

WIRELESS SET NO. 19, MK. III

SECOND TO FOURTH ECHELON WORK

MECHANICAL REPLACEMENTS AND ADJUSTMENTS

Relays S5A and B

1. (a) To lift the relays up for inspection, undo the two nuts and the screw fixing the bracket to the chassis.
- (b) To remove a relay from the set, undo bracket as described in (a) above, undo the two screws fixing relay to bracket, and unsolder connections. Details of connections are given in Tels. F 253/3 table 5 and fig. 3.
- (c) To change a solenoid, undo bracket as described in (a) above, undo screw fixing armature to relay and remove armature, undo nut fixing solenoid to relay, and unsolder wires from solenoid.

Specification of relay

2. Buffer pressure	16-20 grammes
Lever spring pressure	5-8 "
Contact clearance	20 mils
Travel (armature)	31 "
Residual	4 "
Operating current	38 mA
Saturation current	90 "
Resistance of solenoid	100 ± 5 ohms

Wavechange switch

3. To withdraw the spindle, first remove the cover plate from the front panel, then undo the two screws fixing the click plate to the sender R.F. screening box. When replacing, be careful to replace the bakelite washer between the switch wafer and the spindle earthing spring in the screening box, and also to replace the click plate distance pieces on the fixing screws the correct way round. If a switch wafer has been replaced, be careful to line it up so that the spindle slides in easily. Details of switch and coil connections are shown in Tels. F 253/3 fig 5.

Removal of R.F. coils

4. (a) Sender R.F. coils L7 and L21:—Remove wave-change switch cover plate from front panel and remove spindle. Single fixing screw for each coil is then accessible.
- (b) Sender drive coil L4:—Loosen C16A and twist it round to obtain access to single screw fixing L4.
- (c) Oscillator coil L24:—When replacing this with a new coil, make sure that C8A is 5000 pF; if it is 3200 pF, change it to 5000 pF. Condenser section C9B may then require adjustment. This is likely to be necessary only on sets with PC serial numbers below 52566. See D.M.E. Modification Circular (Wireless) T/W62.

System switch S7A

5. If it should be necessary to change a wafer or to remove the switch for inspection or replacement, V4A valve holder plate assembly must first be shifted. Disconnect the short leads from the assembly, undo the two screws at the corners of the plate, and swing the assembly clear, leaving the long leads attached. Undo the switch from the panel, unsolder all accessible connections, and it can then be twisted round so that the other connections can be progressively unsoldered. It is not necessary to remove the front panel from the chassis. Details of the switch connections are given in Tels. F 253/3 table 6 and fig. 4.

Removal of gang condenser assembly

6. (a) Remove index brackets by undoing four 6BA screws.
- (b) Remove slow motion drive by removing knobs and undoing one 4BA screw at L.H. side of drive.
- (c) Undo the centre fixing bolt of the dial knob.
- (d) Loosen grub screw in side of dial knob.
- (e) Remove dial knob and dial.
- (f) Undo the centre fixing screw of the flick lever, loosen grub screw in the hub and remove flick lever.
- (g) Undo the 6BA fixing screws in the dial stops (these go right through the front panel into the gang box).
- (h) Undo screen at rear of gang box.
- (i) Loosen nuts holding 2nd I.F.T. (L8B) so that it can be swung back.
- (j) Disconnect leads from P.A. coil and from A.V.C. line to 3-way tag plate in gang box.
- (k) Remove two screws at base of gang (front end, top of chassis).
- (l) Unsolder four gang connections under chassis.
- (m) Unsolder gang earth connections.
- (n) Remove four screws holding gang to chassis (under chassis).
- (o) If necessary, loosen screws in sender R.F. screening box, which project through chassis into gang box.
- (p) Remove gang.

When replacing gang, the sequence of operations is reversed.

See also D.M.E. Modification Circular (Wireless) T/W58.

Replacement of flick indicators on tuning condensers

7. (a) Turn flick lever to "flick," and rotate dial to position where faulty indicator should drop.

- (b) Unhook spiral spring from indicator, and keep it in place by rubber band or piece of string, etc., stretched between its hook and any convenient projection in the set.
- (c) Remove the flat flick spring which lifts the indicator.
- (d) Unhook the faulty indicator and remove it, bending it as necessary to do so.
- (e) If the new indicator to be fitted is of the old type having a similar skirt on each side, carefully cut off that on the rear side, being very careful not to bend the indicator.
- (f) Carefully fit the new indicator into place and hook it round the bearing rod, avoiding bending it.
- (g) Replace flat spring and its fixing screws.
- (h) Hook the spiral spring into the hole in the indicator, making sure that the bend in the spring rests in the notch adjacent to the hole in the indicator.
- (i) If both indicators on a condenser require replacement, change them one at a time by the above method.
- (j) If the rivetting of the bearing rod becomes loose, the rod may be soldered directly to the back plate.

Gang condenser capacity

8. Tolerances are $\pm 1\%$ or $\frac{1}{2}$ pF, whichever is the greater. 180° is the position of maximum capacity. Capacity law is as follows:—

Degrees	Capacity (pF)
0	0
20	20.5
60	98.8
100	211.0
140	364.0
180	532.0

Removal of front panel

9. This is seldom necessary, and should be avoided whenever possible, owing to the amount of work involved. If it is essential to shift the panel to gain access to something behind it, it is frequently unnecessary to disconnect the leads from the 12-point plugs, as the cables are long enough to allow the panel a fair amount of movement about its left-hand end.

TEST AND ALIGNMENT PROCEDURE**General**

10. The tests described below give all the details necessary for the complete alignment and specification testing of the set. When making repairs, it will not normally be necessary to carry out all of them, and only those applicable to the job in hand should be performed. Do not re-adjust any circuits unless they fail to pass the tests or unless repair work has been done on them. Except where otherwise stated, the L.T. input should be maintained at 12 volts.

Test gear required

11. Signal generator, no. 1 (Marconi type TF144).
Meter, output, power, no. 3 (Marconi type TF340), or no. 2, Mk. I (Furzehill 3-range).
Calibrator, crystal, no. 1, 2 or 3, or
Wavemeter, class C or D.
Wavemeter, no. 4 (20 to 300 Mc/s).
Signal generator, no. 2, Mk. IV (16 to 150 Mc/s).
Voltmeter, valve, U.H.F., no. 1.
Oscillator, beat frequency, no. 1, Mk. II (Furzehill).
Universal Avometer, type 7, 46 range.
Ammeter, R.F., 0-1 amp., or
Voltmeter, valve, 150 volt, no. 1 or 2 (Marconi type T.F.428A/2).
Dummy aerials (paras. 20, 31, 44 and 51), potential dividers and matching networks, as detailed in text.

"IC" AMPLIFIER**Connections**

12. B.F.O. via potential divider, detailed in fig. 1, to pin 3 of 12-point plug PL2A. Output meter to pin 6 of plug PL2A, return to chassis. The correct output load is 40Ω , and if a 150Ω output meter is used, the matching network detailed in fig. 2(a) must be inserted. Switch "IC" on, "A" and "B" off.

Sensitivity (para. 64)

13. Check the input voltage at 400 c/s to give 50 mW output at 12 volts and at 10.5 volts L.T. input.

Stability (see also para. 92)

14. Check that the output is negligible (i.e. less than 1mW) with no A.F. input. Repeat with 15 volts L.T. input.

Fidelity (para. 64)

15. Adjust input for 50mW output at 400 c/s. Measure output at 150 c/s and 5000 c/s.

"B" SET RECEIVER

16. Switch "B" on, "A" and "IC" off.

Quench oscillator frequency range (para. 65)

17. Connect signal generator direct terminal via $0.1\mu\text{F}$ condenser to grid (right-hand top cap viewed from front of set) of V7A. Set signal generator frequency to approx. 160 Kc/s, screw quench adjuster fully in, and adjust signal generator frequency and output until a beat note is heard. Tune signal generator to zero beat, and read frequency. Next, screw quench adjuster fully out and repeat test at approx. 225 Kc/s. The two frequency readings obtained give the quench tuning range.

Calibration of U.H.F. tuned circuit (para. 65)

18. Couple "B" aerial to set with a standard aerial feeder no. 2 and switch set to send. Couple wavemeter to "B" aerial, and set it to 235 Mc/s. If the sender frequency is out of limits, adjust coil L11A so that the frequency is exactly 235 Mc/s with the "B" tuning dial at division 5, and the lid on the screening box. If sufficient adjustment cannot readily be obtained by closing or opening the turns of L11A, further adjustment is available by unsoldering the joints and raising or lowering it on the condenser tags, thus effectively lengthening or shortening the coil leads. Remember, also, that changing V7A or moving its grid and anode leads will also affect the tuning. After completing adjustment, switch set back to receive.

Receiver sensitivity (para. 65)

19. No signal generator is available for 235 Mc/s, but a comparative check can be made against a known good set by measuring the input for 50 mW output, using the second harmonic of 117.5 Mc/s from signal generator no. 2, Mk. IV. If this is not available either, then the set may be assumed O.K. if it passes its other tests on receive and send and if it gives satisfactory reception from another "B" set.

Connections

20. (a) **Dummy aerial**:—This should be made up in a screening can about 2" long \times 1½" dia., having at one end an aerial plug for attaching an aerial feeder and at the other end suitable means for attaching direct to the signal generator. Inside it are two resistances arranged so that stray capacities are as low as possible, 2 K Ω (or 2.2 K Ω) ¼ watt ceramic connected between the high potential input and output points, and 100 Ω ¼ watt ceramic connected directly across the signal generator connections.
- (b) Attach dummy aerial directly to signal generator. Connect a standard aerial feeder no. 2 from dummy aerial to "B" aerial plug on set.
- (c) Take output from pin 5 of 12-point plug PL2A to 100 Ω output meter. If 150 Ω output meter is used, insert matching network shown in fig. 2(b).

Maximum output

21. With large R.F. input modulated 30%, check that output is at least 100 mW.

Noise

22. Check that noise output (hiss), with no signal input, is normal.

Microphony

23. With a large unmodulated R.F. input, tap the chassis hard to test for undue microphony or other noises. If present, it is usually due to V7A, and occasionally to VID.

Low voltage test (see also para. 93)

24. With 11 volts L.T. input to power supply unit, and "A" and "IC" switched on (allow time to warm up), and aerial plug connected in turn through aerial feeders no. 2 and no. 3 to a standard aerial base and rod; check that the set oscillates normally over the whole tuning range (aural test by hiss). Switch off "A" and "IC," and return L.T. input to 12 volts.

"B" SET SENDER**Connections**

25. (a) Connect voltmeter, valve, U.H.F., no. 1, through standard aerial feeder no. 2 to "B" aerial plug.
- (b) Connect B.F.O. to pin 2 of PL2A through potential divider (fig. 1).
- (c) Connect output meter as described in para. 20(c).

R.F. output (para. 66)

26. Check diode current of valve voltmeter over tuning range, with unmodulated output from sender. Check rise in diode current with modulation from B.F.O.

Microphone amplifier sensitivity (para. 66)

27. Check input at 400 c/s from B.F.O. to give 50 mW output.

Stability (see also para. 92)

28. Check that A.F. output is negligible (i.e. less than 1 mW) with no A.F. input.

Fidelity (para. 66)

29. Adjust B.F.O. input for 50 mW output at 400 c/s. Measure output at 150 c/s and 5000 c/s.

"A" SET RECEIVER**A.F. amplifier** (para. 67)

30. (a) **Connections**.—Input from B.F.O. through 0.1 μ F condenser to junction of C17A, R1B and R7C; return to chassis. Output from pin 4 of PL2A to 100 Ω output meter (if 150 Ω output meter is used, insert matching network shown in fig. 2(b)). Switch "A" on, "B" and "IC" off. Set A.F. gain control to maximum.
- (b) **RT position of system switch**.—Check sensitivity at 50 mW output at 400 c/s. Keep input constant at this value for remainder of tests. Check output at 150 c/s and 5000 c/s.
- (c) **MCW position of system switch**.—Check output at 150, 400 and 5000 c/s.
- (d) **CW position of system switch**.—Tune B.F.O. for maximum output from set. Check value of this frequency (approx. 1000 c/s). Check output at this frequency (F), at $F \pm 200$ c/s and at $F \pm 500$ c/s.

I.F. amplifier (para. 68)

31. (a) **Connections**.—Input from signal generator directly between F.C. grid (V2A) and chassis, the normal grid lead being removed. A 0.1 μ F condenser shunted by a 100 K Ω resistance (or suitable alternatives), enclosed in a screening can, should be inserted in the lead to the grid. Output connection as in para. 30(a). Switch to RT. Set R.F. and A.F. gain controls for maximum gain. Set frequency dial and switch to 8 Mc/s.
- (b) **Frequency**.—Check that the resonant frequency (i.e. that at which maximum output occurs) is within ± 2 Kc/s of 465 Kc/s. Do this with input adjusted to give 50 mW output.
- (c) **Sensitivity**.—Check the sensitivity at 50 mW output.
- (d) **Bandwidth**.—Increase input 10 times. Detune signal generator first to one side then to the other, in each case until the output falls to 50 mW. Note the two frequencies at which this occurs. The difference between them gives the bandwidth. The mean of these two frequencies must not differ from the resonant frequency by more than the specified limit (symmetry test). (See also para. 95.) Make similar measurements of bandwidth with input increased 2 and 1000 times, but not checking symmetry.
- (e) **Alignment**.—If the set fails to pass any test in (b), (c) or (d), tune the 6 I.F. circuits for maximum output at 465 Kc/s, starting with the secondary of the 3rd I.F.T. and working back to the primary of the 1st I.F.T. Repeat this procedure. The I.F. response curve should be single-peaked and reasonably symmetrical. The primaries of the I.F.Ts. are nearest the chassis. Repeat tests (c) and (d).

Beat frequency oscillator (para. 69)

32. With system switch at RT, switch to "net," and adjust the B.F.O. coil for zero beat note with an unmodulated signal input of about $100\mu\text{V}$ at the peak I.F.

Heterodyne tone control (para. 70)

33. Switch off "net", switch to CW, and rotate heterodyne tone control. Beat note should vary from zero on the index line to about 3,000 c/s maximum on either side. Change of note should be reasonably smooth.

Dial index brackets and stops

34. Make sure that these are set correctly before proceeding with the next stage. With dial stops slackened, turn variable condensers to maximum capacity (vanes flush). Adjust index brackets so that the lines correspond exactly with the index marks on the scales, and fix them in this position. Then fix stops correctly: these should be pushed down as far as possible without restricting the movement of the condensers over the calibrated portions of the dials (i.e. between 2 and 8 Mc/s), but must in any case engage before the condenser plates themselves act as stops.

Adjustment of master oscillator circuit

35. Connections as in para. 31(a). Check calibration at 8, 7, 6, 5 and 4.5 Mc/s. If out of limits, apply 8 Mc/s signal (about 50 to $100\mu\text{V}$) and set frequency dial of set to 8 Mc/s and wavechange switch to H.F. band. Tune in signal on C35A. Adjust L24A at 5 Mc/s if necessary. Re-adjust C35A at 8 Mc/s, and re-check calibration over band. If the coil is adjusted, seal it with thin coil dope (e.g. British Celanese no. 202). Switch to L.F. band. Check calibration at 4.5, 4, 3.5, 3, 2.5 and 2 Mc/s. If out of limits, trim C10G at 4.5 Mc/s. Pad with C11A at 2.5 Mc/s. If necessary, adjust coil L24C and re-adjust C11A and C10G until calibration is correct. If L24C is adjusted, seal as above.

Note.—If a crystal calibrator is available, it should be used as a frequency standard for setting up the signal generator.

Calibration limits (para. 71)

36. The maximum error at all frequencies is ± 25 Kc/s. It will usually be advisable to adjust much more closely than this in order to maintain sufficiently good tracking with the sender drive circuits, but, before spending a lot of time in striving for extreme accuracy, it will pay to check the drive circuits first and make a careful analysis to find what adjustments will give the desired results with the least amount of work (see para. 103).

Adjustment of R.F. amplifier

Connections

37. Connect signal generator between R.F. grid (V1A) and chassis as in para. 31(a). Output connection as in para. 30(x). Connect a damping shunt of $20\text{ K}\Omega$ in series with a $0.1\mu\text{F}$ condenser between 1st I.F. grid (V1B) and chassis.

Trimming

38. Switch to H.F. band. Tune in a signal at 8 Mc/s and adjust C10A for maximum output. Check trimming on a signal at 5 Mc/s and, if necessary, adjust coil L22A for correct tracking. Re-adjust C10A at 8 Mc/s. (*Note.*—This and all subsequent checks on tracking must be made with a base cover held against the bottom of the chassis.)

Switch to L.F. band. Trim C10D at 4.5 Mc/s. Adjust coil L23A at 2.5 Mc/s if necessary, re-adjusting C10D at 4.5 Mc/s. If either coil is adjusted, it should be re-sealed with a little wax.

Sensitivity (para. 72)

39. Tune in, using the netting switch. Check sensitivity at 8, 6 and 5 Mc/s on the H.F. band, and at 4.5, 3 and 2 Mc/s on the L.F. band.

Stability

40. Remove input connection and damping shunt. Connect a pair of headphones in place of the output meter to pin 4 of PL2A. Increase L.T. input to 15 volts at power supply unit. Check that receiver remains stable at all frequencies with P.A. circuit in tune. Re-check with $100,000\mu\text{V}$ input, unmodulated, at 6 Mc/s, to aerial plug. Reduce L.T. input to 12 volts and replace output meter.

A.V.C. characteristic (para. 73)

41. Apply $100,000\mu\text{V}$ at 6 Mc/s, with 30% modulation, to aerial plug. Tune in carefully, using A.V.C. meter. Reduce A.F. gain to give an output of 50 mW. Reduce input to $100\mu\text{V}$, and check drop in output.

R.F. gain control (para. 74)

42. Check for smooth operation and measure sensitivity of set from aerial plug at 6 Mc/s with control at half-way and minimum gain positions.

Audio output on CW (para. 75)

43. Switch to CW. Tune in an unmodulated signal at 6 Mc/s, applied to the aerial plug, and tune to zero beat with het. tone control at zero mark. Set A.F. gain control to maximum, and adjust R.F. gain and het. tone controls for maximum output. Check value of this output on output meter with het. tone control adjusted first on L.H. and then on R.H. side of zero. Do this in turn with $1\mu\text{V}$, $100\mu\text{V}$ and $100,000\mu\text{V}$ input. If the set fails to pass this test, see para. 96 for action to be taken. When controls are adjusted, at $1\mu\text{V}$ input only, switch off signal generator and measure noise output.

Second channel ratio (para. 76)

44. Connect signal generator to aerial plug via 70Ω non-inductive resistance. At each of the frequencies given in para. 76, tune the set to the generator and, with an input of $10\mu\text{V}$ modulated 30% at 400 c/s, adjust the A.F. gain control for an output of 50 mW. Then tune the generator to the second channel frequency (930 Kc/s higher) and increase its output to the value shown in para. 76. In each case the output from the set must not be more than 50 mW.

Signal/noise ratio (para. 77)

45. Connect signal generator to aerial plug via 70Ω non-inductive resistance and adjust it successively to the frequencies and outputs given in para. 77. With R.F. gain at maximum and system switch on RT, adjust frequency and P.A. controls on set for maximum output. Adjust A.F. gain to give 50 mW output. Switch off modulation and read residual noise on output meter. This must not exceed 0.5 mW at any frequency.

Overall fidelity (para. 78)

46. Modulate signal generator externally from B.F.O. Connect signal generator to aerial plug via 70Ω non-inductive resistance. Adjust it to $10\mu\text{V}$ at 2 Mc/s, 30%

modulation. With R.F. gain at maximum, system switch on RT, and modulation at 3000 c/s, tune the set to the generator so that the frequency control is adjusted for the minimum output between the two maxima, and the P.A. is adjusted for maximum output. Reduce modulation frequency to 400 c/s and adjust A.F. gain to give 50 mW output. Adjust the modulation successively to the frequencies given in para. 78 and read the output meter in each case. The output must not be less than the figures given in para. 78.

Repeat accuracy of flicks

47. With either flick set for 7 Mc/s, tune in a signal by means of the flick device, rotating the gang from each direction in turn 10 times, and note the tuning error each time. To measure this, inject another signal, variable between 455 and 475 Kc/s, into the I.F. amplifier, adjust it for zero beat each time and read the frequency; some form of band spread tuning is desirable. Then, ignoring any exceptionally large error which could be ascribed to faulty manipulation, take the difference between the highest and lowest frequency readings so obtained. This measures the total "tuning spread" and must not exceed 3 Kc/s. If no suitable I.F. signal generator is available, the following method may be used, though this is not so accurate. Tune in the 7 Mc/s signal as described above, but with the set switched to CW. After each flick operation, set the het. tone control to zero beat and make a pencil mark on the panel opposite the pointer. At the end of the test, set the het. tone control to the extreme left-hand mark, put the flick lever to the "tune" position, and tune in the 7 Mc/s signal to zero beat, using the S.M. tuning control. Then turn the het. tone control to the extreme right-hand mark, and measure the frequency of the beat note. This again gives the figure for the total "tuning spread."

"A" SET SENDER

Calibration of drive range on meter

48. With S7A at RT, and the set switched off, set meter switch to "drive," join V4A cathode to chassis, and apply exactly 40 volts between pins 5 and 8 of V6A, or between tag of C34A not joined to V4A, and positive terminal of meter (positive to pin 8 or to meter). Make a temporary mark (e.g. on a piece of adhesive tape stuck to the meter glass) to show the meter reading in this condition.

Drive circuit trimming

49. Disconnect R20A from V4A screen. Remove drive A.G.C. by connecting a 1 M Ω resistance across R43A. Switch to H.F. band. Unless C34A has previously been adjusted, set it nearly at maximum. Adjust trimmers C10B and C10C for maximum drive at 8 Mc/s. Make sure that correct peak is obtained; if wrong, drive will fall off very rapidly as gang is rotated; also, check that drive drops to a very low value at 8 Mc/s when the 465 Kc/s oscillator is stopped by shorting V2B triode grid to chassis—if not, increase capacity of trimmers, as they have been tuned to M.O. frequency. Adjust coils L4A and L7A if necessary to maintain good tracking over the band. Re-trim C10B and C10C at 8 Mc/s. Switch to L.F. band. Adjust trimmers C10E and C10F at 4.5 Mc/s. Adjust coils L4C and L21A if necessary to maintain good tracking over band. Re-trim C10E and C10F at 4.5 Mc/s. Any coils that have been adjusted must be sealed with wax. If adjustment of coils and trimmers is not sufficient to maintain good tracking, adjust gang condenser sections C9C and C9D (first see para. 103).

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Drive voltage

50. Remove 1 M Ω shunt from R43A. Reduce L.T. input to power supply unit to 11 volts and switch on "B" and "IC." Check drive over whole of calibrated tuning scale on both bands. In case gang has any mechanical fault, this should be done, rotating gang fully in each direction with flick arm in each of its three positions. Total variation of drive voltage must not exceed two small divisions on meter scale, and must never fall below 40-volt mark. Also, at all frequencies there must be an increase in drive voltage when the A.G.C. is removed. Restore L.T. input to 12 volts and switch off "B" and "IC." (Further information on correcting faults in drive circuits is given in paras. 98, 100, 101 and 103.)

Connections for remaining tests on sender

51. Reconnect R20A to V4A screen. Connect variometer (Mk. III) to set with aerial feeder no. 1, and join 30 pF dummy aerial and 0-1 amp. thermal meter between variometer output and case (meter on earthy side). Alternatively, connect 45 pF condenser to variometer and 10 Ω non-inductive resistance between this condenser and variometer case. Connect valve voltmeter across resistance. (The 10 Ω resistance consists of five 50 Ω 3-watt carbon resistances connected in parallel between two copper discs 2" dia. 2 $\frac{3}{4}$ " apart, the resistances being soldered at equal intervals round the periphery of the discs.) Connect B.F.O. to pin 1 of 12-point plug PL2A *via* potential divider shown in fig. 1. Connect 100 Ω output meter to pin 4 of PL2A (if 150 Ω output meter is used, insert matching network shown in fig. 2(b)). Insert short-circuited plug in key jack.

Adjustment of drive feed condenser (C34A)

52. Set gang condenser to 6 Mc/s. Switch to CW. Adjust P.A. condenser and variometer together till maximum aerial output is obtained (use the set meter switched to AE for tuning indicator). Read this output on thermal meter or valve voltmeter. Switch to MCW and re-tune P.A. and variometer for maximum aerial output. Switch to RT. Adjust C34A till aerial output is half that obtained on CW. Switch to CW, re-tune, and read aerial output. If this has changed appreciably, repeat procedure for adjustment of C34A. Check anode current of P.A. valve on CW and on RT, with everything correctly tuned for maximum aerial current at 6 Mc/s (para. 80), connecting milliammeter in place of H.T.2 fuse in power supply unit.

Re-adjustment of drive trimmer

53. After adjustment of C34A, it may be necessary to re-adjust C10B to maintain drive voltage at 8 Mc/s. Next, reduce input to 11 volts and switch on "B" and "IC" for a final check on drive at low voltage. Test drive at several frequencies on both bands on CW and with P.A. and variometer in and near tune. Check for pulling down of drive by the other circuits, particularly on the H.F. band; limits of variation are as given in para. 50. Restore L.T. to 12 volts and switch off "B" and "IC."

Measurement of aerial output (para. 79)

54. Check the aerial current on the thermal meter, or voltage on valve voltmeter, on CW at the specified frequencies. Also, at 6 Mc/s only, check on MCW and RT (unmodulated). *Note.*—Tune on MCW for RT operation.

Calibration of P.A. circuit

55. With set tuned for maximum output on CW, the calibration of the P.A. circuit must be within $\pm 3\%$ at all frequencies.

MCW A.F. output (para. 82)

56. Check output measured on output meter. Check frequency annually with one pair of headphones connected to pin 4 of PL2A in place of output meter.

Microphone amplifier sensitivity (para. 83)

57. Check input voltage from B.F.O. at 400 c/s to give 30 mW output.

Microphone amplifier fidelity (para. 83)

58. With input voltage as in para. 57, check output at 150 c/s and 5000 c/s.

Netting adjustment (para. 84)

59. With the system switch at RT and the set on receive, carefully tune in a 2 Mc/s signal from the wavemeter or crystal calibrator, using the netting switch. Then switch to send, and check the frequency with the wavemeter or calibrator. Adjust L25A until this frequency is exactly 2 Mc/s. Check that this adjustment has not altered receiver tuning; if it has, repeat operation. Check netting error at 3, 4, 5, 6, 7 and 8 Mc/s. If it is out of limits, see para. 102.

Calibration of meter

60. Check meter calibration on L.T. with 12 volts input to power unit against figure written on panel, and amend if necessary.

FUNCTIONAL TEST (para. 85)

61. The complete set is tested in two-way communication with a control station. Check particularly such items as intelligibility of speech, netting error, cross-talk between the different services, and any other points not fully covered by the previous tests. Also, check behaviour of set with 10.5 volts and with 15 volts input to power supply unit.

VARIOMETER

Adjustment of R29A

62. Connect the variometer to the set and a 0.1 amp. thermal ammeter and 30 pF dummy aerial between variometer output and case, as described in para. 51. Switch the set to CW send, tune to 4 Mc/s, and adjust P.A. and variometer to give a current of 500 mA on the thermal meter. Adjust R29A so that the AE reading on the set meter is 400 on the 600 V. scale. When checking, acceptance limits for this reading are 350 to 450. If no thermal ammeter is available, use 45 pF + 10Ω dummy aerial with valve voltmeter, as described in para. 51. Adjust P.A. and variometer to give a reading of 5 volts on the valve voltmeter, and proceed as above. The capacity to ground of the 45 pF condenser must be kept small, since otherwise the total output of the variometer will be greater than that indicated by the valve voltmeter, with the result that R29A will be set too high.

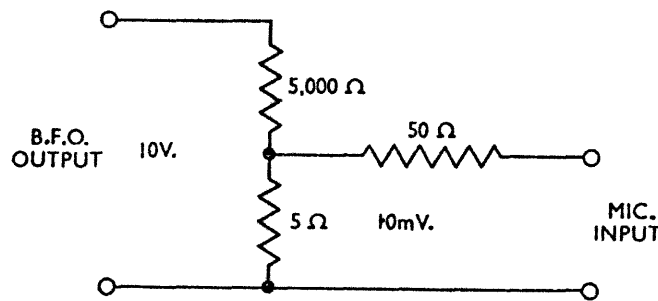
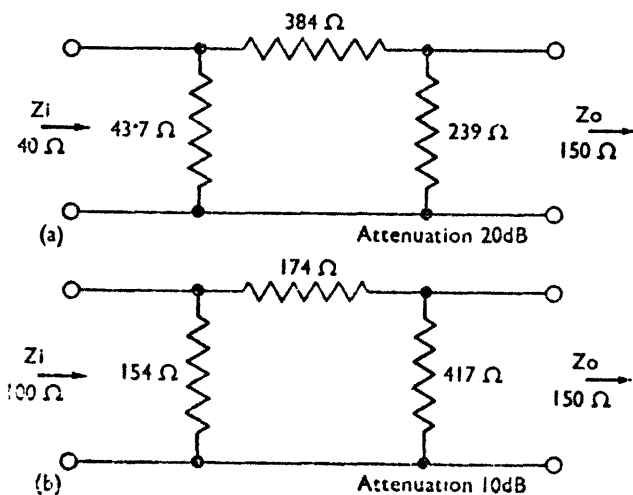


Fig. 1. B.F.O. potential divider

Exact matching networks:—



The following alternatives are sufficiently accurate for routine testing, and use readily available resistances:—

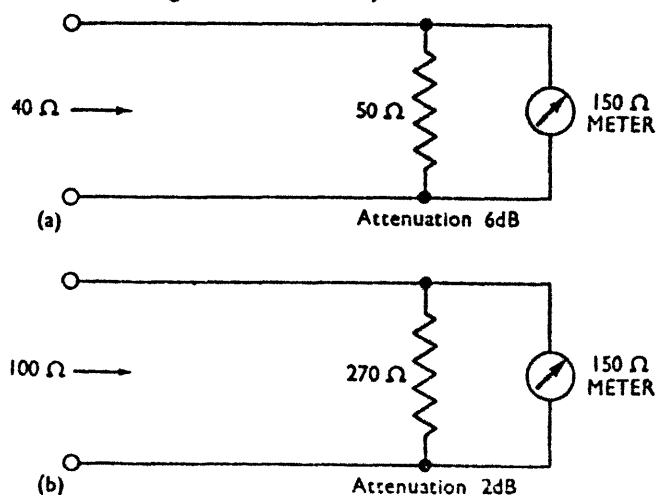


Fig. 2. Output meter matching networks

PERFORMANCE FIGURES

General

63. This information should be read in conjunction with that on test and alignment procedure. It does not give a complete specification of the performance of the set, but includes all the measurements necessary to ensure that the set is up to standard, and which can be made with the facilities available in a well-equipped workshop. (*Note.*—In measuring A.F. outputs, take 50 mW as 0 dB.)

Intercommunication amplifier

64. (a) *Sensitivity* (para. 13).—
10 mV max. input with 12 volts L.T.
15 mV max. input with 10.5 volts L.T.
- (b) *Max. undistorted output.*—At least 500 mW.
- (c) *Fidelity* (para. 15).—
150 c/s: — limits 0 to — 4 dB (50 to 20 mW).
5000 c/s: — limits + 2 to — 2 dB (80 to 30 mW).

“B” set receiver

65. (a) *Quench frequency* (para. 17).—
Minimum greater than 158 Kc/s.
Maximum less than 228 Kc/s.
Coverage greater than 55 Kc/s.
(Frequency limits are necessary to avoid interference with “A” set receiver by frequencies near $465 \times \frac{1}{2}$ and $465 \times \frac{3}{4}$ Kc/s.)
- (b) *Calibration* (para. 18).—Frequency 235 ± 1 Mc/s at 5 on the dial.
- (c) *Sensitivity* (para. 19).—No definite limit can be given, but comparison should be made with known good sets.

“B” set sender

66. (a) *R.F. output* (para. 26).—Subject to variations due to characteristics of valve voltmeter and feeder used. Highest diode current should be between 60 and $100 \mu\text{A}$, lowest reading on any set not less than 60% of highest reading, and no sudden variations in output with tuning.
- (b) *Mic. amp. sensitivity* (para. 27).—Input not greater than 10 mV for 50 mW output.
- (c) *Mic. amp. fidelity* (para. 29).—
150 c/s: — limits + 1 to — 3 dB (63 to 25 mW).
5000 c/s: — limits + 3 to — 1 dB (100 to 40 mW).

“A” set receiver

67. *A.F. amplifier* (para. 30).
RT sensitivity:—400 c/s input not greater than 4.5 V for 50 mW output.

RT fidelity:—

150 c/s: — limits — 4 to — 9 dB (20 to 6 mW).
5000 c/s: — limits + 1 to + 5 dB (63 to 160 mW).

MCW fidelity:—

150 c/s: — maximum output reading — 11 dB (4 mW).
400 c/s: — limits — 3 to — 5 dB (25 to 16 mW).
5000 c/s: — maximum output reading — 11 dB (4 mW).

CW peak frequency (F):—Limits 900 to 1200 c/s.

CW fidelity:—Output limits,

at F, + 2 to — 5 dB (80 to 16 mW).
at F ± 200 c/s, below — 5 dB (16 mW).
at F ± 500 c/s, below — 12 dB (3 mW).

68. I.F. amplifier (para. 31).

Sensitivity:—Input not greater than $120 \mu\text{V}$ for 50 mW output.

Bandwidth at input $\times 2$ >5 Kc/s.
“ „ input $\times 10$ 10 to 15 Kc/s.
“ „ input $\times 1000$ <35 Kc/s.

Symmetry test limits:— ± 1 Kc/s.

Frequency at resonance (check for sets which pass above limits without re-trimming):— 465 Kc/s ± 2 Kc/s.

For reference, average sensitivity at V1B grid is $3,000 \mu\text{V}$ and at V1C grid 0.25 V.

69. Beat frequency oscillator (para. 32).

Check to be made on sets which otherwise do not require re-trimming at I.F.:—Frequency of B.F.O. not to differ from resonance frequency of I.F. amplifier by more than 0.5 Kc/s.

70. Het. tone control (para. 33).

Limits for maximum beat note frequency on each side:—2000 c/s to 4000 c/s.

71. Frequency calibration (para. 36).

Maximum error at all frequencies:— ± 25 Kc/s. Also the actual frequency range covered must exceed the nominal range by at least 25 Kc/s at each end.

72. R.F. sensitivity (damped) (para. 39).

Frequency (Mc/s)	Max. input (μV) for 50 mW
8	80
6	90
5	100
4.5	70
3	80
2	120

73. A.V.C. characteristic (para. 41).

Max. drop in output:—10 dB (i.e. to 5 mW).

74. R.F. gain control (para. 42).

Min. input to aerial plug for 50 mW output:—

$\frac{1}{2}$ gain .. $20 \mu\text{V}$
Min. gain .. $250 \mu\text{V}$.

75. Audio output on CW (para. 43).

Minimum output with $1 \mu\text{V}$ input:—30 mW (—2.2 dB).

“ „ $1,000 \mu\text{V}$.. 120 mW (+3.8 dB).
“ „ $100,000 \mu\text{V}$.. 65 mW (+1.1 dB).

76. Second channel ratio (para. 44).

Signal freq. (Mc/s)	Input at 2nd channel freq. (μV)
6	90
4.5	160
4.5	90
3	280
2	500

77. *Signal/noise ratio* (para. 45).

Frequency (Mc/s)	Sig. gen. output (μ V)
8	12
6	8
4.5	8
4.5	10
3	11
2	12

78. *Overall fidelity* (para. 46).

Mod. frequency (c/s)	Output (mW)	Loss (dB)
400	50	0
750	50	0
1000	50	0
2000	16	5
3000	3	12

"A" set sender

79. *Aerial output* (para. 51).

Frequency (Mc/s)	System	Min. Ae. current through 30 pF (amp.)	Min. voltage across 10 Ω
8	CW	0.65	6.5
6	CW	0.70	7.0
5	CW	0.65	6.8
4.5	CW	0.65	6.8
3	CW	—	5.3
2.4	CW	0.42	—
2	CW	—	4.1
6	MCW	0.42	5.0
6	RT, unmod.	0.35	3.5

80. *P.A. anode current* (para. 52).

Max. current on CW:—85 mA.
" " " RT:—30 mA.

81. *Calibration of P.A. circuit* (para. 55).

Max. error at all frequencies:— ± 3 per cent.

82. *MCW A.F. output* (para. 56).

Not less than 150 mW.
Frequency limits 700 to 1100 c/s.

83. *Microphone amplifier* (paras. 57–58).

Sensitivity:—Input not greater than 50 mV for 50 mW output.

Fidelity:—150 c/s:—limits—5 to—10 dB (16 to 5 mW).
5000 c/s:—limits—3 to—9 dB (25 to 6 mW).

Netting error (para. 59)

84. Netting error at any frequency between 2 and 8 Mc/s must not exceed 500 c/s with any input signal between 2 μ V and 0.1V, and at any L.T. input between 10.5 and 15 volts. If a set fails to pass this test, see para. 102.

High and low voltage test (para. 61)

85. The set must still function with L.T. input to power supply unit reduced to 10.5 volts or increased to 15 volts, i.e., oscillators must not stop working, drive voltage should not fall unduly (although it may not pass tests in paras. 50 and 53 with 10.5 volts L.T.), and there must be no form of instability. At 10.5 volts, V7A in the "B" set may stop oscillating on receive.

WINDING SPECIFICATIONS

Coils and chokes

S6. The information given below is intended for the use of workshops equipped with suitable coil winding machines, to enable them to re-wind damaged coils when no spares are available. In the case of all coils used in tuned circuits, and also U.H.F. chokes in the "B" set, the specifications should be followed as closely as possible. In the case of wave-wound chokes, used in filter circuits, etc., some latitude is permissible. Details of coil formers, positions of windings, connections, etc., are not given: it is assumed that these will be obtained by measuring an old coil. The finish on the coils should also be reproduced if possible: all R.F. coils on formers are brushed with coil dope (British Celanese no. 202 or equivalent); waxed coils are impregnated with S.W.M. 68 (or equivalent) wax at 100–110° C. after the coil dope is dry.

L2A & B. R.F. chokes:—230 turns of 42 s.w.g. en. and s.s.c. copper wire, wave-wound $\frac{3}{16}$ " wide. Dope and wax.

Inductance 470 μ H.
D.C. resistance 17 Ω .

L3A. P.A. tuning coil:—37 turns of 22 s.w.g. en. copper wire, wound at 22 T.P.I., tapped at 8 turns. Dope.
Nominal value of inductance 12.1 μ H.

L4. Drive coil:—

A—23 turns of 26 s.w.g. en. copper wire wound at 38 T.P.I.

B—25 turns of 42 s.w.g. en. and s.s.c. copper wire close-wound over centre of A.

C—39 turns of 32 s.w.g. en. copper wire wound at 59.5 T.P.I.

D—42 turns of 42 s.w.g. en. and s.s.c. copper wire close-wound over cold end of C.

2 layers of .003" Clarifoil between A and B and between C and D. Dope and wax.

Nominal value of inductance A—3.94 μ H
(C short-circuited).

" " " " C—10.6 μ H.

D.C. resistance of coupler B—2.36 Ω .

" " " " D—4.16 Ω .

- L5.** Beat oscillator coil:—
 A—117 ± 117 turns (2 sections) of 6/45 d.s.c. Litz wire, each $\frac{3}{16}$ " wide, wave-wound.
 B—30 turns of 38 s.w.g. en. and s.s.c. copper wire, interwound with start of A.
 C—2 turns of 30 s.w.g. en. and s.s.c. copper wire, wound in groove, spaced $\frac{1}{16}$ " from A.
 Dope windings, assemble on bakelite plate and stick with Durofix. Wax when dry. Fit core, condensers and leads. Winding A is adjusted by stripping turns so that it tunes to 465 Kc/s in 19 set with core about 3 turns from maximum. Alternatively match to a standard coil in a suitable test oscillator circuit.
- L6A.** Het. tone control coil:—10 turns of 30 s.w.g. en. copper wire wound at 66 T.P.I. Dope and wax.
 Nominal value of inductance 0.85 μH.
- L7.** Sender R.F. coil, H.F.:—
 A—23 turns of 26 s.w.g. en. copper wire wound at 40 T.P.I.
 B—26 turns of 42 s.w.g. en. and s.s.c. copper wire close-wound over cold end of A.
 2 layers of .003" Clarifoil between A and B. Dope and wax.
 Nominal value of inductance 3.96 μH.
 D.C. resistance of coupler 2.53 Ω.
- L8A, L8B, L9A.** I.F. transformers:—Each coil 150 + 150 turns of 6/45 d.s.c. Litz wire, wave-wound, each section $\frac{3}{16}$ " wide. Stick coils to bakelite plate with Durofix. Spacing between centres of primary and secondary $1\frac{1}{4}$ " if outside diameter of coils is between .550" and .610", $1\frac{5}{8}$ " if between .611" and .640". Wax after assembly. Coils adjusted by stripping turns so that they tune to 465 Kc/s in 19 set with core about 3 turns from maximum. Flash test 1000V between windings and between windings and can.
- L10A.** R.F. choke:—300 + 300 turns of 40 s.w.g. en. and s.s.c. copper wire wave-wound in 2 sections, each $\frac{1}{4}$ " wide, $\frac{1}{16}$ " spacing between sections. Dope and wax.
 Inductance 1.55 mH.
 D.C. resistance 27 Ω.
- L11A.** "B" tuning coil:—5 turns of 14 s.w.g. bare copper wire, silver plated, wound on $\frac{1}{4}$ " dia. mandrel to overall length $\frac{7}{8}$ ". Ends of coil to be cut $\frac{3}{8}$ " long.
- L12A.** "B" aerial choke:—10 turns of 20 s.w.g. tinned copper wire, insulated with 1 mm. or 1.5 mm. sleeving, close-wound on $\frac{3}{16}$ " dia. mandrel.
- L13A.** "B" cathode choke:—14 turns of 20 s.w.g. insulated tinned copper wire close-wound on $\frac{3}{16}$ " dia. mandrel.
- L14A.** Quench tuning coil:—470 turns of 38 s.w.g. en. and s.s.c. copper wire $\frac{1}{4}$ -wave-wound $\frac{5}{8}$ " wide. Dope. Adjust inductance with core at minimum to 1710 μH ± 2%. Then adjust with core to inductance 3330 μH ± 2% and fix handle to stem so that handle is screwed up against bush to act as a stop.
 D.C. resistance 13.25 Ω.
- L15A.** Quench anode choke:—825 turns of 41 s.w.g. en. copper wire $\frac{1}{2}$ -wave-wound $\frac{1}{4}$ " wide. Dope and wax.
 Inductance 9.6 mH.
 D.C. resistance 80 Ω
- L17A.** L.T. filter choke:—30 turns of 16 s.w.g. en. and s.s.c. copper wire wound in 2 layers. Dope and wax.
 D.C. resistance 0.016 Ω.
- L18A.** H.T. filter choke:—120 ± 120 turns of 30 s.w.g. d.s.c. copper wire single-wave-wound in 2 sections each $\frac{1}{8}$ " wide, $\frac{1}{8}$ " between sections. Dope and wax.
 Inductance 760 μH.
 D.C. resistance 3.4 Ω.
- L21.** Sender R.F. coil, L.F.:—
 A—40 turns of 32 s.w.g. en. copper wire wound at 58.8 T.P.I.
 B—42 turns of 42 s.w.g. en. and s.s.c. copper wire, close-wound over cold end of A.
 2 layers of .003" Clarifoil between A and B. Dope and wax.
 Nominal value of inductance 10.8 μH.
 D.C. resistance of coupler 3.9 Ω.
- L22.** Receiver R.F. coil, H.F.:—
 A—23 turns of 26 s.w.g. en. copper wire wound at 38 T.P.I.
 B—22½ turns of 42 s.w.g. en. and s.s.c. copper wire close-wound over cold end of A.
 2 layers of .003" Clarifoil between A and B. Dope and wax.
 Nominal value of inductance 3.94 μH.
 D.C. resistance of coupler 2.2 Ω.
- L23.** Receiver R.F. coil, L.F.:—
 A—39 turns of 32 s.w.g. en. copper wire wound at 59.5 T.P.I.
 B—38½ turns of 42 s.w.g. en. and s.s.c. copper wire close-wound over cold end of A.
 2 layers of .003" Clarifoil between A and B. Dope and wax.
 Nominal value of inductance 10.5 μH.
 D.C. resistance of coupler 3.6 Ω.
- L24.** Oscillator coil:—
 A—20½ turns of 38 s.w.g. en. copper wire wound at 32 T.P.I.
 B—11½ turns of 46 s.w.g. en. and s.s.c. EUREKA wire, close-wound over cold end of A.
 1 layer of .007" Domolac, corrugated to give air spacing, between A and B.
 C—25 turns of 38 s.w.g. en. copper wire wound at 45 T.P.I.
 D—15½ turns of 46 s.w.g. en. and s.s.c. EUREKA wire, close-wound over cold end of C.
 2 layers of .003" Clarifoil between C and D.
 Brush with thin dope. Do NOT wax.
 Nominal value of inductance A—3.25 μH
 (C short-circuited).
 " " " " " A + C—8.35 μH.
 D.C. resistance of coupler B—115 Ω.
 " " " " " D—125 Ω.
- L25A.** Beat oscillator compensating coil:—45 turns of 38 s.w.g. en. copper wire close-wound at one end of former. Dope. Cover with 2 layers of .003" Clarifoil $\frac{3}{4}$ " wide. Short-circuited turn of 20 s.w.g. tinned copper wire to be sliding fit over this for adjustment in set.
 Nominal value of inductance (without shorted turn) 11 μH.
- L26A.** "B" aerial coil:—5 turns of 18 s.w.g. tinned copper wire, insulated with 1.5 mm. sleeving, close-wound on $\frac{3}{16}$ " dia. mandrel. Overall length $\frac{1}{2}$ " ± $\frac{1}{32}$ ". Tie turns together with thread. Impregnate in wax 2 minutes and shake off surplus wax.

T3A. "A" microphone transformer

87. Secondary:—14,000 turns of 47 s.w.g. en. copper wire.
Screen:—1 layer of 47 s.w.g. en. copper wire.
Primary:—140 turns of 28 s.w.g. en. copper wire.
One layer of oiled silk to be wound half-lap between windings and over finished winding.

Lead	Length	Colour
Inner primary	2½"	Blue
Outer primary	2½"	Black
Screen	2½"	Yellow
Inner secondary	6¾"	Red
Outer secondary	2½"	White

Large blue spot to be painted on oiled silk covering to distinguish from T4A and B.

Primary inductance at 1000 c/s with 5 volts input to be not less than 5mH.

D.C. resistance:—Primary 1.4Ω.
Secondary 4,700Ω.

Flash test:—Complete transformer to be flashed between windings and between windings and core at 500V R.M.S. 50 c/s.

Shorted turns effect not to be greater than that produced by a loop of 36 s.w.g. copper wire ¾" in dia.

T4A and B. "B" and "IC" microphone transformers

88. Each as T3A, with the following exceptions:—
Primary:—280 turns of 32 s.w.g. en. copper wire.
Primary inductance:—Not less than 20mH.
Primary D.C. resistance:—5.5Ω.
Identify with large spot of red paint on oiled silk covering.

Lead	Length	Colour
Inner primary	2½"	Blue
Outer primary	3½"	Black
Screen	3½"	Yellow
Inner secondary	3½"	Red
Outer secondary	2½"	White

T2A. "A" output transformer

89. Secondary 2:—200 turns of 34 s.w.g. en. copper wire, paper interleaved, finished off with 2 layers of oiled silk. Finish to be joined to start of secondary 1.

Secondary 1:—500 turns of 44 s.w.g. en. copper wire, paper interleaved, finished off with 2 layers of oiled silk.

Primary:—2,800 turns of 44 s.w.g. en. copper wire, paper interleaved, finished off with 2 layers of oiled silk and ½" wide unbleached cotton tape.

All end of windings to be brought out at same end of former.

Assemble "E" laminations in transformer. Assemble clamp (with tag plate rivetted in position) with "I" laminations on transformer (butt joint, no spacer). Connect leads to tag plate as shown in Tels. F 253/3, fig. 6. Impregnate with bitumen.

Primary impedance:—Not less than 2,400Ω at 50 c/s (10V A.C.) with 5mA D.C. flowing.

D.C. resistance:—Primary 840Ω.
Secondary 1 140Ω.
Secondary 2 5.8Ω.

Shorted turns:—The shorted turns effect should not exceed that produced by a loop of 32 s.w.g. copper wire, 1½" in dia.

Flash test:—The completed transformer to withstand a flash test of 1000V R.M.S. 50 c/s between windings and between windings and core.

Insulation resistance:—The finished transformer should have an insulation resistance of not less than 1000MΩ between windings and between windings and core at 500V D.C.

Note.—If transformer is not fitted with tag plate, leads must be cut long enough to reach connection points in set, and must be colour coded as shown in Tels. F 253/3, fig. 6.

T5A. "B" output transformer } (assembled in
T6A. "IC" output transformer } one unit).

90. T6A. Primary:—2,200 turns of 42 s.w.g. en. copper wire, paper interleaved. Two layers of .003" Clarifoil between windings.

Secondary:—160 turns of 32 s.w.g. en. copper wire, paper interleaved. Cover with two layers of .003" Clarifoil, and bind with a layer of ½" wide unbleached cotton tape.

Ends of windings to be brought out with 14/36 flex covered with 1.5 mm. sleeving, and to be securely anchored inside winding.

Assemble the "E" laminations in coil, and fit in clamp with "I" laminations and .003" Clarifoil spacer. Secure by squeezing clamp on to laminations.

T5A. Primary:—2,600 turns of 36 s.w.g. en. copper wire, paper interleaved. Two layers of .003" Clarifoil between windings.

Secondary 1:—3,240 turns of 40 s.w.g. en. copper wire, paper interleaved. Two layers of .003" Clarifoil between windings.

Secondary 2:—252 turns of 34 s.w.g. en. copper wire, paper interleaved. Cover with two layers of .003" Clarifoil, and bind with a layer of ½" wide unbleached cotton tape.

Ends of windings as for T6A.

Fit laminations, butt-jointed with .003" spacer, and assemble clamps, feet, tag plates and bracket for T6A. Fix T6A on bracket. Connect leads to tag plates as shown in Tels. F 253/3, fig. 7. Impregnate complete assembly with bitumen.

Test specification:—

T5A primary impedance not less than 2,200Ω at 50 c/s with 10V A.C. and 32mA D.C.

T6A primary impedance not less than 1,500Ω at 50 c/s with 10V A.C. and 25mA D.C.

D.C. resistance:—T5A primary 160Ω
T5A secondary 1 680Ω.
T5A secondary 2 16Ω.
T6A primary 350Ω.
T6A secondary 4.1Ω.

Flash test:—1000V R.M.S. 50 c/s between windings and between windings and core.

Insulation resistance:—Not less than 1,000 MΩ between windings and between windings and core at 500V D.C.

Shorted turns effect not to exceed that of loop of 26 s.w.g. copper wire 2" in dia. for T5A, and loop of 28 s.w.g. copper wire 1½" in dia. for T6A.

POWER SUPPLY UNIT NO. I, MK. III

MAINTENANCE

Lubrication of rotary transformers

105. Remove the end cover plates, which are each fixed with three 6BA screws. Pack the ball races $\frac{1}{4}$ full with Royco 6A or EXG283 grease. Never use ordinary grease or oil except in an emergency, when the first opportunity should be taken to clean and re-lubricate with the correct grease.

Replacement of ball races in rotary transformers

106. Remove all the brushes. Undo the two 4BA nuts clamping the stator assembly, and withdraw the bolts. Remove the end casting and withdraw the rotor. Remove the ball races from the rotor by means of a suitable extractor. When reassembling, reverse the above procedure, being careful to replace everything just as it was before.

Relay S15A

107. Check that movement of the armature is free and positive. See that there is adequate clearance between contacts when open and that good contact is made when closed. See that contacts are not unduly burnt or pitted. Brief specification is as follows:—

Max. coil current at 12 volts.	0.22 amps.
Max. voltage drop across contacts at 10 amps.	0.2 volt.
Min. insulation resistance at 230 volts A.C.	50 MΩ
Min. contact clearance048"

ELECTRICAL TESTS

Conditions of test

108. Unless otherwise stated the test conditions are:—

- (a) The supply voltage measured at the input plug PL1C must be maintained constant at 12.0 volts.
- (b) The full load current for H.T.1 is 120 mA and for H.T.2 is 65 mA.
- (c) The outputs are measured at the contacts on the output plug PL2C.

Regulation and output voltage

109. (a) H.T.1:—The voltage regulation from full load to

no load must not exceed 20%. The voltage at full load must be between 250 and 280 volts.

(b) H.T.2:—The voltage regulation from full load to no load must not exceed 20%. The voltage at full load must be between 480 and 520 volts.

Overall efficiency

110. At full load, the overall efficiency of each H.T. supply must not be less than 50%. The no-load input to either machine must not exceed 1.6 amps.

Ripple voltage

111. The ripple voltage is to be taken as the maximum reading on a valve voltmeter connected across the H.T. output *via* a 4μF paper condenser, the machine being on full load. When measuring ripple on one machine, the other must not be running. The ripple voltage, expressed as a percentage of the output voltage, must not exceed 0.15% for H.T.1 and 2.0% for H.T.2.

High and low voltage operation

112. (a) With an input of 17 volts, H.T.1 at full load must not exceed 390 volts and H.T.2 730 volts.

(b) With an input of 10.5 volts, H.T.1 at full load must be not less than 220 volts and H.T.2 not less than 420 volts.

Flash test

113. Disconnect external connections from machine. When testing either winding, the other must be earthed to frame. Apply a source of 50 c/s A.C. between winding and frame for one minute. Test voltages are:

- (a) 500 volts R.M.S. for L.T. windings.
- (b) 1500 volts R.M.S. for H.T.1 winding.
- (c) 2000 volts R.M.S. for H.T.2 winding.

Insulation test

114. Disconnect external connections from machine. Test with 500 volts D.C. between each winding and frame when the machine is hot. Insulation resistance must be not less than 2 MΩ for L.T. windings and 10 MΩ for H.T. windings.

END