CONCISE DETAILS OF RECEIVER TYPE 88

(Main component of receiving equipment type R.1475)

PURPOSE OF EQUIPMENT	General purpose ground station receiver.
TYPE OF WAVE	C.W., M.C.W., or R/T.
FREQUENCY RANGE	Main channel, 2-20 Mc/s. Guard channel, 2—7·5 Mc/s.
FREQUENCY STABILITY	Thermally-controlled local oscillator gives re-setting accuracy better than 4 kc/s, between 11·3 and 20 Mc/s, and within 2 kc/s between 2 and 11·3 Mc/s.
CRYSTAL	B.F.O. crystal controlled, 600 kc/s. Also gives calibration check facilities at 600 kc/s. intervals. Guard channel local oscillator crystal controlled, crystal being ±600 kc/s. of selected guard frequency.
MAXIMUM SENSITIVITY	1 μV for 50 mW. at high level output, for a signal/noise ratio of 20dB. 1 μV for 1 mW. at low level output, for a signal/noise ratio of 20 dB.
SELECTIVITY	On R/T, I/F cut-off is 8 dB. per kc/s ; A/F output is level to ± 2 dB. from 270 to 2,750 c/s. On C.W., I/F cut-off is 11 dB. per kc/s ; Listening-out band-width is 3 kc/s ; 1·2 kc/s and 300 c/s A/F filters are available.
OUTPUT IMPEDANCE	Provision for 20,000, 600 or 150 ohms loads.
VALVES	V1, V5, V7, VR.53 (Stores ref. 10E/11399). V2, V12, 6J5G, (Stores ref. 10E/348). V3, V4, ARTH.2 (Stores ref. 10E/527). V6, CV.216 (Stores ref. 10CV/216). V8, V9, V11, 6Q7G (Stores ref. 10E/603). V10, VR.54 (Stores ref. 10E/11400). V13, VI.103 (Stores ref. 10E/305).
POWER INPUT	H.T. feed, approx. 65 mA. at 250 volts. L.T. feed, approx. 1·8 amp. at 12 volts.
POWER OUTPUT	Max. undistorted output, low level, 3·75 mW. Max. undistorted output, high level, 150 mW.
STORES REF. NO.	10D/1525.
APPROXIMATE OVERALL DIMENSIONS	*Length* 16½ in. · *Width* 8½ in. · *Height* 8¾ in.
WEIGHT	31 lb.
ASSOCIATED EQUIPMENT	Power unit type 360 (Stores ref. 10K/1260) ; or Power unit type 458 (Stores ref. 10D/17115).

RECEIVING EQUIPMENT, TYPE R.1475

INTRODUCTION

1. The receiving equipment type R.1475 consists basically of the receiver type 88, together with a suitable power unit. The receiver type 88 is a general purpose ground station receiver covering the frequency band 2 to 20 Mc/s in four ranges, namely 2 to 3·6, 3·6 to 6·4, 6·4 to 11·3 and 11·3 to 20 Mc/s. The general appearance of the receiver, as arranged for bench mounting, is shown in fig. 1. The protective grille shown in this figure is not used when the receiver is rack mounted. It should be noted that the photographic illustrations in this publication are taken from a pre-production model, but the production model will not differ from this in any essential detail.

2. The receiver type 88 is tropicalized, and should be capable of withstanding highly humid conditions at temperatures up to + 40 degrees centigrade, or arctic conditions down to —40 degrees centigrade. It is designed for operation under conditions of severe vibration, and may therefore be fitted as part of a mobile installation.

General characteristics

3. A super-heterodyne circuit, with pre-selector stage and a power uo put stage, is employed. Provision is made for C.W., M.C.W., and R/T reception. While the circuits generally follow conventional practice, certain improvements in mechanical design and electrical circuit practice have been incorporated. As a result, the receiver possesses the following characteristic features.

(i) The tuning scale can be set to any frequency within the band 2—11·3 Mc/s with an accuracy of 2 kc/s, i.e. within the side bands of an R/T transmission or within beat-note range of a C.W. transmission. On the 11·3—20 Mc/s band, it can be set to within 4 kc/s.

(ii) The receiver incorporates a self-monitoring system by which the frequency calibration can be checked at 600 kc/s intervals over the whole range, by means of an internal crystal standard. Means are provided for adjusting the calibration to compensate for any permanent or semi-permanent changes due to a gradual temperature drift. Normal changes in temperature are, however, automatically compensated by special thermally-controlled capacitors and inductances in the local oscillator circuit.

(iii) A noise-limiting circuit is incorporated, by which sharp impulsive noises (due for example to the ignition circuits of internal combustion engines) are greatly reduced in amplitude. Since the duration of each such pulse is generally quite small, and the limiting circuit provides for rapid recovery of the receiver, the noise suppression only slightly reduces the intelligibility of R/T traffic. A higher degree of suppression is available where appreciable distortion can be accepted, i.e., for C.W. reception.

(iv) Independent R/F and A/F gain controls are provided, any condition from full A.V.C. to full manual control being obtainable. An improved system of amplified A.V.C. is employed. This is combined with the manual R/F gain in such a manner that the sensitivity can be set manually, but the A.V.C. over-rides the manual setting when the incoming signal strength is sufficient to overload the receiver. The A.V.C. characteristics are such that an 80 dB. change in input causes less than 6 dB. change in output. The A.V.C. time constant is variable in two steps giving optimum conditions either for hand-speed C.W. reception, or for R/T, high-speed C.W. and listening-through during C.W. traffic (see para. 26).

(v) An additional receiving channel is provided, on a single pre-selected frequency in the 2 to 7·5 Mc/s band. This is referred to as the guard channel. This facility can be switched off when not required. When it is in use, signals on the " guard " frequency break through, irrespective of the frequency setting of the main channel. Difficulty may, however, be experienced if the main and guard channel frequencies are in harmonic relationship (see para. 156).

Sensitivity

4. The sensitivity characteristics of the receiver are as follows.

(i) *On C.W.* Throughout the whole frequency range, the sensitivity is better than 1 microvolt for 50 milliwatts at the high level output terminals, or 1 milliwatt at the low level output terminals, for a signal/noise ratio of 20 dB.

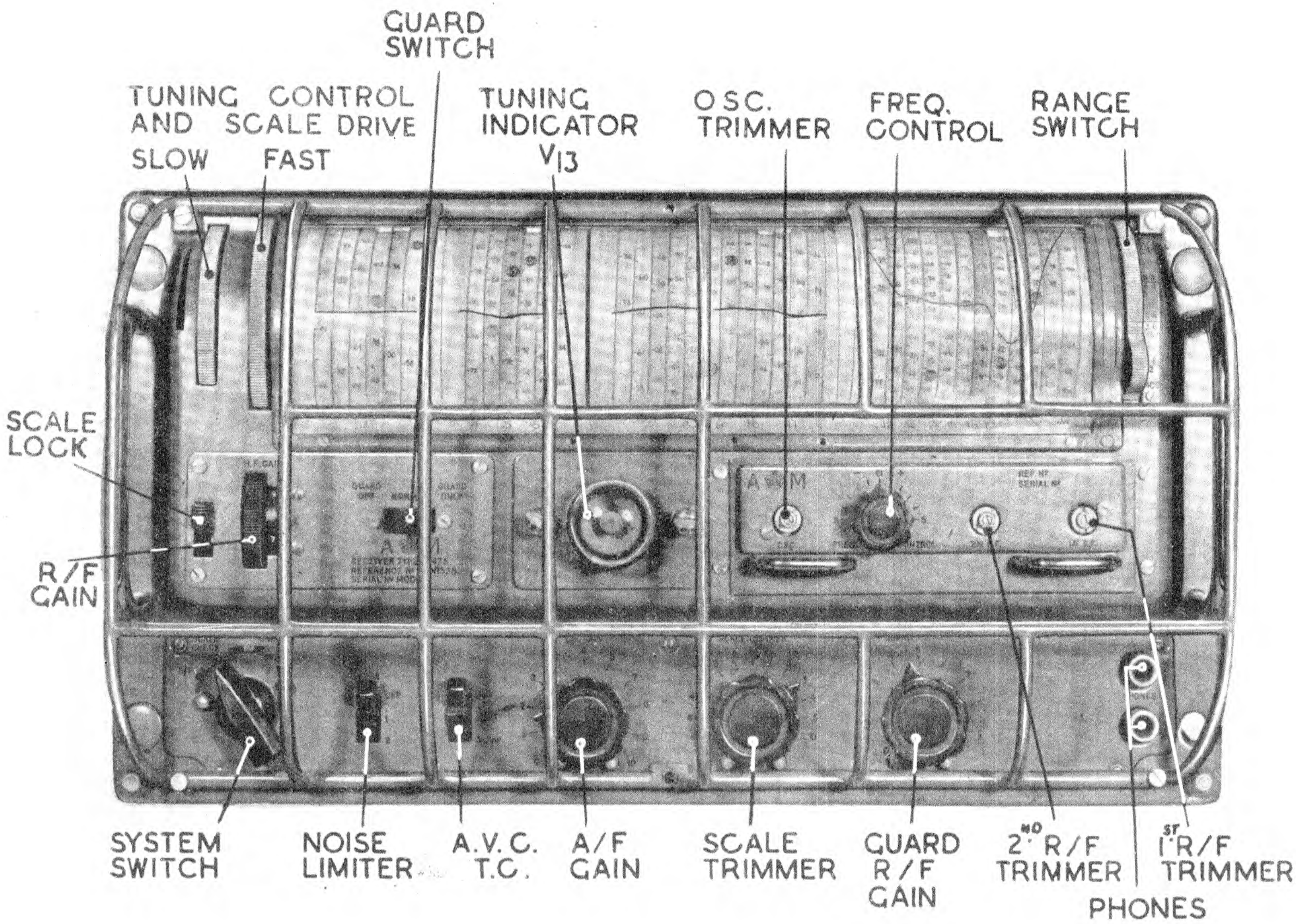

Fig. 1—Receiver unit type 88, front view

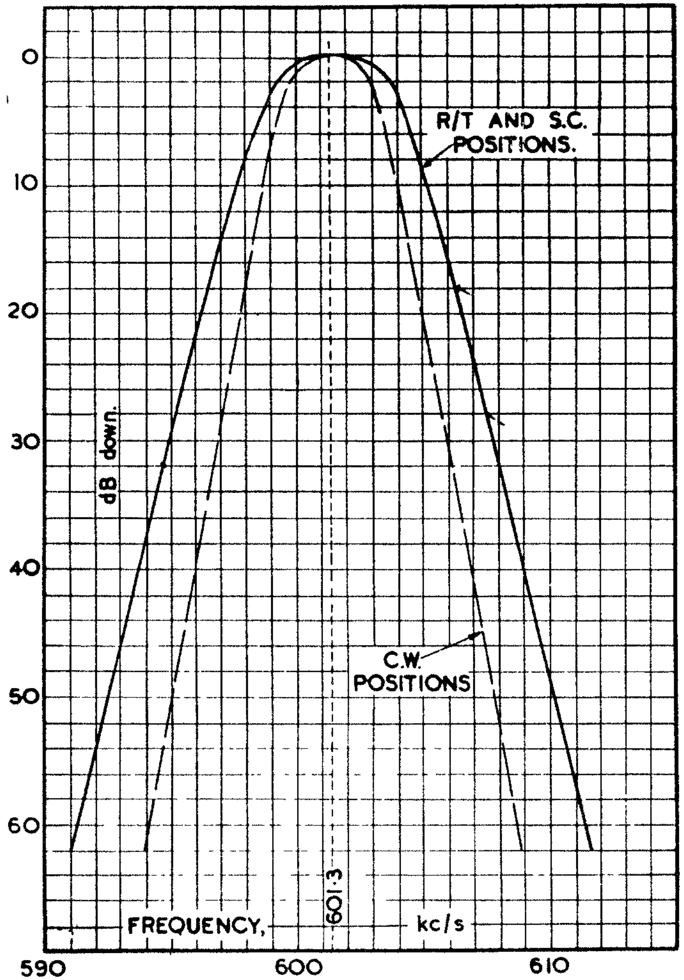

Fig. 3—I/F selectivity

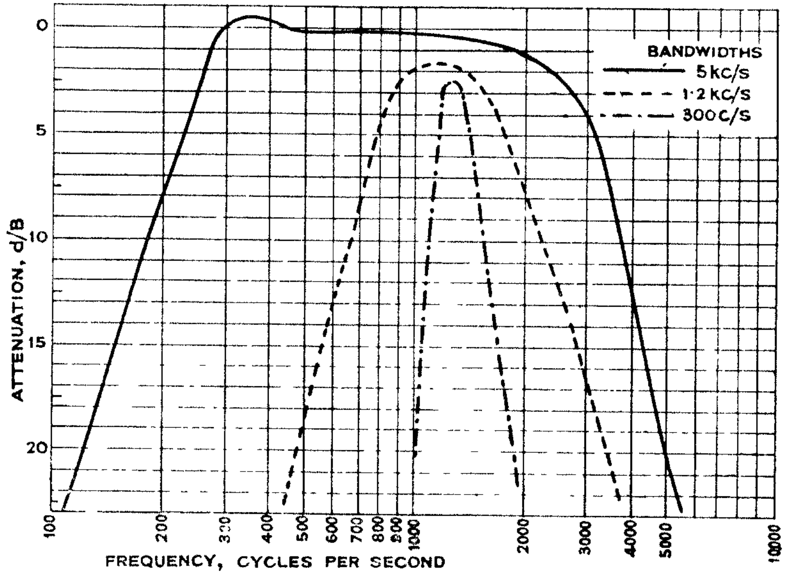

Fig. 4—Overall response characteristics

V8	A.V.C. detector and d.c. amplifier (6Q7G).
V9	Second (signal) detector and B.F.O. (6Q7G).
V10	Noise limiter and A.V.C. delay (VR.54).
V11	A/F amplifier and R/F gain control delay (6Q7G).
V12	Power amplifier (6J7G).
V13	Tuning indicator (VI.103).

All valves have international octal bases. The connections of the valve pins to the various electrodes are given in para. 121. All the valves have six-volt heaters, which are run in "series pairs" across the 12-volt supply as shown in the complete circuit diagram, fig. 32.

10. The main receiving channel includes the R/F amplifier V1, the local oscillator V2, and the main mixer V3, feeding into the common I/F and later stages. The guard channel includes the valve V4, which acts as a crystal-controlled local oscillator and mixer, and also feeds into the common I/F and later stages.

(ii) *On M.C.W. and R/T.* Fig. 2 shows the relation between signal and noise outputs for various signal levels, the signal being modulated to a depth of 30 per cent. at 1,000 cycles per second. These measurements were made at 7·4 Mc/s and the signal/noise ratio does not differ by more than 2 dB. from those shown, over the whole frequency range.

Selectivity

5. The selectivity of the I F amplifier is shown graphically in fig. 3. In the R/T position, the rate of cut-off is 8 dB. per kc/s, and on C.W., 11 dB. per kc/s. The protection against I/F interference is better than 100 dB. throughout the tuning range. Overall response curves are given in fig. 4. On telephony, the overall response is level to within ± 2 dB. between 270 and 2,750 cycles per second. The nominal band-width on C.W. may be either 3 kc/s, 1·2 kc/s, or 300 c/s, the two latter band-widths being obtained by suitable I F and A F filters.

Power supply and consumption

6. Power supply is normally provided by either a power unit type 360 or a power unit type 458. These units may be operated from either a 12-volt battery or from 200-250-volt a.c. mains. Power unit type 458 is an improved version of the power unit type 360, being fully tropicalized and incorporating a more efficient vibrator unit. The power consumption of the receiver is

H.T. feed, approximately 65 mA. at 250 volts,
L.T. feed, approximately 1·8 amperes at 12 volts.

Power output

7. The maximum undistorted output at the low level balanced output terminals is 3·75 milliwatts, and at the high level output terminals, 150 milliwatts. The input-output characteristics of the A F stages are shown in fig. 5 and 6.

Dimensions and weights

8. The dimensions of the receiver type 88 are, length 16½ in., height 8¾ in., depth 8½ in. Its weight is approximately 31 lb. The dimensions of the power unit type 360 are, length 4½ in., height 8¾ in., depth 8½ in. Its weight is approximately 20 lb. The power unit type 458 will be of approximately the same dimensions, but somewhat lighter than the power unit type 360.

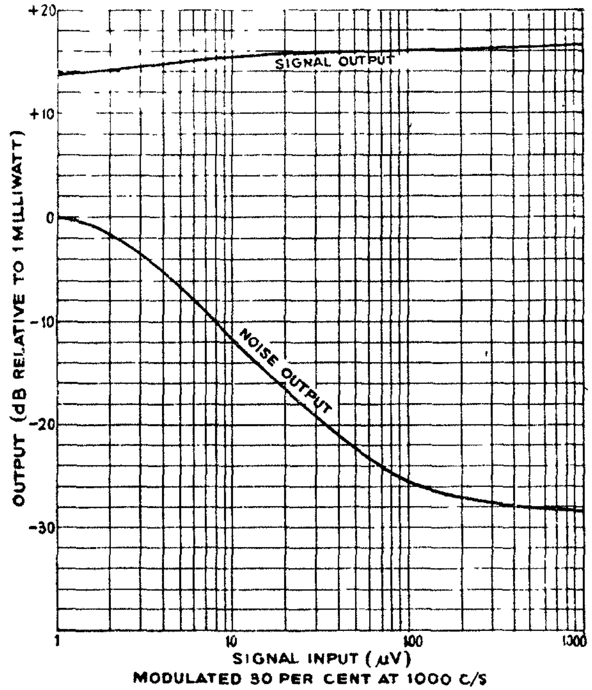

Fig. 2—Relation between signal input, signal output, and noise output

GENERAL DESCRIPTION

Valves

9. The receiver type 88 includes thirteen valves, the notation, type and function of each being as follows.

V1	R/F amplifier (VR.53).
V2	Main channel local oscillator (6J5G).
V3	Main channel mixer (ARTH.2).
V4	Guard channel local oscillator and mixer (ARTH.2).
V5	First I F amplifier (VR.53).
V6	Voltage stabilizer (CV.216).
V7	Second I F amplifier (VR.53).

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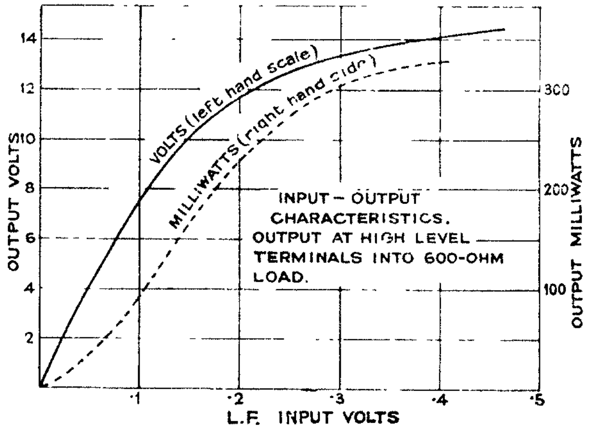

Fig. 5—A/F input-output characteristics (high level)

Controls

11. The operating controls may be divided into two groups, namely, the main and guard channel controls.

Main channel controls

12. The main channel controls are as follows.

- (i) Tuning control.
- (ii) Scale lock.
- (iii) System switch.
- (iv) R/F gain control.
- (v) A/F gain control.
- (vi) Scale trimmer.
- (vii) A.V.C. (time-constant) switch.
- (viii) Range switch.
- (ix) Noise limiter switch.

Guard channel controls

13. The guard channel controls are as follows.

- (i) Frequency trimmer.
- (ii) Guard R/F gain control.

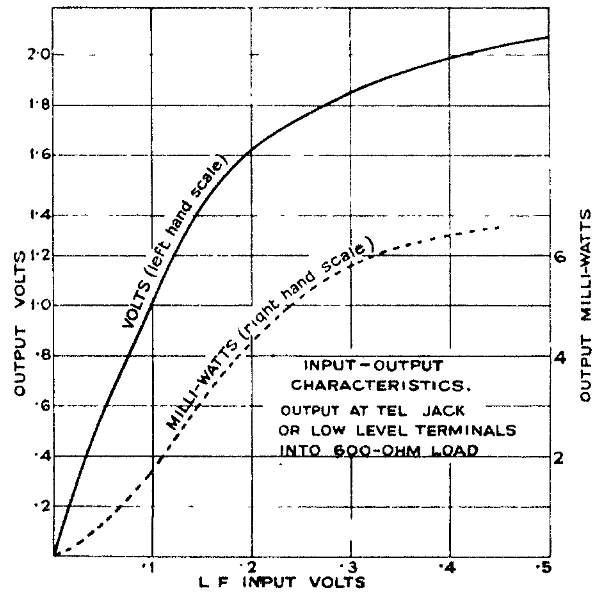

Fig. 6.—A/F input-output characteristics (low level)

- (iii) Guard channel switch.
- (iv) Oscillator trimmer } pre-set.
- (v) First R/F trimmer } pre-set.
- (vi) Second R/F trimmer } pre-set.

14. No B.F.O. control is fitted for C.W. reception, since the scale setting is inherently within beat-frequency range of the nominal frequency. This high standard of discrimination is achieved, in the main channel, by the use of a thermally-compensated local oscillator, and in the guard channel by the use of a crystal-controlled local oscillator fitted with a manually-controlled trimmer giving a small range of frequency variation, together with the use of a crystal-controlled beat-frequency oscillator for C.W. reception. The frequency of the latter is 600 kc/s, and the local oscillators for the main and guard channels respectively are both set up in such a manner that an intermediate frequency of 601·3 kc/s is always maintained. Thus the nominal note frequency in C.W. reception is 1,300 c/s.

Main tuning control

15. In the main channel, the frequency band 2 to 20 Mc s is covered in four bands, namely 2 to 3·6, 3·6 to 6·4, 6·4 to 11·3, and 11·3 to 20 Mc s. As already stated, at the highest frequency the scale can be set to within 4 kc s of the nominal frequency, and at lower frequencies even closer. The whole frequency range is covered by a scale thirty feet long, of which the two lower ranges each occupy five feet, and the two higher ranges each occupy ten feet. The discrimination is thus reasonably uniform over the whole frequency range, 10 kc s steps being represented by about one-eighth of an inch at the higher frequencies, and somewhat more at the lower end of the scale. The scale is marked at 10 kc s intervals over the whole frequency range.

16. The scale itself is a spiral line drawn upon a cylindrical surface divided into four ranges, the axis of the cylinder being horizontal (see fig. 1). The scale lighting is controlled by the range switch so that only that portion of the scale corresponding to the selected range is illuminated. A transparent window carrying a cursor line is fitted close to the curved surface of the scale. The frequency setting is indicated by the intersection of the frequency scale and the cursor line. Four metal flags (one for each range) are fitted near the bottom of the scale. As the scale is rotated, these flags move horizontally along a fixed horizontal scale showing whole numbers of megacycles.

17. Fig. 7 shows, diagramatically, one range of the scale. As stated above, the metal flag indicates the whole number of megacycles per second (reading the number immediately to the left of the flag). At the intersection of the cursor line and the frequency scale is shown the fraction of a megacycle to be added to the whole number. Thus, in fig. 7, the metal flag reads " 8 " on the bottom scale, and the reading at the intersection is 53(3) (the digit in brackets being estimated by eye). The scale is therefore set 8·53(3) Mc s.

18. The frequency calibration can readily be checked at 600 kc s intervals over the whole frequency range by putting the SYSTEM switch to the position marked S/C, which is an abbreviation for SCALE CHECK. In this position the harmonics of the 600 kc s crystal-controlled beat-frequency oscillator are fed into the input circuit of the main mixer valve, the R F amplifier valve and guard mixer valve being switched off. Thus, on rotating the tuning control throughout its whole range, heterodyne beat notes are heard at 600 kc s intervals along the scale,

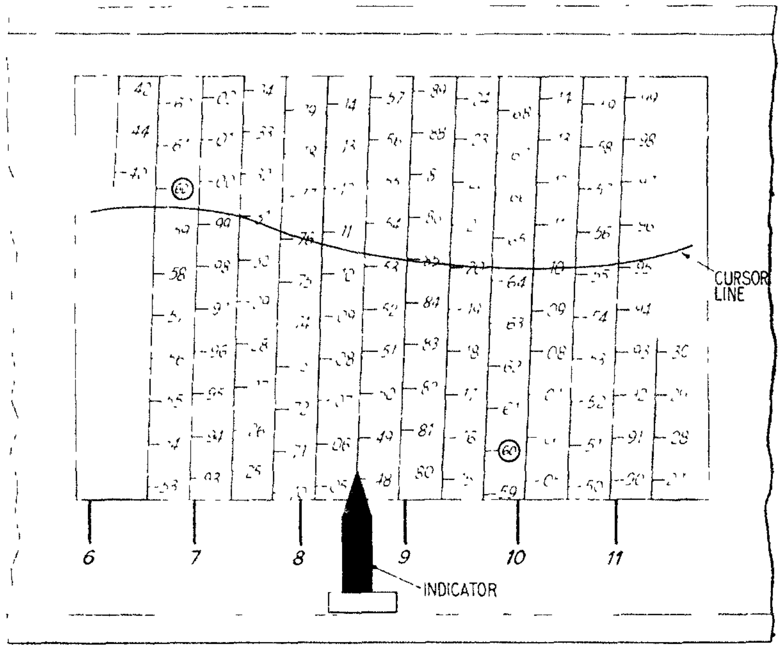

Fig. 7—Method of reading scale

the frequencies at which they occur being of course multiples of 600 kc s. On the range 6·4 to 11·3 Mc/s, the checking frequencies are 6·6, 7·2, 8·4, etc., Mc s. They are clearly indicated on the scale; two of them, 6·6 and 9·6 Mc s, are shown in fig. 7.

19. Tuning is performed by knurled thumb-operated controls at the left-hand end of the scale. Two controls are provided, one giving a one-to-one ratio drive, and the other driving through a five-to-one reduction gearing for fine tuning. The controls are located just above the carrying handle, and the latter forms a convenient support for the hand during the operation.

Scale lock

20. The SCALE LOCK control is provided in order to prevent accidental displacement of the scale, after setting the latter to the desired frequency, It is intended primarily for use when the receiver is installed in a vehicle.

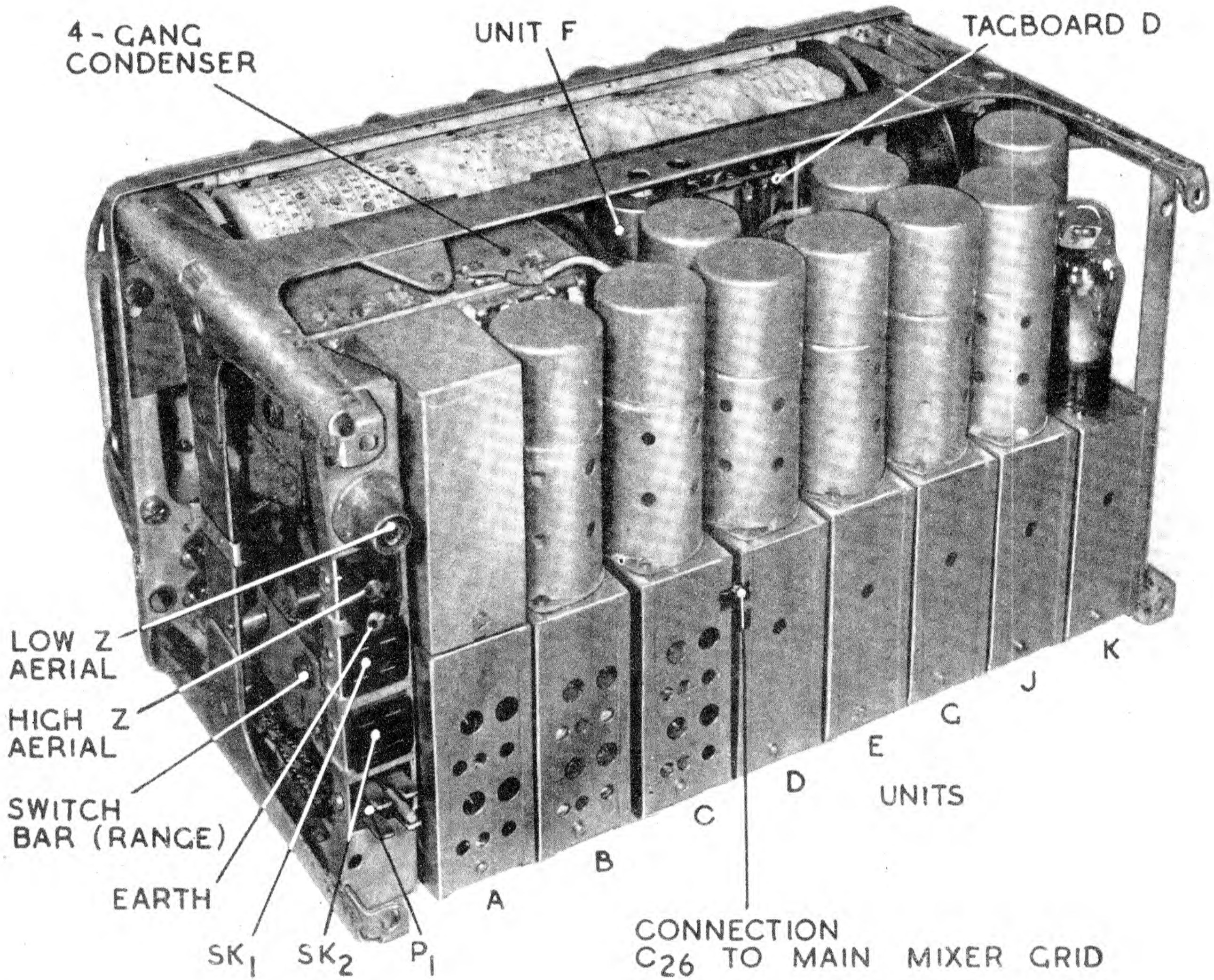

Fig. 8—Receiver unit type 88, rear view from left

In the design of this lock, care has been taken to ensure that the operation of the lock does not displace the scale from the desired setting.

System switch

21. The SYSTEM switch controls three distinct operations, namely

(i) variation of selectivity

(ii) beat-frequency oscillation on-off switching

(iii) circuit changes for scale checking.

The switch has five positions. The first, second and third are marked only by rectangles of varying width, representing C.W. reception on different band-widths. The first gives an I/F band-width of 3 kc/s and an A/F band-width of 300 c/s, the second an I/F band-width of 3 kc/s and an A/F band-width of 1·2 kc/s, the third an I/F band-width of 5 kc/s and an A/F band-width of 3 kc/s.

22. The fourth position, marked S/C (SCALE CHECK) is used when checking the calibration, as described in para. 158-160. In all the above positions, the beat-frequency oscillator is switched on.

23. The fifth position is marked R/T, and provides for either R/T or M.C.W. reception, the beat-frequency oscillator being switched off. The overall band-width is nominally 5 kc/s, and the response is practically level between 270 and 2,750 cycles per second. The circuit changes made by this switch are dealt with in para. 90-96.

Sensitivity and volume controls

24. Independent sensitivity and volume controls are provided, the former being marked R/F GAIN and the latter L/F GAIN. In this publication the latter will be referred to as the A/F GAIN control in accordance with the approved Service nomenclature. The R/F GAIN control is a potentiometer which supplies variable standing bias to the R/F amplifier valve along the R/F A.V.C. line. Full manual control of sensitivity is thus obtainable, but the A.V.C. can over-ride the manual control if called upon to do so. Even if the controls are mis-adjusted, grid blocking cannot be produced by strong signals. The A/F GAIN control is conventional, operating in the control-grid circuit of the A/F amplifying valve preceding the output stage.

Scale trimmer

25. This control is fitted to compensate for any change in the calibration due to temperature drift, or any other cause which affects the whole of the local oscillator circuits equally. It cannot, however, compensate for a change affecting one tuned circuit only, for example, a defective condenser. If, therefore, any component of an oscillator "range" circuit becomes defective, and a replacement component is fitted, the range affected will require re-trimming by adjustment of the appropriate trimming capacitance.

A.V.C. switch

26. This switch has three positions; in the first, the A.V.C. system is switched off. The other positions provide a slow and a fast A.V.C. response respectively. For listening through during C.W. transmission, for reception of R/T, and for reception of high-speed C.W., a fast response (short time-constant) is required, but for hand-speed C.W. reception, a slow response (long time-constant) generally gives superior results. This demarcation is not absolutely rigid, however, and the A.V.C switch should be adjusted to give the best results under the particular conditions prevailing at the time.

Range switch

27. This switch selects the desired frequency range, and in addition switches the scale lighting, so that only the required band on the frequency scale is illuminated.

Noise limiter switch

28. This switch gives two degrees of noise limiting and an OFF position. Position 1 gives a degree of noise limiting suitable for R/T reception, where too drastic reduction may cause excessive distortion. Position 2 gives greater noise reduction, and may be used for R/T reception if the increased distortion can be accepted. Provided the limiter switch is not OFF, the higher degree of limiting is automatically applied when the system switch is in any one of the three C.W. positions.

Guard units (tuning units type 131 and 132)

29. The guard unit allows a constant watch to be kept on any single frequency in the band 2 to 7·5 Mc/s, while using the main channel on another frequency. Two guard units are provided: Unit P (tuning unit type 131) covers the range 2 to 4·2 Mc/s, and unit Q (tuning unit

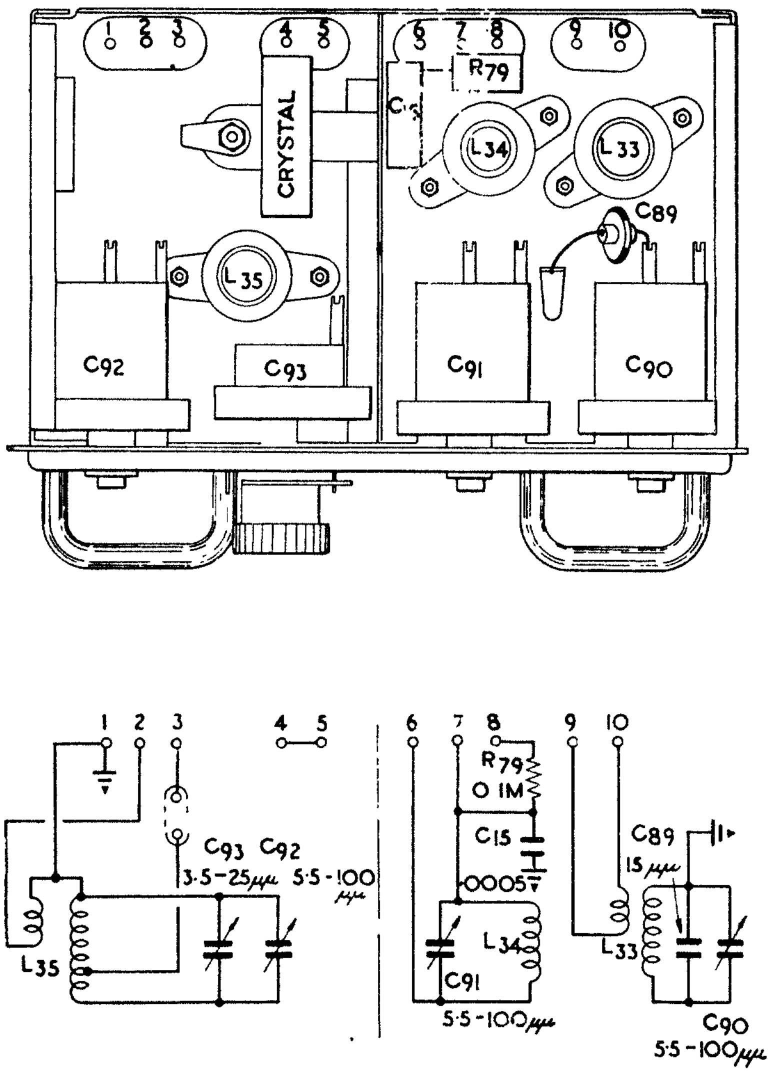

Fig. 9—Guard unit P, circuit and component location

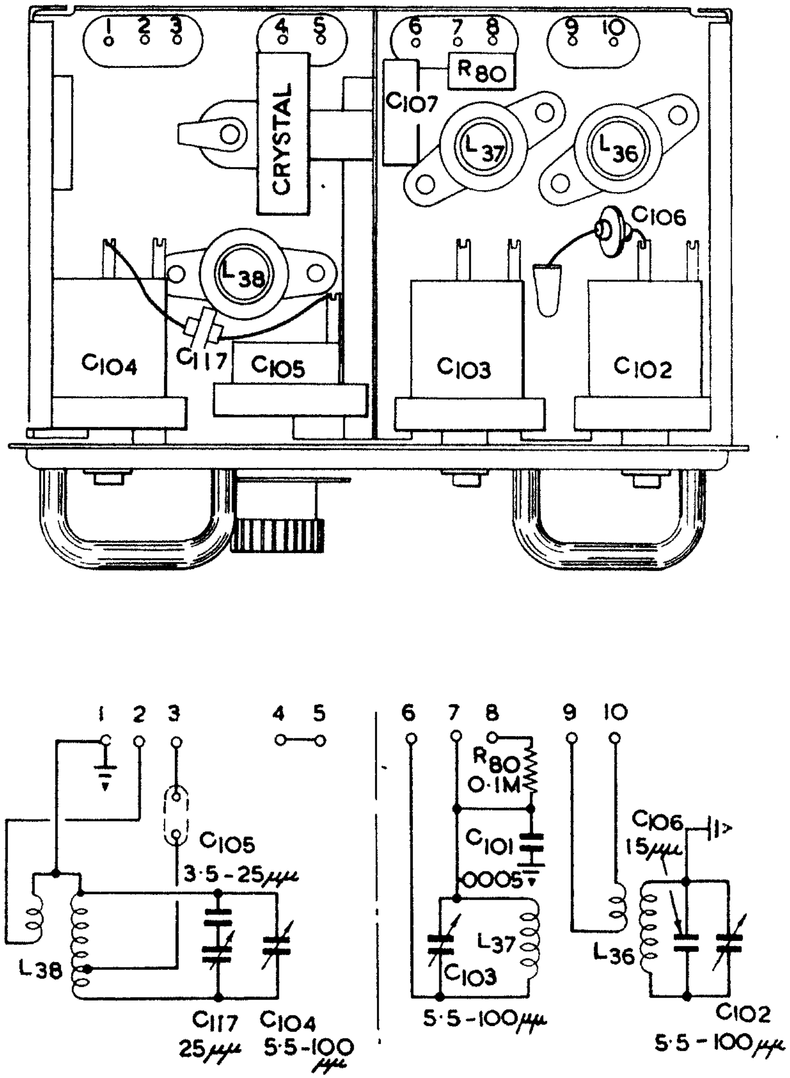

Fig. 10—Guard unit Q, circuit and component location

type 132) the range 4·1 to 7·5 Mc/s. Details of these units are shown in fig. 9 and 10. The required unit should ideally be fitted with a quartz crystal differing by 601·3 kc/s from the frequency allotted to the guard channel, but in practice a crystal differing by 600 kc/s is used, its frequency being " pulled " as requisite to give the correct intermediate frequency, by adjusting the guard FREQUENCY control.

30. After plugging in a crystal unit of the correct frequency, the guard unit is fitted into the guard channel housing through a rectangular orifice in the front panel. Connection to the unit is made automatically by spring contacts, as shown in fig. 32.

31. The guard unit works in conjunction with the guard mixer valve V4. It includes a two-stage band-pass tuner which couples the aerial circuit to the control grid of the guard mixer valve, and also a crystal-controlled local oscillator, which operates in conjunction with the triode section of the guard mixer valve. The output from the latter feeds into the common I/F amplifier stages.

Guard channel controls

Tuning controls

32. Each guard unit has four tuning controls, all of which are simple condenser trimmers. Three of these are pre-set, and are fitted with the common type of slotted-head control. The guard frequency trimmer control referred to in para. 29 is fitted with a small knob and scale, marked in arbitrary divisions up to ± 5. This control serves to " pull " the crystal frequency over a short range, and so allows the correct intermediate frequency to be obtained.

Guard R/F gain control

33. The GUARD R/F GAIN control is mounted on the front panel. It controls the sensitivity of the guard channel, and is so designed that the sensitivity can be reduced to zero. The primary object of this control is to limit the amount of noise introduced by the guard mixer valve. When this has been adjusted, the control may remain set for all normal conditions, the sensitivity of both channels being controlled simultaneously by the main channel sensitivity (R/F GAIN control). The operation of the GUARD R/F GAIN control does not, however, affect the sensitivity of the main channel. When main and guard channels are adjusted to give equal gain, the noise level is only 3 dB. higher than with the guard channel switched off.

Guard switch

34. The guard switch has three positions, namely GUARD ONLY, NORMAL (guard and main channels both ON), and GUARD OFF. When either channel is switched off, a compensating load is thrown into the 80-volt line feeding the screening grids of the main mixer, guard mixer and first I/F valves, in order that the sensitivity of the channel in use shall not require re-adjustment.

CONSTRUCTIONAL DETAILS

Mechanical assembly

35. Most of the resistances, fixed condensers, inductances and switch units are mounted in eight plug-in units, fitted upon the rear side of the vertical chassis, as shown in fig. 8. Viewed from the rear and taken in order from left to right, these units are

Unit	*Function*
A	Aerial unit (fig. 11)
B	R/F band-pass unit (fig. 12)
C	Local oscillator unit (fig. 13)
D	Mixer unit (both main and guard) (fig. 14)
E	First I/F unit (fig. 15)
G	Second I/F unit (fig. 16)
J	Beat-frequency oscillator unit (fig. 17)
K	Output unit (fig. 18).

36. A small unit, referred to as unit F, is mounted directly upon the chassis near the first I/F valve V5. Either of the two guard units (P and Q, para. 29) may be plugged into position from the front of the receiver. Fig. 9 to 18 give details of the respective units, namely, the circuit diagram and the location of components on each side of the wafer upon which they are assembled.

37. Ten switch units, which together form the RANGE switch, are mounted in the units A, B, and C. One switch unit, which controls the scale lighting, is mounted directly upon the chassis. The eleven switch units just mentioned are actuated by a common switch bar, which is a floating fit in the moving member of each switch unit. *It follows, therefore, that the common switch bar must be removed before any attempt is made to remove any unit for examination or renewal.* It is inserted from the right-hand end of the chassis, viewed from the front, and is actuated by the thumb-operated range-change switch on the front of the panel through a link action with a toggle device which locks the switch in the selected position.

38. Similarly, the nine switch units which together form the SYSTEM switch are mounted in units D, E, G, J, and K. These are also operated by a common switch bar, inserted from the left-hand end of the chassis, as viewed from the front. The switch bar is operated through a link action similar to that operating the RANGE switch, but the link is driven from the SYSTEM switch knob through bevel gearing.

39. The panel assembly consists of a metal panel arranged to fit in front of the vertical chassis. It carries the SYSTEM switch and its bevel gearing, the NOISE LIMITER and A.V.C. switches, the A/F GAIN and GUARD R/F GAIN potentiometers, and the SCALE TRIMMER with its control. In addition, two telephone jacks are mounted. The panel is cut away to allow certain components fitted on the chassis to protrude through the panel. These are the range scale window, the TUNING and RANGE controls, the SCALE LOCK, the R/F GAIN (sensitivity) control, GUARD switch, and cathode ray tuning indicator V13. The housing for the guard unit also forms part of the panel, spring contacts being fitted in such a manner that the guard unit is automatically connected into circuit as soon as it is placed in position.

40. The chassis is of especially rigid construction, being of H section when viewed in plan (see fig. 20) and I section when viewed in end elevation (see fig. 19). Vertical stiffeners are fitted across the rear horizontal extensions, while the panel acts as a stiffener for the four front horizontal extensions. This rigidity is essential if the accuracy of the calibration is to be maintained. A dust cover, perforated along the upper edge for ventilation, encloses the chassis. The switch bars referred to in para. 37-8 can be removed, after removing the dust cover, by withdrawing horizontally with a pair of pendulum (i.e., long-nose) pliers.

41. The cylindrical scale is mounted before the vertical chassis, supported by ball bearings mounted in plates attached to the upper horizontal extensions of the chassis. The scale drum has a solid metal spindle with a shallow female-threaded hole at each end; this spindle is of such a length that it fits snugly between the ball-bearing housings. A male-threaded bolt with a knurled head (9/32 in. in diameter and 11/16 in. long) passes through the ball bearing at each end, and mates with the female thread in the end of the spindle. Scale lamps with shades are fitted on the chassis behind the scale. The scale lock consists of a pair of brake blocks which are fitted with springs, and bear upon each side of the knurled tuning control. These blocks are held off the latter when the scale lock is OFF.

42. The four-gang tuning condenser is mounted on the upper right-hand corner of the chassis, and is driven from the tuning control through a countershaft. The countershaft is fitted with a large pinion which consists of two circular toothed plates held together by springs, forming a well-known type of anti-backlash gear. Several groups of components are mounted on the casing of the tuning condenser. These are

(i) Tagboard B, carrying the negative-temperature-coefficient condensers C107, C108, C109, C110.

(ii) small enclosed tagboard A, carrying R5, R6 and C4.

(iii) thermally-controlled condenser C116.

On the left-hand end of the chassis, as viewed from the front (see fig. 19) is a small tag-board C, carrying R59, R62, R61, R75, R56, R51, R52, R60, R58, R57 and C100.

43. The rear of the chassis also carries unit F, the output transformer (with R50 mounted on its tagboard), and a small tagboard D carrying resistances R64, R65, R25, and R54. The scale lamp switch unit S1F is also fitted on the chassis at the left-hand end, viewed from the rear. The lower portion of the chassis is occupied by the eight 10-way sockets into which mate the plugs of units A, B, C, D, E, J, and K. The location of components on the tagboards mentioned in this and the preceding paragraph is shown in fig. 21.

44. On the vertical stiffener at the left-hand end of the chassis, as viewed from the rear, are mounted the outlets for all external connections other than the telephone jacks. These are, from top to bottom,

(i) co-axial inlet SK3 for low impedance (nominally 45 ohms) aerial

(ii) aerial and earth terminal block for high impedance (nominally 500 ohms) aerial

(iii) Jones socket SK1 numbered
13—relay keying,
14—output, high level, for 600-ohm phones,
15—earth,
16—output, low level.

(iv) Jones socket SK2 numbered
13—R/F A.V.C.,
14—balanced output, low level, } into 600-ohm phones,
15—I/F A.V.C.
16—balanced output, low level, } into 600-ohm phones,

(v) Jones plug P1 numbered

13—earth,
14—positive 12-volt supply to heaters,
15—negative H.T.,
16—positive H.T.

45. When the dust cover is removed, and the receiver is viewed from the rear (fig. 8), practically the only components which can be seen are the inlets and outlets referred to in the preceding paragraph, and the eight plug-in units with their valve cans on top. As already stated, to remove any or all of the units A, B, C, the switch bar at the right-hand end of the chassis, as viewed from the front, must be withdrawn. To remove any or all of the units D, E, G, J, K, the switch bar at the other end of the chassis must be withdrawn.

46. It should be noted that there is only one direct connection between any of these units, namely, a short length of copper wire from unit C which is soldered to a pin on unit D, the screening cans being cut away sufficiently to allow this to be done. This connection must be unsoldered before attempting to remove either of these units.

Details of units

47. The plug-in units are of uniform size and very similar in appearance, the only external difference being in the type and number of valves fitted on the top of each unit, and the arrangement of perforations for trimming adjustments.

48. Inside the screening box of each unit is fitted a rectangular plate known as a wafer, upon which all the components are mounted. One or more switch units are mounted approximately in the middle of each wafer, and so located that a common switch bar can be employed. The rotating portion of each switch unit is self-centring, in order to allow for manufacturing tolerances in the relative disposition of the units with reference to the axis of the switch bar.

49. The theoretical wiring of the chassis, external to these units, is given in fig. 22, which may be used in conjunction with the circuit diagrams of the individual units, fig. 9-18.

Unit F

50. This is a small cylindrical can mounted directly on the rear of the chassis. It contains only the third coupled circuit L19, C52, of the first I/F band-pass filter, including a small coupling coil (part of L19) by which this is coupled to the previous circuit of the filter. One end of this closed circuit is connected to the top cap (control grid) of V5. The other end is connected to pin 7 of unit D, thence through R16 to the I/F A.V.C. line.

Aerial unit A (*Tuning unit type* 145)

51. Details of this unit are shown in fig. 11. The valve holder on top houses the aerial attenuator relay. Three switch units are fitted, namely, S2F, S2R and S3R. The principal components on the wafer are the aerial-to-R/F band-pass coupling coils L1, L2, L3, L4, with their trimmer condensers C6, C7, C8, C9. On each coil, alternative input impedances are provided, the top end of each winding being taken to a contact on S2F. The selected range coil is connected by the switch unit (*via* contacts on the attenuator relay) to the high-impedance aerial terminal on the rear of the chassis. Low impedance tapping points on the same coils are connected by the switch unit S2R to the low-impedance aerial plug, also *via* contacts on the aerial attenuator relay.

52. The respective output tappings on the secondary windings of these coils are connected, by the switch unit S3R, to the first section, C95, of the four-gang tuning condenser. The high potential plates of the latter are also connected to R5, R6, and C4, a screened lead from R6 being taken to the top cap (control grid) of the valve V1. As stated in para. 42, the components R5, R6, and C4 are mounted in a small screened tagboard on the rear of the tuning condenser screen.

Band-pass unit B (*Tuning unit type* 146)

53. Details of this unit are given in fig. 12. The valve can on top houses the R/F amplifier valve V1. Three switch units are fitted, namely, S4F, S4R, and S5R. The principal components on the wafer are the coils and trimming condensers comprising the four ranges of R/F-to-mixer band-pass coupling units. The 11·3 to 20 Mc/s range is slightly different from the other three, in that a R/F choke L39 and condenser C128 are used to couple the coil L5 to the R/F amplifying valve, whereas in the other three ranges, mutual inductance coupling is employed. The coils comprising the first stages of the four ranges (L5 to L8) are coupled to the coils comprising the second stages of the filter by mutual induction. For example, the 2 to 3·6 Mc/s range consists of L8 and L12, each coil having its own trimmer. The coil L8 is mounted on the front of the wafer, and L12 on the rear. The two coils are not immediately adjacent to each other on opposite sides of the wafer, but are separated by a distance just sufficient to give the required degree of very loose coupling. Similar considerations apply to other pairs of coils.

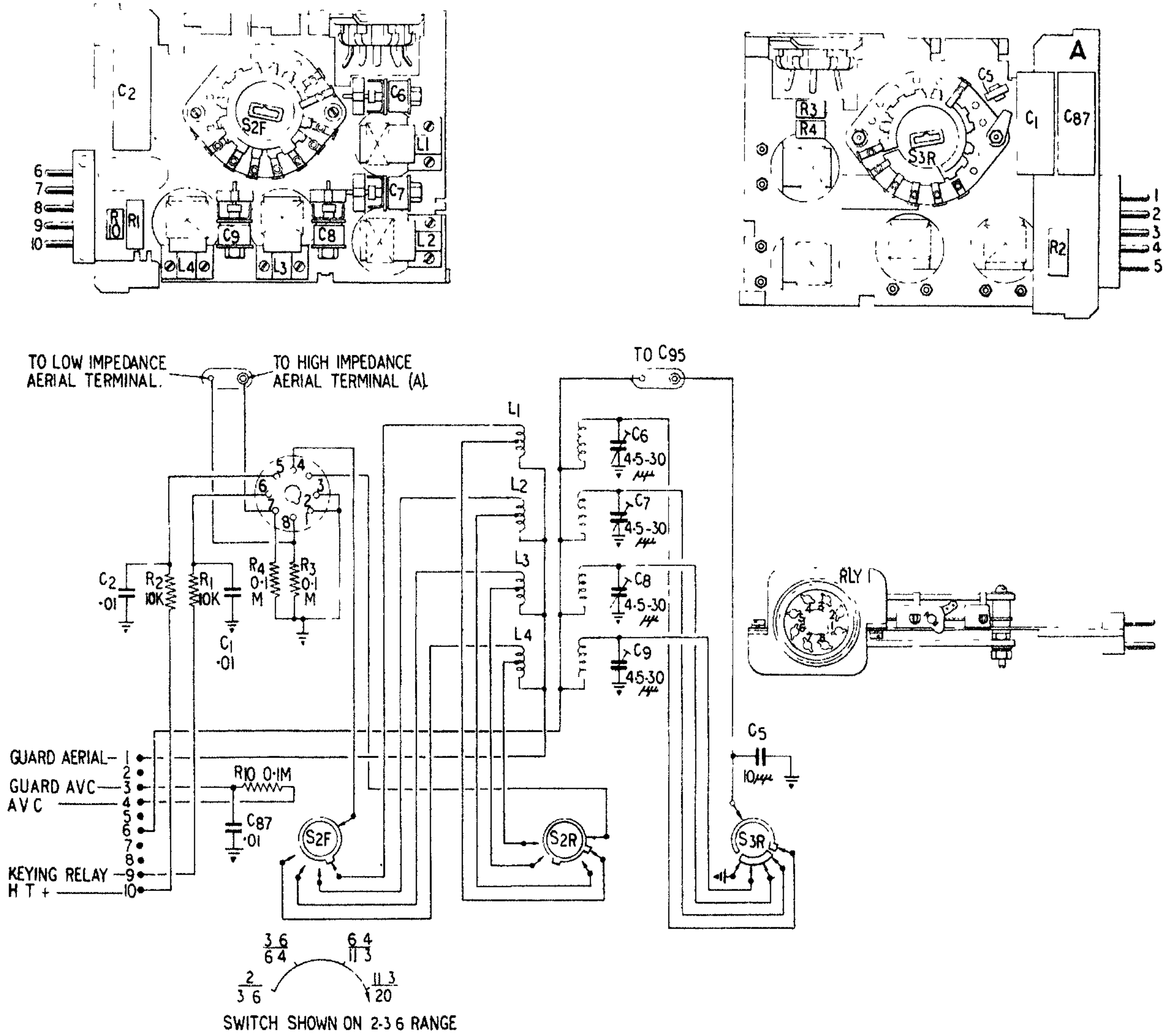

Fig. 11—Aerial unit A, circuit and component location

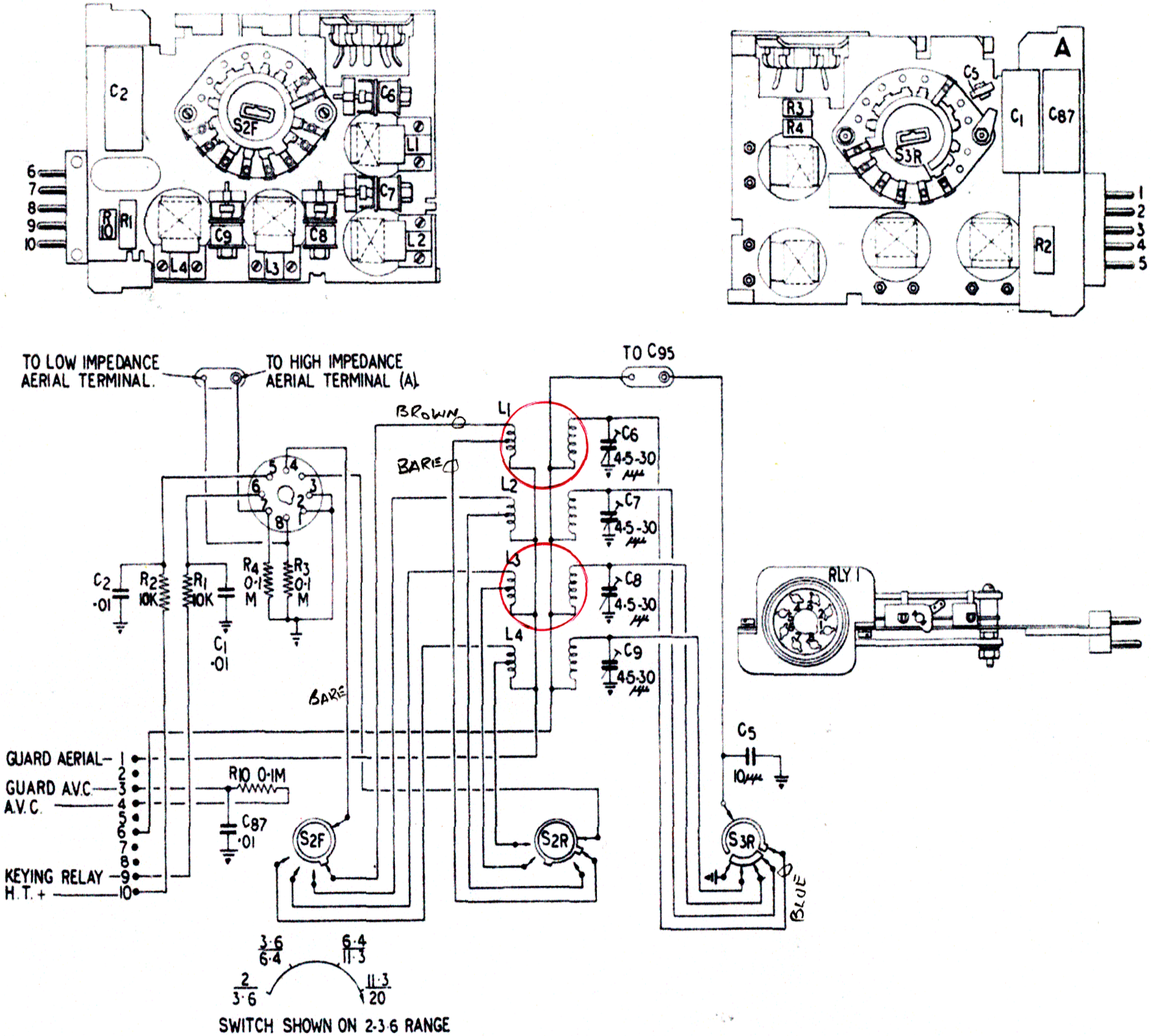

Fig. 11—Aerial unit A, circuit and component location

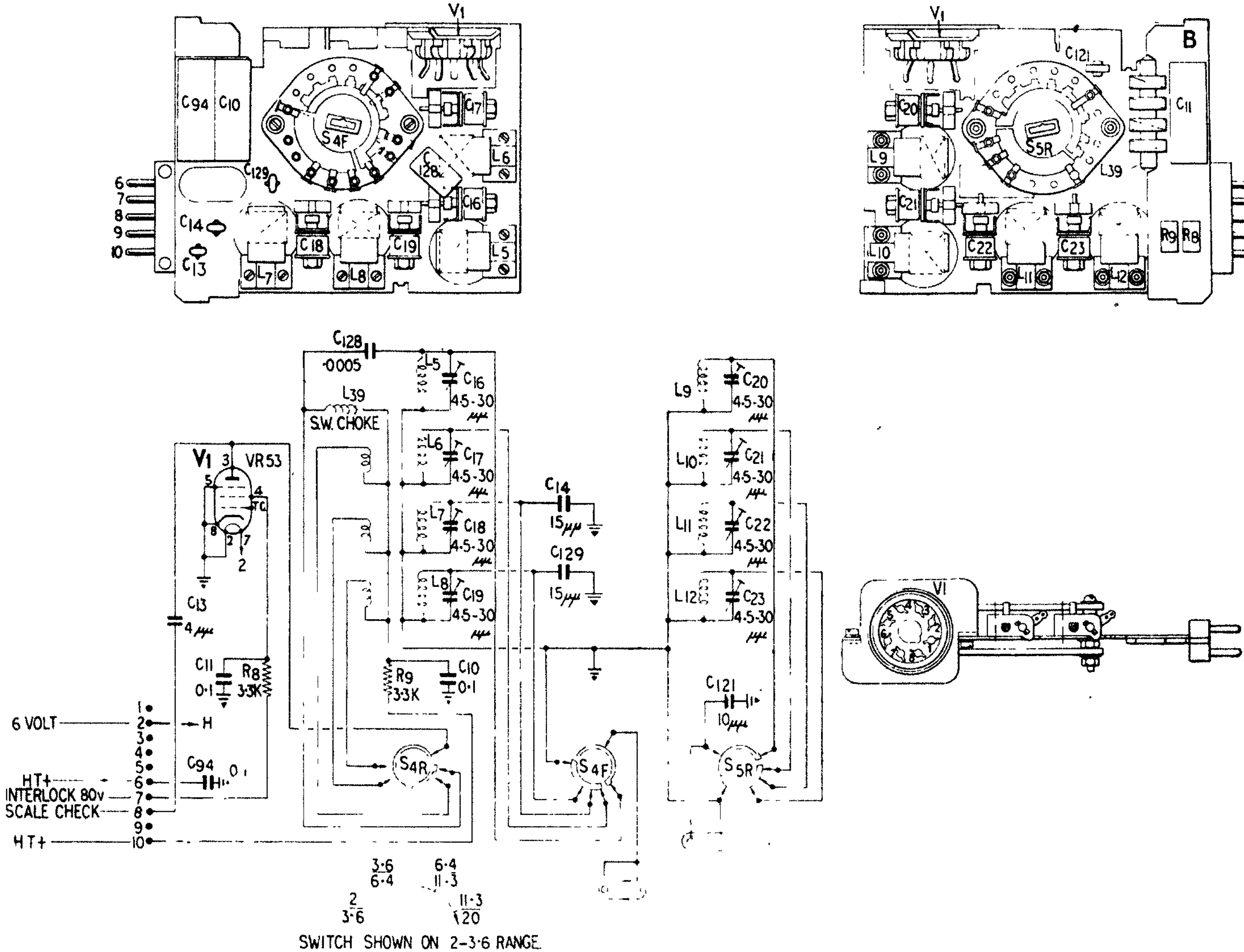

Fig. 12—Band-pass unit B, circuit and component location

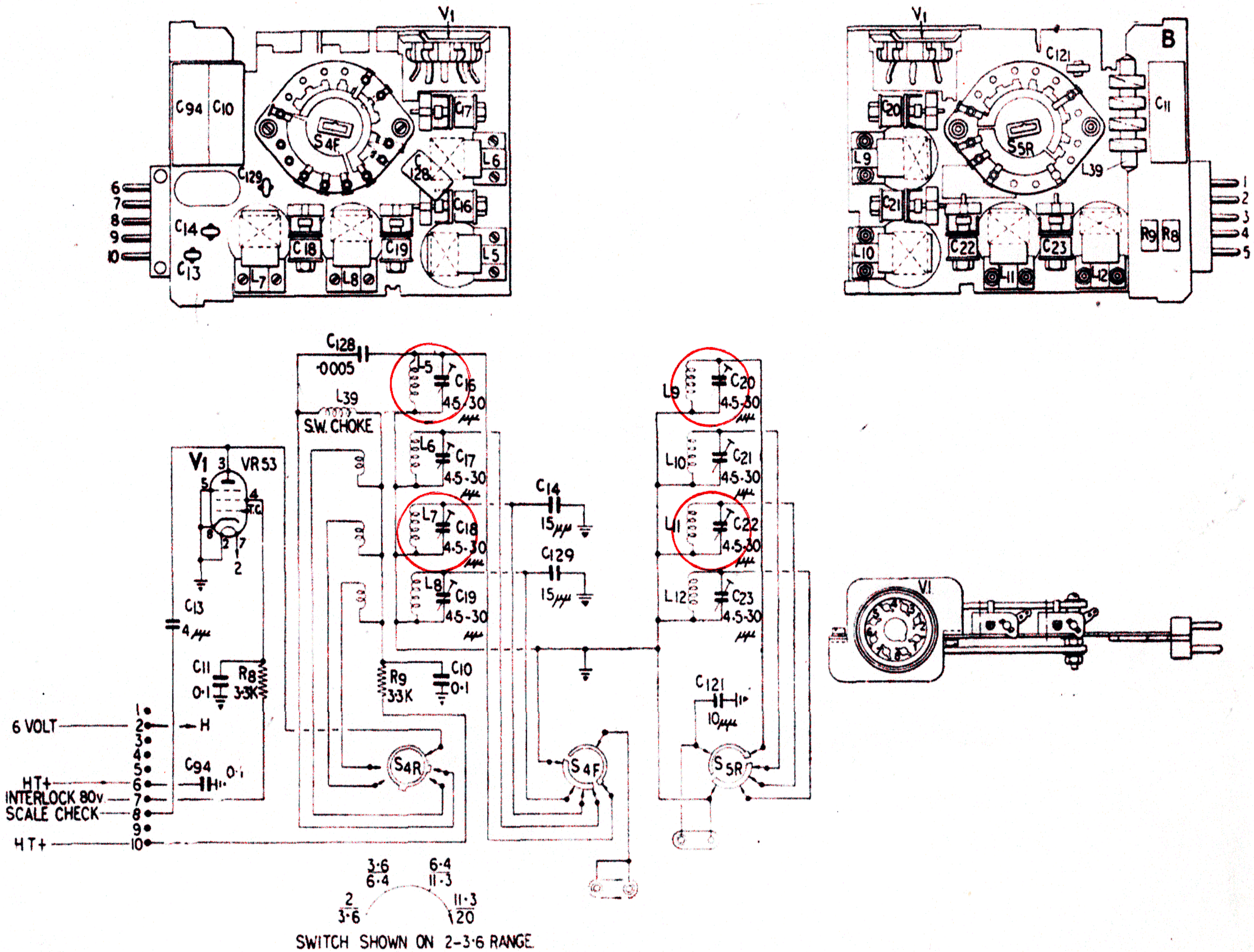

Fig. 12—Band-pass unit B, circuit and component location

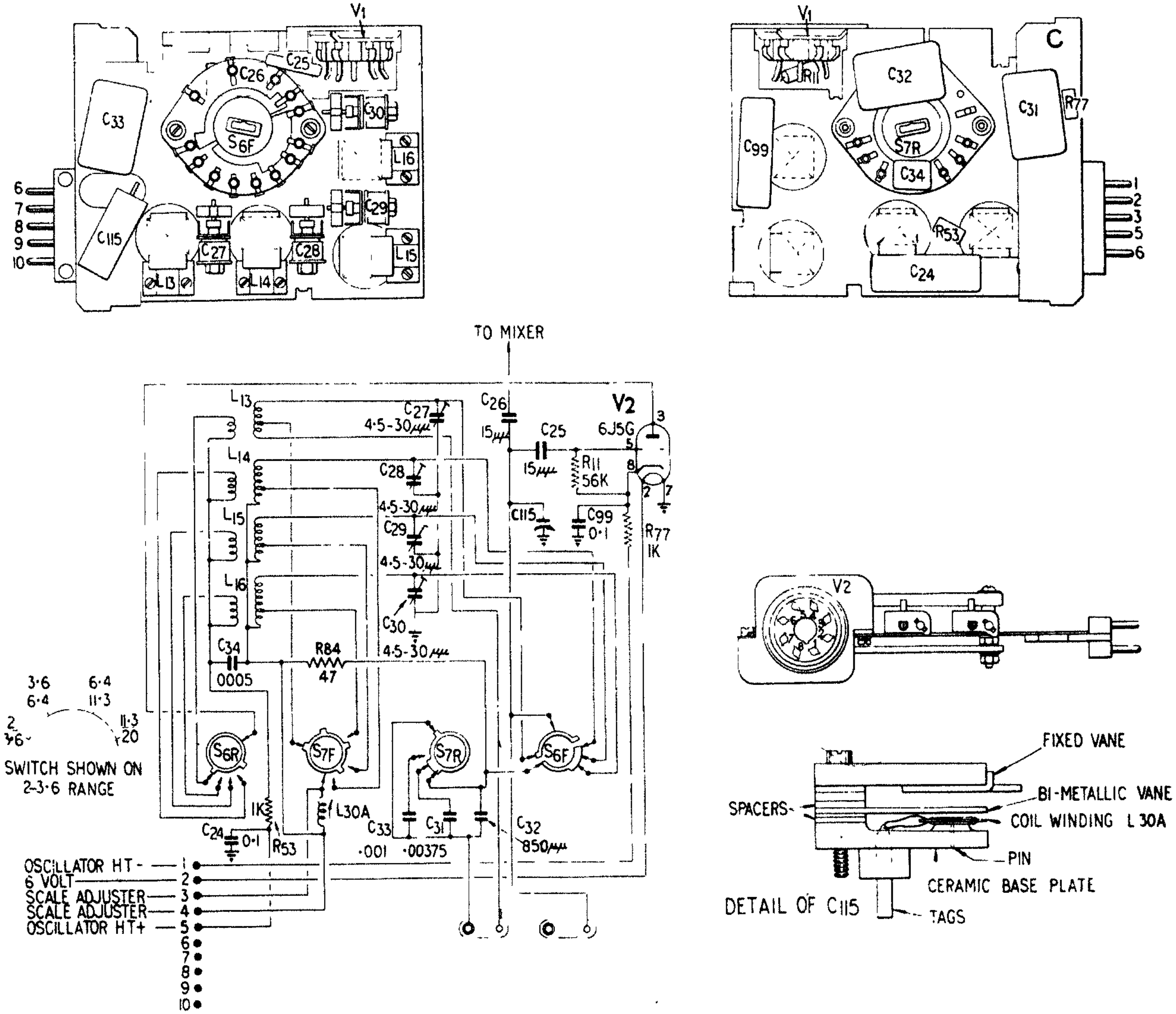

Fig. 13—Local oscillator unit C, circuit and component location

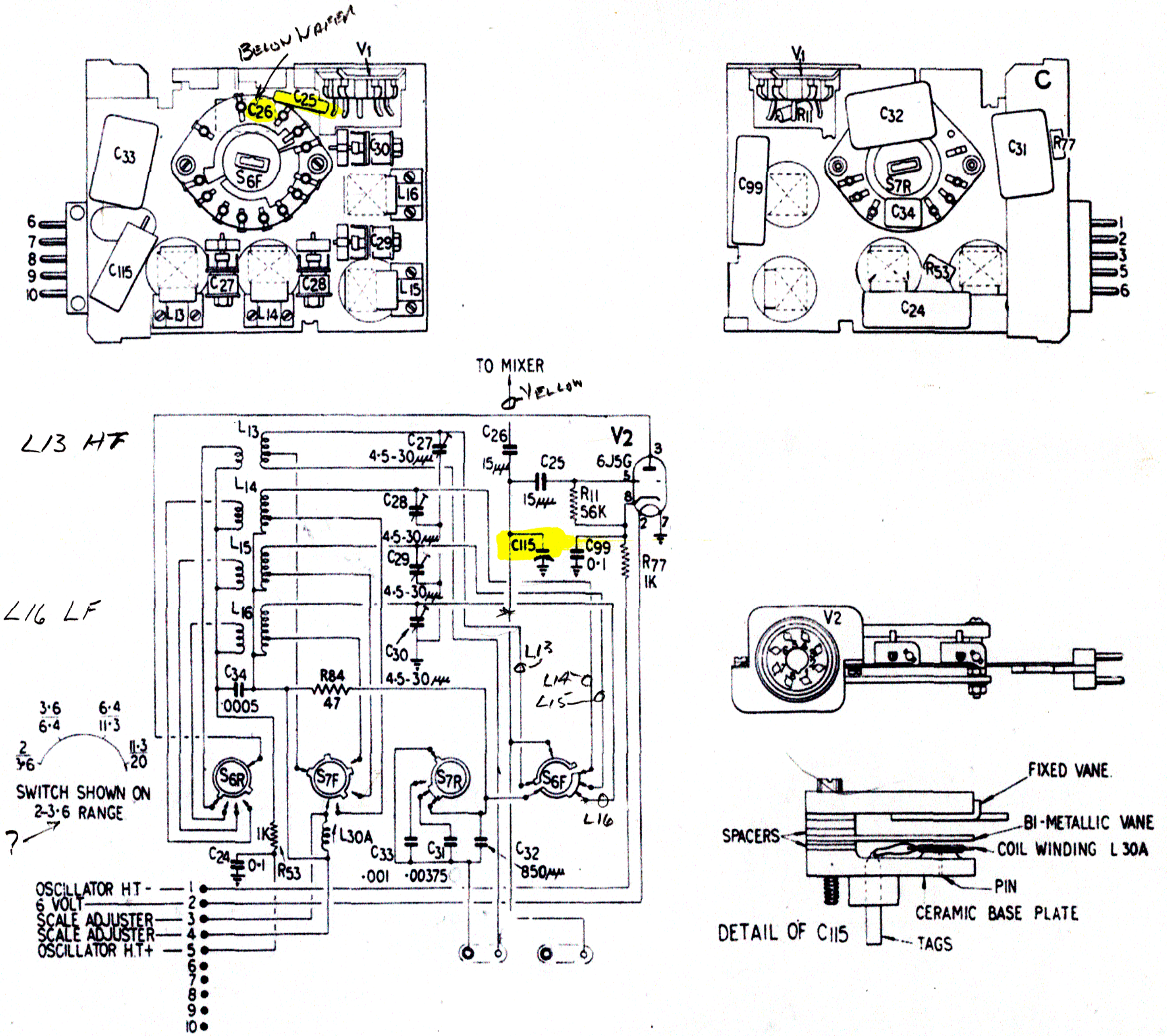

Fig. 13—Local oscillator unit C, circuit and component location

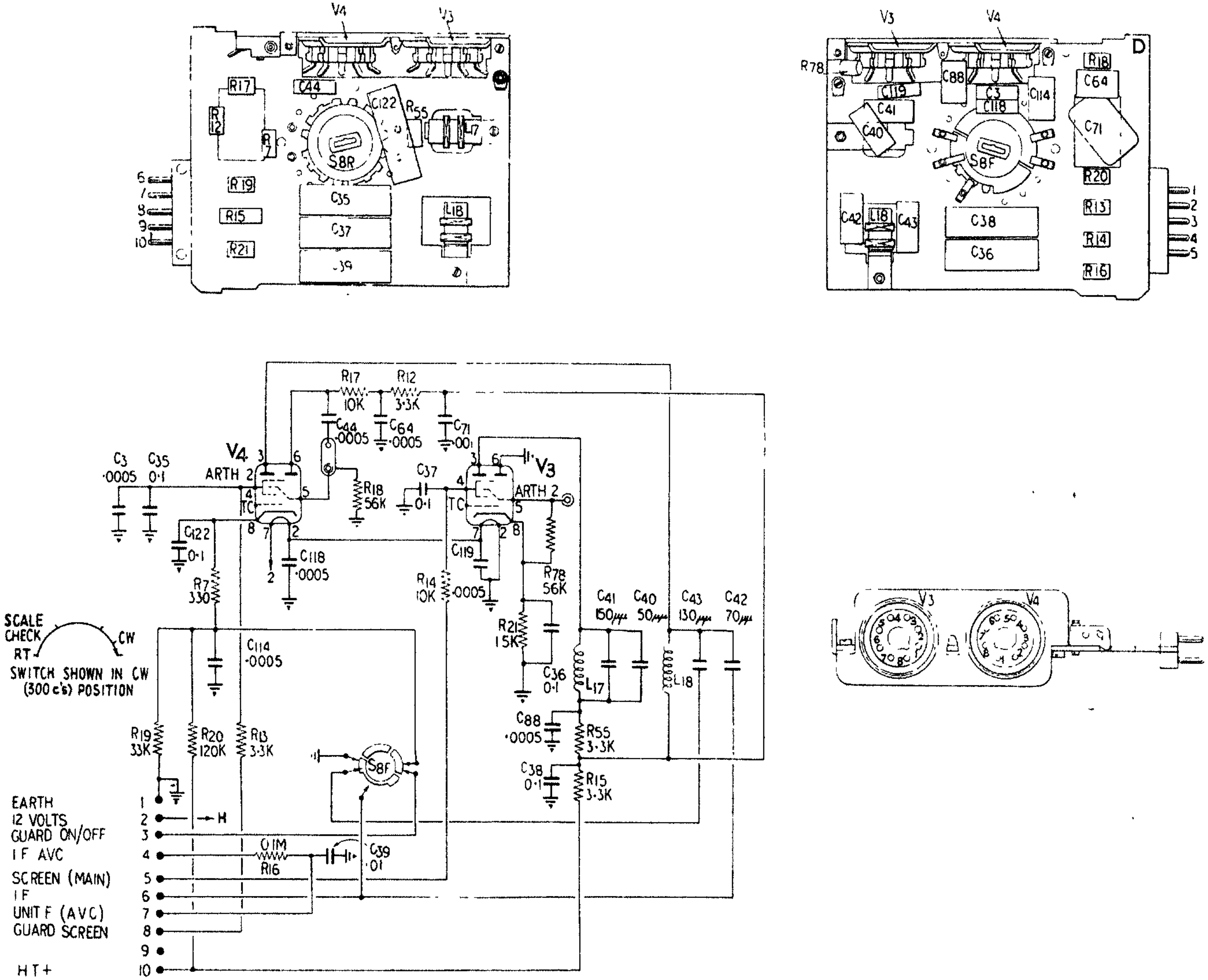

Fig. 14—Mixer unit D, circuit and component location

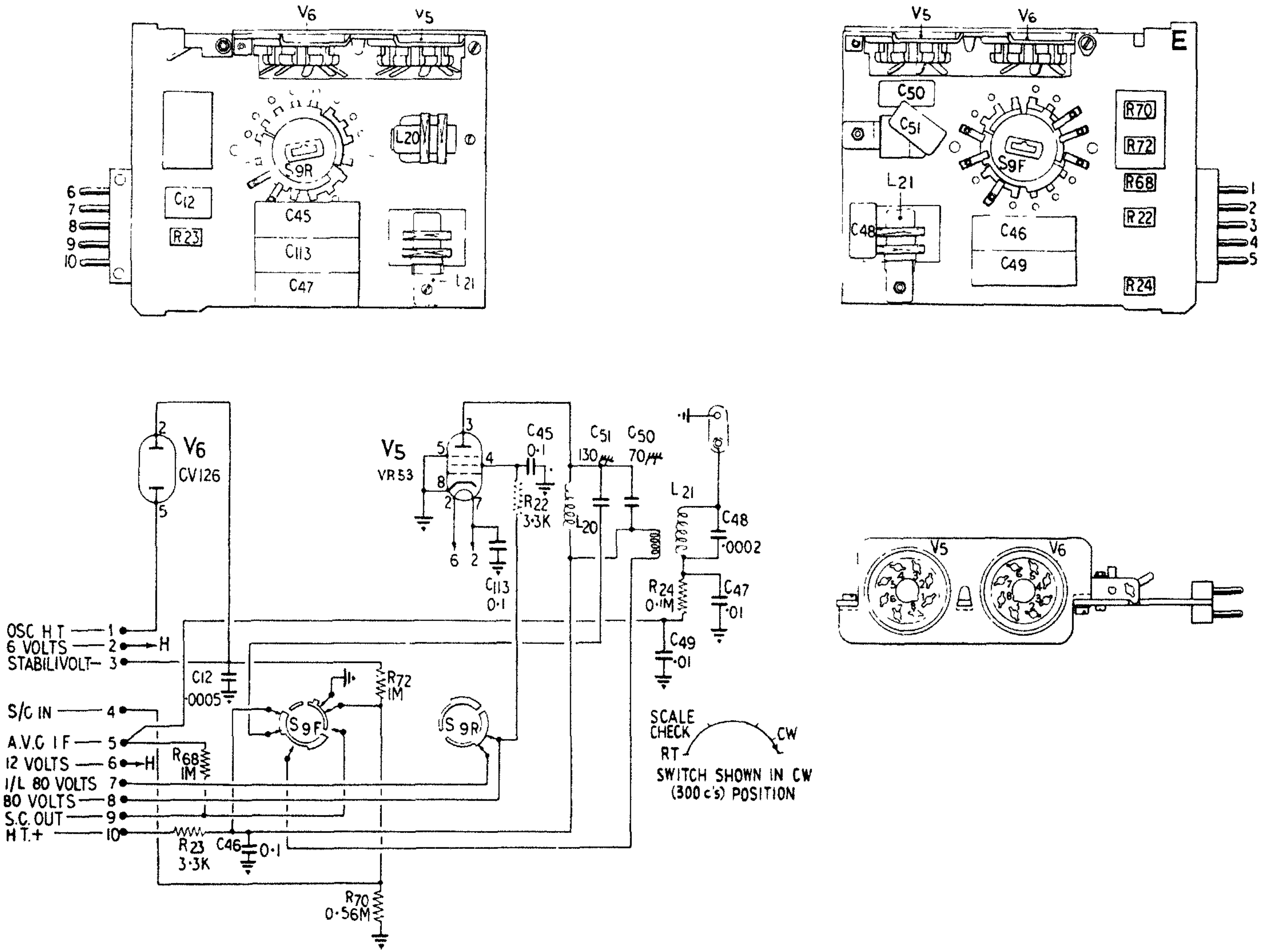

Fig. 15—First I/F unit E, circuit and component location

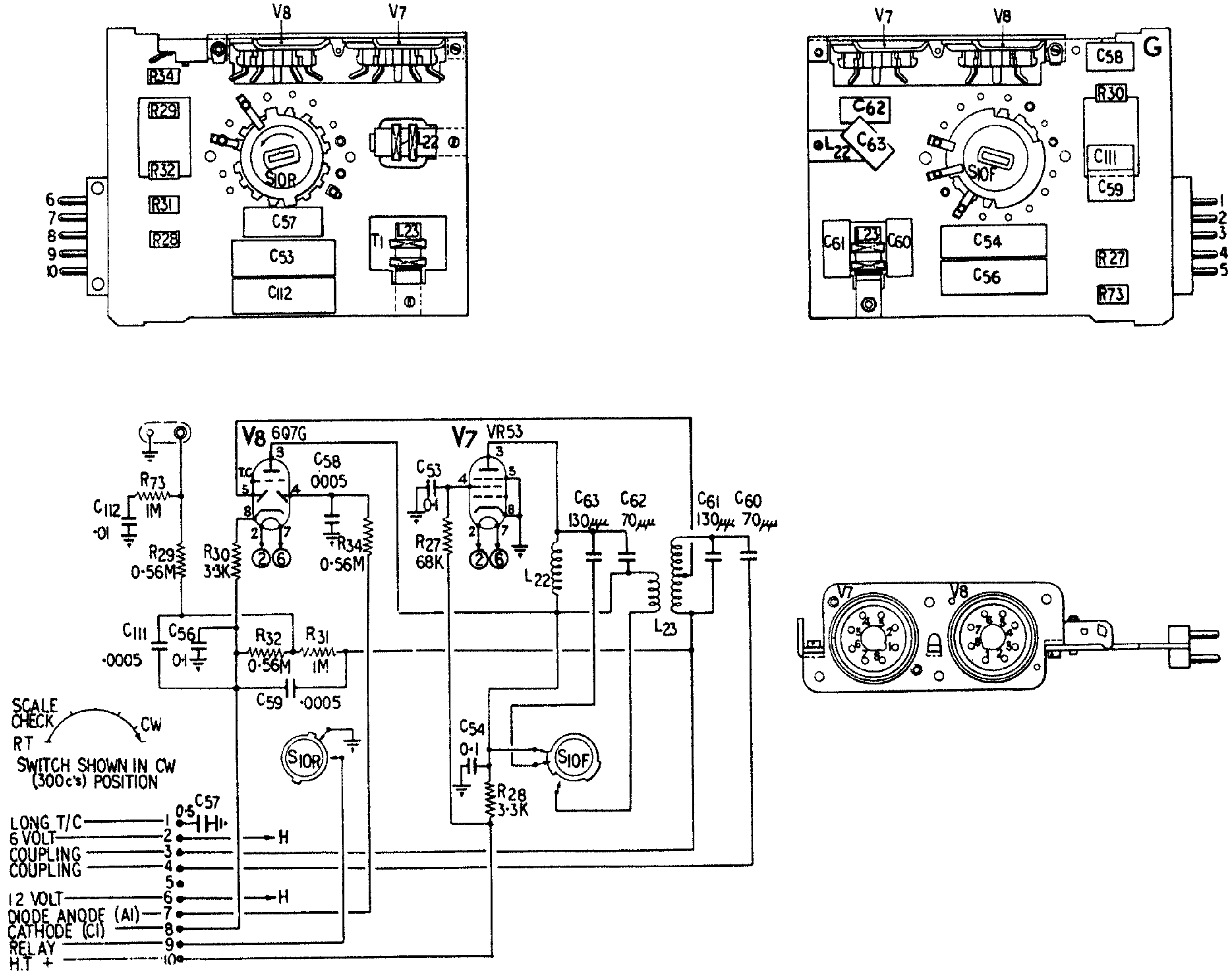

Fig. 16—Second I/F unit G, circuit and component location

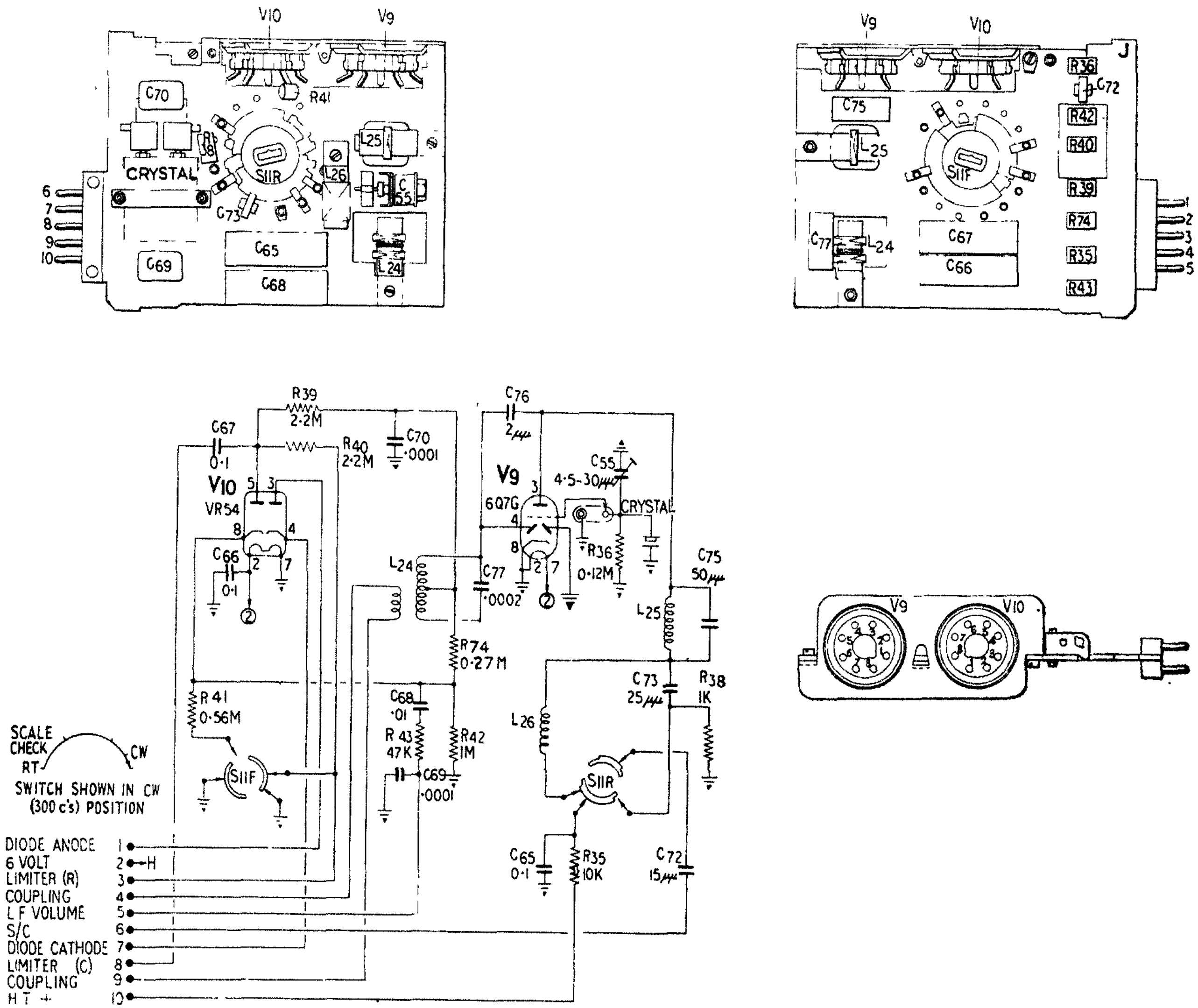

Fig. 17—B.F.O. unit J, circuit and component location

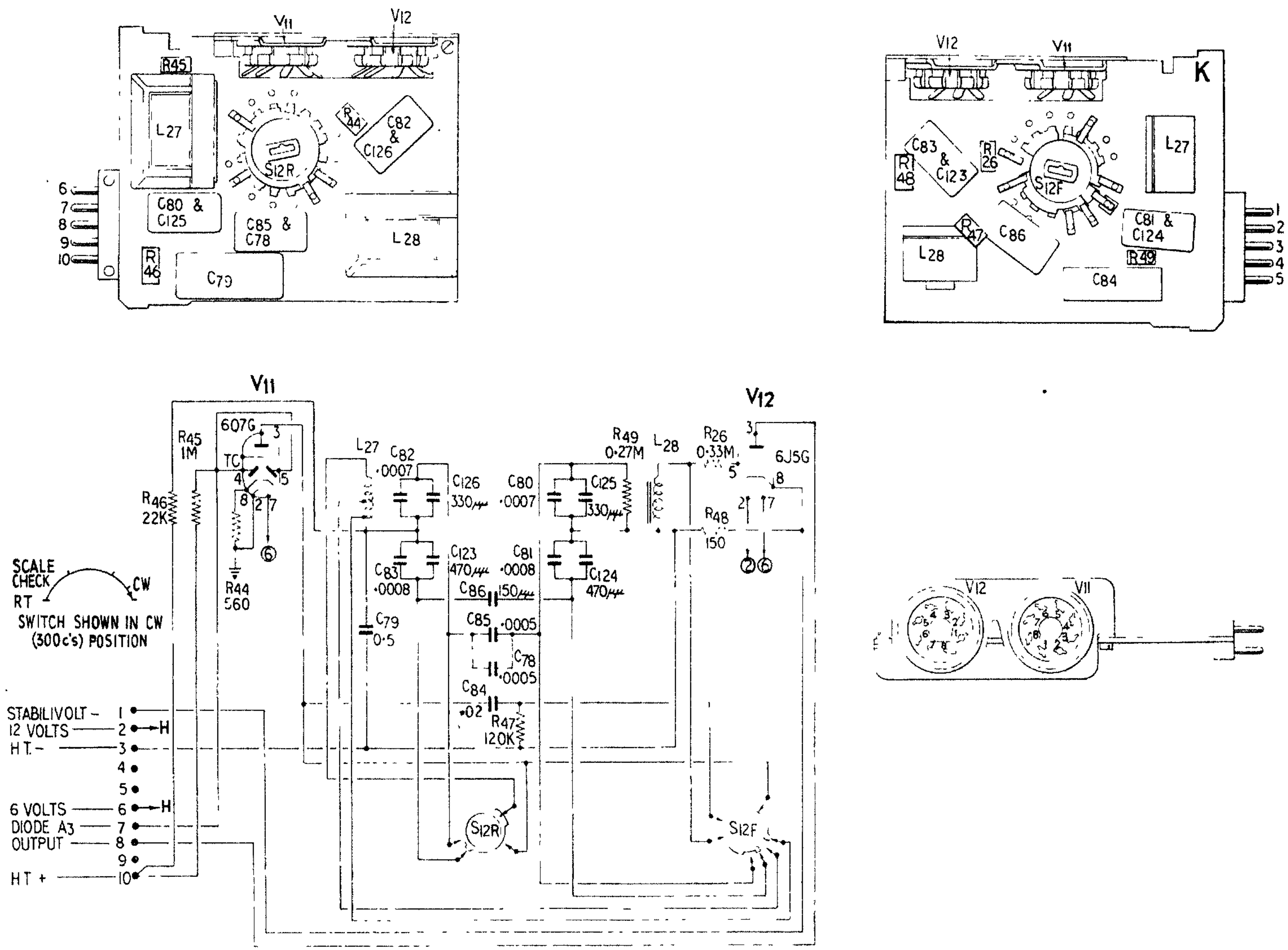

Fig. 18—Output unit K, circuit and component location

54. Two screened flexible connections are taken from sockets on top of the unit. One of these is taken to the appropriate section C96 of the four-gang tuning condenser, the other being the top cap (control grid) lead to the valve V3.

Local oscillator unit C (*Oscillator unit type* 171)

55. Details of this unit are given in fig. 13. The valve can on top houses the main channel oscillator valve V2. The principal components on the wafer are the four ranges of local oscillator coils L13 to L16, with their trimmer condensers, four switch units (S6F, S6R, S7F, S7R), and a thermal compensator, represented in the circuit diagrams by the coil L30A and the condenser C115. The coil and condenser are mounted as a single unit, as shown in fig. 13. The action of this compensator is explained in para. 71.

56. The coupling between the local oscillator circuit and the mixer valve is made via C26, in unit C, to a terminal pin on the mixer unit D, the latter point being connected to the mixer grid of V3. This lead is the only direct connection between plug-in units.

57. The switch unit S6R connects into circuit the desired anode winding of the four oscillator range coils, S7F connects the thermal compensator coil L30A (and also the external scale trimmer in parallel therewith) across the correct fraction of the grid winding. The switch unit S7R connects the required padding condenser of the group C31, C32, C33, in series with the bank of negative-temperature-coefficient condensers C107-C110.

Mixer unit D (*Mixer unit type* 11)

58. Details of this unit are given in fig. 14. The valve cans on top house the main mixer valve V3 and guard mixer valve V4. The principal components on the wafer are the switch unit S8F and the first two tuned circuits of the first I/F band-pass filter. Switch unit S8F is the first of the units comprising the SYSTEM switch; its function is to vary the I/F selectivity as explained in para. 91. It also switches off the guard mixer valve V4 when in the SCALE CHECK position (see para. 94).

First I/F unit E (*I/F unit type* 37)

59. Details of this unit are given in fig. 15. The valve cans on top house the first I/F valve V5 and the local oscillator voltage stabilizer V6. The principal components on the wafer are the switch units S9F, S9R, and the second I/F band-pass filter. Switch unit S9F varies the I/F selectivity, and also performs a special function in the SCALE CHECK position (see para. 96). Switch unit S9R switches off the R/F amplifying valve V1 in this position, as explained in para. 94.

Second I/F unit G (*I/F unit type* 38)

60. Details of this unit are given in fig. 16. The valve cans on top house the valves V7 and V8. The principal components on the wafer are the switch units S10R and S10F, and the third I/F band-pass filter. Switch unit S10R switches on the attenuator relay, when in the SCALE CHECK position; S10F varies the selectivity of the third I/F band-pass filter as in the previous stage.

B.F.O. unit J (*Oscillator unit type* 170)

61. Details of this unit are given in fig. 17. The valves on top are V9 and V10, the former being the B.F.O. and second signal detector, and the latter the noise limiter and A.V.C. delay. The principal components on the wafer are the switch units S11R, S11F, the B.F.O. oscillatory circuit L25, C75, the associated harmonic filter L26, C73, R38, and the quartz crystal, which is of standard Air Ministry plug-in type for 600 kc/s. The condenser C55 is a trimmer which is capable of "pulling" the crystal oscillator by about $\pm$ 50 cycles per second, to compensate for manufacturing tolerance.

62. The switch unit S11R completes the H.T. circuit to the B.F.O. in all positions except R/T, where the B.F.O. is inoperative. In the SCALE CHECK position it also connects the harmonic output from C73 to the input winding of the R/F band-pass unit, via C72, S9F (in the second I/F unit) and C13 (in the R/F band-pass unit). The switch unit S11F operates in the A.V.C. and noise limiting circuits as explained in para. 115.

Output unit K (*Output unit type* 45)

63. Details of this unit are given in fig. 18. The valves fitted on top are V11 (A/F amplifier) and V12 (power amplifier). The principal components on the wafer are the switch units S12R and S12F, and the A/F filter components, L27, L28, with associated resistances and condensers. These switch units control the A/F selectivity as explained in para. 116 and fig. 26. The output from the power amplifier valve is fed into the output transformer, which is mounted on the chassis.

Side tone and listening through

64. The connection from the aerial input socket (or terminal) to the selected aerial circuit range coil is made through contacts on the attenuator relay, the latter being mounted on an octal valve base upon the aerial plug-in, unit A. The operating coil of the relay is fed from the H.T. line through suitable current-limiting resistances, provision being made for keying the relay via contacts 13 and 15 on the uppermost Jones socket SK1 at the rear of the receiver. When keyed, the aerial circuit is interrupted at the relay contacts, but the aerial is not completely isolated from the input circuit of the receiver, owing to the capacitance between the relay springs. The latter are, however, so arranged that the capacitance coupling is very small, and when the relay is energized, the attenuation introduced into the aerial circuit is sufficient to give comfortable " side tone " from an adjacent transmitter. For C.W. traffic, the relay is keyed in unison with the transmitter keying, to give the normal " listening through " requirements.

65. For R/T traffic, the relay is energized when the carrier wave is switched on. The relay is automatically energized when the SYSTEM switch is put to SCALE CHECK, to prevent signals breaking through and becoming confused with the scale checking harmonics.

Guard channel input circuit

66. The low-potential ends of the primary windings of the aerial range coils are all common, and are connected to contact 10 on the guard unit housing. If no guard unit is in place, this point is earthed through a spring contact (see fig. 23). When a guard unit is in place, however, the primary winding of the guard unit input circuit is connected in series with the selected main channel primary circuit, so that the guard frequency input is eventually applied to the guard channel mixer valve V4.

R/F amplifier

67. The R/F amplifier is designed to provide sufficient selectivity to eliminate cross-modulation and blocking effects, and to give a high degree of image signal protection. This selectivity is achieved by using a band-pass filter as the coupling between the R/F amplifying valve V1 and the main mixer valve V3. Pairs of mutual inductance coupled coils are used on each range, the precise degree of coupling for each range being obtained by the spacing and positioning of the coils. The amplification is sufficient to make the noise contribution of the circuits following V1 negligible in comparison with the thermal agitation noise from the aerial circuit.

R/F bias line

68. A variable bias is supplied to the grid of V1 through R5 and R10, from the manual R/F gain control R83 ; A.V.C. is also applied via the R/F A.V.C. line from the resistance network R58, R57, R56, and R83. This network receives the A.V.C. output voltage from the valve V8, and a delay voltage from the valve V11, as explained in para. 104-111.

Local oscillator (main channel)

69. In order to make full use of the advantages of the high discrimination scale, special care has been taken in the design of the local oscillator stage, to ensure maximum stability under conditions of varying ambient temperature. Losses in stray capacitances have been reduced to a minimum by the use of ceramic insulation at all important points. The oscillator and mixer valves are very loosely coupled to the oscillatory circuit, so that variations in valve parameters have no appreciable effect on the frequency.

70. The remaining thermal drift arises from two main sources, the tuning coils and the tuning condenser. These components are compensated in the following manner. The tuning condenser is compensated at the low frequency (maximum capacitance) end of each band by a negative-temperature-coefficient condenser. This consists of C107-C110 in parallel, mounted upon the screening cover of the tuning condenser. To compensate at the high frequency (minimum capacitance) end of each band, a small bi-metallic strip compensator is used ; this is also mounted on the cover of the tuning condenser. In conjunction with a fixed metal plate, the bi-metallic strip forms a capacitance which varies in value with temperature changes in such a manner as to keep the oscillator frequency sensibly constant. This compensator is shown in the circuit diagram as a condenser, C116.

71. A somewhat similar compensator C115 is mounted on the local oscillator unit in order to compensate for the temperature variation of the stray capacitances and inductances. The action of this compensator may be explained as follows. Referring to fig. 13, the capacitive portion is similar to that of the main tuning condenser compensator, but the bi-metallic strip is silver-plated. A small coil (shown as L30A) is mounted near the underside of the strip. When the ambient temperature changes, the strip moves with reference to the

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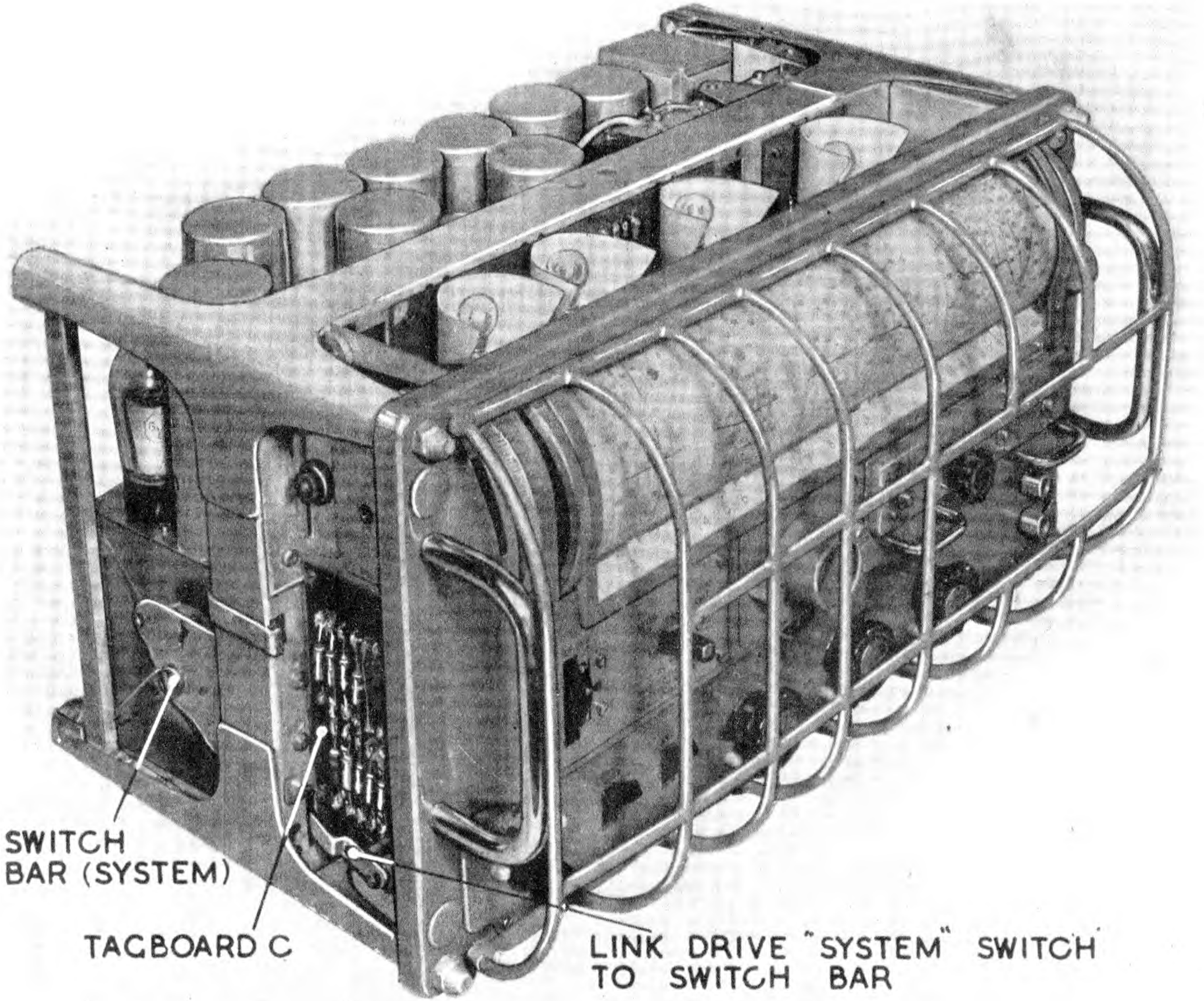


Fig, 19—Receiver unit type 88, front view from left

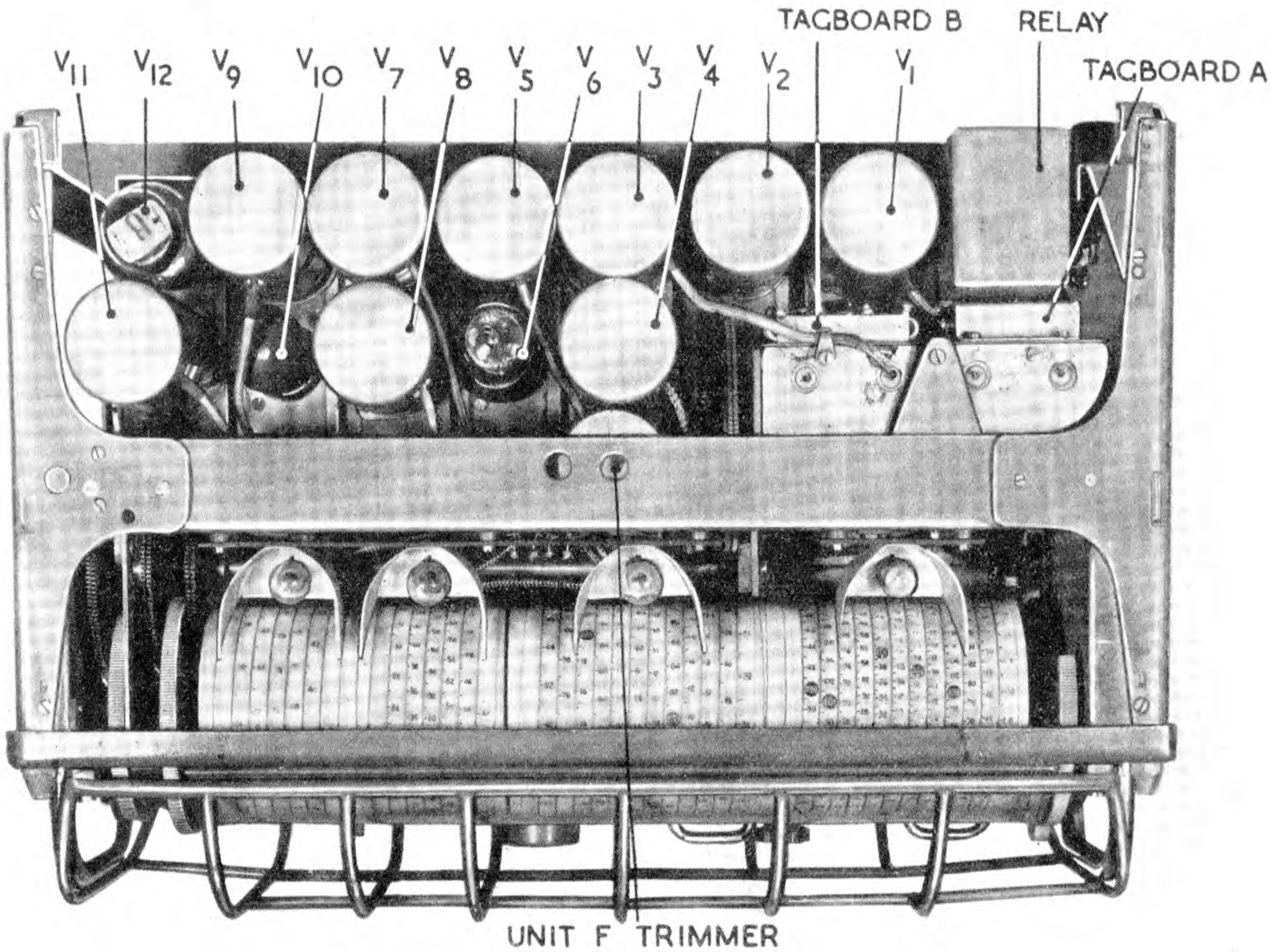


Fig. 20—Receiver unit type 88, plan view

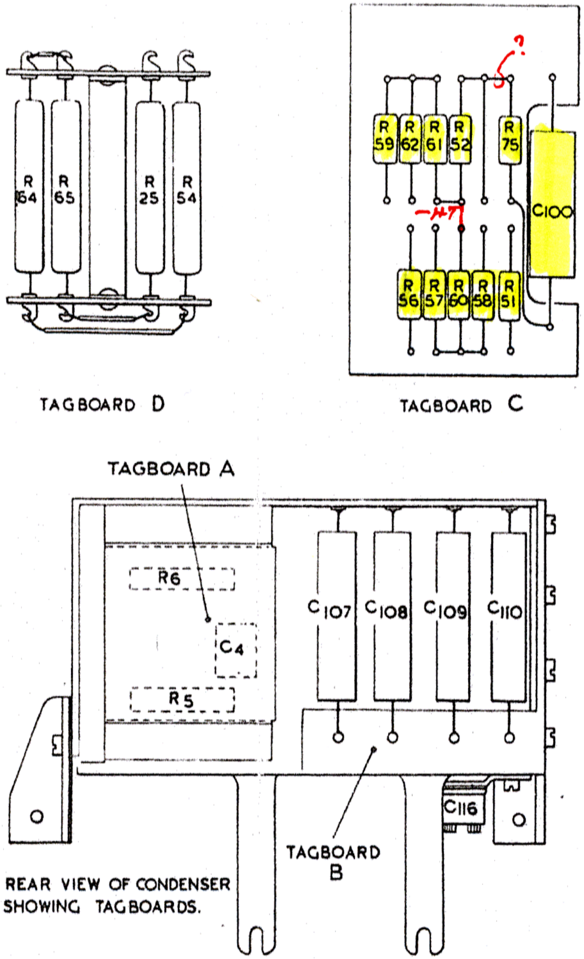


Fig. 21—Tagboards on chassis

fixed plate, and also with reference to the coil. This causes the capacitance between the plates to change, while at the same time the inductance of the coil L30A also changes. The coil is connected to the range coil in use at the same point as the scale trimmer inductance, with which it is virtually in parallel. This compensator is mounted inside the oscillator plug-in unit so that it will follow the temperature vai of the tuning coils as closely as possible.

72. The H.T. supply to the local oscillator is stabilized by ε type CV.216 (V6). Thus the oscillator is kept as free as possibl frequency instability due to voltage variations.

Range switch

73. The range switch operates the scale lighting switch uni mounted directly upon the chassis, and the switch units S2F, S2R S4R, S4F, S5R, S6R, S7F, S7R, and S5F, which are mounted various plug-in units on the rear of the chassis (see fig. 32). functions of these switch units are described in the following para (para. 74-83).

Aerial circuit

74. The switch unit S2F receives the R/F signal input fro " open aerial " terminal A, via the contacts on the attenuator rela switches this input to the high-potential end of the primary winc the selected aerial range coil (L1-L4). The switch unit S2R the R/F signal input from the co-axial aerial socket SK3, via cc on the attenuator relay, to a low-impedance tapping on the sı primary winding. Thus, according to which type of aerial is i the input impedance is appropriately matched.

Main channel input circuit

75. The switch unit S3R connects the first section (C95) of th tuning condenser to the selected main channel secondary wi The signal developed across C95 is applied to the control grid R/F amplifying valve V1 through C4 and R6. The windings bel to ranges of lower frequency than the selected range are short-ci and earthed by the switch unit S3R.

R/F band-pass filter

76. The R/F amplifying valve V1 is coupled to the main c mixer valve V3 by a band-pass filter, a separate filter being pr for each range. The first coil is selected by the switch unit S4 connected to the anode of V1, the other ends of the four coils connected together and to the H.T. line via R9. The required sec winding is selected by the switch unit S4F, the ranges of lower fre than that selected being short-circuited and earthed on the same unit.

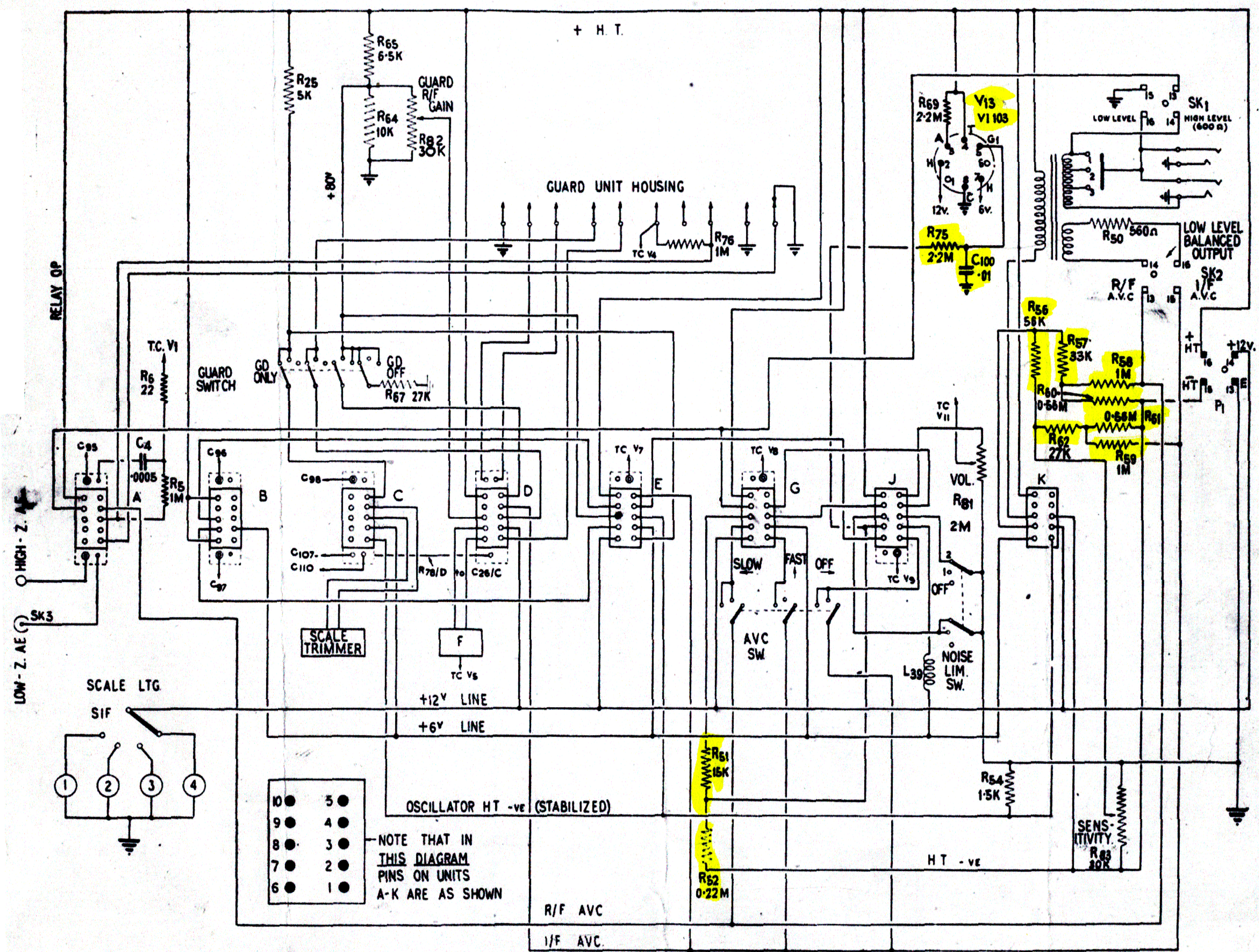


Fig. 22—Chassis circuits. schematic

77. A further section of this filter is provided for each range by the coils L9-L12, each with its own trimmer condenser. The low-potential ends of these coils are earthed, and the high-potential ends are taken to the switch unit S5R, which connects the selected range coil to the third section (C97) of the tuning condenser. Coils not in use are short-circuited and earthed as in previous stages. The selected coil is also connected to the control grid of the hexode section in the main channel mixer valve V3.

Local oscillator

78. The coils L13-L16 are the tuned transformers for the four ranges. The appropriate primary winding is selected by the switch unit S6R and connected in the anode circuit of the local oscillator valve V2. The common ends are connected to the H.T. line through R53, S15R (which is one unit of the GUARD switch), and R25. The switch unit S15R breaks this H.T. supply when in the GUARD ONLY position, and completes it in the NORMAL and GUARD OFF positions.

79. The switch unit S7F controls the scale trimmer inductance L30 (with the thermally-controlled coil L30A in parallel). Switch unit S7R controls the series padding condensers of the oscillator grid circuit, and the switch unit S6F connects the fourth section (C98) of the tuning condenser to the selected winding L13—L16.

80. The high-potential ends of the secondaries are connected to contacts on the switch unit S6F. The selector contact connects the selected secondary to the grid of the valve V2, through the condenser C25, and also to the high-potential side of C98. A second selector contact short-circuits lower-frequency secondaries not in use, and connects the earthy ends of the secondaries to a selector contact on the switch unit S7R. This contact connects the padding condensers C31, C32, and C33, and the negative-temperature coefficient condensers C107—C110 (four in parallel) between the earthy ends of the secondaries and earth.

81. The padding condensers are introduced into circuit as follows. On the range 11·3 to 20 Mc/s, none is in circuit, the negative-temperature-coefficient condensers being connected directly between the low potential ends of the secondaries and earth. On the range 6·4 to 11·3 Mc/s, C31, C32 and C33, in parallel, are in series with the bank C107—C110. On the range 3·6 to 6·4 Mc/s, C32 and C33 are in series with them, and on the range 2 to 3·6 Mc/s, C32 alone is in series with them.

82. The scale trimmer inductance L30 is connected between a selector contact on the switch unit S7F and a selector contact on the switch unit S6F, and is thereby shunted across a portion of the selected range coil. The number of turns so shunted differs on different ranges, and is so selected that the scale trimmer can be made to restore the calibration on all four ranges, if disturbed by any cause which affects the whole oscillator circuits uniformly.

83. The local oscillations generated by V2 are fed into the grid of the triode section of the main mixer valve V3. The anode of this section is earthed, and the triode section does not function as such, being merely used to obtain a connection to the mixer grid of the hexode section.

Mixer stages

84. Fig. 23 is a simplified circuit diagram showing the principal connections of both mixer systems. The main channel signal from the R/F band-pass filter is fed into the control grid of V3, and the local oscillator output to the mixer grid. The output of the mixer valve is fed directly into the first of the tuned circuits comprising the first I/F band-pass filter. The main channel can be switched off when desired by putting the guard switch S15 to GUARD ONLY. This breaks the 80-volt screen-grid voltage supply to V3.

85. The guard channel input is fed into the control-grid circuit of the guard mixer valve V4. A.V.C. voltages are also fed to this grid from the R/F A.V.C. line. The triode section of the valve acts as the guard channel local oscillator and is crystal-controlled. The output of the guard mixer is fed into the second of the three tuned circuits comprising the first I/F band-pass filter.

86. Referring to fig. 23, the cathode of the guard mixer valve is connected to a tapping on the fixed potentiometer R20, R19. When a guard unit is placed in the housing, the contacts 4, 5, are made. Provided that the guard channel is switched on at S15, and that the SYSTEM switch (switch unit S8F) is in any position other than SCALE CHECK, R19 is short-circuited, and the cathode of V4 is only a volt or so above earth potential. The valve V4 therefore passes anode current and functions in the required manner.

87. If, however, the guard unit is removed (thus breaking the circuit at contacts 4, 5) or the guard channel is switched off at S15, or if the SYSTEM switch is put to SCALE CHECK, R19 is no longer short-circuited. The cathode of V4 is then about 40 volts above the potential of the control grid, and the anode current of V4 is cut off, so in effect switching off the guard channel.

Intermediate frequency amplifier

88. Two stages of intermediate frequency amplification are provided, with a total of eight tuned circuits. Three of these form the first I/F band-pass filter, between the mixer valves and the first I/F amplifying valve V5. The third tuned circuit is located in unit F, a small cylindrical can mounted on the chassis. The second I/F filter, between V5 and the second I/F amplifying valve V7, has only two tuned circuits. The third I/F band-pass filter, between V7 and the second detector stage (part of V9) also has three tuned circuits.

89. Two degrees of I/F selectivity are provided, namely, a band-width of five kc/s for R/T, M.C.W., and wide-band C.W. reception, and a narrower band-width (nominally about 3 kc/s) for use with the A/F filters. The band-width is varied by the SYSTEM switch.

System switch

90. The SYSTEM switch controls the group of switch units S8F, S9F, S10R, S10F, S11F, S11R, S12R, and S12F. This switch gives three degrees of C.W. selectivity, with the B.F.O. switched on, the scale check facility, and the wide-band R/T selectivity, with the B.F.O. switched off. For brevity the switch positions will be referred to by numbers, position 1 being the 300 c/s C.W. position and 5 the R/T position.

I/F selectivity

91. The method of varying the I/F band-width in the three filters is the same, and may be explained with reference to the first filter. When the SYSTEM switch is in position 1 or 2, the winding of L18 is, in effect, shunted by C43 via contacts on the switch unit S8F. The closed circuit L18, C43, is coupled to the following tuned circuit L19, C52, by the condenser C42. In positions 3, 4 and 5, C43 is removed from this position and connected in parallel with C42, making the whole filter less sharply tuned.

92. Similar considerations apply to the second and third I/F band-pass filters, the selectivity switching being performed by switch units S9F and S10F respectively.

A/F selectivity

93. The switch units S12R and S12F, which are also controlled by the SYSTEM switch, vary the A/F selectivity as explained in para. 116.

Scale check position

94. The circuit changes made by the SYSTEM switch in the SCALE CHECK position are as follows. The guard mixer valve is rendered inoperative by the switch unit S8F, as described in para. 86. The R/F amplifying valve is also rendered inoperative by cutting off its screening-grid potential, the switch unit S9R interrupting the circuit between R8 and the 80-volt line from the junction of R64 and R65. The attenuator relay is energized from the H.T. line via the switch S10R.

95. The effect of these changes is to isolate the R/F band-pass filter following V1 from the aerial, and also, by shutting down the guard frequency local oscillator, to prevent spurious harmonics of the latter being mistaken for "scale checking" harmonics of the B.F.O.

96. Referring to fig. 24, the source of the scale checking harmonics may be considered to be the choke L26 in the anode circuit of the beat-frequency oscillator valve V9. The harmonics are fed through the condenser C73 to the switch unit S11R, thence, via C72, to the junction of R70 and R72. From this point they are fed, via S9F and the condenser C13, to the anode circuit winding of the R/F band-pass filter following V1, the latter valve being cut off by the absence of screening-grid potential, as explained in para. 94. From the "earthy" end of the band-pass winding the harmonic currents return to the source via the condenser C10, earth, and C65. In fig. 24 the path of the harmonic currents is indicated by arrows on the appropriate leads.

97. The resistance R68 is connected between the I/F A.V.C. line and the junction of R70 and R72, when the switch unit S9F is in the scale check position. This reduces the standing bias on the I/F valves, so that the I/F stages operate in their most sensitive condition during scale checking.

Beat-frequency oscillator

98. The beat-frequency oscillator consists of the triode section of the double-diode-triode V9, together with the oscillatory circuit L25, C75, and the low-temperature-coefficient crystal, with capacitance trimmer C55 and grid leak resistance R36. The capacitance trimmer is provided in order that the beat frequency oscillation may be adjusted to exactly 600 kc/s, since the accuracy of the scale-checking system depends upon this frequency being correctly maintained.

99. The B.F.O. is switched off by interrupting the anode H.T. supply between R35 and L26, at the switch unit S11R, when the SYSTEM switch is in the R/T position.

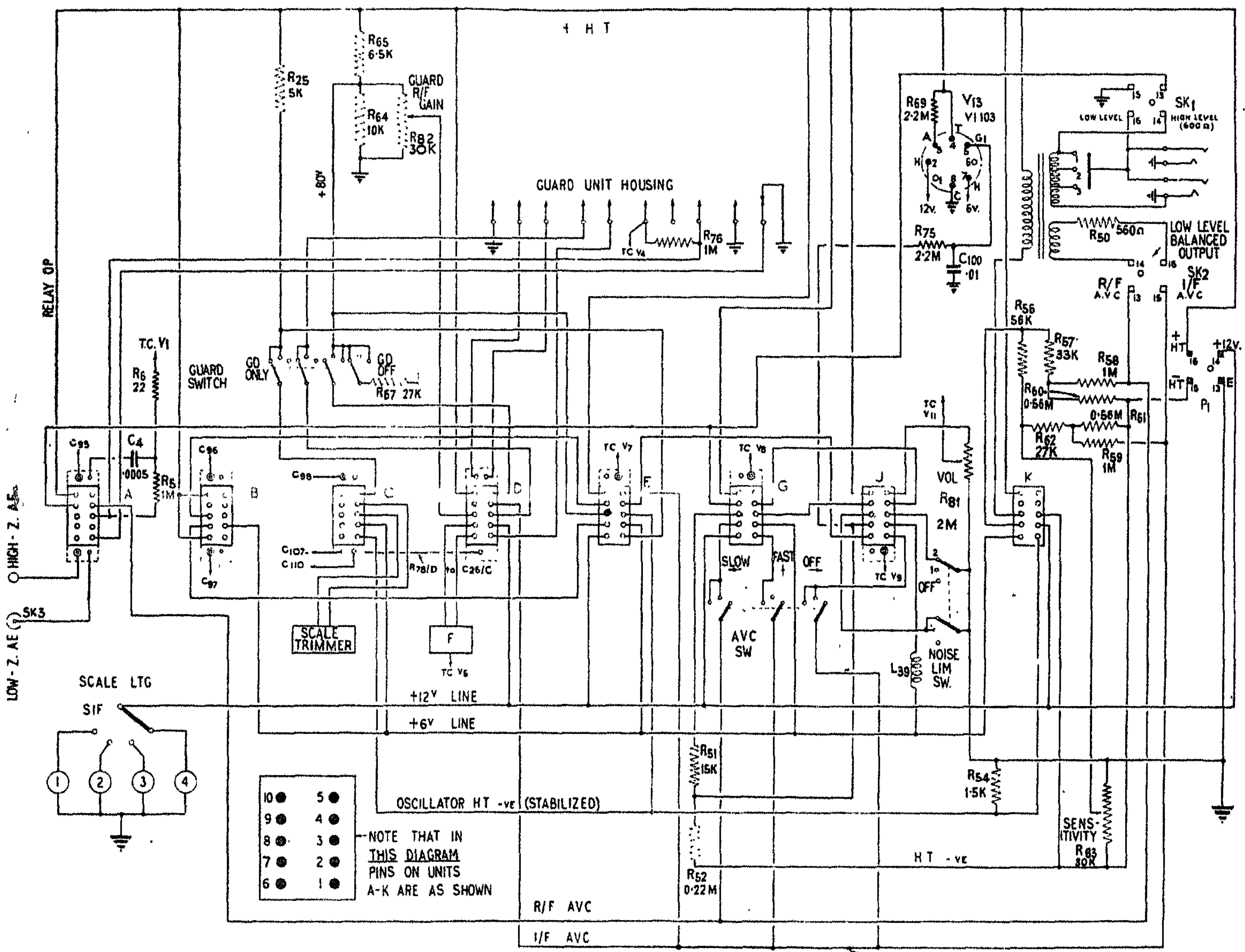


Fig. 22—Chassis circuits, schematic

Second detector

100. The double-diode section of the valve V9 is used as the second detector. When the B.F.O. is switched on, the heterodyne oscillation is fed into the diode detector circuit L24, C77, via the anode-grid capacitance.

101. A simplified circuit diagram is given in fig. 25. The load circuit of the detector consists of R74 and R42 in series, the A/F voltage across R42 being applied, through C68 and R43, to the potentiometer R71, which is the A/F GAIN control. The A/F signal is fed from the tapping on the latter directly into the control grid of the valve V11, the triode portion of which functions as an A/F amplifier. The noise limiting circuit is connected across the diode load, and operates as explained in para. 112-5.

A.V.C. system

102. The more common forms of A.V.C. suffer from the defect that, when the signal strength increases, the signal/noise ratio does not improve as rapidly as is desirable. This is due to the application of the A.V.C. to the R/F stage or stages. In this receiver the defect is overcome by delaying the A.V.C. voltage applied to the R/F amplifier until an appreciable A.V.C. voltage has been applied to the I/F amplifier.

103. In order that efficient A.V.C. may be obtained without controlling the mixer valve, a d.c. amplified system is employed. This eliminates frequency variation with change of signal amplitude, in the local oscillator, and also prevents overloading at high input levels.

104. The operation of the A.V.C. system will be explained with reference to the simplified circuit diagram, fig. 24. The diode D1 (in V8) is the main A.V.C. detector, the input voltage being derived from the tap on the I/F transformer secondary L23. The resulting rectified current flows through R30, R31, and R32. The bias voltage developed across R30, R32, is applied to the control grid of V8 via R29. In the absence of any signal input, the cathode of V8 is maintained at approximately 30 volts positive to earth. When a signal is received, however, the control grid of V8 receives a negative bias via R29, as explained above, and the anode current falls.

105. The space current from cathode to H.T. negative flows through R30, R51, and R52. The switch S14F being closed, there is a chain of components connected between the junction R51-R52 and the tapping of the R/F GAIN potentiometer R83, namely the diode D3 (part of V10) S14F, R59 and R62. Suppose the R/F GAIN control to be set to the mid-point of its voltage range (this is not the mid-point of its travel). Then the tapping (and consequently the anode of D3) will be at —28 volts to earth. When the junction R51-R52 (and consequently the cathode of D3) falls below —28 volts, therefore, the diode D3 becomes conductive, and a bias voltage is developed across R59, R61. This voltage is applied to the I/F valves via the I/F A.V.C. line.

106. Any further increase in the input signal will now cause a further fall of potential at the junction R51-R52, and a consequent increase in the bias voltage across R59, R61, that is, in the I/F A.V.C. voltage. The anode of the diode D2 (part of V8) is, when the switch unit S14R is closed, normally at about 1·5 volts below earth potential. As the signal strength increases, the potential of the cathode of V8 falls, and may eventually become lower than the potential of the anode of D2. If this occurs, D2 also becomes conductive, and a bias voltage is developed across R58, R60. This bias is applied to the R/F amplifier valve V1 via the R/F A.V.C. line, and also to the control grid of the guard mixer valve V4.

107. The standing bias for the I/F valves is provided by the potentiometer network R83, R62, R61, between earth and H.T. negative; standing bias for the R/F valve V1 and guard mixer valve V4 is provided by the network R45, R57, R55, R60.

108. It is desirable to maintain the above-mentioned delay action, by which the bias applied to the R/F valve is delayed until about 5 volts bias is applied to the I/F valves, when the A.V.C. is switched off and manual R/F gain control only is in use. This is achieved by the diode D4 (part of V11) in conjunction with the network R57, R56, in the following manner.

109. The junction R57-R56 is maintained at five volts above earth potential by a positive feed from the H.T. line via R45, in conjunction with the diode D4 and the resistance R44. The resistances forming the fixed potentiometer R57, R60, are so chosen that $6\frac{1}{2}$ volts are developed across R57, with the polarity shown in fig. 24. Thus the junction R57-R60 is $1\frac{1}{2}$ volts negative with respect to earth. This is the standing bias fed into the R/F A.V.C. line.

110. As the sensitivity is reduced by the manual R/F GAIN control, bias is applied to the I/F valves via R62 and R59, but the potential (+ 5 volts) at the junction R57-R56 is held constant by the diode D4 until the R/F GAIN control has been moved far enough to annul this potential. The diode D4 then ceases to conduct and the bias developed

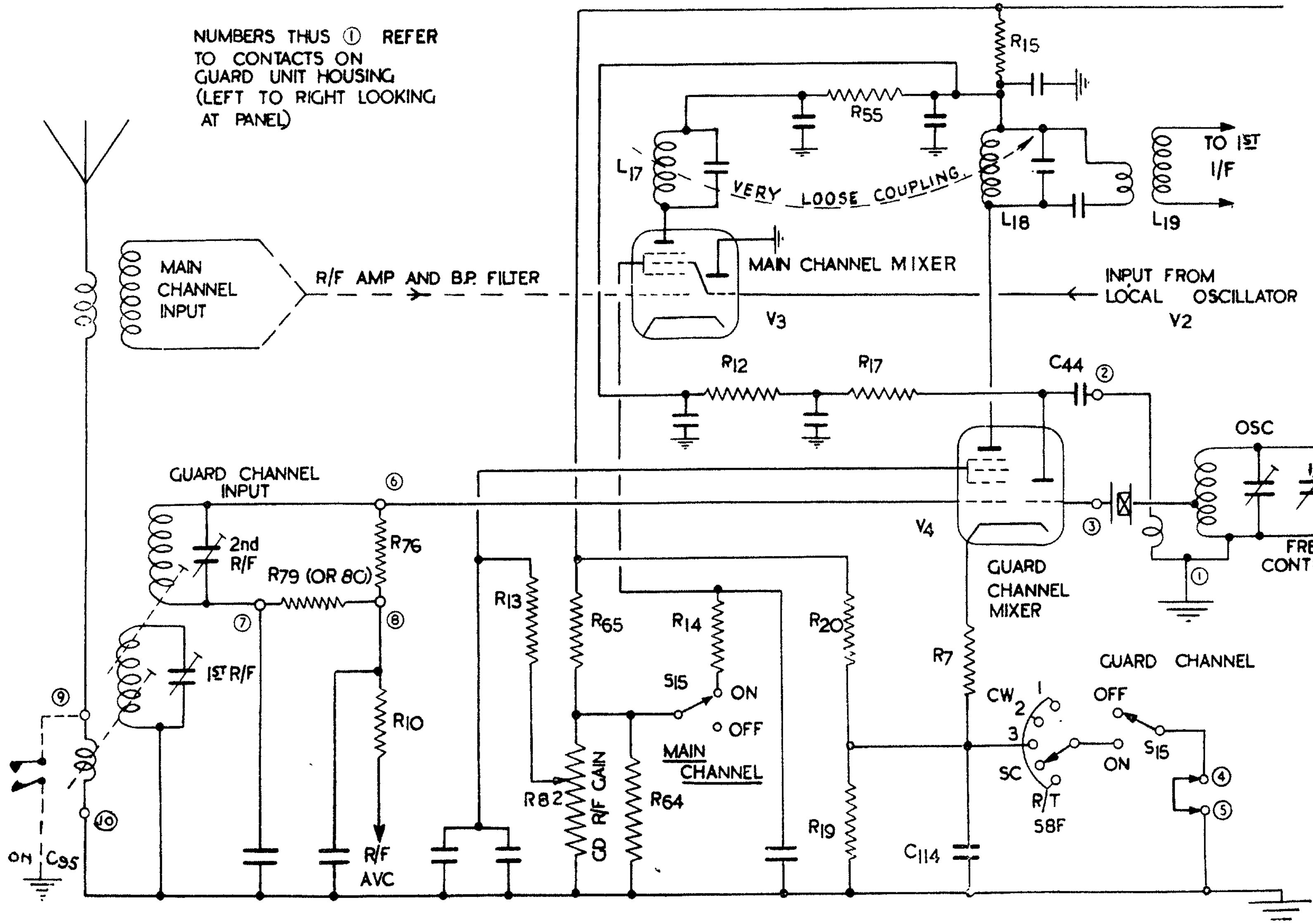


Fig. 23—Mixer circuits, schematic

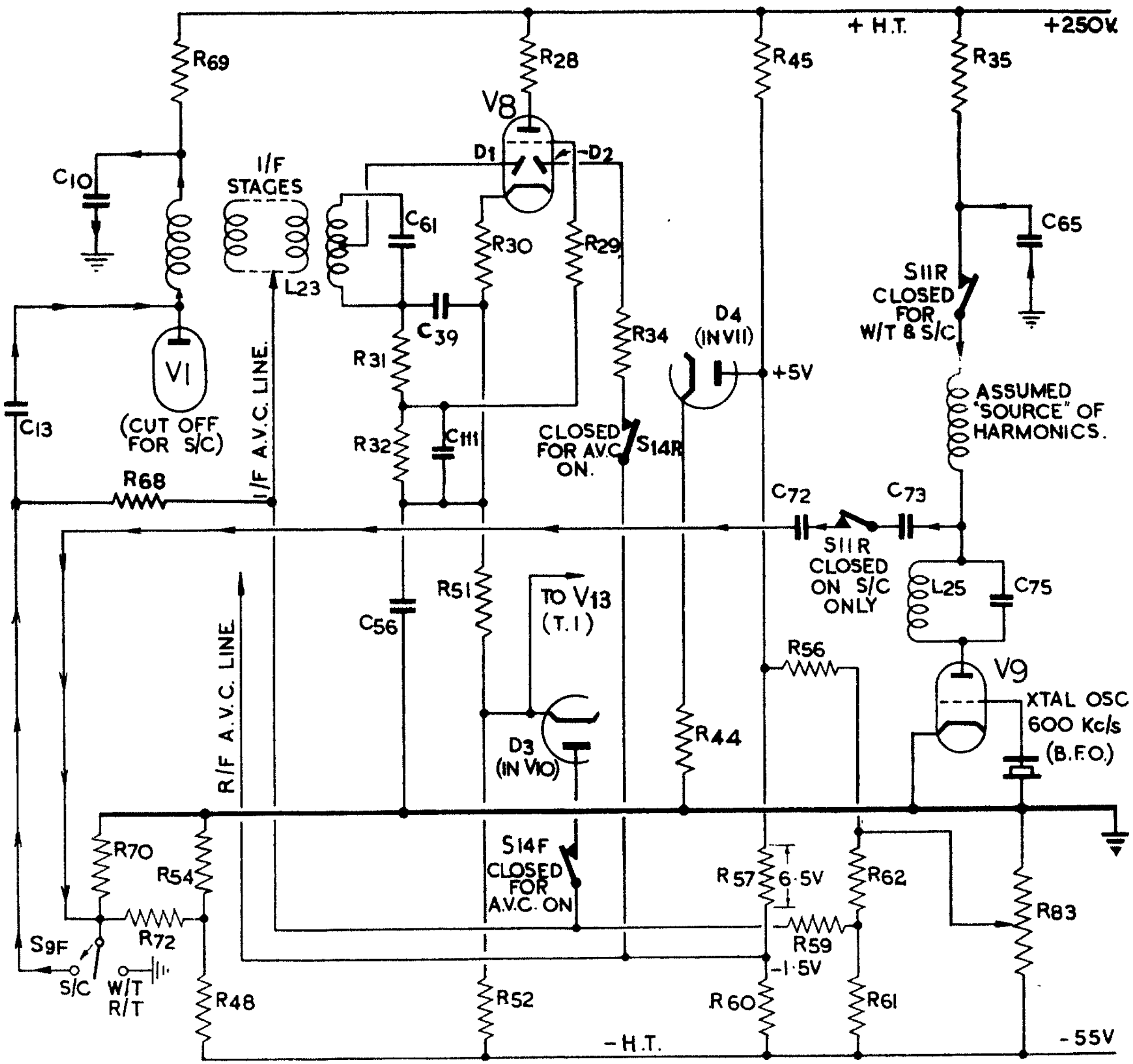


Fig. 24—A.V.C. and scale check circuits, simplified

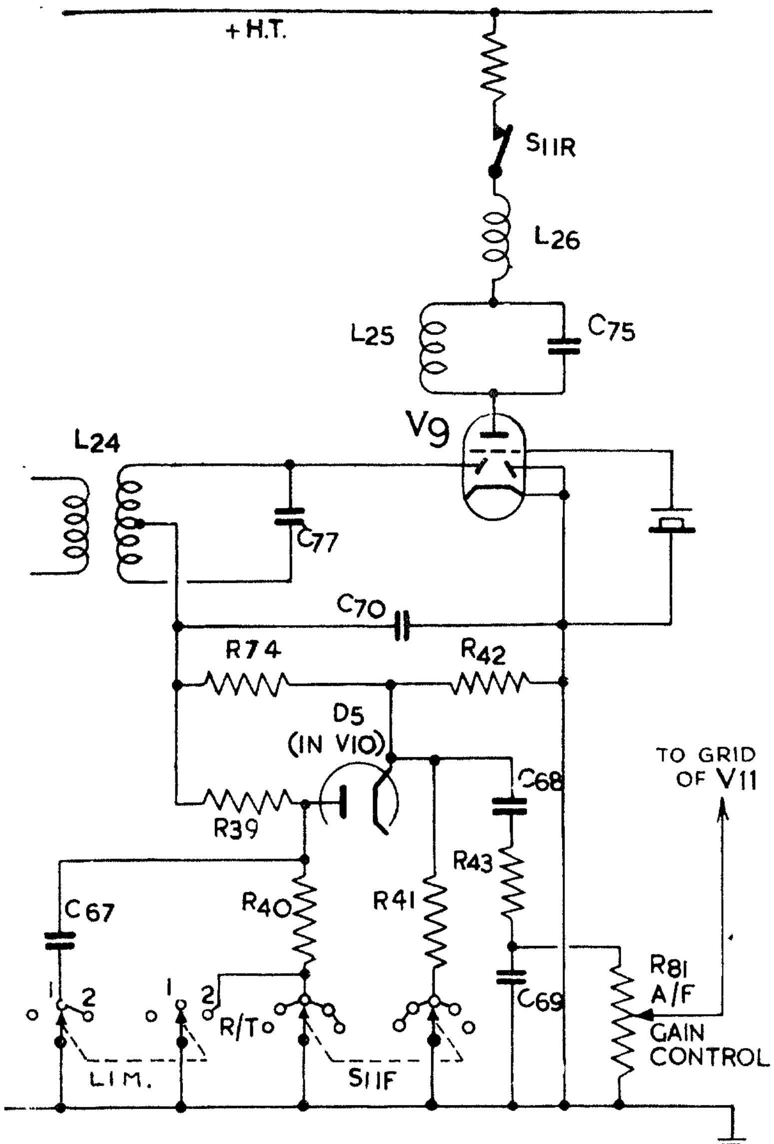


Fig. 25—Noise limiter circuits, simplified

across the operative portion of the R/F gain control is immediately applied to the R/F A.V.C. line, via R57 and R58.

111. From the foregoing it will be seen that the bias applied to the R/F valve is delayed until 5 volts are applied to the I/F valves, whether the A.V.C. is switched on or off, and the highest possible signal/noise ratio is maintained at all signal levels.

Noise limiter

112. The noise limiter operates on any voltage pulse of short duration, the amplitude of which is greater than the instantaneous signal level. The action is as follows. Referring to fig. 25, the cathode of the limiter diode D5 (part of V10) is connected to the junction R74-R42, which are part of the second detector diode anode load (para. 101). The anode of the limiter diode is connected via a 2·2-megohm resistor R39 to the negative end of the resistance R74. The condenser C67 (0·1 μF) is connected from anode to earth by the switch S13, when the limiter circuit is switched on (positions 1 and 2).

113. When a signal of normal level is received the limiter diode does not conduct, because the condenser C67 becomes negatively charged from the detector diode load, via R39. When a pulse of appreciably greater amplitude than the signal level is received, however, the cathode of the limiter diode is impulsed negatively. The limiter diode anode is also connected to a point receiving a negative pulse, but it cannot follow this change of potential instantaneously because of the large time-constant of R39 and C67 (about 0·3 second). The cathode thus becomes momentarily more negative than the anode, and the diode becomes conductive. The diode and C67, in series, now form a low impedance path shunting C68, R43 and R81; in effect, therefore, the input circuit to the A/F amplifier valve V11 is short-circuited during the pulse.

114. When the resistor R40 is also connected to earth, by the switch S13 in position 2, the standing potentials of the anode and cathode of the limiter diode are made more nearly equal, and consequently, upon receipt of a pulse, limiting commences even more rapidly than in position 1. Position 2 is intended chiefly for C.W. or M.C.W. reception, where distortion of the signals is not important.

115. In this connection, it is important to appreciate the action of the switch unit S11F. This unit connects R40 to earth in all positions of the SYSTEM switch other than R/T. It follows therefore that, provided

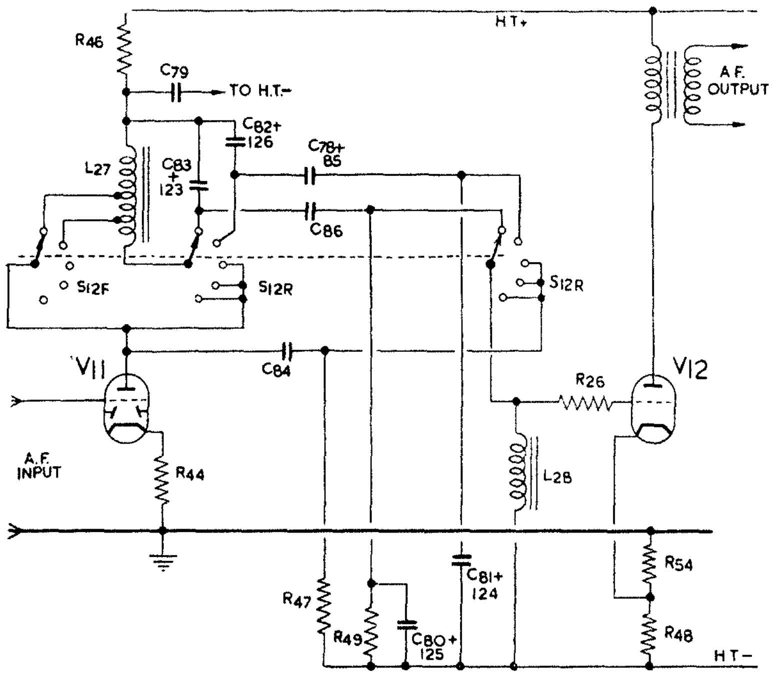


Fig. 26—A/F filter circuits, simplified

the limiter switch is not in the OFF position, the higher degree of limiter action is always applied for C.W. reception. Another pair of contacts on this switch unit connects R41 in parallel with R42 in all except the "300-c/s band-width C.W." position of the SYSTEM switch. This arrangement gives greater A/F gain on the "300 c/s" position, to compensate for the additional attenuation introduced by the narrow-width filter.

A/F amplifier and output stage

116. The A/F amplifying valve V11 is coupled to the output valve V12 by an A/F filter consisting of L27, L28 and several associated condensers. The filter is of the type commonly known as "top-end capacitance coupling." A simplified diagram of the filter circuit is given in fig. 26. Three degrees of A/F selectivity are provided, the switch units concerned being S12R and S12F.

117. The output transformer has two secondary windings. One of these, the low level balanced output winding, is taken to points 14 and 16 on the Jones socket SK2 at the rear of the receiver. The other secondary winding is tapped, the tappings being taken to a small panel mounted on the transformer. This carries terminal points numbered 1, 2 and 3, the desired tapping being selected by a screw-in connector. This secondary gives either a high level or a low level unbalanced output, the arrangements to this end being as follows.

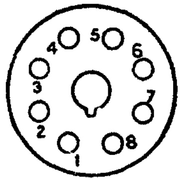
118. The point 14 on the socket SK1 (also at the rear of the receiver) is permanently connected to the high potential end of the unbalanced secondary winding, the other end of which is connected to earth. Point 15 on SK1 is also earthed. From points 14 and 15 on SK1, therefore, a high level output can be obtained into a load of 600 ohms impedance. It should be noted that this facility is available, irrespective of the tapping selected on the transformer. A low level output can be obtained by plugging telephones into the jacks provided on the front panel. The transformer tapping must be set according to the impedance of the telephones, tapping 1 being used for 20,000-ohm phones, tapping 2 for 600-ohm phones, and tapping 3 for 150-ohm phones.

119. The maximum undistorted output at the low level terminals is 3·75 milliwatts, and at the high level terminals, 150 milliwatts.

Tuning indicator

120. The tuning indicator V13 is operated from the cathode of the A.V.C. d.c. amplifier (part of V8). If two or more receivers are used, for diversity reception, with the A.V.C. lines linked together, this method of tuning allows each receiver to be tuned independently by means of its own tuning indicator.

Valve bases



INTERNATIONAL OCTAL (I.O.)

121. All the valves are fitted with international octal bases, the connections (looking on base of valve) being as shown. All valves have 6·3 volt heaters and are connected across the 12-volt supply in series pairs, as shown in fig. 32.

Pin	VR.53	6J5G	ARTH2	CV.216	6Q7G	VR.54	VI.103
1.	M	—	M	—	—	M.S	—
2.	H	H	H	C (cold)	H	H	H
3.	A	A	A	x	A	A2	A
4.	G2	x	G2 G4	x	D2	C2	T
5.	G3	G	Go G3	A	D1	A1	G
6.	x	x	Ao	x	—	x	x
7.	H	H	H	x	H	H	H
8.	C	C	C	x	C	C1	C
TC.	G1		G1		G		

—denotes that a pin is fitted, but no internal connection.
x denotes that no pin is fitted.

POWER UNIT TYPE 360

General description

122. The power unit type 360 is designed to supply H.T. and L.T. power for one receiver type 88, the power input being derived either from a 12-volt battery or from ~~200-250~~ volt a.c. mains.

123. The general arrangement of the main components is seen in fig. 27 and 28. The principal components are the mains transformer T1, the filter unit type 141, the rectifier unit type 4, and the main switch. Fuses are provided in the 12-volt d.c. supply, a.c. supply, and H.T output leads.

124. The filter unit type 141 consists of a metal screening box somewhat similar in size and shape to the plug-in units of the receiver type 88. The vibrator unit is mounted on top of this unit in a cylindrical metal can with an American four-pin base, and is easily replaced by a spare, after removing the dust cover of the power unit. The main body of the filter unit houses the chokes and condensers of the filter system. The location of most of these components is shown in fig. 29.

125. The main switch has three positions, namely 12-V. D.C., OFF, and A.C. It consists of five wafer switches comprising seven switch units, referred to as S1F, S2F, S3R, S5F, and S5R. The five switches are mounted on a common spindle, the end of which is arranged to operate a quick make-and-break switch S6 in the main a.c. supply circuit.

126. The seven switch units perform the circuit changes required for the two kinds of power input. Corresponding contacts of S4F and S4R are in parallel, as are also the corresponding contacts of S5F and S5R. On each of these switch units, also, certain contacts are commoned, for example, on S4F, contacts 7 and 10 are commoned, contacts 3 and 12 are commoned, and contacts 1, 4 and 6 are commoned. This has been done in order to provide ample current-carrying capacity in the switching system. In the circuit description below, where switches or switch contacts are in parallel, only one of the possible paths through the switching system is mentioned.

127. The rear of the power unit carries two Jones plugs, P1, P2, and two Jones sockets, SK1, SK2. The plug P1 is the battery connection and is marked D.C. INPUT. Plug P2 is marked A.C. INPUT.

128. The Jones sockets are alternative outputs, all similarly numbered points being commoned. Points 13 and 14 are the L.T. output, 13 being earthed, and 14 being the L.T. positive. Points 15 and 16 are the H.T. output, 16 being positive. This marking corresponds with the marking on the power input plug on the receiver type 88.

129. A complete circuit diagram of the power unit is given in fig. 30. In tracing circuits, it is well to remember that, when using a.c. supply, the transformer functions in its normal manner, the multi-tapped winding being used as the primary. When using a battery supply, however, this winding becomes the secondary, i.e., output,

winding. For this reason, instead of being marked " primary " and " secondary," the windings have been lettered A, B, C, etc., in the circuit diagram to simplify the following explanation.

Circuit with a.c. input

130. When used with an a.c. input, the circuit is quite conventional. From point 13 on plug P2, the circuit may be traced through switch S6 (quick make-and-break) and fuse F2, to one tapping on winding A, thence through the winding to the other tapping, and through the switch unit S1F, back to point 16 on plug P2. Switch S1F does not break this circuit in the OFF position, since its " break " is not sufficiently rapid to extinguish arcing, hence the necessity for the switch S6.

131. The windings B and C function as the H.T. secondary, and are connected between tags 4 and 6 on the tagboard. From tag 4 the secondary circuit may be traced through contacts 4 and 5 of switch unit S3R to one side of the bridge type metal rectifier. From the other side of the latter the circuit continues via contacts 8 and 9 on switch unit S3R to tag 6 on the tagboard.

132. The first filter condenser C2 is connected directly across the output terminals of the rectifier. From its positive side the circuit continues through the smoothing choke L1 and the H.T. fuse F3 (a 6·2-volt lamp) to point 16 on the output sockets SK1, SK2. The negative end of the rectifier is directly connected to the points 15 on the output sockets. From the output side of the choke L1, the condenser C1 is connected to the H.T. output line, a bleeder resistance R1 being connected in parallel therewith to ensure that it does not retain a permanent charge. The condenser C4 is connected between the H.T. negative line and earth. On no account must the negative H.T. line be directly earthed ; its d.c. potential is 55 volts below earth.

133. The L.T. supply is derived from the windings D, G and E, which are connected between tags 1 and 2 on the tagboard. From tag 2, the circuit may be traced through contacts 8 and 7 on switch unit S4R to the point 14 on the output sockets, which are accordingly marked 12 V. D.C., A.C. The L.T. negative of the receiver being earthed, the current returns to the transformer from earth to contact 8 on the switch unit S5F, thence via contact 7 to tag 1 on the tagboard.

134. The condenser C3 is an additional H.T. smoothing condenser. When using a.c. supply, it is connected, by the switch unit S2F, in parallel with C1. When the switch is in the OFF position, the resistance R2 is shunted directly across, and thus discharges, the condenser C3.

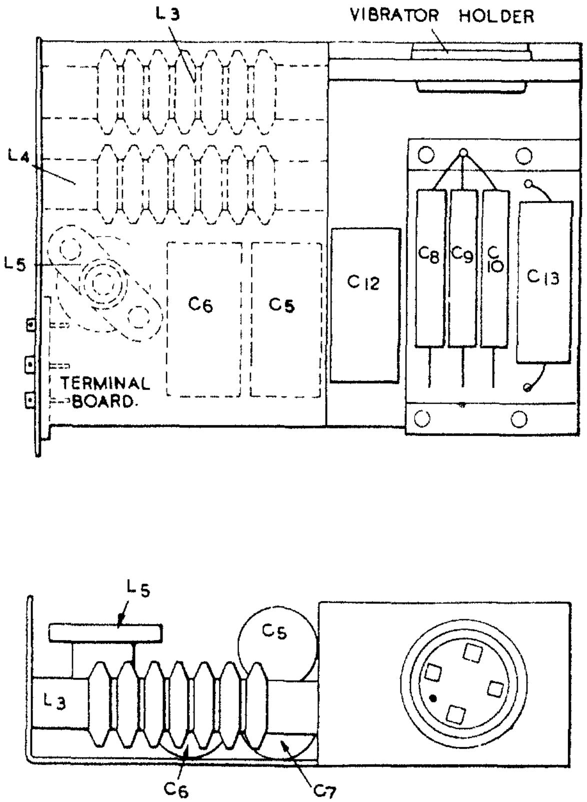


Fig. 29—Filter unit type 141, location of components

Circuit with d.c. input

135. When used with a d.c. input the windings D, E. F, G, H, become the primary winding, and the winding A becomes the H.T. secondary. The battery is connected to terminal 14 (positive) and 15 (negative) on the plug P1. From 14 the circuit may be traced to contact 1 on the switch unit S4R, thence via contact 12 to L10 and L9, on to tag 9 on the tagboard. Here the circuit divides ; one path proceeds via contacts 6, 7, on switch unit S2F to the terminal 3 on the filter unit type 141, thence through chokes L5 and L8, the driving coil of the vibrator unit, and the vibrator reed, to earth. Since the negative pole of the battery is earthed at P1, this completes the driving circuit of the vibrator.

Note.- The transformer T, is actually tapped 0-10-200-220-240 volts. The markings "0" and "10" shown on the terminal block below should therefore be interchanged. (A. L. 3)

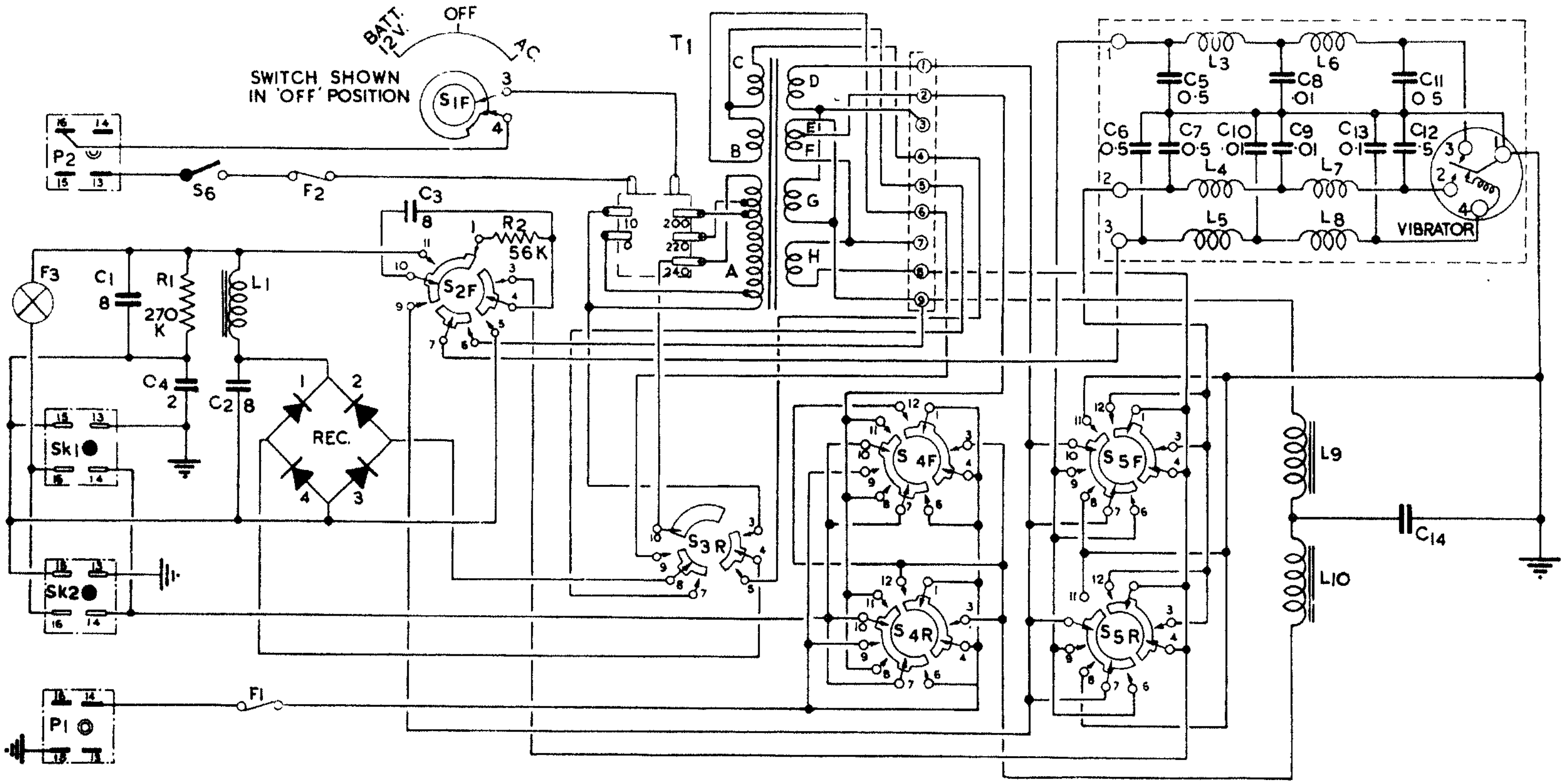


Fig. 30—Power unit type 360, circuit diagram

136. Returning to tag 9, the second branch of the circuit may be traced through windings G and D in series to tag 1. A third branch may be traced through windings E, F, and H, in series, to tag 8. From tag 1 the circuit continues to contacts 7, 6, on switch unit S5F, thence to terminal 1 on the filter type 141, through chokes L3 and L6, to one of the "converter" contacts on the vibrator unit. From tag 8 a similar circuit may be traced via chokes L4, L7, to the other "converter" contact on the vibrator unit. The circuit of one of the two paths is completed to earth by the reed, and when the reed is in vibration, either the second or third branch of the circuit is in operation at any particular instant. The windings on the transformer are so arranged that the two circuits cause fluxes of opposite polarity to be set up in the core. The windings G. D, in series, or E, F, H, in series, act alternately as the primary of a step-up transformer, of which the secondary is the winding A. Since the main switch is at BATT. 12V, the switch S6 and the switch unit S1F are broken, and there is no external circuit back to the a.c. input plug P2, even if the mains remain connected thereto.

137. The H.T. circuit is connected directly to the ends of the winding A. From the "240-volt" end the circuit is taken via contacts 10, 9, on switch unit S3R and winding C on the transformer to tag 5, thence via contacts 7 and 8 on switch unit S3R to one side of the rectifier. From

Note.- The transformer T, is actually tapped 0-10-200-220-240 volts. The markings "0" and "10" shown on the terminal block below should therefore be interchanged. (A. L. 3)

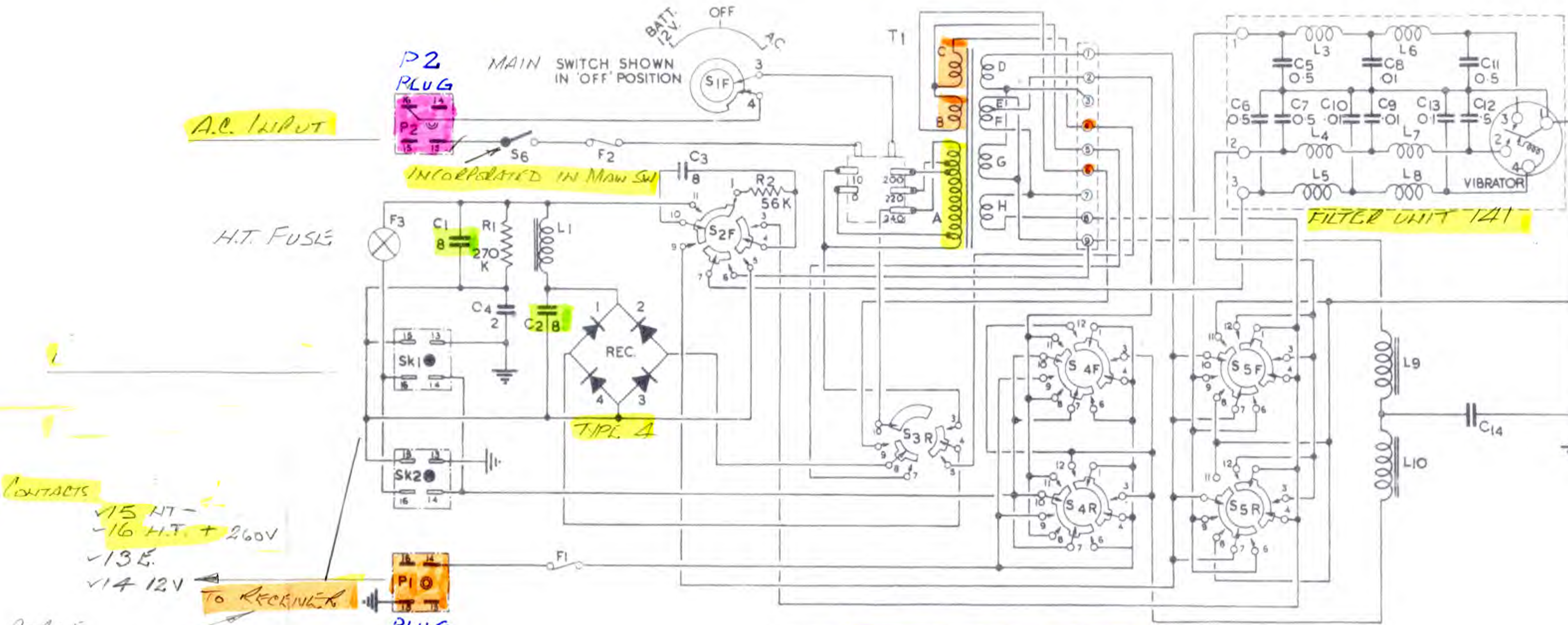


Fig. 30—Power unit type 360, circuit diagram

136. Returning to tag 9, the second branch of the circuit may be traced through windings G and D in series to tag 1. A third branch may be traced through windings E, F, and H, in series, to tag 8. From tag 1 the circuit continues to contacts 7, 6, on switch unit S5F, thence to terminal 1 on the filter type 141, through chokes L3 and L6, to one of the " converter " contacts on the vibrator unit. From tag 8 a similar circuit may be traced via chokes L4, L7, to the other " converter " contact on the vibrator unit. The circuit of one of the two paths is completed to earth by the reed, and when the reed is in vibration, either the second or third branch of the circuit is in operation at any particular instant. The windings on the transformer are so arranged that the two circuits cause fluxes of opposite polarity to be set up in the core. The windings G. D, in series, or E, F, H, in series, act alternately as the primary of a step-up transformer, of which the secondary is the winding A. Since the main switch is at BATT. 12V, the switch S6 and the switch unit S1F are broken, and there is no external circuit back to the a.c. input plug P2, even if the mains remain connected thereto.

137. The H.T. circuit is connected directly to the ends of the winding A. From the " 240-volt " end the circuit is taken via contacts 10, 9, on switch unit S3R and winding C on the transformer to tag 5, thence via contacts 7 and 8 on switch unit S3R to one side of the rectifier. From

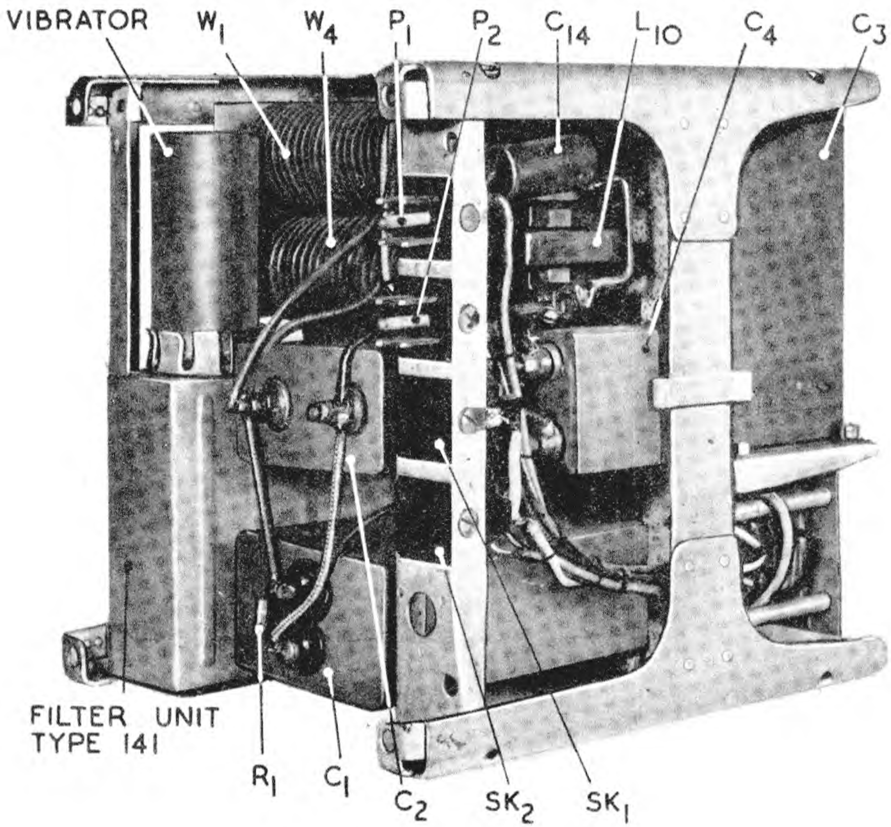


Fig. 28—Power unit type 360, rear view

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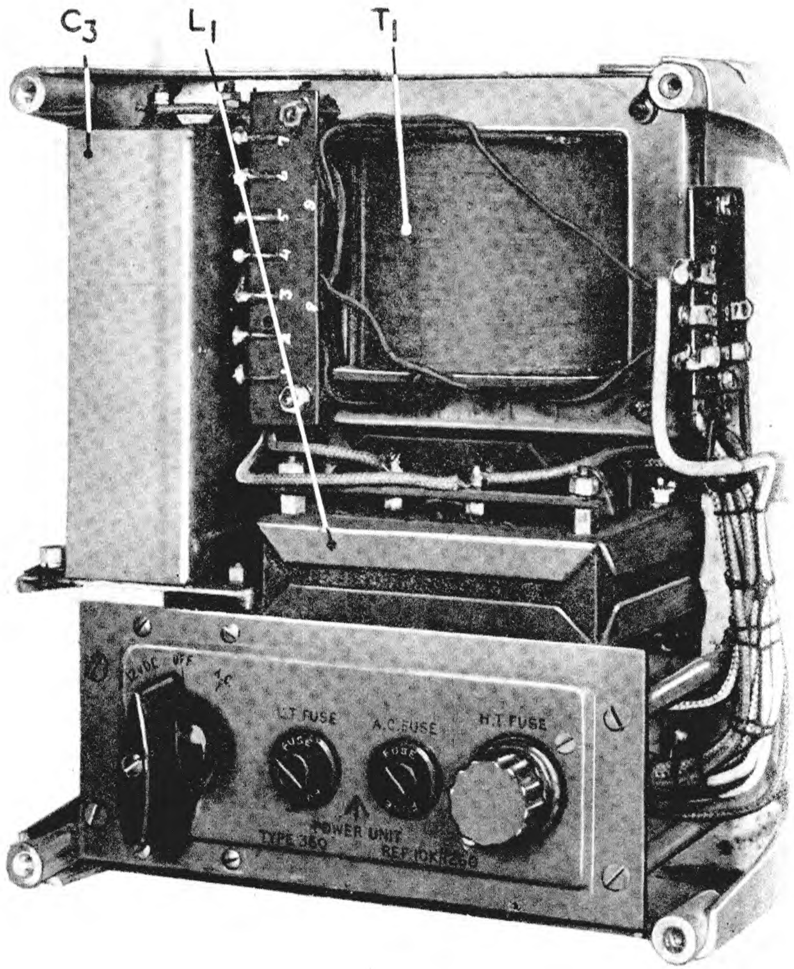

Fig. 27—Power unit type 360, front view (dust cover and front pan

the other side of the rectifier the circuit continues via contacts 4 and 3 on switch unit S3R to the other end ("0-volts") of the winding A.

138. The above arrangements provide a H.T. a.c. supply to the rectifier, which therefore functions in the same manner as when the switch is in the a.c. position. The condenser C3, which as already stated (para.134) is switched by the switch unit S2F, is connected directly across the " converter " input terminals of the filter unit type 141, when the main switch is at 12 V.D.C.

139. When using 12-volt battery supply, the receiver type 88 obtains its L.T. supply directly from the battery as follows. From point 14 on P1, which is connected to the positive pole of the battery, the circuit continues to contact 6 on switch unit S4R, thence to contact 7, and directly to point 14 on the output sockets SK1 and SK2. Thus the receiver receives a direct 12-volt supply from the battery.

POWER UNIT TYPE 458

General description

140. The power unit type 458 will eventually be introduced to supply H.T. and L.T. power for the receiving equipment type R.1475. This power unit will supply power to one receiver type 88, the input being derived either from a 12-volt battery or from 200—250-volt a.c. mains.

141. A circuit diagram of the unit is given in fig. 31. The principal components are two transformers, namely, T1 for battery input, and T2 for mains input, a filter unit, a voltage-doubling rectifier with smoothing system, and the main switch.

142. The filter unit consists of a brass screening box, upon which a vibrator unit type 14 is mounted. The box contains the battery transformer T1 and three filter circuits, the arrangement of these being shown in the circuit diagram, fig. 31. These filters are fitted to suppress radio-frequency interference from the vibrator unit.

143. The vibrator unit is hermetically sealed in a cadmium-plated brass case, fitted with a 10-pin base. The connections of these pins are shown in fig. 31 by numbers in circles. The unit has two vibrating reeds, rigidly coupled mechanically but electrically insulated from each other. One of these is in the primary circuit of the transformer T1 and the other in the output circuit.

144. The voltage doubling rectifier and its smoothing system are quite conventional. The main switch has three positions, A.C. INPUT, OFF, and D.C. INPUT. It is of the rotary type and has four sections. Three fuses are fitted, namely, a d.c. fuse F1, (5 amp.), an a.c. fuse F2 (1·5 amp.), and an H.T. fuse F3 (150 milliamp.).

INSTALLATION

145. The installation of the receiving equipment type R.1475 is very straightforward. Either rack or bench mounting is provided for, according to the type of station in which it is installed. If the equipment is to be rack mounted, the two brackets type 13 supplied in the transit case type 77 must be fitted to the receiver. Before mounting the power unit type 360, the front panel and dust cover must be removed and the mains transformer set for the correct mains voltage, where a.c. supply is to be used. After replacing the panel and dust cover, the power unit must be fitted on a panel type 384, which is adapted for mounting one or two power units, and is also supplied in the transit case type 77.

146. Where bench mounting is to be adopted, the receiver is fitted in a mounting tray type 656 and the power unit in a mounting tray type 657. The protective grille (visor type 28) should be fitted to the receiver as shown in fig. 1.

147. Interconnection between the power unit and the receiver is made by a length of Dumet L.T. cable, fitted with a Jones plug (to mate with the socket on the power unit) at one end and a Jones socket (to mate with the plug on the receiver) at the other. The cable, plugs and sockets are supplied in the transit case type 77.

148. The total length of cable from battery to receiver must be kept as short as possible, and must never exceed 12 feet. The relative lengths between (i) battery and power unit type 360, and (ii) power unit type 360 and receiver type 88, are unimportant, provided that the total length of 12 feet is not exceeded.

149. The metal braid of the Dumet 19 cable forming part of (i) above must be bonded to contact 15 of the socket, together with the negative lead from the battery. The metal braid of the Dumet 19 and Dumet 4 cable forming (ii) above must be bonded to contact 13 of plug and socket together with the side of the heater circuit which is at chassis potential.

150. In certain stations, it is possible that several different receiving channels may be operated from a common receiving aerial, an aperiodic amplifier such as amplifier type A.1416 being used to couple the aerial to the respective receivers. Where this system is adopted, the individual receivers are fed from the amplifier by connecting an output point on the latter to the co-axial (low impedance) aerial plug on the receiver. The amplifier type A.1416 is fitted with output points for seven receivers, a variable attenuator being provided for each.

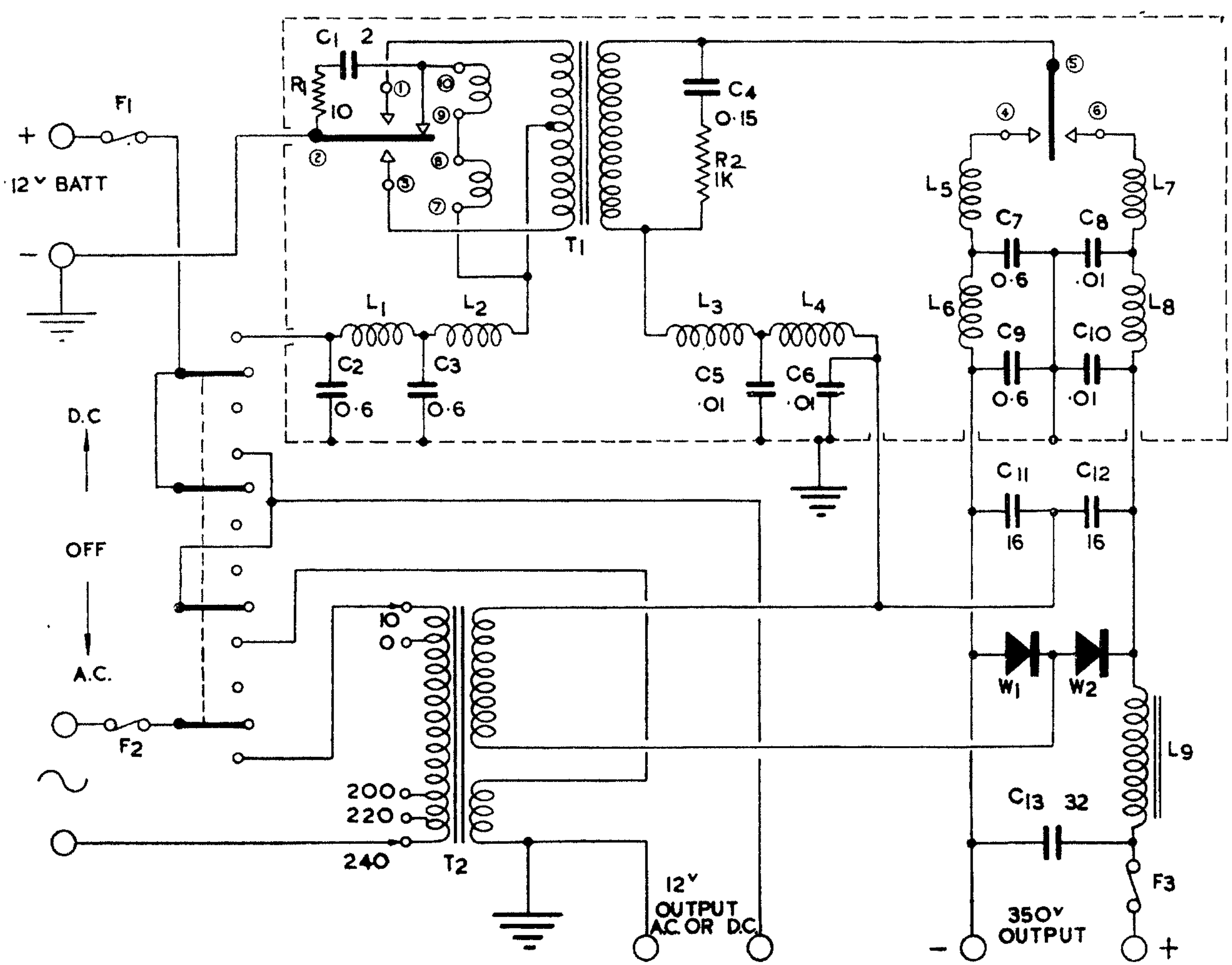

Fig. 31—Power unit type 458, circuit diagram

Main channel adjustments

152. Set the SYSTEM switch to "wide band" for C.W. operation, or to R T for R T or M.C.W. operation. Set the noise limiter switch to OFF, the A.V.C. switch to FAST, and the guard switch to GUARD OFF. Set the gain controls in the following manner before tuning to the desired frequency. First turn the receiver to a loud signal and bring the volume down to a comfortable level by the A.F GAIN control. Retune the receiver to a frequency upon which there is no carrier, and adjust the R/F GAIN control for maximum tolerable noise. The adjustment of the receiver is then correct for maximum useful sensitivity.

153. Set the RANGE switch to the desired range and check the calibration as explained in para. 158, then set the tuning control to the desired frequency. Set the A.V.C. switch to the required position, with due regard to the considerations mentioned in para. 26. The widest band-width will normally be used while listening out on C.W., but may be reduced while actually receiving signals, if necessitated by the prevailing interference. The noise limiter should be switched on if impulsive noise interference is experienced.

OPERATION

151. Before using the receiver, the tapping on the output transformer must be set for the required output conditions. It is necessary to remove the dust cover to do this. The correct tappings for given conditions are given in para. 117-118.

Guard channel adjustments

154. Insert a standard Air Ministry type crystal, differing by 600 kc s from the specified guard frequency, into the appropriate guard frequency unit P or Q, and insert the unit into the guard unit housing. If a suitable signal generator or radiating wavemeter is available, put the

Guard switch to GUARD ONLY, inject a signal at guard frequency into the receiver, and adjust the guard unit FREQUENCY control for maximum signal.

155. The pre-set controls (1st R F and 2nd R/F) must be adjusted for maximum signal strength. Put the guard switch to NORMAL, and adjust the GUARD R/F GAIN control so that a barely preceptible decrease in the noise level occurs on switching from NORMAL to GUARD OFF. Return the switch to NORMAL; the receiver is then adjusted for reception on both channels.

156. When using the receiver in the NORMAL condition, interference may be experienced from the fundamental oscillation or harmonics of the guard frequency oscillator, if the main and guard channel frequencies are in harmonic relationship with each other. For example, suppose the guard crystal frequency is 3 Mc/s, and the main channel receiving frequency is 6 Mc/s. If the crystal oscillation has a second harmonic of sufficiently large amplitude, a continuous whistle may be set up when the SYSTEM switch is in the C.W. position. If in the R/T position, speech may be seriously distorted. Slight trimming of the guard FREQUENCY control may possibly overcome this.

157. If continuous interference is experienced, and the above phenomena are suspected, the source of the whistle (on C.W.) may be confirmed by switching off the guard channel, when the interference should cease. In certain conditions, however, it may be impossible to operate on main and guard channels which are in harmonic relationship.

To check the calibration

158. Set the RANGE switch to the 2 — 3·6 Mc/s range, and the SYSTEM switch to SCALE CHECK. Commencing at the lowest reading on the scale, rotate the tuning control slowly while listening for the harmonic beat-notes. These should occur at 2·4, 3·0 and 3·6 Mc/s, these frequencies ("check points") being specially identified on the scale. If exact coincidence is not obtained, adjust the SCALE TRIMMER control slightly, until the calibration is correct.

159. A similar procedure should be followed on all four ranges, the calibration being checked at each check point. On completing the highest range (11·3 to 20 Mc/s), the lowest range should be re-checked. If it is found impossible to adjust the calibration on all four ranges, it is probable that a defect has occurred in one or more ranges of the oscillator unit C, which should be replaced by a serviceable one.

160. The above procedure is intended to maintain the receiver calibration at the highest possible accuracy over the whole frequency range. When the receiver is about to be used on a particular frequency, the scale should first be set to the nearest check point, and with the SYSTEM switch set to SCALE CHECK, the SCALE TRIMMER control should be adjusted until the calibration is correct at this frequency. Then return the SYSTEM switch to the desired position, and tune the receiver as described in para. 151.

PRECAUTIONS AND SERVICING

Warnings

Removal of plug-in units

161. Before any attempt is made to remove any one or more of the plug-in units, the appropriate switch bar must be removed. If this is not done, even a moderate amount of force exerted upon the unit may result in damage to the switch unit in the plug-in unit, and possibly to the switch units in the adjacent plug-in units. The switch bar may also be buckled, so that it is difficult or impossible to withdraw it subsequently. A warning to the above effect is stencilled across the back of the receiver.

Removal of main tuning condenser gang

162. A special extractor tool will be supplied to Service Units which are authorized to exchange serviceable for defective ganged condensers. This tool is used to remove the large anti-backlash (i.e. spring-loaded double-plate) pinion which forms the final wheel of the condenser drive. This wheel is mounted upon a tapered spindle, and considerable force is required to remove it. Any attempt to do so, without using the special tool, will certainly damage the condenser gang beyond repair, while the wheel itself will also probably be so distorted as to become unserviceable.

Re-alignment of receiver

163 The receiving equipment type R.1475 is issued to the Services in a properly lined-up and calibrated condition, and should not require further adjustment (other than the scale trimming explained in para. 158-160), unless a major repair or replacement (such as a complete ganged condenser) has been made. Such repairs and replacements are made only in properly-equipped Servicing or Maintenance Units. The

following para. 164 to 190 inclusive, explain the manner in which the receiver is initially aligned and calibrated at the maker's works. This information is issued merely as a guide to those concerned in drawing up repair schemes, inspection schedules, etc.

Alignment of I/F amplifiers

164. As the second heterodyne oscillator is crystal controlled, it is necessary to off-set the intermediate frequency in order to obtain the highest performance from the note filter. For this reason, the intermediate frequency must be 601·3 kc/s. There are two methods of ensuring that the I/F amplifiers are aligned to the correct frequency.

(i) By the use of a crystal-controlled signal generator.

(ii) By adjusting the signal generator to give maximum output on the higher side band of the heterodyne note when the 100 c/s. filter is in operation.

To ensure a symmetrical response, by either of these methods, it is essential that the alignment be performed with the intermediate frequency circuits switched to the narrow band selectivity. The adoption of the procedure detailed below enables this condition to be fulfilled; while by returning the output and heterodyne wafer switches to the 5 kc/s R/T position, 400 c/s. modulation may be used without interference from the second heterodyne or A/F note filters. A special short switch bar, operating only on the heterodyne and output units, must be used to obtain this abnormal condition. Care must be taken to replace this special bar by the normal one when the alignment has been completed.

Method 1. *Crystal controlled generator*

165. (i) Connect the signal generator to grid of V3.

(ii) Set controls as follows :—

(a) Range switch	Range 4, 2·0—3·6 Mc/s.
(b) R/F sensitivity	Maximum.
(c) Guard switch	Off.
(d) Noise limiter switch	Off.
(e) A.V.C. switch	Off.
(f) A/F volume control	To a convenient level of about 10 mW.
(g) Selectivity switch	As stated below.

(iii) Set selectivity switch to 300 c/s. filter positions.

(iv) Remove switch bar and insert special short switch bar.

(v) Return selectivity switch to 5 kc/s R/T.

(vi) Tune up I/F circuits for maximum output, using 400 c/s. modulation, commencing at L24 and working back to the mixer L17. It may be necessary to reduce the input periodically to prevent overloading.

(vii) Switch selectivity to 300 c/s. filter position.

(viii) Replace the normal switch bar.

The I/F amplifier should now be correctly aligned for all selectivity positions.

Method 2. *Maximum high-band output*

166. (i) Connect signal generator to grid of V3.

(ii) Set controls as follows :—

(a) Range switch	Range 4, 2·0 — 3·6 M/cs.
(b) RF sensitivity	Maximum
(c) Guard switch	Guard off
(d) Noise limiter	Off
(e) A.V.C. switch	Off
(f) AF volume control	To a convenient level of about 10 mW.
(g) Selectivity switch	As stated below

(iii) Switch selectivity to 300 c/s, note filter position.

(iv) Inject a signal of about 595 kc/s and tune signal generator slowly to a higher frequency. As the signal generator frequency approaches that of the second heterodyne a beat note will be heard which will rise to a maximum at 598·7 kc/s, fall to zero at 600 kc/s, and rise to a second maximum at 601·3 kc/s. This second maximum is the correct frequency and the signal generator should remain at this tuning point throughout the alignment.

(v) Insert short switch bar and proceed as for Method 1.

Adjustment of the second heterodyne

167. There are two adjustments to be made to the second heterodyne unit.

(i) The voltage at the grid of V9 should be adjusted to be about 8 volts peak by means of the screw core in L25. The voltage should fall as the core is unscrewed.

(ii) The frequency must be adjusted to 600 kc/s by means of the trimmer capacity C55.

168. These two adjustments are interdependent to a certain extent, therefore it is important that the frequency adjustment is always performed last. This adjustment should always be done immediately after the "soak test" so that the temperature of the crystal will then be nearer the centre of its operating range. The controls should be set as follows.

Selectivity switch	5 kc/s C.W.
Guard switch	Off
Noise limiter	Off
A.V.C. switch	Off

169. The output of the calibrator should be injected into the grid of the mixer valve V3 and the sensitivity and volume controls adjusted until a low beat note is heard. Adjust the core in L25 until about 8 volts peak is obtained at the grid of V9.

170. The trimmer C55 should then be adjusted to give zero beat. The total adjustment available is of the order of 50 c/s. and final adjustment may most conveniently be performed visually by watching the tuning indicator which will open and shut with the beat note if the sensitivity control is suitably adjusted.

171. Re-check the output voltage and if necessary repeat the above process.

Alignment of first heterodyne oscillator to scale

172. The first heterodyne must be aligned to the printed scale at two points in each band by means of the inductance and capacitance trimmers. Set the controls as follows :—

Sensitivity control	Maximum.
Guard switch	Off.
Noise limiter	Off.
A.V.C. switch .	Fast.
Selectivity switch .	5 kc/s C.W.
A/F. volume .	Adjusted to a convenient level.
Scale trimmer	Zero.

Range 11·3—20 *Mc/s*

173. Tune the receiver until 11·73 Mc/s appears in the centre of the escutcheon windows. Inject a signal of 11·73 Mc/s from a signal generator at the grid of V3. Adjust the core in L13 until a beat note is heard. Check that this is not the image frequency by tuning the signal generator to 12·93 Mc/s, where a signal should be heard.

174. If this is correct re-tune the receiver until 19·1 Mc/s appears in the centre of the escutcheon window. Adjust capacitive trimmer C27 until a beat note is heard. Check that this is not an image frequency by tuning the signal generator to 20·3 Mc/s, where a signal should be heard. If this is correct return to 11·73 Mc/s and repeat the process.

Other ranges

175. A similar procedure is adopted for the other ranges, the appropriate frequencies and trimming adjustments are shown in the table.

Range	*Frequency*	*Trimmer*	*Image check*
11·3—	11·73	L13	12·93
20	19·1	C27	20·3
6·4—	6·65	L14	7·85
11·3	10·8	C28	12·0
3·6—	3·74	L15	4·94
6·4	6·12	C29	7·32
2—	2·08	L16	3·28
3·6	3·47	C30	4·64

176. This procedure enables the first heterodyne oscillator to be aligned with sufficient accuracy to prevent any confusion with image signals when the receiver is calibrated.

Calibration of receiver

177. For calibration, the controls are set as follows :—

Sensitivity control	....	Maximum.
Selectivity control	...	5 kc/s C.W.
Guard switch ...	....	Off.
Limiter switch ..	....	Off.
A.V.C. switch .	....	Fast.
A/F volume control	....	Set to a convenient level.
Scale trimmer ..	....	Zero.

A suitable calibrator unit must be connected to the grid of V3.

Range 11·3 *to* 20·0 *Mc/s*

178. Switch the calibrator to 0·5 Mc/s harmonic sequence. Tune the receiver to 11·5 Mc/s on the scale, and adjust L13 until a beat note is heard. Only a small adjustment should be necessary as this point has already been aligned to signal generator accuracy.

179. Tune the receiver to 19·5 Mc/s on the scale and adjust C27 until a beat note is heard. Repeat these adjustments if necessary, then tune the receiver until the zero beat at the 20 Mc/s harmonic is heard, and mark the window opposite the 20 Mc/s calibration on the scale. Tune the receiver towards the low frequency end of the band and mark the windows at 0·5 Mc/s intervals on the scale each time zero beat is obtained.

Other ranges

180. A similar procedure is adopted on other ranges, the frequencies for alignment and the harmonic intervals being as follows :—

Range 6·4 *to* 11·3 *Mc/s*

(i) Switch calibrator to 0·5 Mc/s sequence.
(ii) Align L14 at 6·5 Mc/s.
(iii) Align C28 at 11·0 Mc/s.
(iv) Calibrate at 0·5 Mc/s intervals commencing at 11·0 Mc/s ending at 6·5 Mc/s.

Range 3·6 *to* 6·4 *Mc/s*

(i) Switch calibrator to 0·5 Mc/s sequence.
(ii) Align L15 at 4·0 Mc/s.
(iii) Align C29 at 6·0 Mc/s.
(vi) Switch calibrator to 200 kc/s output.
(v) Calibrate at 200 kc/s intervals commencing at 6·4 Mc/s. and finishing at 3·6 Mc/s.

Range 2 *to* 3·6 *Mc/s*

(i) Switch calibrator to 0·5 Mc/s sequence.
(ii) Align L16 at 2·0 Mc/s.
(iii) Align C30 at 3·5 Mc/s.
(iv) Switch calibrator to 100 kc/s sequence and commence calibration at 3·6 Mc/s finishing at 20 Mc/s.

181. The window may now be removed and a smooth curve marked through points on inside of window.

Alignment of radio frequency circuits

182. The alignment of the R/F section of the receiver follows normal practice. A special cable input from the signal generator should be used as it reduces signal generator leakage to a minimum. This consists of 3 ft. of uniradio 4 cable, terminated at the receiver end by a plug type 160. At the signal generator end, a 35-ohm non-inductive resistor is fitted, the outer end of this being connected to a plug or socket appropriate to the type of signal generator used. The resistor must be screened by a short length of copper tube, bonded to the signal generator plug or socket, and to the outer conductor of the uniradio cable.

183. The controls should be set as follows :—

Sensitivity control	..	Maximum.
A/F volume control	..	Adjusted to a convenient level.
Noise limiter switch	..	Off.
A.V.C. switch	.	Off.
Guard switch ..	.	Off.
Selectivity switch	..	5 kc/s R/T.
Scale trimmer ...	...	Zero.

Input modulated 400 c/s—30%.

184. The capacitance adjustments should be made first by setting the signal generator to the high frequency gang point and tuning the receiver to maximum output. The trimmer adjustments should be made in the following order.

(i) Mixer grid.
(ii) H/F anode.
(iii) Aerial coil.

The receiver and signal generator should then be tuned to the low frequency gang point and the inductance trimmers adjusted in the same order. This procedure should be repeated until optimum ganging is obtained. Particular care should be exercised at the high frequency end of the 11·3 to 20 Mc/s range as the adjustment of the trimmer tends to pull the oscillator frequency; successive adjustments should be made, rocking the main tuning control for maximum output during each adjustment.

185. The following table shows the ganging frequency and necessary adjustments for each band.

Range	*Frequency Mc/s*	*Adjust*		
		Grid	*Anode*	*Aerial*
11·3—20	19·13	C20	C16	C6
	11·73	L9	L5	L1
6·4—11·3	10·81	C21	C17	C7
	6·65	L10	L6	L2
3·6—6·4	6·12	C22	C18	C8
	3·74	L11	L7	L3
2—3·6	3·47	C23	C19	C9
	2·08	L12	L8	L4

Guard unit alignment

186. Very little trimming should be necessary in the guard units if the coils are adjusted accurately to the standard value before assembly, as there is no ganging involved. Set the controls as follows :—

R F sensitivity ..	Maximum.
A F volume control .	To a convenient level.
Selectivity	5 kc/s C.W.
Guard switch .	Guard only
A.V.C. switch	Off.
Noise Limiter	Off.
Guard sensitivity	Maximum.

Edition A (2 *to* 4·2 *Mc/s*)

187. The method of procedure is as follows :—

(i) Insert crystal of 3·6 Mc/s.
(ii) Insert guard unit.
(iii) Set frequency trimmer to +5 (fully clockwise).
(iv) Inject a signal of 4·2 Mc/s (unmodulated).
(v) Rotate oscillator trimmer until oscillations just commence.
(vi) Retune frequency trimmer to zero (this should vary the beat note).
(vii) Trim first and second R/F trimmers for maximum output.

The unit should then be lined up for this frequency. If oscillations do not commence as the oscillator trimmer is tuned, the oscillator coil L33 is probably too large and the core should be unscrewed slightly.

188. Some confusion may arise in trimming the R/F circuits as a false maximum appears as the second R/F is tuned through the oscillator frequency. The real maximum is very much larger and identification presents no difficulty when this point is appreciated.

189. The above sequence should be repeated at 2·0 Mc/s using a crystal of 2·6 Mc/s.

Edition B (4·1 *to* 7·5 *Mc/s*)

190. The procedure for Edition B (4·1 to 7·5 Mc/s) is identical with the above, the crystal frequencies being 4·7 and 6·9 Mc/s respectively.

Components

191. The following are the Air Ministry type and Stores Ref. numbe of the components mentioned in this volume which may need renewal. The information given here may be added to, or superseded by, Vol. II leaflets or by Vol. III.

Ref. No.	*Nomenclature*	*Qty.*	*Ref. in fig.* 32	*Details*
	List A — Main Components.			
10D/1525	Receiver, type R. 1475			Self-monitoring receiver
	Consisting of :—			
10B/2042	Brackets, fixing type 13	2		Brackets for rack mounting of receiver units type 88
15E/1349	Cable electric L.T. Dumet 19	12ft.		2-core V.I.R. 19 amps.
5E/1328	Cable electric L.T. Dumet 4	12ft.		2-core V.I.R. 4 amps
10D/2196	Case transit for receiver type R. 1475	1		To enclose three cases :— 10K/1958 - 10D/2530 – and 10Y/77
10K/1958	Case transit for power unit type 360	1		
10D/2530	Case transit for receiver units type 88	1		
10Y/77	Case transit type 77	1		For R.1475 accessories (Mountings, brackets, cabl plugs, etc.)
10A/17535	Mounting type 656	1		Tray for bench mounting of receiver units type 88
10A/17536	Mounting type 657	1		Tray for bench mounting of power units type 360
10D/2039	Panel, type 384	1		Rack mounting panel, 19in. drilled for mounting one, or two, power units, type 360
10H/324	Plug, type 195	3		4-pole without bracket
10H/10566	Plug, type 113	1		Coaxial, spring enclosed sleeve
10K/1260	Power unit, type 360	1		For components see List P.
10D/1541	Receiver unit, type 88	1		For components see List B.
10H/327	Socket, type 138	3		4-pole, back entry
10A/17537	Visor, type 28	1		Protecting grill for bench mounted receiver unit, type 88
10A/14846	Covers, type 241	6		For plugs and sockets
10B/1234	Insulator, type 400	6		For plugs and sockets
	List B — Receiver Unit type 88.			
10D/1541	Receiver unit, type 88			
	Consisting of :—			
10H/18209	Block terminal, type 152	1		
10D/2375	Brake assembly	1		
10D/2378	Can screening (valve) body	1		
10D/2379	Can screening (valve) top	1		
10A/13025	Cap valve, type 13	8		
10C/14733	Choke, HF, type 686	1	L39	Filament choke, 20 S.W.G.

List B — Receiver Unit type 88—*continued*

Ref. No.	*Nomenclature*	*Qty.*	*Ref. in fig.* 32	*Details*
10C/13680	Condenser, type 4487	1	C95, C96, C97, C98	Variable, 4-gang, 0-150 μμF. per section, with 3 mounting brackets, and cover plate
10C/4767	Condenser, type 2499	1	C4	500 μμF. ±20%, 350 volts D.C. working
10C/14734	Condenser, type 4940	4	C107—C110	·001 μF. ±10%, 500 volts D.C.
10D/2377	Contact assembly	1		Contact block, 9 short, and 2 long contacts
10D/2374	Countershaft assembly	1		
10A/19175	Dial, type 88	1		Moulded, black bakelite knob
10A/19167	Gear assembly, type 20	1		Condenser gear assembly
10H/18251	Holder valve, type 319	1		International octal
10D/2341	I/F units, type 38	1		See List C
10D/2340	I/F units, type 37	1		See List D
10C/14730	Inductance-condenser units, type 88	1		Two honeycomb coils and 1 condenser in cylindrical metal can (unit F)
	Including :—			
10C/5029	1 condenser, type 2699		C52	200 μμF. ±2%, 350 volts D.C. working
10C/14731	1 inductance, type 1201		L19	2 honeycomb coils, with adjustable iron core
10A/13025	1 cap valve, type 13			Top cap clip
10H/18577	1 plug, type 672			Two-pin plug (¼ in. centres)
10C/14732	Inductance unit, type 65	1	L30	Variable inductance unit
10H/1739	Jack, type 1	2		Telephone single circuit
10A/19157	Knob, type 467	1		
10A/19177	Knob, type 468	3		
5L/2080	Lamp filament 12 volts ·96 watts	4		Miniature Edison screw, clear
10A/19166	Lampholder, type 155	4		Miniature Edison screw
10A/19140	Mixer unit, type 11	1		See List E.
10V/591	Oscillator unit, type 170	1		See List F.
10V/592	Oscillator unit, type 171	1		See List G.
10D/2339	Output unit, type 45	1		See List H.
10H/324	Plug, type 195	1		4-pole without brackets
10H/18577	Plugs, type 672	9		2-pin plug
10F/16663	Relays unit type 117	1		4,000 ohms coil, 2 breaks, 2 changeovers
10W/6424	Resistance, type 6424			
	or	1	R64	10,000 ohms ± 5%, 7·5 watts.
10W/7044	Resistance, type 7044			10,000 ohms ±5%, 12 watts.
10W/16145	Resistance, type 4792			
	or	1	R65	6,500 ohms ±5%, 7·5 watts.
10W/16414	Resistance, type 4994			6,500 ohms ±5%, 12 watts.
10W/16144	Resistance, type 4791			
	or	1	R54	1,500 ohms ±5%, 7·5 watts.
10W/16061	Resistance, type 4718			1,500 ohms ±5%, 12 watts.
10W/15469	Resistance, type 4178			
	or	1	R25	5,000 ohms ±5% 7·5, watts.
10W/15608	Resistance, type 4304			5,000 ohms ±5%, 12 watts.
10W/1605	Resistance, type 1605	1	R6	22 ohms, ±10%, ½ watt.
10W/6322	Resistance, type 6322	1	R76	1 megohm ±20%, ½ watt.
10W/16147	Resistance, type 4794	1		2 meg ±10%, ½ watt., potentiometer

List B — Receiver Unit type 88—*continued*

Ref. No.	*Nomenclature*	*Qty.*	*Ref. in fig.* 32	*Details*
10W/16146	Resistance, type 4793	2	R82, R83	30,000 ohms ±10%, ¼ watt., potentiometer
10W/1889	Resistance, type 9/31	1	R5	1 meg ±20%, ¼ watt.
10W/996	Resistance, type 996	2	R69	2·2 meg ±20%, ¼ watt.
10W/689	Resistance, type 873	2	R50, R44	560 ohms ±10%, ¼ watt
10W/16134	Resistance-condenser unit, type 401	1		See List J
10H/18578	Sockets, type 627	8		10-way
10H/317	Sockets, type 138	2		4-pole, back entry
10H/185	Sockets, type 95	1		Co-axial screened aerial
10D/2376	Spindle and drum assembly	1		2 Double drum assemblies on spindle
10A/19174	Springs tension, type 99	1		
10D/2372	Switch operating mechanism for receiver units, type 88	2		6 positions, 22½° each position
10F/2721	Switches, type 1583	1		3-position, 1-way, wafer type
10F/2722	Switches, type 1584	1		3-position, 3-way, wafer type
10F/2723	Switches, type 1585	1		3-position, 3 pole wafer type
10D/2373	Thumb-lever, switch operating	1		
10AG/11	Tool, trimming, for condensers	1		Bakelite
10K/1841	Transformer, type 1852	1		Output transformer, unshrouded. Primary: 4640 turns of 44 S.W.G. enamelled copper Sec. 1—340 turns 44 S.W.G. enamelled copper Sec. 2—1,000 turns 44 S.W.G. enamelled copp tapped at 85 and 170 volts
10D/2000	Tuning unit, type 131	1		See List K
10D/2001	Tuning unit, type 132	1		See List L
10D/2338	Tuning unit, type 146	1		See List M
10D/2337	Tuning unit, type 145	1		See List N
10E/305	Valve VI. 103 (CV. 1103)	1		"Magic eye" tuning indicator
10E/11399	Valve VR. 53 (CV. 1053)	3		Variable-mu screened pentode, International octal base Top-cap grid
10E/348 } 11OE/68 }	Valve 6J5G (CV. 1932)	2		Triode. International octal base
10E/527	Valve ARTH2 (CV. 1347)	2		Triode-Hexode. International octal base. Top-cap grid
10E/ZA2985 } 10CV/216 }	Valve CV.216	1		Gas-filled voltage stabilizer 150 volts at 30 milliamps
10E/603 } 11OE/57 }	Valve 6Q7G (CV. 587)	3		Double-diode triode
10E/11400	Valve VR. 54 (CV. 1054)	1		Double-diode (separate cathodes). International octal base
10F/2494	Wafer, switch	1	S	Switch wafer 1-pole, 4-way, non-shorting

List C — I/F unit type 38

10D/2341	I F unit, type 38			Second I/F stage in metal screening can
	Consisting of:—			
10D/2399	Can screening	1		Rectangular
10D/2400	Can screening	1		Base of valve screening can

List C — I/F unit type 38—*continued*

Ref. No.	*Nomenclature*	*Qty.*	*Ref. in fig.* 32	*Details*
10C/11126	Condensers, type 3362	3	C53, C54, C56	0·1 μF. ±20%, 350 volts, D.C. working
10C/4702	Condensers, type 2473	3	C58, C59, C111	500μμF. +100% −0%, 250 volts D.C. working
10C/2147	Condenser, type 993	2	C60, C62	70 μ F. ±2%, 350 volts, D.C. working
10C/14803	Condenser, type 4978	2	C61, C63	130 μ F. ±2%, 350 volts, D.C. working
10C/16088	Condenser, type 5362	1	C57	0·5 μ F. ±25%, volts, D.C. working
10C/11123	Condenser, type 3359	1	C112	·01 μ F. ±25%, 1,000 volts, D.C. working
10C/16824	Inductance, type 1380	1	L22	
10C/16825	Inductance, type 1381	1	L23	
10H/18774	Plug, type 687	2		5-pole
10W/6321	Resistance, type 6321	1	R27	68,000 ohms ±10%, ½ watt.
10W/7736	Resistance, type 7736	1	R28	3,300 ohms ±20%, ½ watt.
10W/9601	Resistance, type 2852	1	R30	3,300 ohms ±5%, ½ watt.
10W/754	Resistance, type 892	2	R29, R32	560,000 ohms ±10%, ½ watt.
10W/6322	Resistance, type 6322	1	R31, R73	1 megohm ±20% ½ watt.
10W/8518	Resistance, type 2040	1	R34	56,000 ohms ±10%, ½ watt.
10H/18775	Sockets, type 646	2		2-pole ceramic

List D — I/F unit type 37

10D/2340	I/F units, type 37			First I/F stage in metal screening can
	Consisting of :—			
10D/2399	Can, screening	1		Rectangular
10D/2400	Can, screening	1		Base of valve screening can
10C/11126	Condenser, type 3362	3	C45, C46, C113	0·1 μ F. ±20%, 350 volts, D.C. working
10C/11123	Condenser, type 3359	2	C47, C49	·01 μ F. ±25% 1,000 volts D.C. working
10C/4423	Condenser, type 2289	1	C48	200 μμ F. ±2%, 350 volts D.C. working
10C/2147	Condenser, type 993	1	C50	70 μμ F. ±2%, 350 volts D.C. working
10C/14803	Condenser, type 4978	1	C51	130 μμ F. ±2% 350 volts D.C. working
10C/4171	Condenser, type 2127	1	C12	500 μμ F. ±15%, 250 volts D.C. working
10H/18251	Holders, valve, type 319	2		International octal. Ceramic, with silver-plated retaining ring
10C/16828	Inductance, type 1382	1	L20	
10C/16829	Inductance, type 1383	1	L21	
10H/18774	Plug, type 687	2		5-pole
10W/7736	Resistance, type 7736	2	R22, R23	3,300 ohms, ±20%, ½ watt.
10W/6840	Resistance, type 6840	1	R24	100,000 ohms ±20%, ½ watt.
10W/6322	Resistance, type 6322	2	R68, R72	1 megohm ±20%, ½ watt.
10W/754	Resistance, type 892	1	R70	560,000 ohms ±10%, ½ watt.
10H/18775	Socket, type 646	1		2-pole Ceramic

List E — Mixer unit, type 11

Ref. No.	*Nomenclature*	*Qty.*	*Ref. in fig.* 32	*Details*
10A/19140	Mixer unit, type 11			Mixer unit in metal screening can
	Consisting of:—			
10D/2399	Can, screening	1		Rectangular
10D/2400	Can, screening	2		Base of valve screening can
10C/4767	Condenser, type 2499	7	C31, C44, C64, C88, C114, C118, C119	500 μμ F. ±25%, 250V., D.C. working
10C/11126	Condenser, type 3362	5	C35, C36, C 37, C38, C122	0·1 μ F. ±20%, 350V., D.C. working
10C/11123	Condenser, type 3359	1	C39	0·01 μ F. ±25%, 1,000V., D.C. working
10C/11485	Condenser, type 536	1	C40	50 μμ F. ±%, 350V., D.C. working
10C/14802	Condenser, type 4977	1	C41	150 μμ F. ±2%, 350V., D.C. working
10C/2147	Condenser, type 993	1	C42	70 μμ F. ±2%, 350V., D.C. working
10C/14803	Condenser, type 4978	1	C43	130 μμ F. ±2%, 350V., D.C. working
10C/15097	Condenser, type 5110	1	C71	0·001 μF. ±10%, 350V., D.C. working
10H/18251	Holder valve, type 319	2		International octal Ceramic, with silver plated retaining ring
10C/16830	Inductance, type 1384	1		
10C/16839	Inductance, type 1385	1		
10H/18774	Plug, type 687	2		5-pole
10W/8265	Resistance, type 8265	1	R21	1,500 ohms ±20%, ¼ watt
10W/1870	Resistance, type 9/16	3	R12, R13, R55	3,300 ohms ±20% ¼ watt
10W/1955	Resistance, type 1955	2	R14, R17	10,000 ohms ±20% ¼ watt
10W/7736	Resistance, type 7736	1	R15	3,300 ohms ±20%, ½ watt
10W/993	Resistance, type 993	1	R16	10,000 ohms ±20%, ¼ watt
10W/1008	Resistance, type 1008	2	R18, R78	56,000 ohms ±10%, ¼ watt
10W/1998	Resistance, type 1998	1	R19	33,000 ohms ±20%, ¼ watt
10W/8885	Resistance, type 2305	1	R20	120,000 ohms ±20%, ¼ watt
10W/1078	Resistance, type 1078	1	R7	330 ohms ±10%, ¼ watt
10H/18775	Socket, type 646	1		2-pole, Ceramic

List F — Oscillator unit type 170

10V/591	Oscillator unit, type 170			Beat frequency heterodyne unit in metal screening can
	Consisting of:—			
10D/2399	Can, screening	1		Rectangular
10D/2400	Can, screening	1		Base of valve screening can
10C/14779	Condenser, type 4968	1	C55	3 to 30 μμF. (trimmer) variable air-spaced
10C/11126	Condenser, type 3362	3	C65 - C67	0·1 μF. ±20%, 350 volts D.C. working
10C/11123	Condenser, type 3359	1	C68	0·01 μF. ±25%, 1,000 volts, D.C.
10C/12311	Condenser, type 3857	2	C69, C70	100 μμF. ±10%, 350 volts, D.C.
10C/13138	Condenser, type 4230	1	C72	15 μμF. ±20%, 500 volts, D.C. working
10C/5649	Condenser, type 3074	1	C73	25 μμF. ±20%, 500 volts, D.C. working

List F — Oscillator unit type 170—*continued*

Ref. No.	*Nomenclature*	*Qty.*	*Ref. in fig.* 32	*Details*
10C/10552	Condenser, type	1	C75	50 μμF. ±20%, volts, D.C. working
10C/4423	Condenser, type 2289	1	C77	200 μμF. ±2%, 350 volts, D.C. working
10X/M/600	Crystal unit	1		
10H/18251	Holder, valve, type 319	2		International octal ceramic, with silver-plated retaining ring
10C/16832	Inductance, type 1386	1	L24	
10C/16833	Inductance, type 1387	1	L25	
10C/16834	Inductance, type 1388	1	L26	
10C/18774	Plug, type 687	2		5-pole
10W/6079	Resistance, type 6079	1	R35	10,000 ohms ±20%, ½ watt
10W/8885	Resistance, type 2305	1	R36	120,000 ohms ±10%, ¼ watt
10W/548	Resistance, type 811	1	R74	270,000 ohms ±10%, ¼ watt
10W/1867	Resistance, type 1867	1	R38	1,000 ohms ±20%, ¼ watt
10W/7466	Resistance, type 7466	2	R39, R40	2·2 megohm ±20%, ½ watt
10W/754	Resistance, type 892	1	R41	560,000 ohms ±10%, ½ watt
10W/6322	Resistance, type 6322	1	R42	1 megohm ±20%, ½ watt
10W/6081	Resistance, type 6081	1	R43	47,000 ohms ±20%, ½ watt
10H/18775	Socket, type 646	1		2-pole, Ceramic
)H/18778	Socket, type 647	1		For crystal holder

List G — Oscillator unit type 171

10V/592	Oscillator unit, type 171			Heterodyne oscillator unit in metal screening can
	Consisting of :—			
10D/2397	Can, screening	1		Rectangular
10D/2400	Can, screening	1		Base of valve screening can
10C/14779	Condenser, type 4968	4	C27—C30	3 – 30 μμF. (trimmer) variable air
10C/11126	Condenser, type 3362	2	C24, C99	0·1 μF. ±20%, 350 volts, D.C. working
10C/14799	Condenser, type 4974	1	C31	3,750 μμF. ±5%, 350 volts, D.C. working
10C/14800	Condenser, type 4975	1	C32	850 μμF. ±2%, 350 volts, D.C. working
10C/3198	Condenser, type 1553	1	C33	0·001 μF. ±2%, 350 volts, D.C. working
10C/14801	Condenser, type 4976	2	C25, C26	15 μμF. ±5%, 350 volts, D.C. working
10C/4767	Condenser, type 2499	1	C34	500 μμF. ±25%, 250 volts, D.C. working
10H/18251	Holder, valve, type 319	1		International octal. Ceramic with silver-plated retaining ring
10C/14790	Inductance, type 1208	1	L13	
)C/14791	Inductance, type 1209	1	L14	
0C/14792	Inductance, type 1210	1	L15	
10C/14793	Inductance, type 1211	1	L16	
10H/18774	Plug, type 687	2		5-pole
10W/1008	Resistance, type 1008	1	R11	56,000 ohms ±10%, ¼ watt
10W/1867	Resistance, type 1867	2	R53, R77	1,000 ohms ±20%, ¼ watt

List G —Oscillator unit type 171—*continued*

Ref. No.	*Nomenclature*	*Qty.*	*Ref. in fig.* 32	*Details*
10H/18775	Socket, type 646	2		2-pole, Ceramic
10A/19201	Tag boards, type 599	1		With 9 tags
10D/2401	Thermal compensator for R. 1475	1	C115	Temperature drift compensator.
			L30A	Bi-metal strip, thermally-variable capacitance.
10F/2513	Wafer switch	1		Ceramic, 4-position, 2-pole, one shorting, one non-shorting
10F/2514	Wafer switch	1		4-position, 2-pole, non-shorting

List H — Output unit type 45

Ref. No.	*Nomenclature*	*Qty.*	*Ref. in fig.* 32	*Details*
10D/2339	Output unit, type 45			Output unit in metal screening can
	Consisting of —			
10D/2399	Can, screening	1		Rectangular
10D/2400	Can, screening	1		Base of valve screening can
10C/16826	Choke, L/F, type 694	1	L27	
10C/16827	Choke, L/F, type 695	1	L28	
10C/4237	Condenser, type 2182	2	C78, C85	500 μμ F. ±5%, 350 volts D.C. working
10C/14804	Condenser, type 4979	2	C80, C82	700 μμ F. ±2%, 250 volts D.C. working
10C/12079	Condenser, type 3752	1	C86	150 μμ F. ±5%, 350 volts D.C. working
10C/14805	Condenser, type 4980	2	C81, C83	800 μμ F. ±2%, 350 volts D.C. working
10C/11124	Condenser, type 3360	1	C84	·02 μ F. ±20%, 750 volts D.C. working
10C/16889	Condenser, type 6001	1	C79	0·5 μ F. ±25%, 350 volts, D.C. working
10C/14868	Condenser, type 4996	2	C123, C124	470μμF. ±2%, 350 volts D.C. working
10C/17513	Condenser, type 6068	2	C125, C126	330μμF. ±2%, 350 volts D.C. working
10H/18251	Holder valve, type 319	2		International octal, Ceramic, silver plated retaining ring
10H/18774	Plug, type 687	2		5-pole
10W/8828	Resistance, type 2259	1	R26	330,000 ohms ±20%, ¼ watt
10W/1106	Resistance, type 1106	1	R44	560 ohms ±10%, ½ watt
10W/130	Resistance, type 598	1	R45	1 megohm ±10%, ½ watt
10W/1879	Resistance, type	1	R46	22,000 ohms ±20%
10W/749	Resistance, type 887	1	R47	120,000 ohms ±10%, ½ watt
10W/1842	Resistance, type 852	1	R48	150 ohms ±10%, ½ watt
10W/589	Resistance, type 827	1	R49	270,000 ohms ±10%, ½ watt

List J — Resistance condenser unit type 401

Ref. No.	*Nomenclature*	*Qty.*	*Ref. in fig.* 32	*Details*
10W/16134	Resistance condenser unit, type 401			Assembly on bakelite board
	Consisting of:—			
10C/11123	Condenser, type 3359	1	C100	·01 μ F. ±25%, 1,000 volts, D.C. working
10W/6322	Resistance, type 6322	2	R58, R59	1 megohm, ±20%, ½ watt
10W/1006	Resistance, type 1006	1	R62	27,000 ohms, ±5%, ½ watt

List J — Resistance condenser unit type 401—*continued*

Ref. No.	*Nomenclature*	*Qty.*	*Ref. in fig.* 32	*Details*
10W/8973	Resistance, type 2362	1	R61	560,000 ohms, ±5%, ¼ watt
10W/754	Resistance, type 892	1	R60	560,000 ohms, ±10%, ½ watt
10W/9139	Resistance, type 2491	1	R52	220,000 ohms, ±5%, ½ watt
10W/7466	Resistance, type 7466	1	R75	2·2 mehogms, ±20%, ½ watt
10W/8518	Resistance, type 2040	1	R56	56,000 ohms, ±10%, ½ watt
10W/300	Resistance, type 726	1	R57	33,000 ohms, ±10%, ½ watt
10W/11683	Resistance, type 517	1	R51	15,000 ohms, ±10%, ½ watt
10A/19143	Tag board, type 574	1		With 22 tags

List K — Tuning unit type 131

10D/2000	Tuning unit, type 131			Guard frequency unit (low)
	Consisting of:—			
10C/3066	Condenser, type 1476	3	C90, C91, C92	4·8 — 100 μμ F. variable with screwdriver slot
'0C/3294	Condenser, type 1605	1	C93	3·3 — 100 μμ F. variable with screwdriver slot
'C/4767	Condenser, type 2499	1	C15	·0005 μ F. ±25%, 250 volts D.C. working
C/973	Condenser, type 910	1	C89	15 μμ F. ±10%, 500 volts D.C. working
10C/11746	Condenser, type 3577	1	C120	1 μμ F. ±20%, 500 volts D.C. working
10H/18254	Holder crystal, type 51	1		2-pole with 2 sockets
10XG/	Crystal unit, type	1		
10C/14836	Inductance, type 1232	1		
10C/14837	Inductance, type 1233	1		
10C/14838	Inductance, type 1234	1		
10A/19206	Knob, type 470	1		
10W/993	Resistance, type 993	1		100,000 ohms, ± 20%, ¼ watt

List L — Tuning unit type 132

10D/2001	Tuning unit, type 132			Guard frequency unit (medium-high)
	Consisting of:—			
10C/3066	Condenser, type 1476	3	C102, C103, C104	4·8 — 100 μμ F. variable, with screwdriver slot
10C/3294	Condenser, type 1605	1	C105	3·3 — 25 μμ F. variable, with screwdriver slot
10C/4767	Condenser, type 2499	1	C101	·0005 μ F. ±25%, 250 volts D.C. working
10C/978	Condenser, type 910	1	C106	15 μμ F. ±10%, 500 volts D.C. working
10C/5649	Condenser, type 3074	1	C117	25 μμ F. ±20%, 500 V D.C. working
'OH/18254	Holder crystal, type 51	1		With 2 sockets
JXC/	Crystal unit, type	1		
10C/14786	Inductance, type 1205	1		
10C/14787	Inductance, type 1206	1		
10C/14788	Inductance, type 1207	1		
10A/19206	Knob, type 470			
10W/993	Resistance, type 993	1		

List M — Tuning unit type 146

Ref. No.	Nomenclature	Qty.	Ref. in fig. 32	Details
10D/2338	Tuning unit, type 146			H/F amplifier band pass unit in metal screening can
	Consisting of:—			
10D/2397	Can, screening	1		Rectangular
10D/2400	Can, screening	1		Base of valve screening can
10C/14779	Condenser, type 4968	8	C16 – C23	4·5 to 30 μμF. (trimmer) variable air-spaced
10C/4702	Condenser, type	1	C128	500 μμF.
10C/14809	Condenser, type 4981	1	C13	4 μμF. ±20%, 500 volts, D.C. working
10C/13138	Condenser, type 4230	2	C14, C129	15 μμF. ±20%, 500 volts, D.C. working
10C/12062	Condenser, type 3738	1	C121	10 μμF. ±20%, 500 volts, D.C. working
10C/11126	Condenser, type 3362	3	C10, C11, C94	0·1 μF. ±20%, 350 volts, D.C. working
10H/18251	Holder valve, type 319	1		International octal. Ceramic, with silver-plated retaining ring
10C/14806	Inductance, type 1217	1	L5	
10C/14807	Inductance, type 1218	1	L6	
10C/14808	Inductance, type 1219	1	L7	
10C/14794	Inductance, type 1212	1	L8	
10C/14795	Inductance, type 1213	1	L9	
10C/14796	Inductance, type 1214	1	L10	
10C/14797	Inductance, type 1215	1	L11	
10C/14798	Inductance, type 1216	1	L12	
10C/	Inductance, type	1	L32	Short-wave choke
10H/18774	Plug, type 687	2		5-pole
10W/7736	Resistance, type 7736	2	R8, R9	3,300 ohms ±20%, ½ watt
10H/18775	Socket, type 646	2		2-pole, Ceramic
10A/19201	Tag boards, type 599	1		With 9 tags
10F/2511	Wafer, switch	1		4-position, 2-pole, 1 shorting, one non-shorting
10F/2512	Wafer switch	1		4-position, single-pole shorting

List N — Tuning unit type 145

Ref. No.	Nomenclature	Qty.	Ref. in fig. 32	Details
10C/2337	Tuning unit, type 145			Aerial tuning unit in metal screenng can
	Consisting of:—			
10D/2397	Can, screening	1		Rectangular
10C/14494	Condenser, type 4814	3	C1, C2, C87	·01 μF. ±25%, 1,000 volts, D.C. working
10C/12062	Condenser, type 3738	1	C5	10 μμF. ±20%, 500 volts, working
10C/14779	Condenser, type 4968	4	C6, C7, C8, C9	3 to 30 μμF. (trimmer) variable air-spaced
10H/18251	Holder valve, type 319	1		International octal. Ceramic, with silver-plated retaining ring
10C/14810	Inductance, type 1220	1	L1	
10C/14811	Inductance, type 1221	1	L2	

List N — Tuning unit type 145—*continued*

Ref. No.	*Nomenclature*	*Qty.*	*Ref. in fig.* 32	*Details*
10C/14812	Inductance, type 1222	1	L3	
10C/14813	Inductance, type 1223	1	L4	
10H/18774	Plug, type 687	2		5-pole
10W/6079	Resistance, type 6079	2	R1, R2	10,000 ohms ±20%, ½ watt
10W/993	Resistance, type 993	3	R3, R4, R10	100,000 ohms ±20%, ¼ watt
10H/18775	Socket, type 646	2		2-pole Ceramic
10A/19201	Tag boards, type 599	1		With 9 tags
10F/2509	Wafer switch	1		4-position, 2-pole, non-shorting
10F/2510	Wafer switch	1		4-position, single-pole, shorting

List P — Power unit type 360

10K/1260	Power unit, type 360		Fig. 30	Power unit for receivers, type R. 1475 (AC/DC)
	Consisting of :—			
A/19165	Caps, lamp, type 57	1		For lampholder, type 154 (Red)
10C/14727	Choke, L/F, type 580	1	L1	1½in. D.C. resistance, 90 ohms
10C/14708	Condenser, type 4934	3	C1, C2, C3	8 μF. ±20%, 400 volts, D.C. working
10C/14449	Condenser, type 4784	1	C4	2 μF. ±20%, 250 volts, D.C. working
10P/13119	Filter unit, type 141	1		See List Q
10H/18207	Fuse, type 143	1		20 amp., 1¼in. long × ¼in. dia., glass enclosed, cartridge type
10H/180	Fuse, type 28	1		3 amp., 1¼in. long × ¼in. dia., glass enclosed, cartridge type. White
10H/376	Holder, fuse, type 13	2		Panel mounting, 1-hole fixing
10A/19157	Knob, type 467	1		
5L/2068	Lamps filament, 6·2 volt, 0·3 amp, M.E.S.	1		Miniature edison screw
10A/13419	Lampholder, type 71	1		Miniature edison screw holder for panel indicator light
10H/324	Plug, type 195	2		Complete with contacts and tags (4-pole)
10D/2347	Rectifier unit, type 4	1		4 metal rectifiers, 2 chokes and 1 condenser
	including :—			
10D/2348	4 Rectifiers, metal, type 237			Half-wave, selenium, 70 milliamps, D.C., 14·4 A.C. volts per disc, 20 discs.
10C/14728	2 Chokes, L/F, type 581		L9, L10	Low frequency choke. D.C. resistance 90 ohms
[illegible]/11130	1 Condenser, type 3366		C14	0·5 μF. ±15%, 50 volts, D.C., working
W/589	Resistance, type 827	1	R1	270,000 ohms ±10%, ½ watt
W/8518	Resistance, type 2040	1	R2	56,000 ohms ±10%, ½ watt
10H/327	Socket, type 138	2		4-pole, complete with contacts and tags
10F/2492	Switch, type 1509	1		Rotary 6 bank multi-way
[illegible]/2258	Transformer, type 2112	1		Power transformer :— Input 0–10–200, /220, /240 volts

List Q — Filter unit type 141

Ref. No.	*Nomenclature*	*Qty.*	*Ref. in fig. 32*	*Details*
10P/13119	Filter unit, type 141		Fig. 29	Vibrator and filter unit, in metal screening can
	Consisting of :—			
10C/14714	Chokes, H/F, type 683	2	L3, L4	Pile-wound
10C/14715	Chokes, H/F, type 684	1	L5	1,100 microhenries ± 10%
10C/14716	Chokes, H/F, type 685	3	L6, L7, L8	
10C/	Condenser, type	5	C5, C6, C7, C11, C12	0·5 μF. ± 20%, 50 volts, D.C., working
10C/11126	Condenser, type 3362	1	C13	0·1 μF. ± 20%, 350 volts, D.C., working
10C/12407	Condenser, type 3927	3	C8, C9, C10	0·01 μF. ± 100%, 350 volts, D.C., working
10H/2727	Holder, valve, type 228	1		4-pin Ceramic, Standard American
10K/	Vibrator, type	1		12 volt, non-synchronous 105 cycles per second, in cylindrical metal can, with 4-pin American valve base