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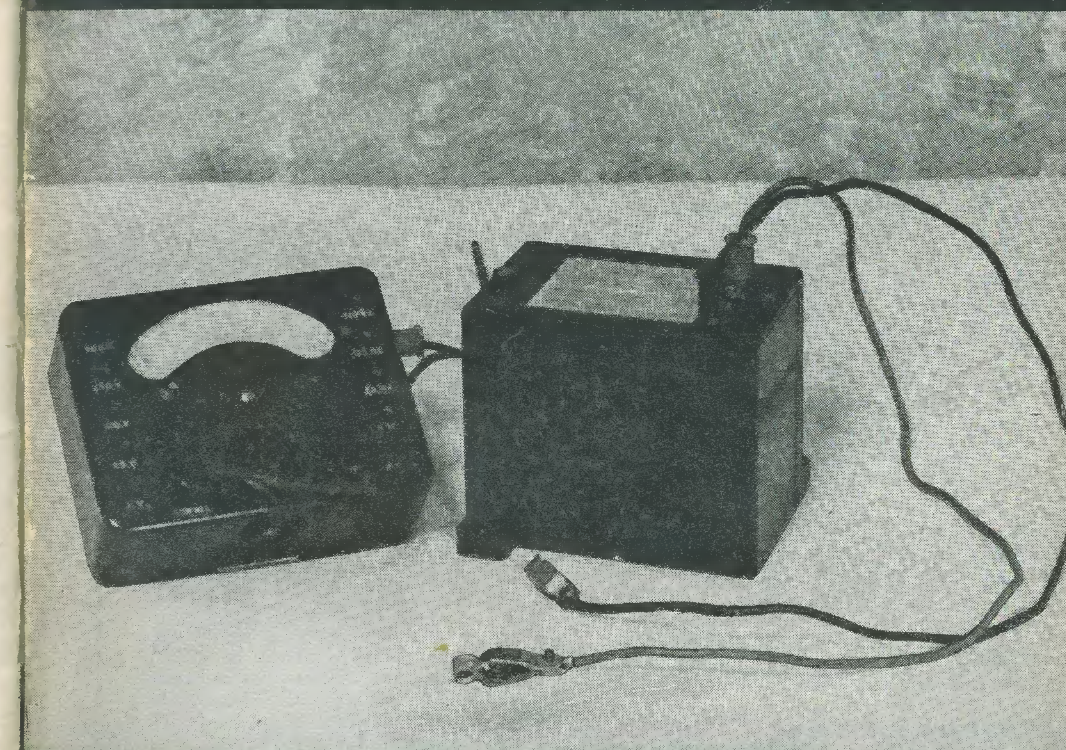
RADIO CONSTRUCTOR

for the Radio and Television Enthusiast



IN THIS ISSUE . . .

1/3

WHAT IS THE I.S.W.L?

(1) The International Short Wave League is an organisation of short wave listeners, amateur transmitters, and others interested in short wave radio communication.

(2) Its objects are to encourage, in every way possible, friendly intercourse and understanding between peoples of every country, through the medium of a common interest in their hobby.

(3) Membership is open to anyone, of whatever race, creed, or colour, provided there is a genuine interest in short wave radio and a desire to further the aims of the League.

(4) The membership fee consists of an annual subscription of 2s. 6d., or its equivalent. There is no entrance fee.

(5) Contests, Set Listening Periods and Dedicatory Broadcasts are regularly arranged, in order to further the aims of the League.

(6) Organisation consists of an HQ staff, Country, County and Town representatives, and local I.S.W.L. Groups. These latter are the essential units of I.S.W.L. activity, as they stimulate and keep together local I.S.W.L. members.

(7) Many free services are available to help members to get the best out of their hobby. Amongst these is a QSL Bureau which is unique in that it handles both amateur and broadcast 'veries.'

(8) A section of 'Short Wave News' is devoted each month to I.S.W.L. affairs, and carries news of contests and Group activities. The purchase of 'Short Wave News' is **NOT** a condition of membership.

(9) The address of HQ is 57 Maida Vale, Paddington, London, W.9., and the telephone number is CUNningham 6518.

IF YOU ARE A
SHORT WAVE ENTHUSIAST
—JOIN US NOW

Radio Constructor

Vol. 4, No. 11 **Annual Subscription 16/-** **June, 1951**

Editorial and Advertising Offices—57, Maida Vale, Paddington, London, W.9
Tel. CUNningham 6518.

Edited by C. W. C. OVERLAND, G2ATV

CONTENTS

Editorial

The warmer and sunnier weather mentioned in our last Editorial disappeared within a few days, but we hope it will have returned by the time this issue appears. For this month the emphasis is on Field Days.

June sees the holding of the annual National Field Day, organised by the *Radio Society of Great Britain*. This is THE event of this nature, but there will also be others on a smaller scale, organised by local radio societies.

One such is the ISWL Field Day, organised especially for listeners, and this will take place on Sunday 29th July. If you would like an enjoyable and interesting day out, why not contact one of your local ISWL Groups. There are over 70 of these throughout the country, and the address of the nearest will be sent to any reader who cares to write for it. HQ address is the same as that of this magazine. Incidentally, the current issue of our companion journal '*Short Wave News*' is a special Field Day Number.

Talking about summer, now is the time to tackle those jobs which are such a nuisance when construction is at full blast during the colder days. How about overhauling and creosoting that aerial pole? Perhaps there is a draughty spot in the shack which could be made good. Copper wire will be rocketing in price, so now is the time to put up that new aerial suggested by the 'Practical Aerials' series. A touch of paint will make the den much more comfortable in the winter, but now is the best time to apply it. Why not, too, have a 'real sort out' of all your components and tools, making good any shortages so that constructional work will not be held up when you have started on the next job?

G2ATV.

NOTICES

THE EDITOR invites original contributions on construction of radio subjects. All material used will be paid for. Articles should be clearly written, preferably 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 an address.

COMPONENT REVIEW. Manufacturers, pub lishers, etc., are invited to submit samples or information of new products for review in this section.

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

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. 7 A 40-70 Mcs Signal Generator

This circuit is suggested for a signal generator covering the range 40-70 Mcs. AF modulation may be switched in or out as desired.

Circuit Details

The signal generator consists fundamentally of a pentode (or triode) valve, (V1), functioning as a Colpitts oscillator. The anode voltage is stabilised by V2, whilst the screen-grid voltage is further maintained steady by the potentiometer R4, R5. AF modulation is provided by V3, working (in this case) as a Hartley oscillator. (Any other type of AF oscillator could be used in order to take advantage of components on hand). The modulation is injected via R3, the degree of modulation being adjusted by R6 which may be either a panel or a pre-set component.

The Oscillator

As the Colpitts circuit has gained popularity amongst amateurs when used as a VHF receiver oscillator, it was decided to employ such an oscillator in this particular circuit. The tuned circuit consists of L2 or L3 shunted by C1, C2, C3 and C4 in series-parallel. C1 and C2 are trimmers, and are used not only to set the tuned circuit to the correct frequency but also to vary the ratio between the RF applied to the anode and to the grid for best oscillator working. (It could be said that they vary the position of the "earth tap" into the tuned circuit.) They should be adjusted such that, with C3, C4 set to minimum capacitance, the total capacitance across the coil (including strays and valve electrode capacitances) is approximately 25 pF. C3, C4 should be a split-stator capacitor, preferably of the "butterfly" type. If it is impracticable to earth the moving vanes of the particular tuning capacitor used they may remain disconnected; C1, C2 and stray capacitances sufficing for the "earth tap" into the tuned circuit. A normal tuning capacitor is not recommended owing to the possible high capacitance between its frame and chassis.

It is intended that the waverange 40-70 Mcs be covered in two steps. Using coil L2, the top frequency is 70 Mcs for a total parallel capacitance of 25 pF; and 55 Mcs for a capacitance of 40.5 pF. With coil L3, a parallel capacitance of 25 pF will cause it to resonate at 55 Mcs; whilst 47.3 pF will give 40 Mcs. It may be seen that the capacitance swing needed from C3 and C4 in series is slightly less than 25 pF. Coil changing could be effected by using plug-in coils or by means of a turret switching device. The coils must be very rigid and must not be subject to any alterations in inductance due to the mechanical handling necessitated when using the plug-in system. The coil dimensions given in the list of values are calculated, and may need slight initial adjustments when put into practical use. Sufficient alterations in inductance could probably be carried out by slightly opening or closing the turns.

To obviate the necessity of changing coils, it may be found possible to use coil L2 for the complete range. L2 will resonate at 40 Mcs when a total capacitance of 76.6 pF is connected across it; thus necessitating a tuning capacitance swing of slightly more than 50 pF. Whether L2 will work satisfactorily over this range in the constructor's particular case may be discovered by experiment.

Coil L1 is, of course, intended for coupling to the output terminal. If plug-in coils are used, L1 could be fitted permanently so that it is in line with whichever coil is fitted. The resistor R1 is intended to load the coil and prevent external circuits from affecting the frequency of oscillation. R1 should be mounted close to the coupling coil.

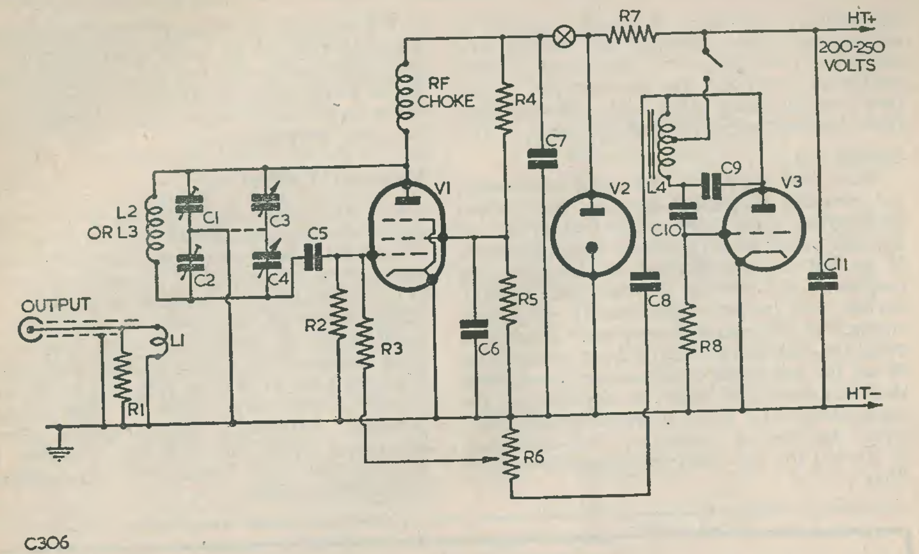


Fig. 1: Circuit of TV Signal Generator.

List of Values

Coils

L1—1½ turns; ½ in. diameter; ½ in. from earthy end of L2, 3.
L2—0.207 µH; 6.6 turns; ½ in. diameter; 1 in. long; 16 swg enamelled—70-55 Mcs.
L3—0.335 µH; 10 turns; ½ in. diameter; 1½ in. long; 18 swg enamelled—55-40 Mcs.
L4—AF oscillator coil.
RFC—Approx. 50 µH; 55 turns 26 swg D.S.C. on ¼ in. former 1¼ in. long.

Capacitors

C1, C2 — Trimmers; Philips concentric; 6-30 pF.
C3, C4 — Tuning Capacitor; see text.
C5 — 50 pF.
C6, C7 — 0.002 µF.
C8 — 0.01 µF.
C9 — AF oscillator tuning capacitor.
C10 — 500 pF.
C11 — 0.1 µF.

Resistors (½ watt unless otherwise stated)

R1 — See text.
R2 — 15 kΩ
R3 — 500 kΩ
R4 — 20 kΩ; 1 watt.
R5 — 40 kΩ; 2 watts.
R6 — 100 kΩ; potentiometer.
R7 — 2-6 kΩ; (to suit stabiliser and HT voltage)
R8 — 20 kΩ

Switches

S1 — Modulation on-off switch.

Valves

V1 — RF oscillator; see text.
V2 — Any suitable stabiliser; VR 105/30, etc.
V3 — Triode AF oscillator; 6J5, etc.

It will be noted that HT is present across the trimmers and the tuning capacitors. This voltage could be isolated by fitting a 0.001 µF capacitor between the anode of V1 and the tuned circuit, but such a precaution is hardly necessary. If desired, a fuse bulb could be inserted in the HT positive line after the stabiliser.

The oscillator valve shown in the diagram is a pentode, the writer having in mind the ubiquitous EF50. However, almost any "all-glass" pentode or triode with low inter-electrode capacitances should cope in the circuit.

Construction

It is, of course, essential to take great care over the wiring around the oscillator valve. All RF connections to V1 and in the tuned circuit should be kept as short as possible. The resistor R3 should be mounted close to the valve grid, even if this necessitates a long lead from its other side.

The main cause of drift will be given by temperature changes. A good method of minimising these consists of having the oscillator valve above the chassis in a well-ventilated position, the components of the tuned circuit being below and kept well away from heat-radiating components such as R7.

Setting Up

When the oscillator has been completed, the presence of oscillations may be checked by inserting a milliammeter in the HT line at the point marked with a cross in the diagram. If oscillations are stopped by touching the oscillator grid with an earthed prod the HT current will increase considerably, thus indicating that the circuit is working. Bearing in mind the fact that C1 and C2 are needed also to set the minimum tuning capacitance, these two trimmers may then be adjusted to the capacitance ratio which gives maximum "dip" with the tuning capacitor half-enmeshed. Trimming for this ratio will probably be very "flat".

The resistor R1 should then be experimentally reduced in value until it begins to load the tuned circuit, this state being indicated by an increase in the HT current reading. A value for R1 which causes slight loading should be quite sufficient.

Frequency Calibration

Calibrating the signal generator for frequency may prove a little difficult without additional equipment. Spot checks may be obtained by beating the output against known frequencies (TV sound, etc.,), the signal generator then being "followed" by using the harmonics of wavemeters or lower frequency generators. Such wavemeters as the BC221 give useful harmonics up to at least 100 Mcs or so; and should prove very useful in this respect. Stronger harmonics from normal signal generators could probably be obtained by feeding their full output into an unbiased aperiodic amplifier.

TELEVISION COILS *on* ALADDIN FORMERS

Part 2

by *F. L. BAYLISS, A.M.I.E.T.*

We present the second of a short series of articles on an interesting topic. The views expressed are, of course, our contributor's and are not necessarily held by us, but there is no doubt that the coil, and its circuit, plays a most important part in any televisor, and this series will have served its purpose if it causes the television enthusiast to devote some thought to this subject.

Aerial and Sound Input

WHILST the vision receiver aerial coil may conveniently consist of a few spaced turns, tapped at the earth end to minimise the effect of aerial and lead-in capacitance, it is a much better plan, in the writer's opinion, to design this coil in conjunction with the sound receiver input coil.

By so doing, it will not be possible to use the first two RF stages as combined sound and vision amplifiers, but there will be few "quality" enthusiasts who will regret this. There will certainly be very few in the Midlands area, where the struggle for vision and sound separation is stern and bitter—I only won by the most careful use of rejectors.

The circuit of Fig. 1 makes use of two standard 3/8" Aladdin iron-dust core formers, and these are wound as follows:—

L1 Aerial Coil. Hold the former base in the left hand, and commence winding about two-thirds of the distance along the former, towards the top. Use 30 or 32 swg enamelled wire, and space the turns about forty to the inch. Wind 3 turns (coil A) bring out a 2" loop of wire and continue with a further 2 turns (coil B) and bring out another loop of wire. Continue with another 6 turns (coil C) for Birmingham or 8 turns for London.

L2. Sound Input. Commence as before and wind 2½ turns (coil D), bring out a loop and finish with 5 turns for Birmingham or 7 turns for London. Use the same wire and spacing as for L1, and coat thinly with polystyrene varnish to keep the windings in position (wax is an alternative).

Circuit Notes

From the Midlands user's viewpoint L2, besides being an ordinary input coil, is also a first-class sound rejector. This must be so, for coil A, which is virtually part of L2, serves to "tap off" the sound fundamental frequency when L2 is tuned to that frequency.

Resistor R1 is a 10 Ω stabilising device whilst R2, normally 4.7 kΩ for the intervalve stages, is reduced to 2.2 kΩ across the aerial coil to give better aerial matching, and a more level response over the extended spread of both sound and vision frequencies handled by this coil.

When tuned, coil L1 should be set to resonate at almost the vision carrier fundamental frequency of 45 Mcs (or 61.75 Mcs). The frequencies of 46 Mcs and 60.75 Mcs should be found to give adequate carrier embrace.

Other Sound-Input Methods

Where the first one or two stages are used as combined sound and vision amplifiers, the sound may be tapped off the following valve grid via a 3 pF or 5 pF capacitor, and taken direct to coil D of L2.

It is important, however, that the capacitor should be wired directly on to the valve grid (normally V3) and that the connection thence to the first sound stage should be in screened co-axial lead, just a few inches long, and having the copper braid earthed to prevent radiation or pick-up and consequent instability.

Where this method is adopted, L1 need consist of coils B and C only; coil A need not be wound.

Another method worth experimenting with is to connect the capacitor to the first rejector coil, thus making the latter the sound input coil. It will probably be found that inductively coupled rejectors in the third tuned stage respond best, but it is worth while trying out also with cathode-connected rejectors.

Sound Couplings

Whilst either the tuned anode or tuned grid systems, described in the last article in this series, may be used in the sound receiver, much the better plan is to construct efficient two-coil RF transformers.

Now, if it were possible to wind both coils on the same Aladdin former and yet still retain ease of tuning (adjustment of core) the writer would not hesitate to proffer this method. The core can, of course, be halved, to allow individual tuning of each coil, but unfortunately the upper half of the former has no thread. With a little patience, however, and careful positioning of the turns, this method *could* be successful—and doubtless some constructors will want to try it!

For those who want "spot-on" tuning in each coil, however, and are willing to pay the price of extra formers and labour to reap the benefit of a more-or-less level bandpass response, the two-coil method is recommended.

Each coil should consist of 5 turns (Birmingham), or 7 turns (London), wound at the top of the former, and spaced 40 turns per inch.

Bring the wire ends out to tags as shown in Fig. 2, and coat the coil with a film of polystyrene varnish.

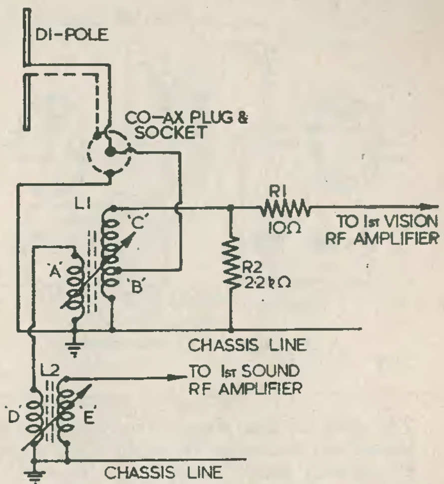


FIG. 1
THE CIRCUIT OF THE AERIAL & SOUND INPUT COILS

C307

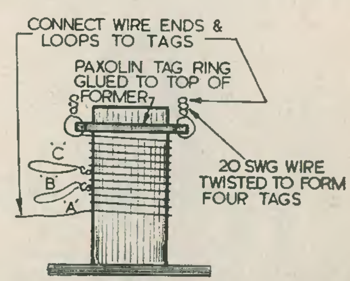


FIG 2
METHOD OF WINDING COIL L1

C308

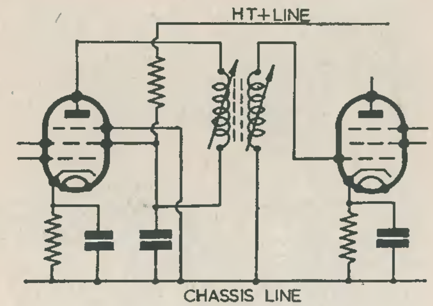


FIG.3
THE SOUND RF TRANSFORMER

C309

The distance separating the two coils when mounted will determine the width of the resonant frequency band. In practice, from ¾″ to 1″ from *centre to centre* has been found satisfactory, whilst variation of this distance from stage to stage will give a series of peaks within the two outer limits that will tend to level the overall response. Fig. 3 shows the transformer circuit arrangement.

Rejectors

Whilst the writer cannot speak with authority anent the advisability of rejectors for London area receivers, he can do so for the Midlands area in which he resides.

Even when the circuit of Fig. 1 is used, two additional rejectors are advisable in a four-stage receiver, and three in a six-stage one.

These may be either (a) inductively coupled to the tuned coil, or (b) connected directly into the valve cathode circuits, using the final RF stages of the receiver in both cases. There is little to chose between the methods although, where regeneration resistors are used in the cathode circuits, inductive coupling may be preferable.

The latter method is also somewhat more preferable because (a) screening is unnecessary, and (b) the additional load on the anode coil (where such is used) is less masked.

When winding either type, use 22 or 24 swg enamelled wire, winding 4 turns at the top of the coil, but bringing out a tapping 1½ turns from one end. Connect a 50 pF capacitor across the 4 turns, and connect the completed rejector into circuit in accordance with either Fig. 4 or 5. The tapping is not used in the inductive method.

Suggestions for Mounting

The long type of chassis shown in Fig. 6, having the sound receiver on one side (that shown) and the vision receiver on the other, allows the coils to be mounted along each side.

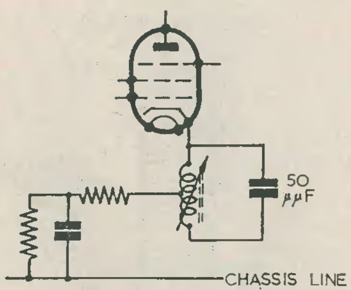


FIG.5
CATHODE-COUPLED REJECTOR

C311

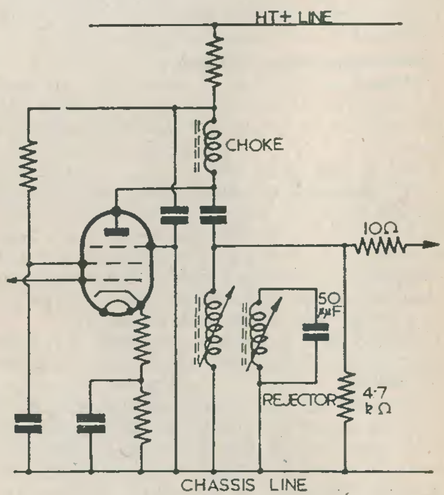


FIG.4
INDUCTIVELY-COUPLED REJECTOR

C310

By drilling 3/8″ holes in the sides, tuning can be effected without up-ending the chassis, and the coil tags, moreover, come immediately underneath the valveholders and require only an inch or so of wire to complete the connection.

Small screens may easily be fitted between the coils and, finally, the sound section completely isolated from the vision receiver by a long screen running down the centre.

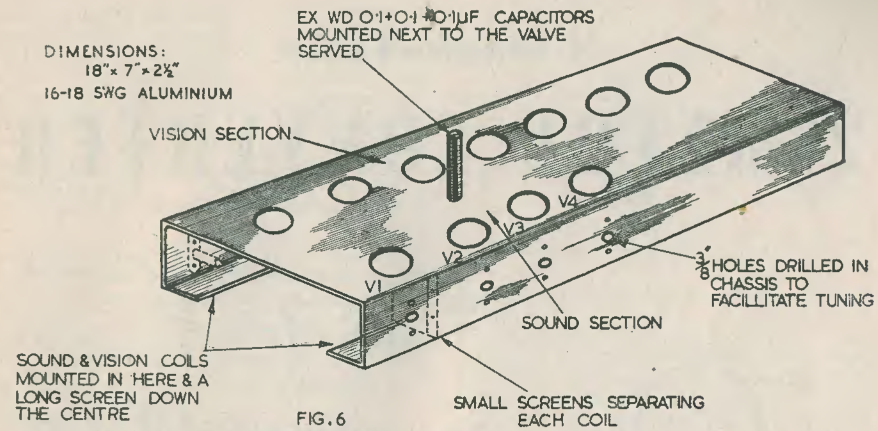


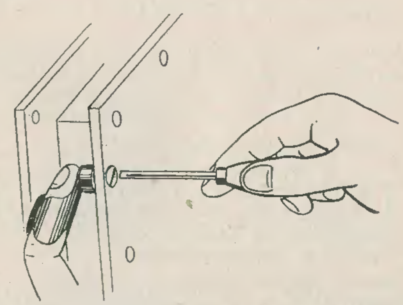
FIG.6
A CONVENIENT & COMPACT CHASSIS
AS BUILT BY THE WRITER

C312

The ex-WD 0.1 + 0.1 + 0.1 μF tubular capacitors shown are useful for decoupling providing the leads are kept short. They cost the writer only 1/6 per dozen and represent remarkable value and a considerable saving in cash and under-chassis space.

(*To be continued*).

TRADE REVIEW



The Acru Finger Tool pictured here is being marketed by the **Acru Electric Tool Manufacturing Co. Ltd.**, of 123 Hyde Road, Ardwick, Manchester 12, and is one of those simple things which make one wonder why they have not been thought of before.

How often it is found, when constructing, that a nut has to be held in an awkward position whilst it is threaded on to a screw, out of reach of the ordinary box spanner, or that a screwhead is similarly inaccessible to the screwdriver. And nuts, screws, and small components have a habit of falling into, and becoming firmly lodged in, places from which they can only with great difficulty be extricated.

These Finger Tools should in great measure solve these problems. The one shown here consists of a plated brass finger holder (thimble) to which is attached a small box spanner. There are four of these, to fit 0, 2, 4, and 6 BA nuts. The set costs 7s. 6d.

Also available is a set of two screwdriver ends with thimble at 3s. 6d., tweezers with sharp, flat or round noses on thimbles at 2s. 10d. each, or a complete set consisting of the above items, plus a blank thimble and a Pyrogrip, in a durable metal case is available at 22s.

The Pyrogrip referred to above is a neat attachment for any screwdriver, by means of which screws can be held on the screwdriver blade and thus inserted into any awkward position. These cost 6d. each.

A Single-Valve
2-METRE CONVERTER

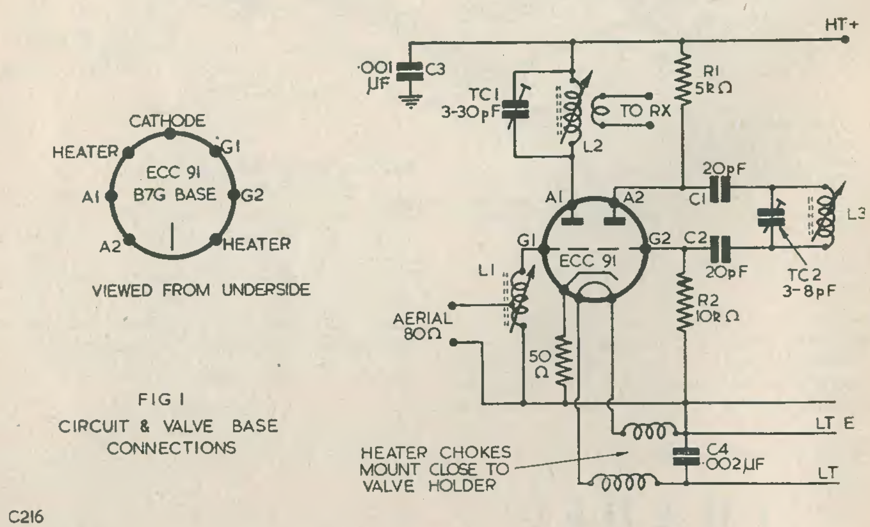


FIG I
CIRCUIT & VALVE BASE CONNECTIONS

By H. E. SMITH, G6UH

USED in conjunction with an efficient aerial, the converter described herewith, which is designed for the beginner on the VHF bands, is capable of surprising results.

As can be seen in Fig. 1, it consists of a Mullard ECC91 as triode mixer and triode oscillator: the only additional requirement being a reasonably good communications receiver, capable of tuning the 28 Mcs band. HT and LT supplies can be taken either from the receiver, or from a small power supply. As the three tuned circuits operate on different frequencies, screening between them is not necessary, but L1 and L3 should be mounted so far apart that direct coupling does not exist between them. Neosid polystyrene coil formers, type DRG450, are recommended for L1, L2 and L3, together with dust iron cores DRG400 Ref. 900, and tag rings type 4 LT/2.

The grid coil L1 is wound with four complete turns of 16 swg silver plated wire—turns spaced twice wire diameter, and the aerial connection soldered one complete turn from the earth end. Method of winding and securing the coil is shown in Fig. 2. L2 (IF coil) is wound with 12 complete turns of 24 swg enamelled wire, the whole being given a good coat of Durofix to secure turns. Clean the ends carefully and solder to tag ring connections. The 3-30 pF trimmer may be soldered directly across these tags. The low impedance coupling coil consists of three turns of No. 18 swg, sleeved with systoflex and wound tightly over HT end of L2. The ends of this coil are soldered to the two spare tags on the tag ring. The IF and coupling coil assembly are shown in Fig. 3.

L3 (oscillator coil) is wound with four turns of 16 swg silver plated wire. Turns are spaced twice wire diameter, and care must be taken to ensure that this winding is absolutely rigid. It is better to wind this coil on a former slightly smaller so that the finished coil will spring on to the Neosid former. All the components of the oscillator section must be mounted rigidly, and the two capacitors C1 and C2 mounted edge-on to the chassis to ensure a further degree of stability. The oscillator coil assembly, with suggested component layout, is shown in Fig. 4.

The heater chokes are each wound with 19″ of 30 swg enamelled wire wound on a 1 MegΩ resistor, the ends being carefully cleaned and soldered to the wire ends of the resistor. These chokes should be rigidly mounted on small stand-off insulators, with connections to the heaters made as short as possible.

Operation

With a short length of 80 or 100Ω balanced feeder, connect the coupling coil to the main receiver aerial socket. Apply HT and LT to the unit, and tune the main receiver to approximately 27 Mcs. Adjust trimmer across L2 until noise level increases and, at the point of maximum hiss, this circuit is in tune. With the trimmer across L3 set to approximately half mesh with the dust iron plunger half way in, and aerial connected to the converter input, carefully tune the main receiver through 28 to 26 Mcs. If signals are heard, ascertain whether it is due to IF break-through, by a slight adjustment of L2 trimmer. If it disappears, it will be a VHF signal, and it is now a matter of patience to locate the 144-146 Mcs band, by listening to signals. Remember that the majority of London area stations operate around the centre of the band. L1 trimmer need not be adjusted until you have located the band and calibrated the receiver. A slight adjustment may then be necessary to bring up the signals to peak.

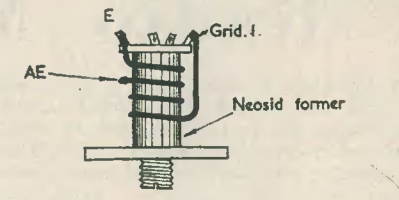


FIG.2. Grid coil assembly.

A simple two metre beam or dipole is essential, and this should be mounted as high as possible. If severe IF breakthrough is experienced due to a poorly screened receiver, it will be better to leave the main receiver set at a point of no signal, and arrange to do all tuning on the oscillator (L2). A rigidly mounted capacitor of low value (10 pF max.) an extension spindle, and a good slow motion dial without backlash are essential.

(Note) Neosid coil formers may be obtained from advertisers in this magazine.

> ## VHF AERIALS
> **. . . . suitable for use with the converter described in this article were described in the series 'Practical Aerials' in the March, April and May 1951 issues of this magazine.**

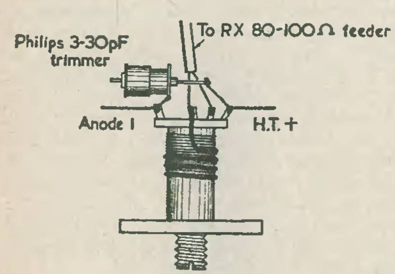


FIG. 3. IF COIL ASSEMBLY.

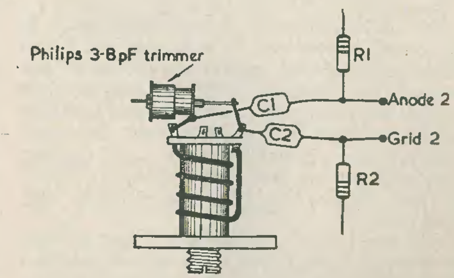


FIG.4. OSCILLATOR COIL ASSEMBLY

Radio Miscellany

FIELD Days are a far less popular event than they used to be. Perhaps modern equipment makes it too easy, and the absence of the uncertainties and excitement which were once inseparable from these occasions can no longer be expected.

It is over twenty years since I took part in my first DF Field Day—a joint effort of a group of local clubs. It would have been a shrewd prophet who, in those days, could have foretold the importance of Direction Finding. As for Radar, we might have conceded it as a possibility of the not-too-distant future had anyone been bold enough to suggest it, but few would have dared to foretell its rapid development and enormous importance. By this I mean, not with elaborate laboratory gear, but with mass produced and semi-portable apparatus in the hands of non-technical operators.

It is, of course, a far step from simple direction finding to radio-location. For the former, two stations are required (or one installation moved to two sites) and the measurement is of bearing only, not of range or angle. While radar does not measure height directly, the slant range is determined and from trigonometrical calculations automatically made by ingenious instruments the altitude is accurately computed. Nor could an aircraft's position be located by direction finding alone without the pilot's active co-operation, and one could not plot the course unless he was helpful enough to continue to send out signals and also tell you the height he was flying!

An Unexpected Effect—And Luck

Perhaps what really makes that first Field Day so memorable for me is the fact that I (and partner) were the first to locate the hidden transmitter.

DF was very much a two man affair in those days. Sets had far less gain per stage, while the batteries needed were clumsy and heavy. The frame aerial, precariously perched on the top of a pole, was considered a highly important piece of apparatus, and no end of embellishments might be added to obtain some imagined improvement in performance. Ours, in itself, was a one-man job to carry and manoeuvre.

Our good fortune in finishing first had its element of luck, following a bit of personal observation of which we then felt justly proud.

Even at that period it was obvious, even to the unititiated, that the location of a transmitter could be ascertained by noting the bearing from which the signals came, when noted at two separate points. All that was required was a couple of lines drawn on a map and, abracadabra, the station would be pin-pointed where the lines intersected. Just as easy as that—in theory.

Maximum Point

Portable sets and frame aerials were both much more common, then, than they are to-day. Frame aerials particularly so. Many flat-dwelling constructors owned really handsome versions with colourful silk-covered wire, gleaming insulators and highly polished bases on ball-bearing turntables. Aerial pick-up really was of some importance when valves did not have the gain of modern types.

It happened, at that time, that I had been experimenting with various sizes and styles of winding of frame aerials. Those readers who have used this type will have soon noted that when the aerial is rotated for maximum reception (pointing to the transmitting station) the point of the strongest signal is not at all critical. In fact, unless one takes the mid-way position between the points where the signal begins to fall off, it is not easy to decide which is the maximum point. This is all very nice from the point of view of broadcast reception, as one can always find a position where one can have a good signal and still have the speaker facing somewhere near the direction you want it. The optimum point is so flat you never need have the set pointing far away from the listeners.

It was when using the frame aerial to get a little extra selectivity that I first noted that the point of minimum reception (or in the case of weaker signals, no reception) was, unlike the maximum point, quite sharply defined. This, of course, is the point where the frame is at right angles to the transmitter. The effect was, in fact, so marked that it struck me as surprising that nobody as far as I knew had commented on it before. This made me suspect that it must be a special characteristic of the particular shape of the aerial I was trying, which happened to be of the 'flat' type wound somewhat in the manner of the old-fashioned basket coil. A quick check with other experimental aerials proved it was common to them all.

Having more or less accidentally stumbled on this, even a dim wit would have enough sense to apply it to Field Day DF.

It Worked

Obviously, there was nothing very original about this idea, although at that time I had not heard of anyone else noting it, let alone attaching any significance to it. Certainly long before the time when the possibilities of radar became to be taken seriously it was recognised practice.

No other pair in that Field Day took advantage of it, and we probably got in first because we did not waste so much time as the others in travelling between our less widely separated points to plot reasonably reliable bearings. Indeed when we attributed our success to this method quite a number of them remained unconvinced that it was better. I suppose it seemed the wrong way to go about it. To find the weakest point and then find the right-angle of it! Perhaps it sounded as Gilbertian as taking a sheep census by counting the number of legs and then dividing by four!

Those who have studied radar know that direction can be more easily found from the minimum rather than the maximum point, and that location detection is based upon it. Perhaps more surprising is the fact that many among those who have not tackled DF work are often unaware that radar bearings are based on the right-angle of the minimum point, and not on a line from the maximum point as one unfamiliar with this fact might reasonably suppose.

CENTRE TAP *talks about*

FIELD DAYS – DF & FRAME AERIALS – DRILLING GLASS

Transparently Untrue

When I was quite a youngster I was assured, by someone who should have known better, that if a sheet of glass was held under water it could be cut with an ordinary pair of scissors. To the youthful mind most things seem possible so, not unnaturally, I tried it. All I got was a cut finger.

I learned later that this was quite a widespread fallacy, spread apparently by persons who had heard of it but who had never tried it and cut their fingers in the process. Possibly the legend grew from the fact that glass can be more easily drilled under water. The water absorbs the vibration and prevents the glass from cracking, and it is, in fact, quite a useful tip. Use a shallow tray and support the glass on a piece of wood and drill in the normal way.

The need to drill holes in glass for aerial feeders, dial windows, etc., often confronts the constructor, but whatever the job I cannot think of any instance where it can be drilled 'in situ'. You simply have to get it on the workbench. Usually, of course, you break the pane in the process of moving it from its fitting. All instructions about drilling glass should begin "Take three sheets of glass of the size of the finished sheet—"

My Favourite Method.

Seriously, though, while the under-water trick does work, I prefer my own pet method. Use an ordinary carbon drill of smaller size than the final hole is required to be, and lubricate the point with a mixture of turpentine and camphor.

The drilling is best done very slowly, and the hole is then enlarged with a three-cornered file—the edges of which have been ground sharp. The corners of the file are used to scrape the glass rather than to reamer it, and care is needed not to flake or crack the area around the hole.

Use the mixture of turps and camphor freely during both the drilling and scraping, and make sure the glass is supported by a firm level surface.

By the way, when the need arises hard cast iron can be comparatively (repeat, comparatively) easily drilled with the aid of this mixture.

Real and Apparent Selectivity

A reader asks, "I have noticed several times that in writing of factory-built broadcast superhet receivers you have referred to them as 'the eternal 4-plus-1'. While I should be glad to see a wider range of better class receivers with an RF stage, there isn't much wrong with the selectivity of most of the sets without one. Or is there?"

This is not any easy question to deal with without going into it at considerable length, but it rather depends to what use the receiver is to be put. If it is wanted for the reception of local stations only, a simple TRF would probably do quite as well—and be a lot cheaper! If a superhet is wanted for the sake of its selectivity, the 4-plus-1 on careful test will be found to be far less selective than a flick of its tuning dial will lead one to suppose.

Another Quote.

"It wasn't even funny enough to make a BBC Studio audience laugh."

Any Further Questions

"My two boys, 13 and 11, have never seen a crystal set. Where have they gone?" asks a reader.

I wouldn't know. To look for a crystal set, perhaps.

TRANSFORMER TOPICS

By ERIC LOWDON

WHAT is one to do on those frustrating occasions when certain voltages are required for an experimental hook-up, but none of the transformers to hand are suitably rated? One solution would be to buy a new transformer which will deliver the goods.

This, however, suffers from the disadvantage that, having got the apparatus working, it may be found that modifications are necessary which require different voltages — and so we sling the new transformer into the junk-box and buy another. If money is no object this procedure is alright, but to most of us the price of a new transformer is worth considering, especially if we are to continue to support the XYL and offspring in the comfort to which they are accustomed.

Another solution which suggests itself is to strip a transformer and rewind it to suit. This is a somewhat monotonous task which will most certainly have to be done again the next time we require the voltage for which the transformer was originally rated.

All is not lost, however, for it is remarkable what can be done with a transformer in the way of obtaining a selection of voltages without the necessity of dismantling it or disturbing the original windings.

Let's take, as an example, a common 350-0-350 volt transformer with, say, two 6.3 volt windings, one 5.0 volt winding, and a primary tapped in steps of 20 volts from 210 to 250 volts as shown in Fig. 1. Let us assume that our mains supply is 230 volts.

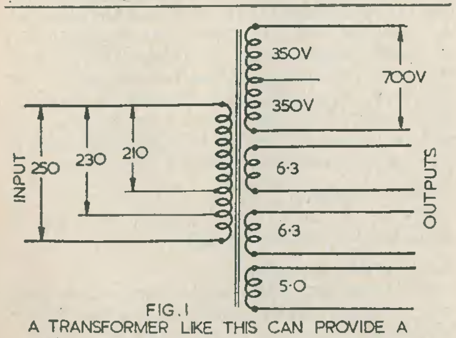


FIG. 1
A TRANSFORMER LIKE THIS CAN PROVIDE A MUCH GREATER NUMBER OF VOLTAGES THAN THOSE SPECIFIED
C326

It is immediately obvious, even before we attempt to make any modifications, that we have quite a large selection of voltages at our disposal. For instance, in addition to the four basic outputs for which the transformer is designed, we can employ the total HT secondary winding to give 700 volts input to a half wave rectifier circuit. This will give nearly 1000 volts DC on no load, since the output is 1.414 times the secondary RMS voltage, that is $1.414 \times 700 = 1000$ volts approx.

If we put our 230 volts into the 200 volts tap 800 volts will appear across the HT secondary, since the ratio between the secondary and primary is $700/200 = 3.5 : 1$, and the output voltage is therefore $3.5 \times 230 = 800$. This gives 400-0-400 volts for use in a full wave circuit, or a DC no load output of 1130 volts in a half wave circuit.

In the same way the 250 volt tap gives a transformer ratio of 2.8 : 1 giving $2.8 \times 230 = 650$ volts across the secondary. That is to say, 325-0-325 volts for full wave rectification, or 920 volts DC in half wave.

The possibilities are not yet exhausted. In Fig. 2 we see the primary and HT secondary windings connected as an auto-transformer, so giving a total output of $230 + 700 = 930$ volts, which represents 1300 volts DC when used in half wave. This voltage will only be obtained, of course, if the windings are connected the right way round so that the primary and secondary voltages add. If they are inadvertently connected the wrong way round then the output will be $700 - 230 = 470$.

You must remember when using this auto-connection that the apparatus is not now isolated from the mains, so proceed very carefully. Remember the amateur's old adage, "Death is so permanent".

So much then for the HT side; let's now take a look at the LT windings. If we connect them all in series we obtain 17.6 volts, or the two 6.3 windings together give 12.6 volts, or a 6.3 winding and 5.0 volt winding gives 11.3 volts. Here again we must remember that these voltages will only be obtained if the windings are connected additively. By connecting windings in opposition other voltages will be obtained. The two 6.3 volt windings connected additively plus the 5.0 winding in opposition will give $6.3 + 6.3 - 5.0 = 7.6$, or one 6.3 volt winding in opposition to the 5.0 volt winding results in 1.3 volts.

We must admit, however, that these are rather odd voltages which are not likely to be used very often. What do we do if we wish to convert a 6.3 volt winding to 5.0 volts, or if we require a two or four volt winding? Well, this is where we do a little work. In most transformers there is usually sufficient space between the laminations and the coil to allow another winding to be put on. Thin rubber or plastic insulated wire is best for this, and the laminations need not be removed since it is quite a simple matter to thread the wire between the core and the coil.

The procedure is to wind on, say, eight turns first of all and measure the voltage across this winding. The turns per volt figure for the transformer is then obtained by dividing the turns by the volts. For example, if two volts are measured on the winding, the turns per volt figure is $8/2 = 4$ turns per volt. Therefore if, say, a four volt winding is required then $4 \times 4 = 16$ turns will be required. In this way an additional winding is obtained which can be used by itself, or interconnected with the other windings to give any desired voltage.

Another dodge which is quite useful, if only a small voltage is required of, say, 1.3 volts to add to the 5.0 volt winding to make 6.3, is to put a winding on one of the outer limbs of the core as shown in Fig. 3. The turns per volt required in this position is double that required on the centre limb, since the winding is threaded by only half of the total flux, but the wire is usually wound more easily here than on the main coil.

In addition to all these combinations we still have the variations which can be introduced by selecting primary taps. The transformer ratio from a 6.3 volt winding to the 200 volt tap is $200/6.3 = 31.7$, and therefore 230 volts applied to this tap gives $230/31.7 = 7.25$ volts. Similarly the ratio for the 5.0 volt winding is $200/5 = 40$ and the voltage output $230/40 = 5.74$. Input to the 250 volt tap gives 5.8 for the 6.3 volt winding and 4.6 volts for the 5.0 volt winding. Thus by interconnecting a fresh range of voltages is obtained.

Now for a few comments. With this scheme, as with everything else in life, a gain in one direction means some sacrifice in another. In the case of the high voltage connections we sacrifice the safety margins given by the manufacturer, particularly so if the filament volts for the rectifier are taken from the same transformer. For this reason it is advisable to use these connections only on high grade components, and if possible to use a separate filament transformer when very high voltages are developed, as in the auto-connected case.

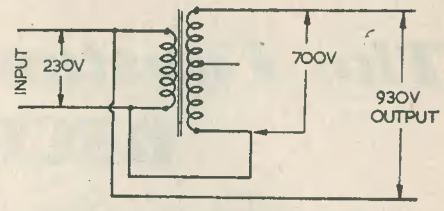


FIG. 2
AUTO-CONNECTED TRANSFORMER. HEATER WINDINGS ARE OMITTED FOR CLEARNESS
C327

Most reputable manufacturers flash-test the insulation at a minimum of 2000 volts, and therefore the insulation will be reasonably safe when used in this manner for occasional experimental purposes, but should not be incorporated in apparatus that is to be used constantly.

In the auto-connected case, for example, assuming that the rectifier volts are taken from a winding on the transformer, 1300 volts will appear between the HT winding and the core, while the pressure between the HT winding and the filament winding will be 2600 volts peak! This latter voltage is made up of the DC output volts in series with the peak AC volts across the HT winding.

Another reason why only good transformers should be used is that some manufacturers of the cheaper type of transformer have the reprehensible habit of working the core at an extremely high flux density—almost into saturation. When 230 volts are applied to the 200 volt tap, the flux density in the core is increased still further and in such transformers this will play havoc with the output waveform, in addition to causing a substantial increase in the temperature rise of the windings and core.

Lastly, also for this reason, taps lower than 200 volts should not be employed with 230 volts input in an attempt to increase the output voltage, even with good transformers. When taps higher than 230 volts are employed to obtain a lower voltage output, the output waveform and core losses are improved.

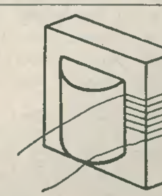


FIG. 3
SHOWING HOW AN ADDITIONAL WINDING CAN BE WOUND ON THE OUTSIDE LIMB OF THE CORE
C328

The Constant Companion RECEIVER

This is an easily made inexpensive three-valve AC/DC receiver which will prove to be a boon in every household. Despite the extreme simplicity of its circuit, a high degree of selectivity and sensitivity is provided by means of an innovation of the designer—"Progressive Reaction".

Part 2

By J. R. DAVIES

In last month's introductory article the circuit of this simple three-valve receiver was considered in detail. We shall now carry on to its construction.

Components.

When a piece of equipment like this is designed, it is always advisable to specify components for inclusion in the reader's model which are, as near as possible, the same as those used by the writer. Particularly is this so when the equipment is fairly compact in layout, and the relative disposition of the components becomes increasingly important.

For this reason a list of recommended components is published in this issue, this giving the maker's name and type number of some of the more important components, or the maximum physical dimensions of the component when it is not necessary to exactly duplicate that used in the prototype.

This procedure should help considerably in reducing the cost of building for those constructors who probably have a lot of the necessary components already on hand, or who are able to purchase them cheaply in the form of government surplus.

The components not included in the list may, of course, be chosen from the list of values given with Fig. 1. Unless otherwise stated, all the resistors should be of half-watt type, as this helps to reduce the space taken up by them in the wiring. Something of the same applies to the fixed capacitors C8, C9, C12 and C14, as it will be found helpful to use capacitors of fairly small size in these positions in order to conserve space and make wiring easier. If possible, the capacitor C11 should have one or more fixing holes, as it has to be mounted on the front of the tuning capacitor. Failing this it could, of course, be mounted on an insulated tagboard.

Trimmers

It will be noticed that trimmers of certain values are recommended in the list of values (Fig. 1) for C2 to C5 inclusive. It is not entirely necessary to purchase trimmers of exactly the values mentioned if others are already on hand. Most single-leaf "postage-stamp" trimmers will have the requisite range for C3, C4 and C5 and can be confidently fitted to the receiver. Similarly, a trimmer which covers the approximate range 100 to 250 pF may be used for C2.

Wiring

Any reasonable connecting wire may be used for wiring the receiver. The writer used thin flexible PVC-covered wire with excellent results. As the receiver is very stable, there is no necessity to take great care over the positioning of the leads so long as they are kept short and run by the most direct route. The only precaution to take with the RF wiring is to ensure that the aerial leads to the coils are kept away from the reaction wiring, and this is carried out more or less automatically by reason of the layout.

It will be found that some of the wiring is passed through that part of the chassis which is cut out to receive the loudspeaker. There is little chance of these wires fraying if the chassis is cut out cleanly and smoothly at this point; but it would nevertheless be advisable to use flexible instead of rigid wiring for these leads. The leads should, of course, be well-insulated.

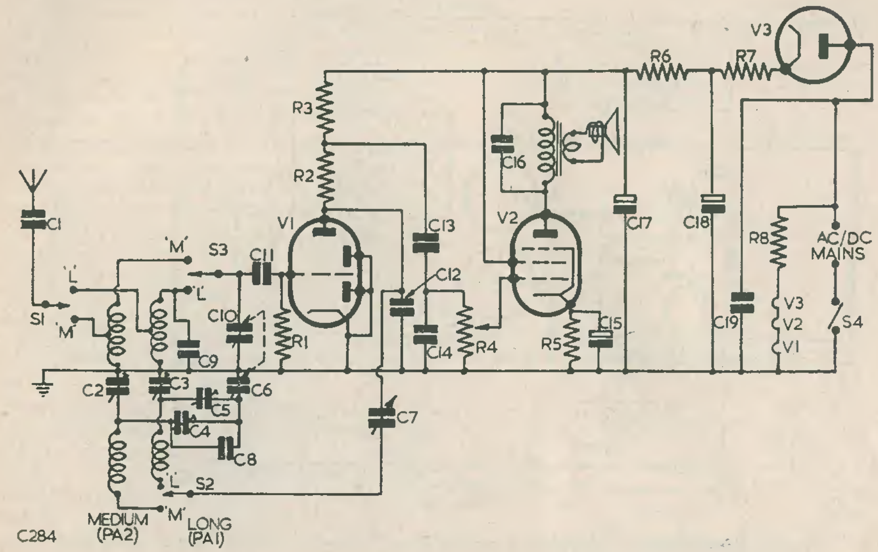


Fig. 1: The complete circuit of the receiver.

List of Values

Capacitors

C 1 — 0.005 µF, 750VDC working
C 2 — 250 pF trimmer
C 3 — 60 pF trimmer
C 4 — 60 pF trimmer
C 5 — 60 pF trimmer
C6, C10 — 500 pF, two-gang
C 7 — 300 pF reaction, solid dielectric
C 8 — 200 pF
C 9 — 100 pF
C11 — 300 pF
C12 — 200 pF
C13 — 0.01 µF
C14 — 500 pF
C15 — 25 µF, 25V working
C16 — 0.005 µF
C17 — 16 µF
C18 — 8 µF
C19 — 0.01 µF 750VDC working

Resistors

(½ watt unless otherwise stated)
R1 — 500 kΩ
R2 — 10 kΩ
R3 — 150 kΩ
R4 — 250 kΩ (with switch)
R5 — 620 Ω, 1 watt
R6 — 2,000 Ω, 2 watts
R7 — 120 Ω, 5 watts
R8 — 960 Ω (3-way line cord)

Switches

S1, S2, S3 — Wave Change
S4 — On-off, combined with volume control

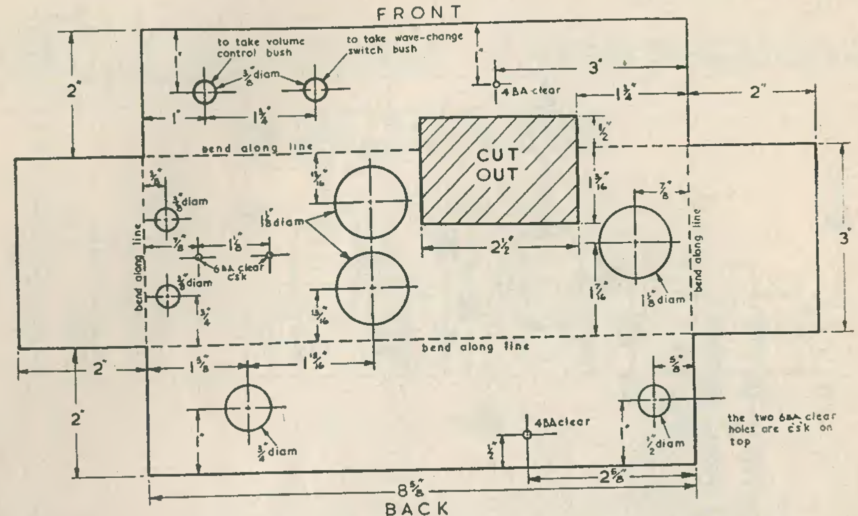
Valves

V1 — EBC33 (or VR55)
V2 — EL32 (or VT52)
V3 — CY31

The Chassis

To commence the construction it will be necessary to mark out and make the chassis. The chassis may be made of any heavy-gauge aluminium (about 16 swg would be ideal). Fig. 2 gives the dimensions for the main holes, which should be drilled before the chassis is bent. The other holes may be drilled after bending.

After the chassis has been drilled out and bent, the next thing to do is to make arrange-



C313

Fig. 2: Dimensions of chassis before bending. This view is of the top of the chassis. The four "flaps" are bent down, away from the reader.

ments for mounting the various components.* The valveholders should first of all have their mounting holes drilled, two for each holder. The holes should be 6 BA clearance, and a valveholder itself may be used as a template. Fig. 3 shows the direction in which the key-ways, to accommodate the valve spigots, should be pointing when the holders are finally

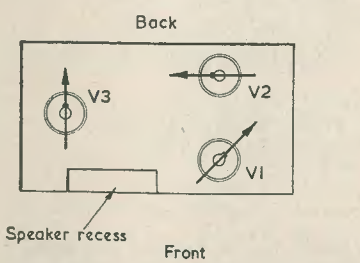


FIG. 3 C314

Fig. 3: Showing directions in which valveholder spigots should point when the holders are mounted. The view is looking down onto the top of the chassis.

mounted. It is important to have the holders mounted in these positions as the wiring otherwise becomes complicated. The valve holders should not be mounted yet.

A clamp for the electrolytic capacitor (C17 and C18) can then be made, as shown in Fig. 4 (a). The dimensions of the clamp are not of great importance, but they should allow the capacitor to be fitted as shown in Fig. 4 (b). The holes in the clamp should be 4 BA clearance, whereupon they should correspond with the appropriate 4 BA clearance hole already drilled in the back "flap" of the chassis. The electrolytic capacitor, also, should not be mounted yet.

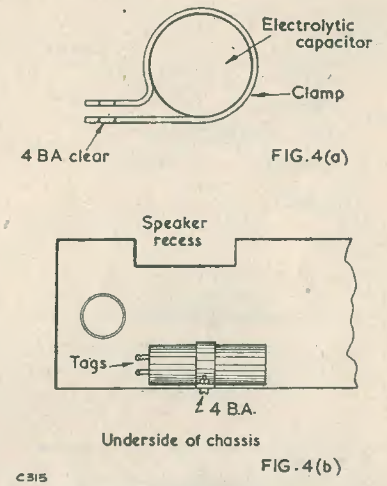
The next component is the reaction capacitor C7. This has to be mounted with its spindle insulated from chassis (it will almost inevitably have a spindle which is common to the moving vanes), and this may be done by mounting it onto a piece of paxolin (or other insulating material) which is then fastened to the back "flap" of the chassis. The large ¾″ diameter hole on the back "flap" should take the bush locking nut of the capacitor adequately without any fear of short-circuits. Again,

*After bending, four small angle brackets may be fitted to the four bottom corners to strengthen the "flaps", if desired. This should not, however, be necessary if a sufficiently heavy gauge of aluminium is used.

dimensions are not of great importance, so long as the heads of the two 6 BA screws do not touch or approach any metal points on the reaction capacitor itself. Once more, after the holes have been drilled in the chassis, this component and its mounting should be removed for the time being.

If the tuning capacitor does not have mounting brackets, these may now be made. The tuning capacitor should be so mounted that a perpendicular line dropped from its spindle lies directly between the two holes for the volume control and the wave-change switch. In other words, the spindle should be 1⅞″ in from the outside edge of the chassis. Fig. 6 shows the idea. After the holes in the chassis have been drilled to accommodate the capacitor, this component should also be temporarily removed.

Small holes can next be drilled in the front "flap" of the chassis to take the locating lugs for the wave-change switch and the volume control (if the latter has one). These holes should be drilled such that, when these components are later fitted, their tags will be positioned in the manner shown in Fig. 7.



C315

Fig. 4 (a): Details of electrolytic capacitor clamp.
(b): The position of the electrolytic capacitor in the chassis.

Mounting the Loudspeaker

The loudspeaker can now be mounted. Immediately below the centre of the recess for the speaker on the front panel of the chassis will be found a 4 BA clearance hole. A ⅜″ 4 BA cheese- or round-head screw should be fixed to this hole with washers under both nut and screw head as shown in Fig. 8 (a). A further nut should be fitted for spacing as shown in Fig. 8 (b), the outside of this nut being approximately 5/16″ away from the front of the panel. The speaker is then fitted to this screw as illustrated in Fig. 8 (c). The voice-coil tags of the speaker should be at the top (when the chassis is stood upright) whereupon it will be found that the speaker will fit comfortably into the recess in the chassis.

For additional strength, a bracket is made (from the same material as the chassis) to hold the speaker on its left-hand side, looking from the front. Fig. 8 (d) gives details of this bracket. The bracket is mounted *behind* the speaker (see Fig. 8 (e)) whereupon it will be found that the curved portion fits snugly to the frame on the underside of the speaker rim.

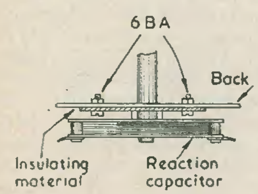


FIG. 5.

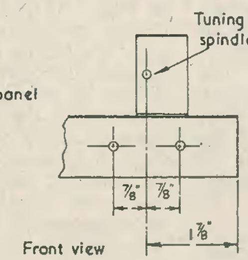


FIG. 6.

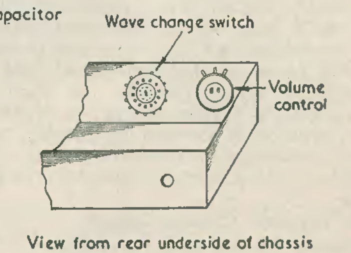


FIG. 7

C316

Fig. 5: Showing how the capacitor C7 is mounted on the rear chassis.
Fig. 6: How the tuning capacitor should be mounted.
Fig. 7: Recommended position of tags of wave-change switch and volume control.

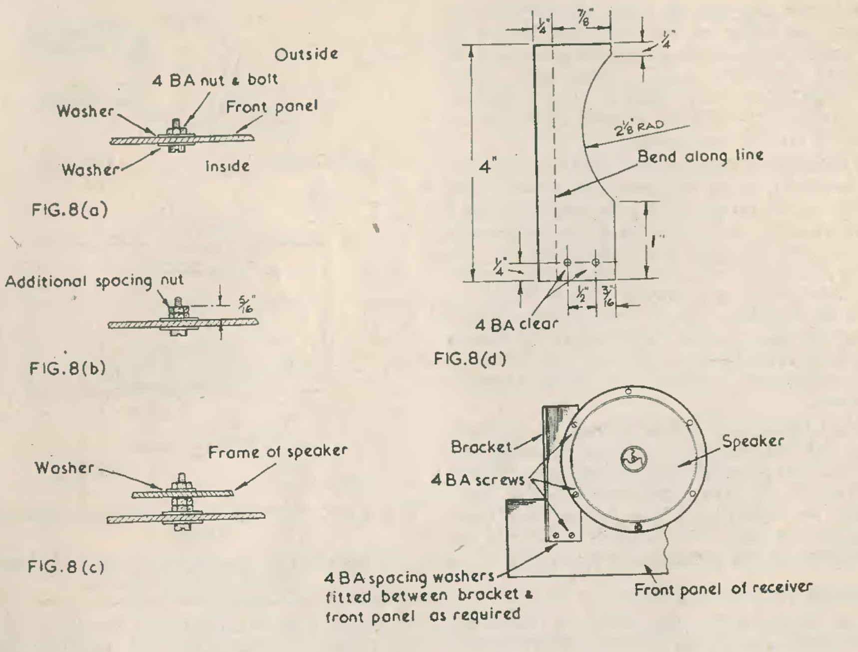


Fig. 8: Details of mounting loudspeaker. The left-hand part of the bracket (d) is bent towards the reader.

With both the bracket (after bending) and the speaker held vertically, the two appropriate mounting holes on the latter are used as a template to mark out two 4 BA clearance holes on the bracket. When these have been drilled the bracket is mounted to the speaker, the two 4 BA clearance holes at the bottom of the bracket being used in their turn to mark out similar holes on the front panel itself. The bracket is then affixed to the front panel, using spacing washers on the two bottom 4 BA nuts and bolts between the bracket and the panel, whereupon it will be found that the speaker is now firmly mounted to the chassis.

The Tag and Trimmer Boards

Nearly all that now remains in the "hardware" line is to make the board for the resistors and capacitors which is mounted above the chassis behind the loudspeaker; and the board which holds the trimmers. Both may be made from paxolin or similar insulating material.

The measurements of the tagboard are given in Fig. 9 (a). Many constructors will have tagboards with sufficient points already on hand and these may be used if desired, provided that their *width* is not greater than 2¾". A simple angle bracket will be needed to mount the tagboard to the chassis, as shown in Fig. 9 (b). Looking at the back of the chassis, the left hand edge of the board should just be touching the screw which will hold the adjacent valveholder (V2) in position. (Indeed it may be necessary to insert this screw in its hole before the tagboard is mounted). The back of the tag board should be as close to the back of the speaker as possible, but care should be taken to see that there is no risk of the underside metalwork of any of the tags shorting against the speaker frame. It may be seen that an earthing solder tag is fitted under one of the bracket-holding screws. If a home-made board is used, the tags may consist of ordinary solder tags fitted to the board with 6 or 8 BA nuts and bolts.

Fig. 10 (a) gives the dimensions of the trimmer-mounting board, the trimmers being laid out as shown in this diagram. It will be

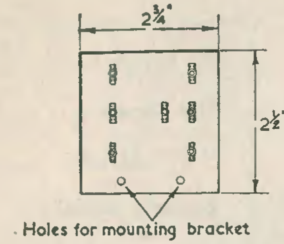


FIG.9.(a)

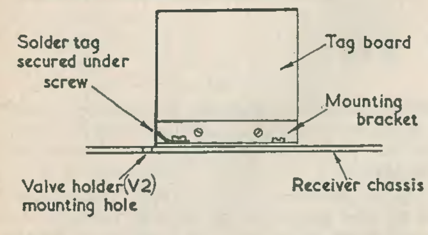


Fig. 9 (a): Outside dimensions of tagboard, showing positions of solder tags.

Fig. 9 (b): Mounting the tagboard on the chassis.

found, in most cases, that the simplest plan consists of mounting the trimmers by their solder tags, central holes being drilled in the board to accommodate the underside projection of the trimming screws. This board is mounted at the right hand side of the tuning capacitor by two simple brackets, Fig. 10 (b). The holes for the brackets may now be drilled in the chassis, but the trimmer board need not be mounted as yet.

The Speaker Transformer

The final part of the chassis work now consists of drilling the two holes for the speaker transformer.

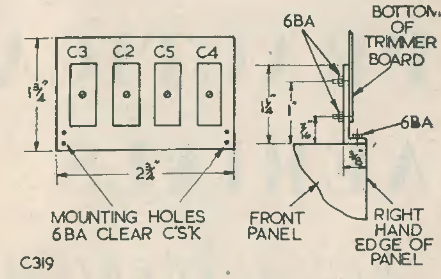


Fig. 10 (a): The dimensions of the trimmer board, and the disposition of the trimmers upon it.

Fig. 10 (b): Detail showing one of the two brackets which hold the trimmer board to the chassis. This bracket is that nearer the front of the receiver.

This is mounted as shown in Fig. 11, spacing washers being fitted to keep the bottom of the transformer away from the head of the bottom speaker-mounting bolt. An extra piece of aluminium, cut and drilled to conform with the bottom of the transformer, is fixed to it as shown, in order to hold the laminations tightly against the transformer frame. The transformer is mounted midway between the bottom of the speaker and the bottom edge of the chassis.

Next Month

We have now "broken the back" of the job of constructing the receiver. In next month's article we shall continue with the procedure of wiring up.

List of Recommended Components

Capacitors

C6, C10—Any 2-gang, 500 pF capacitor whose dimensions do not exceed 2 ⅞ ins. high, 1¾ ins. wide (vanes closed) and

(*Continued on P.* 398

Fig. 11: Showing how the speaker transformer is mounted to avoid fouling the head of the bottom loudspeaker-securing screw.

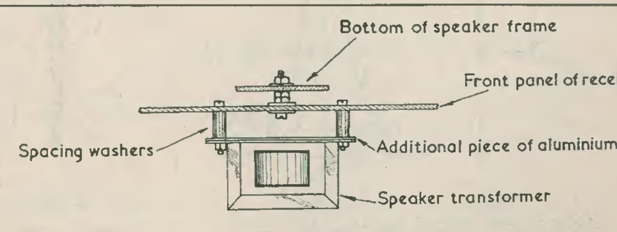


FIG 11 View from underneath

PRACTICAL AERIALS

TV Aerials:—
The Dipole
"H" Aerial
Co-Axial Aerial
Feeders

by "AETHERIUM"

Part 10

Television Aerials

In order to strike a satisfactory balance between the sound and vision frequencies, it is essential that the Television Aerial be a "wide band" aerial, i.e. it must not be sharply resonant. A wide band aerial must, therefore, be of low "Q" value. To lower the "Q" of an aerial it is necessary to increase its "bulk". In the case of a single wire aerial as in Fig. 1, we have the resultant curve Fig. 1A. It can be seen at once that this is not entirely satisfactory because the response at 3 Mcs off resonance is poor. By adding more wires in parallel, however, we lower the effective "Q" and thus increase the bandwidth (Figs. 2 and 2A).

The single wire type of Television Aerial is not used for the above reasons, and tubing is now the accepted material for constructing such aerials. Theoretically, the larger diameter the tubing, the greater the effective bandwidth. For reasons of weight, installation difficulties, and appearance, 1" diameter tubing is about the maximum size used today.

The Dipole

Up to 20 miles from a Main Transmitter, the simple Dipole is all that is required for satisfactory reception, provided that one is not living in an area of bad interference from main road traffic or local factories. (This problem will be dealt with later). A simple Dipole constructed of 16 swg wire is shown in Fig. 3. The impedance of this aerial is approximately 50 Ω. It should be remembered that any Dipole is a "balanced aerial", and as such, should either be fed with balanced feeder, or a suitable balancing transformer installed when using coaxial feeder. Details of a balance-to-unbalance transformer are given in Fig. 4. This not only ensures a balanced system, but minimises standing waves on the feeder with the consequent "ringing" effect on the picture. A bad mismatch will also cause the feeder to pick up interference, and

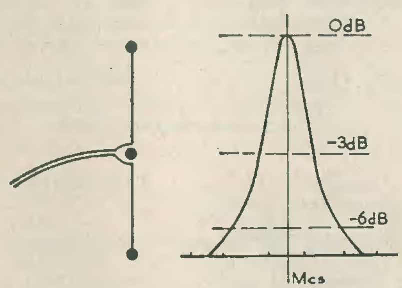


FIG.1 FIG.1A

SINGLE WIRE DIPOLE. HIGH 'Q' RESTRICTS BANDWIDTH TO CURVE SHOWN

C336

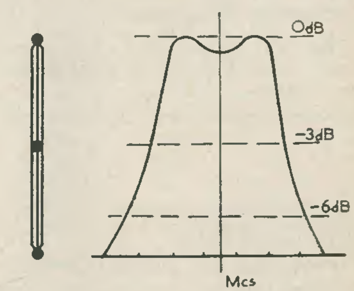


FIG.2 FIG.2A

ADDING MORE WIRES IN PARALLEL DECREASES 'Q' BUT INCREASES BANDWIDTH AS SHOWN

C337

thus the benefit of installing a high aerial to improve the signal to interference level is lost. Another interesting type of aerial, for some reason not often used, is shown in Fig. 5. This is the "Co-axial" or "Sleeve" Aerial. No balancing transformer is required, and it may be fed with 50 or 70 Ω co-axial feeder.

Feeder Losses

The feeder for a Television Aerial should be carefully chosen, and its attenuation figure obtained before purchase. This figure varies with frequency, of course, and some types of cheap 50 Ω feeder have an attenuation figure of 12 dB per 100 feet at 45 Mcs (higher at 60 Mcs). This means a loss of at least ¾ of the signal arriving at the aerial, if 100 ft. of feeder is used. While this is not so important at short distances from the Transmitter, it becomes serious at medium distances, and disastrous in fringe areas. This point should, therefore, be watched closely, and when inferior performance is being experienced, some thought should be given to the feeder, as well as the aerial. In some cases, 300 Ω ribbon feeder is being used with great success; with a simple dipole and receiver with about 50 Ω input impedance, a matching section is required at each end of the feeder. This is extremely simple to make up, and as shown in Fig. 6 consists of two lengths of standard 70 Ω feeder, taped together, with the inners only used. A feeder of this type will enable nearly twice the signal voltage to reach the receiver, even when compared with the best of the thin co-axial feeders.

The "H" Aerial

This is about the most popular form of Television Aerial in use, but the expense incurred in installing such an aerial is often unnecessary. In the majority of cases, within 20 miles from a Main Transmitter, a simple Dipole would have done just as well. The normal "H" Aerial is a Dipole plus reflector, but some are now appearing on the market arranged as Dipole plus *director*. Either of these types are extremely useful when interference is being experienced from main road traffic or local factories. In the worst cases, the aerial must be installed at the angle which discriminates against the noise pick-up, rather than for maximum signal. Additional reflectors are sometimes added at the sides to give a further reduction of local noise pick-up. Adding "parasitic elements" in this manner reduces the impedance of the aerial, and it is often necessary to "fold" the Dipole to produce an impedance step-up to provide a satisfactory

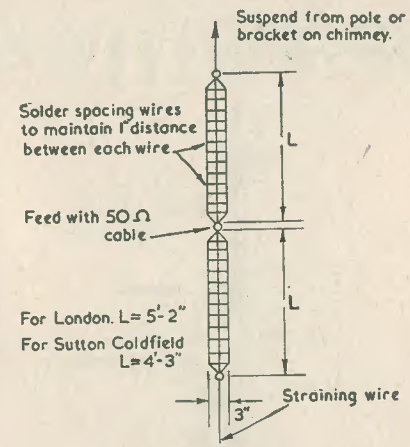


FIG.3. 3 Wire dipole, all 16 s.w.g wire.

C338

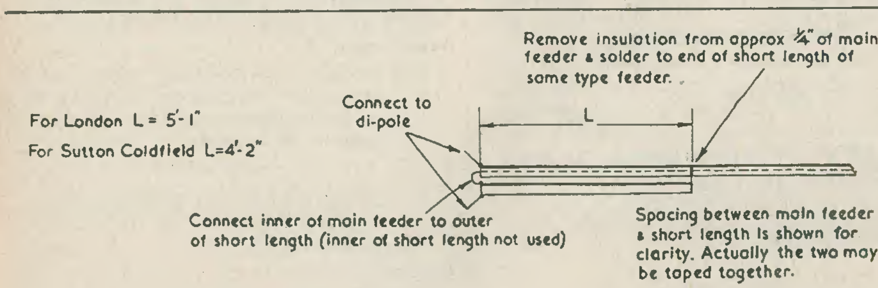


FIG. 4. UNBALANCE TO BALANCE TRANSFORMER

C339

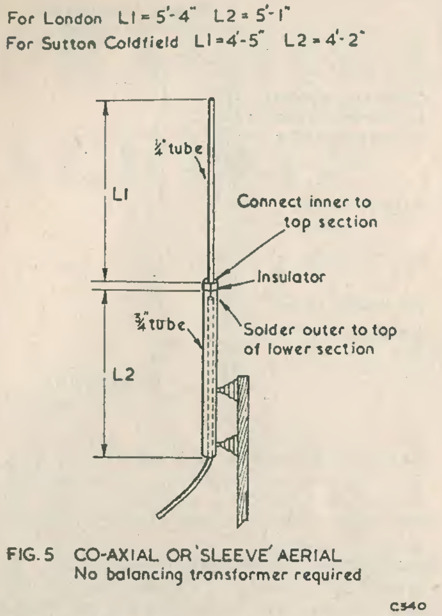


FIG. 5 CO-AXIAL OR 'SLEEVE' AERIAL
No balancing transformer required

match to the feeder. Multi-element beams also suffer from a restricted bandwidth, but folding the Dipole also assists in providing a wider effective coverage of the sound and vision frequencies.

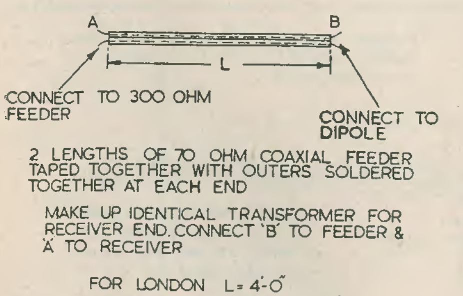


FIG. 6
IMPEDANCE TRANSFORMER (300 OHM RIBBON FEEDER TO DIPOLE)

C341

DESPITE THE FACT

that we are now printing and distributing many more copies of this magazine, we are still receiving letters from readers informing us that they have difficulty in obtaining regular copies. If details are sent to us, then we can take up the matter with the people concerned. Should this prove ineffective, then we shall be glad to supply copies direct, on either 6 or 12 month subscriptions.

CONSTANT COMPANION RECEIVER—
(Continued from P. 395

2½ ins. deep, excluding spindle.
(By "height" is meant the vertical measurement when the capacitor is mounted as shown in the photographs of the receiver. "Depth" then refers to its measurement from front to back).

C17, C18—8 + 16 μF 450 WV. Premier Cat. No. 106.

Resistors

R4—Any suitable volume control, with switch, whose diameter (excluding vol. control tags) is not greater than 1½ ins., and which does not project back from the panel more than 1 1/8 in., including switch tags.

Switches

S1, S2, S3—3 pole, 2 way, miniature switch; (diameter of switch 1¼ ins.).*

Valveholders

International octal—amphenol.

Loudspeaker

Rola 5 in. (outside rim diameter).

Transformer

Any make—approximately 60 : 1 ratio. Maximum dimensions: 1 7/8 in. long (excluding mounting brackets); 1 3/8 in. high; 1 1/8 in. wide.

Valves

V1—Mullard EBC33 or Ex-RAF VR55.
V2—Mullard EL32 or Ex-RAF VT52.
V3—Mullard CY31.

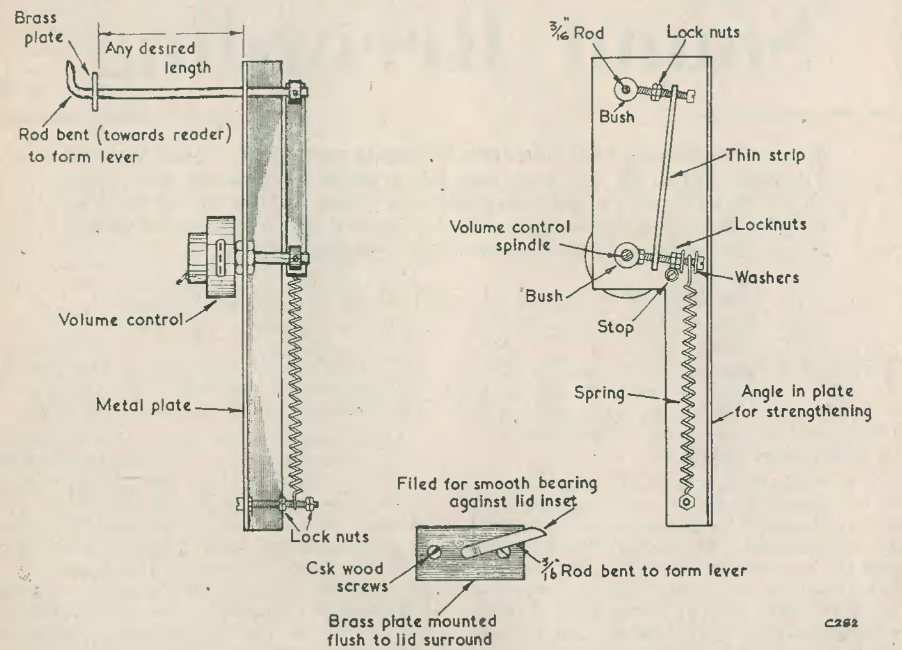
Coils

Medium-Wave—Wearite PA2.
Long-wave—Wearite PA1.

*If any difficulty is experienced in obtaining this switch, Premier offer a miniature 4 pole, 2 way switch of the same physical dimensions.

LID-OPERATED SWITCH

By R. B. KEANE



THE writer was recently asked by a friend, who specialises in woodworking, to make a lid-operated switch which would turn on the intial lights of a cocktail cabinet when the lid was raised. As the switch which was made can be copied very easily by radio enthusiasts, and as it could also be employed for "portable" or radiogram cabinet lids, (or even as a transmitter "door switch"), it was decided to submit a brief description to this magazine.

The mechanism is shown in the accompanying diagrams. It consists simply of a volume control (fitted with a switch) which is rotated by means of a small lever fitted at the end of a rod. The mechanical coupling between the rod and the volume control spindle is given by a thin brass strip. When the lid is closed, a brass plate inset in the lid bears against the lever and turns the volume control against the tension of the spring. On raising the lid, the spring pulls the volume control back to the "on" position, a stop (given by a bolt projecting from the plate) preventing the volume control from turning too far. The volume control is fitted such that its rotation occurs only over the portion needed to operate its switch, the latter being used to control the external circuit. To prevent lateral movement of the 3/16" rod a small washer is soldered to it at the point where it passes through the brass plate adjacent to the lid. Spacing washers are also fitted under the bush at the other end. These washers are not shown in the diagrams.

The cost of the switch used by the writer was negligible as he employed a volume control which would normally have been thrown away since its track was completely worn out. To obtain a free movement of the volume control it was found necessary to strip it down and remove the slider. A fairly heavy grease found on the spindle was also removed, the spindle then being lightly oiled.

In certain cases it may be found necessary to reduce the size of the design shown here. This may be done by having the brass strip on the other side of the spindles, the spring then being fixed to pull the volume control bolt upwards instead of downwards.

MAGNETIC Sound Recording

Magnetic sound recording is enjoying increasing popularity, and the fact that a number of firms are now supplying kits of parts, components, wire, tape, recording heads, etc., enables the radio constructor to build all or much of the gear himself at reasonable cost. Our contributor has had considerable practical experience of home constructed recording equipment.

The last of a series of articles by E. KALEVELD,
PA∅XE

THIS last article of the present series will deal with some refinements and helpful additions to our recording equipment. The first of these is a recording level indicator.

Recording Level Indicator

This addition is almost an essential item, for it is the only way by which one can judge the recording level, as the ear is quite unsuitable for the purpose. We must, therefore, rely upon our eyes, so the sound must be converted into something visual, and the best way to do this is to make it work some kind of meter. A moving-coil meter is best for our purpose, and the handy thing is that any kind of scale division will do, as all that is needed is a relative indication. For a high impedance recording head, we can use the circuit of Fig. 1. The meter is an 0—0.5 or 0—1 mA FSD moving-coil type. With the variable resistor of 25 kΩ we adjust the meter so that half-scale deflection indicates the correct recording volume, which is determined experimentally. The rectifier is an 0.1 or 0.2 mA cell. The L/C circuit serves to keep the RF from the bias off the meter, the L being an old RF choke as used in broadcast receivers.

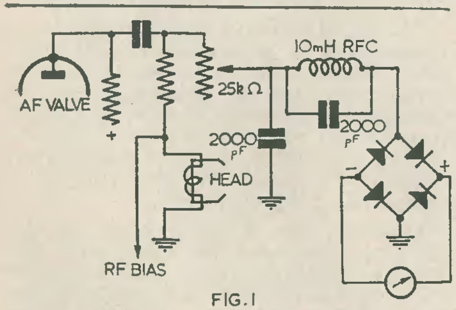


FIG. I
INDICATOR FOR HIGH IMPEDANCE HEAD
C321

A suitable indicator for a low impedance head is shown in Fig. 2. Here, we need not bother to sieve out the RF bias, while the meter may read up to 10 mA FSD. The rectifier cell will have to be correspondingly larger to suit the meter. Adjustment is done with the potentiometer in the same way as for the high impedance indicator. Another but somewhat cheaper method, which dispenses with the meter and rectifier, uses a neon tube as the visual indicator. This method, however, can only be used with low impedance heads. By means of the potentiometer, the neon tube is adjusted so that it just flashes on the strongest permissible AF signals.

Various other methods of record level indicators can of course be devised. The meter with its rectifier could be replaced by a cathode ray tube—the Brush Soundmirror recorder uses such a method. The writer, though, prefers the meter type of indicator.

A Double Tone Control

This refinement is particularly useful, a very good type for tape or wire recording amplifiers being that shown in Fig. 4.

V1 is a normal AF pentode or triode, with its normal anode load. The double tone control follows after the coupling capacitor C1. The potentiometer R1 regulates the low register. The AF is fed across a filter consisting of R2 and C2. The values of these have been chosen so that the lowest frequencies (30 cps) pass unaltered, whilst the higher frequencies are attenuated. Thus, leaving C3 out of consideration for the moment, only the

lower frequencies will reach the grid of V2, via the lower portion of the potentiometer R3. Thus the strength of the lower frequencies is determined by the setting of R1. The higher frequencies follow another route, viz., via C3 and the top section of R3. C3 is quite small in value and thus passes these higher frequencies without undue attenuation. So, again depending on the setting of R3, the high frequencies can reach the grid of V2. In this way, by suitably choosing the values of the components in the network, high and low frequencies can be mixed to give a practically straight amplification curve, and at the same time either high or low frequencies can be selected at will. Some figures in this respect may be of interest. The low frequencies can be brought up to five times the "normal" level, or attenuated to less than one-tenth of this level. Similar figures for the high frequencies are four and one-fifteenth respectively. The attenuation of the system is about six-fold, so if the network is preceded by an AF pentode with g=100, the net amplification following the network will be about 15. An important point regarding the regulation of the high frequencies is the input capacitance of the valve, the grid of which is paralleled by R3. This capacitance must be as small as possible, so if it is necessary to use screened lead, use low capacity cable. As a matter of interest, it is worth noting that this network makes an ideal tone control circuit for a radio or gramophone amplifier.

The best position to locate this tone control in our recording amplifier is between the second half of the 6SN7GT and the output valve, where a low impedance head is used. For a high impedance type, arrange it between the two halves of the 6SN7GT.

Use of Separate Recording and Playback Heads

A very useful arrangement, which facilitates switching in the amplifier, is employed at present on the writer's outfit.

For playback, a high impedance head is used, thus dispensing with the transformer necessary for low impedance, while for recording a separate high impedance head is employed. This has the additional advantage that a simpler system of volume indication (the one in Fig. 2) can be used. The reader will have no difficulty in working out for himself the switching arrangement in this case.

Head Saturation

Some people may find that after prolonged recording or playback sessions the metal in the head gets a bit magnetised because of the friction of the tape. This permanent magnetisation considerably impairs the quality. The writer had this trouble and it was only recently that a cure was found. A suitable

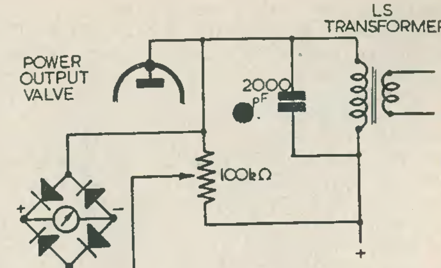


FIG.2
INDICATOR FOR LOW IMPEDANCE HEAD
C322

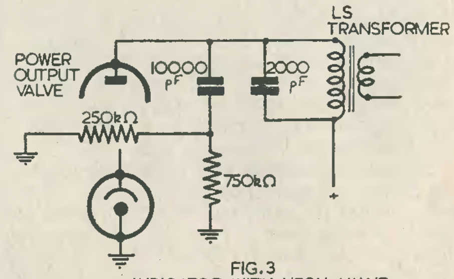


FIG.3
INDICATOR WITH NEON VALVE
C323

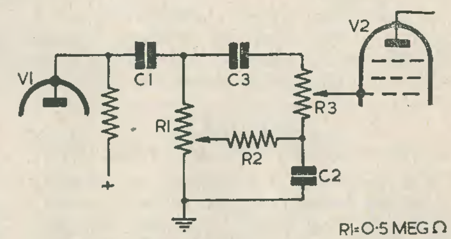


FIG.4
TONE CONTROL SYSTEM
C324

R1=0·5 MEG Ω
R2=0·5 MEG Ω
R3 = 1 MEG Ω
C1=0·05 μF
C2= 1500 pF
C3 = 150 pF

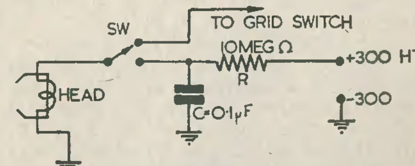


FIG.5
HEAD DEMAGNETISING CIRCUIT
C325

demagnetising circuit is shown in Fig. 5. The SPDT switch is normally for playback or recording when in the position shown in the diagram. The capacitor C is loaded via the very high value resistor R, which is connected to the amplifier HT circuit. Now when the switch is put over to the other position the capacitor suddenly discharges through the head, so that a high-peaked impulse occurs. This very effectively demagnetises the head. The switch SW could most conveniently be of the push-button type.

Multi-track Recording

Multi-track recording is only possible, of course, when tape is used. Commercially, multi-track recording is limited to a maximum of two tracks, and we shall confine our remarks to double-track recording. It is quite possible, however, to produce a number of tracks on even normal width tape, providing a suitable recording head and accurate tracking is employed. For some special applications, recordings have been made on a track only a few thousandths of an inch wide.

The main advantage of double-track recording is that it doubles the playing time. Thus, with a 1200 ft. spool and standard speed an hour's playing time is possible. There is no impairment of quality, though there is some diminution of volume which may have to be corrected by increasing the gain of the amplifier, though in many cases the difference may be hardly noticeable.

There are several points which want careful watching. First of all, the tape must be run absolutely level, without any up or down movement. This can be assured by using tape guides with slots of exactly the same width as the tape. The erase magnet must be such that either the upper or the lower sound track can be erased. This is best secured by using two separate low impedance erase heads with a face surface width slightly less than half the tape width, and connected to the bias oscillator by means of a switch so that either can be used. This is a more satisfactory method than trying to use a small permanent magnet. The record/playback head may be standard, and arranged to be moved up and down by a suitable mechanism to occupy one half or the other of the tape width, but the best arrangement is again to use two separate heads with small faces, and suitable switching. The faces of these heads should be slightly smaller than half the width of the tape, as there is always some flux spread at the edges.

Commercial manufacturers use the following division for double track recording:—

Standard Tape width	¼″.
Outer safety path	1/64″.
Upper sound track ..	3/32″.
Middle safety path	1/32″.
Lower sound track	3/32″.
Lower safety path	1/64″.

With these figures in mind, the very economically-minded constructor should have no difficulty in constructing a three-or-more-track recording machine. Three tables are given in this article, which will be of use to constructors, giving playing time, speed, frequency coverage, etc.

Finally, the writer will always be pleased to hear from any reader who has constructed recording gear, whether similar to that described in this series of articles or not, and he hopes that he has succeeded in introducing others to a most fascinating addition to our hobby.

TABLE ONE

Standard Speeds	*Frequency Coverage in cps*	*Application*
3¾″ per sec.	250- 2500	Speech (Dictaphone)
7½″ per sec.	100- 6000	Music and speech
15″ per sec.	50-11000	Quality reproduction
30″ per sec.	30-16000	Broadcast

TABLE TWO

Necessary tape length for a playing time of 30 minutes with a speed of:

3¾″ per sec. ..	565 ft.
7½″ per sec. ..	1125 ft.
15″ per sec. ..	2250 ft.
30″ per sec. ..	4500 ft.

TABLE THREE

Spool Size	*Tape Length*	*Playing time at* 3¾″/sec. *mins.*	7½″/sec. *mins.*	15″/sec. *mins.*	30″/sec. *mins.*
5″	600ft.	32	16	8	4
7″	1200ft.	64	32	16	8
11″	3250ft.	172	86	43	21½

NOTICE

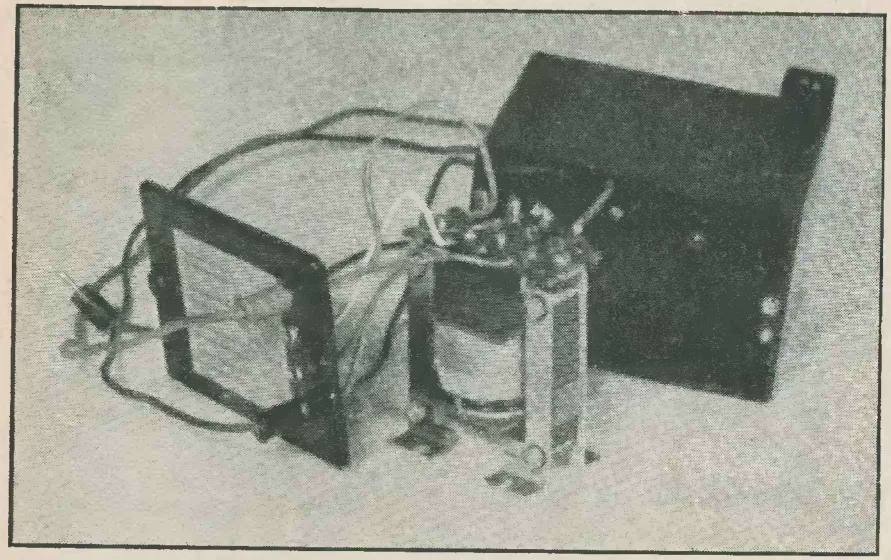
RADIO SOCIETY OF GREAT BRITIAN

The Council of the Society has decided to publish towards the end of this year an "R.S.G.B. Call Book" containing the call signs, names and addresses of licensed amateurs in Great Britian, Northern Ireland, Isle of Man and the Channel Islands.

Any licensed amateur resident in the above countries who wishes his call to appear in the first edition is asked to write his full call sign, name and address on a postcard and send it to:—Mr. J. P. P. Tyndall,
174, The Drive, Ilford, Essex.

Postcards cannot be acknowledged but for changes of address to appear in subsequent editions, notification of receipt will be sent. Non-members of the R.S.G.B. are asked to send changes of address direct to Mr. Tyndall on a prepaid postcard.

Details of the publication of the first edition will be announced in due course.



CURRENT TRANSFORMER *for use with* AVOMINOR UNIVERSAL METER

By W. E. THOMPSON.

MOST universal test meters, like the Avominor, provide for measuring AC and DC voltages, direct current, and resistance. Some meters of this type have additional facilities for such measurements as capacitance and decibels, but not many cater for an alternating current reading.

It is generally appreciated that a DC voltmeter is in fact a current-reading meter, simply because it must consume a small current in order that it can indicate the voltage applied to it. If we use a milli-ammeter having an FSD of 1.0 mA and connect in series with it a resistor of 10 kΩ, we shall need 10V to make the current in the circuit 1.0 mA (Fig. 1a). Similarly, by connecting a suitable shunt resistor across the meter we can read current values which are greater than the FSD (Fig. 1b).

So much for DC; but what happens when we want to read AC voltages? Well, we can connect a small rectifier across the meter, and put a series resistor on the AC side of the rectifier (Fig. 1c). Except for the rectifier this circuit is just like that for DC (cf. Fig. 1a), so our meter is still actually reading a current. It therefore looks as though we have only to shunt the AC side of the rectifier (Fig. 1d) to make the meter read higher values of alternating current, and so we can if we care to tolerate a rather crude method. But, due to certain characteristics of the rectifier, the readings will not be very reliable. It is not proposed to enumerate the details and reasons for this, so suffice it to say that to obtain reasonably accurate alternating current measurements we need to use a current transformer. This article describes how to make a small transformer suitable for use with a Universal

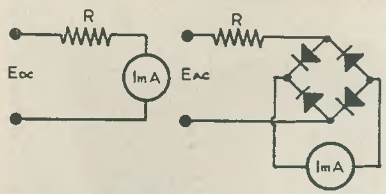


FIG.1a DC VOLTMETER FIG.1c AC VOLTMETER

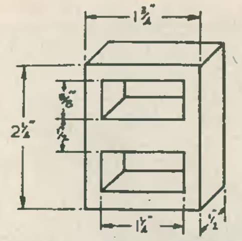


FIG.2 DIMENSIONS OF CORE

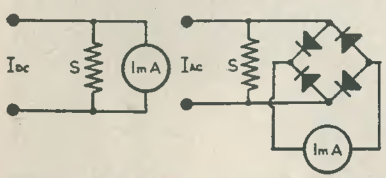
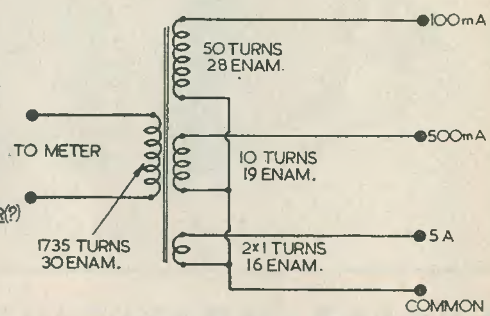


FIG.1b DC MILLIAMMETER FIG.1d AC MILLIAMMETER(?)



C 331

FIG.2b DETAILS OF WINDINGS

Avominor (which has an FSD of 2.5 mA) so that AC ranges of 100 mA, 500 mA and 5 A can be obtained.

For compactness, and certain technical reasons, we need a core of mu-metal stampings, which for convenience could be taken from an old intervalve transformer. General dimensions of a suitable set of stampings are shown in Fig. 2a, and small deviations are not important provided that the cross-sectional area of the centre limb is somewhere around ½″ × ½″ (0.25 sq.in.) to ⅝″ × ⅝″ (0.39 sq.in.).

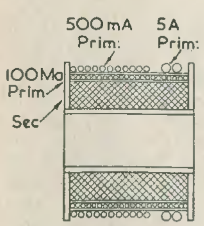


FIG.3a Cross section of coil.

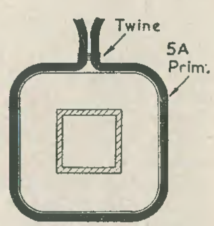


FIG.3b Form of 5 amp primary.

C332

I used a transformer bought in a Govt-surplus store for a shilling!

Fig. 2b gives details of the windings. Having made a bobbin, for which paxolin 1/16″ thick is admirable, wind on the secondary of 1,735 turns 30 swg enamelled wire. Random winding will do, though the more painstaking constructor will prefer to wind his layers evenly and interleave them with very thin paper. Put on two layers of 5-mil. Empire tape over the secondary, then wind the 100 mA primary of 50 turns 28 swg enamelled wire in one layer. Cover this also with two layers of Empire tape, then wind the 500 mA primary of 10 turns 19 swg enamelled wire, keeping this winding to one side of the bobbin so that we can put the 5A primary alongside it. This latter is simply two single turns of 16 swg enamelled wire laid side by side, the two single turns being later connected in parallel to obtain one effective turn of very low resistance. A cross-section of the complete coil is shown in Fig. 3a. Note: the start and finish of each winding must be brought out on the same side of the coil in all cases. The 5A primary must be formed as shown in Fig. 3b, the ends being secured by some thin, strong twine set as close to the coil as possible. A clove hitch made fast with a half hitch is the knot to use, and

you might get a Boy Scout to do this if you cannot remember how to tie the knot.

Build the stampings into the coil in the normal transformer fashion, that is, first a T on the left and a corresponding U on the right, then the next T on the right and its partner U on the left, and so on until the coil tunnel is full. Fit clamps and a tag panel, and connect coil lead-out wires to the tags (Fig. 2b). The completed transformer can be mounted in a small box such as that illustrated. Connection to the primaries can be by plugs and sockets and the secondary can be brought out on flying leads fitted with wander plugs, which are plugged into the Avominor.

A small modification needs to be made to the Avominor itself, since it is necessary to obtain direct connection to both sides of the rectifier. Take the back off the meter, the rectifier being seen to the left of the meter movement. One wire on the rectifier AC side will be found joined to a small wire-wound resistor, which is secured under a nut holding the meter movement. To the junction of this resistor and the rectifier lead we solder an additional wire, the actual joint being made on the resistor. Drill a hole in the side of the case, being careful not to damage the shunt-resistor spools mounted along this side, fit a wander plug socket and terminate the new wire on it. The back of the meter can now be replaced. A sketch of the modification is given in Fig. 4.

To use the meter, switch it to AC, connect the transformer secondary leads to the meter COMMON socket and to the new socket on the side. The transformer primary leads are connected in series with the circuit under test (e.g., valve heater) and plugged to a suitable range socket (Fig. 5). The photograph (see cover) shows the writer's meter and transformer so connected, ready for test. Indication of current will be given on the meter, the scale reading being suitably interpolated to obtain the actual value. Of course, observe the usual safety precaution of starting off on a high current range, connecting to a lower range

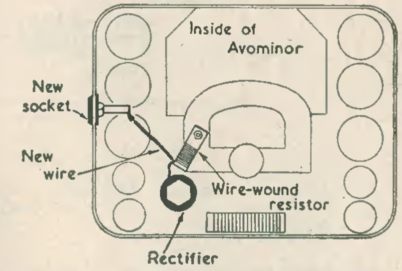


FIG.4 MODIFICATION TO AVOMINOR

C333

only when it is seen that the reading is within the limits of the lower FSD figure.

Never disconnect the Avominor whilst the primary is in circuit, and do not leave the transformer connected to a circuit without the Avominor also being connected, for high voltages can be developed across the secondary when it is not terminated with its proper load, especially on the 5A range.

Apart from checking heater currents, many other uses can be found for an alternating current meter. One which immediately springs to mind is the current taken by a radio set from the mains, from which can be calculated the watts consumed. It is also possible to get a rough check on the inductance of iron-cored inductors, for if one knows the voltage across the coil, its resistance, and the current passing through it, some simple calculations will reveal (1) the impedance, (2) the reactance, and (3) the inductance. It should be appreciated that this final figure will be lower in practice when the inductor is also carrying a direct component.

An example, using typical values, will serve to explain the method. Set up the circuit of Fig. 6, first connecting the inductor directly across the variable resistor as shown by the dotted line. With an AC voltmeter (the Avominor) across the 50 kΩ resistor, adjust slider

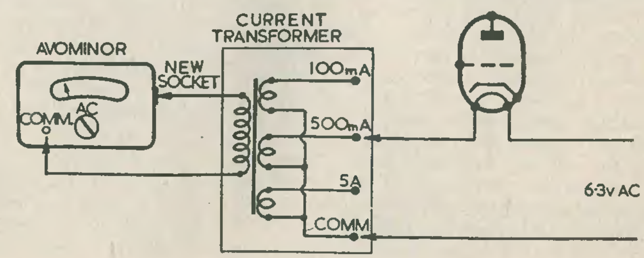


FIG.5 METHOD OF MEASURING HEATER CURRENT

C334

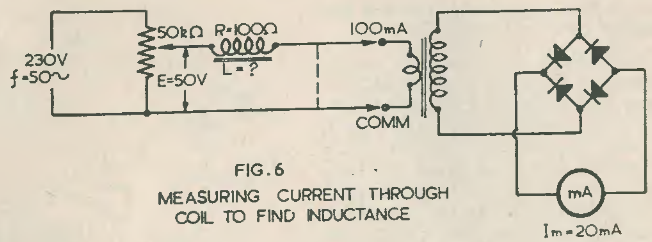


FIG. 6
MEASURING CURRENT THROUGH COIL TO FIND INDUCTANCE

until meter registers 50V, as shown. Connect AC transformer and note reading on meter, in this case 20 mA. Measure DC resistance of coil, again with the Avominor. We assume 100 ohms for this calculation. We can now find the inductance, L.

The Impedance, $Z_L = \frac{E}{I_m}$

$= \frac{50 \times 1000}{20}$

$= 2500$ ohms . . . . . . (1)

Since $Z_L = \sqrt{X_L{}^2 + R^2}$

Reactance $X_L = \sqrt{Z_L{}^2 - R^2}$

$= \sqrt{2500^2 - 100^2}$

$= \sqrt{6240000}$

$= 2500$ ohms approx. . . . . (2)

(The resistance being comparatively low does not greatly alter the "AC" resistance).

Now, $X_L = 2\pi fL$, therefore,

Inductance $L = \frac{X_L}{2\pi f}$

$= \frac{2500}{2\pi \times 50}$

$= \frac{25}{3.14}$

$= 8$ Henries approx. . . . . . . (3)

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.

THE layman's approach to radio has always been a subject of interest to your writer. Although the majority of non-technical people are happy enough to leave their domestic radio worries to the shop serviceman, there are a few who view the activities of wireless mechanics with a great deal of distrust and suspicion. These are the types who, if they have the chance, breathe heavily down the neck of the poor mechanic at the bench and cast beady glances at every solder joint or nut and bolt which he touches. They have a hazy idea of the nomenclature of some radio parts and subject the serviceman to a merciless inquisition on what has been done, what has not been done, and what, in their opinion, ought to have been done. They ask the mechanic for advice, argue about it, do not carry it out, and then tell everyone in the neighbourhood that he doesn't know what he is talking about!

Such people are a nuisance. Not so, however, is the person who openly admits to only a small knowledge but who humorously pretends to understand everything, referring learnedly to such impressive faults as "air-

locks in the foo-foo valve" and the inevitable "water in the tool-box".

In the Tool-Box

Whilst water in the tool-box might be a possible hindrance, there are other things which can find their way to the tool-box and which can make themselves very useful indeed. Particularly is this true of those handy little home-made gadgets which lend themselves ideally for radio work.

A good example in this line is shown in Fig. 1 (a). This consists simply of a long pair of eyebrow pluckers (a cheap pair are all that is needed) whose jaws can be closed by means of a 6 or 8 BA nut and bolt fitted about a third of the way down the body. The pluckers are, of course, drilled to take the bolt. The nut should be of the "terminal" type so that it can be readily adjusted with the fingers. To prevent the screw-head from turning, it is filed to fit into a V-slot cut in the surface of the tweezers, (Fig. 1 (b)). After modification in this fashion, the tweezers are extremely useful for holding nuts in awkward places whilst their bolts are fitted to them. They can also be used for many other applications in which it is necessary to hold small parts steady in positions where the fingers could not themselves be inserted to squeeze the arms of the tweezers.

Another useful contrivance is shown in Fig. 2 (a). This is intended for removing valves fitted to crowded chassis. The functioning of the tool is fairly self-explanatory. The projecting lever at the bottom is placed under the valve base; whereupon the valve may be rocked out of its holder. The bottom of the threaded rod rests upon the chassis and its position is adjustable. It may, for instance, be screwed down as the valve is raised to prevent the tool fouling adjacent components. The adjustable threaded rod also allows for those cases in which the valve-holder is not mounted to the chassis in the usual flush manner. It may prove helpful to file the projecting lever into the shape shown in Fig. 2 (b), whereupon it could be used to obtain a greater purchase by straddling one of the valve pins. It must, of course, be pointed out that, in most cases, the valve should be removed by rocking it alternately on either side of its base, the rocking process being carried out very gently. It is extremely easy to break the spigot off, say, an octal valve by being too violent.

When a receiver with tight, awkwardly-placed valveholders is being serviced, any new valve which is temporarily inserted for testing purposes could be provided with a loop of string fitted under its base and between the pins. Its removal may then be assisted by pulling on the string. Octal valves can sometimes be removed by carefully pushing their spigots from below with a pencil whilst the glass part above is gently rocked.

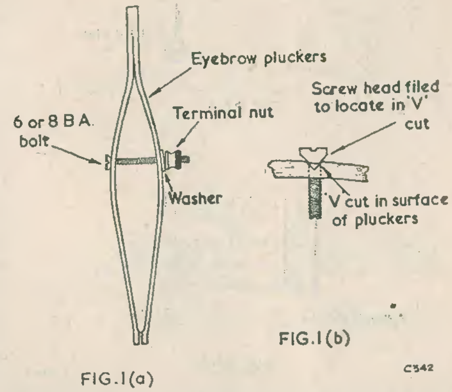


Fig. 1 (a): A modification to a pair of eyebrow pluckers, enabling them to be used for holding nuts and bolts., etc., in "awkward" corners.

Fig. 1 (b): Showing the manner in which the screw-head is prevented from turning as the nut is tightened.

Sticking Plaster

Medical sticking plaster is another unusual accessory which will also be found useful in the tool-box. Its usefulness is due to the fact

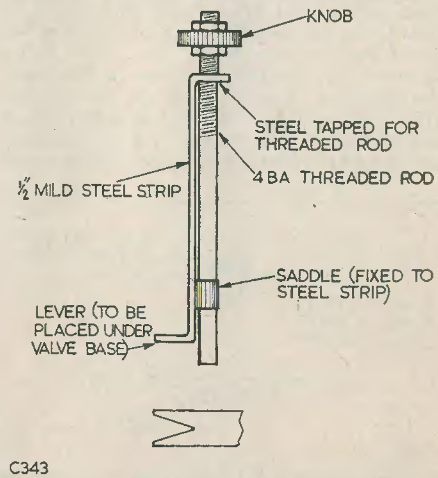


Fig. 2 (a): An adjustable valve-remover.

Fig. 2 (b): A suggested shape for the projecting lever of the valve-remover.

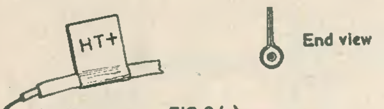


FIG.3(a)

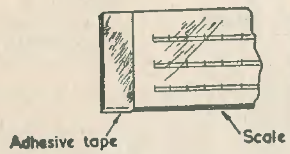
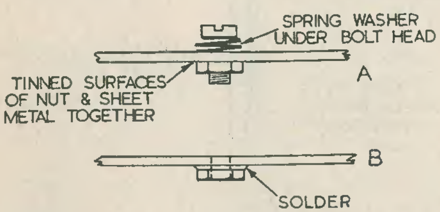


FIG.3(b) C544

Fig. 3 (a): Adhesive tape fixed to wire-ends can be used for identification purposes, as shown here. The end view illustrates how the tape is wrapped around the wire and stuck back on itself.

Fig. 3 (b): Glass tuning scales may often be prevented from rattling by wrapping adhesive tape around the ends.

that it has much stronger adhesive qualities than those of normal insulating tape; although it must be remembered that its insulating properties are not, of course, anything as reliable. Nevertheless, small pieces of sticking plaster could, with advantage, be stuck to commercial midget receiver chassis in places where wire-ended components are liable to short to earth. The plaster is also helpful for identifying battery leads, etc., this being carried out in the manner shown in Fig. 3 (a). The identification can be written on the tape quite easily with the aid of an indelible pencil or a ball-pen. The "elastic" type of adhesive tape can be used to prevent glass tuning scales from rattling, the tape being wrapped around the ends of the glass as illustrated by Fig. 3 (b).



C345

Fig. 4: Soldering a nut to sheet metal to provide an anchor nut. The method of holding the nut before soldering is shown at (a); whilst (b) illustrates the finished job.

Another "sticky" substance, shellac varnish, will also be found useful in the workshop. It should not always be applied liberally. Although, for instance, the varnish is helpful in keeping the ends of a home-wound coil in position, it should not necessarily be painted over the whole coil, as it may alter the self-capacitance and may introduce losses. The insulating properties of shellac varnish are only apparent when it is dry. If a coil wound with DCC or DSC wire (in which case the varnish may soak into the covering and make contact with the wire itself) is painted with shellac, the coil will not work properly until the varnish has set. Shellac varnish should rarely be used on short-wave coils or components.

Other useful but slightly unorthodox tools which may be put to good purpose from time to time include such things as bristle tooth-brushes for switch and contact cleaning, a dentist's mirror for checking hidden components and connections, and a watchmaker's eyeglass (not very expensive) to assist in carring out fine detail work.

Awkward Soldering Jobs

One of the essential qualities of a practical wireless mechanic is the ability to solder not only the conventional electrical connections which are usually encountered, but also the more difficult mechanical joints necessitated by chassis design.

Of the latter, the most often-met example is afforded by the requirement of soldering large areas or of soldering to unfamiliar metals. The large area problem can be solved by the use of a heavy soldering iron or a blowlamp[1]; whilst the choice of the correct flux will enable good joints to be made with almost any metal. Most "chemical" fluxes and modern cored solders contain ingredients which will cope with nearly all of the metals likely to be encountered.

It sometimes proves necessary to anchor ordinary nuts to sheet metal in order afterwards to allow screws to be easily and quickly fitted to or removed from them. A good method of doing this is shown in Fig. 4 (a) and (b), in which the nut is soldered to the metal. The metal to which the nut is to be anchored is first of all drilled, and it is then tinned over the area around the hole. The underside of the nut is also tinned, taking care to ensure that no solder enters its threads. The nut is then smeared lightly with flux and fitted to the sheet metal as shown in Fig. 4 (a). As the

1. If gas is available a bunsen burner could be used instead of a blow-lamp, and might prove cleaner and more convenient.

nut and the metal are prevented from coming into close physical contact by reason of the tinning, a spring-washer is fitted under the bolt head. When the solder used for tinning melts, the washer then pulls the nut tight against the metal.

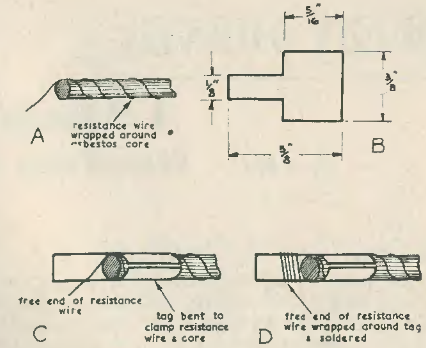
To melt the solder, a heavy soldering iron is pressed against the job until the latter has attained a sufficiently high temperature. When the nut and metal are hot enough a small additional amount of solder is run around the outside of the nut. The iron is then taken away. When the job has cooled, the screw is removed. It may be necessary to use a little initial force to do this in case the solder, or flux (if resin has been employed), has hardened against its threads. The nut will then be anchored as illustrated in Fig. 4 (b).

The secret of success in this process consists of using a bolt made of a metal which is difficult to solder; thus preventing it from being soldered into the job itself. Steel bolts which are a little rusty or which have not been used for some time should be sufficiently oxidised to meet this requirement. In addition, if the surfaces have been well tinned beforehand, the soldering iron does not need to be applied for too long. When several anchor nuts are being fitted in this manner, a different bolt should be used each time; otherwise the fluxes present would cause the bolt to be eventually soldered itself.

Line-Cords

The necessity of providing a suitable termination for line-cord resistance wire is another soldering problem. The resistance element in these cords is usually made up in the manner shown in Fig. 5 (a). If the resistance wire itself is simply soldered to a tag it usually pulls away from the asbestos core, and gives a very unreliable and unprofessional finish. A good method of terminating the wire consists of making a tag which will not only allow a solder joint to be made but will also hold the resistance wire and its core as well.

Fig. 5 (b) illustrates a suggested tag which could be very quickly cut out from thin tinplate. (The measurements given in the diagram are only approximate and may vary for different makes of line cord. The upper part of the tag is bent around the resistance wire and its core as shown in Fig. 5 (c); the appearance of the finished connection being illustrated by Fig. 5 (d). It should be noted that no solder enters that part of the tag which clamps on to the wire and core. After completion, the bottom, unused part of the tag is then soldered to the appropriate point in the receiver. The line-cord proper should be cleated elsewhere on the chassis to prevent strain upon the resistance element.



C346

Fig 5 (a): The resistance element of a line-cord.
Fig. 5 (b): A suggested tag for anchoring the resistance element. The dimensions shown are only approximate and may vary for different line-cords.
Fig. 5 (c): Showing how the tag is bent around the resistance wire and its core.
Fig. 5 (d): The completed tag connection ready for use.

Fitting line-cord to mains plugs can sometimes be a rather fiddling process as well. There is no necessity in this case to use soldered connections, since the resistance wire may usually be held fairly reliably under the screw terminals. The best type of mains plug to use is that in which the wire ends are laid in channels before the top is fitted; the wire being clamped at the point where it enters the plug.

Mnemonics

Although, at the time of writing, Spring is fairly well advanced, its effect upon your writer nowadays is nil. The mental vision of lambs gambolling in the fields and of birds twittering gaily about their lawful occasions is by no means so pleasant as that of a comfortable chair by the fireside with the radio turned, preferably, off. The season cannot therefore be blamed for the following outbreak into poesy:

"One over two pi root L C
Gives you the resonant frequency!"

This little couplet is intended to be a mnemonic; and it may be found quite useful by some as a method of remembering the well-known formula for resonance:

$$f=\frac{1}{2\pi\sqrt{LC}}$$

Mnemonics, (that is, aids to the memory),

(*Continued on P.* 413

QUERY CORNER

A "Radio Constructor" Service for Readers

A Tone Control Circuit

My audio amplifier is at present equipped with a simple tone control arrangement which consists of a capacitor in series with a variable resistor connected across the primary of the speaker transformer. This circuit operates simply by reducing the upper frequency response of the amplifier, and I would like to include something rather more ambitious in the form of separate treble and bass controls. Can you recommend a suitable circuit?

T. Wylie, Croydon.

Tone control circuits which provide separately for the bass and treble response may be divided roughly into two classes, those which employ a combination of resistors and capacitors and those which make use of inductors in conjunction with other components. This latter type have the advantage that they enable a sharp cut-off to be obtained at any particular part of the audio response, a characteristic which is particularly useful in needle scratch filters and frequency crossover networks, but the use of inductors has certain disadvantages in simple tone control circuits. Probably the most outstanding of these disadvantages to the home constructor is that the coils have normally to be specially wound, but the worries do not end in obtaining the coils, for they must be carefully mounted and screened in the amplifier. This is because an inductor is very prone to pick up unwanted signals from stray fields which may originate from adjacent chokes and transformers. Thus the design of the tone

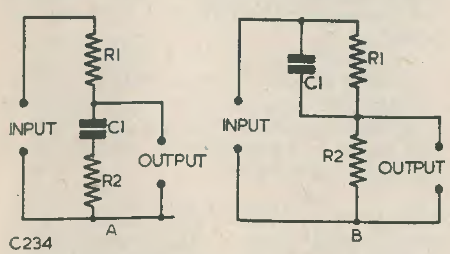


Fig. 1: Bass (a) and treble (b) lift circuits.

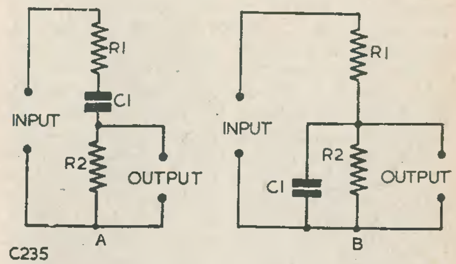


Fig. 2: Bass (a) and treble (b) cut circuits.

control circuit which is about to be described is centred around resistance and capacitance combinations, and although it is not capable of separately providing a very large amount of either bass or treble lift, it does enable a degree of control to be obtained which is, in the writer's opinion, more than adequate.

The arrangement is based on the simple bass and treble lift and cut circuits which are shown in Figures 1 and 2 respectively. Examining the bass lift circuit first, it will be seen that the three components R1, C1 and R2 form a potential divider across the signal source, the two arms of the divider consisting of R1 at the top and the combination of C1, R2 at the bottom. Now the ratio of the resistance of R1 to the impedance of C1 and R2 will directly govern the ratio of the input voltage to the output voltage. The value of the upper limb of the divider is of course independent of the signal frequency, but the lower limb decreases in impedance as the frequency increases, thus the higher the frequency the greater the attenuation of the signal. This is simply another way of saying that the loss at the bass end of the scale is less than that at the treble end. The bass cut arrangement operates in a similar manner, but in this instance the capacitor is included in the upper limb of the divider so that the attenuation becomes less as the frequency increases.

Treble control is obtained by a similar pair of potential dividers, the lift circuit being shown

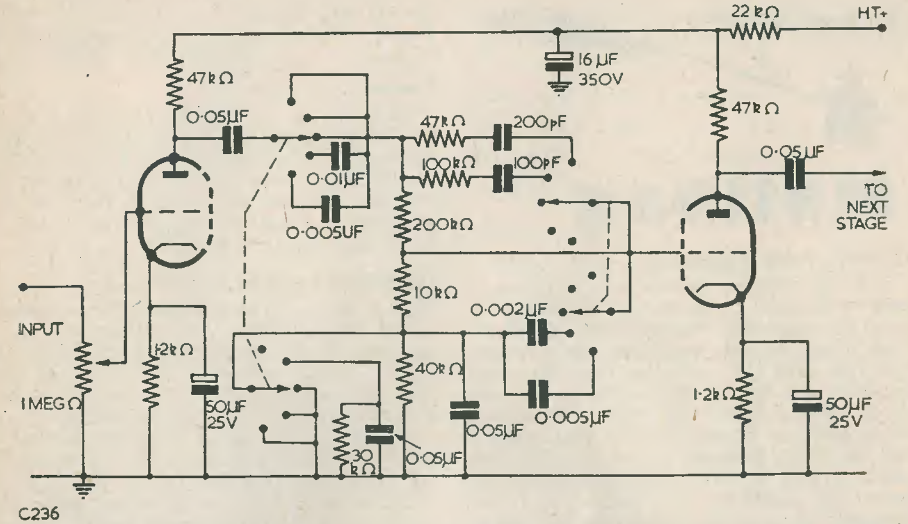


Fig. 3: The complete tone control circuit shown between sections of a double triode. Suitable valves are ECC33, B65 or 6SN7GT.

in Fig. 1B. The resistive potentiometer formed by R1 and R2 provides a predetermined degree of attenuation at the lower frequencies which becomes less as the reactance of C1 shunts R1 at the higher audible frequencies. The treble cut circuit is merely the converse of that used for treble lift, the capacitor being included across the output terminals thereby reducing the output voltage in the upper part of the audible range.

We have so far examined the basic circuits which are normally used in tone correcting arrangements, and it has been shown that each consists of a potentiometer, one limb of which includes a capacitor as the frequency conscious element. The introduction of the circuits into an amplifier obviously reduces its overall voltage gain and it is usually necessary to make up for this loss by adding a further stage of amplification. This is probably most conveniently achieved by substituting one of the triode valves in the amplifier by a double triode, and in these circumstances, the complete stage with tone control arrangement appears as shown in Fig. 3. Examination of this diagram will indicate the method in which the four circuits already described have been incorporated in the final design.

Treble and bass control is obtained by means of two five-way two-pole rotary switches, which should be mounted as close to the valve as is practicable. This is important, as all leads associated with the control circuit must be short so as to avoid unwanted pick-up from stray magnetic fields. When the two switches are set to their mid positions, the response of the amplifier remains unchanged and should be as linear as possible; on either side of the mid positions the bass or trebler is either reduced or boosted according to which way the appropriate switch is turned.

QUERY CORNER

"Rules"

(1) A nominal fee of 2/- will be made for each query.

(2) Queries on any subject relating to technical radio or electrical matters will be accepted, though it will not be possible to provide complete circuit diagrams for the more complex receivers, transmitters and the like.

(3) Complete circuits of equipment may be submitted to us before construction is commenced. This will ensure that component values are correct and that the circuit is theoretically sound.

(4) All queries will receive critical scrutiny and replies will be as comprehensive as possible.

(5) Correspondence to be addressed to "Query Corner," Radio Constructor, 57, Maida Vale, Paddington, London, W.9.

(6) A selection of those queries with a more general interest will be reproduced in these pages each month.

from our Mailbag

Magnetic Sound Recording.

Dear Sir,—Having read the copy of February issue of Radio Constructor, I would like to make one suggestion as regards the article by PAØXE on Sound Recording. In the diagrams on page 234 I note that two 6V6 valves are used, one for the RF oscillator and one for the output valve. As I am in a position where economy is essential, my contention is that use could be made of one 6V6 for both stages, as they are not used together in either record or playback. If switching is used, however, the components must be laid out to suit the oscillator stage, the layout for the output stage not being very important. By this means of switching, it would obviate the expense of a 6V6 (about 6/6) plus heater current of 0.45A at 6V (2.7 watts) and one valve base plus the space of the extra stage on the chassis. I enclose a drawing of my proposed modification, trusting it to be of interest.—A. J. Hudson (Dunstable)

Can Anyone Help?

Dear Sir,—I wonder if any of your readers could provide me with trimming data for the Pye 45 Mcs Strip?—R. J. Darley, 41 South Road, Easthampstead Park, Wokingham, Berks.

Bouquet.

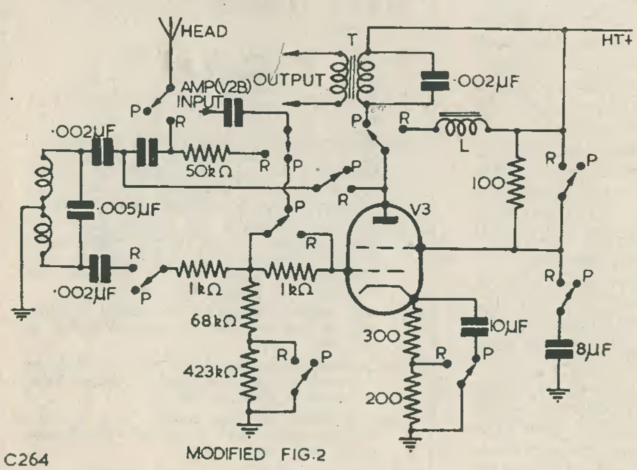
Dear Sir,— . . . The RC has been a great help to me in my constructional and theoretical work. In a recent exam I topped the list with 99.5% I was able to use a number of the ideas and information gained from the RC and wish to thank you for the help given.—R. L. Kenyon, (Liverpool, 8).

HT Supply for Remote Apparatus.

Dear Sir,— . . . In comparing the published circuit with my draft, I notice that I omitted a capacitor in the output feed from the anode of the pentode amplifier. As it is indicated that this lead connects to the main amplifier, it is clear that as it stands the circuit defeats the object it sets out to achieve, namely, to remove HT from a trailing cable. The capacitor should be included in the pre-amp. in order to block DC on the output lead. No doubt most readers would realize that a capacitor ought to appear in the circuit given, and I offer my apologies for neglecting to show it.—W. E. Thompson (St. Leonards-on-Sea).

Correspondent Wanted.

Dear Sir,— . . . I should be pleased to hear from any readers who are interested in tape recording. I have recently made up a tape recorder, which works fairly well. The amplifier is home-made, but the tape deck is commercially made.—A. J. Browning, 49 Old Shoreham Road, Southwick, Sussex.



C264 MODIFIED FIG.2

Proposed Modification of Recording Amplifier.

IN YOUR WORKSHOP

(*Continued from P.* 409

are often a help to the practical man who only occasionally encounters formulae in his work, and who cannot therefore fix them in his mind by frequent usage.

The Ohm's law relationship is not difficult to remember and its derivation is obvious enough. Nevertheless, the writer knows several radio mechanics and electricians who, when they started originally, used to call the familiar

$R = \frac{E}{I}$ to mind by saying to themselves, "Rain is 'Eavy over India"; (i.e. "R is E over I"!)

Such a mental aid may appear more than a little "corny", but it is surprising to what an extent such reminders are used. If any reader knows of any other examples of radio mnemonics it might be not only amusing but definitely instructive to students and beginners to publish them in these pages.

SMALL ADVERTISEMENTS

Readers' small advertisements will be accepted at 2d. per word, minimum charge 2/-. Trade advertisements will be accepted at 6d. per word, minimum charge 6/-. If a Box Number is required, an additional charge of 1/- will be made. Terms: Cash with order. All copy must be in hand by the 10th of the month for insertion in the following month's issue.

PRIVATE

WANTED. Copies Radio Constructor for Jan 1948, Dec 1948 and May 1949.—P. Bysh, 86 Barrenger Road, London, N.10.

HALLICRAFTER Sky Challenger, in perfect condition and unmarked, with matched 12" speaker and 'S' meter. £20.—Box B155.

FOR SALE. MRC1 complete £6. Or exchange for signal generator, normal coverage, with price adjustment.—Blane, 93 Wilmslow Road, Rusholme, Manchester.

HAMBANDER, Speaker, Phones, Perfect, for sale. £14.—Welch, 5 Priestlands Avenue, Hexham, Northumberland.

EXCHANGE VCR97 for Mains Transformer 500-0-500V, 5V. 3A, 6.3V.6A, or EHT transformer 2.5 kV.—S. K. Scarratt, 10 Alice Street, Darwen, Lancs.

SELF-CONTAINED 25W Table Top Transmitter, crackle case, fully metered, 6V6—807. £12.—Box B156.

VALVES. 6C4, 6AG5, 6SN7, 6SL7, 2050, 2051. 7s. 6d. each.—Sevenoaks, Davenham, Cheshire.

AMATEUR SELLING OUT. Quantity components, literature, for sale. Stamp for list. Apply to Green, 6 Elmwood Avenue, Baldock, Herts.

100 VARIOUS copies Short Wave News, Short Wave Listener, Radio Constructor, Short Wave Magazine, Practical Wireless. Wanted, R1116.—Phillips, St. Mary's Lane, Dilton, Wilts.

WANTED. ASB8 or RF Cavity therefrom. Valves not necessary.—Boedo-Yanez, Arundel, Knightcott, Banwell, Somerset.

TV PRE-AMP, with power pack. Not Ex-WD. 1355 with power pack and new RF26 Unit. Offers.—Dixon, 638 Bacup Road, Waterfoot, Rossendale, Lancs.

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