BLANK			

FIG. 2. TYPE 86M TRANSMITTER

k. Adjust the common coupling control (knurled knob in transmitter section), 4th tuning control (on the frequency that gave the highest recorded meter reading), to read as near as possible to 0·63, with meter switch in position 3 and 4th tuning control adjusted to a minimum. Finally press channel release and lock locking nuts by carefully tightening against cam pile.

TUNING A SINGLE CHANNEL. Press channel button preceding the channel it is desired to tune and channel release. Loosen locking nuts, press desired channel button and proceed with normal channel tuning. It may be necessary to check *k* above.

TUNING CHECK. With meter switch in position *c*, rotate first 3 controls slightly against positioning indent. There should be no *increase* in meter. Likewise with control 4 there should be no *decrease*.

RECEIVER

13. **Frequency Build-up.**

$$\text{Crystal frequency} = \text{Signal Frequency} \begin{cases} -12 \div 11 \text{ for } 100 \text{ to } 108 \text{ Mc/s} \\ -12 \div 12 \text{ for } 108 \text{ to } 116 \text{ Mc/s} \\ -12 \div 13 \text{ for } 116 \text{ to } 124 \text{ Mc/s} \\ -12 \div 14 \text{ for } 124 \text{ to } 132 \text{ Mc/s} \\ -12 \div 15 \text{ for } 132 \text{ to } 140 \text{ Mc/s} \\ -12 \div 16 \text{ for } 140 \text{ to } 148 \text{ Mc/s} \\ -12 \div 17 \text{ for } 148 \text{ to } 156 \text{ Mc/s} \end{cases}$$

14. **1st R.F. Amplifier.** A variable mu pentode whose grid and anode circuits are tuned by capacitors which are ganged to the r.f. Tuning Control. The anode output is transformer coupled to the grid of the Mixer.

15. **Crystal Oscillators and Audio Squelch.** A double triode; one triode has a crystal controlled grid circuit connected to one of four crystals. The frequency range of crystals to be used is 8 to 8·72 Mc/s. The anode output circuit is broadly tuned by screwdriver adjustable coil cores, and capacity coupled to the harmonic generator. The other triode acts as a squelch or noise suppressor valve.

16. **Harmonic Generator.** A triode with the output circuit tuned to appropriate crystal harmonic (i.e. Fs – 12 Mc/s). The output circuit is tuned by a variable capacitor which is ganged to the Oscillator tuning control, and is capacity coupled to the harmonic amplifier.

17. **Harmonic Amplifier (Buffer).** A pentode which amplifies the harmonic generator output. The output circuit is tuned by a capacitor which is ganged to the Oscillator tuning control and is transformer coupled to the mixer.

18. **Mixer.** A pentode with the grid circuit tuned by a capacitor ganged to the r.f. Tuning Control. The oscillator output is always lower than the signal frequency by the amount of the i.f. (12 Mc/s). The mixer output is tuned transformer coupled to the 1st i.f.

19. **I.F. Stages.** These consist of three pentodes, the first two being variable mu, all with tuned transformer coupled inputs tuned to the i.f. (12 Mc/s). The output of the 3rd i.f. is transformer coupled to the Detector.

20. **Detector, 1st A.F. Amplifier and A.G.C.** A double diode pentode, the two diode anodes being strapped together and working as a single diode.

a. DETECTOR. The A.F. output is fed to the grid of the 1st a.f. via a noise limiter valve and a.f. Gain potentiometer which is screwdriver controlled.

b. A.G.C. Negative bias is applied to the grids of the 1st r.f. and 1st and 2nd i.f. via the second triode of the Crystal Oscillator which provides a delayed a.g.c.

c. 1ST A.F. AMPLIFIER. This comprises the pentode of the valve and the output is capacity coupled to the grid of the 2nd a.f. (output valve).

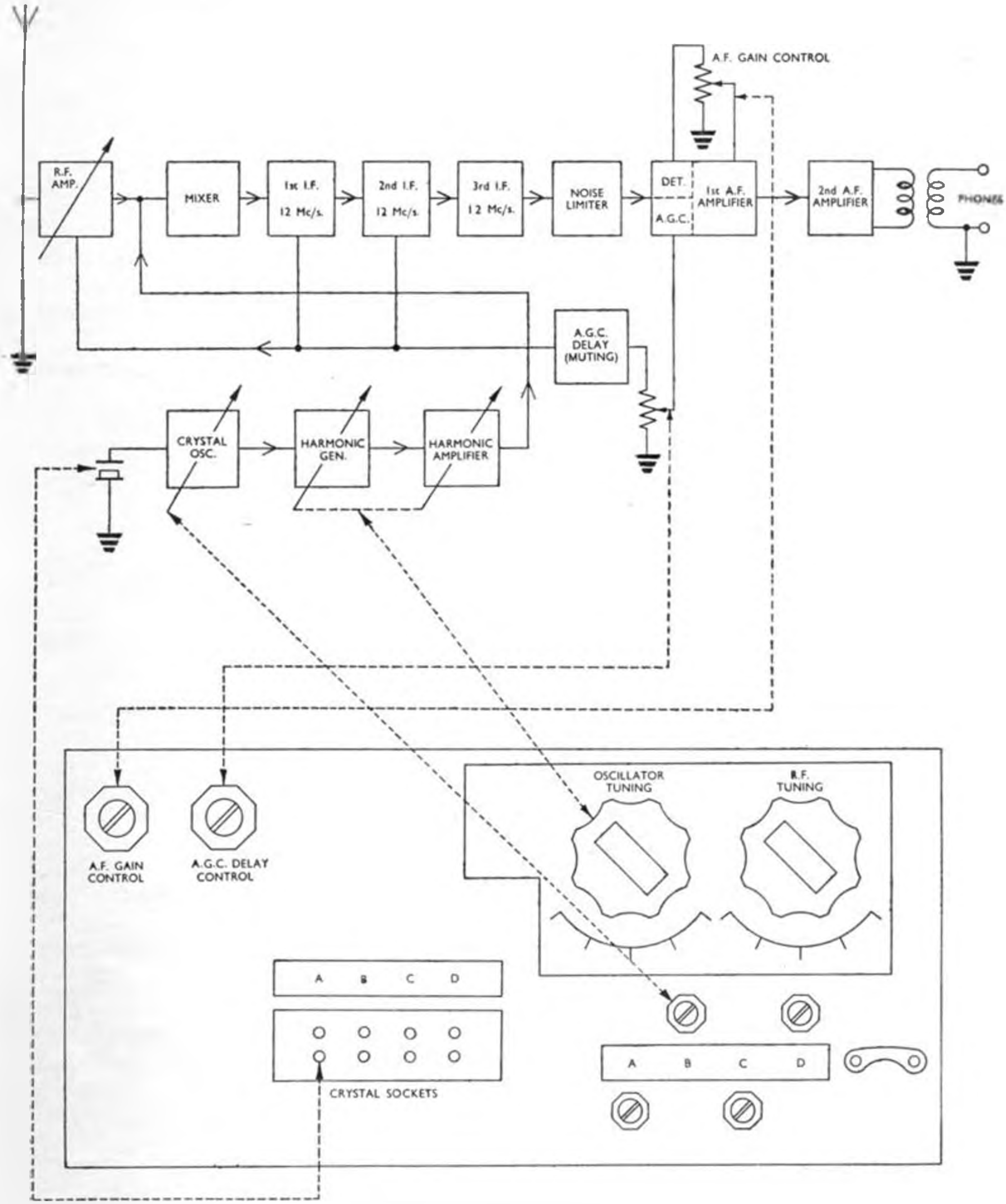


FIG. 3. TYPE 86M RECEIVER

21. **2nd A.F. Amplifier (output).** The anode load acts as the primary of the output transformer which has three tappings of its secondary supplying impedances of 8,000, 6,000 and 50 ohms.

22. **Receiver Controls.**

AUDIO. A.F. gain. Screwdriver control. Adjusts a potentiometer in the input of the 1st a.f.

RELAY. This control:

a. In certain modified receivers adjusts the voltage level at which the a.g.c. delay valve functions.

b. In certain receivers adjusts the cut-off level of the muting (squelch) circuit when fitted.

CHANNEL RELEASE. A push button on the left of the receiver. Frees the ratchet system.

OSCILLATOR PLATE TUNING. Four screwdriver controls, one for each channel, adjust the coils in the crystal anode circuit.

OSCILLATOR TUNING. Adjusts the ganged variable capacitors in the harmonic generator and harmonic amplifier output circuits.

R.F. TUNING. Adjusts the ganged variable capacitors in the r.f. input and output and mixer input circuits.

METER. A separate piece of equipment used for tuning.

23. **Tuning Instructions for Receiver**

a. The transmitter must be tuned before the receiver.

b. Insert appropriate crystals. Crystal Frequency $= \frac{\text{Signal Frequency} - 12}{\text{Harmonic}}$

c. Transfer meter to receiver socket, set relay control fully clockwise and audio control almost fully clockwise.

d. Press button D, channel release, loosen locking nuts and press button A.

e. Check key on controller electric to R.

f. Place Tune Receiver switch to Tune Receiver.

g. Set both receiver controls to approximate frequency and unscrew oscillator plate tuning control until 5 or 6 threads are showing.

h. Adjust the two tuning controls alternately for minimum meter reading.

i. Screw in the oscillator plate tuning control until there is an increase in meter reading and a pronounced click in the phones, then screw O.P.T.C. anticlockwise until meter reading drops again and continue approximately $\frac{1}{4}$ of a turn in the same direction.

j. Slightly readjust tuning controls for minimum meter reading.

k. Tune remaining channels as for A, pressing buttons B, C, and D as required in that sequence.

l. Press channel release and lock locking nuts.

m. Press each channel button in turn and check that meter readings have been maintained.

n. Place Receiver switch to OFF.

TUNING A SINGLE CHANNEL. Press channel button preceding the channel it is desired to tune and channel release. Loosen locking nuts, press desired channel button and proceed with normal channel tuning.

TUNING CHECK. Before *n* above, rotate tuning controls against positioning indent. There should be no decrease in meter readings.