28

SERVICE MANUAL

MURPHY RADIO LTD., WELWYN GARDEN CITY
HERTS.

050.336

Foreword

The primary purpose of this manual is to enable dealers to service the 28 models with confidence.

A great deal of the contents will, however, be found to have general application, and for this reason I commend it not only as a Service Manual, but as a useful work of reference.

E. J. POWER
Chief Engineer

MURPHY

CONTENTS

DIAGRAMS

A28 CONSOLE

THE CIRCUIT

THE Murphy A28C is a supersonic heterodyne receiver employing a total of eight valves, excluding the mains rectifier. Of these, six perform normal functions, while the remaining two are concerned with the processes of automatic tuning correction and inter-station noise suppression.

Multiple valves can be regarded as separate valves contained in the same envelope. In order to discriminate between two systems of this kind, distinguishing names will be given to them: thus the two valves enclosed within the V2 envelope will be spoken of as V2 Pen and V2 Triode, while reference will be made to V5 D1A and V5 D2A, and similarly for V6.

The function of individual valves will be more readily understood if the following brief description is studied in conjunction with the A28C circuit diagram (Fig. 1).

V1 and V4 are variable mu. H.F. pentodes, the first acting as an amplifier at signal frequency and the second at intermediate frequency. V2 is a triode-pentode, which serves as oscillator and first detector; V5 is a duo-diode, acting as second detector and also supplying the A.V.C. voltage; V7 functions as interstation noise suppressor, and also affords a certain degree of L.F. amplification, while V8 is a sensitive output pentode valve.

Still referring to the circuit diagram it will be seen that the aerial is coupled to a band pass tuning arrangement (L3, L7, C1A, C1B, etc.) which incorporates an image frequency suppression circuit LO, CO. From the secondary of the band pass circuit signals are passed via C10 to V1 grid, where they are amplified and fed to the control grid of V2 Pen. the coupling arrangement here being an H.F. transformer, L9, L10, L11. The primary winding L9 is tuned above the broadcast band in order to increase the gain at the higher wavelengths, while the secondary is tuned in the normal way by C1C. A sharply tuned circuit is undesirable at this stage, so R4 and R5 are introduced in order to provide a certain amount of damping. At the grid of V2 Pen. the incoming signals are mixed with the local oscillations produced by V2 Triode and rectified, thus producing an I.F. signal at 119 Kc/s. This signal is fed through the I.F. transformer L19, L20, to the I.F. amplifier V4, and thence through the second I.F. transformer L21, L22, to the detector diode of V5, (D1A). It should be noted that this anode is fed from a tapping on the secondary of the I.F. transformer, and in consequence receives only a fraction of the voltage existing across L22. This has the effect of reducing damping and improving the A.V.C. action.

The comparatively large I.F. voltages developed across L21 are applied *via* C34 to the A.V.C. diode of V5, (D2A). The load resistances R23, R24, across which the rectified A.V.C. voltage is developed, are returned to chassis; the cathode of the valve on the other hand is positive to chassis, being connected to the positive side of V7 cathode resistance. This makes D2A negative with respect to its cathode by some 20 volts, so that no rectification takes place, and consequently no A.V.C. potential is applied as bias to the controlled valves until the signal voltage exceeds this amount.

The full A.V.C. voltage is applied *via* the decoupling network R20, R21, C38, C14 to the grids of V1 and V2 Pen., but V4 receives only a portion of the control bias owing to the fact that its grid circuit is returned to a tapping point on the A.V.C. diode load; decoupling in this instance is provided by R22 and C31.

Reverting to the I.F. signal voltage at D1A, this is rectified and results in an L.F. voltage across R17, which with C35 forms the diode load. In parallel with this load is a potentiometer formed by R18 and R25, and the voltages developed across R25 are fed to V7 grid through C37.

At the lower audio frequencies C36, which is in parallel with R18, has very little effect, and as R18 is of considerably higher value than R25, only a small proportion of the signal voltage is developed across the latter, and passed on to the grid of V7.

At the higher audio frequencies conditions are somewhat different: C36 lowers the effective impedance of R18, thus allowing a greater proportion of the signal voltage to develop across R25. In this way compensation is obtained for the high note attenuation in the I.F. circuits.

The grid of V7 is isolated from D.C. potentials in the preceding circuits by C37 and is returned to the negative end of R27 from which it obtains its bias; the purpose of R26 is to prevent any possibility of parasitic oscillation. In the anode circuit of V7 a heterodyne filter (L25, L26, C54, C55, C56, C57) of the standard A24 type is included, and from here the L.F. voltages developed across the anode resistance R31 are applied to the grid of V8 through C47 and the volume control. R32 is the usual grid stopping resistance.

R33 and C49 provide the smoothed bias for V8, while R43, C51, in parallel with T1 primary, constitute a tone correction circuit which, owing to the low value of R43 made possible by tone compensation in an earlier stage, results in the minimum of distortion at the higher audio frequencies. A switch, S9, is arranged to short circuit R43, thus giving a fixed degree of tone control.

There remain V3 and V6 to consider. These valves provide automatic tuning correction, of which a brief description will be given here.

It will be seen that V6 is a double diode, the two anodes of which are fed symmetrically from the anode of V4 via small condensers C39, C40. Each anode has associated with it a tuned circuit, one L23, C41 being adjusted to a frequency of 120½ Kc/s and, the other L24, C42 to 117½ Kc/s. The circuits are thus tuned by equal amounts above and below the resonant frequency of the I.F. circuits, which is fixed at 119 Kc/s. The components R34, R35, are the load resistances for D1A, and D2A respectively.

A station which has been correctly tuned-in will give rise to an intermediate frequency of 119 Kc/s, and as this will affect equally the two tuned circuits associated with V6, equal and opposite voltages will be set up across R34 and R35 and the total voltage appearing across them will be zero. On the other hand, if the receiver has been incorrectly tuned to a frequency slightly above or below that of the station required, one of the circuits mentioned above will be nearer a resonant condition, and the balance will be upset, a nett voltage appearing across R34, R35. These resistances are effectively connected between the outer grid and cathode of V3, and consequently the conductance of this valve will be affected by the bias voltage thus developed. By virtue of the particular circuit associated with V3 the valve acts as a reactance in the oscillator circuit, and thus determines to some extent the frequency produced. Voltages applied to V3 outer grid as described above have the effect of altering the apparent reactance of the valve (because of the change in conductance) and hence the frequency to which the oscillator circuit is tuned. This change is arranged to compensate for the incorrect setting of the tuning control, the intermediate frequency being shifted towards the correct value of 119 Kc/s. This correction continues until a balance position is reached, differing by a negligible amount from the correct frequency.

The correction band is in the order of 12K/c on each side of a carrier. In order to simplify tuning and enable the desired station to be obtained at the correct dial setting, S8 is introduced. This switch cuts out the A.T.C. when the tuning knob is rotated.

V7 acts as noise-suppressor and L.F. amplifier, and is of a special type similar to V3.

The action of V7 is not difficult to follow ; inter-station noise is effectively eliminated by the application of a negative voltage to the outer grid of the valve, which causes a sharp cut off in anode current, and prevents L.F. signals reaching the grid of V8. In the absence of a carrier wave, V7 outer grid is maintained at a potential sufficiently negative to produce this effect, by being returned through R30 and R35 to a tapping on the cathode resistance R27, R28, R29.

As soon as a station is tuned in, the I.F. signal applied to V6 D2A will produce a rectified voltage across R35 in opposition to the negative voltage across R27 and R28. If the station is sufficiently strong, the voltage produced in this way will be great enough to allow V7 to amplify normally, and the signal will be passed on to the grid of V8, the output valve.

The H.T. supply is obtained from V9, an indirectly heated full wave rectifier valve, the initial smoothing being carried out by the speaker field (which has a resistance of 1,400 ohms) and C52. At this stage the supply for the output valve is tapped off ; additional smoothing is required for the earlier valves, and this is obtained by the use of L18 in conjunction with C33. The function of the hum-bucking coil fitted to the speaker is to inject externally into the speech coil a certain percentage of any A.C. voltage which may be present in the speaker field. In this way, the corresponding hum voltage normally induced in the speech coil (due to ripple current in the field coil) is neutralised.

DISMANTLING

CHASSIS

To remove the chassis from the cabinet, first take off all control knobs, carefully preserving the shakeproof washers, and unplug the loudspeaker leads from the sockets at the rear. Loosen the four screws holding the wooden back in position, disengage the back from the lower screws by raising upwards and withdraw, taking care that the metal cowl does not foul the valves. Remove the 10-way plug from its socket on the power pack, and disengage the cable and the mains lead from the retaining clip attached to the cabinet. The chassis is held in position by means of three ¼-inch Whitworth bolts, which can be reached from the loudspeaker compartment. As the two front screws are situated near the loudspeaker cone, care must be taken to avoid damaging the cone when removing the bolts. In this connection a large screwdriver will be found the most satisfactory tool, a box spanner being less convenient and adding to the risk. The chassis should be withdrawn straight out from the back; if it is swivelled or tilted in any way, the underframe of the escutcheon may damage the pilot lamps.

POWER UNIT

The power unit is held in position by three bolts projecting through the floor of the cabinet. Working from the back, with the cabinet tilted forward, they can be removed quite easily, and there is no risk of the power unit sliding bodily out of the cabinet. Before removal, disconnect the " Field " plugs from the sockets on the mains transformer.

PRACTICAL LAYOUT

The layout of the A28C comprises two sections, the main chassis and the power unit.

The latter is accommodated on a shelf below the loudspeaker, and carries the mains transformer and rectifier valve, a smoothing choke (L18), two electrolytic condensers of large capacity C52, C53 and a ten-pin socket for connection to the receiver. Figs. 7 & 8 show the plan and underside views of the power unit ; the code numbers of all the components are marked for reference.

Fig. 5 is a plan view of the main chassis, showing components, while Fig. 6 shows the underside and also the fittings on the back edge. The position of S8 should be noticed particularly. This is fitted to the front of the condenser drive, and serves to put the A.T.C. out of action while tuning is being carried out.

In order that the wiring of the components enclosed within the coil cans may be clearly seen, diagrammatic views of these assemblies are shown in Figs. 13, to 21, the views are drawn looking at the coils from the top with the cans removed. In reading these diagrams care must be taken to see that the coloured tracers in the external connecting wires correspond exactly to the colours given in the illustration, otherwise confusion may arise owing to the diagram and the actual assembly being looked at from different angles.

A separate diagram of the heterodyne filter is not given, as the internal wiring can easily be seen when the assembly is dismantled.

The sequence of valves reading from left to right in a half circle is :—

V1	Mazda	ACVP1	(Met)
V3	,,	ACSP1	,,
V2	,,	ACTP	,,
V4	,,	ACVP1	,,
V5	,,	V914	(Clear)
V7	,,	ACSP1	(Met)
V6	,,	V914	(Clear)
V8	,,	AC2Pen	,,

V9, the indirectly heated rectifier valve, is on the power-unit ; the correct type here is

Mazda UU3

N.B.—V3 should not be replaced indiscriminately, for full information refer to page 52.

On turning the chassis over, we get the inverted plan viewshown in Fig. 6. The wave-range switch is mounted with the contacts in a vertical plane The output transformer (T1) is mounted against the front panel, while the volume control and on-off switch are combined as in the "26" series. It will be noticed that the mains input lead comes through the chassis at a point adjacent to the on-off switch, so that it is not brought into proximity with more components than is absolutely necessary : this helps to reduce mains-borne interference to a minimum. Next to the mains lead a ten-way cable, which connects the receiver to the power unit, passes through the chassis. A diagram is included (Fig. 37) showing the points to which the various leads connect. This diagram should be used in conjunction with Figs. 35 and 36, which show the connections between the transformer and the power socket.

The band pass coupling coils L5, L6, are mounted as usual beneath the chassis, adjacent to the wavechange switch. The position of the image neutralising condenser C0 should however be noted ; it is accommodated between the grid coil assembly and the chassis, as this arrangement allows of short leads between C0 and the image neutralising coil L0.

Separate illustrations are given of five component assemblies, in order that the different components may be quickly located.

W2500. This is a block of ten paper condensers : Fig. 29 shows how it is arranged looking towards the tags. The code numbers on the condensers show where they are in circuit by reference to the circuit diagram. The three resistances R2, R7, R16 are connected externally directly across the soldering tags in order to simplify the wiring.

W2587. This lies behind V8 underneath the chassis. The internal and external connections can be seen in Fig. 23.

W2588. This lies behind the **W2500** bank, and is shown in Fig. 25.

V2584. This is adjacent to the wavechange switch, and the connections are shown in Fig. 22.

SCREENS Nos. 1 and 2.

A developed view of these is shown in Fig. 32. It should be noted that the position of R11 is very important ; this resistance should project by equal amounts on each side of the screen.

CONTROLS

The actual controls of the set are four in number :—

(1) Upper (large) knob : Ganged tuning condenser.
(2) Left-hand knob : volume control and on-off switch.
(3) Right-hand knob : wave change switch.
(4) Knob at rear of chassis : tone control switch.

TRIMMING

The I.F. and discriminator circuits of the 28 receiver are essentially critical, and the degree of permissible error in the tuned circuits is extremely small. It cannot be too strongly emphasised that unless a reliable test oscillator is available, *no attempt whatever should be made to adjust any of the tuned circuits*, with the exception of the aerial and local oscillator.

A test oscillator which is inaccurate will also lead to errors in adjustment, which will adversely affect performance. It is not advisable therefore to take the accuracy of an instrument on trust, particularly as it is not difficult to check the calibration against transmissions from British Broadcasting stations, which offer a very useful standard of frequency.

No apparatus is required except a broadcast receiver known to be in perfect working order, and a sheet of graph paper divided into inches and tenths, approximately 16″ x 13″. The latter is required in order to plot a curve covering the I.F. range of the oscillator. The method of procedure is as follows:

CHECKING AN R.F. OSCILLATOR

I.F. RANGE.

Connect the receiver to aerial and earth, switch on, and tune in Droitwich (200 Kc/s) turning the volume control to maximum. Attach the oscillator via the dummy aerial between aerial and earth, switch to the I.F. range and cut out internal modulation. Set the oscillator to 100 Kc/s as indicated by the existing calibration chart, when a whistle should be heard which varies in pitch as the oscillator dial is rotated. At a certain setting of the dial a silent point will be noted, any deviation from which, in either direction, will cause a rising note to appear. Adjust carefully until this silent point is obtained, if necessary, varying the output from the test oscillator (by means of the attenuator) to give the clearest beat note. The setting of the oscillator now corresponds accurately to a frequency of 100 Kc/s (this effect is due to the 2nd harmonic of the test oscillator). If this reading is indicated by the existing calibration, the oscillator is accurate at this intermediate frequency, and the next stage can be proceeded with.

If, however, an error is noted, the graph paper should be brought into commission. Along the vertical axis mark out in tens, the number of degrees on the tuning scale using 1″ or ½″ to represent each ten degrees, depending upon whether the scale is divided into 100 or 180 degrees. In the former case, one division will correspond to one degree on the dial, thus making reference a simple matter.

Along the horizontal axis, intermediate frequencies from 100 to 150 Kc/s should be marked in a similar manner. To plot the point determined above (*i.e.*, for 100 Kc/s) draw in pencil a faint vertical line from 100 Kc/s and a faint horizontal line from the point corresponding to the oscillator dial setting. Where these two lines intersect, place a dot: then rub out the pencilled lines. The whole of the above procedure must now be repeated on several I.F. frequencies, taking the table given below as a guide, and working through the complete list.

I.F. CHECKING POINTS

Osc. setting to be checked.	*Station to which receiver is tuned.*		*Harmonic utilised*	
100 K.c.	Droitwich	1,500 m.	2nd Harmonic of	200 K.c.
109½ ,,	London Reg.	342 m.	8th ,, ,,	877 K.c.
112 ,,	Warsaw	1339 m.	2nd ,, ,,	224 K.c.
115 ,,	Luxemburg	1304 m.	2nd ,, ,,	230 K.c.
119 ,,	Kalundburg	1261 m.	2nd ,, ,,	238 K.c.
126½ ,,	Midland Reg.	296 m.	8th ,, ,,	1013 K.c.
130 ,,	Oslo	1154 m.	2nd ,, ,,	260 K.c.
144¾ ,,	Midland Reg.	296 m.	7th ,, ,,	1013 K.c.

When a powerful nearby station is being used for checking purposes, it will be necessary to employ a very short aerial (possibly only a foot or two of wire) in order to make the beat note clearly audible.

The points plotted by the foregoing method may now be joined with a smooth curve, which can be used for finding the correct setting for any intermediate frequency in the band covered.

It is also possible to draw a fresh calibration curve for the medium and long wave bands, by causing the oscillator to beat against stations of known wavelength, *i.e.*, the correct dial reading for 342 metres can be obtained by adjusting to the silent point against London Regional. Similarly, the dial position corresponding to all the other British stations can be obtained in the same way.

However, so complete a calibration is hardly necessary in this case, as only two wavelengths are required for R.F. trimming —namely 261, and 1,300 metres, (English Nationals and Luxemburg) for M.W. and L.W. respectively. In districts where these two stations are not well received, the most reliable transmitters should be chosen having wavelengths as close as possible to those given.

APPARATUS REQUIRED:

(1) A modulated R.F. "Service Test" oscillator covering the normal broadcasting and I.F. wavebands.

(2) A D.C. milliammeter range 0—10. This is used when trimming the I.F. and discriminator (A.T.C.) circuits and is inserted, in series, with the anode lead of V1 and V3, respectively.

(3) Two fixed condensers of approximately 0.1 mfd. One is needed in order to by-pass H.F. currents from the milliammeter. The other is used to couple the test oscillator output to the I.F. circuits, preparatory to I.F. trimming. A dummy aerial should not be used in this instance, as it is liable to give rise to undesired resonance effects.

(4) A $\frac{1}{8}$th watt, 100,000 ohm resistance soldered to a 0.1 mfd tubular condenser, the other side of the latter being connected to a flexible lead terminating in a crocodile clip for attachment to earth. The free end of the resistance must be soldered to V4 grid socket and V2 Pen. anode socket alternately while trimming C19 and C20 respectively. A $\frac{1}{8}$th watt resistance is stipulated on account of its small physical size and low self capacity.

(5) A rectifier type A.C. voltmeter with a range of from 0—50 volts for use as an output meter or indicator when trimming R.F. circuits. If an A.C. voltmeter scaled from 0—5 volts only is available, a 50,000 ohm resistance may be connected in series with it in order to extend the range to the required value. It is essential, however, that a rectifier type meter should be employed.

(6) A 1.0 mfd condenser for use in series with the A.C. voltmeter.

(7) A shorting strap, comprising a six inch length of wire terminating in two crocodile clips. This is used to remove noise suppression when carrying out R.F. adjustments.

(8) An insulated screwdriver, the blade of which should be about six inches long and $\frac{1}{8}$-inch wide, and must be covered with sleeving or bound with insulation tape to within $\frac{1}{16}$-inch from the tip.

GENERAL INSTRUCTIONS FOR TRIMMING

It is vitally important that all trimming adjustments should be made with the greatest possible care, bearing in mind that the operation is essentially critical and that faulty trimming can completely spoil the performance of a receiver. The following are the principal points to be observed:

(1) When using a milliammeter indicator for I.F. trimming:—

- (*a*) Couple the I.F. output from the service oscillator to the receiver via a 0.1 mfd. condenser.
- (*b*) Short circuit the coupling coils L12 and L13, by connecting the wire strap between tag G and V2 cathode, to stop V2 triode oscillating.
- (*c*) Connect the series resistance and condenser combination referred to in paragraph four under "Apparatus Required," across the secondary winding of the 1st I.F. transformer when adjusting the primary, and vice versa.
- (*d*) While adjusting the trimmers always keep the milliammeter current at about 7 m.amps, using the attenuator to do so: this ensures that too strong a signal is not used.

(2) When using a voltmeter indicator (for R.F. trimming):—

- (*a*) Connect O.P. meter in series with 1 mfd condenser between V8 anode and E.
- (*b*) Keep the oscillator output sufficiently low to prevent A.V.C. coming into operation. This condition is fulfilled when the voltmeter specified is used.
- (*c*) Set the manual volume control at its maximum position: this ensures a readable deflection on the output meter with an input sufficiently small to justify (*b*) above.
- (*d*) Cut out the noise suppression by short circuiting V6 cathode to V7 cathode.
- (*e*) Close S8 by means of a crocodile clip.

The above points are summarised in Fig. 27.

N.B.—If a receiver is to be completely re-trimmed, the discriminator circuits must first be aligned, then the I.F. circuits, and finally the R.F. and oscillator stages. It should be emphasised, however, that normally it will not be necessary to adjust either the I.F. or the A.T.C. circuits, and the operation should only be carried out when the general symptoms indicate it to be required. (See fault finding tables under "Calibration" and "A.T.C.")

If the following points are fully grasped, the process of trimming will be greatly simplified:

Adjustments to the A.T.C. trimmers affect to some extent the adjustment of C21, C22, the 2nd I.F. trimmers, but the adjustment of the I.F. circuits does not affect the A.T.C. trimmer positions.

I.F. TRIMMING

A reliable calibrated oscillator with an accurate and clearly readable scale is absolutely essential for this work. On no account should adjustments be carried out to I.F. or A.T.C. circuits if this is not available. It should moreover, be periodically checked for accuracy as described on page 10.

(*a*) Disconnect the valve cap connector from V1 and interpose a 0—10 milliammeter, connecting the positive terminal of the meter to the anode lead and the negative terminal to the valve. The brass spring clip of a valve cap connector fitted with a terminal or nut provides a convenient method of connection to this point. Join the 0.1 mfd. condenser from the negative terminal of the meter to chassis. Connect V2 cathode to tag G (main condenser bank) by means of the shorting strap : this will stop V2 triode oscillating.

(*b*) Next connect the earth socket of the oscillator to the receiver earth socket, and take a lead from the oscillator aerial terminal to the grid of V4, via a 0.1 mfd. tubular condenser. This method of coupling is preferable to using a dummy aerial.

(*c*) Switch the oscillator to the I.F. range and to internal modulation, and tune it to 119 Kc/s. Then switch the set on and adjust C21 for *minimum* reading on the anode current meter. C22 must next be adjusted ; on rotating the trimmer between maximum and minimum capacity, it will be found that two " troughs " (lowest values of current) are obtained (see diagram), and C22 should be adjusted to the mid-point between the two, *i.e.*, to the point of *maximum* current between the two " troughs." Go back to C21 and repeat the adjustment and finish by a second adjustment to C22. In making these adjustments, the output from the oscillator should be set to a value which gives a convenient deflection on the meter (about 6—7 m.amps.).

While the effect of C21 is critical it is not apparently so, and small current variations must therefore be watched for particularly carefully. The effect of C22 on the other hand is readily noted. A reliable check upon the accuracy of adjustment of C21 and C22 can be obtained very simply as follows :

Swing the service oscillator dial from about 110 to 125 Kc/s. As this is done, it will be observed that the current indicated by the meter first falls, then rises, falls again, and then begins to rise. If the adjustment of C21 and C22 has been correctly carried out, the same reading will be obtained at the two points of minimum current. If the two readings are not equal, first re-trim C22 very carefully as described above, and then slightly readjust C21 until the two minimum readings are of equal value. The simplest method is to set the service oscillator to the frequency producing the smaller of the two " troughs," and adjust C21 in order to decrease the reading by half the difference between the two minimum current values.

Transfer the oscillator output to V2 Pen. grid (C1C) and switch the receiver to long waves. In order to damp the circuit, connect the 100,000 ohm resistance and 0.1.mfd. condenser previously mentioned between V4 grid and chassis, and adjust C19 for *minimum* current reading on the meter. Transfer the damping device to V2 Pen. anode, and adjust C20 in the same way.

When the I.F. trimmers are being adjusted it may be found that two distinct peaks can be obtained with each trimmer. This is only apparent, as the effect is due to physical distortion of the condenser plates when the screw is tightened, leading to a decrease in capacity. It is essential to adjust to the outer peak (*i.e.*, with the trimmer more unscrewed) as this places less strain on the plates.

This completes the adjustment.

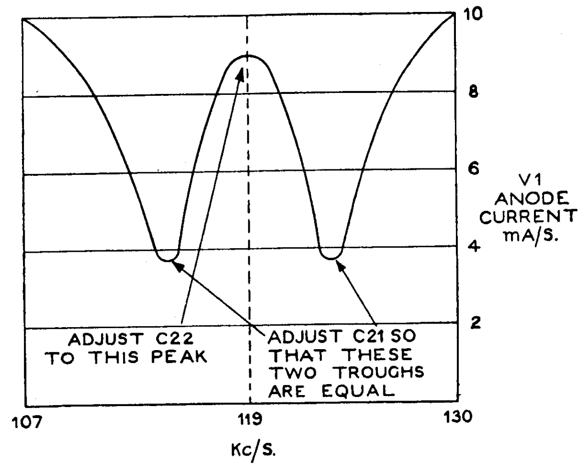


Diagram showing variation in V1 Anode Current with change in Intermediate Frequency.

A.T.C. TRIMMING

Before commencing operations make sure that S8 is open.

(*a*) Insert the 0—10 milliammeter, in V3 anode circuit as described for V1 under I.F. trimming: next remove from tag C the connecting wires, and join their ends together. Now connect V2 cathode to chassis with the short length of wire fitted with crocodile clips.

(*b*) Connect the service oscillator output between V4 grid and chassis, and adjust it to a frequency of 120½ Kc/s. Adjust C41 until *minimum* current is registered on the anode meter, *i.e.*, trim to the "trough." If the reduction in current is too great, so that the correct point cannot accurately be determined, reduce the output from the oscillator.

(*c*) Next set the service oscillator to 117½ Kc/s and trim on C42 to obtain *maximum* current reading. Finally, set the oscillator to 119 Kc/s and notice if any change in anode current results when the oscillator is switched off. If it does, slightly alter the setting of the oscillator dial above or below 119 Kc/s until a position is found at which no change occurs. Carefully read off the exact frequency from the oscillator dial: if this lies between 118½ and 119½ Kc/s, the circuit adjustment can be taken as satisfactory. If the frequency falls outside these limits, sufficient care has not been taken, therefore C41 and C42 should be readjusted.

Owing to the fact that the I.F. and A.T.C. circuits are closely interlinked, adjustment of the latter affects the former to some extent, consequently, when the A.T.C. adjustments are complete, the 2nd I.F. circuits C21 and C22 should be checked and slightly readjusted if necessary. When this has been done, there is no need to attend further to the A.T.C. trimmers.

R.F. TRIMMING

It is very seldom that a receiver is so badly out of gang that complete retrimming is necessary. In the majority of cases trimming will be carried out in order to correct calibration errors, in which case the oscillator trimmers only need be touched.

It must be remembered however, that adjustment of the medium wave trimmer should be followed by a check of the long-wave calibration, and adjustment of the long-wave trimmer if necessary.

For such adjustment the chassis need not be removed from it's cabinet as a hole is provided in the shelf supporting the receiver making it possible to reach the oscillator adjustment screws with a long bladed insulated screwdriver. If in addition to a calibration error the gain is low, it is advisable to check the R.F. trimmers also. Furthermore if a screened aerial system is employed the aerial trimmers may be adjusted with advantage. In either case, the chassis must be removed from the cabinet, but when the trimming is complete, it is necessary to make a final adjustment to the oscillator trimmers after the set is returned to the cabinet, as the operation of boxing, and the presence of an earthed metal screen on the cabinet shelf, may affect calibration appreciably. The adjustment of calibration with the set in its cabinet is given first, as being of more general use, and the complete R.F. trimming process is described subsequently.

CORRECTING CALIBRATION WITH CHASSIS IN CABINET

Medium Waves

(*a*) The A.T.C. circuit must be rendered inoperative before an attempt is made to adjust the oscillator trimmer. A convenient and effective method of doing so without removing the chassis from its cabinet, is to wedge a piece of cardboard between the tuning knob and the cabinet. Unscrew the dome nut slightly, pull the knob forward, insert the wedge and retighten the nut. The wedge should be sufficiently thick to hold the control in any position to which it is set against the tension of the spring and clutch device acting upon S8 and tending to keep the contacts open. In other words, its function is to maintain S8 in a closed position.

(*b*) Now tune to a station of a known wave-length between 220 and 265 metres, ignoring calibration. As only a weak signal is required, the aerial should not be more efficient than is necessary to obtain a small output with the volume control well over to maximum. This, of course, will be governed entirely by circumstances and in some instances just a few feet of wire will be sufficient.

(*c*) Switch the test oscillator to the I.F. range and cut out internal modulation. Connect the oscillator earth to that of the receiver, and attach a length of insulated wire to the remaining oscillator output terminal (a dummy aerial should not be used) making metallic contact. The wire should be long enough to reach well into the receiver; cut the free end so that no bare wire is left exposed and thread two or three inches of it through the hole in the metal screening cover of the H.F. transformer assembly. This is a convenient method of impressing an external I.F. voltage upon the grid of V2 Pen., so that it may beat with the I.F. voltage produced by the incoming signal.

(*d*) Make sure that the screening caps of V2 and V3 are pushed well down on the valves.

(*e*) Set the test oscillator dial to 119 Kc/s, when a whistle will be heard which will vary in pitch as the dial is moved to either side. Next set the tuning indicator of the receiver to the correct wave-length of the station being received, ignoring any resultant variation in signal strength. In carrying out this tuning operation, the control should be rotated smoothly and continuously in the required direction, thus ensuring that the switch S8 remains closed: no further adjustment should be attempted in the opposite direction, otherwise the switch contact may be broken.

(*f*) Proceed to adjust the oscillator trimmer C8 in the direction which increases the volume of the broadcast signal; simultaneously, the whistle will fall in pitch. Continue the adjustment until the trimmer is set to the position where the whistle vanishes, and where the slightest movement on either side causes it to reappear. As the screwdriver tends to introduce a capacity effect, causing a variation in the pitch of the beat note, due allowance must be made for this fact. This means that when the silent point is obtained on the trimmer, it may be necessary to screw slightly further inwards until the note commences to rise again. With a little care and judgment it will be possible to find an optimum point at which zero beat is produced when the screwdriver is withdrawn.

Long Waves

In order to correct an error on long waves, adopt exactly the same procedure as above, but select a station such as Luxemburg or one of lower wave-length, and trim C9.

If the screwdriver is inserted at an angle into the hole in the shelf, it will be found possible to locate the long-wave trimmer adjusting screw, provided that a screwdriver is used which approximates to the dimensions given under "Apparatus Required."

Adjustment on Broadcast Only

In general, the procedure is identical with that outlined above. The I.F. oscillator is dispensed with and a reliable station of known wave-length, within the limits already given (*i.e.*, between 220 and 265, or 1,000 and 1,305 metres) is tuned in to maximum strength. It is still necessary to wedge the tuning knob, and to work with a fairly weak signal.

Set the cursor to the correct wave-length of the station concerned, and trim C8 and C9 for maximum output, the latter, of course, applying to long-waves.

As the position of the screening caps of the AC/SP1 and AC/TP valves influence calibration to an appreciable extent, before commencing oscillator circuit adjustments make sure that the caps are pressed well down on these valves.

Adjustment in the Customer's Home

This can be quickly and conveniently carried out as described above, using a broadcast signal.

COMPLETE R.F. TRIMMING

When it is necessary to adjust the R.F. as well as the oscillator trimmers, the chassis must be removed from the cabinet. The procedure is as follows:

(*a*) Connect V6 cathode to V7 cathode, close S8 with a crocodile clip, and check medium-wave calibration against a broadcast station of known wavelength. If this is exact, proceed to (*b*) below. If it is not correct, adjust C8, as described previously under "Correcting Calibration." It is not necessary to wedge the tuning dial, as S8 is kept closed with the crocodile clip.

(*b*) Connect an output meter as described under "General Instructions." Join the R.F. oscillator (through the dummy aerial) between aerial and earth of the receiver. Switch the oscillator to internal modulation, adjust it to about 230 metres on the M.W. band, and tune in this signal on the receiver for maximum reading on the output meter.

(*c*) Now adjust in turn C6, C4 and C2 to increase this reading if possible. During this operation the input from the oscillator should be kept as small as possible compatible with a reasonable deflection on the meter.

(*d*) Switch the receiver to long-waves, and check the calibration. If this is correct, proceed at once to (*e*) below. If inaccurate, adjust C9 as described previously.

(*e*) Switch the R.F. oscillator to L.W. and to internal modulation, and adjust it to about 1200 metres.

Tune in this signal on the receiver to obtain the greatest reading on the output meter. Adjust the oscillator output to give a small reading on the meter.

(*f*) Now adjust C7, C5 and C3 in turn to increase this reading if possible.

(*g*) Replace the receiver in its cabinet, and bolt it down firmly. Now make final adjustments to C8 and C9 as described under "Correcting Calibration." This is necessary, because the mechanical effect of boxing, and the presence of the earthed metal screen on the cabinet shelf may alter the calibration to an appreciable extent.

Adjusting the Image Frequency Suppressor

This operation differs from other balancing operations in two ways: in the first place, the greatest possible output is required from the test oscillator, and secondly, the adjustment is for minimum and not maximum speaker response. The latter condition entails the use of the ear as indicator, as in this special case an aural test is more sensitive than one employing a meter.

The actual adjustment is as follows:

Join together the cathodes of V6 and V7, connect the output from the test oscillator between the aerial and earth sockets on the receiver and adjust the test oscillator to 333 metres. Set the attenuator to maximum, and tune the receiver to approximately 460 metres, when the test signal will be heard faintly; this is the unwanted image frequency. Short circuit S8, and adjust the set to receive the image as well as possible; then with an insulated screwdriver, adjust the erinoid screw situated at the top of the band pass secondary (grid) coil until the minimum signal is heard in the loudspeaker: this adjustment must be made with the can in position. When the operation is complete, any movement of the erinoid screw should cause the image interference to increase.

FAULT FINDING

GENERAL INSTRUCTIONS

It will be found when referring to the ensuing fault finding tables that various components are indicated as possible causes of failure, and their location will be apparent from the accompanying diagrams. No mention is made of the actual method of test to employ, however, as this would involve unnecessary repetition; instead, the following remarks may be taken as applying in a general way to all cases.

Obviously, the experienced service man will use the tables as a short cut to the diagnosis of faults. It is therefore catalogued in such a manner as to facilitate this and act as a general guide to servicing.

On the other hand, the list has been made sufficiently comprehensive to enable the junior commencing his career as a service man, and assistants who may be pressed into service work at a busy period, to locate faults with the minimum of assistance from more technical and experienced members of the staff.

There are two possible ways of ascertaining the cause of a fault indicated by an incorrect voltage reading or a complete absence of voltage. The first is by means of voltage tests, working backwards from the point at which incorrect voltage is apparent and allowing for the voltage drop which should take place across components in the particular circuit under test. The alternative method is to carry out resistance measurements or continuity tests between the point at which voltages are normal and that at which incorrect reading was obtained. For instance, a complete break in wiring or a component will result in a zero reading at, say, the anode of a valve and usually a somewhat *higher* reading than normal, at the next test point in the circuit at which a voltage reading can be obtained. This indicates an O/C conclusively and the method is obviously the quickest which can be employed as it merely necessitates two or three moves of the test prongs. If the lack of voltage is due to a short circuit to earth (S/C to E) the voltage reading will be *lower* than normal at the next test point at which reading is obtained. This being the case, continuity tests are carried out in order to discover the point in the circuit which gives the *lowest* resistance reading. From this point all wires should be disconnected and the branches tested separately, so that by a process of elimination, the fault is traced to a particular circuit or component.

In addition to the faults outlined, there remains the possibility of a short circuit component (S/C), in which case the voltage reading will be the same on each side of the component, and measurement of the D.C. resistance between the two points is necessary to obtain confirmation.

It may be taken as a general rule that variations in voltage within plus or minus 10% of those shown in the voltage tables are permissible and can be ignored. This of course only applies in cases where all voltages are high or low to the same extent.

Still generalizing, a short circuit to chassis (S/C to E) is usually caused by soldering tags making metallic contact with the chassis or earthed components such as screening cans.

With regard to short-circuits, very few components alter in value after assembly in the receiver, so, if tests indicate zero resistance across a component, wiring should first of all be suspected. This particularly applies to coils, and the possibility of a stray piece of wire causing the trouble should not be overlooked. In the case of a fixed condenser, there is slightly more likelihood of a complete S/C occuring, due to the breakdown of the dielectric. Even here, however, it is as well to check the possibility of external wiring being the cause. As a short circuit may give rise to an excessive flow of current through associated components, causing serious overload, it is important, in all cases where this fault is suspected, to disconnect the receiver from the mains before proceeding further with tests. For the same reason, in all cases where H.T. volts are found to be low, a test for short circuit or partial short should be carried out before proceeding to the fault finding tables.

The symptoms given by a specific fault often vary considerably, depending upon the degree to which a component is impaired. Weak signals may be obtained as a result of a partial S/C whereas a complete S/C would prevent any signals whatsoever from being received. In the same way, close to a powerful transmitter, weak broadcast signals may be obtained despite a fault which would result in no signals if the receiver were situated at a greater distance.

No signals and weak signals therefore fall within the same category, and the systematic stage by stage tests outlined in Table A are applicable to either. In addition, to add to the utility of the tables as a means of tracing faults from the symptoms given, Table B, which covers the more difficult faults which result in weak signals, is included. Similarly, the more usual faults are tabulated against the relevant symptoms under the various other headings.

MAINS TRANSFORMER

The principal faults which can occur in a mains transformer are :—

(1) Short circuited turns, giving rise to overheating and low voltage readings.

(2) Open circuit in windings.

(3) Leakage between windings or between windings and chassis causing hum, instability, or abnormal voltage readings.

(4) Mechanical faults, such as loose laminations or windings, causing buzz.

The usual symptoms given by the above faults are :—

(1) May cause the transformer to burn out, and will in any case produce a rise in temperature.

(2) Will be indicated by a zero voltage reading across the tags connected to the broken winding : before rejecting the transformer, examine the tag to make sure that the fault is not due merely to the winding lead out wire being disconnected from it.

(3) Can best be checked by the use of high reading ohmmeter or "megger" which should be connected between the windings after all wires have been removed, not forgetting those to the 6-way earthing tag. The resistance indicated should not be *less* than .5 megohm.

(4) If the buzz is due to loose laminations, the trouble can be cured by tightening the clamping screws. On the other hand, if the windings are loose, the only cure is to change the transformer.

The mains transformer may be suspected when the main H.T. voltage is low, or when zero voltage reading is obtained across the tags on the transformer terminal strip. Before finally rejecting the transformer however, remove from it all connecting wires, not forgetting those to the 6-way earthing tag, and retest. If the fault persists, whether it be a zero voltage reading (indicating an O.C. or S/C) or leakage between windings, the transformer must be replaced ; this will be found a simple matter, as all the external connections are shown in Fig. 35.

INTERMITTENT FAULTS

If the transformer is suspected of being intermittently faulty, the symptoms may sometimes be reproduced by pressing against the various windings in order to disturb the layers slightly. If such pressure causes the fault to reappear, even momentarily, the transformer may reasonably be blamed.

CONDENSERS

(1) **Open Circuit.** (O.C.) This fault may be checked by placing a condenser of like capacity in parallel with the suspected component.

(2) **Short Circuit** (S/C). A Galvo (Ohmmeter) test is necessary, and if the component is O.K., the reading obtained should be " infinity." Care must be taken to remove from circuit any parallel resistance.

(3) **Of wrong capacity.** The best check for incorrect capacity involves the use of a capacity measuring bridge (such as the "Mufer") or the capacity tester described in Measurement No. 2, issued to dealers some time ago. If such an instrument is not available, complete substitution with a condenser of the correct capacity will be necessary. A capacity bridge also gives reliable check on open circuit condensers.

RESISTANCES

These do not generally give much trouble. They may break down (through overload consequent on a condenser short) or become noisy; or they may develop high resistance. An ohmmeter is obviously indicated for testing here, and noisiness can generally be detected by tapping the suspected component. If in doubt, change the resistance provisionally.

VALVES

The simplest method is to have at hand a range of test valves which can be substituted. An alternative is to have a comprehensive valve test panel, which will indicate low emission, " softness," or low mutual conductance. To test for noisiness, however, it is best to tap the base of the valve with a rubber ring on the end of a pencil, or to tap the valve envelope lightly, when the defect should become apparent. If valves are tested by substitution, always make sure first that the voltages at the electrodes are normal, to avoid the risk of harming the test valves. The method of checking V3 is described on page 52.

COILS

The D.C. resistance of a coil gives a fairly reliable indication of its condition. For this purpose an ohmmeter capable of reading down to about ¼ ohm is required. A quick method of testing coils is as follows.

To test L3, L4, L5, L6, connect the ohmmeter across C1A. Place switch in L.W. position. Resistance should then be L3 + L4 + L5 + L6 = 17.4 ohms. Now switch to M.W. This shorts out L4 and L5, so the reading should now be L3 + L6 = 4.4 ohms.

SWITCHES

These should be tested with a low reading ohmmeter to make sure that they are opening and closing correctly. If the COILS are tested as described above, the action of the switches is automatically checked.

TRANSFORMERS AND CHOKES

These can generally be tested by taking resistance readings. Occasionally a high resistance leak to chassis or a few shorted turns may cause trouble; the first really needs a high reading ohmmeter or a megger to detect it while the best check for the second is comparison with a substitute.

VOLTAGES AND CURRENTS. A28C AND RG

The following table of voltages and currents is given as a guide only—considerable variations may occur without necessarily detracting from the efficiency of the receiver.

Owing to the inclusion of A.V.C. and noise suppression in the A28, the various voltages depend to some extent on the strength of the applied signal. For this reason, certain readings were taken with and without a strong signal in order to give an idea of the changes to be expected under working conditions. A weaker or stronger signal used in taking these measurements will, of course, give correspondingly different variations.

In the case of RG models, certain voltages will be found to change, when the instrument is switched to the " gramophone " position: accordingly such voltages are given for both positions of the gramophone switch. Except where otherwise stated, voltages are to chassis, and are obtained with a " 1000 Ohms per volt " meter, using 250v. range wherever possible.

Valve	Electrode		No Signal volts.	No Signal mAs	Strong Signal volts.	Strong Signal mAs
VI	A	Radio	215	10	260	1.0
		Gram.	260	—	—	—
	SG		215	—	260	—
	C	Radio	3.5	—	0.5	—
		Gram.	30	—	—	—
V2 Pen.	A	Radio	185	—	235	—
		Gram.	250	—	—	—
	SG		175	—	240	—
	C	Radio	4	—	1.5	—
		Gram.	30	—	—	—
V2 Triode	A		50	—	50	—
V3	A		230	2.5	—	2.5
	SG		230	—	265	—
	C		12	—	13	—
V4	A		230	10	265	5.0
	SG		230	—	265	—
	C		2	—	1	—
V5	D1A					
	D2A					
	C		20	—	25	
V6	D1A		1	—	—	—
	D2A		7	—	—	—
	C		7	—	—	—

Valve	Electrode		No Signal volts.	No Signal mAs	Strong Signal volts.	Strong Signal mAs
V7	A	Radio	215	0	170	4
		Gram.	140	3.5	—	—
	S.G.		230	—	265	—
	C		20	—	25	—
V8	A		230	27	265	32
	SG		230	6.5	265	7
	C		4.5	—	5.5	—
V9	A1	A.C. voltage to chassis.	300	—	300	—
	A2	A.C. voltage to chassis.	300	—	300	—
	F	D.C. voltage to chassis.	375	—	385	—
H.T. Line Voltage.		Tag of C52 to chassis.	250	—	270	—
Voltage across L.S. Field.		Between C52 and C53.	125	—	115	—

CONSUMPTION FROM MAINS

100v and 200v	50 cycle	92 watts	A28C
	25 cycle	95 watts	
200v	50 cycle	107 watts	A28RG
	25 cycle	140 watts	
100v	50 cycle	107 watts	

NO SIGNALS, or VERY WEAK SIGNALS

A. ON EITHER WAVE-BAND

(1) Apply pick-up or other A.F. voltage between V8 cg and chassis, and turn receiver volume control to half way position.
If signals are heard proceed at once to (2) below.
If no signals, check V8 by substitution.
If still not OK check voltages of V8.

All Volts O.K. Check T1 Sec, L.S. (speech coil) for O/C or S/C ; R32, R19 for S/C to E ; C51 for S/C (with tone control at deep).

H.T. Volts Low or Zero. Remove power plug from socket and check for S/C to E, from Main H.T. line (Continuity test). If S/C is indicated disconnect H.T. wires (mostly pink) until cause is located. If no S/C is indicated replace power plug and check V9, T2 windings for O/C or S/C; C52, C53 for S/C; L27 (L.S. Field) for O/C or S/C to E ; L18 for S/C to E ; T1 prim. for O/C or S/C to E ; S9, C47, C51 for S/C to E ; Power Cable for O/C or S/C between pins-Plug and socket for contact.

Anode Volts High. Check R33 for O/C (check C49 which is subjected to overload in the event of R33 being O/C).

(2) Transfer pick-up to V7 cg and chassis, connect V6c to V7c, to eliminate noise suppresion, and turn volume control to maximum.
If OK proceed to (3) below.
If not OK check V7 by substitution.
If no improvement, check voltages of V7.

All Volts OK. Check C47, R32, R19 for O/C or S/C to E.

Anode Volts Low or Zero.
Check heterodyne filter, R31 for O/C or S/C to E ; C47 for S/C to E.

Anode Volts High. Check R27, R28, R29 for O/C; R25 R26, C37 for S/C to E. (In the event of R27, R28 or R29 being O/C., check C48 which is subjected to overload.)

(3) Apply pick-up across R17 leaving V6 and V7c connected together. The output should now be weaker than at (2) above, and may be slightly distorted ; this can be taken as normal.
If no signals, check V5 by substitution. If no improvement check C37, C36, R18 for O/C or S/C to E; C35, R17 for S/C or S/C to E; C22, L22 for S/C to E.

(4) Connect modulated test oscillator (at 119 K/C.) to V4cg.
If a normal test signal is heard, proceed to (5) below.
If no signal, check V4 and V5 by substitution.
If no improvement check voltages of V4.

All Volts O.K. Check C20. L20 for S/C or S/C to E; L21 for S/C; L22 for O/C or S/C; C21, C22 for S/C; C35 for O/C.

Anode Volts Low or Zero. Check L21 and anode lead for O/C.

Cathode Volts High. Check R16 for O/C.

(5) Remove connection between V6 and V7 cathodes.
If OK proceed to (6) below.
If no signal, check V6 by substitution.
If no improvement check V6 heater volts.

Heater Volts O.K. Check C40, for O/C; C42, C44, L24, R35 for O/C, S/C or S/C to E ; R14, R15, R30 for S/C to R43, (on No. 1 panel Fig. 23.)

Heater Volts Low or Zero. Check power cable plug and socket for O/C or S/C ; T2 heater winding for O/C or S/C.

(6) Transfer test oscillator, still at 119 K/C to V2 Pcg (at junction of C1C and screened grid lead) and switch receiver to L/W.
If OK proceed to (7) below.
If no signals, check V2 by substitution.
If no improvement, check voltages of V2 Pen.

All Volts O.K. Check L20 for O/C; C19, L19 for S/C; C16 for O/C; R4 for S/C to E; C1C, C6 for S/C; V2 grid lead for O/C or S/C to metal braid.

Anode Volts Low or Zero. Check L19 for O/C or S/C to E; C19 for S/C to E; C16 for S/C to E; R9 for O/C or S/C to E.

Anode Volts High. Check L12, L13, R7 for O/C.

Screened Grid Volts Low or Zero.
Check R6 for O/C or S/C to E; C15 for S/C or S/C to E.

(7) Leave the test oscillator connected to V2 Pcg. Switch it to L/W and adjust to about 1200 metres ; endeavour to tune in the signal on the receiver.
If OK proceed to (8) below.
If no signal is heard the fault must lie in the oscillator valve circuit. This is proved by the fact that an I/F signal applied to V2 Pcg. was reproduced, but no signals were obtained on substituting a radio frequency.
The next step therefore is to check V2 Triode and V3 by substitution.
If then OK, check C30 for O/C.
If not OK, check voltage of V2 Triode anode.
If no improvement remove V3 anode cap.

Anode Volts O.K. Check C25, C1D for O/C; C9 for S/C; C24 for O/C; L12, L14 for S/C; L12, L13, L14, L15 for S/C to one another. C17, R8 for O/C, S/C or S/C to E; R9 for S/C; C25, C18 for O/C.

Anode Volts Low or Zero. Check R10, L14, L15 for O/C or S/C to E; C25 for S/C to E; L16 for O/C; C8, C1D for S/C; R11 for S/C to E; V3 anode lead for S/C to metal braid or E.

Anode Volts High. Check C25, R10 for S/C.

(8) Transfer the test oscillator, still set to L/W to the junction of C10 and C1B and endeavour to tune in the test signal.
If OK proceed to (9) below.
If no signal, check V1 by substitution.
If no improvement check voltages of V1.

All Volts O.K. Check L9 for S/C; L10, R4 for O/C or S/C to E; C14 for O/C; C10 for O/C or S/C to E; R1, L7, C4, C1B for S/C to E.

Anode Volts Low or Zero, Screen Volts O.K. Check L9 for O/C.

Anode and Screen Volts Low or Zero. Check R3 for O/C; C13 for S/C.

Cathode Volts High. Check R2 for O/C.

(9) Connect the test oscillator, still adjusted to L/W, to C1A flexible lead on panel 3. Endeavour to tune in signal.
If OK proceed to (10) below.
If no signal, check L3, L7, L6 for O/C, S/C or S/C to E; C1A, C2, C5 for S/C; S2, S3 for S/C to E; C3, C4 for S/C.

(10) As signals were obtained at C1A, but not when connected to the aerial socket, the fault must lie in either L1 or the associated wiring. Check L1 for O/C or S/C to E; L/O and C/O for O/C (wiring).

B. On M/W only L/W O.K.

(1) Check action of S1, S2, S3, S4, S5, S6, S7. S7 and S4 open on M/W. S1, S2, S3, S5, and S6 close on M/W. Check C24 for S/C; L1, L3, L6, L7, L10, L12 and L14 for S/C.

(2) No signals M/W weak signals L/W. Check for C30 O/C.

C. On L/W only M/W O.K.

(1) Check action of S7 and S4 (closed on L/W) and S1, S2, S3, S5, S6 (opened on L/W). Check L2, L4, L8, L11, for O/C, S/C or S/C to E; L5 for O/C or S/C; C3, C5, for S/C; R5, C23 for O/C; L13, L15 for S/C.

WEAK SIGNALS

In general, tests for the cause of weak signals may be made in the same manner as outlined for NO SIGNALS. However, a few of the more difficult faults are given below, as they may lead to a quick diagnosis of the trouble.

(1) Very low gain M.W. Low gain L.W. ..... C31 O/C.
(2) Low gain L.W. calibration low .... C29 O/C.
(3) Low gain 900 metres .... C38 O/C.
(4) Low gain L.W. and M.W. .... C16 O/C.
(5) Low gain L.W. .... C15 O/C.

If a quick test of the above components does not reveal a fault proceed as instructed under " no signals."

INTERFERENCE

General Instructions

In all cases of interference with reception, it is necessary, in the first place, to ascertain whether this is due to external causes such as " man made static " or to a defect in the instrument.

It is insufficient to short circuit A to E as a check; in addition, V5 and V6 cathodes should be joined together in order to remove noise suppression. If the actual centre pins of these valves are joined it is unnecessary to remove the chassis from its cabinet when modifying the receiver in this way. If crackles are not heard under these conditions with the volume control at maximum, it is a reasonably clear indication that the set is not responsible.

An outstanding exception is the case in which there is high resistance or a badly soldered joint in tuned circuits, including the variable tuning condenser, a condition which usually does not give rise to crackle in the absence of H.F. currents due to a strong carrier.

Among the causes of interference or crackles are:—

(*a*) Intermittent s/c or o/c in fixed condensers.
(*b*) Dust between variable condenser vanes or poor connection between the rotor spindle and contact brush.
(*c*) Defective resistance elements.
(*d*) Partial breakdown of transformer, choke, or coil windings.

More usually, however, symptoms of this nature will be due to dry joints, imperfect connection at a plug and socket, or between an earthing tag and chassis, or to a partial short circuit between a component at H.T. potential and an earthed screen or the receiver chassis.

There are therefore two main principles to observe when attempting to diagnose faults of this nature. First of all, carefully work through the fault finding table in order to localise the fault in one particular stage. Secondly, carry out a microscopic examination of all wiring, screen leads and components, including coils, in the suspected stage. In this connection, full use should be made of such expedients as: physically distorting component assemblies; applying pressure to the outer case of a block condenser bank, or to the windings of a mains transformer; and lightly tapping valves with a piece of india-rubber. A piece of rubber is also extremely useful for applying pressure to switch contacts as a check upon their efficiency. Faults in quick break toggle switches are often intermittent in character and can sometimes be provoked by moving the control knob very slowly while switching on and off, watching carefully for arcing during the process.

If it is found that noise is heard only when a signal is tuned in, it must not be assumed that the fault is outside the receiver; such symptoms do, however, establish that the fault occurs prior to V7 or the circuits associated with V6. In the absence of a signal, V7 is inoperative, and the crackle disappears. The following systematic step by step tests greatly simplify location of the faulty component.

(1) Short V6 to V7 cathodes to remove noise suppression.

(2) Turn down volume control.
If noise stops, turn up volume control and proceed to (3) below.
If noise continues, suspect V8, T1, R33, R43, C49, C51, L.S. speech coil or field, S10 a, and b, T2, V9, C52, and C53. L18. Power cable and socket.

(3) S/C V7 control grid to chassis.
If noise stops proceed to (4) below.
If noise continues, suspect V7, audio filter, R30, R31, R19 and C47.

(4) S/C R17.
If noise stops, proceed to (5) below.
If noise continues, suspect C36, C37, R18, and R25.

(5) S/C V4 grid to chassis.
If noise stops, proceed to (6) below.
If noise continues, suspect V4, L21, L22, L23, L24, C21, C22, V5, C34, C35, C38, C39, C40, and examine wiring in 2nd I.F. and discriminator coil cans for H/R joints.

(6) S/C V2 Pen control grid to chassis.
If noise stops, proceed to (7) below.
If noise continues, S/C V2 cathode to tag G.
If noise then stops, suspect V2, R10, C25, C1D, C8, C9, R8, C17, C18 and examine wiring in oscillator coil can, for H/R joints.
If noise continues, however, remove V3 anode cap connector.
If noise still continues, suspect V2, L19, L20, C19, C20, R6, R9, C15, C16, C23, C24, R7, R11 and C26.
If noise stops when V3 anode cap is removed, suspect V3, C27, C28, C29 and C30, R12 and R13.

(7) S/C V1 control grid to chassis.
If noise stops, proceed to (8) below.
If noise continues, suspect V1, R3, C13, S4, L9, L10, L11, C14, C6, C7, C1C, and examine wiring of H.F. transformer for H/R joints.

(8) S/C C1A fixed vanes to chassis.
If noise stops, proceed to (9) below.
If noise continues, suspect C1B, C4, C5, S3, L7, L8, L5, L6, C10, R1, and examine wiring of grid coil assembly for H/R joints.

(9) S/C aerial to earth socket.
If noise stops, fault lies in L1, L2, L0, C0, S1, aerial or earth.
If noise continues, suspect C1A, L3, L4, C2, C3, S2, and examine wiring of aerial coil assembly for H/R joints.

INSTABILITY AND DISTORTION

Whistles on Carriers with weak signals. Check C33 for O/C.

Motor boating with Volume Control at maximum when tuned to powerful station. Check C46 for O/C.

Motor boating or howl on L/W, no signal on M/W. Check C30 for O/C.

Distortion, tendency to blast, or whistle. Check V7 outer grid circuit for O/C or H/R joints.

Weak muffled signals, noise between stations. Check V3 and V7 by substitution. If no improvement, check wiring of V3 and V7 outer grid circuits for S/C to H.T. feed lines. In particular check R14, R15 and R30 for S/C to R43 (on No. 1 panel).

HUM

With Volume Control at minimum. Check all valves by substitution. Check E tag No. 1 panel for contact.

With any setting of Volume Control. Check all valves by substitution. Check C49 for S/C.

Only when tuned to a carrier wave. Check all valves by substitution. Check insulation resistance between L/T secondary windings of T2.

CALIBRATION ERRORS

Owing to the effect of A.T.C. there is a possibility that what really constitutes a calibration error may be mistaken for an A.T.C. fault.

This is explained by the fact that the A.T.C. action is judged superficially by the extent to which a station pulls in from either side of the graduation corresponding to its wavelength.

Under normal circumstances this embraces a band of about 12 Kcs on either side; if therefore calibration is inaccurate by say 6 Kc the station willl appear to pull in by 6 Kcs from one side of the graduation corresponding to the wavelength of the received station and by 18 Kcs from the other. This effect is only apparent however and is entirely due to the wavelength markings being displaced to the extent of the calibration error.

Obviously, therefore the only reliable way of checking calibration is to short-circuit S8, and to tune to maximum signal strength. A D.C. voltmeter (range 0—250v.) connected between V1SG and chassis will provide visual indication of this adjustment, exact resonance being denoted by maximum voltage readings.

Practical Faults

(1) UNIFORM WAVELENGTH ERROR ON BOTH WAVEBANDS. GAIN NORMAL.
Check condenser drive and cursor system, see page 36.
If OK, refer to (8) below.

(2) CALIBRATION LOW AND LOW GAIN ON L.W. C29 o/c.

(3) CALIBRATION LOW OR HIGH L.W. ONLY. INACCURACY GREATER AT 1,000 METRES.
Adjust C9 (and check other L.W. and M.W. trimmers).

(4) CALIBRATION LOW OR HIGH L.W. ONLY. INACCURACY GREATER AT 2,000 METRES.
C23 wrong value or I.F. trimmers out of adjustment.

(5) CALIBRATION LOW OR HIGH M.W. AND L.W. ERROR GREATEST AT 200 AND 1,00 METRES.
Adjust C8, C9 and check other M.W. and L.W. trimmers.

(6) CALIBRATION HIGH M.W. AND L.W. ERROR INCREASES TOWARDS 550 AND 2,000 METRES.
Suspect C24 low capacity, or I.F. trimmers out of adjustment. Check V3 (see page 52).

(7) CALIBRATION LOW M.W. AND L.W. ERROR INCREASES TOWARDS 550 AND 2,000 METRES. Check V3 (see page 52).
If O.K., suspect I.F. trimmers out of adjustment.

(8) A uniform calibration error, not due to mechanical effects, can be attributed to a combination of the faults indicated above. As a first step, trim C8 and C9 in order to correct the error at the lower end of the scale. The extent and position on the scale of any remaining error will determine to which fault finding table reference should next be made.

(9) If, after a set has beeen completely re-trimmed and the value of the padding condenser checked, the calibration is found to be still inaccurate, the fault will lie in either the oscillator coil or the gang condenser. If the error increases or decreases gradually, as the set is tuned from 200 to 550 metres or from 900 to 2,000 metres, the coil will most likely be at fault. If on the other hand the error is irregular in in that it first increases and then decreases (or vice versa) the ganged condenser can safely be blamed.

A.T.C. NOT WORKING CORRECTLY

Before deciding that the A.T.C. is at fault, make sure that the trouble is not of a mechanical nature. The cursor operating cord may have slipped, or the drum may not be correctly positioned on the condenser spindle. Instructions for correctly adjusting these items are given on Page 36.

(*a*) SET PULLS OUT OF TUNE EVEN WHEN ACCURATELY ADJUSTED.
Check V6 for loss of emission (by substitution). Check components and wiring in the discriminator coil cans for O/C or S/C. Note particularly that the iron cores in the coils are not loose, check C18 for O/C. If O.K. check the adjustment of the A.T.C. trimmers C41 and C42.

(*b*) SET PULLS IN FROM ONE SIDE ONLY—QUALITY O.K.
Check that S8 is opening correctly.
If O.K., check V3 (see page 52).
If O.K., check adjustment of C41, C42.
If O.K. suspect C45 S/C.
Calibration may be faulty, giving erroneous impression. (See remarks under " Calibration errors.")

(*c*) SET PULLS IN FROM ONE SIDE ONLY, QUALITY VERY WOOLLY, BUT O.K. WHEN S8 IS CLOSED.
Check V3.

(*d*) SET WILL NOT PULL IN FROM EITHER SIDE, OR DOES SO INTERMITTENTLY.
CHECK S8 (NOT OPENING). C38 for S/C; C50 for S/C; C26 for O/C; C27 for S/C.
L.W. ONLY NOT PULLING IN. CHECK C28 for S/C.

(*e*) SET ONLY PULLS IN FROM BELOW AND PULLS OUT WHEN PUT IN TUNE.
Check adjustment of C41, C42, and I.F. trimmers.

(*f*) If the A.T.C. works only at certain settings of the dial, this may be due to the "U" spring riding out of the groove of the roller on S8 switch arm.

MECHANICAL

CONDENSER DRIVE ADJUSTMENT

When correctly set, the condenser stop should come into operation at the same time as the cursor locates with the mark at the top of the long-wave scale (above 2,000 metres). The scales of certain earlier receivers are not graduated above 2,000 metres, so 550 metres should be used as a reference mark in sets of this series. If the cursor is found at its maximum position to be either above or below the correct mark this must be corrected, or calibration errors may ensue. Correction is not difficult, although care is necessary. The procedure is as follows. (See Fig. 33.)

The first step is to ensure that all screws connected with the drive mechanism are quite tight. These include the drum clamping screws, all pulley bracket screws, the stop fixing screws (which can be reached, one at a time, through the hole in the drum), the condenser drive spindle bracket, and the "U" spring bracket. Having done this, turn the drum anti-clockwise to its stop. Grip the free ends of the cursor cord with pliers, slacken the two screws by which it is clamped, and adjust the relative lengths of the cord ends until the cursor takes up the correct position. The cord tensioning arm should be in a position equidistant from the spindle and the rim of the drum, to give the correct degree of tension. Make sure that the cord clamping screws are tight after adjustment.

A.T.C. SWITCH ADJUSTMENT

A correctly adjusted A.T.C. switch makes contact on either side, no matter how slowly the spindle is turned, and breaks contact as soon as the spindle is released, at all points of the cursor travel. Two main adjustments are provided — the position and stiffness of the "U" spring, and the position of the drive spindle. The spring fixing may be moved after slackening the two screws of the spring bracket, and should be placed so that the normal position of the moving switch arm is midway between the fixed contacts. If the spring is too stiff, the switch will not make contact when the spindle is turned slowly, if it is too weak, the switch will not break contact on releasing the spindle. If it is necessary to bend the spring slightly, care should be taken that it remains flat, and that the inner ends of the Vees are opposite, otherwise it may ride over the roller grooves.

The drive spindle should rotate freely in its bearings, at both of which there should be visible end clearance, this being governed by the position of the drum on the condenser spindle. Both bearings may be lubricated.

REPLACING A DRIVE SPINDLE AND SWITCH ARM ASSEMBLY

Remove the flexible wire from S8 contact, and unsolder one side of the bare wire bridging the two fixed contacts. Disengage the "U" spring from the small brass rollers, rotate the tuning condenser to maximum position, and unscrew the bracket which acts as a bearing for the drive spindle. Loosen the grub screws holding the drum to the main spindle of the condenser and draw the drum slightly forward.

The drive assembly will be found free and can be lifted clear. Care should be taken not to disengage the drum completely, or to allow the drive cord to slip off the rim. Having proceeded this far, the method of fitting the new drive should be apparent, and providing care is taken not to stretch the cord or rotate the main condenser spindle, calibration will not be affected. The condenser should be at maximum when the drum is engaged with its stop.

In order to insert the flanged edge of the drum between the spring-loaded bush and the collar of the drive spindle, it is necessary to lever the two latter items apart against the action of the spring. This can most easily be done with the aid of a screwdriver, after completely assembling the drive, but before finally tightening up the bearing bracket. Care should be taken over this operation to avoid damage to the driving faces.

PROVIDING PICK UP CONNECTIONS ON THE A28C.

In order to provide for gramophone reproduction with the A28C, it is necessary to connect the pickup in the grid circuit of the L.F. valve V7 so that sufficient amplification may be obtained. At the same time, the radio side of the receiver must be disconnected to prevent break-through of radio signals during the playing of records. Moreover, it is essential that the outer grid of V7 should be brought to cathode potential to enable this valve to function correctly as an amplifier. All these modifications are carried out by a four pole change-over switch, and will actually be found in the A28RG, so that the modified A28C should correspond exactly to the former model. Fig. 34 shows the changes involved.

It will be necessary to fit a bakelite panel of the type used in the A28RG. This carries three sockets, marked P, U and C, and is pierced with a half-inch diameter hole to accommodate a four pole change-over switch.

The complete list of components and material required is as follows:

One A26RG change-over switch.
One A28RG pickup socket panel assembly.
One ¼ watt resistance 100,000 ohms.
One ¼ watt resistance 49,000 ohms.
5—6BA ¼" screws with nuts.
One 6BA soldering tag.

These may all be obtained from the Service Department for the inclusive price of 6/-, which is subject to the usual discount of 27½%.

PRACTICAL DETAILS OF THE WORK

Unfasten the tone control switch from its panel, and remove the latter from the chassis by drilling out the four aluminium rivets. Now fix the new panel in position by means of four of the ¼" 6BA, round headed screws and nuts. This done, the tone control switch may be remounted on the new panel.

Next mount the R.G. change-over switch in the ½" diameter hole. Remove the wire link between tags D and J (on the main condenser bank) and connect in its place the 49,000 ohms ¼ watt resistance: the wiring may now be commenced. The diagram shows the alterations necessary; C37, which is mounted on Sub-Panel No. 2, must be disconnected from the junction of C36, R18, and its free end connected to the soldering tag, which is secured to the panel with a 6BA screw and nut. The leads to be connected are ten in number. They are as follows:

(1) From "C" socket to earthed side of V7 heater.
(2) From "U" socket to contact "8" on the R.G. switch, and to V7 cathode.
(3) From "P" socket to RX (see text).
(4) From other side of RX to contact 5, of change-over switch.
(5) Strap together contacts 2 and 6 of switch.
(6) From switch contact 1 to junction of R18, C36.
(7) From switch contact 2 to C37.
(8) From switch contact 7 to V6 cathode.
(9) From switch contact 3 to Tag J.
(10) From switch contact 4 to "C" socket.

It will be seen from the wiring diagram that the output from the pickup is not applied directly to V7 grid, but through the resistance RX. This has a value of 100,000 ohms, and its purpose is to prevent V7 overloading; RX and R28 form a fixed potentiometer which halves the applied voltage. This arrangement will be found suitable for a pickup whose sensitivity is of the same order as that used on our radio-gramophones, but if a pickup having a much larger output is used, such as the piezo electric type, it will be necessary to mount an additional resistance on the motor

board in series with the pickup lead connecting to RX, in order to prevent overloading. The value of this resistance will depend on the sensitivity of the pickup, but in general it will lie between 50,000 ohms and 1 megohm, and is best determined by trial as follows:

Select a softly recorded disc, and set the receiver volume control at maximum. Then try a few different values of resistance until one is found which is judged to give the full output from the speaker without any overloading. If a high value is dictated by these requirements, it may be necessary to shunt the pickup itself with a resistance of .25 to .5 megohms to prevent the reproduction becoming unduly shrill. (Or becoming muffled in the case of the piezo electric type.)

The modification to the chassis is now completed, but it will be necessary to cut a slot in the cabinet back to clear the R.G. switch and sockets. This can be done by extending the existing hole for the tone control switch so that the total length is four inches and the width ⅞ inches, to correspond with the slot on the left-hand side of the back. The woodwork is sufficiently thin to be cut with a fret saw or fine hack-saw blade, and the exposed edges may be stained black.

FITTING A VARIABLE TONE CONTROL

If the A28C is modified as described above, it may be an advantage to fit a variable tone control in order to allow for variations in the quality of records. In addition the control can, of course, be used on radio programmes.

The alterations necessary are simple. First, disconnect and remove S9 (the existing tone control switch) from its panel, and mount in its place a 50,000 ohms variable resistance. Connect the wires which previously went to the two sides of S9 to the middle tag and one outer tag of the variable resistance. Then remove R43 (see Fig. 23) from Panel 1, and wire in its place a ½-watt resistance of 25,000 ohms. This completes the modifications.

A28 RADIO-GRAMOPHONE

THE CIRCUIT

If the circuit diagrams of the A28C and R.G. are compared, it will be seen that they are essentially similar. The differences which do exist are connected with the switching arrangements, carried out by S12 *a*, *b*, *c* and *d*. (See Figs. 1 and 2.)

S12 *b* and *c*, are arranged to change the connections of V7 grid circuit from V5 diode load to the pickup, while S12 *d* connects R30 to V7 cathode, thus removing the bias on V7 outer grid, and allowing the valve to act as a normal amplifier.

A resistance (R45) is interposed between the low potential ends of C11, C18, C24, R2, R7 and chassis: as this resistance is in the cathode circuit of V1 and V2 Pen a large bias is applied to these valves. In addition, V2 Triode is prevented from oscillating, owing to the fact that R45 is in series with the tuned circuit, and consequently introduces a large amount of damping. These various precautions are taken in order to prevent radio break-through when records are being played. R45 is shorted out for radio reception by S12 *a*.

The pickup itself is connected between V7 cathode and C37, but a resistance (R44) is placed in series with it in order to limit the A.C. voltage applied to the valve.

PRACTICAL LAYOUT

Here again, the only differences are the few additional components required for record reproduction. On the chassis itself S12 (shown in Fig. 41) is mounted on the tone-control switch panel, on which are also three sockets for the pickup connections. R44 is attached directly to the "P" socket and S12.

Owing to the switching arrangements, one or two alterations will be found in the sub-panels and assemblies, consequently additional diagrams are given of the W.2500 bank and the W.2588 assembly. (Figs. 30 and 26.)

It will be noticed that a resistance (R45) replaces the wire link between tags D and J on the W.2500 bank. In all other respects, the arrangement of the bank is identical with that in the console model.

DISMANTLING

THE RECEIVER CHASSIS

To remove the chassis from the cabinet, first take off all the control knobs, (carefully preserving the shakeproof washers), unplug the loudspeaker leads from the sockets at the rear, loosen the four screws holding the wooden back in position, and lift the latter sufficiently to allow the flexible wires attached to it to be unplugged from the chassis. The back can now be removed completely, but care must be taken that the metal cowl does not foul the valves.

Take out the pickup plugs from the sockets on the right-hand side of the receiver, and unclip the metal link from the radio-gramophone switch dolly, by pulling the link outwards.

Remove the 10-way plug from its socket on the power unit, and disengage the cable and the mains lead from the retaining clip attached to the cabinet.

With a ¼″ Whitworth box spanner or a large screwdriver, remove the three holding down bolts, working from below the shelf holding the chassis. The chassis should be withdrawn straight out from the back : if it is swivelled or tilted in any way, the under-frame of the escutcheon may damage the pilot lamps.

THE POWER UNIT

This is held in position by three bolts projecting through the floor of the cabinet. Working from the back, if the cabinet is tilted forward, they can be removed quite easily, and there is no risk of the power unit sliding bodily out of the cabinet.

THE MOTOR BOARD

This may be removed as follows. Unplug the pickup leads from the receiver, and the motor plugs from the power unit, detach the earthing lead from the speaker, and allow them to hang loosely so that they will pass easily through the hole in the cabinet when the motor board is withdrawn. Now detach the upper end of the R.G. switch operating link from the crank arm to which it is held by a single nut. Next remove the twelve wood screws securing the motor board. To enable the three at the rear edge to be unscrewed, it is necessary to remove the lid stay from the lid. Two screws hold this in position : if the upper one is removed first, the second one can be reached more easily.

The motor board may now be lifted out, but great care should be taken not to scratch the cabinet with either the metal plate or the crank arm. To this end the motor board should be lifted upwards and to the left so that the crank arm may clear the cabinet. The motor board also is easily scratched and should be carefully handled.

REPLACING THE MOTOR

Removing the motor and fitting a new one does not present any difficulty, as there are only three fixing screws to be released. It is, however, *most important* that the motor should be re-fixed so that the spindle falls exactly in the centre of the hole in the motor plate. Some form of jig is advisable to obtain the degree of accuracy which is necessary if the auto-stop mechanism is to function correctly and without undue noise.

GRAMOPHONE FAULTS

NO SIGNALS ON GRAMOPHONE, RADIO O.K.

This is obviously due to a fault in the pickup, the pickup leads or the change-over switch, S12.

The pickup should be given an ohmmeter test for o/c or s/c, and the switch action should be checked to ensure that S12C and S12D both close with the switch in the gramophone position.

RADIO BREAKTHROUGH ON GRAMOPHONE

This can be caused by a short circuit across S12A or the associated wiring, or by failure of S12A to *open* with S12 switched to gramophone.

DISTORTION ON GRAMOPHONE ONLY

There are two points to be checked here:

(*a*) Check that S12B is *open* for gramophone.
(*b*) Check R44, which may be shorted out.

THE MOTOR BOARD

Fig. 43 shows the plan view of the motor board as fitted to the A.C. radio-gramophone. The turntable is omitted in order to disclose the details of the auto-stop mechanism, the names of all the principal parts of which are given.

The various parts are shown in the positions they occupy when a record has just been played and the pickup returned to its rest. Thus the switch lever is in the "off" position, and is in contact with the adjustable stop M. A brief description will be given of the action of the mechanism, in order to make clear the function of each part.

The motor is switched on by moving the pickup to the right: this causes the pin H to engage with the switch lever, thus throwing the motor switch K to the "on" position. Simultaneously another pin O on the tracking link moves the tracking lever to the right, and this, acting through the friction device, causes the tracking arm to withdraw the switch lever away from the motor spindle to the fullest extent of its travel.

When the pickup is moved to the left and the needle placed on the record, the tracking link is carried to the left also, and, due to the action of the radius arm, moves away from the pin L on the switch lever. During the playing of the record this action is continued until a diameter of six and a half inches is reached, when a third pin R on the tracking link engages with the tracking lever, and, acting through the friction device as before, but in the opposite direction, causes the tracking arm to slide the switch lever slowly towards the motor spindle.

With the needle at about six inches diameter the switch lever shoe has arrived at a position where its right-hand corner comes in the path of the striker mounted on the turntable, although its left-hand corner is still clear: the striker therefore pushes the lever back slightly. By the time the striker has completed a further revolution, the lever has again moved up, and is again pushed back sufficiently to allow the striker to pass. This action also forces back the tracking arm: as, however, the tracking lever is held by the pin R, the movement can occur only by virtue of the slip in the friction joint. This process continues until the final groove is reached, where the inward movement of the needle is greatly accelerated. The result is that the switch lever moves so far inwards that the left side of the shoe engages with the striker, and the lever is thrown over, thus switching off the motor. Although the striker is immediately brought to rest, the turntable is able to continue for a further half revolution owing to the fact that the two parts are frictionally connected, so that no sudden jar occurs at the moment of stopping.

When the pickup is returned to its rest the tracking link moves to the right and, under the influence of the radius arm, bears upwards on the pin L, thus withdrawing the switching lever from engagement with the striker. The mechanism is now re-set for playing the next record.

Speed Regulator. A speed regulator is fitted to the non-standard A.C. motor, in order to allow for differences in supply voltage: the control functions in the usual manner, by means of felt pads bearing on the governor plate, and has a sufficiently large range of adjustment to enable the speed of the motor to be correctly adjusted with supply voltages between 200 to 250 volts.

THE MOTOR

Three types of motor are used on the A28RG. These are the YLC, the YDD and the YDD Special. The first of these is the standard 50 cycles synchronous type, and is adaptable for 200 volt or 100 volt mains by means of a movable link which places the windings in series or parallel. Two paper condensers of 0.5 mfd are contained in a bank mounted in the motor casing: these are phasing condensers, and render the motor self-starting.

The YDD motor is used on all the non-standard A.C. models except in cases where the mains are 100—120 volts 40—100 cycles.

Two alternative panel assemblies are used with this motor. One consists of two resistances and an H.F. filter, and this is suitable for all high voltage supplies, (200—250 volts). For 25—33 cycles both resistances and the filter are employed: for 40—60 cycles, one resistance and the filter: and for 80—100 cycles the filter only. The other panel carries a filter only, and is suitable for mains of 100—120 volts, 25—33 cycles.

The YDD Special is mechanically identical with the standard YDD, but the windings are of lower resistance, so that the requisite current may flow with a low voltage mains supply (100—120 volts) of high periodicity (40—100 cycles).

This motor is fitted with a filter only for supplies of 80—100 cycles, but with an additional resistance when the periodicity of the main is between 40 and 60 cycles.

MAINTENANCE

The YLC motor is provided with an adjustable spring loaded bearing at one end. If it becomes necessary to adjust this to cure chattering or because the motor fails to start, the clamping screw should be loosened and the bearing moved slightly inwards or outwards until the position which gives the best running conditions is obtained.

The YLD type motor is provided with a detachable cover plate at the end remote from the driving spindle. If this is removed, it is possible to examine the commutator and brushes for arcing, or to clean the commutator with a piece of rag, while the motor is running.

The brushes can be removed for inspection by turning the bakelite holders through 90 degrees and withdrawing. They should be carefully examined as they are taken out, so that they may be returned in the same position; failure to observe this point will result in arcing taking place until the brushes are again bedded down. The brushes will, in any case, require renewing in the course of time, since, when they have worn down beyond a certain limit, the pressure upon the commutator will become too low to maintain proper contact.

The regulator can easily be adjusted if a piece of paper is gummed to the turntable, so that the number of complete revolutions made in a minute can be counted. This should be done while a record is being played, to allow for the slight drag of the needle. The result should be 78. If it is either above or below this figure the regulator must be adjusted to correct this.

Oiling. A small amount of oil should from time to time (every six months or so) be applied at the points indicated, but on no account should the friction joint be oiled. If the latter is found to be out of adjustment, the spring washer should be removed, slightly bent so as to exert more or less pressure as required, and replaced.

A little lubricant may with advantage be applied to points A, E and T, in order to keep these bearing surfaces quite free. Attention to this will often correct faulty action of the auto-stop mechanism without adjustment of the friction spring washer. A good quality car engine oil is suitable for all lubrication purposes.

N.B. As each oiling hole on the motor is closed with a spring loaded ball, it is necessary to exert a slight downward pressure on the can while oiling.

AUTO-STOP MECHANISM FAULTS

Failure to switch off at end of records. Presuming that an unsuitable size or type of record has not been used, this fault may may be due

- (*a*) To the friction joint being out of adjustment,
- (*b*) To lack of lubrication where the switch lever passes through the switch bracket.
- (*c*) To the pin on the tracking arm having ridden out of the hole in the motor board.

To make sure on these points, remove the turntable, move the pickup arm to the right so as to switch on the motor, and move the arm slowly back again to the left. This should cause the switch lever to move slowly downwards as soon as the pin R has engaged with the tracking lever. If this does not occur, the three points mentioned above must be checked and adjusted if necessary. The friction joint, which should be attended to last, since it is unlikely to loose its correct setting, may be adjusted as follows.

Remove the retaining clip from the friction joint by sliding it to one side—this will enable the other five components parts to be lifted off. Now clean the fibre washer and the metal parts with a piece of cloth. If the parts are reassembled with the fibre washers reversed, the joint may function correctly without further attention. If not, the spring washer may be bent slightly so as to exert greater pressure against the tracking arm.

The correct order in which to replace the various parts, starting from the bottom, is as follows.

- (1) Tracking lever.
- (2) Fibre washer.
- (3) Tracking arm.
- (4) Spring washer.
- (5) Plain metal washer.
- (6) Retaining clip.

Motor stops before end of record. This can be caused by ,
(*a*) The motor being incorrectly mounted.
(*b*) A damaged switch lever shoe.
(*c*) The friction joint being too stiff.

This fault cannot be investigated with the mechanism in action: because the striker is mounted on the turntable. Consequently, it will be necessary to proceed by trial and error with the three points mentioned above. The motor spindle should be moved, if necessary, to lie exactly in the centre of the hole in the motor board, while the spring washer in the friction joint may be bent slightly to exert less pressure.

D28 CONSOLE

THE CIRCUIT

The theoretical circuits and practical layout of the A28 and D28 receivers are almost identical. Service men are therefore advised to familiarise themselves with the description of the circuit, under these headings, in the A.C. section before studying the text below which deals only with the essential differences between the two models.

The circuit of the D28 is shown in Fig. 3.

Commencing at the mains input leads, an H.F. filter (L29, L30, C59) is included in order to minimise the amount of H.F. interference entering from the mains. S10A and B is the double pole on-off switch which completely isolates the set from the mains. The circuit divides at this point, one part consisting of the valve heaters, and the other of the H.T. supply to the valve anodes and the speaker-field (L28) which is in parallel with the H.T. supply. The valve heaters are, of course, in series, and pass a current of 0.2 amp. The current is adjusted to this value on 200 volt mains by R36, while on supplies of higher voltage, additional 50 ohms resistances (R37—41) are brought into circuit as required. The order in which the valve heaters are arranged can be seen from the circuit diagram. Smoothing is provided by C58.

The H.T. supply is smoothed initially by L27 and C52, after which the hum level is sufficiently low to allow the speaker-field and output valve anode to be fed from this point. Additional smoothing is necessary for V8 S.G., and for the earlier valves: this is provided by L18 and C53.

The pilot lamp is connected in the negative mains lead, and hence carries the whole of the current taken by the receiver. In order to minimise the risk of a burnt out lamp, a resistance R42 and a fuse bulb in series, are connected in parallel with it, and help to by-pass a proportion of the current. The fuse is rated at 0.15 amp.

PRACTICAL LAY-OUT

THE RECEIVER CHASSIS

The plan and underside views of the D28 receiver chassis are shown in Figs. 9 and 10 respectively. It will be noticed, that a bank of electrolytic condensers (C53, C48, C49) is used instead of individual condensers. A separate drawing is given of No. 1 panel, as there are several minor points of difference: the assembly is reproduced in Fig. 24.

THE POWER UNIT

The D.C. power unit is dissimilar in many ways from that of the A28. The plan and underside views are shown in Figs. 11 and 12. Above the chassis are mounted the mains voltage tapping panel shown in Fig. 40 which carries the five resistances R37—R41 ; the loud-speaker field and motor sockets ; the two smoothing chokes, L18 and L27 ; a condenser bank C52, C58 ; and the main current limiting resistance in the heater circuit, R36.

On the underside of the power unit are the H.F. filter (L29, L30, C59) and the ten-way socket. A diagram of the latter is given in Fig. 38 and this should be used in conjunction with Fig. 39 which shows the corresponding plug connections from the main chassis.

FAULT FINDING

In general the process of fault finding on the D28C is exactly similar to that given for the A28C under the various headings.

The equivalent condensers and resistances on A.C. and D.C. models bear the same code numbers, so that the references in the fault-finding tables can be applied directly to the D28C. There are, however, one or two components on both models which have no counterpart, and these will be found in the respective power units: they are: T2 and C53 in the A28C, and L29, L30, C59, R36—R42 in the D28C.

There are one or two faults which are peculiar to the D.C. receiver on account of the series arrangement of the valve heaters.

Any case of frequent breakdown in the valve heaters or the pilot lamp and fuse bulb is likely to be caused by a fault located in the wiring of R36—R41 (on the power unit), by incorrect wiring to the power plug or socket, or by a heater to cathode short circuit in one of the valves. A short circuit between any part of the heater wiring and chassis is also likely to have the same effect.

The following list gives the symptoms which may be experienced when a heater to cathode short circuit occurs.

V1 No signals. Pilot lamp very bright.
V2 No signals. Pilot lamp bright.
V3 Pilot lamp bright ; hum.
V4 No signals. Pilot lamp very bright.
V5 Weak signals, M.W. Very weak or no signals.
L.W. Calibration high.
V6 Calibration high.
V7 Very weak signals.
V8 No signals, or very weak. Pilot lamp dull.

PICK UP CONNECTIONS

In general it is inadvisable to fit pick-up connections to D.C. receivers. Rather than attempt to modify the D28C, where gramophone reproduction is desired, a D28RG is to be recommended.

VOLTAGES AND CURRENTS D28C and RG

The following table of voltages and currents is given as a guide only—considerable variations may occur without seriously detracting from the efficiency of the receivers. Owing to the inclusion of A.V.C. and noise-suppression in the D28, the various voltages depend to some extent on the strength of the applied signal. For this reason, certain readings were taken with and without a strong signal in order to give an idea of the changes to be expected under working conditions. A weaker or stronger signal used in taking these measurements will, of course, give correspondingly different variations.

In the case of R.G. models, certain voltages will be found to change when the instrument is switched to the "Gramophone" position: accordingly such voltages are given for both positions of the gramophone switch.

Except where otherwise stated, voltages are to chassis, and are obtained with a "1000 Ohms per volt" meter, using 250v. range wherever possible.

CONSUMPTION FROM MAINS

200v	56 watts	D28C
250v	75 watts	D28C
200v	83 watts	D28RG
250v	108 watts	D28RG

MAINS VOLTAGE 240

			No Signal volts.	No Signal mAs	Strong Signal volts.	Strong Signal mAs
V1	A	Radio	195	8	200	1
		Gram.	200	—	—	—
	SG		190	—	200	—
	C	Radio	1.5	—	0.6	—
		Gram.	30	—	—	—
V2 Pen.	A	Radio	160	—	165	—
		Gram.	190	—	—	—
	SG		160	—	175	—
	C	Radio	3.5	—	2.5	—
		Gram.	30	—	—	—
V2 Triode	A		60	—	60	—

		No Signal volts.	No Signal mAs	Strong Signal volts.	Strong Signal mAs
V3	A	195	1.5	200	—
	SG	195	—	200	—
	C	12.5	—	12.5	—
V4	A	195	9.0	200	5.0
	SG	195	—	200	—
	C	2.0	—	1.0	—
V5	D1A				
	D2A				
	C	15	—	16	—
V6	D1A	1	—	—	—
	D2A	6	—	—	—
	C	6	—	6	—
V7	A Radio	175	0	125	2.5
	A Gram.	140	2.5	—	—
	SG	195	—	200	—
	C	15	—	16	—
V8	A	180	—	185	—
	SG	195	—	200	—
	C	8	—	8.5	—
H.T. Line voltage C53 positive tag to chassis.		195	—	200	—

D28 RADIO-GRAMOPHONE

THE CIRCUIT

As in the case of the A28RG, the radio-gramophone chassis does not differ appreciably from that of the Console model, so that it is only necessary to describe the switching methods employed to alter the circuit for record reproduction.

The pickup is of low impedance, and is coupled by an input transformer, T2, of high ratio to the grid circuit of V7: this method is adopted in order to prevent hum, due to inductive or capacitive coupling with the motor winding.

The secondary of T2 is shorted by S12c when radio reception is required, but is interposed between R25 and V7 cathode when S12c opens for record reproduction, so that the stepped-up pickup voltage is applied to V7 grid. S12b is arranged to short circuit the signal diode load, R17, for gramophone reproduction, and S12a inserts a high resistance, R45, in series with the oscillator circuit and with V1 and V2 cathode resistances: this effectively prevents radio break-through.

PRACTICAL LAYOUT

In addition to the components to be found on the D28C, the R.G. chassis carries the pickup transformer, T2, the change-over switch S12, and the pickup socket panel. Owing to the fact that the wiring is slightly modified to include the pickup connections, No. 2 panel is somewhat different in the R.G. chassis, so a separate drawing is given in Fig. 28. The wiring to the change-over switch is shown in Fig. 42.

THE MOTOR BOARD

The D.C. motor board and auto-stop mechanism are practically identical with those of the A28RG, but the fixing screws and oiling holes for the motor are in slightly different positions, and, in addition, a speed adjustment screw is fitted. Consequently, a separate diagram is given in Fig. 44.

THE MOTOR

The motor used in the D28RG is the YDD type referred to in connection with the A28RG. The panel attached to it carries a single voltage dropping resistance, but no H.F. filter is required, owing to the fact that this is included in the receiver itself.

CHECKING THE CONTROL VALVE

The control valve V3 may be checked for emission or electrode breakdown in the same way as an ordinary H.F. pentode. When directed in the fault-finding tables under the heading "Calibration Errors" and "A.T.C. not working correctly" to check the valve, it becomes necessary to check the control range of the valve. Similarly, when a new valve is fitted, in addition to checking the control range, the resistance of R13, which is matched to the characteristics of the original valve, should be checked.

In order to simplify these tests and enable service-men to arrive at the correct value of R13 without calculation, a template, comprising a scale calibrated in wavelengths and ohms, and a pointer, is provided in an envelope attached to the back cover.

A service test oscillator and a straight receiver employing reaction, such as the B23, are required. The procedure is similar to that adopted when checking calibration by the beat method, only instead of a broadcast programme, a beat is obtained by means of the reaction receiver. Connect the test oscillator exactly as described in para (*c*), page 18, and set it to 119 K/c.

Connect both receivers to earth, no metallic contact is made between the aerial terminals, but a short length of wire should be attached to the 28 aerial socket for coupling purposes.

Bare both ends of a 7″ length of wire and fix a crocodile clip to one end. Remove V3 and twist the other end tightly round the c.g. pin in such a way that it will not foul other pins or the chassis when the valve is re-inserted. This wire is used to short the c.g. to earth whilst taking measurements. Do not omit to replace the anode lead and screening cap.

Accurately set the 28 cursor to 520 metres and slip the pointer over the knob with the tip at about 11 o'clock. Insert the scale between the control knob and cabinet, and move it round until the 520 mark registers with the pointer. Short circuit V3 control grid by attaching the crocodile clip to the metal earth plug.

All apparatus may now be switched on. Turn the 28 volume control full on. With reaction control at maximum tune the straight receiver between 510 and 540 metres, when a whistle which varies in pitch should be heard. If this is not apparent do not re-adjust the 28, as the coupling is probably insufficient. Try moving the coupling wire in the 28 aerial socket closer to the straight set. In certain circumstances it may be an advantage to couple the two aerial terminals direct. Having obtained the whistle, tune the straight receiver for the silent point. Next remove the crocodile clip from earth when the whistle should rise in pitch.

Make sure that the 520 metre mark on the template is still registering with the pointer and that it does not slip during the next operation. Rotate the 28 control knob slowly and evenly, in order to keep S8 closed, towards 530 metres. At the first movement of the knob, at the moment S8 closes, the whistle will disappear, but continue turning, taking care not to release the knob, through the fall in pitch until the silent point is again obtained. If the knob is released, opening S8, the set will continue to tune itself towards the silent point, and thus give a misleading answer. If this should accidentally occur, return the knob quickly to the 520 m. mark and slowly repeat the operation. Note the new setting of the pointer, if it falls within one division on either side of the 530 metre mark the control range is normal and the resistance value of R13 is correct. If outside these limits, a change in the resistance value of R13 is necessary and this should be of the amount indicated on the ohms scale. The figure should be added to or subtracted from the existing resistance R13. The ohmic values to the left of the template, marked –, represent numbers to be subtracted, while the + or right-hand side denotes addition. For instance, if a reading of 100 ohms + is obtained and the present value of R13 is found to be 150 ohms, the total resistance required is 250 ohms. A new resistance of this value may, therefore, be substituted, or 100 ohms joined in series. On the other hand, if the pointer registers midway between zero and 100 ohms on the – side, 50 ohms should be subtracted from the existing resistance. In this case a 100 ohms total resistance is required. If the required resistance works out to be anything lower than this figure, the valve is unsuitable, and should be kept as an L.F. valve.

Finally, calibration should be checked at 250 metres, re-trimming C8 if necessary. Also, check at 520 metres, if calibration is inaccurate at this wave-length refer to page 34 of the fault-finding section under the heading "Calibration."

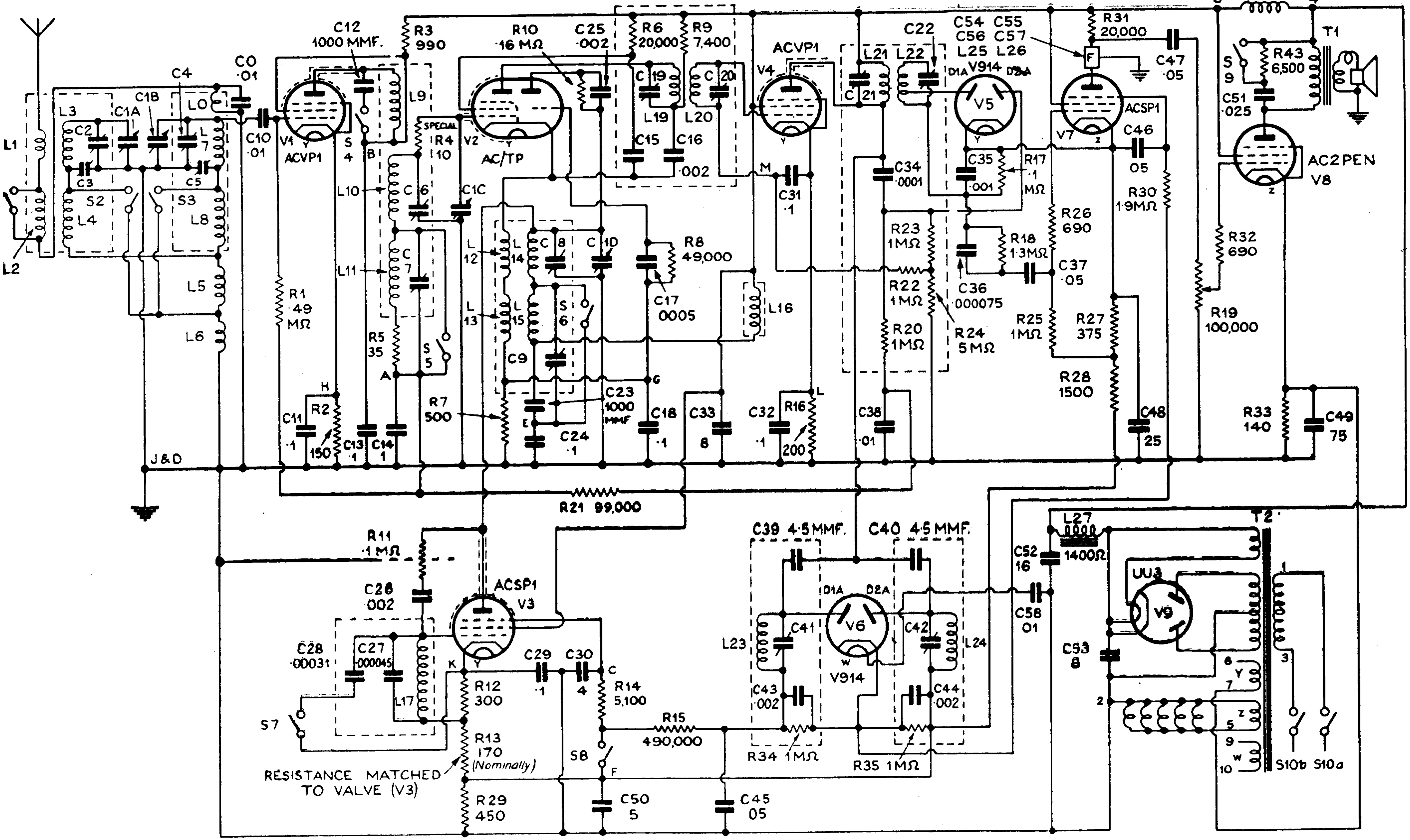


FIG. 1

A28C CIRCUIT DIAGRAM

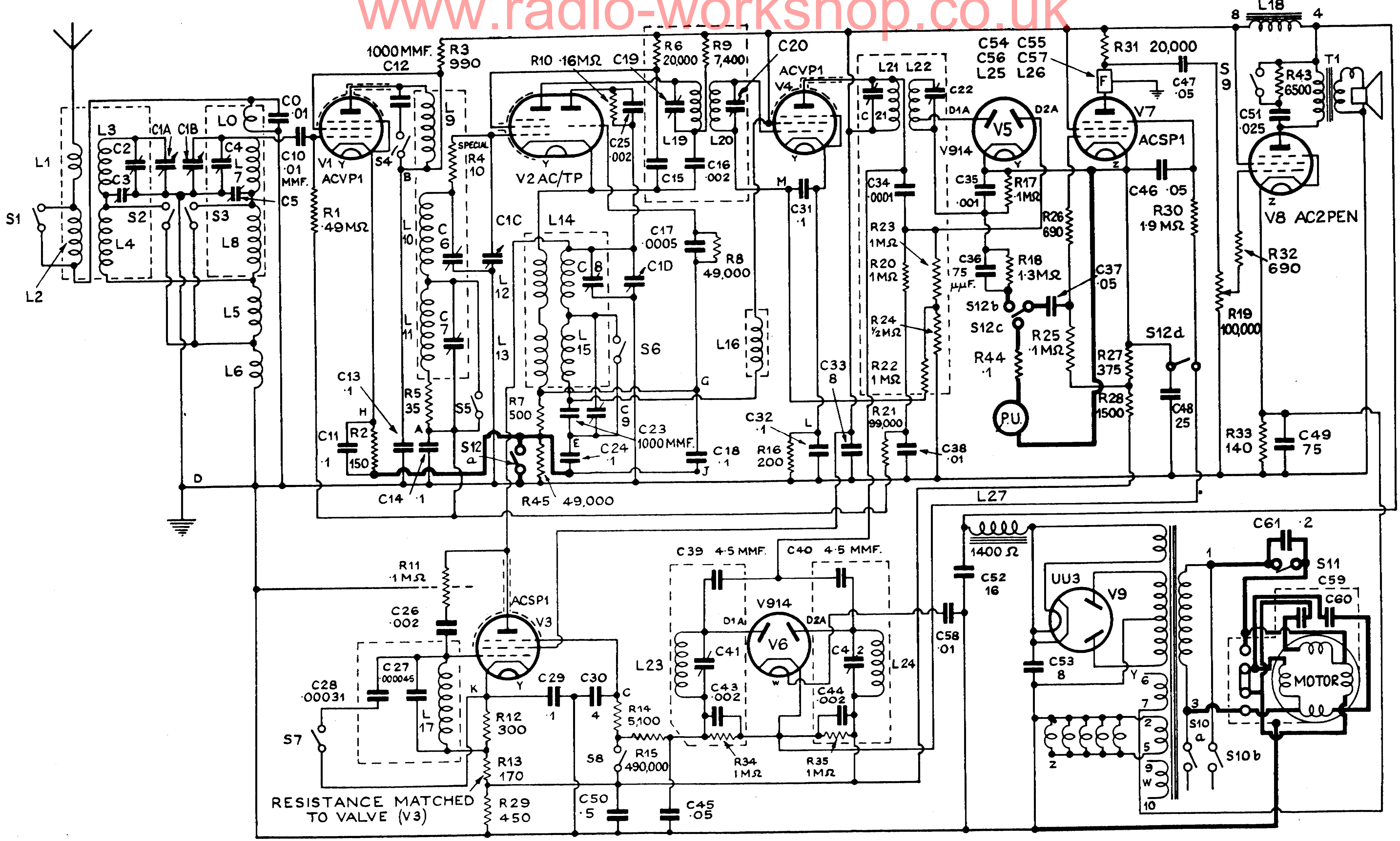


FIG. 2

A28RG CIRCUIT DIAGRAM

VALUES OF COMPONENTS NOT GIVEN IN THE DIAGRAM

INDUCTANCES

No.	D.C. RESISTANCE	No.	D.C. RESISTANCE
L0	0.1 Ω	L12	In series
L1	1.2 Ω	L13	Total 2.5 Ω
L2	8.5 Ω	L14	3.5 Ω
L3	4.2 Ω	L15	7.5 Ω
L4	10.5 Ω	L16	48 Ω
L5	2.5 Ω	L17	7 Ω
L6	0.2 Ω	L18	200 Ω
L7	4.2 Ω	L19	40 Ω
L8	10.5 Ω	L20	40 Ω
L9	13.5 Ω	L21	31 Ω
L10	4.2 Ω	L22	31 Ω
L11	11 Ω	L23	17.5 Ω
		L24	17.5 Ω

CONDENSERS

No.	CAPACITY	No.	CAPACITY
C0	0.01 μf.	C7	10/80 μμf.
C1A	0.0005 μf.	C8	5/25 μμf.
C1B	0.0005 μf.	C9	10/45 μμf.
C1C	0.0005 μf.	C15	0.001373 μf.
C1D	0.0004 μf.	C19	84/119 μμf.
C2	5/50 μμf.	C20	84/119 μμf.
C3	10/80 μμf.	C21	86/121 μμf.
C4	5/50 μμf.	C22	142/177 μμf.
C5	10/80 μμf.	C41	140/175 μμf.
C6	5/50 μμf.	C42	140/175 μμf.

TRANSFORMERS

No. & MODEL	WINDING	RESISTANCE
T1	Primary Secondary	300. Ω 0.20 Ω
T2 200v. 50 ∽	Primary H.T. Sec.	200.213v. 12 Ω 214.228v. 13 Ω 229.244v. 14 Ω 245.260v. 15 Ω 240 Ω
T2 200v. 25 ∽	Primary H.T. Sec.	200.213v. 19.5 Ω 216.228v. 21.0 Ω 229.244v. 22.5 Ω 245.260v. 24.0 Ω 395 Ω
T2 100v. 50 ∽	Primary H.T. Sec.	100 107v. 4.0 Ω 108.116v. 4.4 Ω 117.125v. 4.7 Ω 240 Ω
L.S.	Speech Coil 2 Ω	
P.U.	4,500 Ω	

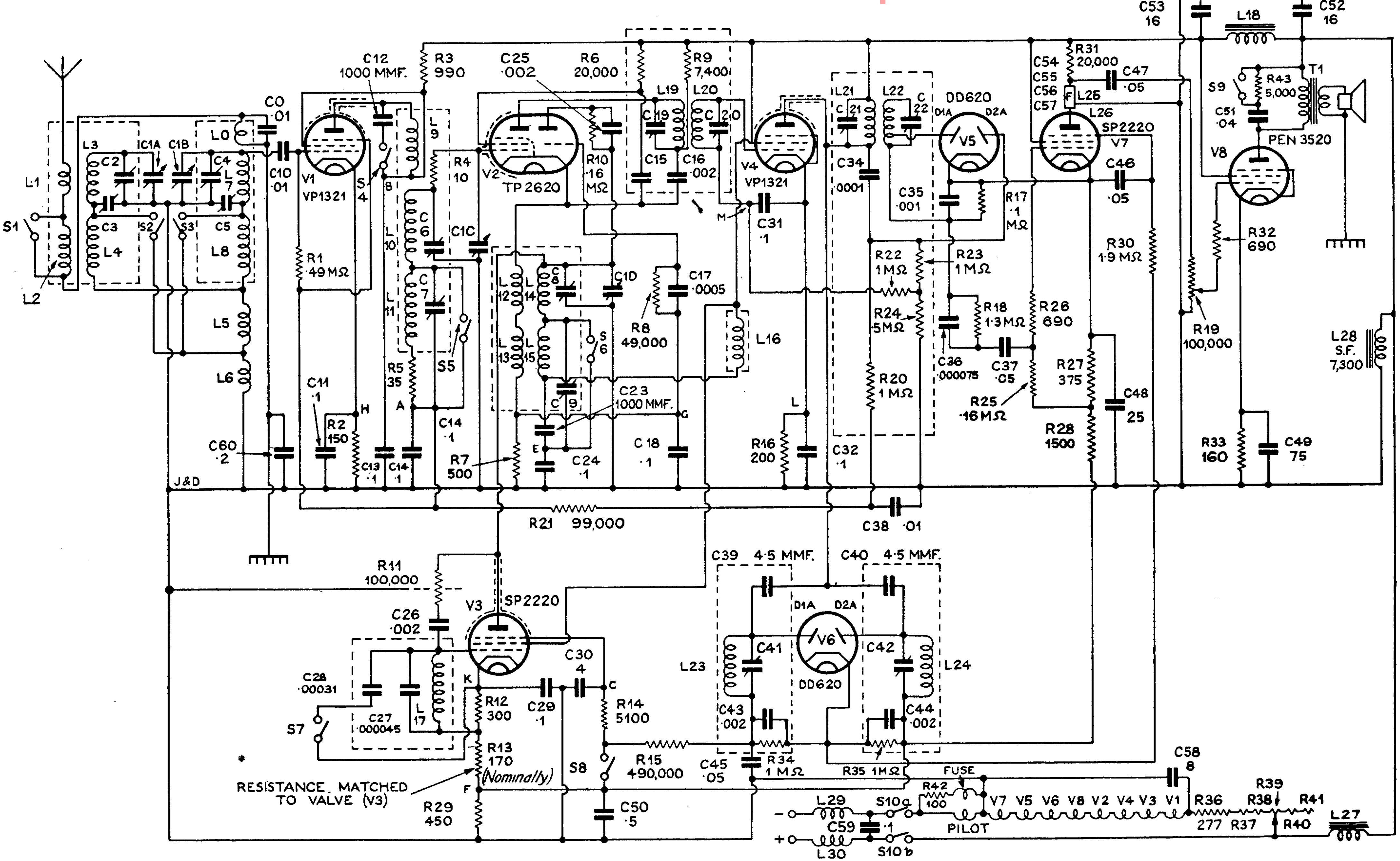


FIG. 3

D28C CIRCUIT DIAGRAM

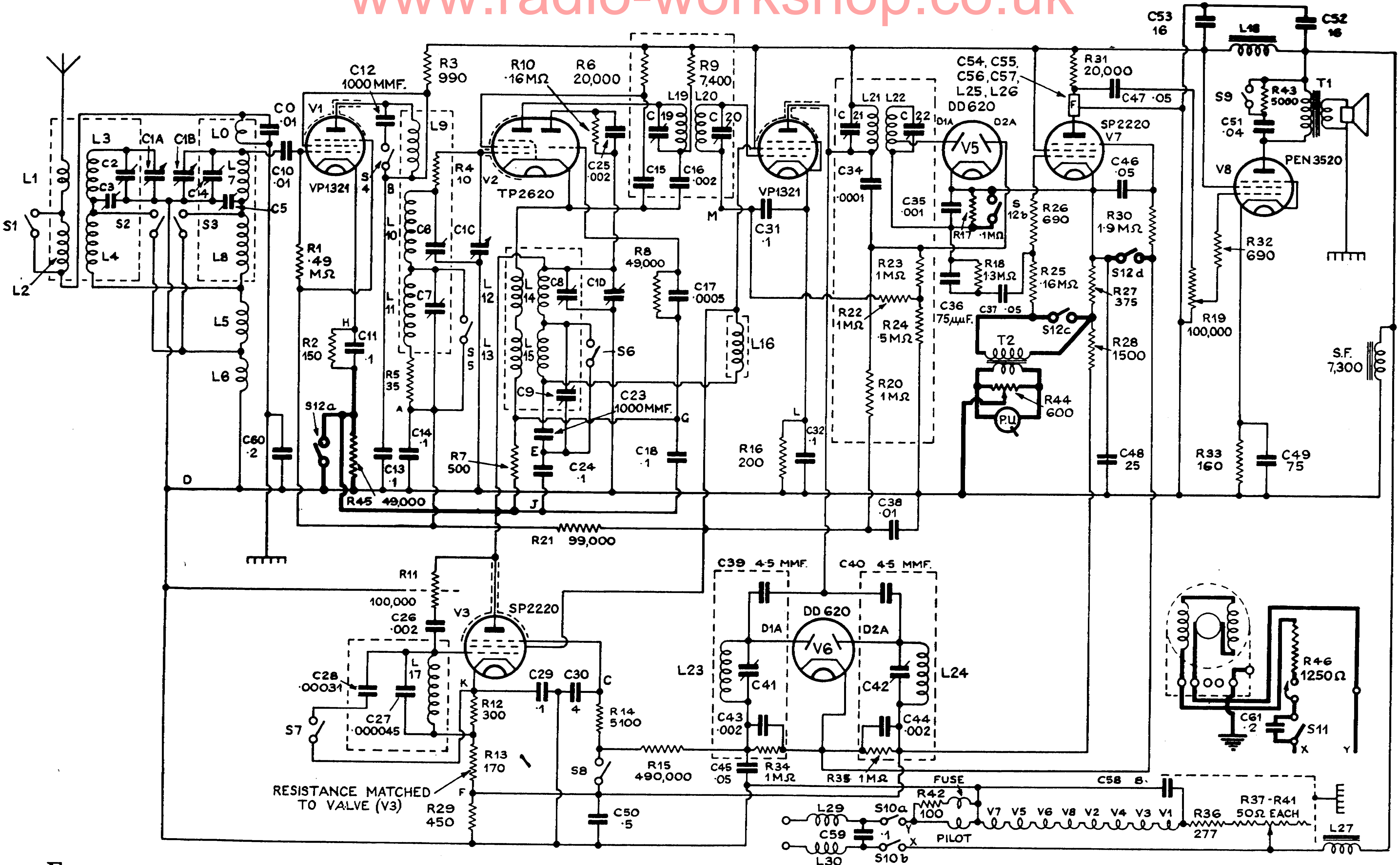


FIG. 4

D28RG CIRCUIT DIAGRAM

VALUES AND FUNCTIONS OF COMPONENTS NOT GIVEN IN THIS DIAGRAM

INDUCTANCES

No.	VALUE	No.	VALUE
L0	0.1 Ω	L14	3.5 Ω
L1	1.2 Ω	L15	7.5 Ω
L2	8.5 Ω	L16	48 Ω
L3	4.2 Ω	L17	7 Ω
L4	10.5 Ω	L18	200 Ω
L5	2.5 Ω	L19	40 Ω
L6	0.2 Ω	L20	40 Ω
L7	4.2 Ω	L21	31 Ω
L8	10.5 Ω	L22	31 Ω
L9	13.5 Ω	L23	17.5 Ω
L10	4.2 Ω	L24	17.5 Ω
L11	11 Ω	L27	105 Ω
L12 }	In series	L29	2.4 Ω
L13 }	Total 2.5 Ω	L30	2.4 Ω

CONDENSERS

No.	VALUE	No.	VALUE
C0	.01 μf	C7	10/80 μμf.
C1A	0.0005 μf.	C8	5/25 μμf.
C1B	0.0005 μf.	C9	10/45 μμf.
C1C	0.0005 μf.	C15	0.001373 μf.
C1D	0.0004 μf.	C19	84/119 μμf.
C2	5/50 μμf.	C20	84/119 μμf.
C3	10/80 μμf.	C21	86/121 μμf.
C4	5/50 μμf.	C22	142/177 μμf.
C5	10/80 μμf.	C41	140/175 μμf.
C6	5/50 μμf.	C42	140/175 μμf.

TRANSFORMERS

No.	VALUE
T1	Primary 280 Ω Secondary 0.25 Ω
T2	Primary 65 Ω Secondary 1500 Ω
P.U.	50 Ω
L.S.	Speech Coil 2 Ω

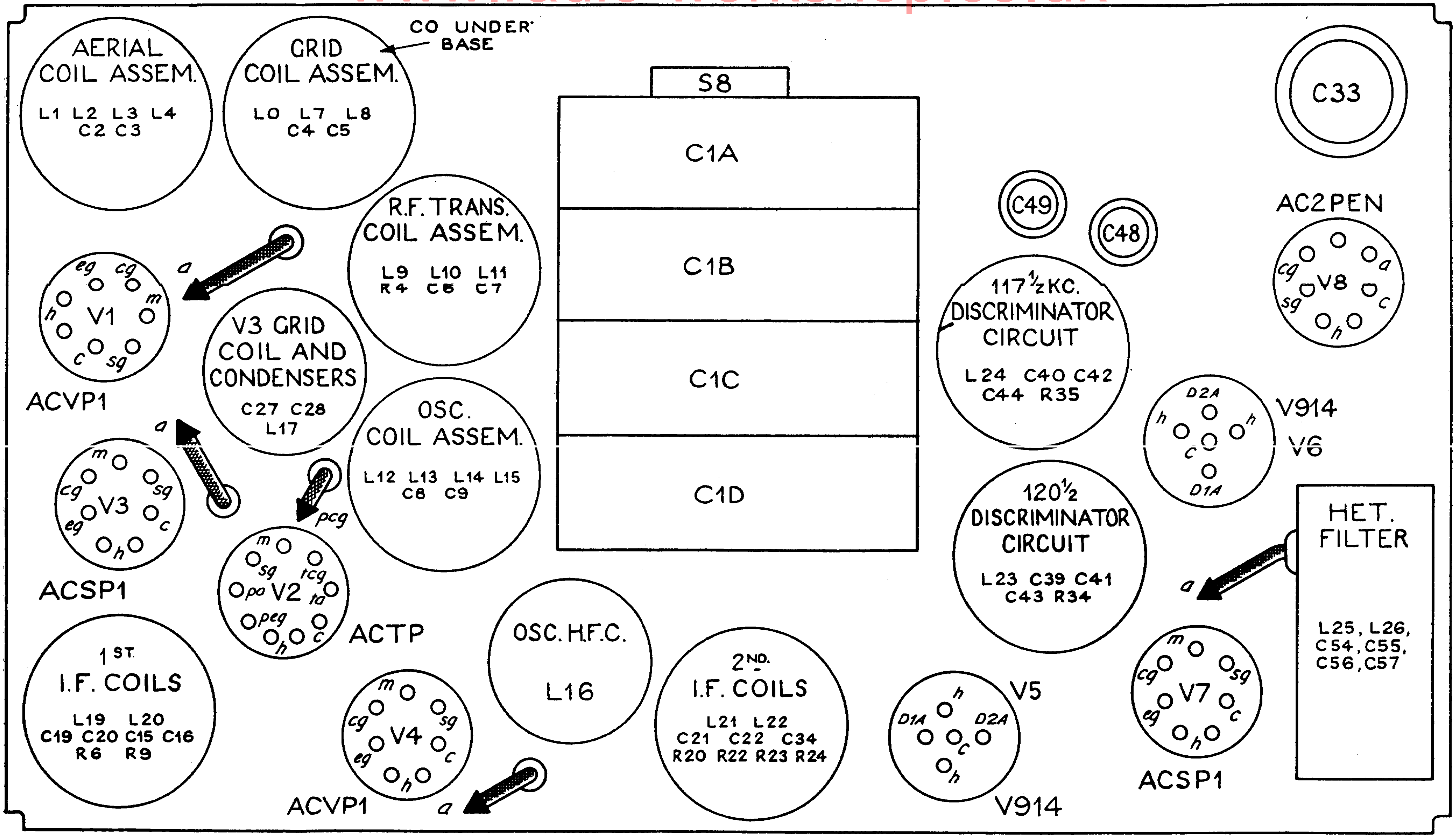


FIG. 5.

PLAN OF A28 CHASSIS

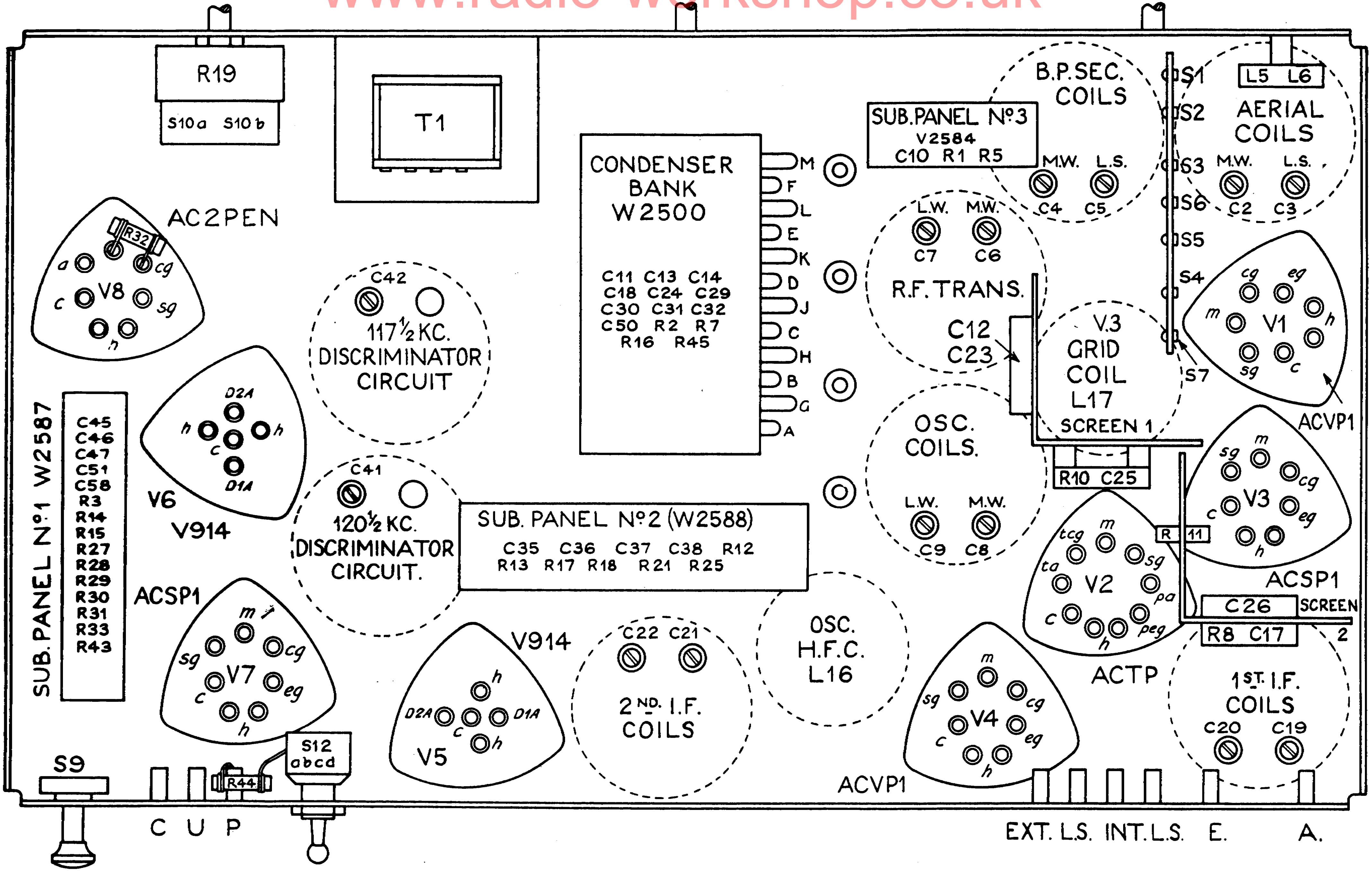
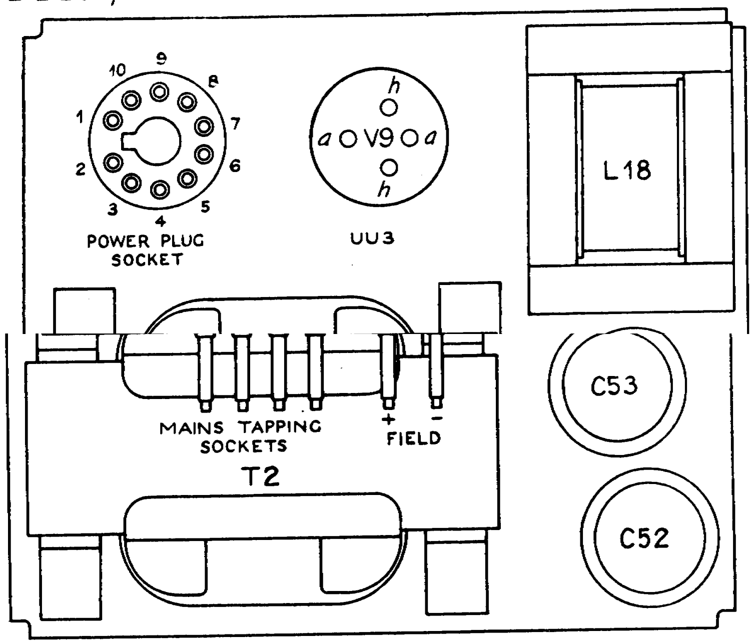


FIG. 6.

UNDERSIDE OF A28 CHASSIS

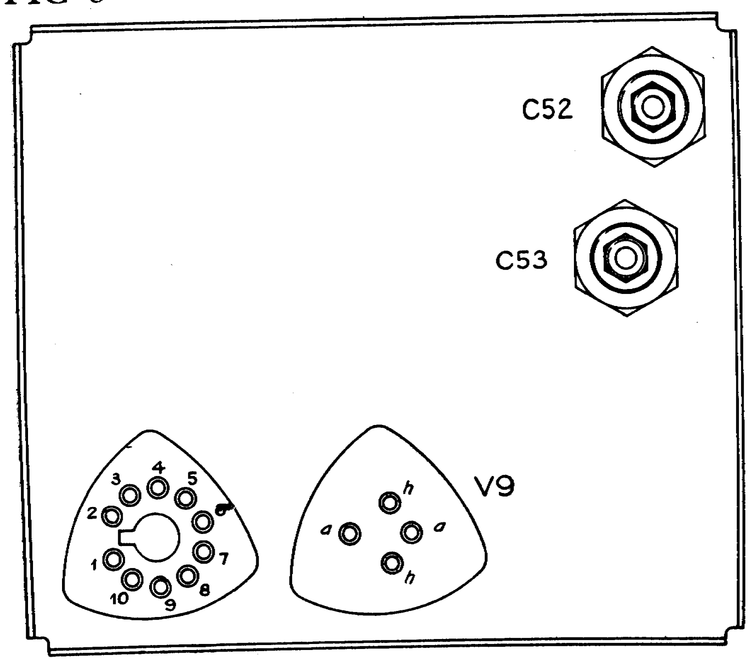
PLAN OF A28 POWER UNIT

FIG. 7



UNDERSIDE OF A28 POWER UNIT

FIG 8



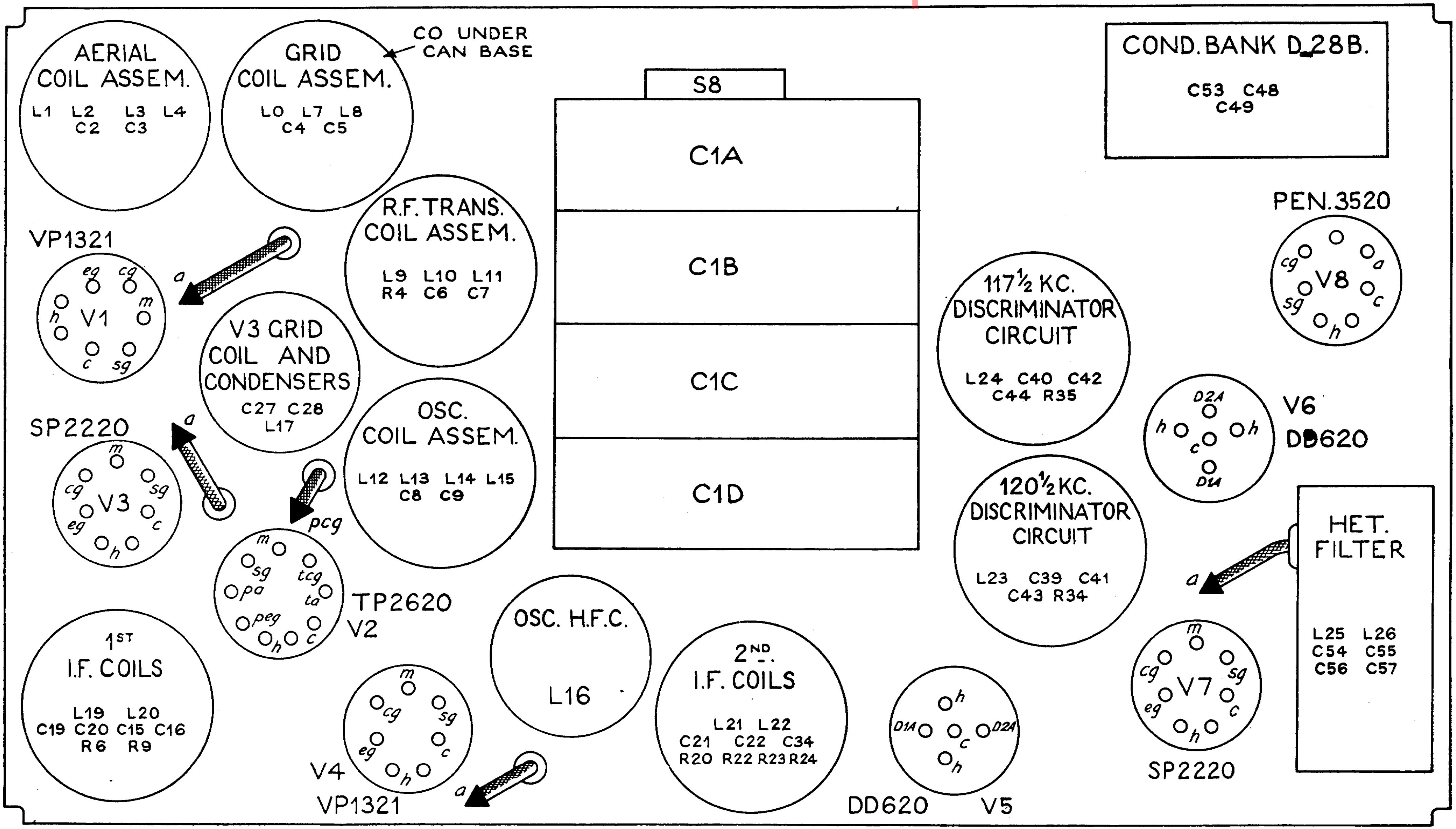


FIG. 9

PLAN OF D28 CHASSIS

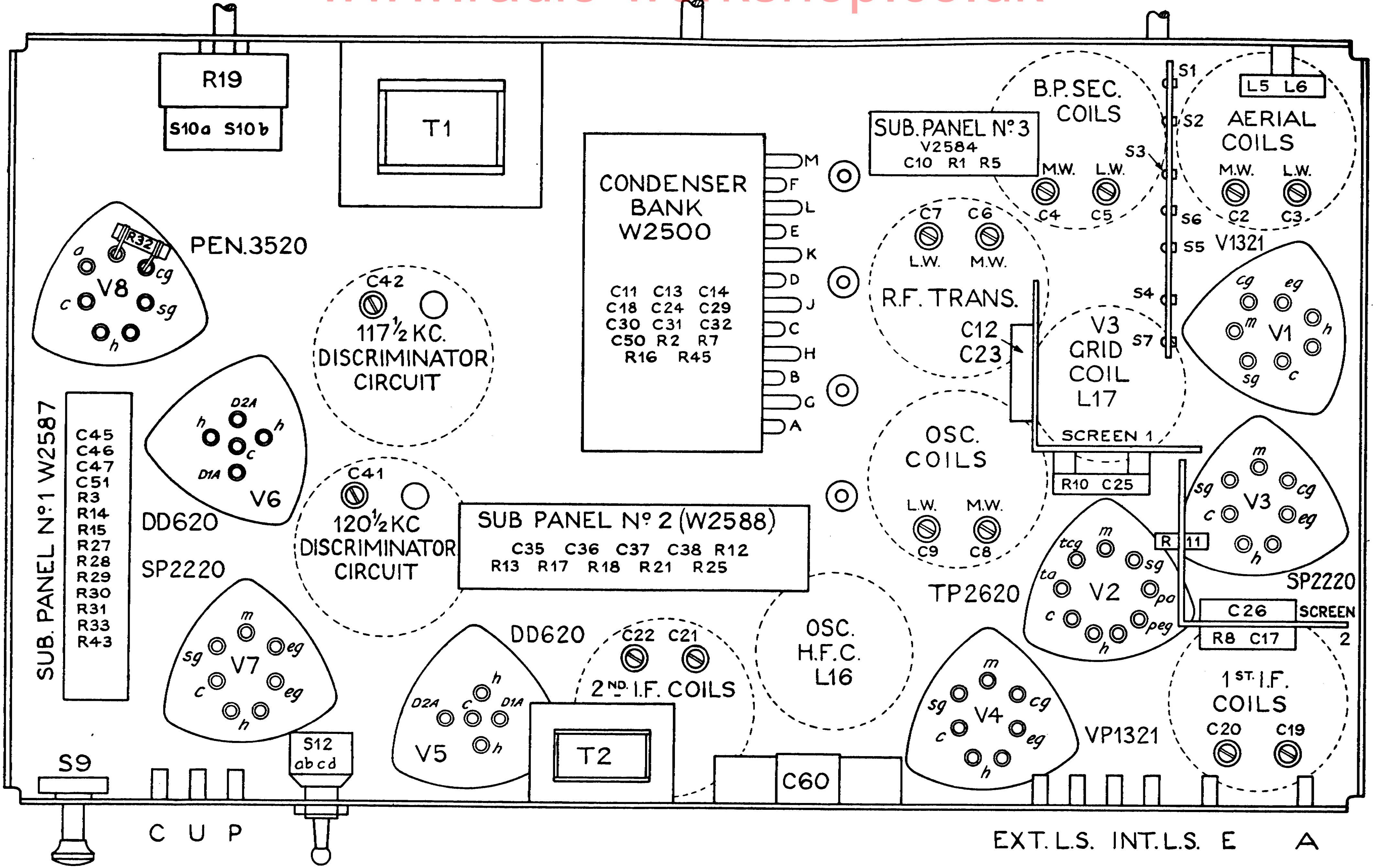
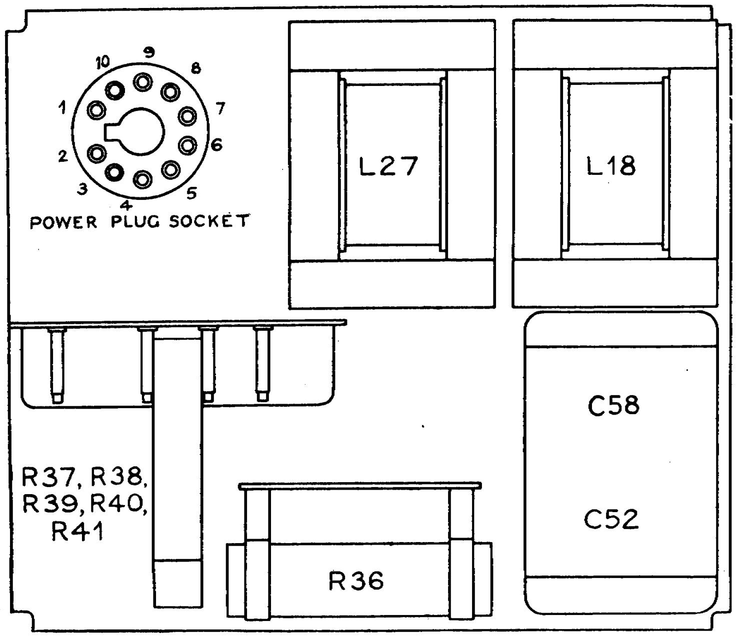


FIG. 10

UNDERSIDE OF D28 CHASSIS

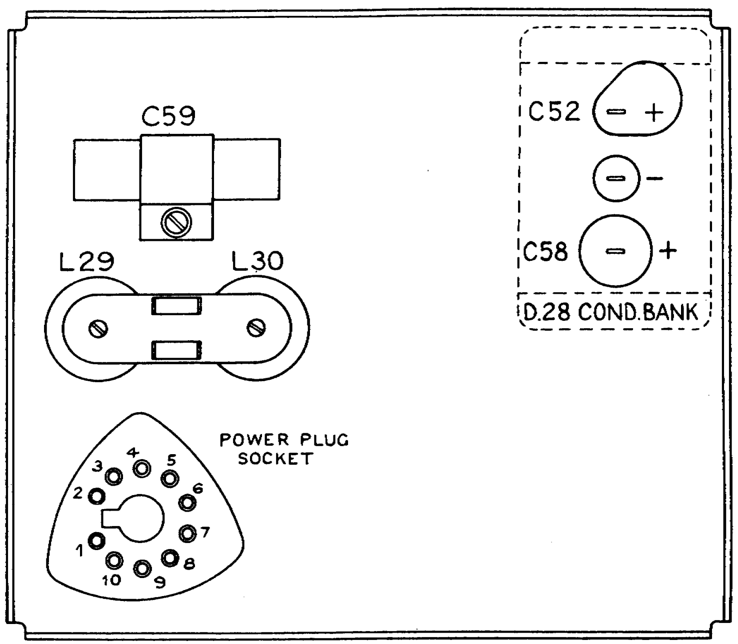
PLAN OF D28 POWER UNIT

FIG. 11



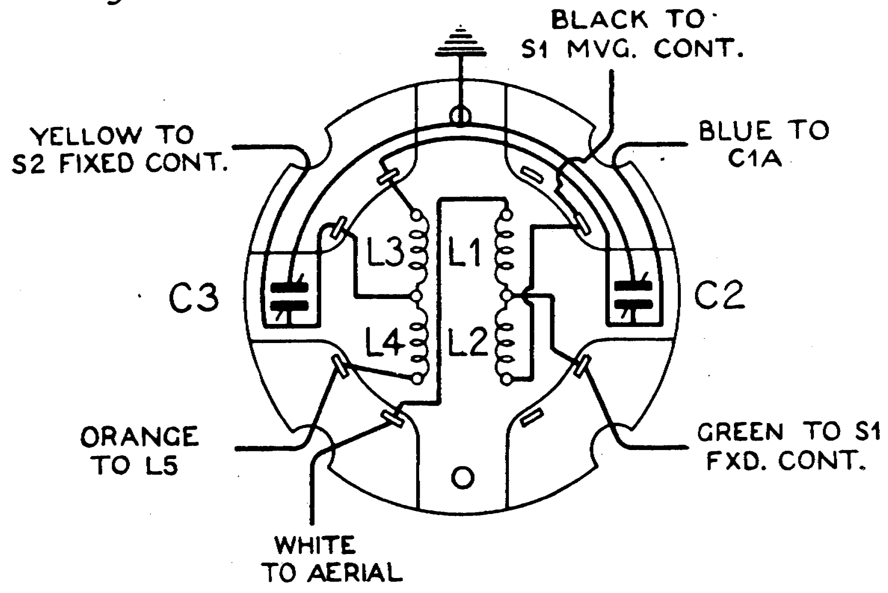
UNDERSIDE OF D28 POWER UNIT

FIG. 12



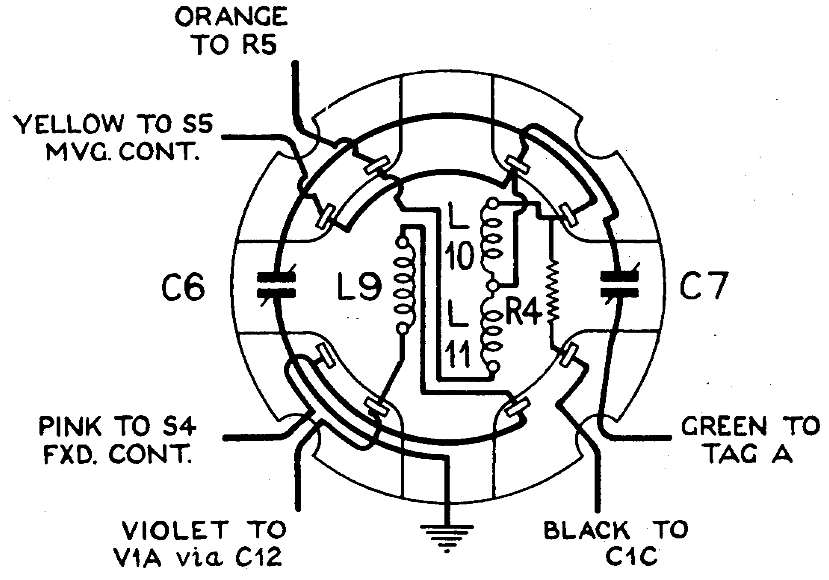
AERIAL COILS

FIG. 13



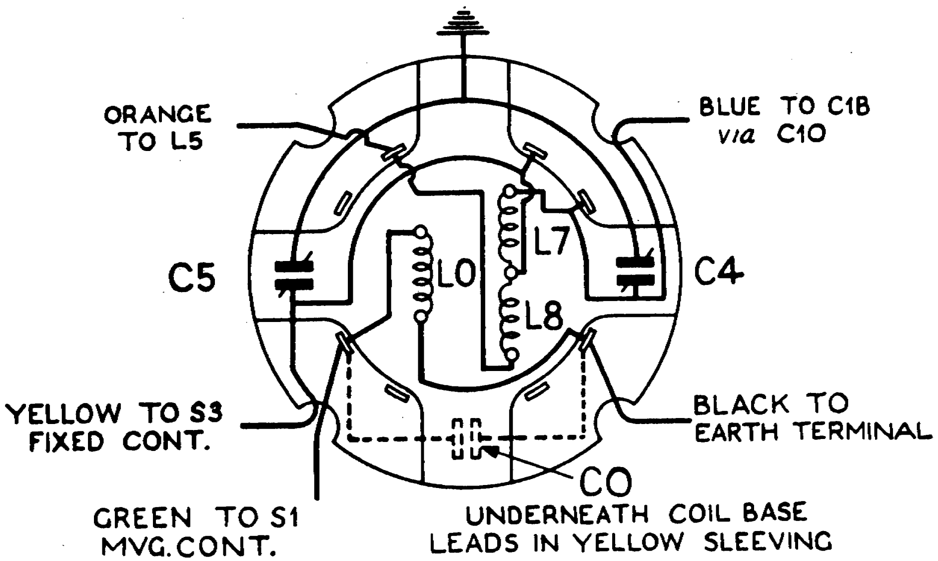
R.F. TRANSFORMER

FIG. 15



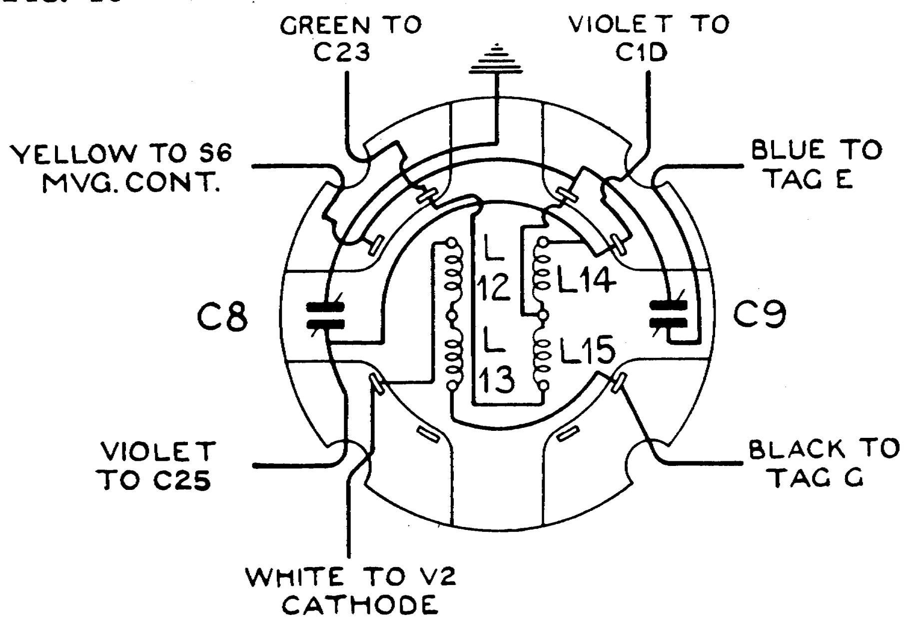
GRID COILS

FIG. 14



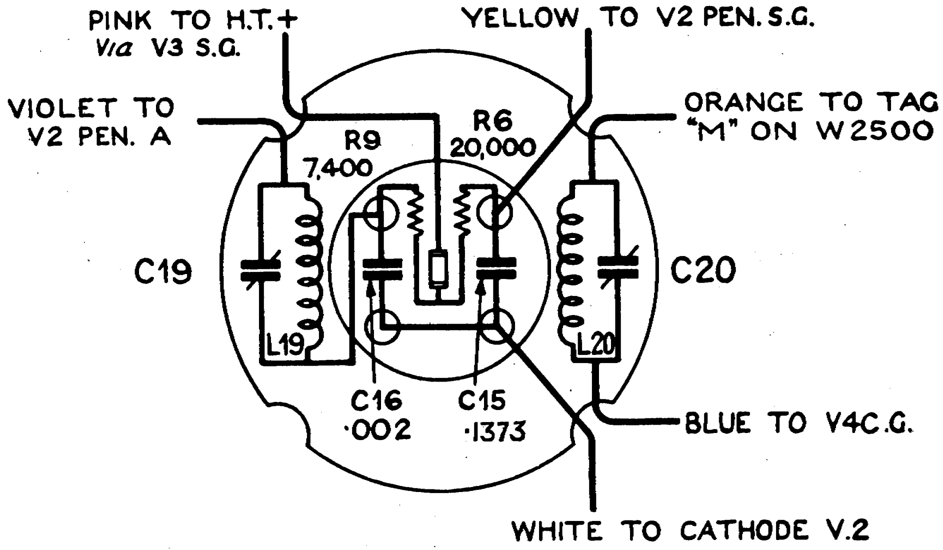
OSCILLATOR COILS

FIG. 16



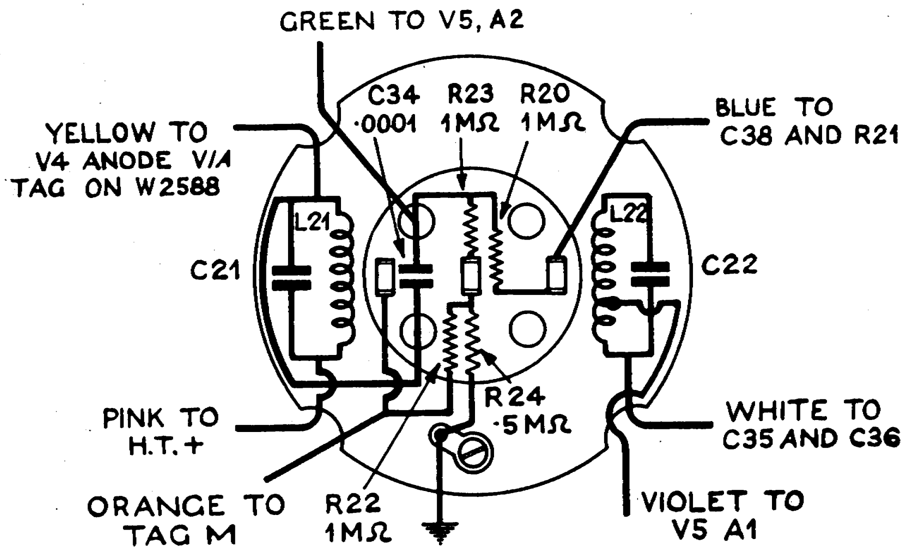
FIRST I.F. COILS

Fig. 17



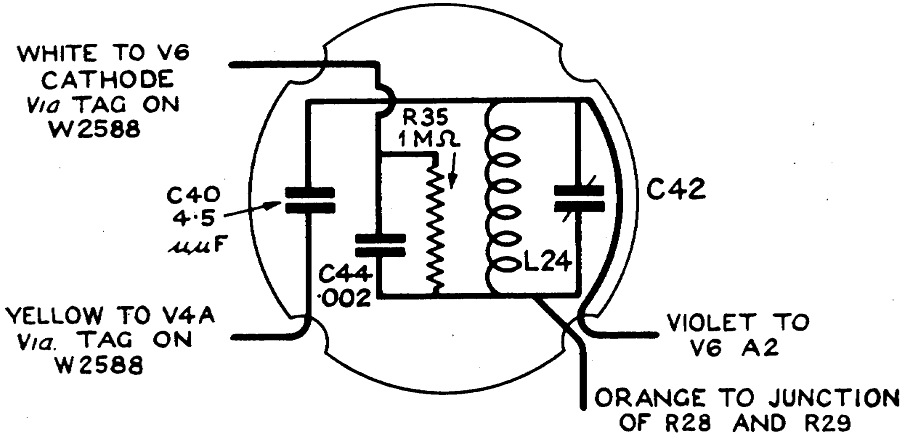
SECOND I.F. COILS

Fig. 18



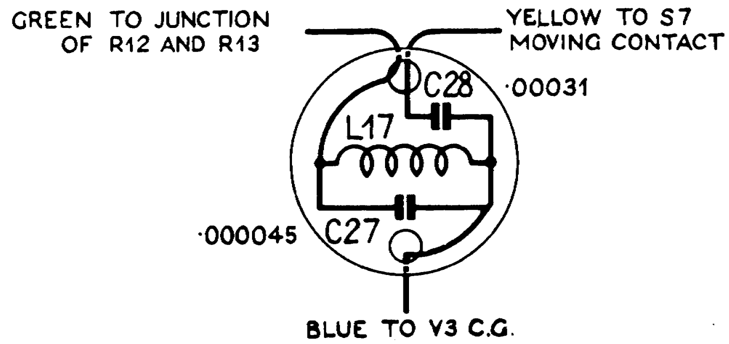
117½ KC/S CONTROL COIL

FIG. 19



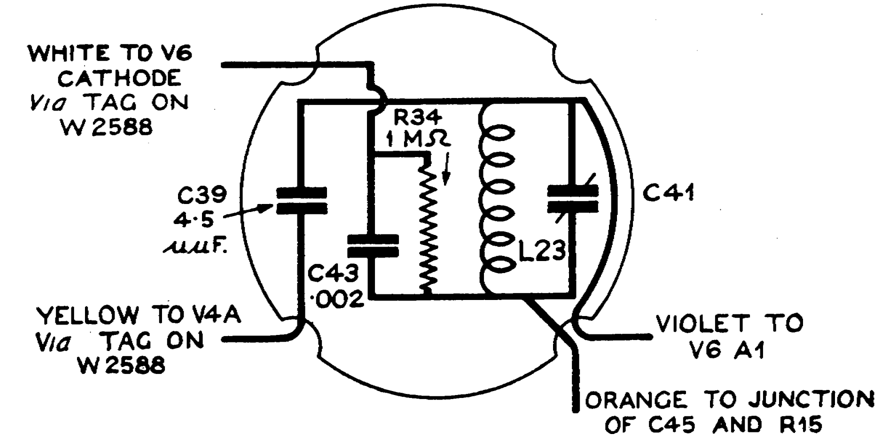
V3 GRID COIL

FIG. 21



120½ KC/S CONTROL COIL

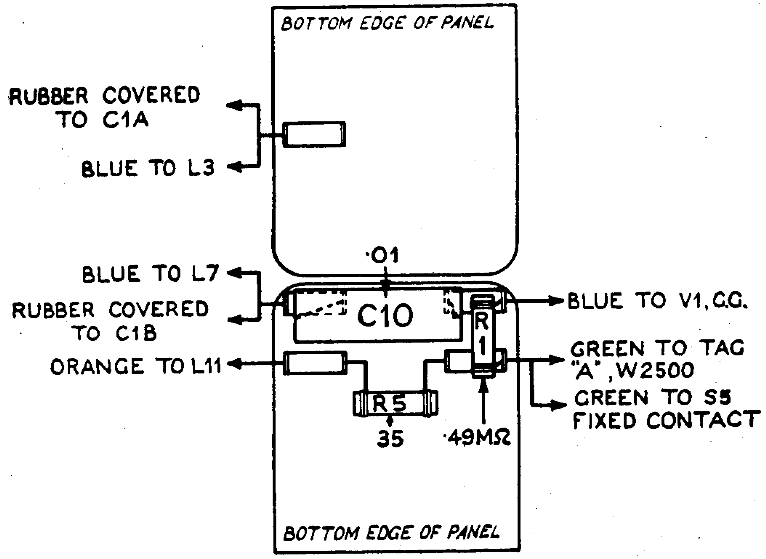
FIG. 20



V2584 ASSEMBLY

FIG. 22

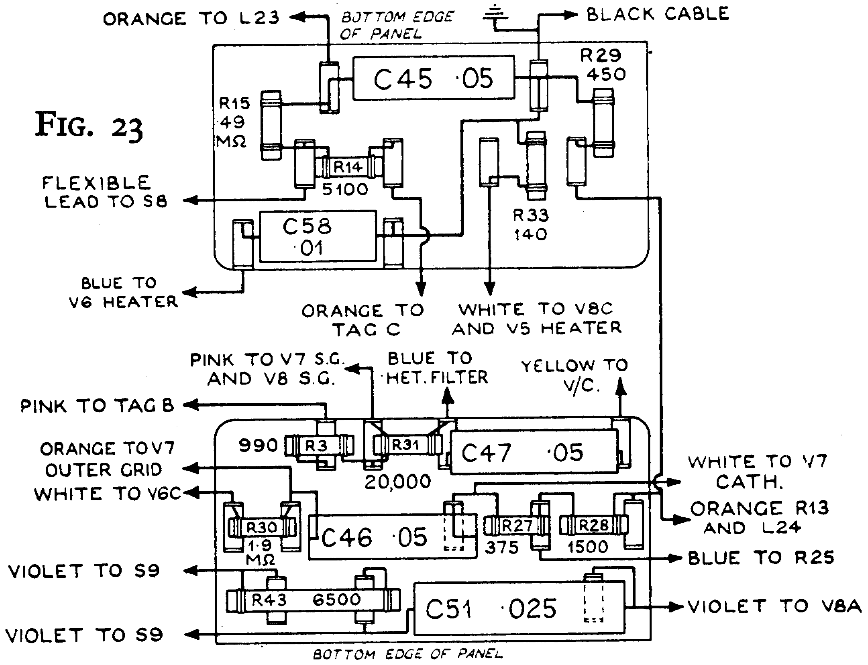
(Showing both sides of Panel)



W2587 ASSEMBLY A28C/RG

(Showing both sides of panel)

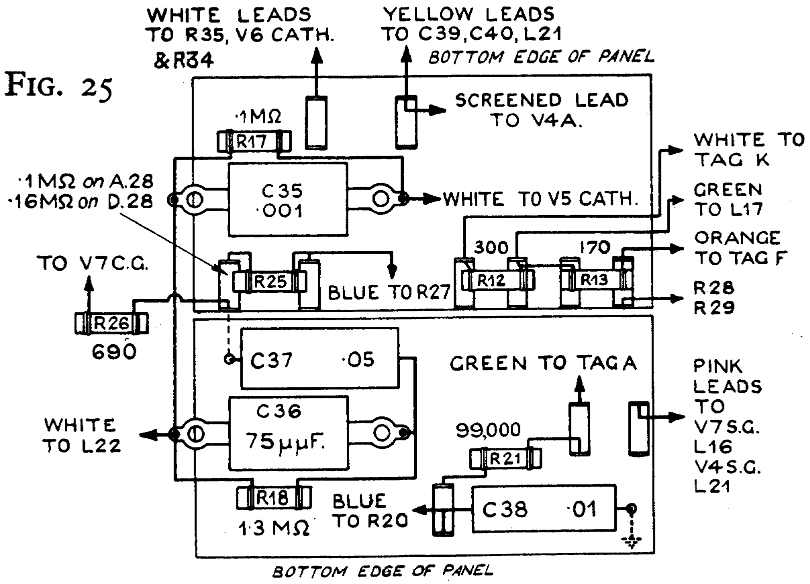
FIG. 23



W2588 ASSEMBLY A28C, D28C

(Showing both sides of panel)

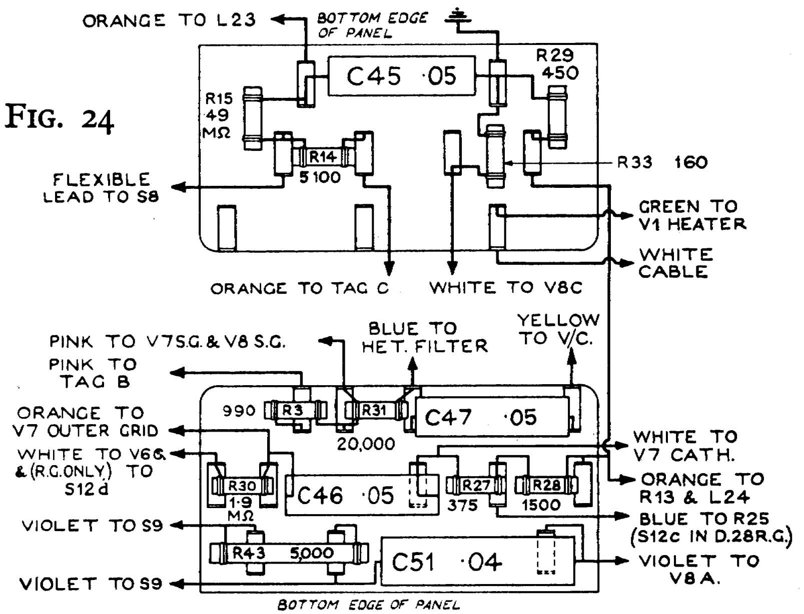
FIG. 25



W2653 ASSEMBLY D28C/RG

(Showing both sides of panel)

FIG. 24



W2588 ASSEMBLY A28RG

(Showing both sides of panel)

FIG. 26

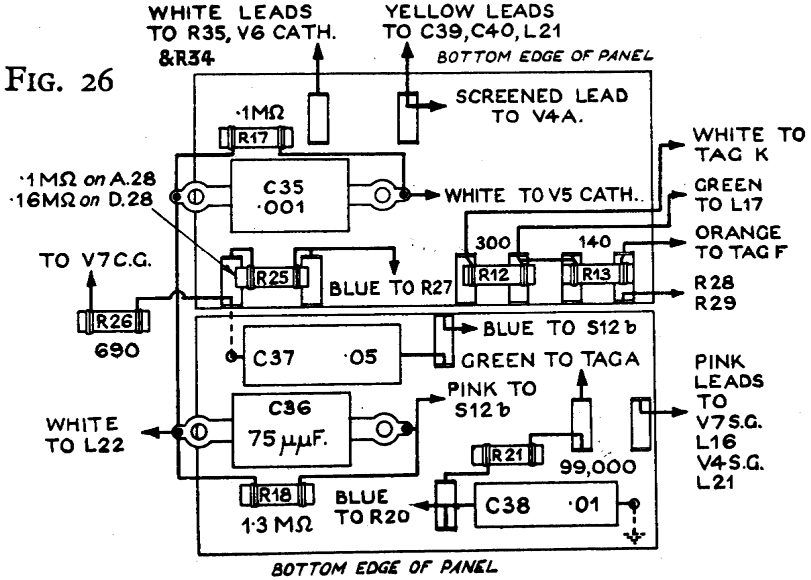
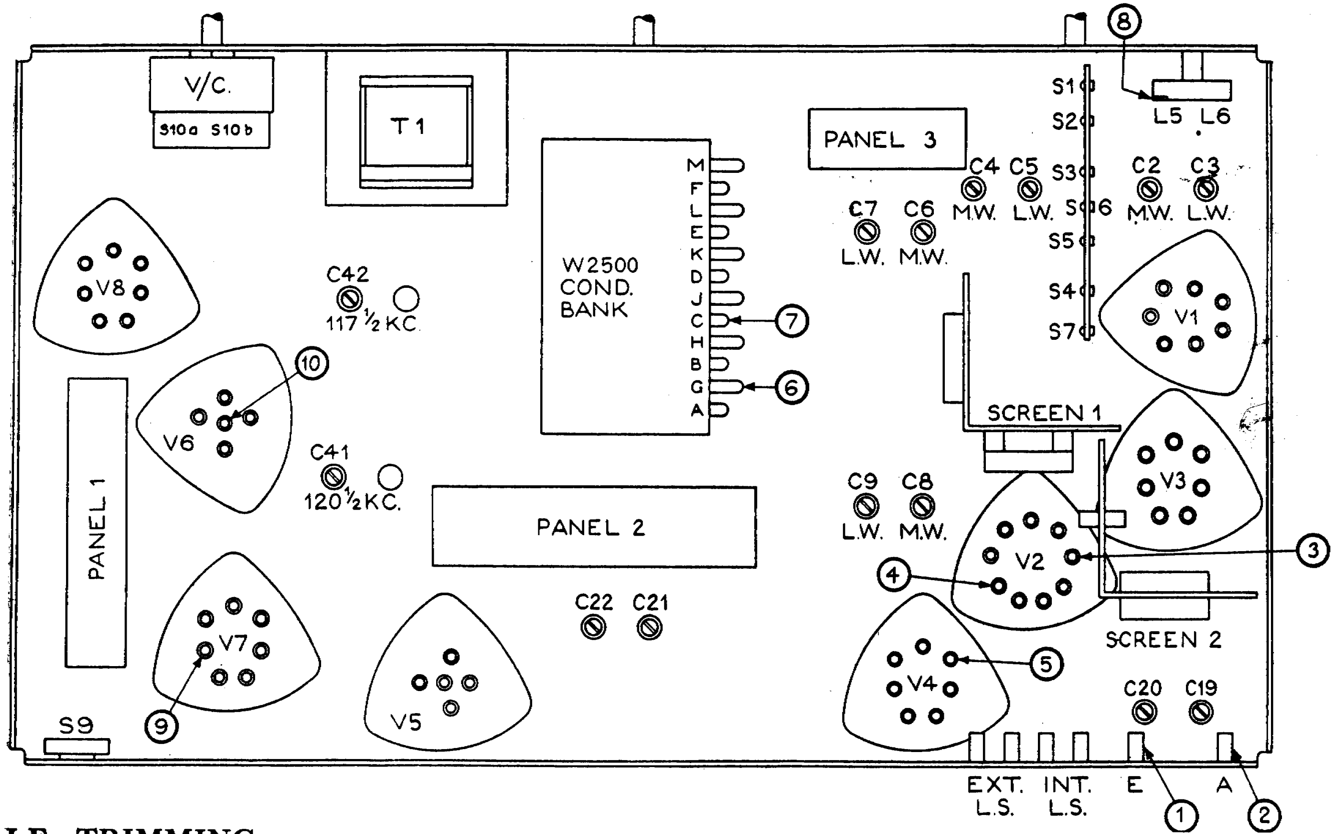


FIG 27. TRIMMING DIAGRAM



R.F. TRIMMING

(1) Close S8, and check calibration. If O.K., proceed to para. (9).

(2) If not O.K., join together (9) and (10).

(3) Tune in a station between 220 and 265 metres, ignoring calibration.

(4) Connect E of test osc. to (1). Attach length of insulated wire to test osc. A socket, and introduce free end into R.F. transformer can.

(5) Set test osc. to 119 Kc/s (unmodulated) when whistle will appear.

(6) Set receiver to exact wavelength of station chosen.

(7) Adjust C8 till whistle falls to zero.

(8) Proceed as (1) to (7) above, but switch to L.W., trim on C9, and use Luxemburg.

(9) Connect test osc. via dummy Ae between (1) and (2).

(10) Switch test osc. to M.W. and to int. mod., and set to about 230 metres.

(11) Connect O.P. meter to receiver.

(12) Tune in signal from test osc. for max. O.P. meter reading.

(13) Adjust C6, C4 and C2 to increase reading.

(14) Switch receiver and test osc. to L.W., and adjust latter to about 1,200 metres. Tune in signal for max. O.P. meter reading.

(15) Adjust C7, C5, and C3 to increase reading.

(16) Replace set in cabinet, bolt down, and recheck calibration.

(17) If inaccurate, wedge tuning knob with cardboard to keep S8 closed, and trim C8, C9, through hole in cabinet shelf (when included).

I.F. TRIMMING

(1) Disconnect V1 anode lead and interpose 0—10 milliammeter. Join 0.1 mfd condenser between – terminal of meter and E.

(2) Join (4) to (6) with shorting strap.

(3) Connect test osc. E to (1), and join test osc. A to (5) via a 0.1 mfd condenser. Do not use dummy aerial.

(4) Adjust test osc. to 119 Kc/s, and switch on set.

(5) Adjust C21 for *min*. meter reading.

(6) Adjust C22 to *max*. of peak between two troughs (see Fig. on page 15).

(7) Repeat above adjustments to C21, C22.

(8) Adjust C22 to make two " troughs " equal (see Fig. on Page 15)

(9) Transfer test osc. input to V2 Pen c.g. (C1C), and switch receiver to L.W.

(10) Connect 0.1 mfd condenser and .1 MΩ in series between (5) and (1).

(11) Adjust C19 for *min*. meter reading.

(12) Transfer res. and condenser combination to (3) and (1).

(13) Adjust C20 for *min* meter reading.

IMAGE FREQUENCY SUPPRESSION

(1) Join (9) to (10).

(2) Connect test osc. between (1) and (2), switch to int. mod., adjust to 333 metres, and set output to max.

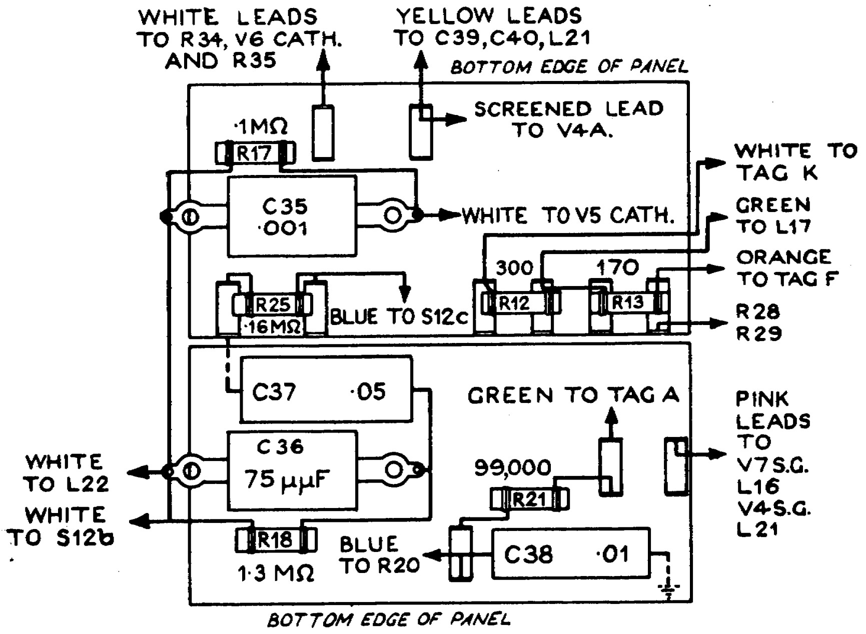
(3) Tune receiver a little above 450 metres, when a weak signal should be heard. Tune this in accurately.

(4) Adjust the erinoid screw at top of grid coil can to *reduce* signal to min.

W2654 ASSEMBLY D28RG

(Showing both sides of panel)

FIG. 28



A.T.C. TRIMMING

(1) Make sure that S8 is open.

(2) Insert 0—10 milliammeter in V3 anode circuit.

(3) Connect 0.1 mfd condenser between – terminal of meter and E.

(4) Join (4) to E.

(5) Disconnect wires from Tag C (7) and join them together.

(6) Connect test oscillator between (5) and chassis, and adjust to 120½ Kc/s.

(7) Adjust C41 for *min.* meter current.

(8) Set test osc. to 117½ Kc/s.

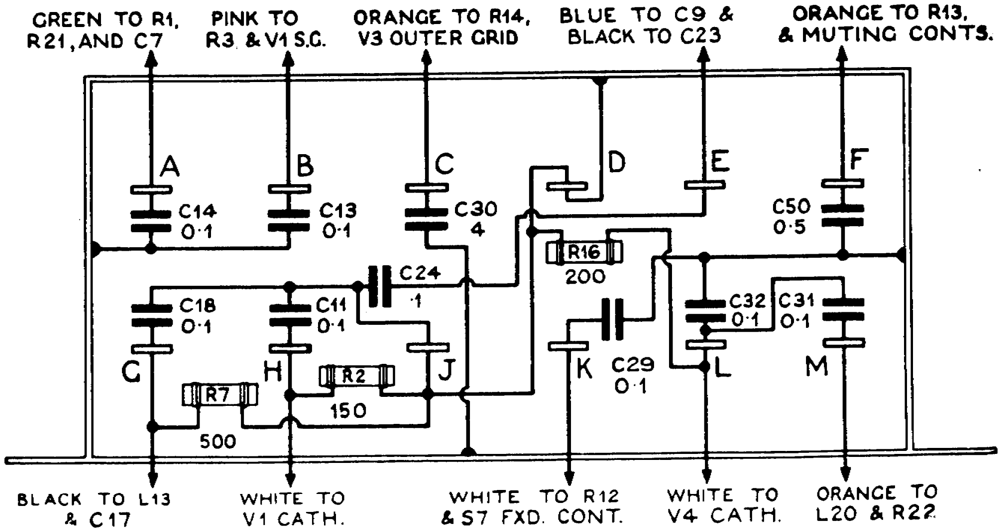
(9) Adjust C42 for *max.* meter current.

(10) Check that V3 anode current is normal with test osc. adjusted to 119 Kc/s.

(11) Check adjustment of C21, C22.

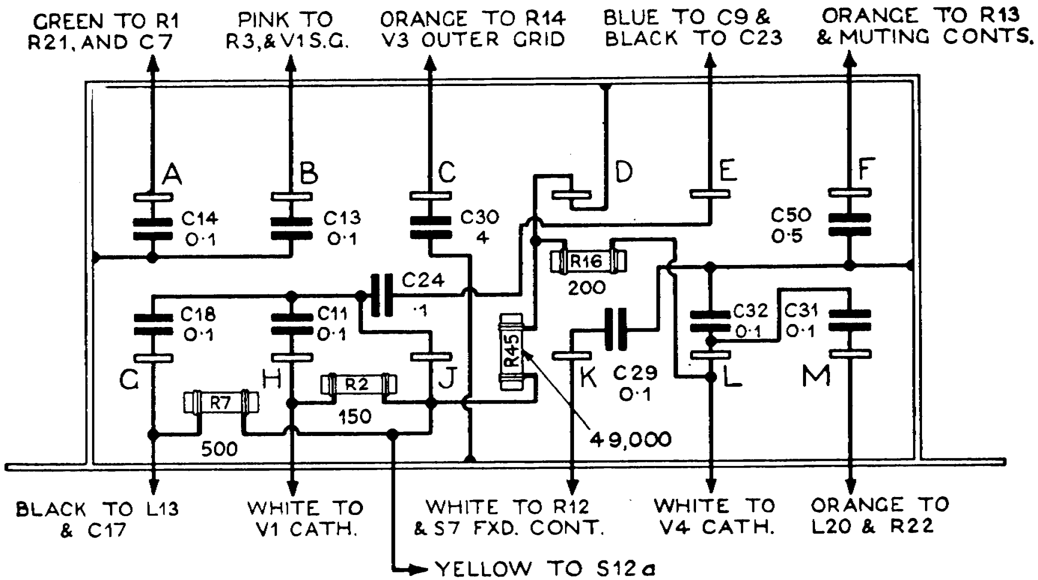
W2500 BANK A28C & D28C

FIG. 29



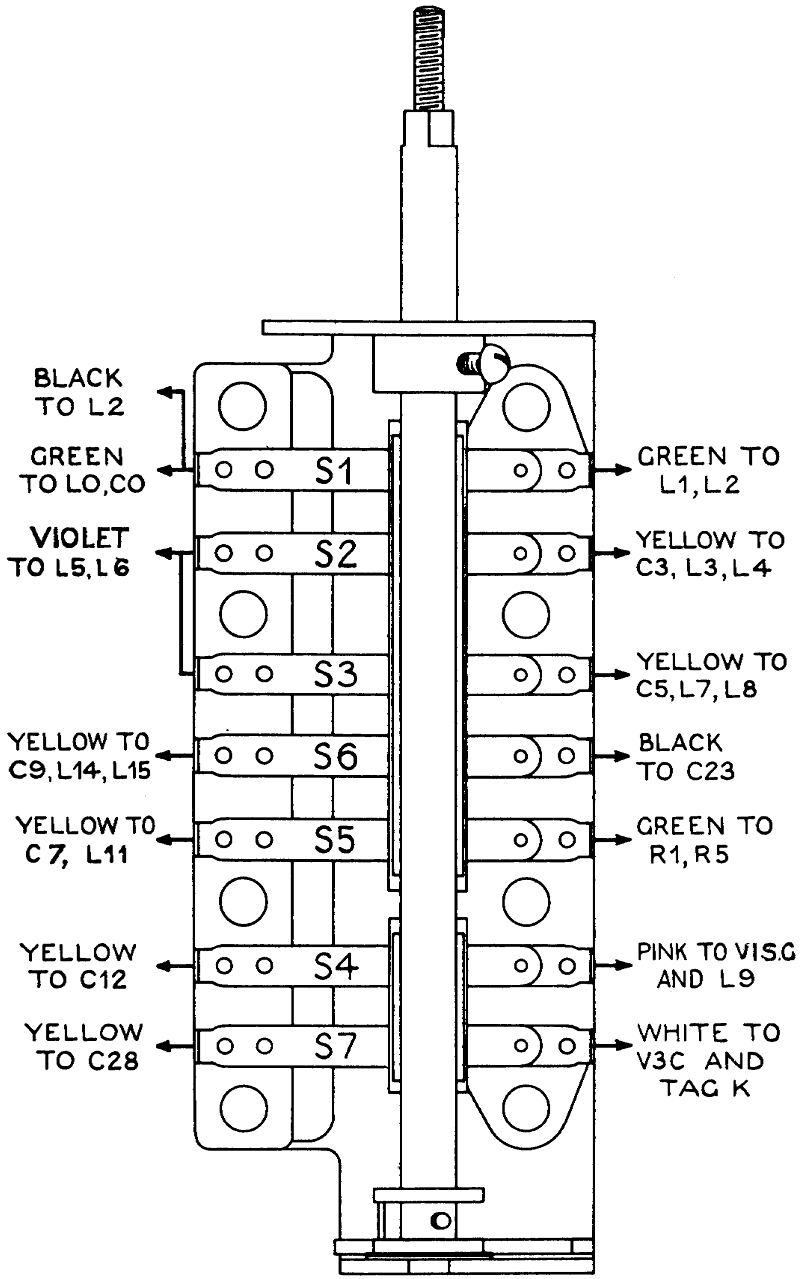
W2500 BANK A28RG & D28RG

FIG. 30



W/C SWITCH CONTACTS

FIG. 31



SCREENS 1 and 2
(View shows screens opened out)

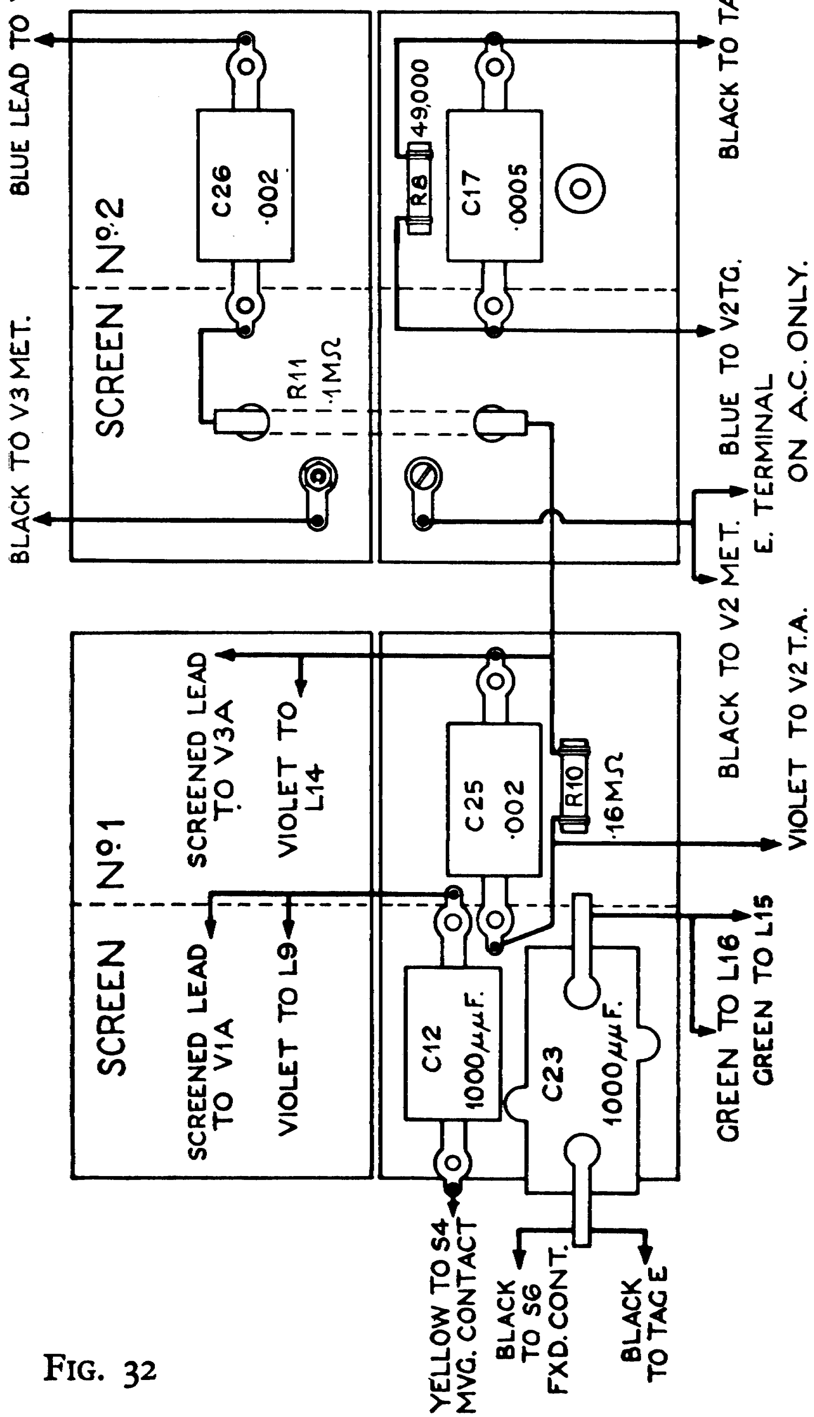
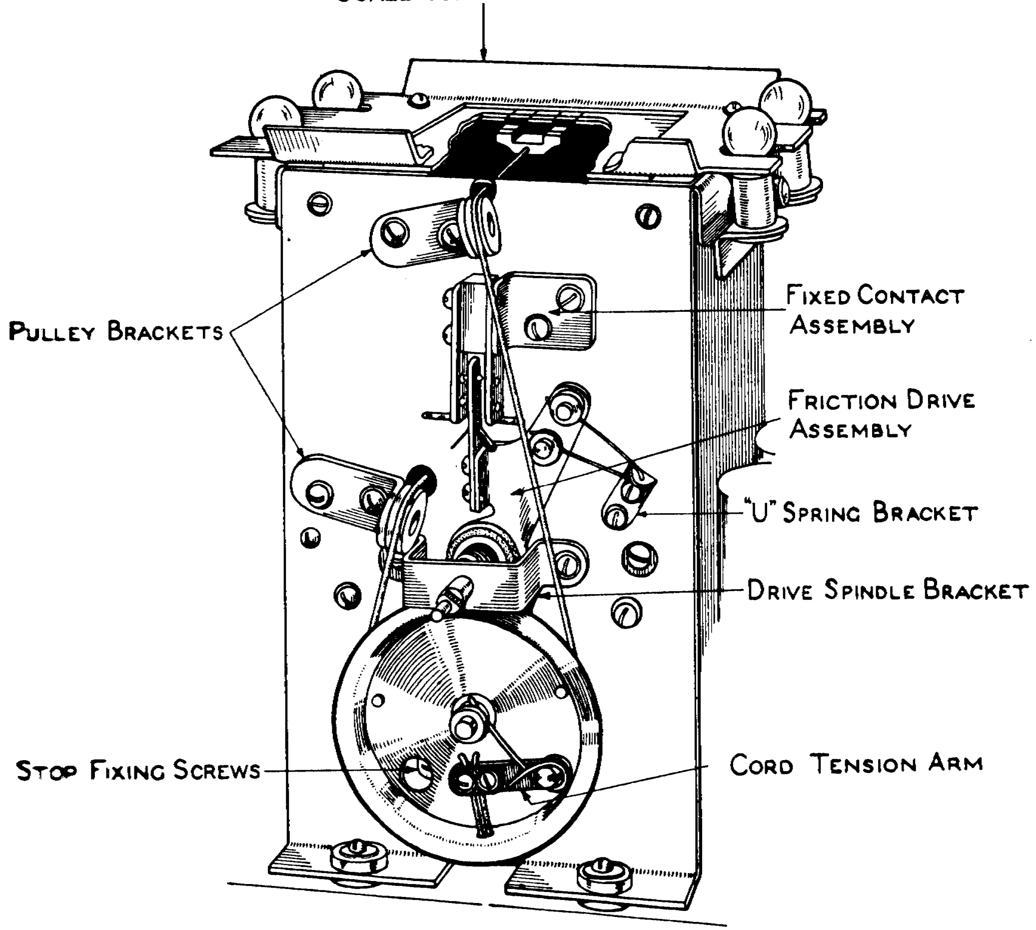


FIG. 32

CONDENSER DRIVE

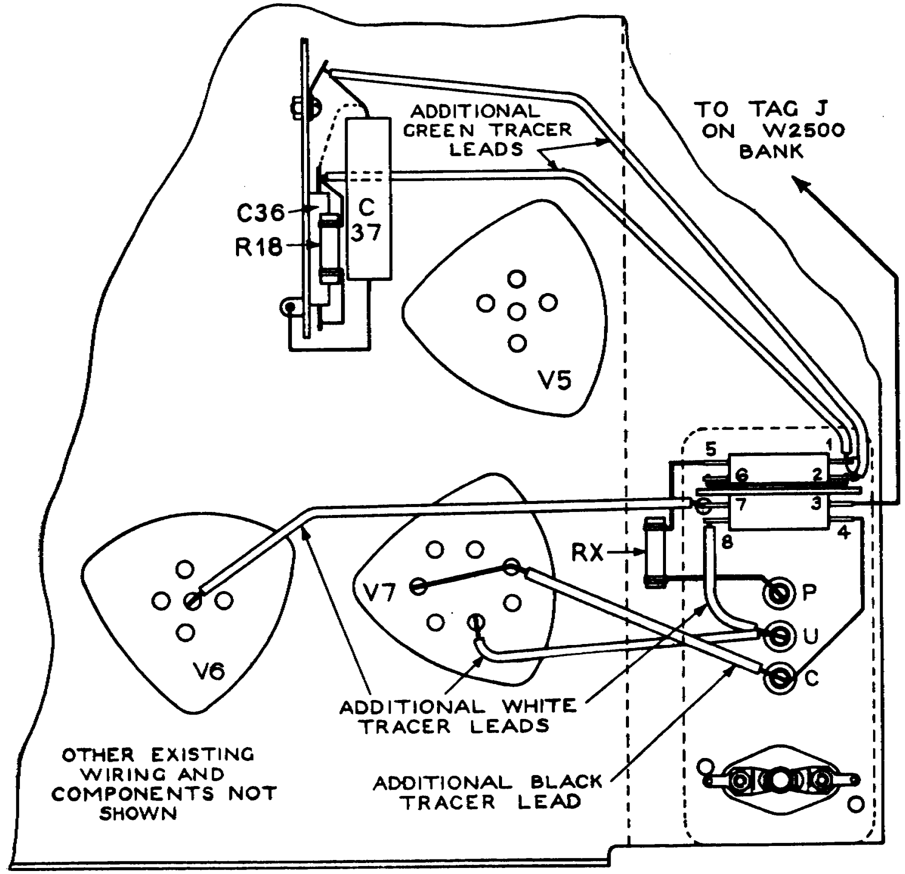
FIG. 33



A28C PICK-UP CONNECTIONS

FIG. 34

N.B. REMOVE WIRE LINK BETWEEN TAGS D AND J AND CONNECT IN ITS PLACE A ¼ WATT RESISTANCE OF 49000 Ω



MAINS TRANSFORMER

FIG. 35

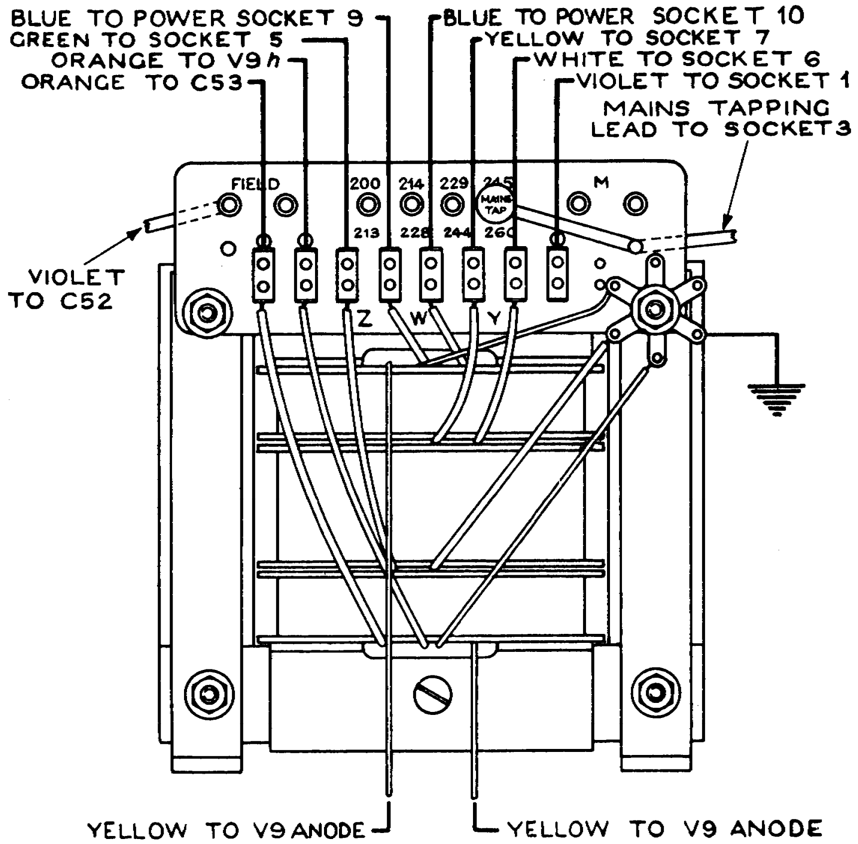


FIG. 36

A28 POWER SOCKET

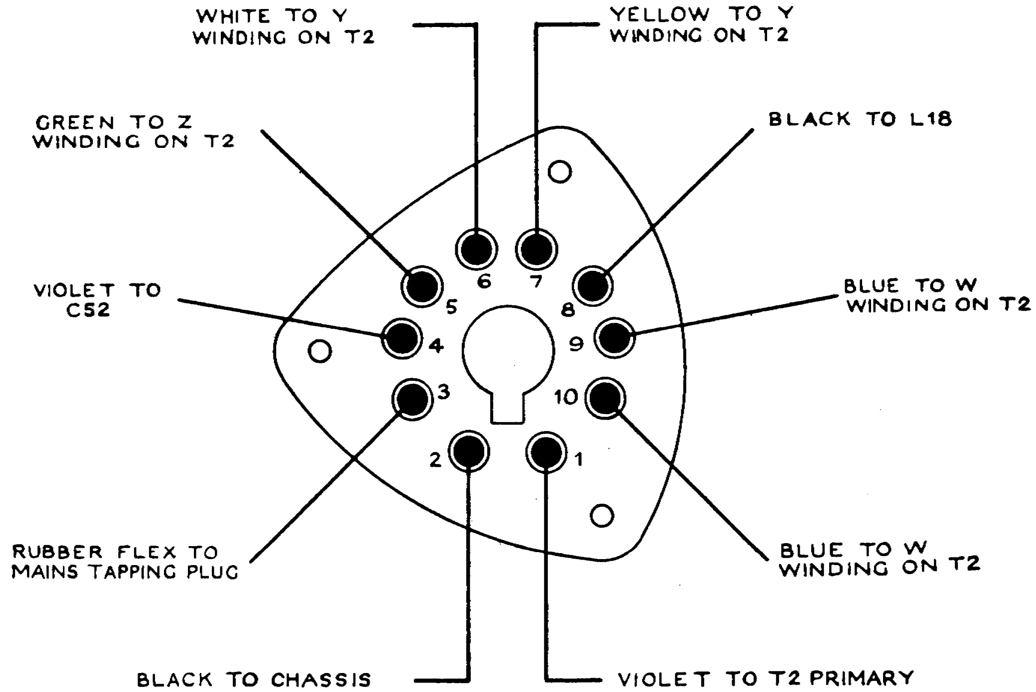


FIG. 37

A28 POWER PLUG

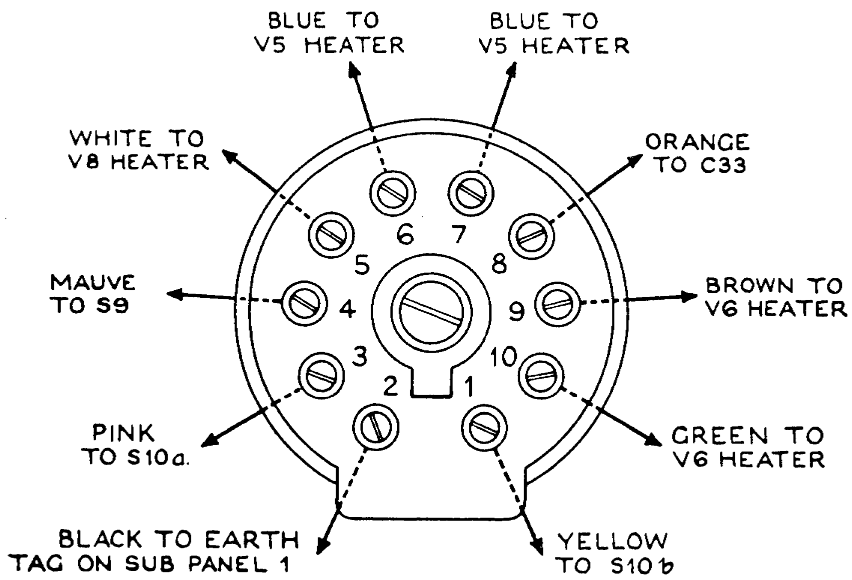


FIG. 38 D28 POWER SOCKET

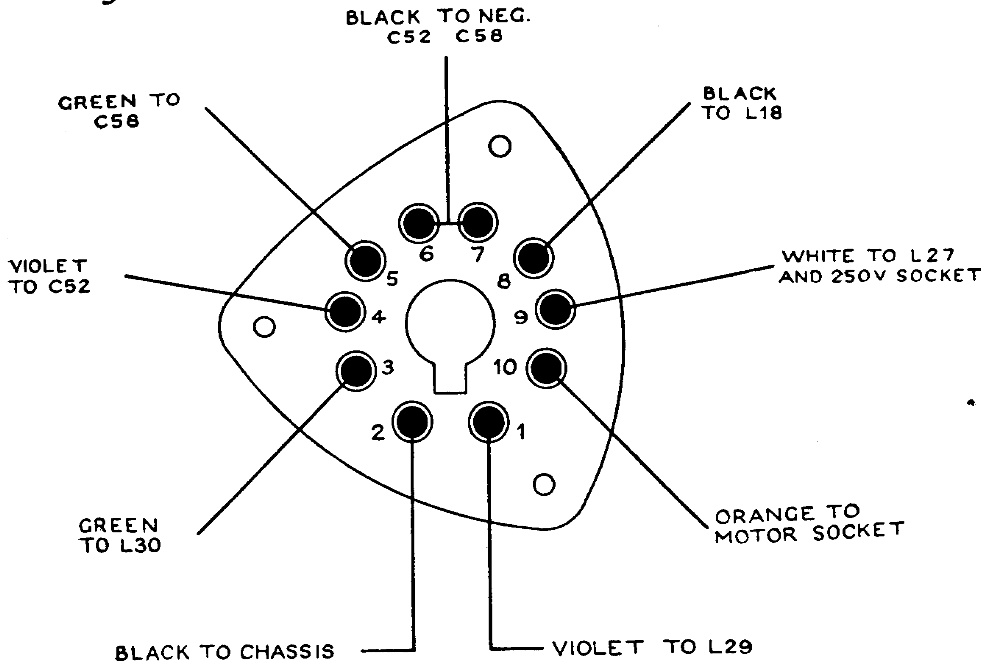
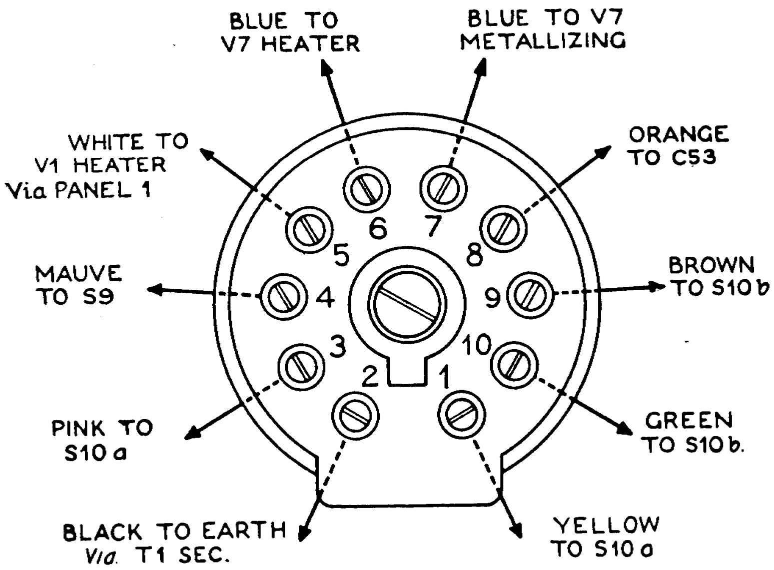
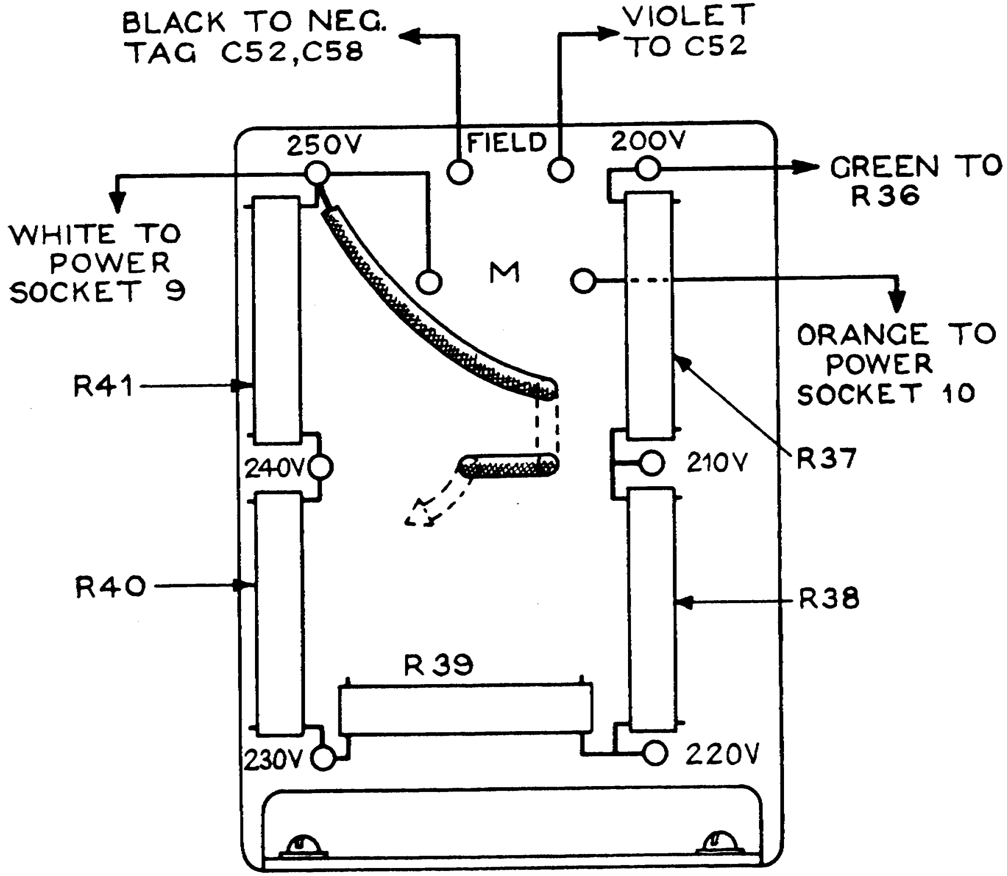


FIG. 39 D28 POWER PLUG



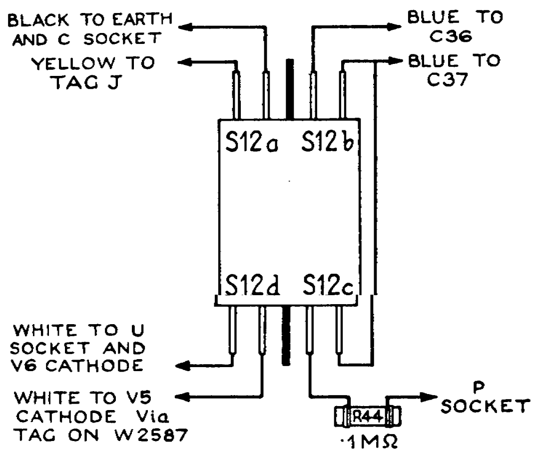
D28 MAINS-TAP PANEL

FIG. 40



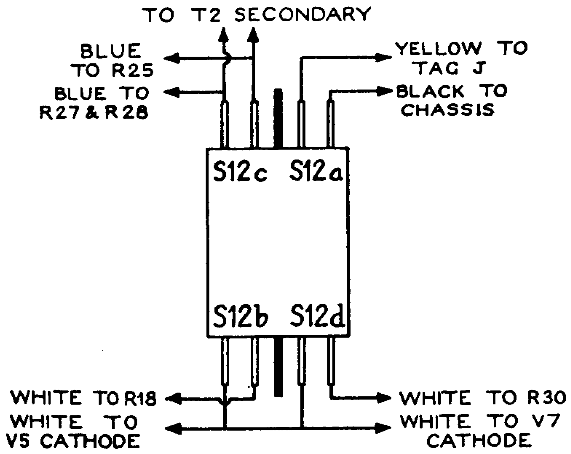
A28RG GRAM SWITCH

FIG. 41



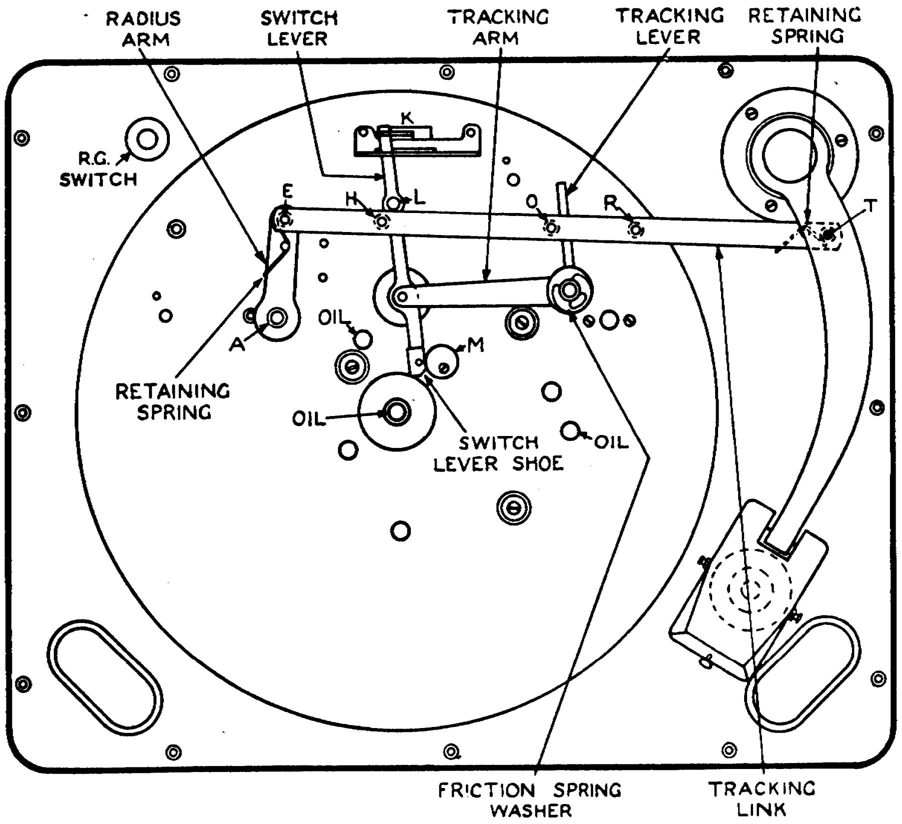
D28RG GRAM SWITCH

FIG. 42



A28RG MOTOR BOARD

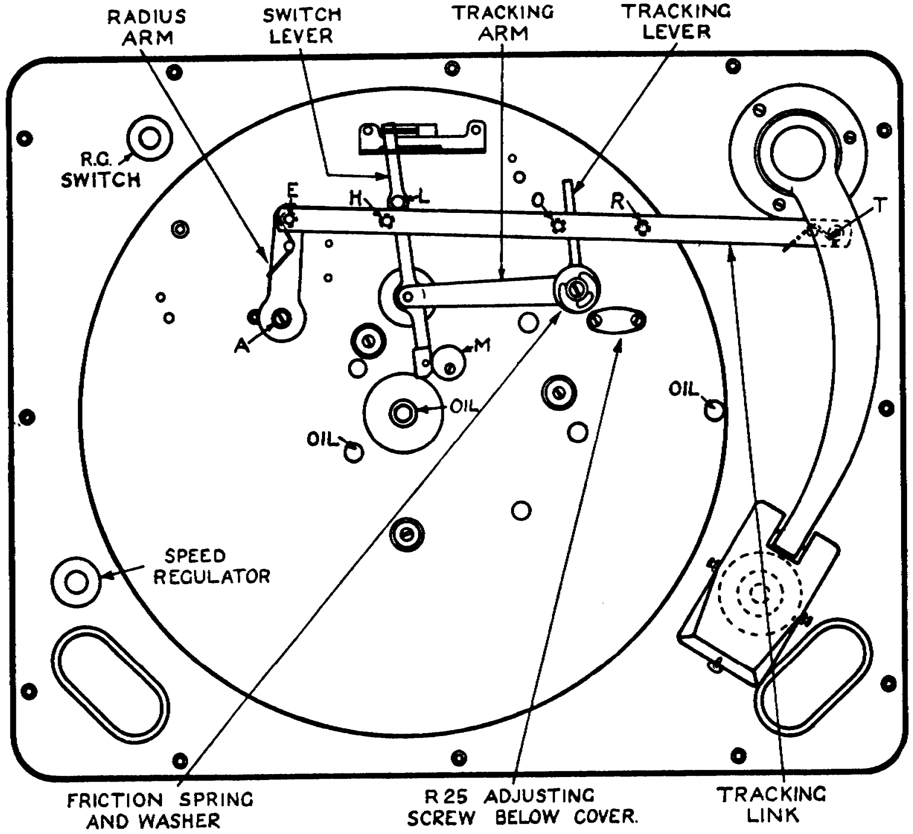
FIG. 43



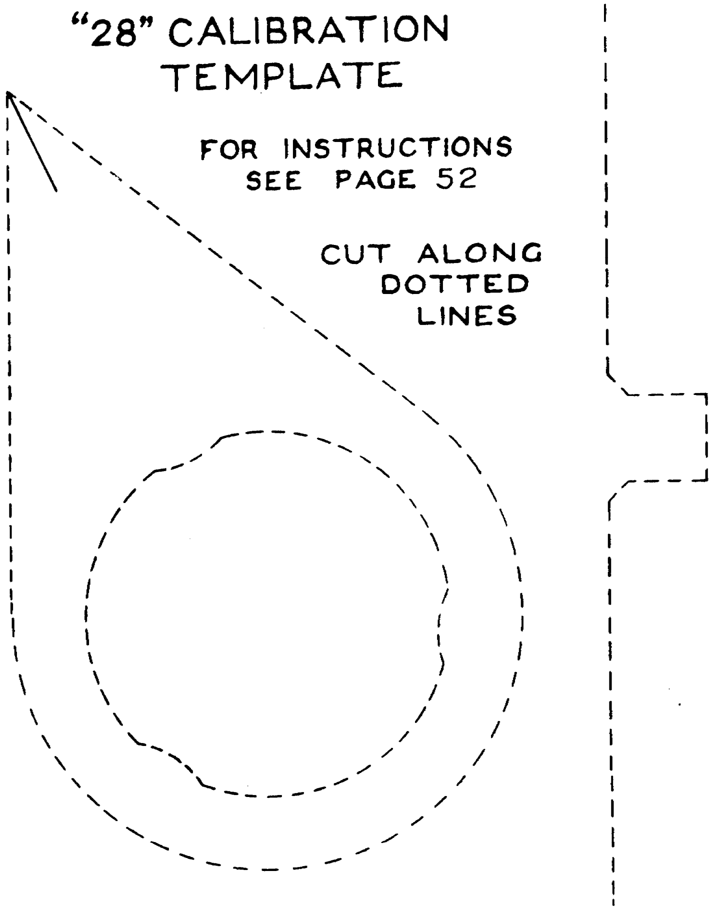
BLOCK LETTERS REFER TO KEY POSITIONS MENTIONED IN THE TEXT

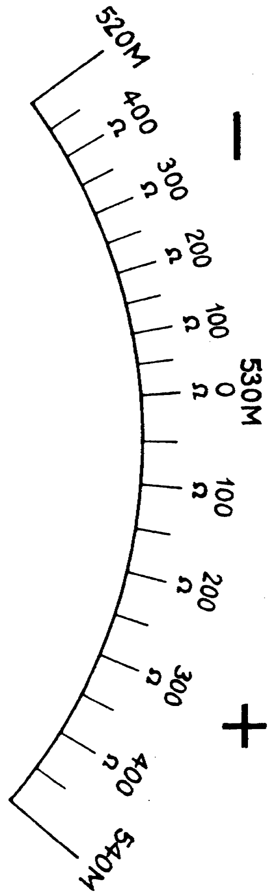
D28RG MOTOR BOARD

FIG. 44



BLOCK LETTERS REFER TO KEY POSITIONS MENTIONED IN THE TEXT


"28" CALIBRATION TEMPLATE
FOR INSTRUCTIONS SEE PAGE 52
CUT ALONG DOTTED LINES


520M
400 Ω
300 Ω
200 Ω
100 Ω
530M 0 Ω
100 Ω
200 Ω
300 Ω
400 Ω
540M
−
+