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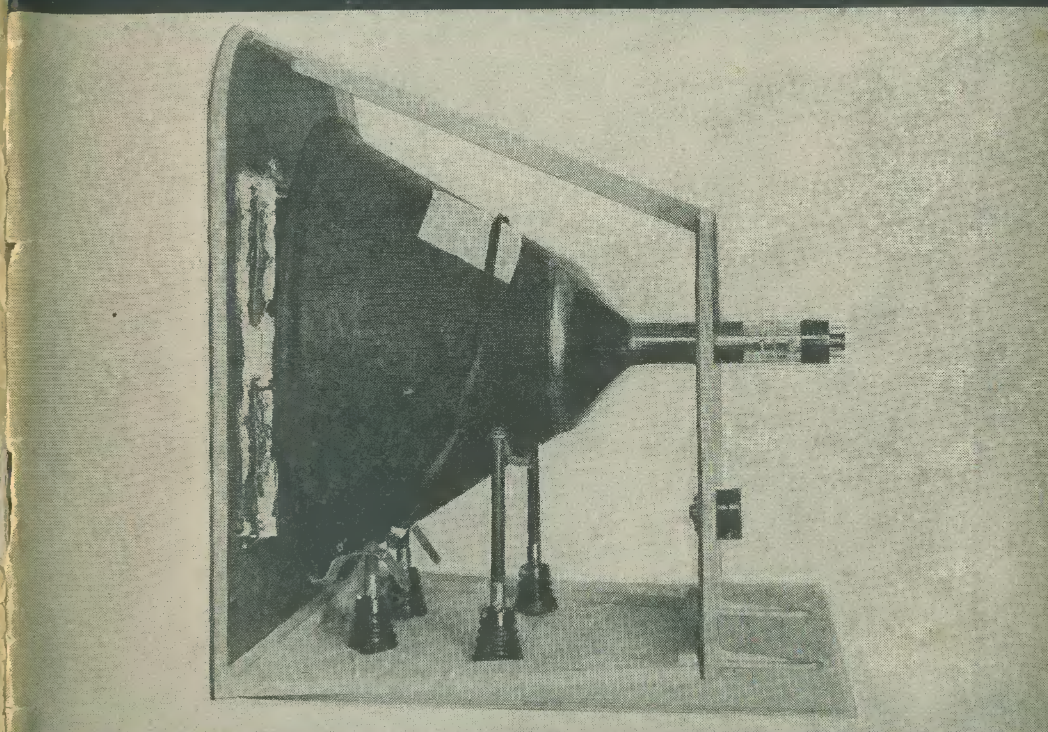
Number 7
FEB./MAR. 1952

RADIO CONSTRUCTOR

for the Radio and Television Enthusiast



IN THIS ISSUE . . .

Large Screen TV · 2 Volt Vibrator Unit · Series Noise Limiter · Slide-Back Valve Voltmeter · Low Resistance Tester · Different(ial) Kind of Circuit · Decorative Panel Finish · Improving TV Sound Output · Standing Waves and All That

etc., etc.

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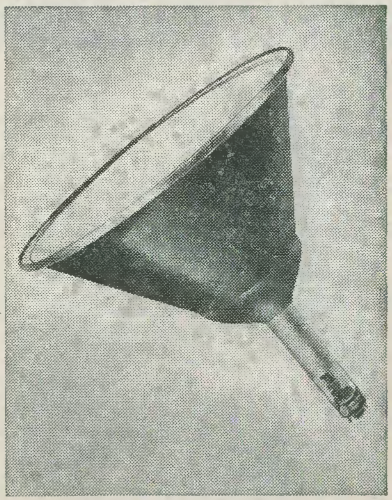

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Edited by C. W. C. OVERLAND, G2ATV

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LARGER AND LARGER.

Regular readers will have noticed that our last issue contained an extra four pages. This issue contains a further four, in pursuance of our policy of giving as bright and big a magazine as it is within our powers to do. That we have been able to do so is due to the continued support of our advertisers, which we gratefully acknowledge, and to our steadily rising circulation.

But, when penning the above heading, we really had television in mind. This side of our hobby continues to attract many adherents, as witness the success of our publication " Inexpensive Television." Here, we should like to apologise to the many readers and traders who have been kept waiting for the latest revised addition, due to circumstances outside our control.

The trend in TV now is towards larger and larger size pictures—many set manufacturers have, indeed, abandoned anything below 12" tubes. The English Electric Co. some time ago introduced a 16" tube, and when we approached them had received some 2,500 enquiries from interested constructors. This interest, coupled with the absence of information on the use of, and difficulty of scanning such a tube with normal components, decided us to probe further into the subject. The result is a series of articles commencing in this issue, and entitled " Large Screen TV," which we are sure will be appreciated by many readers.

Suggested CIRCUITS *for the* EXPERIMENTER

The circuits presented in this series have been designed by G. A. FRENCH specially for the enthusiast who needs only a circuit and the essential relevant data.

No. 15: A Series Noise Limiter

This circuit is that of a series-diode noise limiter which is very effective in reducing pulse-type interference, such as ignition noise. It is intended for connection at the second detector stage of a superhet. In addition to the limiter circuit, the diagram illustrates also the necessary subsidiary components needed for detection; and for undelayed AVC as well, should this be desired. The circuit may be fitted as it stands into any superhet, to provide both limiting and detection.

Circuit Action

The action of the circuit is fairly simple. On reception of a carrier, the diode V1 rectifies, causing a negative voltage (relative to earth) to be built up across R1 and R2, appearing in full at the junction of R1 and R3. This full voltage is applied, via R3 and R4, to the cathode of V2. Half the voltage (split by R1 and R2 in series) appears at the anode of V2. This anode is therefore positive with respect to its cathode, and V2 correspondingly conducts.

Also appearing across R1 and R2 is the AF modulation voltage obtained by the detecting action of V1. As V2 is conducting, that part of the AF voltage built up across R2 is passed to its cathode and, when the switch S1 is set to "On," to the subsequent AF amplifier via C4.

When a pulse of interference is received, it is immediately detected by V1, causing a correspondingly high negative voltage to be built up across R1 and R2. Half of this high voltage is applied immediately to the anode of V2. The cathode of this valve, however, rises only slowly to the negative voltage; this delay being due to the relatively long time constant given by R3 and C2. The anode of the diode therefore becomes more negative than its cathode and it ceases to conduct; thereby cutting off altogether the AF output to the subsequent amplifier. The time constant of R3 and C2 is such that the interference pulse will have ceased to exist well before the cathode approaches the voltage at the anode. Thus, after the pulse has finished, the circuit settles down to normal working again.

Detection

Apart from its limiting action, this circuit also offers the correct facilities for second detection. RF decoupling of the AF output is given by the filter C1, R1 and C3. The subsequent circuit, (probably a leak or volume control) which follows C4 should present an input impedance of at least 1 MΩ. (A lower value would reduce fidelity). It is possible that hum may be picked up by the noise limiter components and care should be taken to see that AC leads are kept well away. If necessary, the limiter circuit could be fitted in a screened compartment. The limiter should work just as efficiently if V2 were replaced by a germanium crystal.

Undelayed AVC can be obtained from the point indicated by the dashed line. Using the recommended value of 2 MegΩ for R5, the subsequent AVC by-pass capacitor to earth could conveniently be 0.05 or 0.1 μF.

FOR . . . . .
LARGE SCREEN TELEVISION
See Page 268.

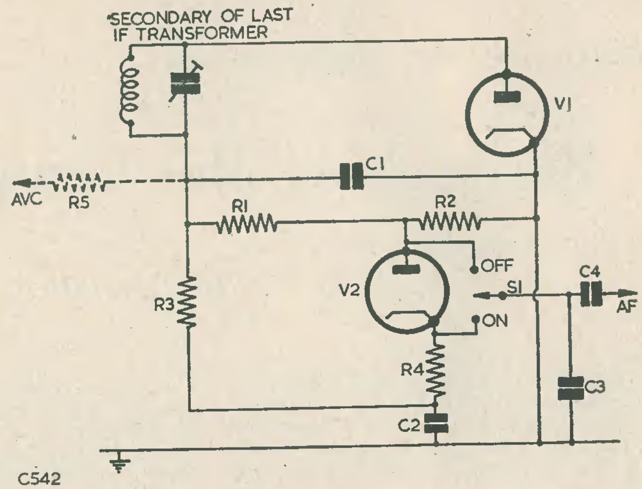
List of Values

Resistors

R1, 2—250 kΩ
R3, 4—1 MegΩ
R5 —2 MegΩ

Capacitors

C1—200 pF
C2—.01 μF
C3—100 pF
C4—.01 μF



C542

TELEVISION SOCIETY ANNUAL EXHIBITION

Reported by A. Torrance.

Held at Century House, this is a small show designed to present new materials and trends. A refreshing and private exhibit of colour scanning was shown by B. Eastwood. Using a closed circuit, a representative range of colours were reproduced on a standard magnetic tube by means of a tri-colour wheel.

Ediswan showed spot wobble at its best, and there can be no doubt it is an advantage on large tubes where 405 lines seem rather like a venetian blind.

The Post Office Radio Branch exhibited a new method of direct photography from a TV Tube; utilising the positive side of the deflection assembly, full frame, half or quarter pictures may be taken at will. This may open possibilities for manufacturers wishing to make instantaneous examination of line formation.

Decca showed for the first time their direct large projection model, with first class definition. The picture is thrown on to a screen (4 ft. × 3 ft.) which, when not in use, slides down into a container. Personally, the writer preferred picture quality when seen on an ordinary distempered wall.

A rather unfortunate selection of master pattern generator, supplying most of the exhibits, produced a picture with an obvious fault. At a top technical show of this sort one does not expect to see this kind of thing.

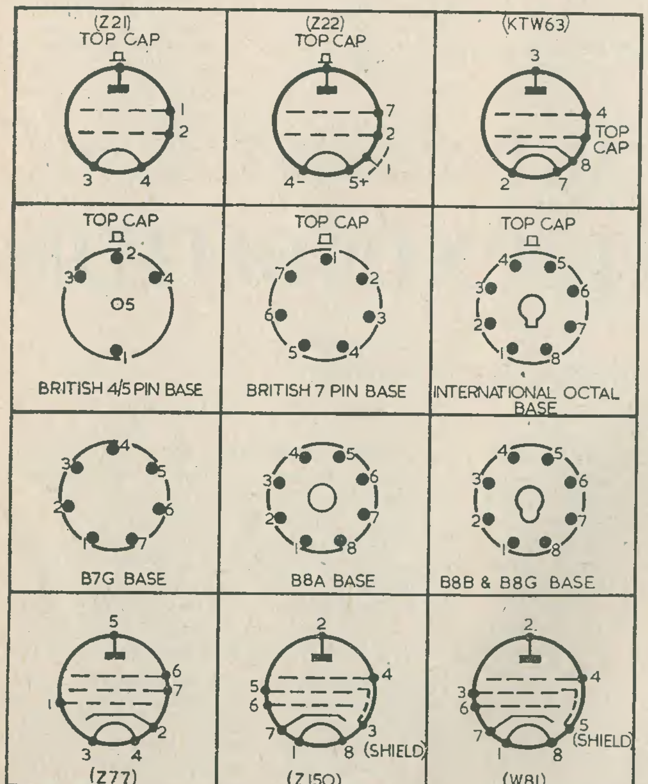
All in all—progressive!

Mainly for the Beginner . . .

Recognising the Component

By H. E. SMITH, G6UH.

Having dealt with the valve as a generator and an amplifier of voltages, let us examine the components associated with it operationally. RF by-pass capacitors, grid resistors, anode load resistors, and RF coupling capacitors are almost invariably situated very close to the valve holder. A knowledge of valve socket connections is essential for the correct indentification of any component. Some manufacturers supply a chassis layout diagram which depicts the physical disposition of the components, but in many cases, especially with surplus equipment, such a diagram is not available. The first step, then, is to become acquainted with the method by which valve bases are numbered. Several types are shown in Fig. 1, and it must always be remembered that the numbering is from the *under* side of the valve socket; in other words, viewed from the *underside* of the chassis. The first of these is the standard British 4 or 5 pin base. In the case of triodes, of course, pin No.2 is always the control grid (G1). The top cap is usually the anode, and with indirectly heated types, Pin 5 is the cathode. Taking a simple TRF battery operated receiver, using, say a valve of the Marconi Z21 type as an RF Amplifier, pin No. 1 is the screen



C543

Fig. 1: Specimen valve base connections, with a schematic drawing of typical valves to suit each base.

grid, pin No.2 is G1 (or input grid), pin Nos.3 and 4 the heater, and the top cap the anode connection. The components connected to socket No.1, therefore, will be the screen feed resistor and the screen bypass capacitor. This latter is usually connected quite closely to the tag on the socket. To socket No.2 will be connected the tuned circuit and gang capacitor, either directly coupled, or via a fixed capacitor (Fig. 2). The two sockets 3 and 4 are the filament, and one of these usually connects to chassis.

Moving across the chassis (remembering we are still looking at the inside of the chassis) we come to the detector stage. This is possibly a valve of the HL2 type. Socket No.1 will be the anode; the connections to this will be either to the primary of an intervalve transformer, or to the anode load resistor, a capacitor of 0.01 or 0.1 μF (coupling to the audio stage) and possibly a small capacitor of 100 pf or so soldered from the socket to earth. This is an anode bypass capacitor and assists in excluding unwanted RF from the audio stage. Socket No.2 is the input grid. Soldered to this, usually quite close to the socket, will be found the grid capacitor and grid leak. The other end of the grid leak is sometimes connected to the positive side of the filament supply. Sockets No.3 and 4 are the filament, and if the valve is of the metallised type, the metallising is connected internally to pin 3. Pin 3 should, therefore, be the earthed or negative heater connection.

Now to the output valve. This is probably a small power valve of the LP2 class, the socket connections being precisely the same as the previous valve. No.1 is anode, and connected to this is the output transformer primary. Socket No.2 (grid) will be either connected direct to the volume control slider, or to a 0.1 μF capacitor and a fixed resistor which connects to the grid bias battery. Fig. 3 shows two methods of connection to the output valve which may be encountered. Having now established the location of some of the principle components, it is a comparitively simple matter to reconstruct the circuit.

Reverting to the RF valve (Z21), the top cap, is of course, connected to the tuned circuit. A simplified circuit diagram of the 3 valve TRF under discussion is given in Fig. 4.

In most cases receiver wiring follows a colour code system. HT wiring is in red, RF and grid circuits in green, and heaters in black and white. The black usually denotes earth. Screen decoupling and audio coupling capacitors are usually tubular, while grid capacitors are flat and much smaller. By reference to Fig. 4, it will be seen that only one resistor is shown in circuit with the HL2 anode. One will often find two resistors in series with the centre taken to a capacitor connected to earth (chassis). This is provided for RF decoupling in the anode circuit, the resistor nearest

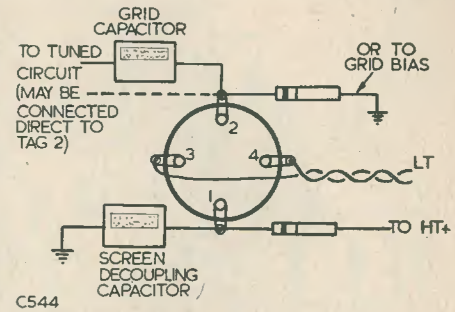


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Fig. 2: Underside view of Z21 RF valve, and typical associated components.

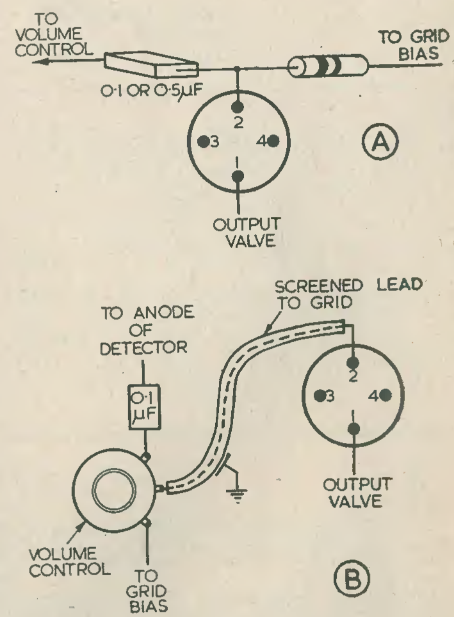

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Fig. 3: Two methods of coupling to the output valve which may be encountered.

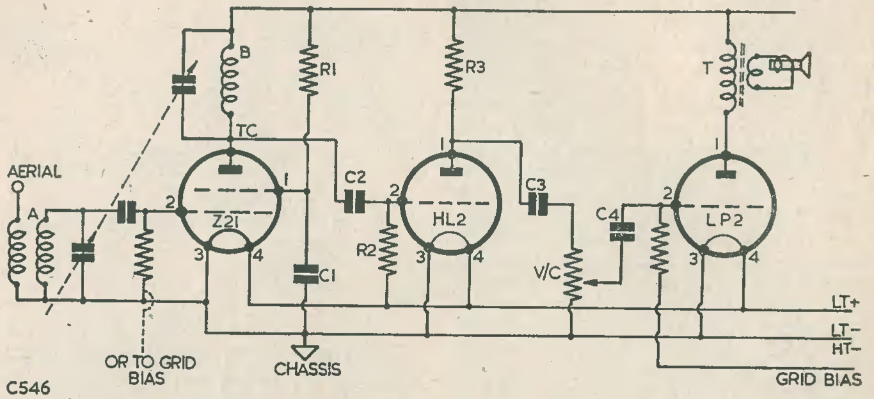


Fig. 4: Circuit of a TRF receiver using valves fitting the British 4/5 pin base.

A and B,	*Grid and anode tuned circuits.*
R1,	*Screen feed resistor*
C1,	*Screen decoupling capacitor.*
C2,	*RF coupling capacitor.*
R2,	*Grid resistor*
C3 and C4,	*Isolating and coupling capacitors*
R3,	*Anode load resistor*
T,	*Output transformer*

the anode being approximately four times the value of the other. The "grid leak" or grid resistor (R2) is usually of between 1 and 2 MegΩ, and the grid resistor in series with LP2 grid and grid bias battery will probably be of between 1000 and 10,000 ohms.

An additional capacitor of 100 pF or so is sometimes found across HL2 anode and earth. The purpose of this is to provide additional RF bypass to earth (i.e.) to keep RF out of the audio circuit). C3 and C4 are usually of 0.1 µF or larger. They must be of sufficient capacity to offer a low impedance to the lowest audio frequencies, otherwise the response of the receiver will be lacking in bottom register. When pentode output valves are used, it is quite common to find an additional capacitor of some 0.002 µF or so across the output transformer primary. This is fitted as a "tone corrector" to prevent the "hiss" and over-emphasis of high notes so often prevalent with pentodes.

(To be Continued)

NOTICES

THE EDITOR invites original contributions on construction of radio subjects. All material used will be paid for. Articles should be typewritten, and photographs should be clear and sharp. Diagrams need not be large or perfectly drawn, as our draughtsmen will redraw in most cases, but relevant information should be included. All Mss must be accompanied by a stamped addressed envelope for reply or return. Each item must bear the sender's name and address.

TRADE NEWS. Manufacturers, publishers, etc., are invited to submit samples or information of new products for inclusion in this section.

ALL CORRESPONDENCE should be addressed to *Radio Constructor*, 57 Maida Vale, Paddington, London, W.9. Telephone: CUN. 6518.

Converting the 21 RECEIVER

By J. R. DAVIES

This article concludes the step-by-step conversion of this well-known ex-Government receiver.

68. Continuing with the modification, we now proceed to make the chassis ready for fitting the Osmor HO coil-pack. First of all, the chassis must be turned upside down again.

A black and white lead travels from pin 7 of V1C to a two-way socket on the front panel. Disconnect this lead at pin 7 and remove the socket (with its now-disconnected earth lead) by drilling out the four small rivets holding it.

69. Remove valveholder V1C completely.

70. Drill a hole in the front panel to the dimensions and in the position illustrated in Fig. 5. Remove the adjacent front upright brace (indicated in Fig. 5) by unscrewing two 4-BA screws at its bottom and one at its side, and cut it to the dimensions given in Fig. 6. Refit the brace with the same three screws.

Remove the mounting nut and shakeproof washer from the Osmor HO coil-pack and check that it may be fitted to the hole just drilled without fouling any component or part of the chassis. After this test has been carried out, remove the coil-pack and refit its mounting nut and washer. The coil-pack is not fitted yet.

71. Refit the two 4-BA bolts and the two 6-BA nuts and bolts removed in Step 62; thus bolting the outside frame together again.

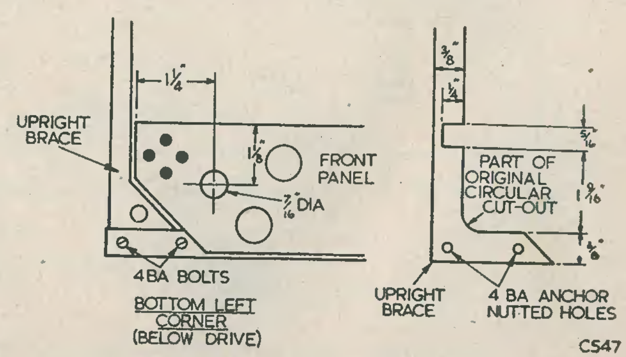
72. Before the Osmor HO coil-pack is fitted it must be modified and have the HF Stage leads connected to its switch.

Connect three seven-inch insulated leads to tags B, C and 9 of the coil-pack switch (see the Osmor leaflet supplied with the coils). These leads should be fairly thin and, if still available, three lengths of the cotton-covered wire removed earlier from the chassis would cope excellently here.

Considering the coil-pack itself, it will be seen that a lead from the front right-hand trimmer connects to the tag on the wave-change switch next to the "c" tag. Cut

Fig. 5 The dimensions and position of the extra hole needed for mounting the HO coil-pack.

Fig. 6 The bottom front part of the upright brace mentioned in Step 70 is cut to the dimensions shown here.



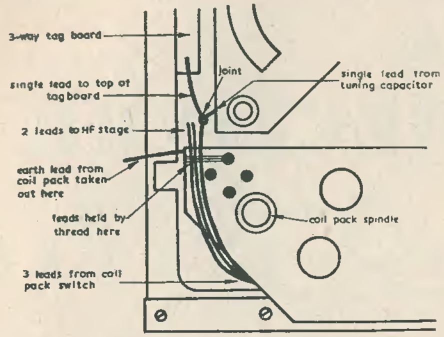


Fig. 7 How the leads from the coil-pack are taken out, (Step 73). Also showing how the connections of Step 75 are made.

C548

this lead at any convenient point and remove the top half from the trimmer tag. (The bottom half of the cut lead may be left soldered to the switch tag, as it is not now connected to any part of the circuit). Connect tag A of the wave-change switch to the trimmer tag just mentioned.

Identify the earth tag on the coil-pack to which the aerial padder is connected. (This tag is on the same side of the coil-pack as are the aerial coils). Taking care not to overheat the padder, solder a two-inch length of insulated wire to this tag.

It is worth while identifying the three leads to tags 9, B and C (say, by taking a note of their colours), so that they may afterwards be easily recognised.

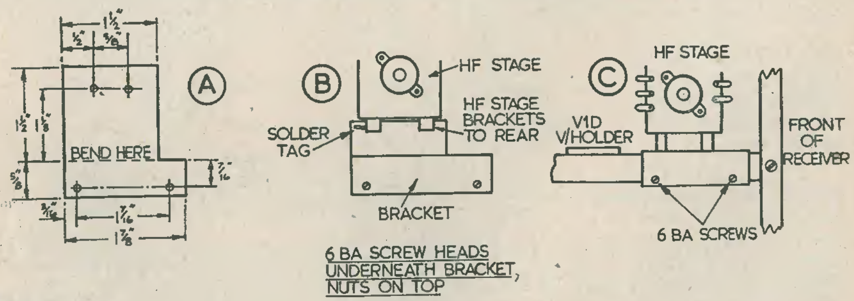
If it is desired to cut the spindle of the HO coil-pack switch to the same length as the other spindles in the receiver this should be done now, before it is fitted.

73. Fit the HO coil-pack to the front panel. The three seven-inch leads, and the two-inch earthing lead, are taken out through the space in the front panel as shown in Fig. 7 (which also illustrates the processes of a later Step).

Fitting the HF Stage

74. Make a small bracket to the dimensions shown in Fig. 8 (a). Mount the Osmor HF Stage to this bracket by two 6-BA nuts and bolts (keeping the nuts on top, and fitting an earthing solder tag as well), in the same manner as illustrated in Fig. 8 (b). Turning the receiver chassis right way up again, the bracket is screwed to the two front 6-BA anchor-nutted holes on the extreme left-hand side; the assembly taking up the position illustrated in Fig. 8 (c). Connect the five-inch tinned copper lead of Step 66 directly to the earthing tag on the bracket, cutting off excess wire.

75. Following Fig. 7, connect the seven-inch leads from tags B and C of the HO coil-pack switch to the corresponding B and C tags on the HF Stage (see Osmor leaflet), shortening as necessary. Join the lead from switch-tag 9 to the lead from the front fixed vanes of the tuning capacitor (Step 66), again shortening as necessary (see Fig. 7), and take a lead from this point to the top tag of the 3-way tagboard to the left of the tuning drive (Step 62 mentions this tagboard). Cover this three-way joint with tape or sleeving. The three leads may be held flat against the front of the chassis by tying with thread as indicated in Fig. 7.



C549

Fig. 8 Successive steps in fitting the HF Stage.

76. Replace the green fly-lead and top-cap connector already soldered to the centre tag of the tagboard just mentioned by another which is long enough to comfortably reach the top-cap of an ARP 12 plugged into valve-holder V1D.

77. It is necessary to make certain that none of the components fitted in this and the next step would foul an ARP 12 plugged into V1D valveholder. First of all, connect an additional 500 pF capacitor between tags 8 and 6 of the HF Stage. Fit the 120 kΩ resistor which was removed in Step 31 between tag 6 and the earthing solder tag on the bracket.

78. Take an additional 7.5 kΩ resistor and solder an eight-inch length of additional wire to one of its ends, covering the joint with sleeving. Solder the other end of the resistor to tag 8 of the HF Stage. Connect another eight-inch length of wire to tag 7. (The link fitted by the manufacturers between tags 7 and 8 is not disturbed during these connections, which would also apply correctly to a three-waveband HF Stage).

79. Run these two eight-inch leads along the chassis as shown in Fig. 9.

80. Connect the lead from tag 7 of the HF Stage to pin 3 of V1A; and that from the 7.5 KΩ resistor to pin 2 of the same valve-holder, shortening both leads as necessary.

81. Solder two three-inch lengths of tinned copper wire to tags B and C of the HF Stage and bend outwards.

82. Make two brackets as shown in Figs. 10 (a) and (b), and mount the HF Stage trimmers to the receiver with the aid of these brackets in the manner illustrated by Fig. 10 (c). This necessitates removing and refitting the two 6-BA screws holding the HF Stage bracket. The 6-BA screw holding the tuning drive to the outside frame is now also refitted by this process.

83. Connect the two three-inch lengths of tinned copper wire from tags B and C of the HF Stage (Step 81) direct to the two top trimmer tags, cutting off excess wire.

Connecting up the Coil-pack

84. Turn the chassis upside down again.

Shortening as necessary, connect the under-chassis lead from the centre fixed vanes of the tuning capacitor to tag 4 of the HO coil-pack (see Osmor leaflet). Similarly connect the underchassis lead from the rear fixed vanes to tag 3 of the coil-pack. Connect an additional 100 kΩ resistor between tag 2 of the coil-pack and the earthing tag fitted in Step 54. Join pin 1 of V1D to this same earthing tag. Remove the 150 pF capacitor (originally parallelled by a 25 kΩ resistor) from the old coil chassis and connect it between tag 5 of the coil-pack and pin 3 of V1B.

Although the HO coil-pack is earthed via its mounting bush, it is advisable, in this case, to use a more direct connection. Identify the 4-BA bolt indicated in Fig. 10 (c) and fit a solder tag under it. Connect the two-inch earthing lead of Steps 72 and 73 to this tag, shortening as necessary.

Identify the second contact down on the right-hand side on the centre wafer of the original wave-chance switch. (This contact is used only as a dummy). Remove a 0.01 µF capacitor from the old coil chassis and connect this between the wafer contact and tag 1 of the

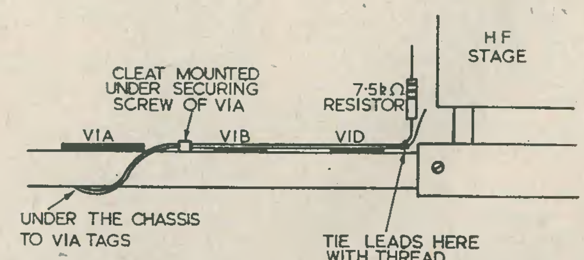


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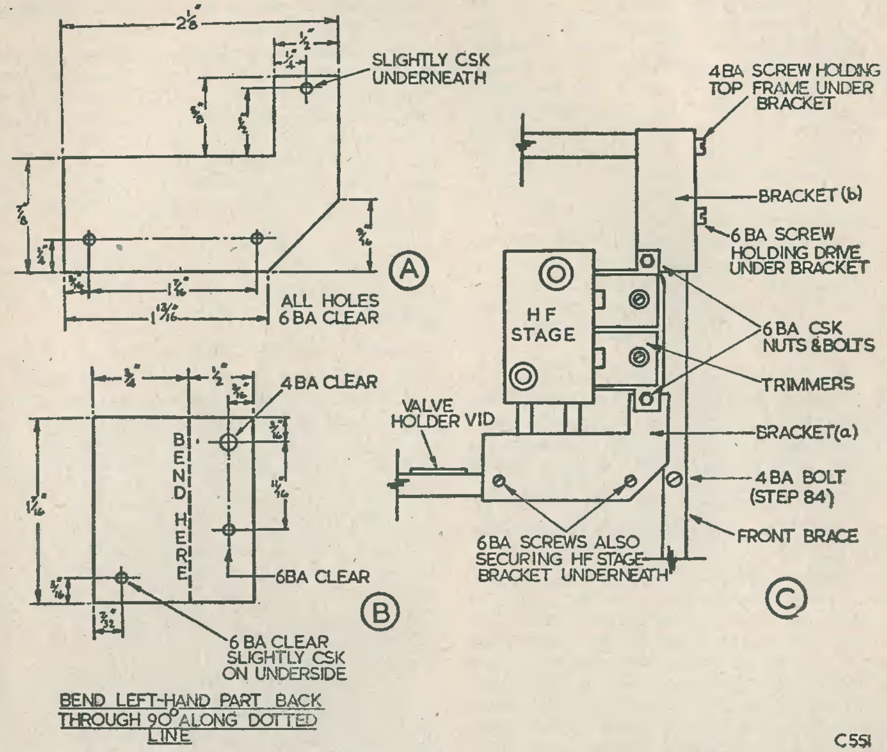
Fig. 9 Fitting the two leads from valveholder V1A to the HF Stage.



Figs. 10 (a) and (b) The two brackets used for mounting the HF Stage trimmers.
Fig. 10 (c) Side view of the receiver showing how the trimmers are fitted. The reference to the "4-BA bolt" is intended for a later step.

coil-pack. Connect an additional 10 kΩ resistor between the same wave-change contact and the earthing tag of Step 54 just mentioned.

Connect another 0.01 μF capicator (also from the old coil chassis) between the same wave-change contact and the third contact down on the left-hand side (another dummy) of the same wafer. Connect an eighteen-inch length of single flex to this latter wave-change contact. Take this flex out through the back of the chassis, passing it through the large hole under the speaker transformer. This wire will be referred to later as the "aerial lead."

85. Connect the three pins 1 of V1D, V1B and V1A together. Similarly join the pins 8 of the same three valve holders. Connect together pins 1 and 6 of V1A. Connect together also pins 1 and 6 of V1B. Run a lead across the chassis connecting pin 8 of V2A to pin 8 of V1A.

86. Remove the 100 pF capacitor from the two-way tagboard at the rear of the old 5-gang tuning capacitor, and fit it between pin 5 of V1D and pin 3 of V1B. Remove a 240 kΩ resistor from the rear coil of the old coil chassis and fit it between pins 5 and 1 of V1D.

87. Run a lead across the chassis (under the centre wave-change wafer) from pin 4 of V2B to pin 7 of V1B.

From this pin 7 the following connections are made: a 5 kΩ resistor (from old coil chassis) to pin 2 of V1A, an additional 50 kΩ resistor to pin 3 of V1B, an additional 200 kΩ resistor to pin 4 of V1B, and an additional 150 kΩ resistor to pin 4 of V1A.

88. Directly behind the right-hand securing bolt of the rear screen of the original wave-change switch are two holes in the

chassis; the first plain, the second anchor-nutted 6-BA. Fit an earthing solder tag to this second hole. Remove three more 0.01 μF capacitors from the old coil chassis and connect one end of each to pin 4 of V1B and to pins 2 and 4 of V1A respectively. The other ends of the three capacitors are connected together and are taken to the earthing tag just fitted.

Final Steps

89. Turn the chassis right way up again and re-fit valves V1A, V1B and V1D (all ARP12's). Remove the two-way tagboard (mentioned in Step 86) from the old 5-gang capacitor, together with one of the tapped angle brackets holding it. Clean the contacts on the tagboard and remove and retain the green fly-lead. Mount the tagboard to the 3-gang tuning capacitor as shown in Fig. 11 (a). Refit the green fly-lead, shortened so that it just reaches the top-cap of valve V1B. The lead from the top tag of the centre fixed vanes (Step 66), is connected, shortened as necessary, to the other tag. The diagram also shows how an additional 200 pF capacitor and a 100 kΩ resistor are connected in this particular circuit.

(These two components should be mounted so that they are not higher than the top outside frame. Otherwise the receiver could not be turned upside down without causing damage to them).

90. Above the universal coupling of the old 5-gang capacitor is a three-way tagboard. Remove this tagboard and clean the tags, leaving the already-fitted 300 pF capacitor and 1 Meg Ω resistor as they are. Using one of the spacing washers supplied with the Osmor HF Stage, fit the tagboard to the rear of the tuning capacitor as shown in Fig. 11 (b).

Identify the green lead coming up through the adjacent grommet (see Step 45) and connect it as shown in the diagram. This diagram also illustrates the other connections needed for the tagboard circuit.

Testing the Receiver

The conversion is now practically complete and the receiver may be tested. The external LT and HT supplies should be connected up once more and an aerial coupled to the aerial lead. Due to the use of end-coupled coils, an earth connection, either to chassis or to the negative 2-volt terminal will prove of assistance during the initial tests.

The Osmor wave-change switch should be turned to the long-wave position (fully clockwise), whereupon it should be found possible to receive the Light Programme or any other strong transmitter at reasonable strength. One or two stations should also be received on the medium and short-wave bands; this indicating that the oscillator and the tuned circuits (although not yet aligned), are functioning satisfactorily on these two bands.

The fidelity of reproduction should be good and, with a reasonably sensitive speaker, volume should be more than ample. AVC should be fully effective and background noise should drop on reception of a strong carrier.

It will be found that the old wave-change switch now offers two positions of selectivity. The clockwise position causes the IF's to be flattened, whilst the anti-clockwise position gives the sharpest selectivity. Sensitivity may be slightly higher on the

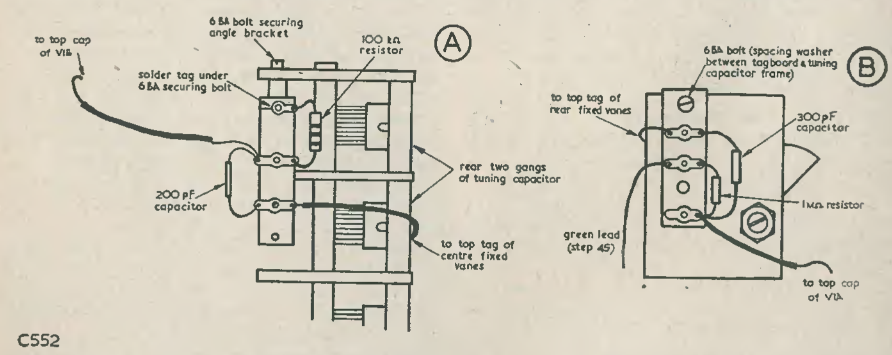


Fig. 11 (a) Top view of the 3-gang capacitor, illustrating the method of fitting the two-way tagboard of Step 89.

Fig. 11 (b) Rear view of the tuning capacitor showing the connections to the three-way tagboard of Step 90.

"flat" position, although the impression is, perhaps, heightened by reason of the increase in the higher audio frequencies and noise then passed to the audio stages. Reproduction should not be shrill if the speaker is correctly matched, and the capacitor across the speaker transformer primary should not therefore need to be increased in value.

Alignment

Before the RF and oscillator trimmers and cores are touched, the IF transformers should be accurately aligned to 465 kcs. This really necessitates the use of a signal generator to ensure that alignment to the correct frequency is obtained. The IF transformers of the set modified by the writer were found to be already aligned approximately to 465 kcs; but this fact cannot be relied upon with other models.

The IF's should be aligned with the variable selectivity switch set to the "sharp" position. If desired, a visual check of the state of alignment can be obtained by connecting a high-resistance voltmeter between the screen-grid of V1A and chassis, and trimming for a "rise" in reading. This method utilises the AVC voltage from the second detector.

The signal and noise oscillator circuits can now be tackled, and reference should be made to the Osmor Alignment Instruction Sheet. The HF Stage cores and trimmers can be adjusted in the order given for the Aerial cores and trimmers. The aerial (or signal generator) may be connected directly to the top-cap of V1A (via a 0.01 μF isolating capacitor), for primary adjustments to the oscillator and HF Stage. When their alignment is approximately correct, the aerial can be transferred to the proper aerial connection. The aerial coils and trimmers may then be adjusted; and the HF and oscillator stages retuned where necessary.

Completing the Conversion

Before the conversion can be considered finally complete, it will be necessary to fit an on-off switch and to make proper battery connections.

First of all, a lead should be taken from pin 5 of V2C to tag 9 of the rear plate. Tag 9 now becomes the tag for LT negative and speaker, and the temporary connections to chassis from these services should be re-connected to this tag.

An additional DPST tumbler switch is fitted to the hole previously used by the SPDT switch of Step 41. This switch controls the LT positive and HT negative supplies, and is connected in the circuit as shown in Fig. 12. The four additional leads necessitated by the switch circuit could be laced into a harness and laid along the left-hand side of the chassis. The temporary battery leads used during the conversion may now be replaced by properly-finished wires; the external connections to the rear plate now being as follows:—

Tag 9 —LT negative,
Tag 11—LT positive,
Tag 7 —HT negative,
Tag 1 —HT positive,
Tags 2 and 9—Speaker.

The aerial lead should now be cleated to the back of the chassis. An earth lead may also be fitted, if desired, connecting either to tag 9 or to chassis. The aerial and earth leads may be terminated by crocodile clips, etc.; or an additional aerial-earth socket could be fitted at the rear of the chassis.

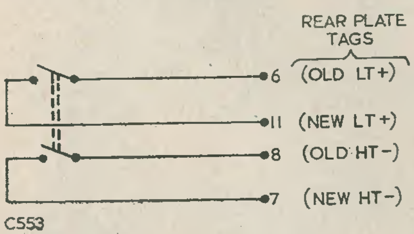


Fig. 12 The connections to the new on-off switch.

Using the BFO

If the BFO is not required in the converted receiver, the valve V2C may be removed. The top-cap connector to this valve should be removed as well, the fly-lead being taped up. The resistor bridging pins 4 and 8 of V2C may also be taken out.

Should it be desired, instead, to employ the BFO, the following operations should be carried out. First of all remove the resistor across pins 4 and 8 of V2C and connect the two pins together. Connect a lead from the "+" tag of the rear panel (adjacent to the V2A tag) to the HT positive tag of the speaker transformer primary.

The BFO may then be controlled by connecting an externally mounted switch between tags 10 and 6 of the rear plate.

To set up the BFO, the receiver should be tuned accurately to a station on the medium or long waveband. The BFO should then be switched on and its iron-core adjusted until a comfortable note is heard.

Mains Modulation

Although the converted 21 set is a battery receiver it is still possible, in some localities, for 50 cycle hum to be picked up on the aerial. Should this occur the hum may be by-passed by shunting an all-wave RF choke (manufactured also by Osmor) across the 10 kΩ resistor which is connected in the aerial circuit of Fig. 1.

Circuit Readings

When complete and working correctly, the receiver should take an LT current of 0.45 amps. The HT current should be approximately 12 mA. When the output valve is heavily over-run by turning the volume too high on very strong signals, the HT current may increase to as high a value as 18 mA.

Some of the test points on the rear panel are still connected, and readings for the anode voltages of valves V1C, V1E and V1F may be taken from them. Using a 1,000 ohm per volt meter switched to 500 volts, and with the aerial disconnected, each test point should give a reading of approximately 90 volts.

Acknowledgments

Before concluding, the writer would like to offer grateful acknowledgments to Messrs. Charles Britain (Radio) Ltd., who provided the receiver converted by him.

Further acknowledgments are also due to Osmor Radio Products Ltd., who provided the writer with a great deal of helpful information and assistance.

An Unusual Fault

by W. E. Thompson

I recently had one of those American AC/DC midgets brought to me to "look at" because it had suddenly developed a shocking mains hum. The most prevalent cause of such faults being electrolytics which have given up work, they were immediately tested, and discouragingly found to be O.K. It was then noticed that when the volume control was advanced the hum seemed to decrease, and further, when the usual tests for localising the source of hum were made, the double-diode-triode stage was found to be the seat of trouble. Valve line-up was 6A8, 6K7, 6Q7, 25A6 and 35Z4.

All components relevant to the 6Q7 stage were systematically tested on the capacity-resistance bridge without a fault being revealed, and it was at this juncture that the hum chose to become somewhat intermittent in nature, being worse at times and much quieter at others. This rather pointed to the possibility of a bad contact somewhere, so the volume control came under suspicion, mainly because it appeared to have some control over the intensity of hum and also because it incorporated the mains on-off switch. Further tests on it did not give support to the thought that it could be blamed, but a study of the circuit and method of wiring did, however, offer a clue. Theory was proved by connecting the screening cover of the volume control to chassis with a short piece of wire, and the fault was cleared! Just a question of screening, you think? No, not that!

Actually, the fault is an object lesson in the value of making good and secure chassis connections. The mains switch, when operated, connected one side of the mains to chassis—the switch was wired on the chassis side to one of the three tags of the volume control, the low-potential end of the track which was also chassis-connected. Nothing wrong with that. The strap between these two tags continued on to the screening case of the volume control and was securely soldered to it. Nothing wrong with that either. The fact that the volume control was securely fastened to the chassis with its fixing nut would lead one to believe that a sound chassis connection existed. But no, the insertion of a definite wiring connection to chassis proves there is a high-resistance connection to chassis via the screen of the volume control.

Closer inspection of the volume control revealed that the cover was secured to the metal front by three small ears, bent over and apparently secure. This was the fault—the ears were making bad contact, sufficient in fact to enable a hum voltage to be set up across the contact-resistance to chassis. There is a certain sense of satisfaction in running a fault right down to earth—or chassis, as the case may be! In this instance the extra trouble saved the cost of a new volume control, as well as providing another "queer one" for recording in the note-book.

A DIFFERENT(IAL) KIND OF CIRCUIT

By FRANK L. BAYLISS, A.M.I.E.T.

Ancient "Lights"

THE writer has never been able to discover whether it is his (quite undeserved) locally famed genius for receiver repairs, or his profound and complete inability to charge enough for such repairs, that b ings such a variety of noxious and ancient receivers to his workroom.

Whatever the reason, the fact remains that, time and again, someone will turn up with what seems to be a box of hideous junk, probably at least twenty-five years old, and raked out of the attic—and proudly proclaim the bewhiskered and musty heap to be a receiver, the mellow and dulcet tones of which must truly be heard to be believed.

"This set," the proud owner will say of the ghastly mess, "used to get 2LO as clear as if it were in your own room, and even now it can get Luxembourg."—"On dark, cold nights," he will add as an afterthought.

I turn a baleful and distant eye on such clients and enquire gently; "Well, what do you expect me to do—bring Luxembourg here on fine days?" But such heavy wit is invariably wasted.

Surprising though it may seem, however, stripping and repairing ancient receivers is not always the uninteresting and messy business one would expect. Little dodges and wheezes—the spice, almost the lifeblood, of radio construction twenty or more years ago,—are often revealed in the "4-BA studded" interiors (for soldering, in those days, was quite out of the ordinary).

Wave-traps, rejector and acceptor coils, loading coils, bandpass units with massive four-gang tuners, and weird and wonderful regenerative circuits—all come to light and reveal with surprising clarity the basis upon which modern receiver design has been built.

Often, I marvel at the ingenuity—yes and at the unstinted craftmanship in design and manufacture, as well as in assembly—and at the care lavished on "ruler-straight" wiring and superb right-angle bends. With what loving care every wire was set beautifully into place! With what caressing touch was four or five yards of cotton wool wrapped around the detector valve!

Lastly, but by no means least, how surprisingly selective were these sets, with their rejectors and so forth!

Differential Selectivity

One design, a screen-grid three (we would call it a TRF three) contained such a neat and effective intervalve coupling coil arrangement that I straightaway committed it to paper, and am at present designing and building a mains three valver based on the circuit.

The original, however, was a battery set, a commercial model of unknown make, that in use would have given points to many a modern battery superhet.

For those constructors whose interest has been whetted, I have sketched out the circuit in Fig. 1.

The coils were air-cored and wound on $1\frac{1}{2}''$ paxolin formers, one above and one below the steel chassis. Wiring was short and direct, and the complete chassis measured only $8'' \times 5'' \times 2''$.

The effectiveness of the circuit is that the output from the RF amplifier, V1, is not taken direct to the V2 control grid (the usual method) but is fed into the reaction coil of L2 via a differential reaction capacitor.

Thus, with the moving vanes engaged with the "A" set of fixed vanes the output from V1 goes down the drain, no reaction can be obtained, and volume is at an absolute minimum.

List of Components

Resistors
- R1 —5kΩ, $\frac{1}{2}$ watt.
- R2 —20 kΩ, $\frac{1}{2}$ watt.
- R3 —100kΩ, $\frac{1}{2}$ watt.
- R4 —2.0 MegΩ, $\frac{1}{2}$ watt.
- R5 —1.0 MegΩ, $\frac{1}{2}$ watt.
- R6 —500Ω, $\frac{1}{2}$ watt.

Capacitors
- C1, C12 —0.001 μF Mica.
- C2, C3 —500 pF. (each section), 2-gang tuning capacitor.
- C4 —0.1 μF Tubular paper.
- C5 —300 pF (each section), differential reaction capacitor.
- C6 —300 pF Mica.
- C7 —8.0 μF, 250 volt electrolytic.
- C8 —2.0 μF, 250 volt, Mansbridge (paper), or electrolytic.
- C9 —0.002 μF Mica.
- C10 —0.1 μF tubular paper.
- C11 —25.0 μF, 25 volt electrolytic, (connect + to chassis).

Switches
- S1, S2 —2 pole QMB
- S3 —1 pole QMB
- S4 —1 pole QMB

(All obtainable cheaply as ex-W.D.)

Coils
- L1, L2 —Matched pair of TRF coils (see text).
- L3 —Sectionalised H.F. choke.

Transformers
- T1 —1 : 3 or 1 : 4, Nickel or mu-metal core intervalve transformer.
- T2 —Output transformer to suit V3.

Valves
- V1, V2 —SG215 (VR.18) or, 220 VSG (VR.28) or 210 SPT (VR.49).
- V3 —PT2 or KT.2 (VR 118).

Loudspeaker
- Perm. Magnet M/coil.

Power Supplies
- 120 volt H.T. Battery.
- 2.0 volt L.T. Accumulator.

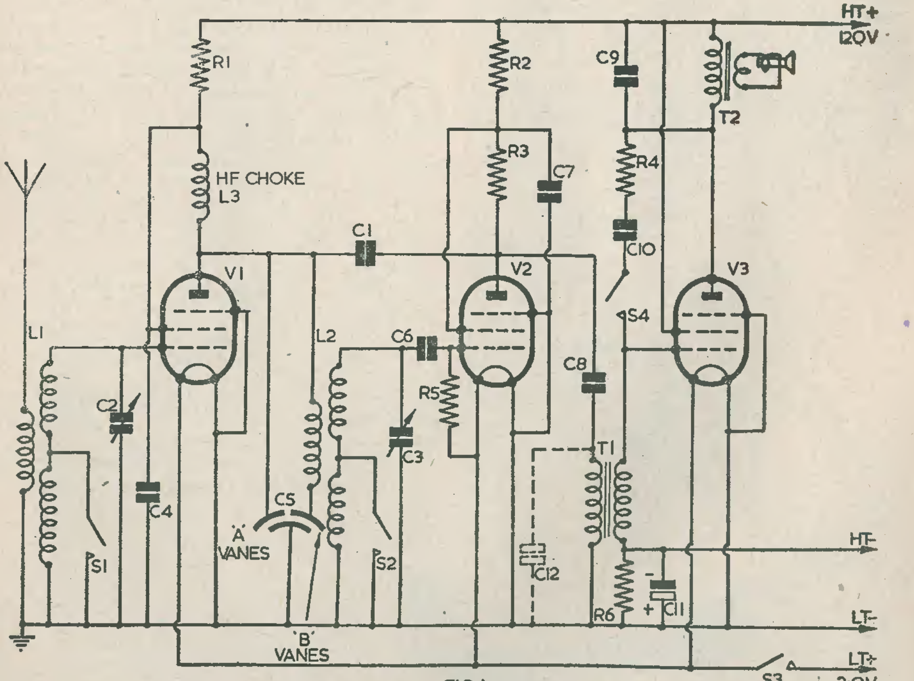


FIG.1
THE OLD CIRCUIT DESCRIBED IN THE ARTICLE SUCCESSFULLY MODERNISED BY THE AUTHOR.
C12 IS AN ADDITIONAL TONE CONTROL (TOP CUT) IF REQUIRED.

C566

As the moving vanes are advanced into the "B" set of fixed vanes, however, the output from V1 is coupled to V2 via the reaction winding of the coil, and reaction from V2 anode is simultaneously applied to V2 grid via the capacitor C1.

There is thus an increase of volume through additional coupling plus reaction, and an *increase of selectivity*, also due to reaction.

This intervalve circuit together with the aperiodically coupled aerial coil made it a very selective little receiver, having the advantage, too, that no other form of volume control is required.

The valves had, undoubtedly, been changed several times before the set reached me, so I cannot give the original types. However, I should think that any 2V battery RF pentodes would be suitable for V1 and V2, with a pentode such as a PT2 or KT2 as the output valve.

Any constructor wishing to use the circuit either as a household receiver or as a portable will find some very suitable ex-WD 2V battery types on the market, just now.

The differential reaction capacitor—an uncommon component, these days—were obtainable, at the time of writing, at Premier Radio Ltd.

The coils, which should be an identical pair, may be purchased ready wound, or be home made, according to taste.

Do not forget the small capacitor C1. This serves to isolate the anodes of V1 and V2 with respect to DC.

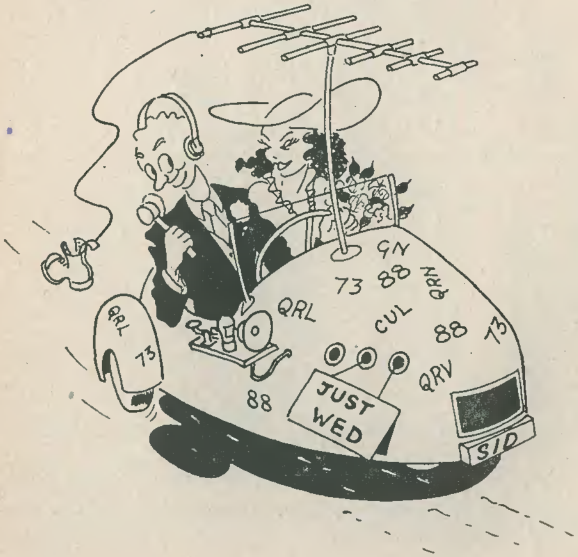
Do not be sparing with decoupling in the anode and grid circuits. High gain battery receivers can be the very devil to get nicely stable. Use metallised valves if possible, and screen each coil from the other.

Modern Additions

The negative feedback circuit (R4 and C10 with switch S4) between the anode and grid of V3 is an added device for constructors living near a local station or having good, high aerials. The reduction in volume on its account is about 25%, but the greater stability, and smoother and rounder tone, obtained with these components in circuit is well worth the sacrifice. Switch S4 enables feedback to be switched out for reception of distant stations.

The intervalve transformer was originally an iron cored one, direct coupled, but a modern mu-metal component in a parafeed circuit will give much better results.

If there is any tendency to overloading of V3—although, since volume is controlled at the grid of V2 this should not occur—the transformer should be replaced by an 0.1 μF capacitor and the grid of V3 taken to HT− via a 500 kΩ resistor.

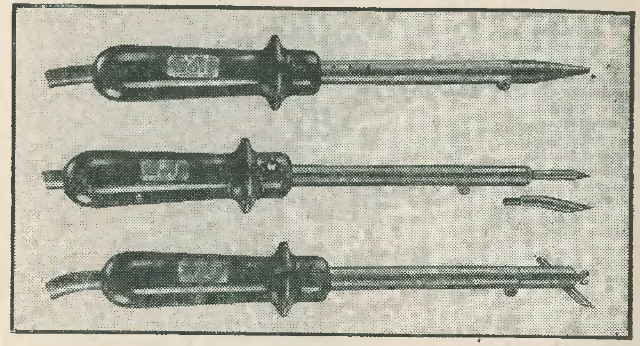


RUFUS

—The Radio Constructor

"—Am likely to be QRT for a while, OM!"

Trade News



WOLF ELECTRIC SOLDERING IRONS

New additions to the range of Wolf Electric Soldering Irons have recently been announced and all these are the straight handle type. They comprise three models—Types 22, 32, and 42, which, whilst retaining all the general features so popular in the original range, have been designed to meet the demand for conventional straight handle types of Wolf design and manufacture.

Amongst the first important users of these new models was the G.P.O. Engineering Department. To them, the straight handle soldering iron was indispensable in their work, involving as it does the daily soldering of many thousands of connections in telephone exchanges throughout the country. In this respect they were desirous of standardising upon an electric iron of unusually high efficiency in a range of models for all standard voltages to meet the consistent and exacting requirements of constant use.

In keeping with all other models the heating elements are designed to concentrate heat on the working point providing a rapid and constant heat. They are sturdily built to withstand heavy usage and are fitted with hard wooden handles with a heat deflecting skirt.

COLOUR TELEVISION

Faced with the impossibility of electronic colour television for a number of years to come, a British manufacturer J. and S. Newman Ltd., 100, Hampstead Road, London, N.W.1, today introduces a tri-colour screen which colours the black and white picture on present television receivers. This is made possible by means of skilfully blending three colours on to the colour screen, and it gives these added advantages:—No dilution of picture, less strain on the eyes, no glare and no distortion.

The new screen—known as "COLOR-VISION"—is immediately fitted to all existing television receivers by fixing materials supplied. The price of the screen is 21/- and can be obtained from any radio retailer or direct from the manufacturers.

The Color-Vision screen is a scientific invention, bringing to the many thousands of viewers in this country more picturesque, realistic and enjoyable viewing, and will have a special appeal to children.

The screen does not, obviously, give "technicolour" pictures—grass may be red, the sky green, and so on—but it has its applications.

NEW—Multi-coloured identification of Tenawire

P.V.C. covered wire has always been limited to the standard range of self-colours. Many specifications stipulate variations in shade for identification as unacceptable, so that, limited to the primary colour range P.V.C. has been out of favour although it has so many advantages.

Now Tenaplas Ltd., London and Nottingham, have produced wires with 2-colour identification. This has been made possible by the development of special pigments and lacquers which are highly resistant to abrasion, light fast, and resistant to most corrosive acids and solvents.

All standard gauges of wire, both single and multi-stranded, are being produced with P.V.C. installations of all thicknesses in which the base colours of the P.V.C. with a superimposed and lacquer spiral of different colours enable colour coding. Colours can be any specification.

A 2-VOLT VIBRATOR UNIT

By D. A. G. KING

THE basis of the unit to be described is the 2-volt Synchronous Vibrator by RCA which is, at time of writing, available on the surplus market. The unit supplies 100V at 10–15 mA for operating normal battery receivers, and consumes approximately 0.6A—slightly more than the filament current of the average receiver.

For receivers employing a common HT– and LT– (or HT– and LT+) one accumulator may be used to supply both HT and LT. Where a grid bias battery is used, this should be retained.

For the modern receiver, where HT negative is taken to a common bias resistor, LT negative being returned to the other end of this resistor, it is essential to use separate accumulators for HT and LT unless re-designing of the receiver is contemplated. Once the accumulators are acquired, however, this is an advantage as they are discharged at a low rate, and instead of having one accumulator charged twice per week, two are charged once per week. A further advantage is the complete absence of hum.

The Circuit

Fig. 1 shows the complete circuit and the operation, briefly, is as follows. The accumulator voltage appears across pins 4 and 7 of the vibrator, operating an internal electromagnet which causes the blade attached to pin 7 to vibrate. This in turn operates contacts 2 and 3 and 5 and 6 alternately. The accumulator voltage is also applied to the primary winding of T1 via its centre tap, contacts 1 and 6 of the vibrator causing each half of the winding to conduct alternately. This induces a voltage in the secondary which is automatically rectified by contacts 2 and 5, unidirectional pulses appearing at the centre tap of the secondary.

These pulses are filtered of RF noise by L1,C3 and smoothed by Ch1, C4 and C5. Capacitors C1 and C2 limit the peak inverse voltage across the transformer secondary, and they should be good quality components with a rating of at least 750V.

R1, R2 assist in damping any sparking which may occur between contacts 2 and 5, which carry a relatively heavy current. Their earthing via pin 3, rather than direct to earth, was found to completely eliminate RF crackle.

C6, C7 and C8 together with Ch2 block RF and AF noise from the LT lines.

Components

The *Transformer* is constructed from an old output transformer. Any type having a core area, i.e., the height of the stack × the width of the centre limb, of 0.5 sq. in. or more will do. In order to keep losses to a minimum, a stack having well insulated laminations should be chosen, and in order to accommodate the windings the window should be at least 1″ × 3/8″.

For a core area of 0.5 sq. in., 15 turns per volt should be wound. For 0.75 sq. in., 10 turns per volt will suffice.

The old windings should be completely removed from the bobbin, and rewinding commenced with 42 swg enamelled copper wire (if the window space is large enough 38 or 40 swg should be used in order to reduce the resistive losses). Copper wire tables will give the number of turns that can be wound per square inch and will assist in calculating the gauge of wire that the core will hold.

Turns should be laid on evenly in layers, and interleaved with 1 mm paper every two or three layers.

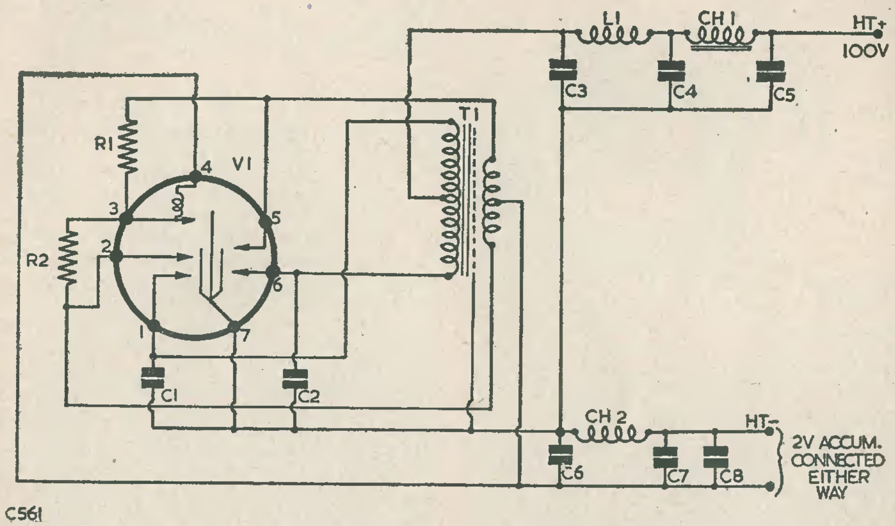


Fig. 1: Complete circuit of Vibrator Unit.

For 15 TPV, 1500 turns should be wound, plus a further 200 turns to compensate for losses. At 1700 turns, a tap should be brought out and the winding then continued for a further 1700 turns. Finish off with a layer of Empire Tape or two/three layers of paper, then fit the screen. This consists of a single layer of copper, brass or tin foil about 1″ wide, to which is soldered a lead which is brought out through the bobbin cheek (an old paper capacitor might provide suitable material). Care should be taken to ensure that the screen does not come into contact with any of the windings, and to this end it is advisable to cut the foil so as to leave a margin of just under 1/8″ from either cheek of the bobbin. The foil should be run onto the bobbin together with a strip of Empire Tape or paper, in order that the ends do not come into contact (see Fig. 2). Should this happen, the screen will form a high current loop which will quickly run down the accumulator, not to mention causing the transformer to overheat.

After further insulating the screen, the primary should be wound. This will consist of 60 turns tapped at 30, of 22 swg, and interleaved at each layer. This is for the smaller core area; for the larger size, 40 turns tapped at 20 are required. The object in winding the primary last is that, should there be insufficient output from the secondary, one or more turns may be removed from each half of the primary without disturbing the more delicate winding.

After checking the bobbin for continuity and shorting between windings and the screen, the core should be re-assembled. In this instance, the "E's" should be inserted in the bobbin from opposite ends alternately.

Component List

V1,	2 volt synchronous vibrator.
R1, 2,	100Ω ¼W.
C1, 2,	0.005 μF 750V wkg.
C3,	0.01 μF 250V wkg.
C4, 5,	20 μF elect. 150V wkg.
C6, 7,	0.1 μF 150V or up.
C8,	500 μF or up, 6V wkg—see text.
L1,	see text.
Ch1, 2,	see text.
T1.	Pri: 2—0—2V 0.75A. Sec: 120—0—120V 20 mA.

Chokes

Ch1 ideally should have an inductance of 20H at the current being drawn, but in practice it was found that any small iron-cored choke serves the purpose. In the original, an ex-RAF intervalve transformer was used. The 900Ω winding was used

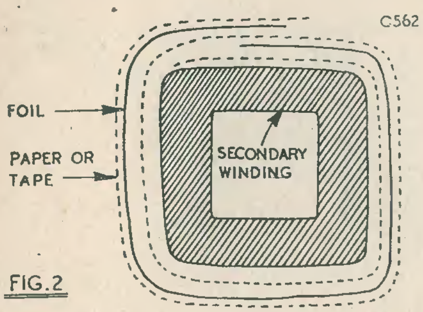


FIG.2

as the choke, the remaining windings being disregarded. Any convenient coil resonating between about 300 and 1000 metres will do for L1. The winding from a discarded 465 kcs IF transformer serves admirably in this position.

Ch2 consists of 60–80 turns 16 or 18 swg enamelled copper wire evenly wound in layers on any convenient former approx. 1/4″ to 3/8″ diameter and 1″ to 1½″ long. C8 may be a 50 μF bias capacitor when two accumulators are used, but to keep hum to a minimum the value should be increased to around 500 μF—better still, 5000 μF if available—when working with one accumulator. These high value capacitors are available on the surplus market for a few shillings.

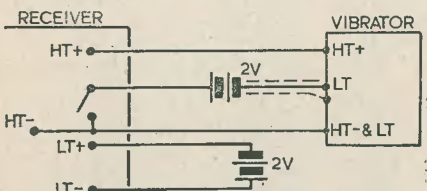


FIG 3

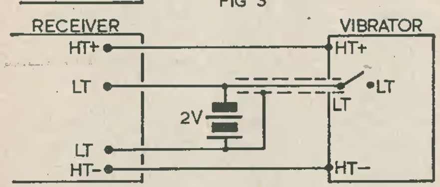


FIG 4

C563

Layout

Layout is by no means critical, but in general the components should be grouped as far as possible to avoid long leads. It is absolutely essential that the complete unit be built in a totally enclosed metal box in order to ensure adequate screening. The lead from the accumulator to the unit should consist of a single conductor in a screened cover.

Switching

When using two accumulators, this can conveniently be carried out at the set if a switch is already in use for HT. The latter should be disconnected and the two ends of the lead thus made joined together. A flying lead should be taken out from one side of the switch to the accumulator, the other switch contact being wired to the HT– lead at its connection inside the set. This lead then performs the dual purpose of carrying LT to the unit and HT from it (Fig. 3).

In the interests of hum reduction where only one accumulator is employed, the switching should be carried out at the power unit. In this case, the outer covering of the screened lead may be used as a return (Fig. 4).

Operation

Before connecting the unit to the receiver, connect up the accumulator and check the output, using initially the highest range on the meter. Should the readings be low, i.e., 3–10V, reverse the connections to pins 1 and 6 of the vibrator. Should the reading be *negative*, reverse the connections to pins 2 and 5 of the vibrator (it may be necessary to reverse pins 1 and 6). In the interests of preserving the meter, the leads should only be touched on the terminals momentarily, when determining polarity. Having obtained the correct polarity and voltage, the receiver may be connected and operated. The vibrator unit should be kept away from the RF end of the receiver, and if any RF interference is experienced should be placed, with its accumulator, as far away from the receiver as is possible—underneath, if a shelf is handy.

Finally, it is stressed that the terminal and battery lugs should be kept scrupulously clean, and slightly greased with vaseline.

A Slide-back VALVE VOLTMETER

By M. WALES

In response to many enquiries from radio enthusiasts, the unit described here was designed and built with the intention of fulfilling certain requirements. The main one was a method of measuring voltages, such as those found in AGC circuits, where only minute currents are flowing; this necessitates using an instrument which has a very high input impedance, in order that the circuits being measured should not be influenced by the meter. Another factor to be considered was that the cost of component parts should not be high. Also, calibration had to be effected without the use of external apparatus.

This instrument has, of course, many uses, and can prove very versatile. For instance, it can be employed for measuring the voltage outputs of oscillators, or audio outputs from receivers and amplifiers. It can also be used for power output measurements if the impedance of the output circuit is known.

Construction is very easy, as the circuit is a most simple but reliable one. No difficulty should be experienced, either, in obtaining the components required. Most of them will probably be already on hand.

The circuit is quite conventional, so it is not proposed here to deal with the theory of it. It is a slide-back type of valve voltmeter, the action of which is explained in numerous text books.

The potentiometers R1 and R2 should be of the wirewound type; their adjustment will be found not critical.

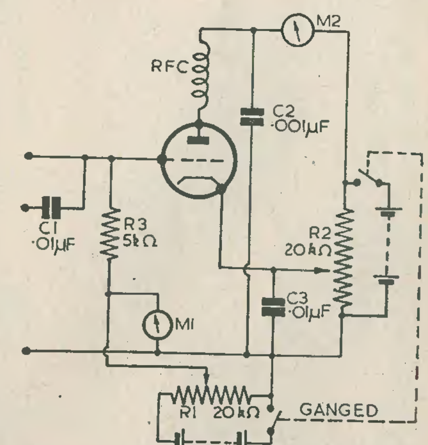
The meter M2 should preferably have a full scale deflection of 5 mA, although it may be substituted by one having a somewhat larger range. M1 should preferably have a full scale deflection of around 40V, although here again a larger reading can be tolerated.

C2 and C3, the decoupling capacitors, should be of the mica type.

Almost any valve type will be found suitable. In the original instrument built by the writer, a Mazda 1P10 was used strapped as a triode; the filament rating being 1.4V, it was suitable for running on an ordinary single dry cell. Other suitable valves would be the 1T4, 1N5 and 1Q5, in the same filament range. The batteries for the unit may consist of two of the 45V type, now obtainable in small sizes, or the ordinary 90V HT battery broken at 45V to provide the two necessary 45V supplies, one for HT and the other for bias.

The practical layout of the meter is not critical, and it is up to the constructor to use whatever cabinet and chassis he cares to employ. Room should be supplied for the batteries, so that the finished instrument is completely portable.

Operation is as follows. R1 is adjusted so that no reading is given by M1, and R2 is varied so that M2 also does not read. When coupled across the unknown voltage, meter M2 will give a reading. Again adjust R1 so that M2 falls back to zero, when the voltage being measured can be read directly off M1.

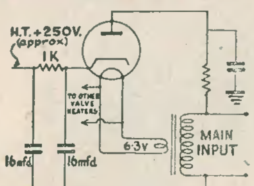


C539

The Slide-Back Valve Voltmeter.

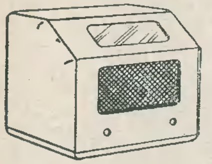
ELPREQ PAGES

A POWER PACK FOR 15/-



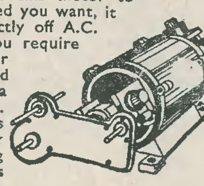
Efficient power supply, O.K. for operating a receiver, amplifier, instrument or other device requiring up to 80 mA. at approx. 250 v. Parcel consists of filament transformer, rectifying valve, smoothing resistor and 16 x 16 mfd. 350 v. Electrolytic condenser. Note the filament transformer will supply enough current to operate 3 or 4 other 6.3 v. valves.

BARGAIN FOR CALLERS ONLY



Cabinet size 12in. x 10in. x 7in. deep, nicely finished in pastel shades, suitable for bedroom radio or extension speaker. Only 7/6 each. (We regret we cannot dispatch these.)

MULTI-SPEED MOTORS



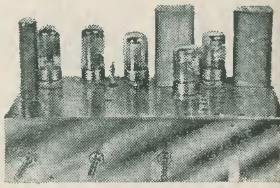
You can adjust this motor to almost any speed you want, it will work directly off A.C. mains, or if you require greater power or greater speed work it through a metal rectifier. This motor is fitted with a gear box enabling speeds down as low as 1 r.p.m. to be obtained. Price 14/6, postage and packing 1/6 extra.

ELECTROLYTIC CONDENSERS

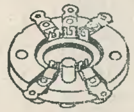
1 mfd. 150 v. ... 1/-	16 mfd. x 16 mfd. 450 v.... ... 6/-
1 mfd. 250 v. ... 1/-	16 mfd. x 16 mfd. 500 v.... ... 7/-
1 mfd. 450 v. ... 1/3	20 mfd. x 20 mfd. 200 v.... ... 4/-
2 mfd. 350 v. ... 1/3	24 mfd. x 24 mfd. 200 v.... ... 4/6
2 mfd. 450 v. ... 1/6	25 mfd. x 25 mfd. 200 v.... ... 4/9
4 mfd. 350 v. ... 1/8	32 mfd. x 32 mfd. 150 v.... ... 4/9
4 mfd. 450 v. ... 1/10	32 mfd. x 32 mfd. 450 v.... ... 6/9
8 mfd. 150 v. ... 1/6	100 mfd. x 100 mfd. 150 v. ... 5/6
8 mfd. 350 v. ... 2/-	10 mfd. 25 v. ... 1/-
8 mfd. 450 v. ... 2/6	12 mfd. 50 v. ... 1/4
8 mfd. 500 v. ... 3/3	20 mfd. 50 v. ... 1/6
16 mfd. 350 v. ... 2/9	25 mfd. 25 v. ... 1/6
16 mfd. 450 v. ... 3/6	25 mfd. 50 v. ... 2/-
16 mfd. 500 v. ... 4/9	50 mfd. 12 v. ... 9d.
32 mfd. 150 v. ... 2/3	50 mfd. 50 v. ... 2/3
32 mfd. 250 v. ... 2/3	250 mfd. 12 v. ... 2/3
32 mfd. 350 v. ... 2/9	8 mfd. x 8 mfd. x 8 mfd. 450 v. 3/9
8 mfd. x 8 mfd. 350 v.... ... 3/-	
8 mfd. x 8 mfd. 450 v.... ... 3/9	
8 mfd. x 8 mfd. 500 v.... ... 3/9	
8 mfd. x 16 mfd. 450 v.... ... 4/9	
8 mfd. x 16 mfd. 500 v.... ... 6/-	

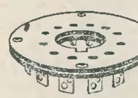
5-VALVE IF/AF AMPLIFIER

(For AC/DC working.)



The subject of this month's "Guess What" Competition. This is on an aluminium chassis, size 11½in. x 7in. x 3in. deep. The layout is neat and simple and provision is made and in fact holes are drilled so that tuning condenser and coil pack may be easily fitted if same are required. Alternatively this vacant space can be used for mounting a control panel to which various points of the circuit can be brought to plugs, this making faults tracing by circuit substitution a very simple job. It uses one of the latest valve line-ups as follows: 14S7 Triode Hexode, 7B7, IF Amplifier, 7C6 D.D.T. 35A5 output, 35Z3 Rectifier. The IFs are preset at 465 Kc/s, but are variable over a fairly wide range. Price £6/10/-.





VALVEHOLDERS

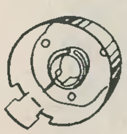
Type	Paxolin	Amphenol	Ceramic
	s d	s d	s d
British 4-pin ...	6	—	9
British 5-pin ...	6	—	9
British 7-pin ...	6	—	9
British 9-pin ...	9	—	—
UX 4-pin ...	6	—	1 6
UX 5-pin ...	6	—	9
UX 6-pin ...	7	—	—
UX 7-pin ...	8	—	—
Large UX7 ...	—	—	1 0
Diode B3G ...	6	8	—
B7G	6	8	10
B8G Loctal ...	9	—	—
B8A	1 3	1 6	—
B9A (Noval) ...	1 3	—	—
B9G	1 0	1 0	—
B12A (Duodecel) ...	1 3	—	—
Int. Octal ...	6	9	1 6
Mazda Octal ...	6	9	—
8-pin side Contact	—	2 6	—
Jumbo 4-pin ...	—	—	3 6
4-pin Hivac ...	9	—	—
5-pin Hivac ...	9	—	—
5-contact Acorn ...	—	—	1 6

VALVE SCREENING CANS

	s d
Suitable for standard size valves consists of three parts, bottom plate, main body and spring top... ...	1 3
B7G fixing base and top screen with spring	1 6
Screen for octal G.T. Valves ...	6

VALVE RETAINERS

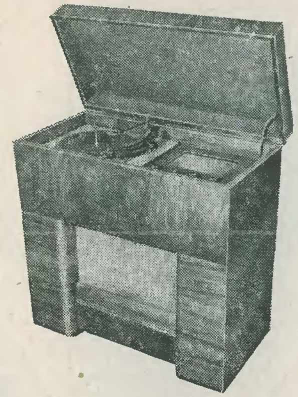
	s d
Spring type for EF50	3
Threaded type for EF50	3
General type for all valves, consists of a silk cord and two springs ...	3



VALVE TOP CONNECTORS

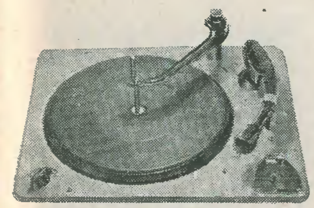
Type	Plain	Screened	Insulated
	s d	s d	s d
British ¼in. top	1½	9	1 6
American ¼in. type	1½	9	1 6
Screw to clip adaptor (for modern equivalents)...			6

RADIOGRAM CABINETS



Full size console type cabinets with highly polished walnut finish. Designed to take standard type auto change gram unit. You can have these at £12/10/- each, which means a really nice radiogram for less than £30, for we can supply a 5-valve 3-waveband chassis at £10/10/-. (Minor alterations to the radio chassis will, of course, be necessary.)

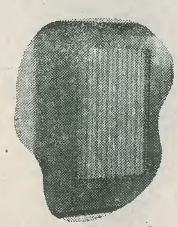
Special Offer. Gram unit ordinary from £5/5/-, auto from £11/15/-. Cabinet complete with auto change gram. unit and pick-up £22/10/-. Please note delivery charge will depend on distance.



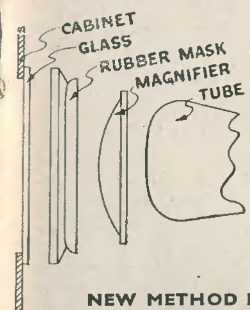
AUTO-CHANGE GRAM UNITS

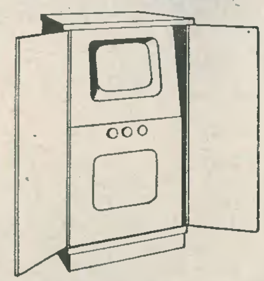
Single speed and 3-speed models available from stock. The one illustrated is the Collaro 3-speed model with dual-purpose pick-up. Price £15/11/9, carriage paid.

THIS MONTH'S SNIP



This month we offer you a really lovely loudspeaker fabric "Somweave" at approximately a third of today's cost. It is 42in. wide and our price is 12/- per yard or panels 12in. x 12in., 1/9 each. This is also very suitable for covering plain wooden cases, for portable radiograms, amplifiers, etc.

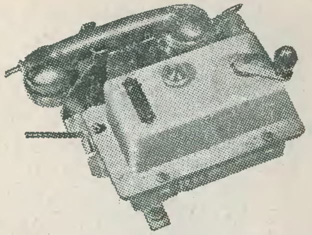




NEW METHOD IMPROVES APPEARANCE

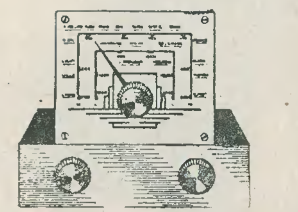
This T.V. is fitted with a 6in. (VCR97) tube, but by using the method shown in the diagram, the impression of a much larger tube is created. We have available magnifier, mask and armoured glass in the parcel, price 29/6 the set, plus 2/6 post. Please note that the magnifier is tinted to offset the green effect. Mask and armoured glass only 7/6 the two, plus 2/6 post.

EX-ROYAL NAVY SOUND POWERED TELEPHONE



These require no batteries, and will go for long periods without attention. Complete with generator and sounder which gives a high pitched note, easily heard above any other noise. Also fitted with an indicator lamp which in quiet situations can be used instead of the sounder, or where several 'phones are used together will indicate which one is being called. Size 7¾in. x 9in. x 7¼in., wall mounting, designed for ships' use, but equally suitable for home, office, warehouse, factory, garage, etc. Price 37/6 each, plus 3/6 carriage.

ALL MAINS CHASSIS



This is the equivalent of a 4-valve receiver for it uses three valves and metal rectifier. It is all wired up ready to work off A.C. mains, complete with modern valves, ganged tuning, high precision dust-cored coil, first grade condensers and resistors, all on metal chassis. Tunes long and medium wave-bands. Large clear dial. Receives Home services; Light programme; Luxemburg, etc. Chassis size approximately 9in. x 4in. x 5in. Complete with valves, but less speaker, 69/6. Suitable speaker with matching transformer, 16/6—nothing else needed. Postage and packing 2/6 extra.

FLEXIBLE COUPLING

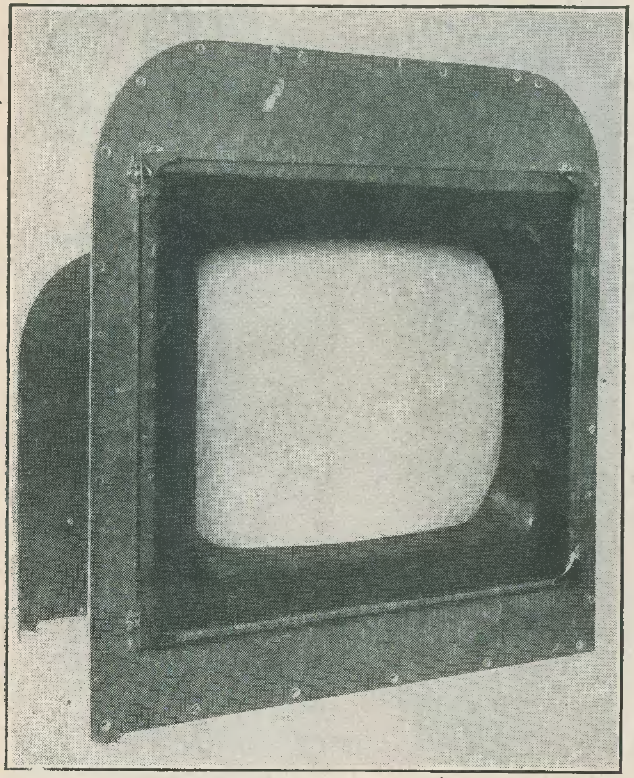
These are sometimes known as bellows couplings because they will extend as well as bend. They are ideal for joining shafts which are out of alignment and for slug tuning controls where the core has to come in and out. Price 1/9 each.

Orders by post are dealt with by our RUISLIP depot. To avoid delay address to:—E.P.E. Ltd., Dept. 3, Windmill Hill, Ruislip, Middlesex.

Orders under £2 add 2/6, under £1 add 1/9. Postable items can be sent C.O.D., additional charge approx. 2/6. List 6d. Early closing, Wednesday—Ruislip, Saturday—City.

ELECTRONIC PRECISION EQUIPMENT

WINDMILL HILL, RUISLIP MANOR, MIDDLESEX.
152-153, FLEET STREET, LONDON, E.C.4.



Large Screen T.V.

A series of articles describing the fitting of the English Electric 16″ tube, the problems involved, and how they were overcome.

TREMENDOUS interest has been shown by the home constructor in the trend towards large-screen television. So much so, that Radio Constructor decided to investigate the position.

Projection is one solution—if you can get it. On the other hand, large tubes are available. As a result of preliminary enquiries, it was ascertained that over 2,500 enquiries had been received from home constructors by one manufacturer, the English Electric Co., with regard to their 16″ tube. We therefore selected this tube for conversion, and to find out, under practical conditions, just what problems were involved.

To be of real use, our approach had to be similar to that which would be made by any of our readers—no use was made of special facilities which would not be available to the constructor.

It may be stated, here, that all the difficulties which arose were easily overcome. Provided the constructor proceeds along the lines to be described, remaining true to the cardinal points in the design, there is considerable scope for deviation to suit individual requirements.

Probably the most troublesome features about this conversion were the screen mask, insulation and precautions against dust and humidity.

These points were satisfactorily cleared up, and the final installation passed all laboratory tests. If the set-up described is adopted in principle, the element of danger is practically eliminated and, indeed, there

is greater safety than in many installations employing smaller tubes which have been seen by the writer.

All points involving personal safety will be described; at the same time, the elements of danger will also be covered.

THERE WILL BE VOLTAGES IN THE REGION OF 10–14 kV. IT IS, THEREFORE, DESIRABLE THAT THESE FACTORS OF DANGER, AND THE SAFETY MEASURES ADOPTED, ARE FULLY UNDERSTOOD, EVEN THOUGH THE EHT IS NON-LETHAL.

The work involved is more than amply rewarded by "the end product"—to use a well-known TV catch-phrase—for it is a pleasure to see a picture on a screen of this size. All readers using the English Electric 16″ tube should obtain the comprehensive data sheet available (publication EV/102) from the makers.

Construction

The deflection assembly caused considerable thought. It is not a simple matter to scan this size of tube at an angle of 70°. We found, however, that Messrs. I.K.O. Patents had spent nearly two years on this work and, on investigation, their components performed this function with ease.

One great virtue of this equipment is that it can be adjusted to suit standard 9″ tubes, and in addition requires a rail voltage of some 250V only.

This clearly means that anyone entering the field of TV construction can, at any time, go over to a large tube without the need to replace this equipment; also, with such a low operating voltage it becomes possible to contemplate a large tube when residing in areas on DC mains.

This range of components is being produced and made available by Allen Components, Ltd.

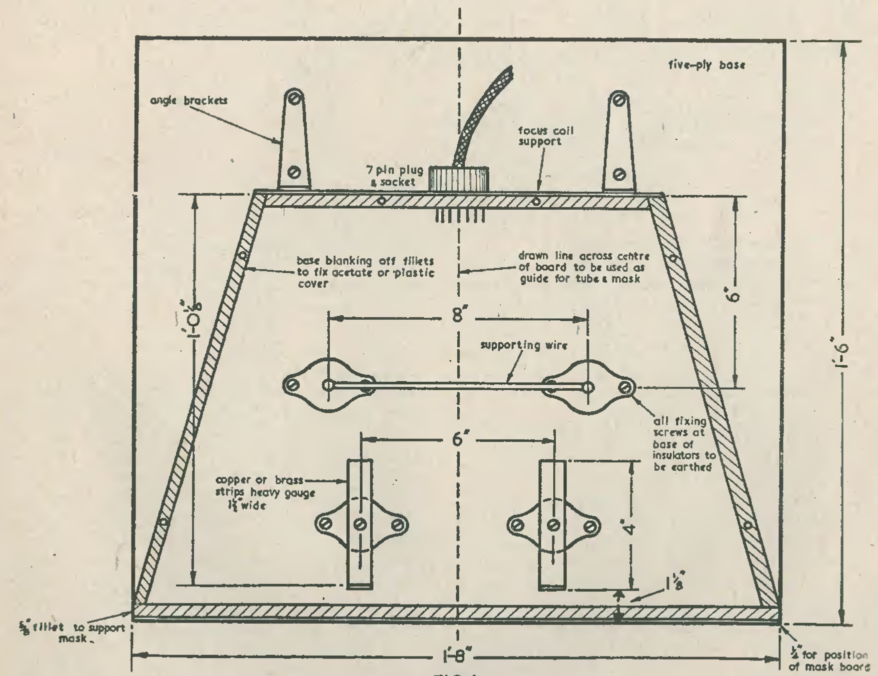


FIG. 1
BLANKING-OFF FILLETS ROUND MASK BOARD & FOCUS-COIL SUPPORT NOT SHOWN FOR CLARITY

C556

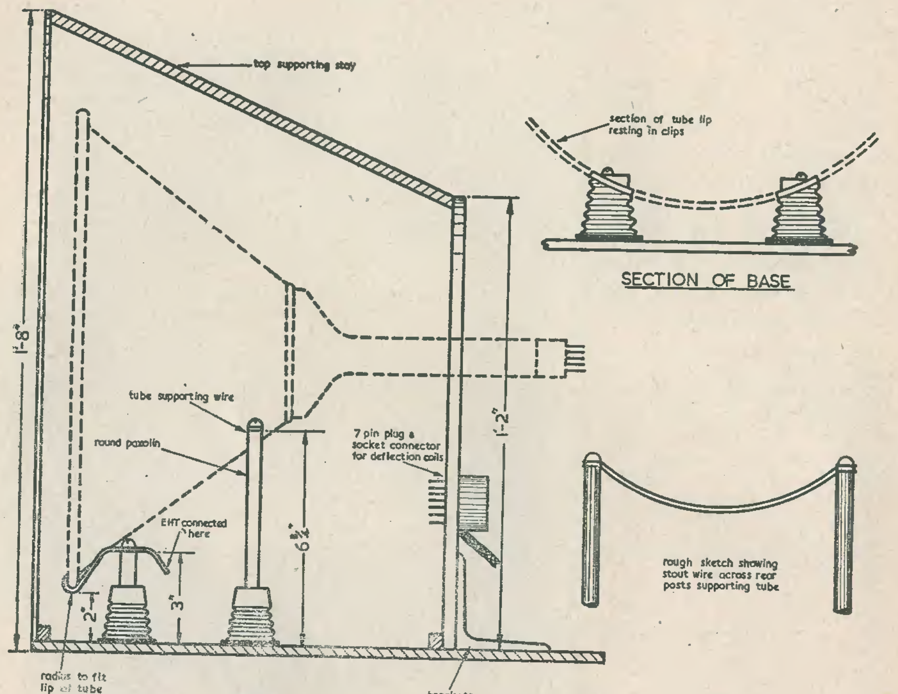


FIG.2
MASK CONSTRUCTION & BLANKING-OFF FILLETS NOT SHOWN
NOT TO SCALE

CS57

Tube Mounting

The photographs and sketches are quite descriptive and should be constantly referred to for guidance. For instance, a large radius (4″) cut from the mask board and focus coil unit can be clearly seen. This is done to simplify covering all this section, down to the base board, with acetate or PVC sheeting (NOT celluloid).

With the exception of the neck of the tube, the STEEL CONE and GLASS SCREEN are all at EHT level—the glass is semi-conductive—but, with a covering and plenty of air space around the tube, the constructor enjoys a large margin of safety. Equally as important, DUST, which can cause a deal of trouble with this type of tube, is kept away. To help in this, all edges of the covering are sealed with Scotch tape.

The insulators should be of high quality; the writer has seen many base-mounting types which permit of extensions of paxolin or similar material to be mounted (see sketches). These extensions must not be relied on for insulation purposes. They are merely a convenient method of construction, and insulation against the EHT voltage should be effected by the stand-off insulators themselves. The clips on the front insulators were made of heavy gauge copper, with all corners rounded, to support the front of the tube and enable good electrical connection to be made to the tube lip, which is the correct place to introduce the EHT. The rear edge of each of the two front clips is bent down, and the tube firmly held by passing a strong rubber band of the catapult type over the top of the tube and under this extension on both sides (see photo).

All screws or bolts holding the insulators to the baseboard must be earthed and the leads brought back to the connecting plug on the rear focus coil support.

(Note.—In cases of exceptional humidity, it is possible for brush discharge to travel down the surface of the insulators, when the entire structure, perhaps even the cabinet, might be alive to EHT. Taking the precaution advised, the worst to ensue would simply be a dull picture, gradually brightening as humidity conditions improved).

The front board should, preferably, be made of paxolin or plastic, but plywood would do as it is imperative that there be an airspace between the rear of the mask and the glass screen of the tube. The minimum distance between the two is 3/8″.

The next article in this series will deal with the construction of the mask, focus coil support, and construction procedure.

(To be Continued)

Book Review

TELEVISION WORKS LIKE THIS. A book for young people by Jeanne and Robert Bendick. Published by Phoenix House Ltd., 38, William IV St., Charing Cross, London. Price 8/6.

This book is just the one for those parents who are tired of answering the eternal question, "how does it work?" ; to present to their enquiring offspring. Well illustrated with clear and often amusing pictures, this book explains the whole technique of television from camera to televisor in a way which the twelve year old can assimilate without difficulty. An index adds to the value of the publication which should be on the bookshelf of every technically minded boy or girl.

THE WORLD RADIO VALVE HANDBOOK. Published and edited by O. Lund Johansen. Price 11/6.

This is a most valuable reference book for all whose work or hobby brings them into contact with radio receiving valves. The most commonly used receiving valves of the world are listed in readily available form together with their data, uses, base connections and information for enabling one to choose the most suitable substitute. Prepared with the thoroughness for which Mr. Lund Johansen has become well known through his World Radio Handbook for Listeners, this book fills a long felt gap in reference books for radio engineers.

IN YOUR WORKSHOP

In which J. R. D. discusses Problems and Points of Interest connected with the Workshop side of our Hobby, based on Letters from Readers and his own Experiences.

We ended our last article on a note of regret. This was occasioned because our words on the subject of screening had to be curtailed in order to prevent us from trespassing on the space of other contributors. This month, therefore, we shall finish off the business of screening; and we will have plenty of space afterwards to talk about other topics of workshop interest.

Readers may remember that we devoted our time in the last article to the theory of RF screening designed to prevent both capacitive and inductive coupling. We showed also the importance of "skin depth" for efficient screening, and gave an idea of how this characteristic depends upon the thickness and conductivity of the metal used.

Let us carry on now to screening at AF and mains frequencies.

Screening at AF

Inductive screening by the use of non-ferrous metals is not of much use so far as audio and mains frequencies are concerned. The relatively slow rate of change of flux at AF prevents the formation of sufficiently large currents in the screening metal, and so the opposition fields set up are too small to offer any effective neutralisation of the original field. (One cannot, for this reason, visualise skin effect or skin depth at audio frequencies).

Inductive screening of a component at low frequencies is carried out by enclosing the component in a cover made of a metal which has a high permeability. It is usual to use specially-produced metals for this type of screening, and modern alloys, such as mu-metal, etc., are almost ideal. Soft iron could be used, but its performance would be inferior.

The screening action of the cover relies on the fact that any lines of flux formed outside the component tend to concentrate in the metal; this offering a considerably easier path than does the surrounding air, which has a very much lower value of permeability. In practice, such a screen is so effective that hardly any flux at all may be detected outside it. The screen also, of course, carries out the converse function of screening the enclosed component away from external fields.

Complete screening

Returning again to radio frequency screening, it will have been noticed that the process of fitting a complete inductive screen around a component automatically ensures that good capacitive screening is obtained as well. Nevertheless, this does not reduce the importance of considering capacitive screening when an original design is being worked out. Even in the case, say, of a completely screened coil, capacitive screening may also be necessary for some of the leads which enter the screening can. The grid fly-lead from an IF transformer presents a typical example of this point.

In the same manner, inductive screening by high permeability metal also ensures capacitive screening of the enclosed component but does not obviate the possible necessity of screening some of the leads which may travel to it.

When a very high degree of screening is required, it is essential that the screening covers employed should completely enclose the circuits concerned. To say that the screening should be "water-tight" is not an example of over-fussiness, but is a case of what is literally dictated by necessity. In addition, all joints in screening covers such as this should be lapped, the joints being welded, rivetted or bolted at short intervals, or soldered along the lap. Screening as efficient as this is required by nearly all signal generators, as well as by a variety of other types of equipment. Many signal generators use double screening, one screening cover being mounted inside the other.

Usually, however, screening requirements do not need to be as exacting as all this. To take an example: if a coil is mounted in a can, the provision of holes for trimmers and mounting purposes, etc., would cause no trouble at all. The same reasonable amount of screening would apply also to most other of the examples which enter the workshop of the home-constructor.

Servicing Tips

So much for screening. And now for a bit of gossip on other workshop matters!

Of these, servicing is one which always holds an interest for the amateur. Whether the professionals like it or not, many amateurs still carry out repairs on their own and their friends' receivers. The desirability of such an arrangement has been a bone of contention for a number of years, and has prompted the writing of many letters to this and other magazines. However, the writer does not want to enter the argument in these columns because he is interested in the technical aspect of radio servicing rather than in its monetary and occupational background. In any case, as these words will probably be read both by professional and amateur radiomen, their value lies entirely in the information which may be given.

A useful dodge for initially finding the cause of instability in a receiver was passed to the writer recently by a friend. His procedure consists of tuning the unstable receiver to a station so that a beat note is obtained between the carrier of the station and the unwanted oscillation. All that one then does is to pass a large screwdriver over the underside of the chassis and note at what place the presence of the screwdriver causes the greatest change in beat note. That part of the receiver circuit under the screwdriver then probably contains the component which has gone wrong.

The writer passes on this information because it is interesting and useful, but he would like to point out that such a test is only reliable in certain cases. It would not cope, for instance, with the average four-plus-one receiver unless the components were well spread out on a large chassis. It would certainly be worth trying in a large set with an RF stage. In all instances, of course, a change of note will be obtained when the screwdriver approaches an unscreened oscillator coil. The value of the test lies in the fact that, although it may only assist occasionally, it takes no time at all to carry it out.

Incidentally, instability in a four-plus-one is usually one of the easiest snags of all to clear. The most likely offenders are the screen-grid decoupling capacitors for the frequency-changer and IF valves, followed by the decoupler across the main HT supply. Faulty valve metallising is also an obvious thing to look for. The decouplers can usually be checked by temporarily shunting similar capacitors across them. The writer's favourite approach is to keep a 4 μF paper capacitor permanently fitted with short test leads; one of these leads is clipped to the chassis and the other, fitted with a prod, can then be used to test all possible points in the shortest space of time.

Most instability in domestic receivers stems from the IF stage or stages. This is because more amplification at a single frequency occurs here than elsewhere. IF instability can often be recognised by the clear single-tone beat note that is formed on receiving a station. As the continuous oscillation present usually forms a large AVC voltage, the receiver is very insensitive. If the AVC line is shorted to chassis the clear note (or possible hiss in the absence of a carrier) may change to a rough, squegging noise, but it will be possible to receive many more carriers. The change given by earthing the AVC line is due to the fact that much larger oscillations are then built up and cause grid current.

If the oscillations *stop* when the AVC line is shorted to chassis, try a new AVC decoupling capacitor!

Reliability of Components

The writer recently repaired a rather old receiver whose owner had been told that it needed several new valves. As the valves used were of an obsolete pattern replacements would be difficult and expensive, and the owner wanted to make certain that the money and trouble spent in obtaining them would not be wasted.

The fault was an intermittent one, the receiver ceasing to work after it had been switched on for a quarter of an hour or so. After it had stopped functioning, it was necessary to let it cool off for at least half an hour before it could be got to work again. Fate smiles sweetly on even the lowliest of people and the writer was able to find the fault fairly quickly, this being mainly due to a lucky accident.

When the set was upside down on the bench after having warmed up sufficiently for the fault to appear, your scribe placed his meter on a corner of the chassis whereupon the set immediately began to work. Removing the meter caused it to stop again. The next check proved that pressing the chassis down by hand also caused the receiver to work.

It looked, at first, as though the additional pressure was effecting a slight distortion of the chassis and thus causing a recalcitrant connection to be temporarily made. However, all the connections and components on the chassis were found to be above reproach. The final solution rested in the fact that, when the chassis was upside down, part of its weight on the bench was taken by one of the valve top-caps. This top-cap (an old-fashioned terminal type) was the cause of the intermittent fault.

Apparently, the wire leading from the glass of the valve to the top connector had been held with a cold joint ever since manufacture, and it was this which had finally failed. The joint could not, of course, be seen, so the writer pressed a soldering iron against the outside of the metal screw forming the terminal in the hope that the solder joint inside would reform. Fortunately it did, and the receiver was once again in working condition.

Apart from giving an indication of a possible procedure for faults of this type, the foregoing also offers an illustration of a popular misconception about radio servicing. This is that far too many people think that valves need replacing every time a set becomes faulty when, in actual fact, they are probably the last thing that is wrong.

One would imagine, especially in these days, that the faulty valve legend would have been scouted and done away with many years ago. But it hasn't been and it still flourishes strongly. Valves definitely wear out in time and also develop faults, but never at the rate which some people seem to imagine. It is probably the fact that a valve is essentially a plug-in component that gives the impression of its unreliability.

The valves most likely to give trouble with time are the midget battery types. Their small construction, coupled with the fact that they are liable to be bumped about when they are fitted to portable receivers, definitely helps to hasten their demise. They also develop burnt-out or broken filaments fairly frequently. Apart from these small battery valves, however, almost all other types are capable of carrying on for many years without giving any trouble at all.

A more frequent cause of trouble in radio equipment is given by capacitors. Electrolytics, although still perhaps the most unreliable type of capacitor, are nowadays much more trustworthy than they used to be. If they give any trouble at all it is usually due to a gradual loss of capacitance caused by their drying out. Breakdowns are fairly rare.

Breakdowns are, perhaps, more frequent in paper capacitors. (The writer was recently rather surprised to read that ceramic capacitors in American television receivers were also guilty of breaking down fairly frequently). Open-circuited capacitors are usually caused by careless soldering or handling. Leaky paper capacitors of the 0.005 to 0.1 μF class are very frequent, although the leaks are usually too small to stop their associated circuits from working. Most leaks vary in ohmic value from about 20 megohms to as low as 500 kilohms; lower than this indicates a potential breakdown. A capacitor which is at all leaky is, of course, completely useless for AVC or anode-to-grid coupling circuits.

Modern resistors are very reliable components. Practically their one and only failing is that they may occasionally become open-circuit without giving a visual indication of the fact by an outward appearance of overheating. Those resistors which burn out usually do so because they have been overloaded.

All At Sea

The writer gets some interesting jobs at times, but that of working on radio gear aboard a ship of some 600 tons has proved to be more intriguing than most others he can recall.

This Hornblower episode occurred recently and proved to be a source of some memorable experiences, not the least of which was the longing of one's stomach for self-expression whilst out in a choppy sea.

One snag was encountered during this time which might prove of interest to readers. This happened when one of the receiver aerials became unserviceable. Later checks showed that a lead-covered feeder had become broken, allowing the ingress of water. This feeder was about an inch in diameter, the centre conductor consisting of a single copper wire. Paper insulation was used.

The water which had entered the feeder not only caused a short-circuit: it developed a voltage! As read on the only meter available this was equal to about half a volt; but the reading would almost certainly have been larger if a high-resistance meter had been used. The centre core of the feeder was the positive pole.

The writer has not had time to try and work out the type of cell given by the combination of lead cover and copper conductor; but would be very interested to hear from any readers who might have a theory. The feeder, incidentally, is mounted vertically and is nine feet long. The water entering the feeder would not necessarily be pure, and might have contained a large proportion of sea water caused by spray. Any ideas?

HARMONIC DRIVE

Part Five

By P. TURNER

Why Does An Oscillator Give A Distorted Wave Form?

Now let us lift up the lid of that box of tricks and see what we can find. When you build a tuned circuit you pick out the values of inductance and capacitance to give the frequency you wish for. There are always strays present, however. These cannot be calculated, and they cannot be easily measured. The only ones known with any certainty are those due to the valve, stated in the maker's catalogue. Some of the others cannot be measured at all. Imagine diving into a swimming bath and trying to measure the length of a particular pint of water with a foot rule. It can't be done because you would never know whether you were trying to measure the right bit or not. Some kinds of strays are like that. These stray capacitances and inductances are not lumped together like the capacitances and inductance of the components which were put in. As you know, they are distributed all over the coil and the capacitor and the wires and everything else. At frequencies of a few tens of kcs these strays are so small in relation to the main values of the circuit that they have little effect on oscillatory currents set up by the main components. At frequencies of several hundreds of kcs and upwards they have increasingly more effect as the frequency rises. The difficulty at high frequencies is this; it is possible for stray values of inductance and capacitance to set up subsidiary circuits which may have resonant frequencies which are very close to multiples of the frequency determined by the main components. These subsidiary circuits are, so to speak, circuits within a circuit, and they cannot be isolated and measured, neither can they be resonated independently of the main circuit. They do modify the effect of the main components, however, and in so doing they upset the rate of change of the current in the circuit. The result is a distorted current waveform (relative to a sine wave), and the possibility of circuits resonating at higher frequencies being set into oscillation. This possibility of harmonic drive is sometimes a useful thing, as in frequency multiplying circuits, and sometimes not so useful, as in the final stages of a transmitter. It is possible to make use of this source of distortion, however, particularly in crystal oscillators where frequency multiplying has to be done. Look at Fig. 12. This shows a crystal oscillator

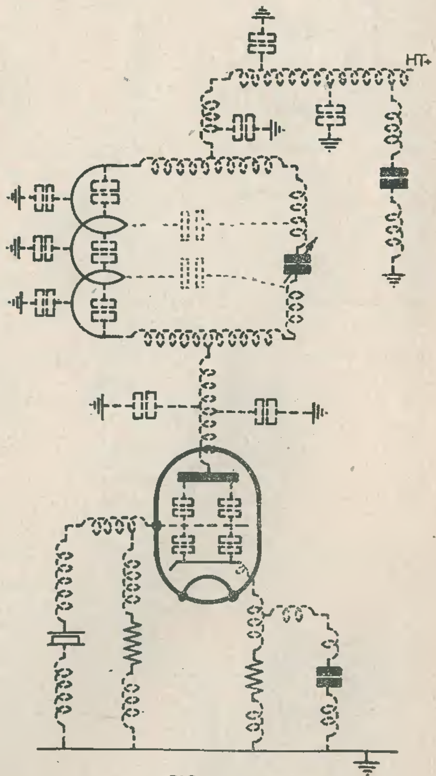
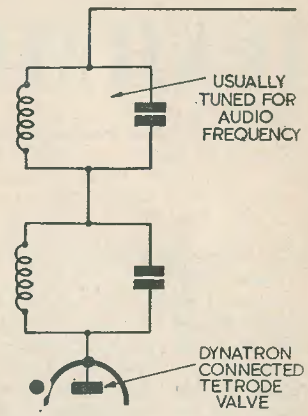


FIG. 12A

C558

anode circuit. The stray values of inductance and capacitance are shown in dotted lines. If the circuit has been carefully built, paying attention to short leads and suchlike, it is doubtful whether they will have much effect on the oscillating current. By a judicious application of 'artificial strays' we can cause quite large disturbances in the oscillating current and, therefore, make it possible to obtain harmonic drive of ample power at the frequency we desire. If this idea of introducing 'artificial strays' to modify the waveform is carried to what we may call a logical conclusion, it results in a type of circuit which is already familiar in one

FIG.13



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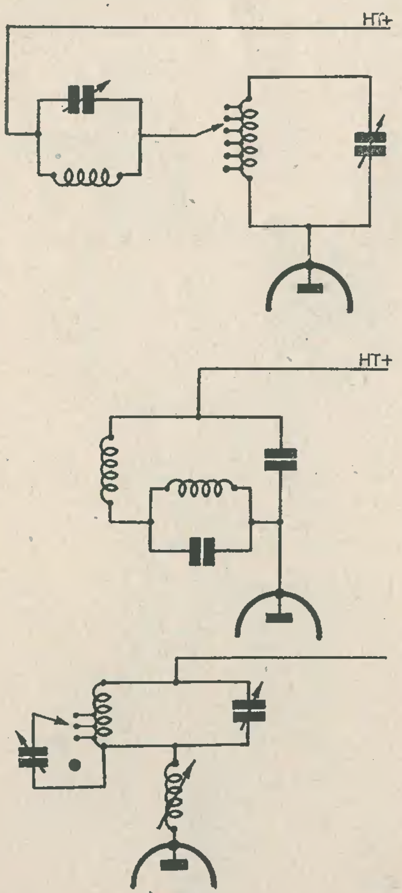

C559 FIG.12B

respect. Look at Fig. 13. Here are shown two resonant circuits connected in series between the anode of the valve and the HT positive wire. Many oscillators of the non-crystal type use two resonant circuits, though not in quite the same way. The usual reason for using two resonant circuits is to obtain a radio frequency output modulated at an audio frequency. In our crystal oscillator the idea is more a kind of *mutual* interference rather than the one-sided interference of ordinary modulation. I think a note about the use of a variable capacitor in the anode circuit of a crystal oscillator having a circuit like that shown in figure twelve may help here. The anode circuit of this kind of crystal oscillator is not tuned to the resonant frequency of the crystal by the variable capacitor. The requirement is that at the frequency of the crystal the anode circuit shall be inductive. The anode circuit therefore has to be tuned to a *higher* frequency than that of the crystal in use. There are limits of inductive reactance, in between which the crystal will oscillate, and the variable capacitor is there to adjust the inductive reactance (by the introduction of more or less capacitive reactance) to the value required by the crystal. The capacitor can be swung between wide limits without doing more than varying the amplitude of oscillation in the circuit. If the crystal is connected as shown in Fig. 12, increasing the capacitance will cause the amplitude of oscillation to build up gradually to a maximum and then suddenly fall to zero. Connecting the crystal between the anode

and the grid will give the opposite effect. I personally prefer to use the grid to earth connection for the crystal, as I do not enjoy getting my fingers tangled up with the volts. The grid to anode crystal circuit, incidentally, resembles the Colpitts oscillator, while the grid to earth crystal circuit resembles a tuned anode tuned grid oscillator. The circuit of figure twelve may be shunt fed as shown in Fig. 14. This is a good thing to do, as it enables one to handle the oscillatory circuits with impunity, thus saving the necessity for switching off every time an alteration has to be made. It also enables one to experiment with series resonant circuits, which, of course, will not work if the anode of the valve is series fed, as the capacitor introduces a break in the circuit.

It is possible to use many other ways of introducing artificial strays. Fig. 12 'B' gives some idea of the many variations possible.

(To be Continued)

Radio Miscellany

I have a new fan for this column. Every reader can judge for himself whether that fact is noteworthy or not, but this time it *is* rather remarkable. It is a young lady! She's eighteen and prefers radio to boy friends, *and* she buys her own R.C. every month. There is no question of borrowing or sneaking it from a male member of the family—she hasn't any brothers and her father is not radio-minded. She has been interested in radio since she was 15, and started off by repairing the discarded family receiver for use in her bedroom when pop bought the new one. She asks me not to publicize her name as her mother already thinks her interest in the hobby to be a deplorable lapse in femininity.

Perhaps, after careful scrutiny, she is not really a fan of this column after all. In fact, to be quite honest she doesn't even say she reads it. All she asks is whether I know of any other YL constructors.

As she is only 18 she probably does not know I am supposed to be an Old Timer. If I run true to form I ought, after stroking out my long white beard, to mutter a few trite remarks on the unmaidenliness of the modern young woman. Only last year they had a Women-cricketers Test team here from Australia. We shall be having women servicing engineers next, then women radio designers and before I know where I am some pushful young woman will take over my column!

With my characteristic truthfulness I can only say she is the first YL reader who has written to me, although I know of well over a dozen YL's who hold British Transmitting licences. The number has risen sharply in recent years. I have also QSO'd with a Danish, an Austrian and one American YL op., and I believe there are quite a number in the States. I have met three of them, all British, but none had built her own gear. I was disappointed to find that the three I have met did not have the sort of glamour I admire. (Now I must be more careful than ever to preserve my anonymity).

As for all my female relatives, they don't know the hot end of a soldering iron—let alone the cold end of a tank coil. In fact, they can't (or more probably, won't) learn how to repair a fuse, and I should not be surprised to discover that they believe that velocity microphones are the sort used by fast talkers.

Anyway, I am all for YLs genuinely interested in the hobby—especially if they have a wee bit of glamour too.

CENTRE TAP *talks about*

YL CONSTRUCTORS – PREFERRED VALUES

Tolerance

Every season brings its new crop of beginners, and with the same regularity questions about resistance values re-occur. It seems inevitable. The newcomer builds a receiver and while it *does* work it fails to give quite the performance he expected. He wonders where he has gone wrong and makes a careful check of the wiring, etc., only to find everything is apparently correct according to the description. But what about the resistors?

They are not all exactly the specified values—so he decides that is the trouble. That shifty-looking chap in the shop palmed him off with some odd ones. Forty-seven thousand instead of fifty, and twenty-seven instead of twenty-five, with a cock-and-bull story about it making no difference. If the designer meant 25 or 27 surely he would have said so!

Then the experts tell him the same thing and point out that many resistors have a tolerance of 20% plus or minus, which is near enough for most purposes, but others are within 5%, and in some circuits this higher degree of accuracy is necessary. He then wonders how he, as a beginner, is expected to know which can safely be as much as 20% off rating without loss of performance. Even when he is assured that none of the values in his particular circuit need be nearer than 20%, he is still a little uneasy and finally re-wires with resistors rated within 10%. Of course, the set works no better than it did before.

Why all this near-enough business, he wonders, and why have resistors of such overlapping values as 22, 25, 27, 30, 33 and so on?

There is no simple answer—it just happened. In the good old days, resistors were rated in nice round figures such as 10,000, 20,000, 30,000 and so on, with a few odd ones such as 15,000 and 25,000 in between. Then some smart mathematician brought his mind to bear on the subject and fixed on the sequence of 22, 27, 33, 47, 56 and 68, etc.

You can add as many noughts as you like, it makes no difference.

When you study them, you will find there is something particularly crafty about these figures after you begin to juggle around with the ten or twenty per cent plus and minus. For instance, the first two:—22 plus 10% makes 24.2 and 27 minus 10% gives us 24.3. Thus any resistor which turns out to be somewhere between 19.8 and 29.7 ohms can happily be classified as within 10% of one or other of those values. Looking into it a little closer, we find a resistor which has a value of 29.7 ohms exactly can be classed either within 10% of either 27 or 33 ohms. You simply have to decide whether to daub the body with red or with orange paint. Add as many noughts as you like, you cannot upset this sequence of figures. That's why it is easier to get a 2.2 Megohm grid leak than the "old-fashioned" 2 Meg.

Preference

Now let us have a look at what happens at the 20% tolerance rating. The measured value of a freshly made resistor is found to be 81,000 ohms. All that remains to be done is to spin a coin to help us to make up our minds whether to call it 68,000 or 100,000 ohms. It is within 20% of either figure, so, unless we happen to be in need of one or the other to sell to some beginner, we can paint it the appropriate colour to make it fit in with the code.

By the way, I forgot to mention that this latter sequence of figures is known as "preferred values." The only reason I can suppose is that it is preferred by the resistance manufacturers. Perhaps the Stockists prefer them too as they do not have to carry quite such a wide stock. Except of course, the latter have to put up with dam' fool beginners going back to ask if they are sure that a 47,000 ohm will do in place of 50,000.

Hide and Seek

The new low-power B.B.C. Relay Station serving the Folkestone area which came into service on the 23rd December on 206 metres, is temporarily being operated from a Caravan measuring only twenty by seven feet. With the building situation in its present state, a similar caravan relay station, which will be sited near Barnstaple, is also to be put into service very shortly.

While this neatly solves the housing problem, I think we can take it for granted that the B.B.C. won't play ball and fit them out with portable aerials so they could join in the fun and games when local Clubs have their Field Days!

NE"W" PLUGS FOR OLD

By P. TURNER

Most people who buy surplus equipment eventually accumulate a stock of the chassis plugs, called 'W' plugs I believe, which were used so extensively on the British equipment. The corresponding cable sockets do not seem to be so common, so that most of the chassis plugs are useless. There are a fair number of the American cable sockets about however, sold along with a length of multicore cable. Here is a simple method of modifying the 'W' plugs to take American cable sockets.

The majority of the pins on 'W' plugs are .080″ in diameter. This diameter suits the American socket, but of course the pattern of the holes is different so that the two will not mate. If the patterns can be made the same, then the plug and socket can be used together. The first step is to remove the central screw from the American cable socket and remove the front Bakelite plate. This is used as a templet. Two pieces of Paxolin or similar material are needed, cut to the correct diameter to fit into the metal ring of the 'W' plug, not forgetting a little protuberance to act as a key to prevent them from turning in the ring. A hole is drilled in the centre of each piece, of the correct size to take a holding screw of about one-eighth inch diameter. The two pieces of Paxolin and the Bakelite disc from the cable socket are fastened together with a nut and bolt and, using the disc as a templet, are drilled through all the holes with the correct size of drill. This is .093″ or Number 42 or 13 swg or 3/32″ or 2.38 mm. These sizes are all within some .003″ of each other, so any will do. The screwed portion of the metal ring of the 'W' plug is of no use, and will not allow the large sizes of cable sockets to be used, so it can be cut away with a hacksaw and the ring trimmed up with a file, leaving just enough metal to accommodate the Paxolin replacement. It only remains to reassemble the 'W' plug with its new centres and replace the front of the American cable socket and the job is done.

It might be as well to mention that the American cable sockets were designed to be assembled by putting the pin sockets into the front part *first*, and then putting the rear Bakelite disc in position. If this order is reversed it is likely that some of the metal sockets will be squashed flat, and opened out. To avoid this, while leaving the soldered cable in place, take a sharp penknife and well chamfer the edges of the square holes in the Bakelite disc, going right up to the corners. This will allow the disc to be pushed home easily, if the chamfer is made big enough, without doing any damage. The chamfering of the holes does not detract from the socket in any way. Fig. 1 shows a finished chassis plug and the cable socket with which it mates.

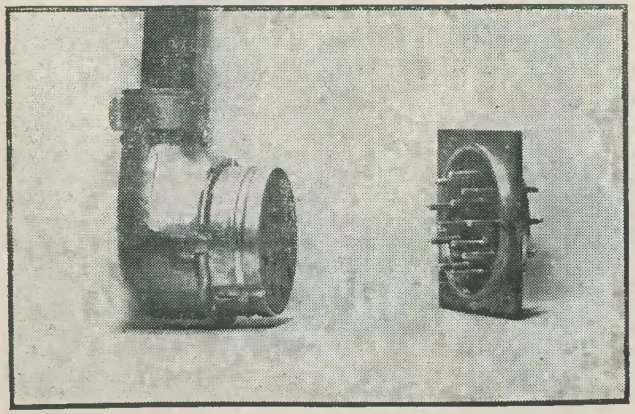

Fig. 1 A completed chassis plug (originally 10H-396) and the American cable socket, ZA/US-10624, with which it mates.

A LOW RESISTANCE TESTER

by H. L. CARTER

THE usual circuit for the determination of unknown values of resistance is shown in Fig. 1.

This is the simplest idea, consisting of a battery, milliammeter and variable resistance in series, of such values that, when the 'X' terminals are shorted, the variable resistance can be adjusted so that a full-scale deflection of the meter is obtained.

From Fig. 1, let

I_1 = full scale deflection of meter in mA.
V = voltage of battery
R_a = sum of resistances $R_m + R_b + R_v$,

where

R_m = resistance of meter
R_b = internal resistance of battery
R_v = amount of variable resistance in circuit.

Then,

$$I_1 = \frac{V}{R_a}$$

Now, if any unknown resistance R_x is placed in series in the circuit there will be a corresponding reduction in the current flowing, say to a value I_2. Then,

$$I_1 = \frac{V}{R_a + R_x}$$

Equating these two, we get

$$I_1 R_a = I_2 (R_a + R_x)$$
$$I_1 R_a = I_2 R_a + I_2 R_x$$
$$I_2 R_x = I_1 R_a - I_2 R_a$$

or

$$R_x = \frac{R_a (I_1 - I_2)}{I_2}$$

Thus, R_x can be obtained from the two meter readings I_1 and I_2, and the total resistance R_a of the circuit, and it is on this latter value that the accuracy depends.

Let us examine this circuit resistance R_s. It consists of R_w, the meter resistance which we can assume to be constant, R_b, the internal resistance of the battery, and R_v, that portion of the variable resistance in circuit. R_b and R_v are dependent on the state of the battery. R_b increases due to age, and R_v decreases as the battery voltage drops, also due to age.

This change in resistance may be only in the order of tens of ohms and, whilst not affecting materially the calibration at the higher resistance end of the scale, will have greater effect at the low end, where accuracy is usually more important.

This defect was overcome as shown in Fig. 2. The battery was put in parallel with the variable resistance, thus taking it out of the main series circuit—most readers will be acquainted with this change—but the variable resistance R_v was split into two sections R_1 and R_2, operating in tandem.

Their total resistance values being equal to each other and also equal to the equivalent single variable resistance R_v in Fig. 1, and referring to Fig. 2., it can be seen that if the slider of R_1 is altered to put additional resistance into the main circuit, an equal amount is subtracted by the slider of R_2.

Therefore, allowances can be made for a drop in battery voltage, and at the same time the circuit resistance R_a remains constant.

This idea is incorporated in a resistance tester to read fairly low values, as in Fig. 3.

Values of the unknown resistance R_x compared with milliammeter readings are given below:—

Milliammeter Reading, mA.	0.2	1.0	2.0	3.0	4.0	4.8
Resistance, Ω.	12000	2000	750	334	125	20

Any intermediate value can be calculated using the formula:—

$$R_x = \frac{R_a (I_1 - I_2)}{I_2}$$

For example, 1.5 mA.

$$R_x = \frac{500\,(5 - 1.5)}{1.5}$$

$$= \frac{500 \times 3.5}{1.5}$$

$$= 1167\ \Omega.$$

In this case, 500 Ω is the circuit resistance R_a, composed of the milliammeter, the two potentiometers in tandem (Note: the effective resistance of these is still only 400 Ω due to the way they are connected) and the 80Ω to make the total up to the round figure of 500 Ω.

The voltage necessary to drive the full 5 mA through this total resistance in order to obtain zero position on the instrument is therefore $\frac{5.0 \times 500}{1000}$ = 2.5V, so two 1.5V cells can be used in series, which allows a spare 0.5V for ageing of the battery.

Using different circuit constants in the expression $R_a \frac{(I_1 - I_2)}{I_2}$, the range of the instrument can be altered to suit individual preference.

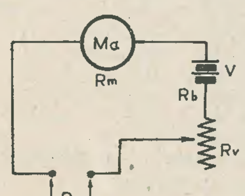

FIG. 1

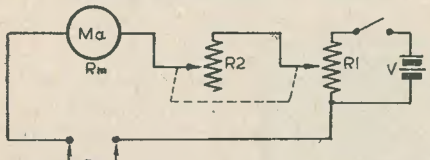

FIG. 2

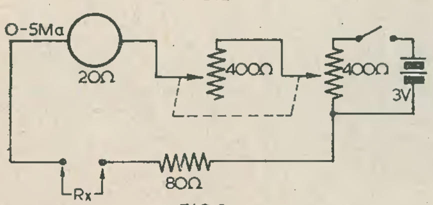

FIG. 3

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Decorative Panel Finish

by L. MILLER

DURING the course of a recent conversation, your Editor paid me the compliment of asking me why I had not written any articles lately, to which I replied to the effect that I have been too busy of late to tinker around with radio, as I am now in the paint manufacturing business. Whereupon he immediately suggested I write an article on paint!

When I had got as far (with the article) as to state that all walls should be carefully washed down with sugar soap, I realised that possibly your Editor wanted something on paint as applicable to the radio fraternity, so here it is, suitably modified.

It is quite obvious that the majority of radio constructors and experimenters take a pride in the appearance of their handiwork. Station-named dials, cabinets and other accessories which have no bearing whatsoever on the ultimate performance of a set are available and are purchased in large quantities; nevertheless, a lot of equipment is built on "communications" lines with metal panels, and these, together with AF amplifiers and the like, when home-built do normally lack that professional finish. It is here that the judicial application of the correct type of paint would make all the difference in the finished appearance.

Domestic oil (hard gloss) paints and enamels must be ruled out on account of their slow drying properties, resulting in dust settling on the surface. Quick drying varnish paints will still pick up some dust and may crack when knocked, due to the extreme brittleness of the varnish used in its manufacture.

It is possible to get a fairly dust-free surface, using cellulose enamels which dry quickly and are very durable. However, if the brush is to be preserved for future use it must be washed in special thinners, and if this is not done thoroughly and dried, the bristles will be hard and useless a few hours later. As a good soft brush must be used if brush marks are to be avoided, this may be a very expensive type of panel finish.

There are many synthetic enamels on the market which require no special precautions as far as brush cleaning is concerned, immersion in white spirit and drying with a clean rag being sufficient to remove all traces of paint from the brush. (For those who use their brushes frequently, possibly the ideal way of keeping brushes in good condition is to immerse the bristles in a small can or bottle of linseed oil (raw or boiled), keeping the tip of the bristles off the bottom of the container.

As far as the radio constructor is concerned, all of these 'smooth' finishes suffer from one very important defect, namely their inability to obliterate faulty workmanship. Perhaps

I am treading on dangerous ground when I suggest that any reader is guilty of faulty workmanship, but I am including under this heading such minor and almost inevitable faults as scratches on aluminium surfaces, slight imperfections in bending, and buckling. Indeed, smooth, glossy finishes often accentuate such blemishes.

In this respect the type of finish often (and incorrectly) known as crackle is ideal for the job. Not only does it cover scratches, but it tends to hide buckles, dents and warped surfaces caused by too great a drill pressure. The finish is, of course, pleasing in appearance, and is used to a very great extent in the radio trade.

It may be of interest to define these finishes. 'Crackle' is a two coat application, and has the appearance of crocodile skin. A special (usually light) undercoat is applied, followed by a finishing coat of contrasting colour (usually dark). Due to the properties of the paint used especially for this purpose, gasses in the undercoat are formed which forces its way through the top coat in literally millions of places, which causes the top coat to crack. On drying, the light undercoat shows through the cracks caused in the top coat. This finish is used extensively on wooden cabinets of the 'portable set' kind, as the appearance is similar to that of rexine cloth, and is, of course, considerably cheaper than cloth. To the best of my knowledge, this is only available as a stoving finish.

Secondly comes 'Crystaline.' This is often an enamel gloss paint with the addition of a wax which has the property of crystalising out when dry. The appearance is self explanatory, being a one coat and one colour finish, usually in black. This finish is often erratic as to its crystalisation properties on drying, especially when air dried. Best results are obtained when the painted surface is subjected to a gentle heat from *gas* fumes.

The last of these finishes is termed 'wrinkle,' and is the one used almost exclusively in the radio industry. It is essentially a stoving finish requiring a heat of around 100 degrees C. Tung or wood oil is the essential ingredient, which expands when subjected to heat, but not before it has partially 'stuck' to the surface, with the result that it cannot expand outwards due to the partial adhesion so it expands 'upwards' or away from the surface at innumerable points, causing the familiar wrinkle finish.

Stoving is quite a practical proposition to the average home constructor, as a very low heat only is required, such as could be obtained in a domestic oven with the gas turned down as low as possible and the door left slightly open. Some residual smell is, however, inevitable, so it is not advisable to carry out stoving operations Sunday morning. If the oven door is left open for an hour or so afterwards, even the most unreasonable OW could hardly complain! Stoving time is usually about half an hour. Wrinkle finish is available in black and many colours, and also as a clear varnish. The latter is handy for rejuvenating faded wrinkle panels when it might be difficult to match up to the original colour.

When a new panel or chassis has been wrinkled and stoved it is advisable to leave it a day or two to harden, and then, of course, care must be taken to ensure that it does not get scratched when the parts are being assembled, it being assumed that all holes are cut before wrinkling. However, screwdrivers do slip, even in the most experienced of hands, which rather points to an air drying wrinkle which could be applied *after* the set has been built and tested as being the ideal finish for the home constructor.

At the risk of being accused of attempted advertising in an article I must include, if only for the sake of comprehensiveness, some details of a finish I have devised and marketed, which is air drying and has an appearance something between wrinkle and crystaline. Perhaps 'web' would be an appropriate description. Whilst the appearance is not quite so striking as a genuine wrinkle, being slightly smoother on the surface, it has the advantage of being applied after the set is finished. If the chassis is being painted, the above-chassis components such as condenser packs, potted transformers, chokes, coil cans, etc., can be painted over at the same time, giving a very pleasing professional finish to the whole.

Summing up, to the reader who takes a pride in the appearance of his rig, painting is worth while, and wrinkling is fun!

NOTICE: Readers will notice that this issue of Radio Constructor is dated 'Feb/Mar 1952.' This does not indicate any break in publishing arrangements. The next issue will be on sale as usual in March, but will be dated 'April.'

BLACK CRACKLE *by N. A. Mummery*

A few days ago, having a job on hand, I decided to invest in a tin of black crackle enamel. Since I work in a laboratory and have access to reasonably large ovens, I decided to experiment a little, the results of which appear below.

I found that the main conditions which govern the crackle finish are (i) The thickness of the coat of enamel, (ii) The length of standing before stoving.

In the first test, a thin coat of enamel was applied and put straight into the oven; this resulted in a perfectly smooth glossy finish which was quite useless.

The next time I applied a thick coat of enamel, and put this straight into the oven. A lovely crackle finish was obtained but it was rather heavy such as is found on domestic equipment, e.g., electric fires and the like.

In the third test I applied a thin coat and let it stand for four hours. To my delight a beautiful crackle finish had begun to form, so I put it into the oven for half an hour. This resulted in a very fine finish such as that found on optical instruments.

The last test was a heavy coat which was stood for four hours and then put into the oven. This was the perfect finish and really looked professional. In all the tests the oven was at 90° Centigrade.

As an afterthought, I decided to apply a thick coat and let it dry in air; this took two days and gave a very fine finish, and would be useful to those who have not got a big oven.

In case of disappointment I'll give a few tips.

(1) If on completion you find some smooth uncrackled patches don't try to paint over them, the result will be useless. Wipe off the complete coat with a solvent such as Acetone, and start again.

(2) When applying a coat, don't paint in long strokes as you would with normal paint or you will get a grain effect; you will get a better result if you dab on the enamel in the same manner that you would a stencil; if you have a spray-gun that would be better still.

(3) Make sure that the surface you are painting is quite smooth, as any scratches will show through the enamel.

IMPROVING THE AUDIO OUTPUT

from

LOW GAIN TELEVISION SOUND STRIPS

by " WACCO "

The average Television sound strip is usually designed to be economical in its HT current requirements, consistent with delivering sufficient audio gain for comfortable listening. An average sound unit will consist, perhaps, of two Z77 valves as RF Amplifiers, a D77 operating as detector and noise suppressor, and a final Z77 as output stage. This arrangement, with a good aerial, will provide sufficient output for the average viewer up to, say, 15 miles from the Transmitter. Beyond this the volume control has, more often than not, to be set at maximum, and listening to quiet passages becomes a little painful.

Adding a further LF stage usually means additional current drain of the order of 15 mA or so, and this is often impractical. Alternatively, the chassis carrying the sound unit may have insufficient room to accommodate an extra valve. In cases where a Z77 is being used as the output valve, the following modification is suggested. It consists of removing the Z77, re-wiring the base connections, and fitting an ECC91 or 6J6. Using the component values specified, the audio output is increased by at least 12 dB, with a startling improvement in the top register. Total current drain of the sound strip is increased by only 2 mA.

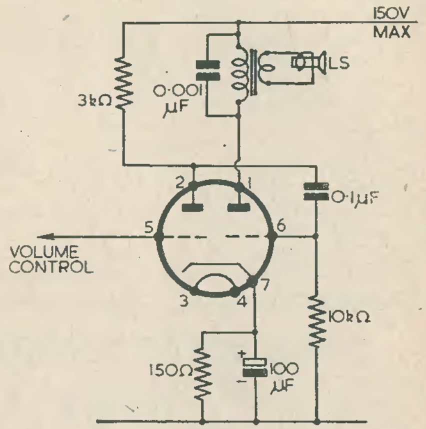

FIG. 2
THE ECC91 AS A TWO STAGE AUDIO AMPLIFIER

C511

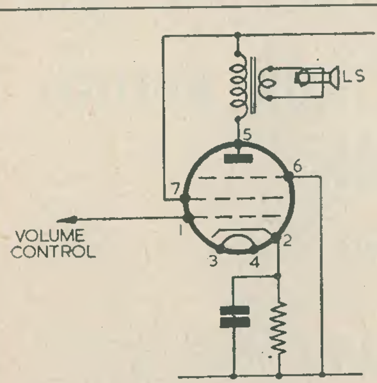

FIG. 1
THE Z77 AS A LF AMPLIFIER

C510

Fig. 1 shows the normal Z77 connected as an LF Amplifier. Fig. 2 shows the changes necessary in the wiring, together with the components to be added. The 100 µF cathode by-pass condenser is important; any lower value will cause motor-boating and LF instability. The ECC91 or 6J6, wired up in this manner, will, of course, make an ideal audio output stage for short wave receivers, and thus effect a saving of both space and HT current.

STANDING WAVES

. . . . and all that

by **JOHN L. EMMENT**

So much has been written on the subject of measurement of standing wave ratios that everyone knows, more or less, how to carry out these measurements.

There are, however, several snags connected with this job with which many will not be familiar. It is well known that a high standing wave ratio results in certain losses additional to the loss factor of the feeder. The higher the loss factor of the feeder, the higher the loss for a given standing wave ratio. Other factors involving losses are:—

(1) Radiation from the feeder, which occurs when the system is unbalanced, and,

(2) Dielectric losses;—with low impedance feeders, the conductor loss is high because there is a higher current flowing, and with higher impedance feeders, the dielectric loss is greater because of the higher voltage.

Air spaced feeders are better from this point of view, but if a state of unbalance exists, the losses due to radiation can be far more serious than on the close spaced type of feeder.

Let us look at a few examples of mismatching and see what losses are involved. For convenience, we will deal with 144 Mcs only. Lower frequencies will, of course, be subject to lower loss figures. A 50 foot length of 300 ohm ribbon feeder has a loss figure of approximately 1.5 dB at 144 Mcs. By a miscalculation, we have connected this to a beam aerial having a radiation resistance of 100 ohms. The mismatch is 3 : 1, and will give a theoretical loss of 1 dB plus the 1.5 dB loss figure of the feeder. Total loss, theorectically, is 2.5 dB in a power ratio. (We are already losing nearly half of our RF.)

As the feeder is now not "flat", we have difficulty in coupling efficiently to the transmitter or receiver. If we have been lucky in the choice of length, a voltage node *may* appear at the coupling coil. It is more likely, however, to be a point which is neither a voltage or current loop, and a large amount of reactance will be present. Although the transmitter may appear to load up nicely, a fair amount of re-tuning of the PA will usually be necessary. These conditions will cause further losses by heating of the coupling coil (another dB or so). Unless the feeder is electrically balanced, still further losses will occur, due to radiation. This unbalance will also cause false readings to be obtained when standing wave measurements are being made. If the coupling loop method of measurement is being used, no change in reading should be observed when the polarity is reversed (Fig. 1).

If a change is noticed, it is a sign that the feeder is unbalanced, and the whole length should be examined with regard to its proximity to earthed objects, etc. The starting point for good matching is obviously the beam itself, and this brings us to the point of this article. Close spaced and medium spaced beams, of the 3 and 4-element class, have a radiation resistance of anything between 8 and 20 ohms. The usual procedure is to fold the fed element. If the radiation resistance of the beam works out at, say, 10 ohms, a multiplier of 30 is required to match our 300 ohm feeder. This means that the ratio of D1 to D2 has to be 6 : 1, while the spacing between the two will have to be approximately 10 times the radius of D1 (Fig. 2).

An error of only a few per cent. in these calculations will result in a standing wave radio of 1.5 : 1 or more, and in any case, this system does not take into account the changes of impedance effected by the presence of a roof of nearby earthed objects. There is, therefore, no means of finding out exactly what the radiation resistance is without the aid of expensive measuring gear. In order to find an alternative method of feeding a beam, a series of experiments were carried

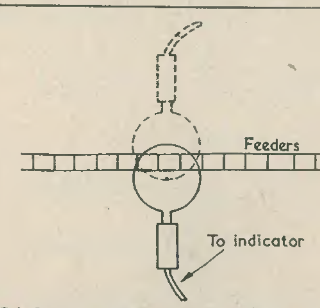

FIG. 1. Reversing polarity of coupling loop on SWR measurements

C272

out, and as a result a much easier method has been found.

Nearly all close spaced beams have a reflector spaced 0.15 or 0.2 wavelengths from the radiator, and in the case of the 4-element, the 1st director is usually 0.1 wavelength spacing, so we have radiation resistances of between 8 and 15 ohms to deal with, sometimes perhaps 20 ohms. The dipole is now "folded", using another length of tubing of the same diameter as the radiator, and spaced the diameter, i.e. if ¾" tubing is used, the spacing between the two is ¾". This gives an impedance step up of approximately 4 times.

A transformer is now made of two 16" lengths of 300 ohm feeder taped together and fanned out for 3" at the top (see Fig. 3).

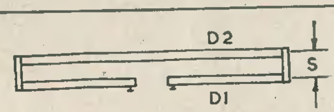

FIG.2. Showing the 3 major factors in obtaining an impedance step up on a folded dipole. C273

The 300 ohm feeder is connected as shown. Tests have proved that the standing wave ratio is lower on this arrangement than on any other method tried. The transformer automatically adjusts itself to the range of impedances encountered in close spaced beams, and no noticeable change in SWR was observed over the range of 35 to 75 ohms radiation resistance. (Measured SWR was approximately 1.2 : 1). For 100 ohm balanced feeder, 4 lengths of 300 ohm feeder as above may be connected in parallel, although with this arrangement, some rise in SWR takes place when the radiation resistance of the beam is

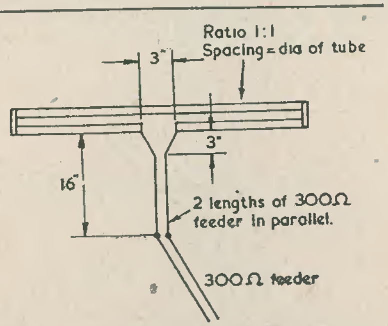

FIG.3. Connections & dimensions of matching transformer

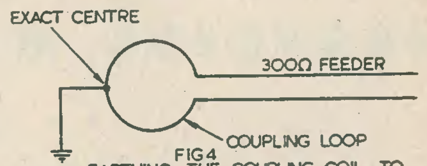

FIG4 EARTHING THE COUPLING COIL TO IMPROVE BALANCE ON FEEDER C275

higher than 60 ohms. Particular attention should be paid to the balance of the feeders. 300 ohm ribbon should never run nearer than 1 foot from any metal work or house wiring, and the coupling coil to the transmitter or receiver should be carefully measured and earthed in the exact centre. (Fig. 4).

Finally, a brief summary of the comparisons made between the transformer match and the high step-up folded dipole methods. From a SWR of nearly 2 : 1, the transformer method gave 1.2 : 1. Local field strength measurements increased by over 6 dB. Signal to noise ratio improved by 2 dB (less noise being picked up on the feeder). The beam appeared to be much "sharper." Nearly an "S" point improvement on all received signals. Better signal strength reports from stations over 100 miles distant. All above checks were made on a 4-element Yagi in roof space.

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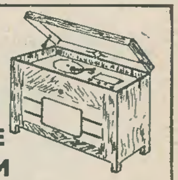

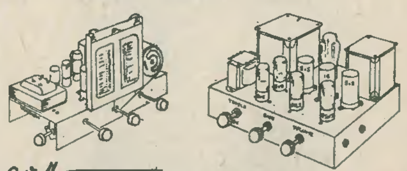

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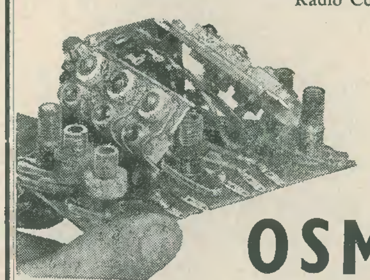

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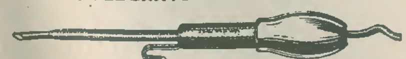

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