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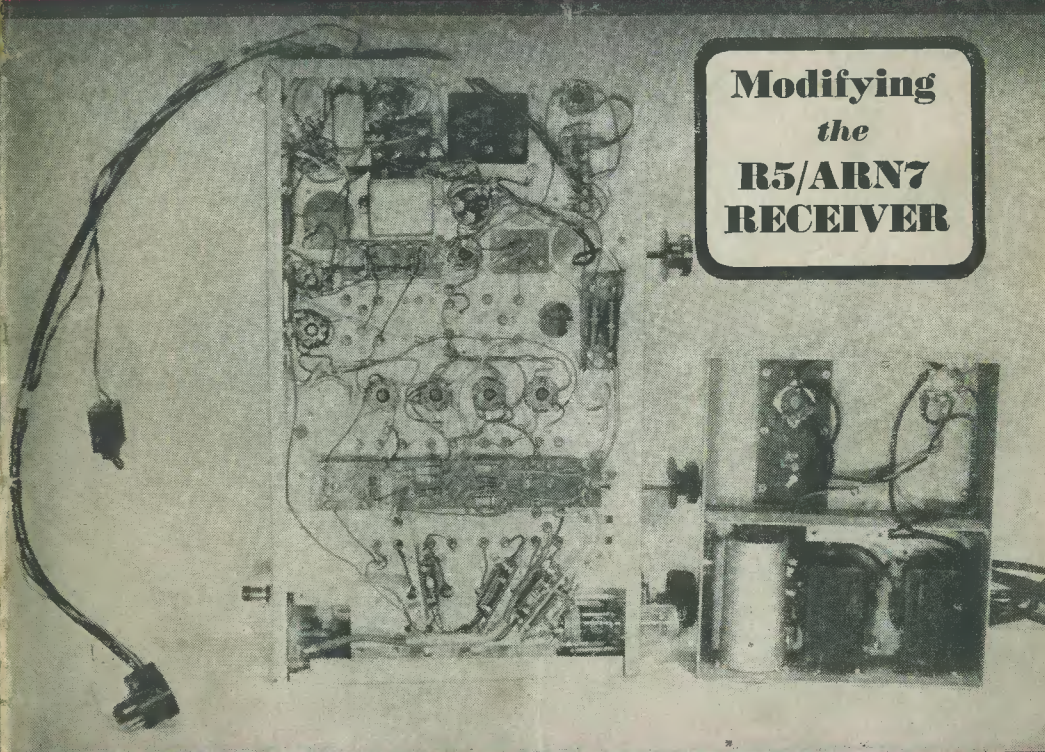
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Vol. 5
Number 1
AUG.
1951

RADIO CONSTRUCTOR

for the Radio and Television Enthusiast



**Modifying
the
R5/ARN7
RECEIVER**

ALSO
IN THIS ISSUE . . .

Compact AD/DC Amplifier • RF Adaptor for Wrotham
Medium EHT • Economical Timebase • Radio Miscellany
Modernising an Old Set • Harmonic Generator • Query
Corner • Constant Companion Receiver, Part 4
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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
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Radio Constructor

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August, 1951

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Edited by C. W. C. OVERLAND, G2ATV

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Editorial

For some years prior to the last war, the activities of the radio constructor had tended to become, more or less, a settled routine. With the advent of ex-WD equipment, however, more fields have been opened up. Television is undoubtedly the greatest of these and, though the initial enthusiasm has worn off, it still holds the interest of a large number of fans. Magnetic recording has, more recently, also captured a great deal of interest, and it seems that this will be followed by radio control of models.

This is quite a fascinating subject, which has been receiving attention for some time from model engineers. Like magnetic recording, it requires mechanical ability, or the help of someone who can look after this side. The ideal combination would be the radio constructor plus the model engineer.

The radio control of models will be the chief feature of the "Model Engineer" Exhibition to be held August 22—September 1, at the New Horticultural Hall, Greycoat Street, Westminster, S.W.1. Models of all kinds will be in action, with a water tank 30' x 40' in which the ships can operate. This show is, in any event, well worth attending, but this year it is a "must" for all interested in radio control.

We are, ourselves, now engaged on a controlled ship and an aircraft, and will shortly be publishing in this magazine a number of articles on the subject.

G2ATV.

NOTICES

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

sender's name and address.

COMPONENT REVIEW. Manufacturers, publishers, 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, London 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. 9 A Sub-Standard 200 kcs. Harmonic Generator

This circuit is intended to provide a series of checks over all the usual frequencies employed for domestic and short-wave listening and servicing, the check points being obtained from harmonics based on a 200 kcs fundamental. Contrary to his usual policy, the writer has not tested this particular circuit in practice and therefore offers it as an experimental project only.

Principle of Operation.

The circuit works on the principle of amplifying an RF source of known frequency and stability, and then applying the amplified signal to a stage capable of adding a rich harmonic content, the output then being used to provide heterodyne tests for checking receiver, signal generator and wavemeter calibration, etc. In this case, the RF source has a frequency of 200 kcs and is obtained from the BBC Light Programme transmitter on 1500 metres.

The disadvantages of an arrangement such as this consist of the necessity of constructing a fairly complex circuit, and the cost of providing the parts. However, the latter can be reduced considerably by the use of surplus

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.

valves and components.

The advantages are given by the fact that the accuracy of the frequency checks obtained is as good as that employed by the BBC in maintaining transmitter frequency stability, and is therefore probably much higher and more reliable than that given by the average crystal oscillator.

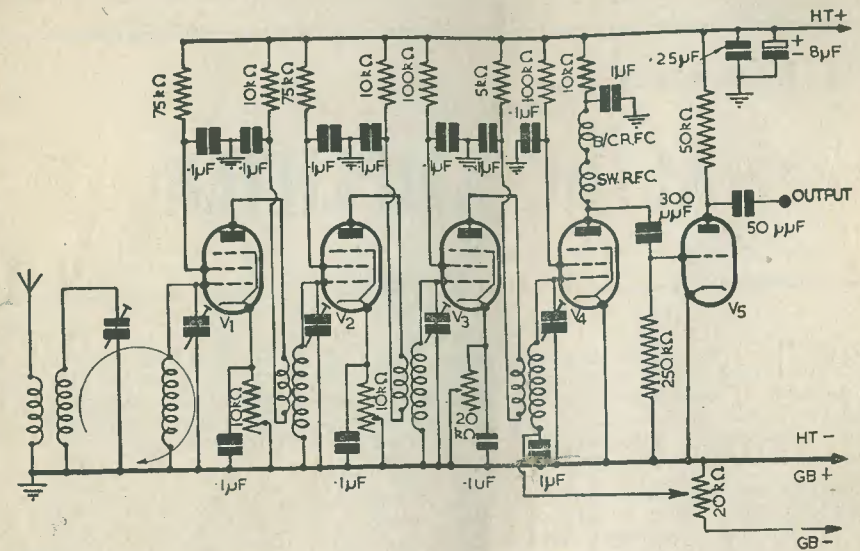
The Circuit

In the circuit shown here, V1, V2 and V3 are variable- μ RF pentodes, and they are employed to amplify the 200 kcs signal in the usual manner. Their gain is controlled by variable cathode resistors, which are set to obtain the greatest amplification from each stage without running into grid current.

The amplified signal should then be sufficiently strong to permit of harmonic generation. It is applied to the grid of V4, a "straight" RF pentode, whose bias can be altered by a grid bias potentiometer. This valve is made to distort the signal either by the application of excessive bias or none at all, it being found experimentally which procedure offers the greater amount of harmonics. The anode circuit of V4 is completed by a short wave choke in series with a medium and long wave choke. The signal is then applied to the triode detector which will again increase the harmonic content.

Practical Points

Owing to the comparatively low frequency of the fundamental RF, the layout of the harmonic generator should not prove very difficult. Efficient screening of each stage should remove any tendency to instability. Normal long wave coils can be used for the first three stages and the band-pass aerial coupling could be obtained by mounting two coils side by side. A good aerial and



Circuit of the Harmonic Generator

earth system is advisable.

Really good components should be chosen for the two chokes connected in the anode circuit of V4. If one of the old-fashioned "binocular" chokes can be obtained, this would do excellently for the medium and long wave section. It might also be worthwhile to keep the RF wiring around V4 and V5 reasonably short.

Modulation

It is appreciated, of course, that the original 200 kcs signal will be modulated whilst it is being used for test purposes, and that the sidebands obtained will also be multiplied with the carrier. In addition to this, the multiplying stages are almost certain to introduce cross-modulation between sidebands and harmonics, etc. As, however, these unwanted frequencies will be constantly changing they could hardly be confused with the steady, stronger note which would be obtained from the original carrier and its harmonics. It should be pointed out, though, that the circuit could not really be relied upon during the time when the BBC transmits its tuning signal!

SUPPORT the ISWL

TRADE REVIEW

Miniature Output Transformer

We have received from John Bell and Croyden of 117 High Street, Oxford, a sample of a new sub-miniature output transformer which they are manufacturing.

The overall dimensions are extremely small, being only 0.75" x 0.55" x 0.44", with a correspondingly low weight of $\frac{3}{8}$ oz. "F" shaped laminations are used with a specially moulded bobbin, and the completed unit is dipped to give a finish which is highly resistant to damp, and incidentally makes a really strong job of the transformer despite its small size.

Normally, the transformer is supplied with a turns ratio of 50 : 1, having 5,000 turns 48 swg wire for the primary with a secondary of 100 turns 38 swg wire. The number of secondary turns can, however, be varied to suit individual requirements.

We tested the sample submitted to us, and found it performed its normal function efficiently. We also tried it out as an input transformer with a moving-coil microphone, and obtained good speech quality. The small size was a big advantage in this instance, too.

With a Hand Mike No. 13, it was found possible to fit the transformer into the case quite comfortably.

A Compact . . .

AC/DC AMPLIFIER

By D. H. SIMPSON

RECENTLY I was called upon to supply a friend with a small amplifier, suitable for use with a gramophone pickup. This caused a rather feverish search through available components, with suitable valves as the first consideration.

Prolonged investigations revealed a 6J7 and a 25L6GT. Both these tubes are small physically, and this was advantageous as the amplifier had to fit into a very small space. An old RF24 Unit was unearthed, and it was decided to use this for the chassis; the dimensions of the layout given herewith are determined by this.

The circuit values given are not very critical, but if comparable results are wanted they

should not be deviated from too much. Of course, the layout is a matter of personal choice and depends to some extent upon the material available. The arrangement given has proved wholly satisfactory.

The Circuit

Fig. 1 shows the theoretical circuit, which, it will be seen, is quite a simple affair. The signal is fed into the grid of the 6J7. Cathode bias is used, via R2 and the decoupling capacitor C1, and the grid leak R1. The screen is series fed through R4, decoupled by C2.

The amplified signal from V1 is fed to the output stage, using the 25L6GT, via the coupling capacitor C3, and a potentiometer

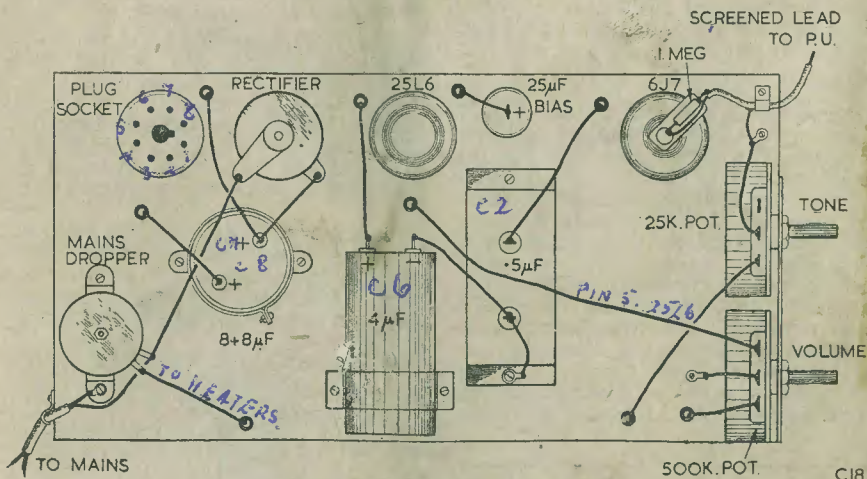


Fig. 2. Showing layout above chassis.

6x5

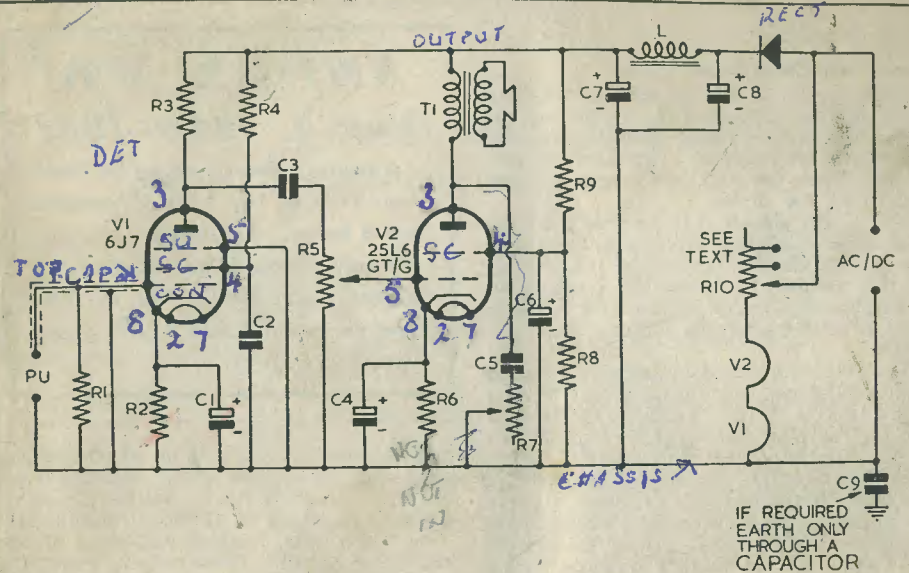


Fig. 1. Theoretical circuit of the amplifier.

LIST OF COMPONENTS USED

- | | |
|------------------------------------|---------------------------------|
| R1, 1 MΩ ½W ✓ | C1, 25 µF 25V elect. ✓ |
| R2, 1,200 Ω 1W ✓ | C2, 0.5 µF 350V paper ✓ |
| R3, 200 kΩ 1W ✓ | C3, 0.05 µF 350V paper ✓ |
| R4, 1 MΩ ½W ✓ | C4, 25 µF 25V elect. ✓ |
| R5, 500 kΩ pot. ✓ | C5, 0.05 µF 350V paper ✓ |
| R6, 150 Ω ✓ | C6, 4 µF 350V elect. ✓ |
| R7, 25 kΩ pot. ✓ | C7, 8 µF 350V elect. ✓ |
| R8, 20 kΩ ½W = 22k ✓ | C8, 8 µF 350 V elect. ✓ |
| R9, 12 kΩ ½W ✓ | C9, 0.25 µF 500V paper ✓ |
| R10, 0.3A mains dropper, see text. | 1, Valve type 6J7 (V1) |
| 1, RF24 Unit chassis. | 1, Valve type 25L6GT (V2) |
| 1, Metal rectifier, 250V 60 mA | 2, International octal holders: |
| Knobs, grommets, wire, etc. | 1, Octal valveholder (original) |
| | 1, Energised speaker (see text) |
| | 4, Capacitor clips. |

R5 which acts as grid leak for V2 and gives control over the audio gain. R6 provides cathode bias in this stage, decoupled by C4. The screen is fed from a potentiometer consisting of R8 and R9, and is decoupled by C6. The latter is not at all critical as regards value, and anything between 2µF and 8µF may be employed. Tone control is given by the variable resistor R7 in series with C5.

Half wave rectification is used for the HT supply, and space can be saved here by employing a metal rectifier, and an energised speaker in place of the smoothing choke. For the latter, the field coil should have a resistance of

around 1500 Ω. The ratio of the output transformer required is calculated as follows:

$$\sqrt{\frac{\text{Optimum Load}}{\text{Speech coil impedance}}}$$

The value of the mains dropping resistor R10 is found as follows:

The series heater voltage V1 + V2 = 6.3 + 25 = 31 approx. Thus voltage to be dropped across R10 = mains voltage, say 240, less 31 = 209.

$$\text{Using Ohm's Law, } R10 = \frac{209}{0.3} = 698 \Omega.$$

The actual value is not too critical, so 700 Ω

will be satisfactory.

Layout and Construction

Although the RF24 Unit chassis only has a depth of just over an inch, by placing the larger components upstairs quite a reasonable layout can be achieved. The accompanying drawings show this, and the wiring both above and below the chassis.

If a similar chassis is to be used, here are a few notes which may save some time. Strip the unit completely above deck. Clear away all the components below the chassis, but leaving the tag boards in partitions 1 and 3. Next remove the screens forming these partitions.

The volume and tone controls are mounted on a small panel, which is bolted to the front of the unit as shown. Leads should be kept short. The plug socket, which is really one of the original Mazda valveholders, carries the output to the speaker transformer and the supply to the field coil or choke L. Looking at this plug from beneath, the connections are: Pin 8, field. Pin 2, output transformer. Pin 6, field and transformer common. Other pins may be used as anchorages for wiring, if required.

Although this unit is small—just slightly longer and about an inch narrower than this magazine—and is ideal for tucking away in a small space, it should be remembered that adequate ventilation must be provided.

Results

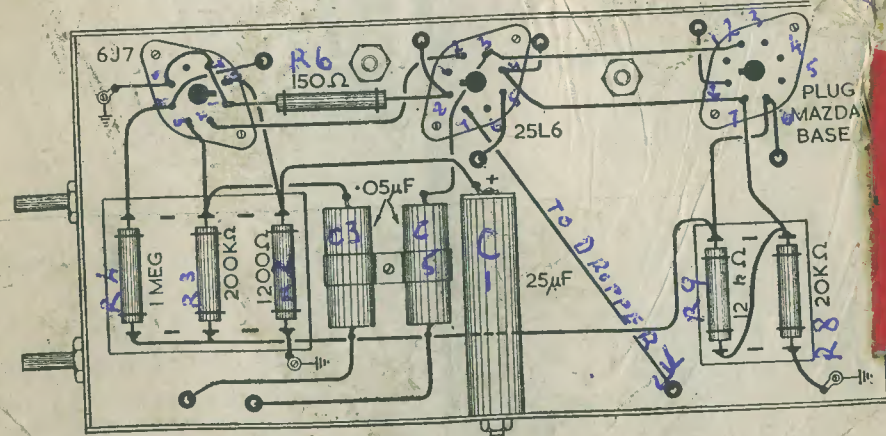
The amplifier was tested with an ordinary

INDEX TO Vol. 4. 1950-1951

A four-page index covering the issues Aug. 1950 to July 1951 is available free of charge. Just send in a stamped, addressed envelope of suitable size, marked "Index RC" in the top left-hand corner, to A.S.W.P., 57 Maida Vale, London, W.9.

magnetic pick-up. As with all AC/DC equipment, the valves take about 30 seconds to warm up. A fairly new record was chosen—Crosby's rendering of "Friendly Mountains"—on which bass, baritone and tenor voices are clearly heard. The result was extremely satisfactory; the gain was more than adequate and the quality was far better than was expected from such a simple circuit.

A couple of final points: Earth the amplifier only through a capacitor of ample voltage rating, preferably one of the mica types, and of a value around $0.25 \mu\text{F}$ 500V. that all AC/DC apparatus must with respect!



UNDERSIDE OF CHASSIS

Fig. 3. Layout of the amplifier below chassis.

QUERY CORNER

A "Radio Constructor" Service for Readers

Picture Distortion

I recently completed a television receiver using a 9 inch magnetically deflected cathode ray tube. After a little experimental work the results obtained, with the gear laid out on a bench, were most satisfactory, so it was decided to instal the receiver in a cabinet. This was done, but upon switching on I was surprised to find that the bottom right hand corner of the picture was distorted. Several components in the time base unit have been changed but without success; what do you suggest is the most likely cause of the trouble?

D. Parkson, Slough.

The distortion experienced with this receiver occurs only in the bottom right corner and therefore involves only a part of the line scan. Now it is most unlikely that the line time base would operate in a linear manner for the majority of the scan but become distorted towards the bottom of the picture, as such an effect could only result from severe interaction between the frame and line time bases. Such interaction would in all probability affect the whole of the lower part of the picture and not just one corner as is the case with this receiver. It would seem, therefore, that the trouble is due to a stray magnetic field originating from a source which is located near the bottom part of the tube screen. This field could result in an unwanted deflection of the electron beam in the CR tube, and might easily cause distortion in one part of the picture. The offending field may originate from the magnet of the loud speaker or from a smoothing choke in the power pack, and some re-arrangement of components within the cabinet should eliminate the source of the trouble, and in all probability result in a cure. If difficulty is encountered in moving components, the stray field may be screened from the tube by means of a metal shield. This material is expensive and difficult to obtain in suitably sized sheets, but there are a number of ex-Government cathode ray tube screens available at present which may be easily cut to size. These screens were originally intended for use with 3½ or 6 inch electrostatic tubes, but by carefully cutting along the seam they may be opened out to form a shield which is sufficiently large to screen the offending field from the tube. A

little experimental work will soon indicate the optimum position for the screen.

Finally a word of warning; when working these screens no attempt must be made to heat them to facilitate bending, as heating will ruin the magnetic properties of mu-metal.

Colour Code for Pick-Ups

I recently obtained a new gramophone pick-up which is suitable for use with either standard or long playing records. The unit is supplied with three different heads which are distinguished by coloured dots, and can be interchanged merely by plugging the appropriate one into the end of the tone arm. Can you tell me the meaning of the colour which is used on the modern pick-ups?

G. Best, Norwich.

The introduction of the long playing slow speed records has provided a number of problems which did not exist with the older type of recording. These slow speed records must be played on a turntable which is particularly free from vibration and because of the increased number of grooves per inch, a fine needle and light weight armature is essential in the pick-up. Some manufacturers

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.

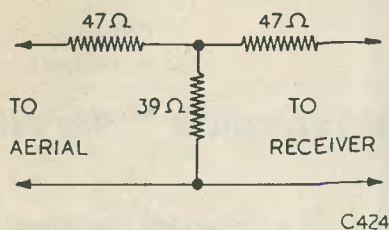


Fig. 1: An 80 Ω attenuator.

have overcome the difficulties and produced gramophones which will play both standard and long playing records by means of a dual speed motor (78 and 33 1/3 r.p.m.) and a pick-up equipped with interchangeable heads. These heads are identified by means of a colour code as follows:—

Red.....	Long playing (33 1/3 r.p.m.)
Green....	Standard (78 r.p.m.)
Violet....	Universal (33 1/3 or 78 r.p.m.)

Whilst on this subject it is worth mentioning that a colour code is also used to distinguish the different sizes of stylus which are now used as standard. The colour is located on the tip of the stylus which is coded as follows:—

Red.....	0.001 inch.
Yellow...	0.002 "
Green....	0.0025 "
Blue....	0.003 "
Orange...	0.0035 "
Violet....	Universal.

The material with which the stylus is tipped is indicated by a coloured band on the shaft and is coded as follows:—

Black....	Hard Metal.
White...	Diamond.
No-colour	Sapphire.

These codings represent a simple and neat method of identifying the different classes of pick-up and stylus which are in current use.

T.V. Overloaded

I have a commercial television receiver which appeared to give a good picture at a friend's house, but when installed in my house the definition was poor and there was a tendency for the sound to modulate the vision signal. As the receiver has in no way been modified, can you suggest a possible reason for the trouble?

E. Lewis, Chingford.

We note that the receiver is installed in a district where the signal is high, and as it is in all probability still in good working order, the trouble is very likely due to overloading of one or more of the valves in the vision channel. However, before deciding that this is the case

the position of the contrast control which provides the best picture should be determined. If this setting is found to be at or near the minimum position of the control there can be no doubt that the poor results are due to over-loading.

The cure is a simple one, and consists of joining an attenuator in the lead between the aerial and the receiver. Such an attenuator may consist of a number of resistors connected in such a manner that they do not upset the matching of the aerial system to the set. The resistor values suggested have been chosen from the 10% tolerance range, and are suitable for use in a 70 to 80 Ω transmission line. An attenuator of this type may conveniently be assembled in a small metal screening box, and connected by means of plugs and sockets in the aerial feeder. Standard carbon resistors are used, wire wound resistors being avoided because of their self inductance.

The method of assembling the attenuator will be made clear by reference to Fig. 1.

H.T. Fuse

I have constructed a power pack for general use in the workshop, but I am not clear as to which is the best position for the fuse. Where do you suggest this should be connected, so as to safeguard the components in the power pack against an accidental short circuit?

E. Lawrence, Devonport.

A fuse should ideally be so positioned in the circuit that it protects all the components against accidental short circuits, and also all components against the failure of any one. This is often impossible to arrange in practice, and a compromise has to be made between the number of components protected and the number of fuses used. In a full wave HT rectifier circuit, the main fuse is best connected in the negative line immediately between the centre tap on the mains transformer and the reservoir capacitor. In this position it safeguards all components with the possible exception of the transformer, should this latter develop a short within the windings. This condition usually means that the transformer is a total loss and it will in all probability overheat very rapidly, thus endangering other components. To prevent this happening, additional fuses must be included in the mains lead as indicated in Fig. 2.

A power supply which is fused as suggested will be completely safeguarded against short circuits or faults occurring within its components.

As a general rule, the HT fuse should be rated to carry three times the maximum HT current. The rating for the mains fuse will depend upon both the HT and LT loading on the transformer, and may be calculated by

TRADE REVIEW

A VERSATILE WAVE-METER.

We have recently been given the opportunity of testing out one of the new E.M.I. Absorption Wavemeters, type AD/U.408. (a product of the Amateur Division). Its appearance is beyond reproach, and one has only to remove the base plate to find evidence of the first-rate workmanship and careful design that one would expect from a Company of such high repute.

An outstanding point is the absence of plug in coils. The tuned circuits are connected via a coupling loop on a flexible probe, which proves invaluable in obtaining access to oscillator circuits which the usual type of absorption meter will not reach. We were struck by its sensitivity in checking receiver oscillator circuits, and by the ease in which tests and checks may be carried out with the unit lying on the bench. For the transmitter, this versatile unit will also provide comparative field strength measurements, over-modulation checks, standing wave measurements, and harmonic indication.

Altogether a fine unit, and in these days of rising production costs, very reasonably priced at £8.15.0. (tax free).

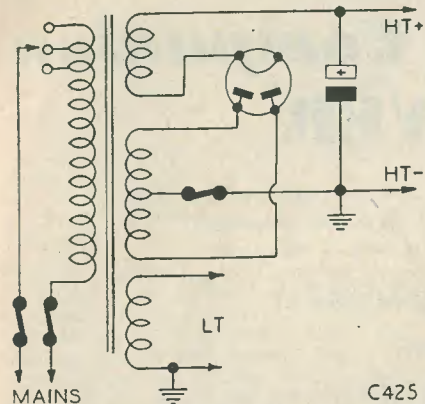
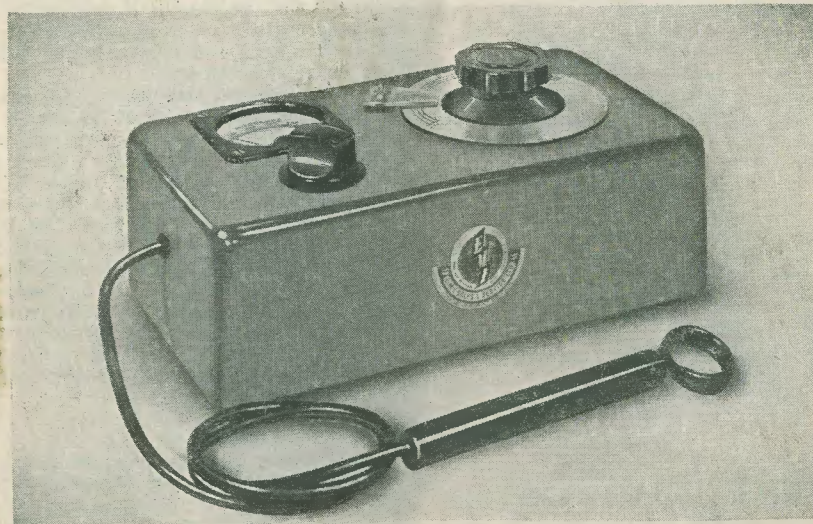


Fig. 2: Showing positions of fuses in a typical power pack (smoothing omitted).

adding the individual loading on each of the secondary windings in watts and dividing the result by the mains voltage. The answer will be a close approximation of the primary current in the transformer, and the mains fuses should be selected to carry three times this current.



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 4

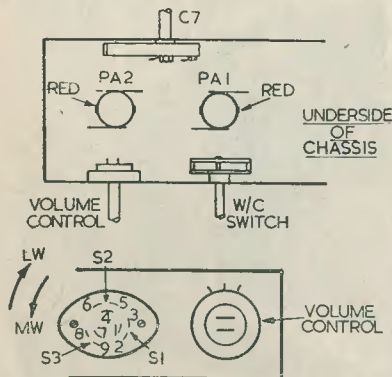
By J. R. DAVIES

Up to date we have wired our receiver "back to" the output grid. We have also modified our PA1 and PA2 coils.

We may now proceed to mount and wire the remaining components.

Fitting the Coils

Before the coils are fitted, it is first of all necessary to mount the reaction capacitor, C7, and the wave-change switch. It may be found that the latter rests against pins 7 and 8 of the V1 valveholder, whereupon



C401

Fig. 1: Layout of coils.

Fig. 2: View of rear of wave-change switch, showing how the tags are numbered for later reference.

these should be bent slightly downwards. If the correct chassis layout has been adopted these pins will be at chassis potential, so there is no risk of short circuits.

The coils can now be mounted by using the two 6BA countersunk holes on the chassis, following carefully the layout shown in Fig. 1. It is important to see that the "red" tags on the coils are in the position shown in this diagram. The two tags on each coil which project upwards should be bent back.

Looked at from the inside rear, the wave-change switch will have the appearance shown in Fig. 2. This switch consists really of three parts, the various tags of which are numbered 1 to 9 in the diagram. We may now start on the connections to the switch, using the references of Fig. 2.

Fig. 3 shows the preliminary connections. For convenience these should be carried out in the order: 2, 3, 1, 9, 8. The lead connected to tag 1 of the switch should be about a foot long and should be passed to the top of the chassis through the loudspeaker recess, away from the rest of the RF wiring. Its other end will be connected later. The additional aerial tap wires from each coil can be taken directly to the appropriate tags on the wave-change switch, and should not be covered with sleeving as this may weaken them. They should be kept fairly close to the coils and the chassis to prevent other wires breaking them.

The Tuning Capacitor

The two-gang tuning capacitor may now be mounted. The section of the capacitor nearest the front of the receiver, (C10), carries out the tuning; whilst that at the rear, (C6), is for reaction purposes. Three

leads should be soldered to the fixed vanes as shown in Fig. 4. Two rubber grommets are next inserted in the two $\frac{3}{8}$ " holes at the extreme end of the chassis, the 7" lead from the capacitor being passed through the forward one. Finally, the board holding the trimmers can be fitted to the chassis.

The next part of the wiring consists of connecting up the grid circuit of the output valve, and the anode circuit of V1. We left the output valve grid connected temporarily to chassis via a leak, which should now be removed.

The AF Circuits

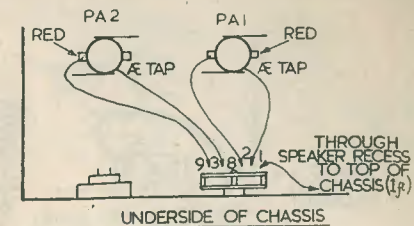
Wiring up the output grid circuit is started by fitting a length of screened lead to the volume control as shown in Fig. 5 (a). It will be seen in this diagram that the right hand tag of the volume control proper is connected to one of the switch tags, and it is imperative to ensure that this tag be the one which is connected to the earthy solder tag adjacent to V1 valveholder. After passing through the grommet to the top of the chassis, the screened lead is taken over the route shown in Fig. 5 (b),* it being anchored to the tuning capacitor frame by small solder tags bent to form cleats. It will be necessary to insulate the screened lead below the chassis to prevent it short-circuiting against the tags of the medium-wave coil; the simplest way of doing this being to wrap tape around or slip sleeving over the lead for this length before it is fitted.

Screened wire is used here in order to avoid RF interaction.

The rest of the under-chassis circuit to V1 may now be wired up as illustrated in Fig. 6. This wiring should be carried out in the following order: earthing solder tag to "red" tag of PA1 coil; C13, R2 and R3 to pin 6 (dummy) of V1 valveholder (C13 being mounted vertically); the other end of R2 to pin 3 of V1 together with C12 and lead to C7 (of which the other end may now be connected); the other end of R3 to pin 4 of V2; pins 4 and 5 of V1 together and thence to "red" tag of PA1 coil, together with other end of C12; the top unused lead of C13 to left-hand tag of volume control, R4 (it may be necessary to extend this lead; and it should also be covered with sleeving); and C14 across R4. (In practice the wiring would, of course, be shorter and more direct than that shown in the diagram.)

We next proceed to the grid of V1. Turning the chassis right-way-up we first of all mount C11 to the tuning capacitor frame as shown in Fig. 7. We then take the four-inch

*For purposes of simplicity, the trimmer board is not shown in this diagram, although it is already fitted.



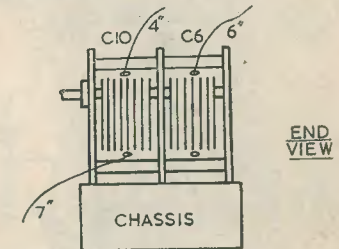
C402

Fig. 3: Preliminary wiring to wave-change switch.

lead of Fig. 4 and, shortening it as necessary, connect it to the bottom end of C11. (The wires projecting from this capacitor may be cut short and used for anchoring purposes, but they should not be overheated by the soldering iron). If the tuning capacitor front earthing contact appears behind C11 it may be used for the chassis connection of R1, (the tuning capacitor is itself connected to chassis by its mountings); but, should this not occur, a solder tag will have to be mounted under the screw which secures C11.

Wiring the Coils

Our receiver is now nearly complete, all that is mainly necessary being to wire the coil circuits. This is done as illustrated in Fig. 8. The wiring should be carried out in



C403

Fig. 4: Connections to the fixed vanes of the two-gang capacitor after mounting.

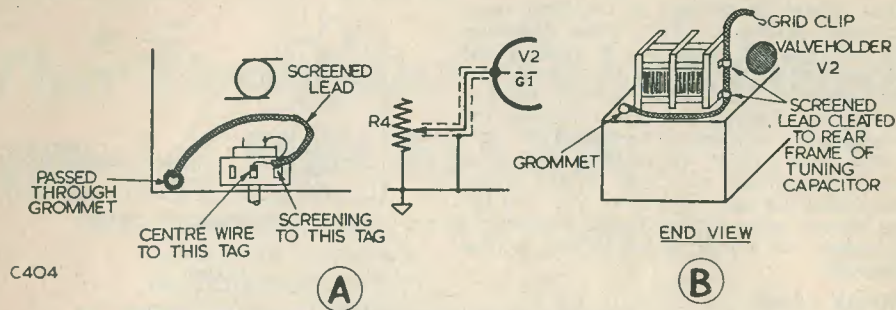


Fig. 5 (a): The connections to the volume control.
Fig. 5 (b): The route taken by the screened lead above the chassis.

the following order: seven-inch lead from C10 (see Fig. 4), shortened as necessary, to tag 7 of the wave-change switch; C9 between tag 8 and PA1 "red" tag; moving vanes of C7 to tag 4; tag 5 to PA1 coil; and tag 6 to PA2 coil. This now leaves a free tag on both PA1 and PA2 coils, that tag being the one nearest the front panel in both cases.

The board holding the trimmers is now connected up as illustrated in Fig. 9. The leads labelled "to PA 1 coil" and "to PA 2

coil" are connected to the free tags left after the wiring shown in Fig. 8 was completed. The "earth tag on the tuning capacitor" is the same as that used by R1 in Fig. 7.

The aerial isolating capacitor, C1, may next be mounted on the rear of the tuning capacitor. See Fig. 10. The lead from tag 1 of the wave-change switch, which was passed through the speaker recess in Fig. 3, is connected, shortened as required, to the bottom end of this capacitor. An eighteen-inch length of flexible wire is connected to the other end. This wire is for the aerial connection and may be terminated in a crocodile clip. It is anchored to the rear of the tuning capacitor frame.

Testing the Receiver

The "Good Companion" receiver is now complete and ready for tests.

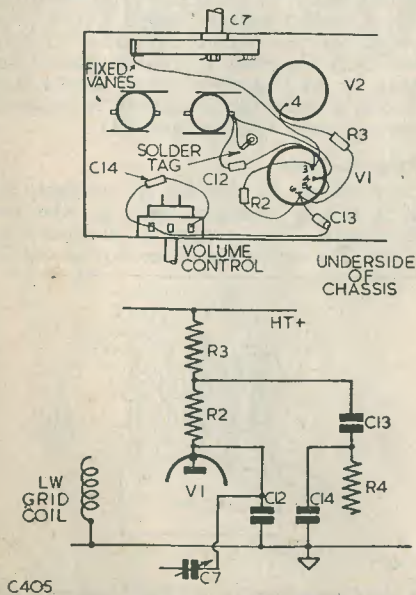


Fig. 6: Connections to the anode circuit of V1.

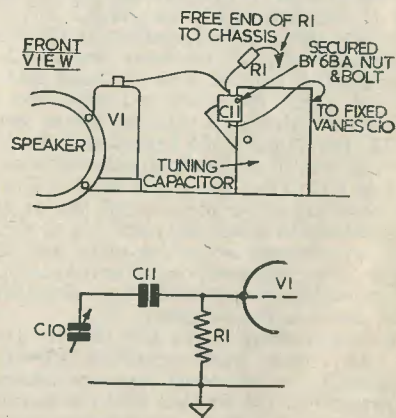


Fig. 7: Wiring the grid circuit of V1.

Before starting, the four trimmers, C2 to C5, should be screwed up tight. An aerial can then be connected to the aerial lead. An earth connection should not be used as the chassis is at mains potential; the symbol in Fig. 1 (May & June) indicates chassis—not earth.

After the set has been connected to the mains and has warmed up, the AF stages may be checked by touching the grid of V1 with the finger, the volume control being set to "full". A loud hum or other noise will then indicate that the AF circuits are apparently satisfactory.

The wave-change switch should be turned clockwise (for medium waves) and the tuning capacitor rotated. C7, at the rear of the chassis, can be used as a normal reaction control for the time being. Reaction should be smooth and free from backlash.

It should be possible to tune in at least the local station and, at night time, many other transmitters. It will be found that the application of reaction greatly increases selectivity and sensitivity; whilst, should a station then become too loud, its volume may be reduced by the volume control. The "Constant Companion" is an extremely stable receiver and adjusting the volume control should not have the slightest effect upon the reaction setting.

The receiver may then be switched to the long wave band, whereupon the Light programme on 1500 metres should be received at good strength. Radio Luxembourg and several other stations may also be heard.

The Action of the Trimmers:

The trimmers may now be adjusted. This process is quite simple, but it would be as well to quickly run through the results obtained from them before commencing.

It must first of all be appreciated that it will not be possible to obtain a state whereby reaction is just below oscillation point at all parts of the dial. This was explained in the introductory article of this series. The results which may be obtained, are, of course, very much better than would occur if normal pre-set reaction were used; adjustments being made to enable the required amount of feedback over the largest amount of the band to be obtained.

Figs. 11 (a) and (b) show the conditions of feedback in this particular receiver for different settings of the tuning capacitor. Individual models will present slight discrepancies but, if care has been taken in the construction of the receiver, these differences should not be very great. Fig. 11 (a) illus-

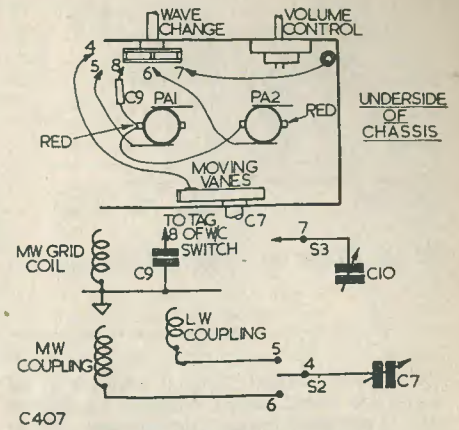


Fig. 8: Further coil wiring.

trates the optimum results obtained on the medium-wave band, whilst Fig. 11 (b) represents those for the long-wave band. Of the two the medium-wave band is the easier to set up and give results which are the more apparent. This is due mainly to the fact that on the long-wave band, a fairly small value of feedback capacitance is given by the trimmers, and the extra capacitance brought into circuit by rotating C7 has, therefore, a relatively smaller effect upon the actual strength of signals than it has on the

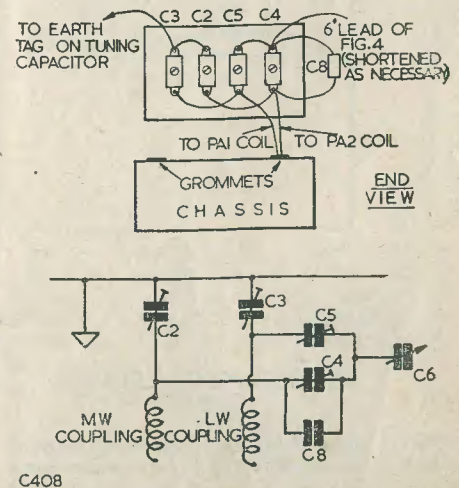


Fig. 9: The connections to the trimmers.

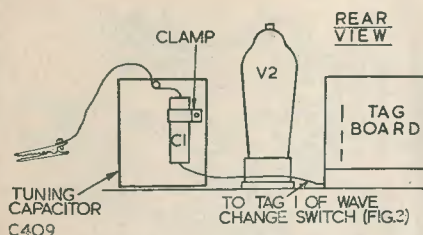


Fig. 10: Fitting the aerial isolating capacitor, C1.

medium-wave band. Thus it will be found in practice that if, say, 15 degrees of rotation of C7 is necessary to make the receiver oscillate at the extreme low-frequency end of the long-wave band, (where the curve of Fig. 11 (b) goes up), the effect upon the actual feedback capacitance is only small.

In all cases, when trimming is being carried out, the state of the reaction circuit is checked by experimentally turning C7 to see if the receiver is just below oscillation point.

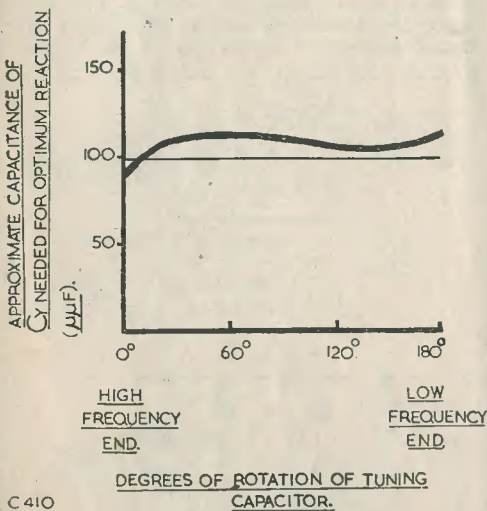


Fig. 11 (a) and (b) Curves showing feedback obtained on medium and long wave bands respectively. For Fig. 11a, see Fig. 3a, May issue.

Adjusting the Trimmers

The receiver should be connected to an aerial before trimming is commenced. If a very large aerial is used a capacitor of 300 pF should be connected in series with the aerial to reduce the capacitive load upon the tuned circuits.

The set is switched on and allowed to warm up. The wave-change switch is put to the long-wave position (anti-clockwise). C3 is then set to approximately half-capacitance, all the other trimmers being set to minimum capacitance. The tuning capacitor is set to the high-frequency end of the band and C7 is adjusted until the receiver just goes into oscillation. The tuning capacitor is then rotated until the vanes are about three quarters in mesh, and C5 is adjusted until the set is just below oscillation point. This will introduce extra capacitance across C3 whose value will have to be slightly reduced at the high-frequency end again. If this reduction is outside its range the value of C7 itself should be slightly reduced.

Long-wave reaction is now roughly set up, and capacitor C7 should not be touched for the time being. The receiver is switched to medium-waves and the tuning capacitor set with its vanes about a quarter enmeshed. Capacitor C2 is then adjusted to bring the receiver just below oscillation point. The tuning capacitor vanes are then set to maximum capacitance and C4 adjusted for optimum reaction. The tuning capacitor is set back to the first position again, and C2 and C4 are readjusted as before. The receiver is then switched to long-waves whereupon it might be found necessary to slightly reduce the capacitance of C3 to prevent oscillation over too much of the long wave band. (The receiver should go into oscillation over only a few degrees at the high-frequency end of this band).

The receiver is then returned to medium-waves again, and the response over the whole band is checked. It may happen that the receiver will go into oscillation for a short space on the centre of the band and this may be eliminated by a very slight reduction in the value of C2.

The trimmers are now set up and reaction over both bands may be checked by seeing that C7 is in the correct reaction position over nearly all of both bands; remember that a fairly large movement of this capacitor only entails a small increase in feedback capacitance on the long wave band. As was explained in the introductory article, the only adjustments now needed are those to C7

when the receiver is connected to a different mains supply, or to an aerial whose characteristics are greatly at variance with those of the original one.

The Tuning Dial

Directions for fitting a dial have not been included in these articles as they will depend upon the dimensions and layout of the cabinet in which the receiver is housed. Nevertheless a "panel sheet" which will offer a very neat dial was printed in the last issue. A suggested cabinet layout was shown on the cover of the May issue.

It may have been noticed that, in the photographs, an epicyclic drive is fitted to the tuning capacitor spindle. This fitting can of course be carried out by individual constructors quite simply, and there is no necessity for the writer to give illustrations or dimensions, etc. Two pieces of thin wire soldered to the drive and painted black would make an effective pointer for the tuning scale.

Next Month: Making a Cabinet for this Receiver.

from our



Mailbag

AP — SC — or both ???

Dear Ed,—The following observations may be of interest to those using the RF25 and 1355 receiver. It will, no doubt, be of special interest to those readers on the fringe areas of AP and SC.

With the RF25 Unit tuned to AP and the oscillator tuning to the higher frequency of 52.5 Mcs (45 + 7.5 Mcs), we have the SC transmitter working with a bandwidth of 59—61.75 Mcs. Taking the approximate centre of this bandwidth, and remembering that the oscillator can also work 7.5 Mcs below the video signal, we have 60 Mcs—7.5 Mcs = 52.5 Mcs., the same oscillator frequency as used for AP. The RF Unit, therefore, picks up SC signals, even when the mixer and RF stages are tuned to 45 Mcs, providing the signals are strong enough. The RF25 Unit, unmodified, gives good pictures in my own locality, and prior to the opening of SC gave good service from AP.

Final Details

The "Constant Companion" has been tested on various aerial systems and mains supplies, DC and AC. The receiver worked well under all these conditions with hardly any trace of hum and, in all cases except one, no modulation hum. This latter case occurred when the set was connected to the output of a local un-earthed DC/AC rotary converter, and the trouble was cleared by connecting the chassis to earth via a 0.01 μF capacitor. However, such exceptionally poor supply conditions will not exist when normal mains supplies are used. Sometimes improved results might be obtained on AC mains by reversing the mains plug, (a fact common to most "universal" receivers, straight or super-het); this bringing the chassis to the potential of the "neutral" supply line.

It was also found that very large aerials are liable to slightly damp the receiver coils. This may be obviated by connecting a 300 pF capacitor in series with the aerial.

It is possible that in the fringe area, although the Unit may be tuned to AP, signals may be coming in from SC. It is also possible that both signals are being received. A time lag between these two signals will result in ghosts.

A simple check-up can be made by unscrewing the trimmers of the RF and mixer stages. If the signals become stronger, then SC is being received, and if the signals become weaker then the Unit is picking up AP. When it has been determined which station is being received, the following modifications are worth while. If two signals are received, the stronger of the two should be chosen.

To receive AP

Add 1 turn to the switch end of the oscillator coil, and re-trim No. 2 oscillator trimmer. This will cause the oscillator to work at the lower frequency, which is well away from the SC oscillator frequency.

To receive SC

Remove 1 turn from the switch end of the coils in the oscillator, mixer, and RF stages. This will cause the oscillator to work at the higher frequency, 69.25 Mcs, and the mixer and RF stages will also peak.—H. W. Arundel (Birmingham).

Magnetic Recording

Dear Sir,.....Incidentally, would it be possible for me to contact any other reader who lives locally and is interested in recording? —Alfred Roberts, 15 Clarens Street, Catford, London S.E.6.

Radio Miscellany

There are many people in this country who regard radio repairing and servicing as a racket. Most of us know of instances where friends have been rooked over trivial repairs, and of cases where practically new sets have been put miles out of alignment and sometimes damaged by clumsy and ignorant botchers.

Such racketeering was once even more widespread. So much so, that radio servicing has a name which conscientious repairers find constant difficulty in living down. Indeed, they are often immediately suspected of pulling a fast one whenever they estimate for a repair entailing any of the more expensive replacements.

Many a worthy housewife after the set, working perfectly, has been re-installed, has complained "It doesn't sound the same as before" and is secretly convinced that the repairer has pinched the best of her valves and replaced them with worn out ones!

One shudders to think what goes on in the name of radio servicing in some parts of the world where there is a less enlightened public. For instance, the servicing notes from an Indian magazine says, with delightful frankness, "Many servicemen do not read the manufacturers instructions at all."

Spiivs

There, too, even the dealer seems to have his own troubles. Another issue tells us of the following, under the heading "Blackest Profiteer". The rather quaint, but expressive wording, is retained. "A dealer in Karachi having branches in many places sold one Yard of Drive Cord for annas eight only to another dealer when that Drive Cord is available at Rs. 1/12 for 500 yards. What A Margin of Profit! Wants to be rich the next morning, it seems."

At that rate of profit I should imagine he would get rich that morning without waiting for the next!

Mail Order houses, too, come in for casting under the heading "Bogus Price Lists". It tells us "Some Dealers publish price-lists and on receiving the same, if one places an order immediately the prices are raised or part order is obeyed. For example if you order valves some They will Send you, but others will be out of stock. Then what is the need of printing a Price list. The above Karachi Dealer Published a price-List showing Capacitors' discount 50% & 5%. When you go and purchase well it is 50% only on the very day."

It's a wicked world. Apparently there are other forms of spivery besides selling nylons from Oxford Street pavements.

Trans-Atlantic TV

Following my recent mention of the reception of a recognisable picture in New York of a Baird transmission, the question of the first (and probably the only) occasion when a TV transmission from America was received in England, has been raised. This occurred in September, 1930, when Douglas Walters, G5CV, then living in West London, received recognisable pictures transmitted by the General Electric Co. in New York. He had for some years been an engineer with the Baird Company, and was closely associated with their pioneering experimental work.

At the time of reception (which was confirmed by cablegram) he was fortunate in having experimental discs other than the then standard British 30-line. A 60-line disc gave a clearly recognisable picture, although it was of incorrect aspect ratio.

Synchronisation could only be effected by running the disc motor too fast and controlling the speed by braking with the thumb and finger on the shaft. The thrill of being the first to see American TV from this side of the Atlantic was well worth far greater discomfort than the resultant soreness and blisters!

I know of no other authenticated claim of reception of trans-Atlantic TV in this country and, by all the rules, it will be a long time before there is another. The transmission was then around 15 Mcs. and with the present frequencies Dx of this nature could only occur under the rarest of freak conditions. Readers will remember that in the winter of 1948/49 a South African amateur, ZS1P, during a period of high sun spot activity was able to receive satisfactory pictures and sound from Alexander Palace, plus considerable interference from other TV and navigation air transmissions.

Who knows what chaos may be in store during similar conditions when there are as many TV stations in operation as there are broadcasters today?

A Forgotten Art?

Younger readers—by that I mean those born after the Armistice of 1918, who could at the most have been but 12 years old at the time of Mr. Douglas' feat—can scarcely appreciate quite what an achievement trans-Atlantic TV was. Home constructed receivers, built bread-board fashion, were still the order of the day. The mass-produced factory-

built set was in its teething stage, and the enthusiastic constructor was still finding plenty of scope for activity in building sets for his friends and relatives. The screened-grid valve was already an established favourite but multi-electrode valves, on the horizon, were regarded with grave suspicion by constructors who did not like the superhet circuit—sometimes from experience but more often because of its reputation for poor quality. They were "new-fangled and" did not very easily fit in with the sort of wireless that the handyman-constructor felt he understood.

It may sound funny to-day, but when "high-efficiency" was sought for short-wave work it seemed quite reasonable and natural to pull off the bases from detector and RF valves and solder them direct into the circuit in an aim to reduce capacitances. To keep the set at its peak of sensitivity one had it on the brink of oscillation, and to keep it at that point one dare not go near it for fear that it "spilled over". Hence we used eighteen-inch extension rods on all the controls, and the reaction had to be capable of superfine adjustment.

Even for broadcast listening the straight set died hard, but the handyman went into a decline as the commercial superhet made possible by efficient multi-electrode valves beat him even on the grounds of cheapness. By 1935 he was a rare bird, doomed to early extinction.

CENTRE TAP talks about RACKETEERING - TRANS-ATLANTIC TV - THE FUTURE

Looking Ahead

In recent months I seem to have spent a lot of time in looking back on the good old days, and I am now asked "Why not look forward for a change?". By tootling the jolly old trumpet I could put in a word or two of one or two minor prophecies scored in the past and—well, every prophet hopes his misses are forgotten. Older readers are requested not to remind me about what I said of long-wave broadcasting in 1937—there's been a War since then!

There is, however, one forecast I regard as a banker. I refer to the approaching change from amplitude to frequency modulation. The advantages are so obvious that one does not have to gaze into the crystal. It is odd when one recalls that FM was one original method used in "wireless telephony" but was abandoned in favour of AM. Unfortunately, the transition will have to be gradual as so

many sets cannot easily be modified.

Those who have heard FM transmissions know what a revelation their first experience of it was. Greater faithfulness, improved selectivity, and far less background. It has, too, the added virtue of requiring a narrow waveband, thus making it possible for more stations to operate without interference.

The cost of FM broadcast stations are very much cheaper, and it would be easily possible for universities, municipalities, etc., to run their own transmissions, although the BBC are not likely to yield their monopoly without a struggle.

Other Probable Developments

With television, we find there are quite a number of possibilities even for immediate development. In fact, TV telephones, colour-vision and stereovision could all be introduced within months—if the money and public interest were forthcoming, and the BBC were not already committed to continue on the present lines.

There is, too, another accomplishment which has not been given the attention it deserved—the transmission of both sound and vision on the same frequency. Readers will already know that the time required to scan a single line is in the region of 90 millionths of a second, and the flyback interval—when the beam returns to begin the next scan—takes about 10 millionths. These otherwise—

wasted 10 millionths parts can be used for the transmission of sound by filtering the vision and feeding the sound to the speaker. This would not only allow space for alternative local programmes but would considerably reduce the cost of both transmitters and receivers.

Facsimile Reproduction

Modern high speed facsimile reproduction methods have given many successful repeat performances. In fact, in America, a whole book was reproduced this way. Printed pages, including pictures if necessary, are photographed and placed before a TV camera and transmitted in a similar way to ordinary TV programmes. There is nothing very new about this, but here is where the novelty comes in. At the receiver end the pictures are photographed by a high-speed camera, developed, printed and dried in a matter of seconds. (Continued on P. 30)

MEDIUM EHT

By

J. K. OWEN

JUDGING by the literature which has appeared on the subject, the construction of oscilloscopes is very popular, and, considering the utility and versatility of a well made instrument, this is not surprising.

Probably the most popular tube for this purpose is the VCR97 chiefly on account of its availability—it was probably the most over-worked tube in the Forces during the war. At the same time, it is generally purchased in a case, complete with most of the valves and associated equipment, which bears a strong resemblance to what the constructor imagines his completed instrument should look like, thereby removing at once one of the major bugbears attaching to the construction of such an article.

The popularity of the VCR97 is reflected in the advertisement pages of the technical press, where it is not difficult to find all that is required to fill in the gaps left in the original purchase. However, the VCR97 is not always the most suitable tube for an oscilloscope. Its size, for one thing, makes the dimensions of the finished instrument a source of embarrassment on many a test bench, while its signal input requirements necessitate in most cases a large amplification of the test voltage, with the attendant risk of distortion.

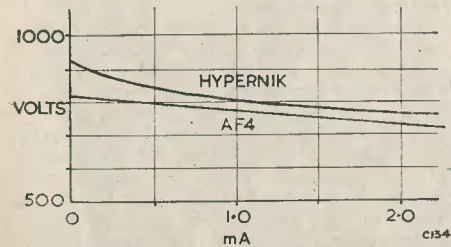


Fig. 1: Voltage regulation curves of the Lissen "Hypernik" and Ferranti "AF4" transformers.

From many points of view, the 3" or 4" diameter tube, requiring some 800 to 1,000 volts on the final anode, is eminently suitable for a general purpose instrument, but this modest EHT requirement is, surprisingly, itself a source of difficulty, for whereas the 2,000 to 3,000 volts required by the larger tubes are readily obtainable, to purchase a 1,000 volt transformer is another matter.

A solution which has been in regular use by the writer for the last 18 months or so is the use of an inter-valve transformer, with the primary connected across the mains. A transformer with a 1:3.5 ratio, connected in this way across a 230 volt supply, delivers approximately 800 volts RMS, which, when rectified and smoothed in the usual manner, and with the normal load taken by a tube circuit, is practically equal to the peak input voltage, i.e., over 1,000 volts DC.

While there is nothing critical about the transformer, there are one or two points to consider before one is finally chosen. Since

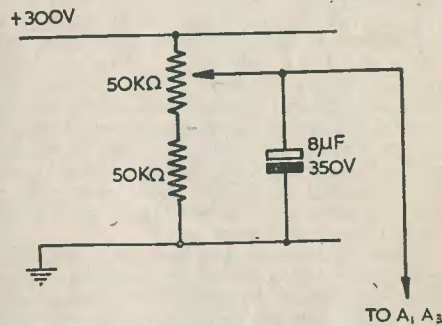
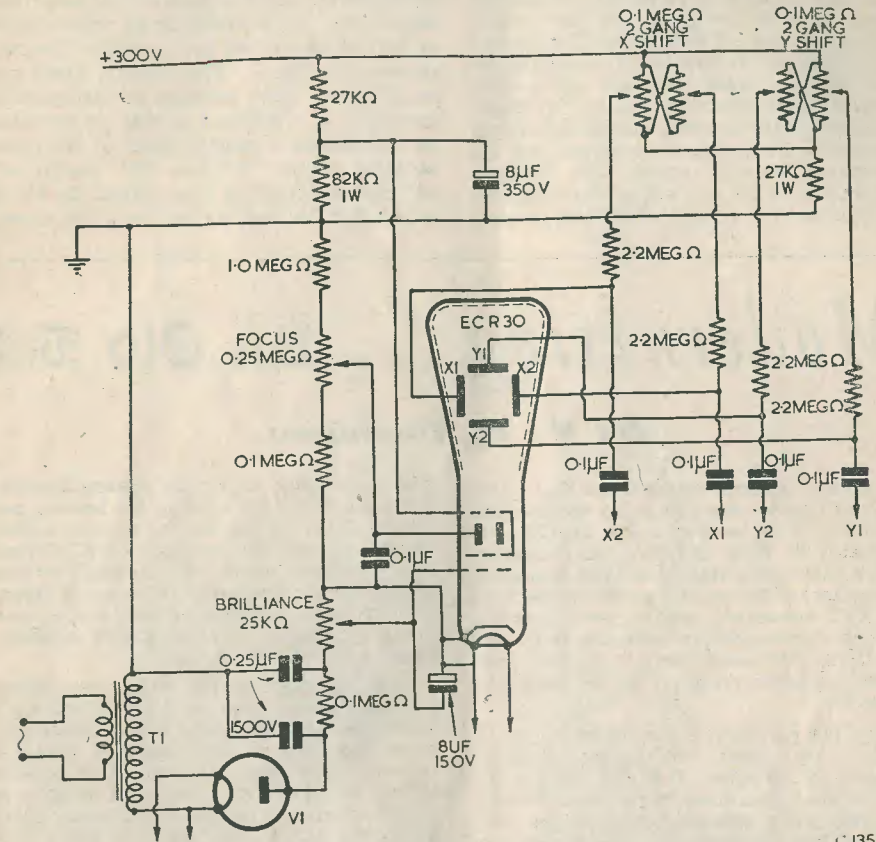


FIG 3

Fig. 3: Alternative connection for A1, A3, providing astigmatism control.



C135

Fig. 2: Complete tube supply network. All resistors except where otherwise stated may be 1/2W type. V1 may be any suitable HV rectifier. T1 is the inter-valve transformer, the ratio depending upon the EHT required.

it will be called upon to deliver something up to about 2 watts, this rules out the small modern "parallel feed" type. It is essential (particularly if the "junk-box" is the source of supply) to test the transformer first by connecting the primary, in series with a 1 amp. fuse, across the mains. If a suitable AC voltmeter is available, this should be connected across the secondary. A transformer which "hums" at all under these conditions should be discarded—it probably means shorted turns on either the primary or secondary.

The writer has tested a number of transformers for this application, and has had no difficulty in finding a suitable component.

Fig. 1 gives the voltage regulation curves of a Lissen "Hypernik" (4:1 ratio) and a Ferranti AF4 (3.5:1) over a range of 0 to 2 mA, this range amply covering the current requirements of most tube circuits.

In Fig. 2 is given the complete tube supply network used by the writer with an ECR30, (VCR 139A).

No originality is claimed for this circuit, but the "X" and "Y" shift controls are worthy of mention. The ECR30 is essentially a tube for symmetrical deflection, and is so operated in the writer's oscilloscope, with push-pull SP61's in the output stages of both the time-base and "Y" amplifiers.

The advantages of this type of operation are largely off-set by the use of the more usual single-ended type of shift control, as correct focus of the spot is then only obtained in the centre of the screen, and any appreciable displacement, in either the "X" or "Y" plane, is accompanied by a corresponding de-focusing. This trouble is completely overcome by the symmetrical controls shown. The first and third anodes of the tube are shown connected to a fixed point in a potential dividing network

across the HT supply, which in practice proves satisfactory, but it would be an improvement to take them instead to a variable resistor, as shown in Fig. 3. This control, which can be a "pre-set", then becomes an "astigmatism control". It is adjusted so that the potential on the anodes is exactly equal to the mean potential of the "X" and "Y" plates, and as this mean potential never varies, the focus, once set, holds over the whole of the screen.

Modernising ... An Old Set

By W. E. Thompson.

IT recently occurred to the writer that it was about time his domestic radio needed some attention. This receiver, a Pye QAC/2, was purchased in 1938 and has given excellent service, but quality and volume had noticeably deteriorated of late to such an extent that even the XYL remarked upon it, and since the female ear is notoriously oblivious to foul distortion things had surely come to a pretty pass! It was therefore necessary to do something about it.

Now this particular Pye superhet was produced in two types, one having frequency changer, IF amplifier, D.D.Pen. output and FW rectifier, the other being similar except that there was a separate pentode output valve preceded by a double-diode. The same chassis seems to have been used for either type and this point was noted when it was decided to service the set. In the course of previous valve replacements the original types had been replaced by Mullard equivalents, so that the present line-up was FC4, VP4B, Pen4DD and DW4/350.

The first thing that came to light was that all valves were below par, so the immediate reaction was to go out and buy new ones, but second thoughts on the matter made me consider that instead of laying out some £3 or more on new bottles, I could possibly make use of some of the many octal-based 6.3V types that had come to hand in purchasing odd bits of ex-Govt. gear. A search revealed that plenty of useable types were on hand, and it was decided to use the following line-up:—EK32, EF39, EBC33, EL32, 6X5.

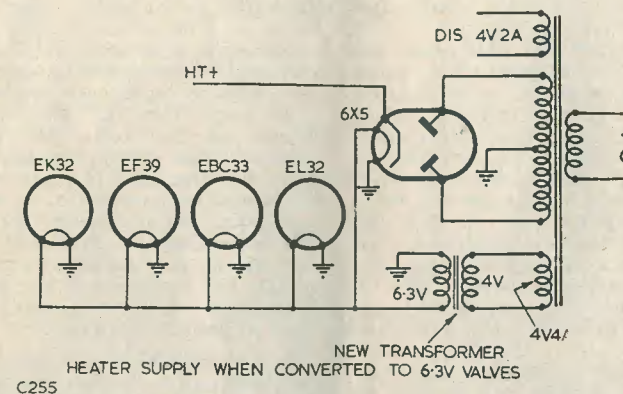
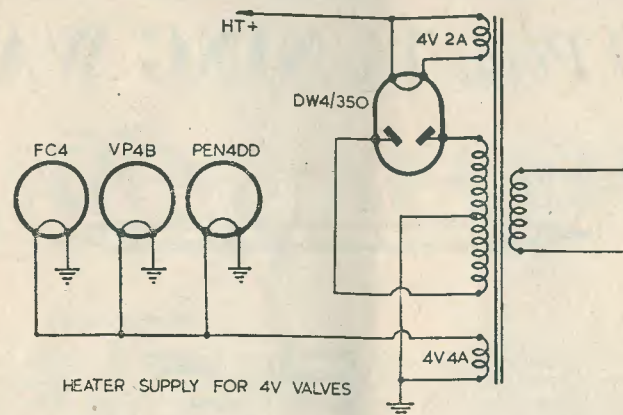
The discerning reader will straight away say, "Yes—but what about the mains transformer!"

And quite rightly so, for the existing transformer has a 4.0V 4.0A winding for heaters, and a 4.0V 2.0A winding for the rectifier heater, whereas the new line-up requires a 6.3V winding. Obviously neither of these could be used directly for the new valves, so it would appear that one must either buy another mains transformer or rewind the existing 4.0V windings. In actual fact I did neither.

In the first place the 6X5 rectifier was chosen purposely (rather than say a 5Z4 which has a 5.0V heater) because it has a 6.3V heater and, more important, its heater-cathode voltage is rated at 450V peak. It is therefore possible to feed its heater from the same winding as the other valves, a method which is very popular in the U.S.A. but somehow seems little used in this country.

Change of valve bases, wiring changes etc., are obviously necessary, but these need not be dealt with here since the main purpose of the article is to point the way to feeding the 6.3V heaters from the existing 4.0V winding of the mains transformer. Really the answer to the problem is quite simple, for all we need to do is fit a small transformer to step up the 4.0V to 6.3V, connecting the primary to the existing transformer and the secondary to the valve heaters. It is now only a question of getting a suitable transformer, and again we use our cunning and make one!

The total heater consumption of the three 4.0V valves in the set was 3,55A, amounting to nearly 16.0W. The total consumption of all five 6.3V valves quoted amounts to only 1.4A so the load is but 9.0W, or just over half the original figure. Now a transformer capable of handling 9.0W secondary load need be only



very small, and I used stampings taken from an output transformer with a dis primary which once belonged to an old Celestion speaker. These stampings have a centre limb roughly 0.75 in. wide, the stack being nearly 0.75 in. thick, the outside dimensions of the core being 2.25 in. by 1.875 in., and the winding window 1.0 in. by 0.375 in. Calculation will show that for a secondary delivering 6.3V at 1.4A, the primary needs to carry 2.24A at 4.0V. We can safely use 19 swg enamelled wire for the primary and 22 swg enamelled wire for the secondary.

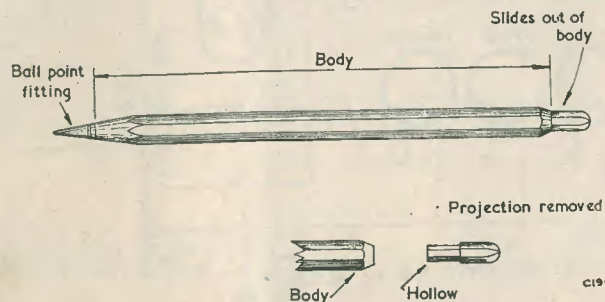
A turns-per-volt figure of 16 being decided upon for this core, the primary turns are $4 \times 16 = 64$, and the secondary turns $6.3 \times 16 = 101$. Now this will run from the 4.0V 4.0A heater winding and the load taken is roughly half that this winding can deliver, and the 4.0V 2.0A winding will not be used, so the loading on the mains transformer is somewhat reduced. There will in consequence be a slight rise above

4.0V, sufficient in fact to enable us to neglect any IR drop in the new transformer, which means that we need not make the usual compensation in turns ratio. The transformer was therefore wound as calculated, that is, 64 turns 19 swg for the primary and 101 turns 22 swg for the secondary, two layers of Empire tape serving as insulation between windings.

This modification to the set works quite well, and taking into account current prices for the ex-Govt. valves quoted and the small cost of the wire used for the transformer, the cost has turned out to be less than half the price of a new set of 4.0V valves. The small heater transformer takes up little space and has in fact been mounted on top of the existing mains transformer. The diagrams appended show the heater supply arrangement before and after conversion to 6.3V valves

(Such a transformer can also, of course, be used for feeding 4.0V valves from a 6.3V source—Ed.).

A Ball Point TUNING WAND



By Eric Lowdon

THE rough draft of this little article was written with a ball-point tuning wand, which also serves, when the occasion arises, for checking the alignment of tuned circuits. And what, exactly, is a ball-point tuning wand? Well, most old timers will be familiar with the "tuning wand" part of the title, which refers to a very useful little gadget that was in common use before the war. In these days of multiple tuned circuits it certainly deserves to be better known. It consists simply of a short rod of insulating material, such as bakelite or perspex, with a small brass slug mounted on one end, and an iron-dust slug on the other.

The device is used to check whether or not the tuned circuits, perhaps in a receiver, are properly peaked, without the necessity for disturbing the trimmers, which may possibly be sealed. It will also indicate the direction in which the circuit is off tune; that is to say, whether or not the trimmer capacitance requires to be increased or decreased for peak resonance. This is accomplished by simply feeding a signal into the receiver, and advancing each end of the wand, in turn, towards the coil to be checked. If the output decreases each time, then the circuit is peaked to maximum, but if the output increases as one end is introduced into the coil and decreases with the other, then the circuit is off tune. The direction in which the circuit is off tune is deduced according to which end of the wand gives rise to an increase in output.

For example, when the iron dust slug is introduced into a coil it causes an increase in inductance and, if this increases the output, then it is immediately obvious that the trimmer capacitance will have to be increased to peak the circuit. The effect of the brass slug is to

decrease the inductance, and if this causes an increase in output it will be necessary to make the trimming capacitance smaller.

So much, then, for the "tuning wand." Where does the "ball-point" come into the picture? This merely indicates that a ball-point pen was used to make this particular wand, without impairing in any way its writing properties. As a matter of fact, the make of pen in question is so admirably suited for the conversion, that one would almost think the makers had tuning wands in mind when they designed it. Ten minutes should see the job through from start to finish.

It is called the "Scroll" pen, and sells for five shillings (no, I don't have shares in this firm) and the feature which makes it so useful is shown in Figure I. The body of the pen consists of a slim hexagonal tube, suitably shaped at one end to take the brass ball-point attachment—this is our brass slug—while the other end terminates in a hexagonal projection. This projection slides out of the body—a fact which I discovered accidentally—and it is hollow. The rest is easy. A tuning slug (the writer used a broken one taken from an IF transformer) is pared down until it is thin enough to fit into the hollow projection, with a spot of adhesive to keep it in position. Reassemble the pen and the job is done. The fact that the metal ink receptacle runs the length of the body does not affect it in any way.

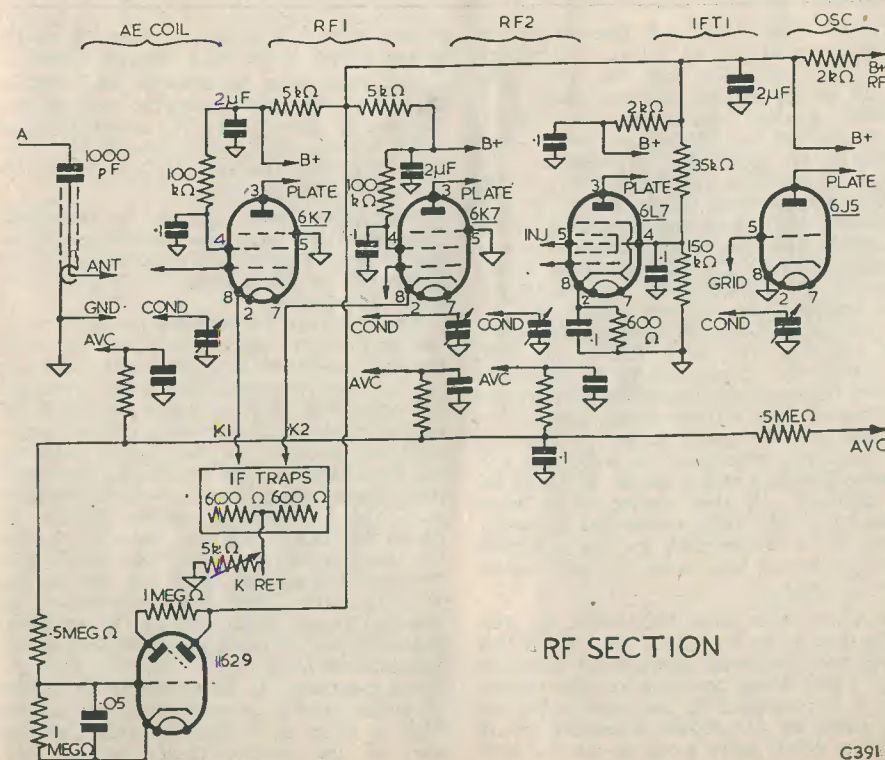
We now have a handy tuning wand which can also be used for writing, and is already fitted with a pocket clip. If you do not possess such a pen or feel like buying one, then the wand can be made on the lines indicated at the beginning of this article. It is well worth the trouble.

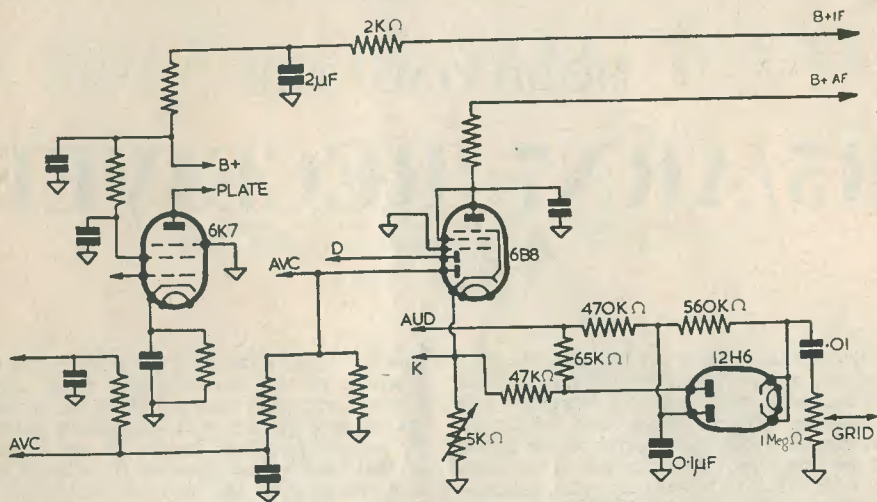
MODIFYING THE R5/ARN7 RECEIVER

by J. W. H. Birch.

This receiver, part of the Compass Receiver used in American aircraft, replaced the Type BC433G with which many constructors will be familiar. The following hints on conversion can be applied in general to the BC433 but the later type, if it can be got, is the better buy. The R5/ARN7 covers four bands:—100/200, 200/410, 410/850, 850/1750 kcs.—the

first band was missing in the BC433, and the addition of the low frequency band which covered what had been the IF of the receiver was accomplished in a very ingenious manner by switching capacity in the IF transformers so that the first band uses an IF of 243.5 kcs, and the others the original frequency of 142.5 kcs. This switching is also necessary





IF DEMODULATOR-NOISE LIMITER

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in the IF traps, which are inserted in the cathode return of each RF valve. The receiver circuit falls naturally into two parts—the first up to the second detector, where it is necessary to stick closely to the original, and the second the AF portion, where there is plenty of scope for experiment. The receiver is available on the surplus market at about £5 new with valves, but as far as I have been able to find out the circuit details are scarce, and the present conversion was accomplished with the assistance only of the circuit of the BC433. The portion of the valve line-up which is used is 6K7—6K7—6L7—6J5—6K7—6B8, in addition to which there are two 6K7, 6N7, 6SC7, two 6F6, two 2051, 6B8. Since this is an American set the markings on the chassis follow American conventions, so it will be necessary to adhere to these in this article—most constructors who have any experience of American sets or radio literature will have no difficulty on that account. In this connection it must be said here that this conversion is hardly a job to be undertaken by the complete novice, or anyone who needs a point-to-point wiring diagram.

Since the writer is on DC mains, the conversion has to be a DC/AC job, and if this is followed the usual precautions must be taken when doing anything on the chassis while it is connected to the mains. On the other hand, an AC version is feasible and in fact gives much more scope in the AF end.

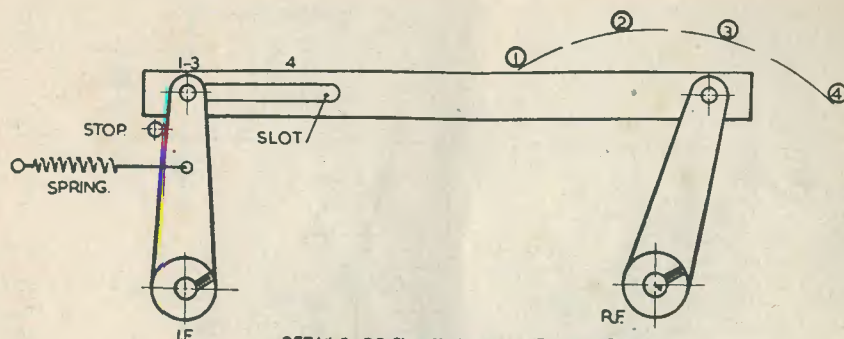
In any case it is almost a necessity for the power supply to be on a separate chassis.

The final valve sequence is 6K7—6K7—6L7—6J5—6K7—6B8 (using the triode portion to provide delay for AVC only)—12H6 as noise limiter—1629 magic eye—12SJ7 AF—12A6 output. The six volt alternatives for the last four are obvious.

Since the chassis has to be completely isolated in any case, the controls are taken out at what was originally the left hand side looking at the front panel. This gives much easier construction.

The first step is to remove the parts which are surplus to requirements, and in doing this it is advisable to cut the wires close up to the part removed and then investigate the other end of each before cutting it out entirely. Many of the connections can be used for another purpose. After removing the front panel and the rod locking the chassis into its case, the following parts can be taken out:—the two relay switches behind the panel, the 'LOOP' coil box, the valve holders for the first 6K7, the first 6B8, 6SC7, 6N7, the rear 6F6, the rear 2051, the cans marked 169, 168, 601, 610, and the whole of the terminal board under the new front panel. Some 20 yds. of good pushback wire should be obtained from this.

Gang capacitor. It is necessary to remove the worm drive but not the mounting bracket. This is done by cutting through the front part of the casting diagonally. A fairly

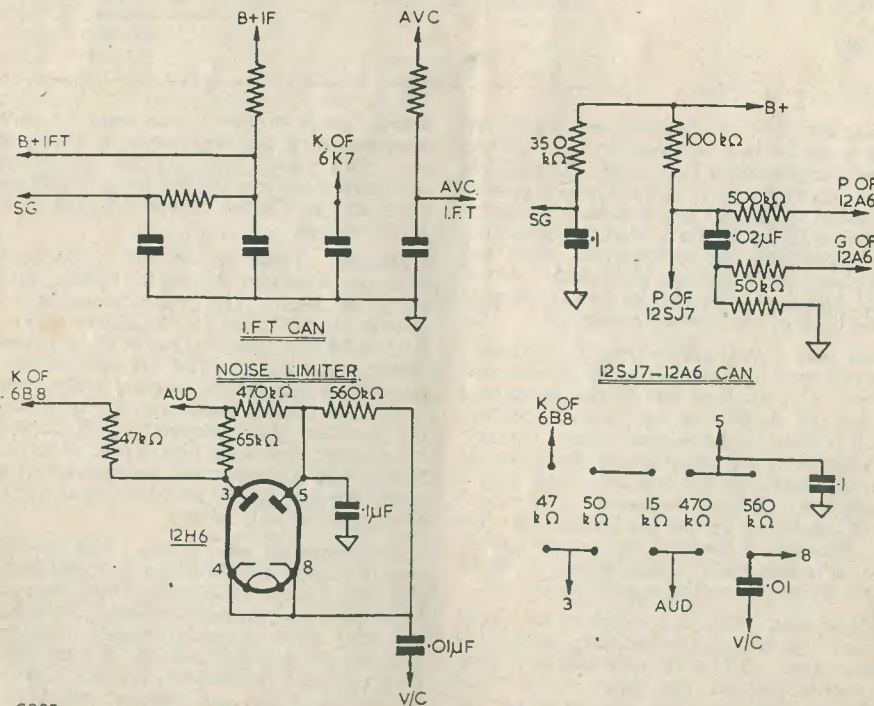


DETAILS OF SWITCH LINK - NOT TO SCALE.

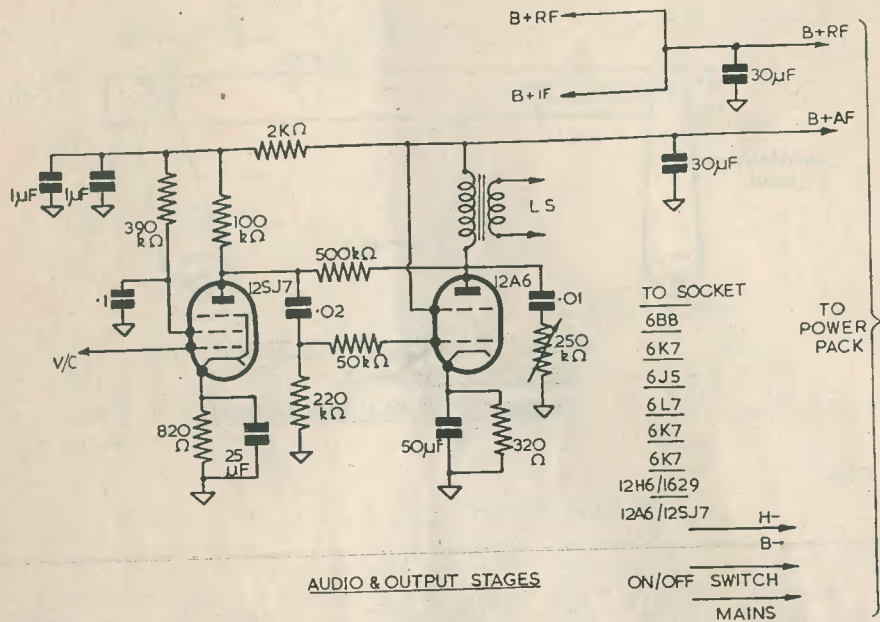
SWITCH IS IN POSITION 3.

REMOVE LOCATING BALL FROM I.F. SWITCH.

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C385



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substantial drive is necessary for the heavy capacitor—the best is probably a National Velvet Vernier ex the TU5 series. To fit it, cut a hole approximately $1\frac{1}{4}$ " diameter opposite the end of the spindle and mount the drive on short distance pieces. To connect to the spindle remove the loose half of the driven wheel and bolt across the remaining solid half a strip of metal with a $\frac{1}{4}$ " bush, similar to that already at the back of the Velvet Vernier.

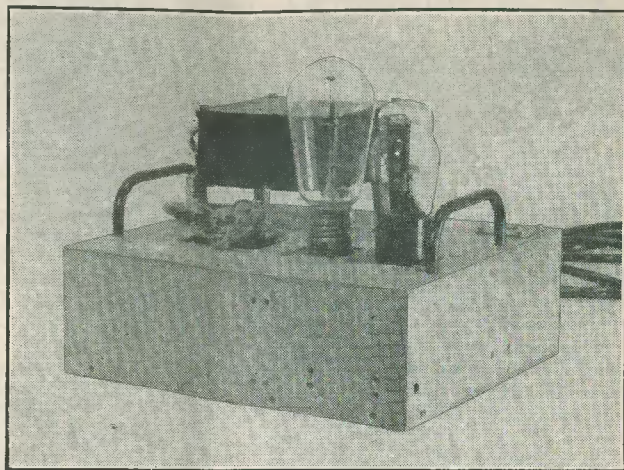
Coil pack. Withdraw carefully the actuating rod and remove the ratchet motor completely. Cut the loop box in two to make a bracket to support a new switch control, which is fitted to the original holes. Connect the control to the actuating rod by a flexible link, and earth the far end to chassis with a flexible link. The control spindle must extend about two inches beyond the chassis side. It is an advantage if this and the similar control used to switch the IF transformers is of the type in which the locating agent is a steel ball.

Magic Eye. This is located in the lower half of the chassis, immediately below the tuning drive. Drill a $1\frac{1}{4}$ " hole and mount the valvholder behind the panel on distance pieces, so that the valve extends about $1\frac{1}{2}$ " through the hole. Convert the terminal

board, which originally was used for AVC components on the loop circuit, to supply the decoupling for the eye. As the AVC voltage will more than close the eye the grid is tapped down and is affected by about $2/3$ of the AVC voltage.

Heaters. These can be put in the proper series order without altering the existing wiring except in detail. The proper sequence is:—chassis to (12SJ7/12A6) to (12H6/1629) to RF1 to RF2 to Mixer to Osc. to IF to Take-off socket to terminal. The take-off socket is the valve holder of the original VT74, which is wired to provide heater and B plus voltages for auxilliary gear. Normally it is occupied by a valve base with pins 2 and 7 shorted. Since a type 304 barretter is used the additional heater voltages can be accommodated without affecting the main chain.

IF transformers and IF trap. The switching was originally controlled by a relay, but as this uses 3 amps at 28 volts it was necessary to devise a mechanical substitute. To remove the relay (this is not absolutely necessary) drill out the spot welds which hold the bridge piece on which the relay is screwed. Unscrew the switch wafer and remount on distance pieces screwed to the bridge piece. Replace

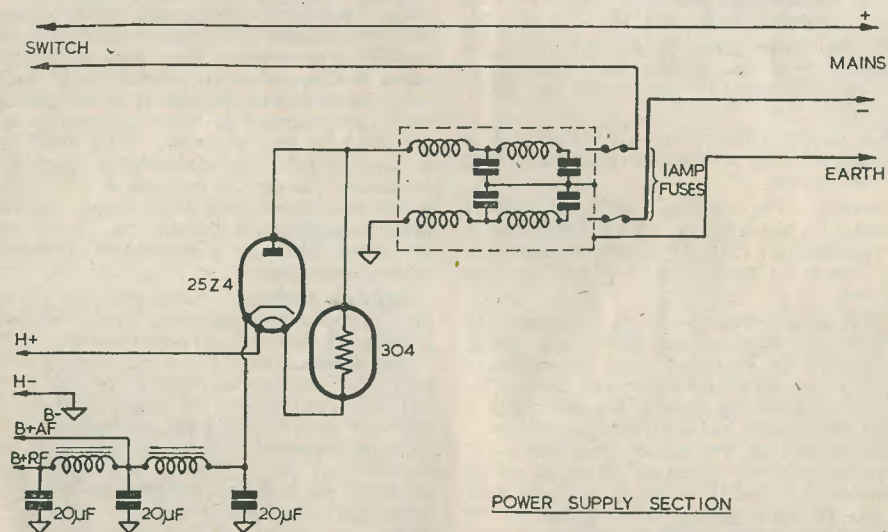


Power Pack for the R5/ARN7 Receiver, see circuit below.

The cover photo shows the underside of the receiver and power pack.

the spot welds with screws and nuts. The connections inside the second IFT are altered as in the diagram. The 601 can is cut in half and mounted upside down to provide a support for the switch control, which is coupled by a flexible coupler to a new actuating rod long enough to go right through the three cans; this is earthed to chassis at the far end.

IF valve circuits. The terminal board holding the decoupling components for this valve is removed from its position above the 5μF capacitor and mounted with the screen components in a can similar to the 601 in the vacant hole on the opposite side of the 6K7. It will be necessary to colour-code the leads emerging from the can.



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POWER SUPPLY SECTION

6B8. This is used to supply second detector and AVC only. The variable resistor in the cathode lead supplies measurable AVC delay voltage. The signal grid (top-cap) is earthed direct to chassis, as is the side of the coupling capacitor which originally went to the next grid. The 0.5 μ F bathtub which couples the compass output is removed.

Noise limiter. This circuit is effective without affecting gain or quality, and is always in circuit. It was taken from the similar one used in the NC173 and other American receivers, and has been recommended in the RSGB "Bulletin". The 5 μ F capacitor is replaced by a 0.1 μ F, and the terminal strip mounted above it.

The volume control is mounted on a bracket at the front and connected by a two-way screened and insulated pair of wires to the components at the rear. The screen is earthed only at the point nearest the 12SJ7 grid. These connections are rather too long for comfort, but if made in this way no instability should result.

The 12SJ7 is mounted in place of one of the 2051's the other space being occupied by the variable (preset) tone control. The coupling can is in place of one 168, and a valve holder mounted in place of the other to take the 12A6. The mains transformer is used effectively as an output transformer into a 10" 3 ohm speaker. The connections are:—

Plate 3
B plus 5
connect 14 and 16
speaker to 12 and 15.

Details of the generous decoupling can be gathered from the photos and schematics. All the 2 μ F and 1 μ F capacitors are 600V bathtubs.

All power connections are taken by a multi-cable from a terminal board near the take-off socket.

Antenna. The original antenna post is mounted in the existing hole at the rear, and is connected to a 1,000 pF (or smaller) capacitor and thence by coax cable to "Ant" on the coil box.

Wave-band switching. It is necessary to provide that although the RF switch covers four bands, the IF switch must be stationary over the first three and move with the fourth. This is ensured by linking the two with a metal strip which has a long slot at one end. It is mounted on two radius arms about 1 $\frac{1}{4}$ " long (these were obtained from an APQ transmitter). The IF switch is normally held to the left by a spring, but is pulled to the right when the RF switch moves from 3 to 4. The length of the link and the position of the radius arms is arranged so that the slack

is taken up at No. 3. To check that the RF switch is in the correct position, connect an ohmmeter across Plate and B plus of one of the RF valves. Moving the switch from left to right, there should be an increase in the resistance from band to band—of the order from 10 to 200 ohms in all.

The photos show an RF gain control in the centre of the panel. This is a 5k Ω potentiometer connected between K RET on the IF traps and chassis. This was found to be unnecessary in view of the very effective AVC over four stages, but it would be of assistance where the receiver is installed close to a transmitter. The 6L7 is in any case removed from K RET and the return circuit earthed as shown.

In the original conversion the mains leads were fused in both poles, and in addition an ex-AM suppressor was in circuit. In the circumstances no separate earth connection is necessary, but the case of the suppressor must be insulated from the power pack chassis.

This conversion was undertaken with the primary object of making a receiver capable of receiving all the regional programmes under any conditions in Lancashire. It certainly does that and more. No details are given of the panel trim or of the cabinet work as these will clearly depend on individual needs and tastes.

The next thing is to get a 50 kcs multi-vibrator working so as to get fairly complete calibration!

Components. The actual choice of additional components not already on the chassis will be governed by those in hand—no one capable of completing this conversion would make a Chinese copy. Hence, only those components which are added to the original or which are changed in value or position are identified in the schematic. The exception is the 30/30/50 μ F electrolytic smoothing capacitor. Except in the case of the noise limiter and screen droppers, the next nearest value available will usually do. Note that the values used are a mixture of 'preferred values' and others.

Negative feedback. Note the very simple but effective arrangement used. Without it there will be too much gain from the 12SJ7.

Smoothing chokes. Those used were actually from the low voltage supply for the 1155, but anything capable of taking 80 mA will suit—the lower the resistance the better.

Mains suppressor. This is taken from the control unit for, I believe, the GEE gear. As these are intended for 28V use (tho' the capacitors are rated 350WV) it should be tested at mains voltage for insulation. I have had no trouble with several on 230DC and one on 230AC.

PRACTICAL AERIALS

by "AETHERIUM"

Part 12

TV Aerials

Conclusion
of
Series

Television Aerial (cont.) and conclusion.

It is not often realised that, in areas of good signal strength, one aerial may be shared by two viewers without the aid of a complicated distribution system. It so often happens that when only one high chimney stack is available, and this is already occupied by an "H" aerial, the neighbour either has another aerial installed on the same stack, with consequent risk of interaction, or puts up with an inferior aerial in the roof space. A little "get together" on the subject will often result in a satisfactory arrangement. All that is required is a weather proof junction box, two resistors, and an extra length of Coaxial Feeder. Fig. 1. shows the essential connection. Signals will be 6dB down from the original at each point, which in most cases can be taken care of by an adjustment of the contrast control. So much then for Television Aerials. We will now return to some of the chief problems in general aerial installation, and summarise the subject.

Standing Waves

The actual measurement of Standing Wave Ratio is difficult for the beginner, and unless a transmitter is available it is virtually impossible. It is, therefore, most important that a good Handbook should be carefully studied in order that the correct impedance feeder is used for any particular type of aerial. Remember that as the frequency is increased, so the feeder losses rise, and the additional standing wave loss increases in proportion, i.e. a total loss (including feeder and, say, a standing wave ratio of 4.1) at 7 Mcs may be 6dB. At 45 Mcs, with the same feeder and SWR, this loss may increase to 12dB, and to a still greater figure as the frequency is increased.

Most Handbooks state that a standing wave ratio of 2:1 is an acceptable figure for normal amateur practice. This may be perfectly correct for frequencies up to 30 Mcs, but for the higher frequencies every effort should

be made to secure a better figure, and on 144 Mcs a maximum SWR of 1-25:1 should be the aim.

Reception of Weak Signals

The limitation of reception is the circuit noise in the receiver coupled, of course, with reception conditions. Approximately 80% of the circuit noise in any receiver emanates from the valves, the other 20% being from the components (and from badly soldered joints!). The signal, to be audible, must be of sufficient intensity to overcome this circuit noise; in other words, it must be "above noise level". It is, therefore, most important that the correct degree of coupling between the aerial and the receiver be used. When operating on the VHF bands particularly, it is as well to know the "input impedance" of the particular valve in use. This figure varies with frequency, and most valve manufacturers will supply the information on request. If, for instance, a valve has an input impedance of 1000 ohms at 100 Mcs,

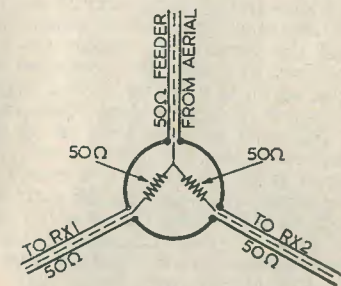


FIG. 1
METHOD OF CONNECTING TWO FEEDERS
TO ONE TV AERIAL

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and your feeder impedance is 300 ohms, you will know that a transformation ratio of just over 3:1 is required for accurate matching. Therefore, a start can be made with the aerial coil consisting of approximately 1/3rd of the turns of the grid coil, with provision made for varying the amount of coupling. In some cases, the input impedance of the valve may be lower than the impedance of the feeder. It is then quite in order to make the aerial coupling coil larger than the grid coil. Particular attention should always be paid to the input circuit of the receiver, especially on 28 Mcs and VHF bands. Do not rely on an increase of noise as being the pointer to correct aerial coupling. On the VHF bands this increase may mean that regeneration is taking place. While this may be an advantage and an aid to selectivity on the LF bands, it is useless on VHF, as the increase in noise makes the reception of weak signals far more difficult. Aim, if possible, to carry out the adjustments while listening to weak signals, or from a local signal generator, attenuated to a micro-volt or so of output.

Beam directivity

Always bear in mind that when working on 7, 14 or 28 Mcs with a sharply directional beam, it must point towards the desired direction. A few degrees error either side will often

make all the difference. On the VHF bands, however, due to local reflections and other peculiar factors, it is often found that optimum signals are received from certain directions with the beam quite a few degrees "off". When searching for stations it is a good plan to slowly rotate the beam a few degrees across the approximate direction.

Masts and Guys

Make certain that your mast is safely guyed, and that the guy wires are not of such a length that they will resonate at your reception frequencies. Insulators should be inserted whenever it is suspected that resonance may be occurring. Use stranded galvanised wire and never single strand wire for guys. With rope halyards, it is always wise to treat the rope before installation, either by boiling in wax, or treating with grease. This latter makes it somewhat messy to handle, but it certainly increases the life, and retards shrinkage in wet weather. When installing a high mast, fix two pulleys and two halyards to the top. One is thus retained as a spare in case of accidental breakage or loss of the other. (Conclusion.)

(Note) Erratum Part 9

The Cathode Coil in Figs. 3 (lower) and 4 and 4A should have a 0.01 μ F Mica capacitor connected between bottom end and earth.

Radio Miscellany (Continued from P.17)

All that is left is for us to fix the date when it might come into everyday use. Then we shall leap out of the old four-poster (figuratively speaking, of course—it takes me four times as long to get out as it does to hop in) and simply lift the newly printed newspaper, complete with stop press items, out of the receiver.

Radio control of ships, aircraft and freight trains are other innovations which are just around the corner. At present the control station has to follow the controlled model around, which is a bit of a bind, except as a nice toy or for experimental development.

At this point we seem to come up against a blank wall, and are left to guess at such problems as the transmission of energy in the form of light and heat. In the early thirties all sorts of extravagant claims were made for death rays by power transmission, and in the late thirties curious rumours were given wide publicity of mysterious rays which brought all motor traffic on certain Czech border highways to a standstill by interference with their ignition systems.

It was, of course, part of the Nazi war of nerves. Certainly no such ray could be

produced by any of the belligerents during the War. Theoretically it is possible—at extremely close range, but even bearing in mind the magnetron valve which is capable of developing power pulses on centrimetrical waves in pencil-point beams, we have still to go a long way before power-ray transmissions become a new secret weapon.

Don't Forget . . .

That, this year, the 18th National Radio and Television Exhibition will be held at Earls Court, London. It will be open to the public from Aug. 29th to Sept. 8th inclusive.

the Radio Show

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.

Dummy Tags

Most valve bases have a spare tag which can be used for dummy purposes. Such a tag is particularly useful for such things as HT positive points, to which may be anchored screen-dropping resistors and similar components. If a solder tag is fitted under one of the securing nuts of each valveholder during construction, it can be used to hold the earthy ends of any decoupling capacitors (screen-grid and cathode, etc.) and resistors which are later fitted in the circuit of that particular valve. However, when certain RF amplifying circuits are being built, too much reliance should not always be placed upon chassis solder tags for earthing purposes.

The same applies to the input circuits of high-gain audio amplifiers. Fig. 3 (a) shows a layout which, at first sight, might appear to be perfectly satisfactory and workable. Nevertheless, when the layout is broken down into the circuit shown in Fig. 3 (b), it may be seen that a loop (or one-turn coil) is connected in series with the input. (In this case, the loop is partly screened.) It is possible for such a loop to pick up hum from the field of a nearby mains transformer or smoothing choke and, if the subsequent gain is sufficiently high, to cause it to be reproduced over the loudspeaker. The layout of Fig. 3 (c) prevents such a loop being formed and should therefore be used in preference to that of Fig. 3 (a). The formation of "loops" through the incorrect choice and positioning of chassis solder tags can also upset the working of high-gain RF amplifiers, especially if they function at VHF and higher frequencies.

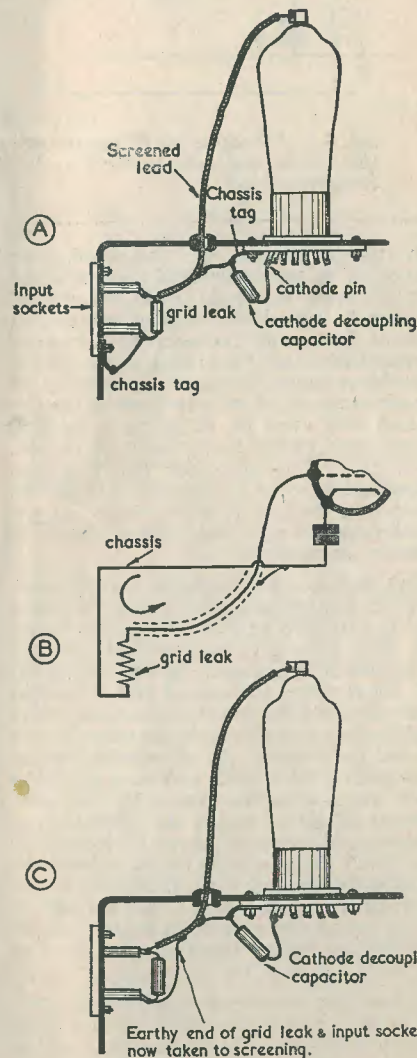
Screening

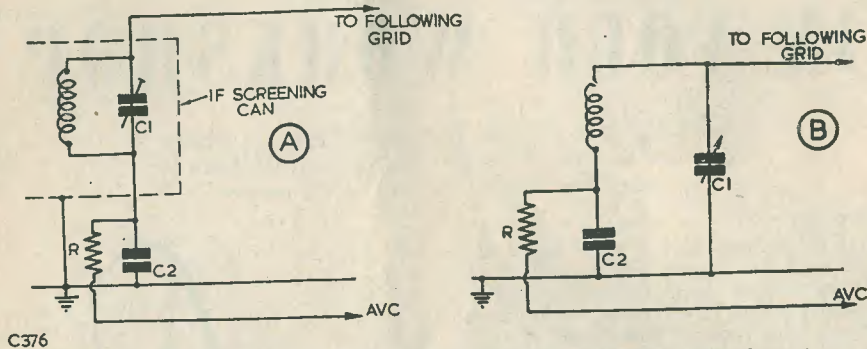
It often proves useful to take advantage of certain points of wiring in order to prevent instability and other faults which may occur

Fig. 3 (a): An apparently correct method of laying out the input circuit of a high-gain AF amplifier.

(b): The layout of (a) represented as a fundamental circuit. Note the formation of the loop, (partly screened in this case).

(c): A better method of laying out the input circuit, using only one chassis connection.





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Fig. 4: Circuits of an IF transformer secondary, (a) : and of an RF grid circuit, (b). These are used in the text to illustrate the circuit functions of various connecting wires.

when the equipment is completed. For instance, if a particular lead is considered liable to cause a certain small amount of radiation or capacitive coupling without, at the same time, really necessitating the use of screened cable, (an AF output anode lead is a feasible example here), the possibility of back-coupling can often be reduced by keeping the lead very close to, or lacing it in with, one or more earthy leads, (such as chassis, HT+, etc.) This procedure partly screens the lead and increases its capacitance to chassis. If, however, the lead is liable to pick up any radiation (say, a grid lead) then it should, if necessary, be screened.

Advantage may also be taken of component layout to provide screening between different circuits. To take an example, certain valves have their grids and anodes both brought out to pins at their bases. In the case of the 6SJ7, for instance, the control grid is brought out to pin 4 and the anode to pin 8, capacitive coupling then being possible between the two pins and their wiring. It so happens that the screen-grid of the 6SJ7 connects to pin 6 whilst the chassis connection to the valve screening is taken to pin 1. Therefore, if the screen grid decoupling capacitor is mounted close up to the underside of the valveholder and directly between pins 6 and 1, it will effectively screen pins 4 and 8 from each other, and so reduce the possibility of undesirable coupling. A similar idea can often be used with other valves of the same type.

Incidentally, waxed paper decoupling capacitors should always be fitted so that their "outside foil" ends are connected to earth. These capacitors are made by rolling up two lengths of foil interleaved with waxed paper;

with the result that that part of the foil which finally appears on the outside of the "roll" forms a screen for the rest of the capacitor. The outside foil connection is usually marked with the letters "O.F." or by means of a red or black ring around the body of the capacitor.

Short connecting leads

When a new chassis is being wired up, the constructor should always have in mind the function of each connecting lead. The most important wires are those which complete the tuned circuits and these *must* be kept short. Indeed, the chassis itself should be designed with this end in view. Grid and anode leads, particularly RF-carrying leads, are next in importance and must also be kept short. Decoupling circuits should employ short wiring as well, this point being usually fairly easy to ensure. The rest of the wiring consists of what could be called "dead" leads, (HT, supplies, etc.) and can nearly always be run along any convenient route in the chassis, its length being, within limits, immaterial.

Fig. 4 (a) shows the circuit of an IF transformer secondary. In this case, the tuned circuit is completed by the short wiring inside the transformer can itself. The lead from the tuned circuit to the AVC decoupling capacitor, C2, should be kept short but not necessarily so short as that of a tuned circuit. The lead from C2 to the decoupling resistor, R, should also be kept fairly short; but the AVC lead from the other side of R is practically "dead" and can be positioned almost anywhere in the chassis, there being hardly any necessity at all to worry about its length.

The RF tuned circuit of Fig. 4 (b) is quite different. This time the AVC capacitor is

(Continued on P. 35.)

An Economical TIMEBASE

Push-Pull Deflections in both Directions with only Three Valves

By W. GROOME

UNTIL he sold the Rolls Royce, the yacht, and the country mansion in order to finance the purchase of a 12" magnetic CRT, a lot of the writer's spare time in 1950 was spent in experiments with scanning circuits for electrostatic tubes.

And, let it be emphasized, economy was often the key-note of the investigations. So, in order to assist constructors to have TV and still eat, the present article describes a timebase which gives push-pull scanning in both directions by the use of three valves only. Despite the economy in valves, components, chassis size and labour, the outputs are sufficient to scan a VCR97 even when the tube is groaning under the strain of an EHT of over 3 kV.

Any further reduction in the number of valves would mean dispensing with push-pull—too great a sacrifice in deflection power and picture form.

In the accompanying diagram, the sawtooth generators are V1 (line) and V3 (frame). Transistrons are used because of the high output and good linearity. The output is, in fact, about half of the total required, and may be doubled by the use of a single paraphase valve, feeding one deflector plate from the transistron anode and the other from the anode of the paraphase valve.

Each transistron, then, requires a paraphase valve to partner it, and in the present circuit the two valves needed are contained in one "bottle". The label on the bottle reads "6SN7".

Paraphase circuits are, of course, quite well known, and in many circuits the paraphase valve is a pentode. It should be remembered, though, that the peculiarity (and virtue) of the circuit is that the output cannot be more than double that of the single transistron. The

higher gain of a pentode compared with that of a triode results in the presence of more feedback, but the self-balancing action reduces its output to the required amount. Any valve with a reasonably high gain will do, the difference being only in the degree of feedback, but not in output, unless one uses a valve whose gain is so low as to cause the feedback to work against the transistron and reduce its output. Even then the output will be balanced.

One need have no fears on this point with the two triodes of the 6SN7.

Many amateurs have found transistrons to be tricky little devices to get going properly at first, but once adjusted they are excellent. The difficulty in specifying a circuit is that component variations within the tolerance limits, and quite small differences in HT voltage and layout, can make quite large differences in frequency, flyback time, and output.

The circuit given has been repeated in several sets, however, and has given very good results. The networks R3—C2—R4 on line and R14—C12—R17 on frame are particularly likely to affect results—especially on frame, where at 50 cps the transistron is getting towards the limit of its capabilities in the low frequency direction. Often, a troublesome transistron can be tamed by having a variable component in this network. This could conveniently be R4 on line and R17 on frame, the latter being the most likely to require this treatment.

One frequently hears complaints about non-linearity with frame transistrons, and this again is due to the use of a transistron at a frequency close to the range where its efficiency falls off. With care, however, it can be made to give good results without special circuitry.

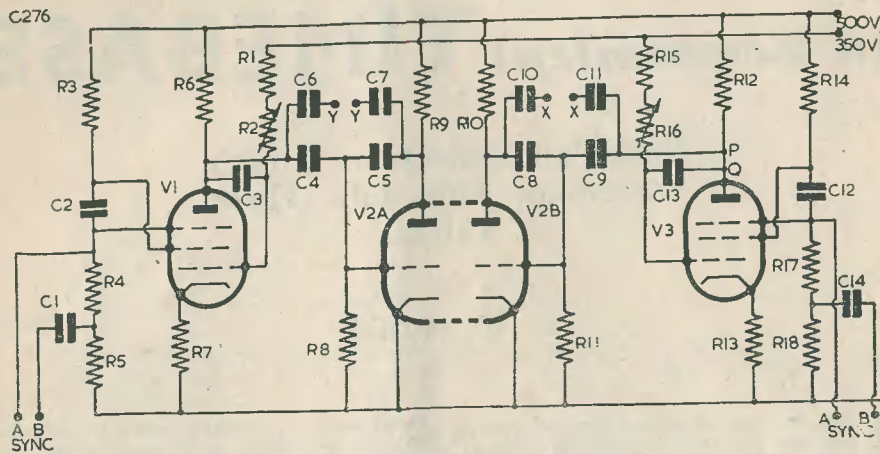


Fig. 1: Timebase Oscillators and Amplifiers.

COMPONENT VALUES

R1,	270 k Ω $\frac{1}{4}$ W	C1, 14,	See text
R2, 16,	2 Meg Ω pot.	C2, 3,	100 pF
R3, 14,	56 k Ω 1W	C4, 5,	62 pF
R4,	56 k Ω $\frac{1}{4}$ W (see text)	C6, 7, 10, 11,	0.1 μ F (see text)
R5,	5.6 k Ω $\frac{1}{4}$ W	C8, 9,	0.001 μ F
R6, 9, 10, 12,	100 k Ω 2W	C12, 13,	0.01 μ F
R7, 13,	1 k Ω (see text)	V1, 3,	6SN7 or EF50
R8, 11,	2.7 Meg Ω $\frac{1}{4}$ W	V2,	6SN7
R15,	1 Meg Ω $\frac{1}{4}$ W	Note:	'Y' = Line scan connections
R17,	100 k Ω $\frac{1}{4}$ W		'X' = Frame scan connections
R18,	10 k Ω $\frac{1}{4}$ W		'A' 'B', See text
			'P' 'Q', See text

The distortion can be confined to the top half-dozen lines, after which the scan abruptly becomes linear and remains so. It is rarely that the top few lines contain the most gripping portion of the picture; little is lost by letting them gleam unseen behind the mask.

The 6SN7 valve calls for little comment. For the purposes of this circuit it functions as two quite separate valves. The writer has not tried any other valve, but if the constructor considers using a different type of double triode he should remember that it must have separate cathodes.

As the frequencies handled by the two sections of the valve are very different, no trouble is likely because of interaction.

It will be noticed that two alternative connections are given for the sync inputs to each

timebase. Connections should be made to 'A' if the sync separator is of the single valve type described in 'Inexpensive Television' or the modified version on page 242 of the February issue of this magazine. If the two-valve arrangement on page 243 of the same issue is used, then C1 and C14 of the present diagram become C20 and C105 respectively of Fig. 2 in that article, and connections 'B' are used.

As with all circuits for electrostatic deflection, an HT of some 500V is necessary to obtain sufficient amplitude to scan the tube if 2500V EHT is applied. The coupling capacitors C6, 7, 10, 11 should be of at least 3 kV rating where the EHT is negative-earthed, and not less than 750V rating with earthed-positive and 500V above earth.

R7 and R13 in the cathodes of the transistors may seem unusual and may often be omitted, but they help to make the oscillators self-starting. One sometimes finds that a timebase which just 'won't go' will function beautifully from the moment one switches off until the HT disappears and the heaters go cold. They merely need a kick to start them, and this is quite often available in the form of random impulses supplied by HT or stray fields, and of course during transmission times the sync pulses do it. The cathode resistors are shown as a hint to those whose transistors sometimes fail to start in the absence of transmissions and, as has been stated, they may often be omitted.

No amplitude control is needed on line, which should be connected to the 'Y' plates—the more sensitive pair in the VCR97 tube. Then with frame connected to the 'X' plates it is generally found that the aspect ratio is close to that required, but some reduction may be necessary. Quite often this is arranged by reducing the HT supply to the frame pair, but the transistron at 50 cps is touchy, and changes in voltage upset the circuit and alter the frequency.

The method used by the writer requires only one small resistor, and its effect upon frequency is not troublesome. The extra resistor is connected between the points shown on the diagram at 'PQ' in the anode load of V3, so converting it into a fixed potentiometer in

which point 'P' selects a fraction of the output. For example, if examination of the picture leads you to estimate that 80 per cent. of the output would be about right, fit a resistor between 'P' and 'Q' of sufficient value to cause R12 to be 80 per cent. of the total. A 25 k Ω would suit this example, making the total anode load 125 k Ω . R12 at 100 k Ω now forms only 80 per cent. of the resistance, and so only 80 per cent. of the output appears at 'P'. V2b will balance automatically. A 1W resistor will do for this smaller portion of the load. The method is cheaper than that of making R12 a wire-wound potentiometer.

If your sync department is very good and holds firm over a wide variation of the frequency control R16, then amplitude can be altered by a very simple trick. With good frame pulses, variations of R16 will alter amplitude without change of frequency over as much as half a turn of the control, and with luck one can find the correct amplitude within the range of steady lock. No amplitude control will then be required. This is no dodge to try if sync is poor, and one should take care that interlace does not suffer.

And now, before coyly returning to 'Quiz Corner', the writer dares to express the hope that, apart from presenting a useful little timebase, this article may be found to contain a few helpful hints on transistron circuits in general.

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. . . SEE EDITORIAL FOR FURTHER DETAILS.

In Your Workshop — contd. from P. 32

itself part of the tuned circuit, and it has to be mounted such that its leads are kept very short. It must be remembered that the earthy end of the capacitor should not now be taken to the nearest chassis point, but, by the shortest route, to the tuning capacitor moving vanes themselves. This point is sometimes taken care of by connecting the capacitor to a tag fitted under one of the screws which bolt the tuning capacitor frame to the chassis. An improvement on this would consist of connecting the capacitor as directly as possible to the moving vane wiper contact, as is done on some of the more comprehensive commercial receivers.

It was stated above that HT and LT leads could be laced together into a single harness, if desired. If an AC supply is used for the heaters it would be advisable to twist the heater leads together before they are made up into the harness. Quite a few commercial receivers do not have their heater leads twisted in this fashion, and one or two even use a single wire with chassis returns at each valveholder. However, such methods of connection cannot be recommended for fitting in new, untried circuits, where any possible sources of trouble should be eliminated in the original design and not after construction has been completed.

Adapting the . . .

RF UNITS 26 AND 27

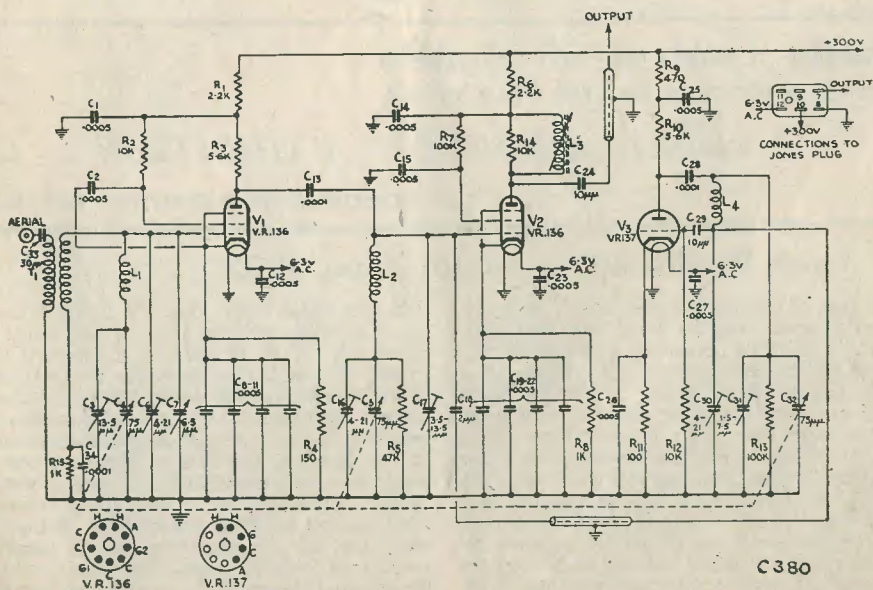
for the

WROTHAM EXPERIMENTAL TRANSMISSIONS

By

H. S. BRODRIBB

RECEPTION conditions in the South East after dark are notorious, especially reception of the London Home Service. The new Third Programme transmission is a great improvement, but it is not free from fading. On the other hand, the AM and FM experimental stations at Wrotham relay either of these programmes, and provide excellent reception over a wide area.



Original Circuit of the RF26 Unit.

The RF Units 26 and 27 can be quickly and easily modified for this purpose and, being tunable, will pick up both these stations. Further, the valves used—VR136 and VR137—are efficient down to 100 Mcs at least, and certainly between 90 and 94 Mcs, which is the region with which we are concerned. This coverage may be achieved by reducing the number of turns on each of the coils L1, 2, and 3, to 4 turns.

The wavetrapp coil has been removed from the RF Unit used by the writer, though there is room for experiment here. The aerial, a horizontal long-wire used primarily for long and medium waves, was coupled via a 10 pF capacitor to a single turn, spaced the wire thickness from L1.

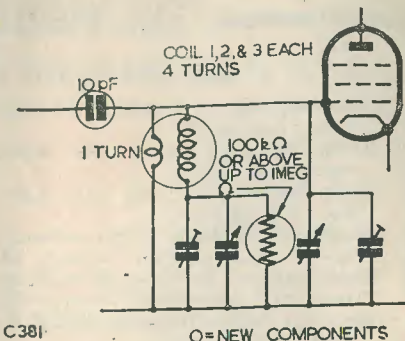
The writer did not adapt the existing air-cored coils, in case they should be needed for replacement. His coils were wound on ribbed formers, normally present in RF24 Units, which were shortened to fit under the RF26 chassis. The existing silvered wire was retained—the same gauge as is used in the RF26 coils.

Individual variations may occur, and it may be necessary to take a further half turn off the mixer coil (L2) leaving 3½ turns only.

The trimmers below the chassis should be adjusted with the dial set to about 15 degrees. The oscillator trimmer is set a little towards the minimum side of the half-way position. The carrier should be heard faintly around here, though it is a tricky adjustment, and it can easily be missed. When heard, the signal is easy to boost up by making mixer and aerial adjustments, in that order. The writer found that the setting for the mixer trimmer was below minimum at one point, though it was brought into range by re-adjusting the dial and oscillator settings. A fine adjustment, after the unit cover has been replaced, can be made by altering the padders with a long, insulated screwdriver.

It should not be forgotten that adjustment of the core of the output coil (IF around 7 Mcs) will affect the strength of the signal, especially if the 10 KΩ damping resistor is removed.

The 7 Mcs output can be fed into a receiver tuned to that frequency, or into a special IF unit, which in the writer's case forms part of his television sound receiver. His Wrotham adapter is only one of a series, others being used for (a) pre-amplifier and TV sound (b) 10 metre amateur band, and (c) 10-20 metres reception. The writer has adapted the output coil to a low impedance system—scrapping the 10 pF capacitor, and winding 4 turns around

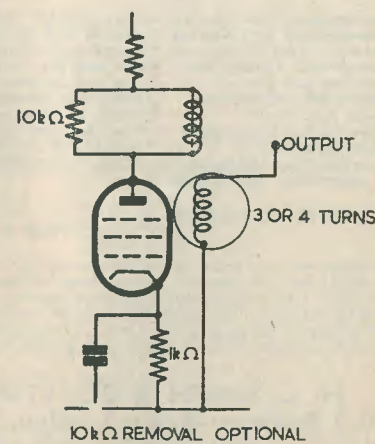


Input modifications.

the former below the existing coil. All connecting leads must be well screened to avoid any 7 Mcs pick-up from stations working on that frequency.

The adapter is fed here (some 40 miles from Wrotham) into a single IF stage (SP61) followed by diode detector, triode and 6F6 output stage, and it gives tremendous loud-speaker strength, with excellent quality (This, of course, refers to the AM station).

No trouble has been experienced from fading or instability, and no special precautions, such as stabilising the HT supply, have been taken.



Output modifications.

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