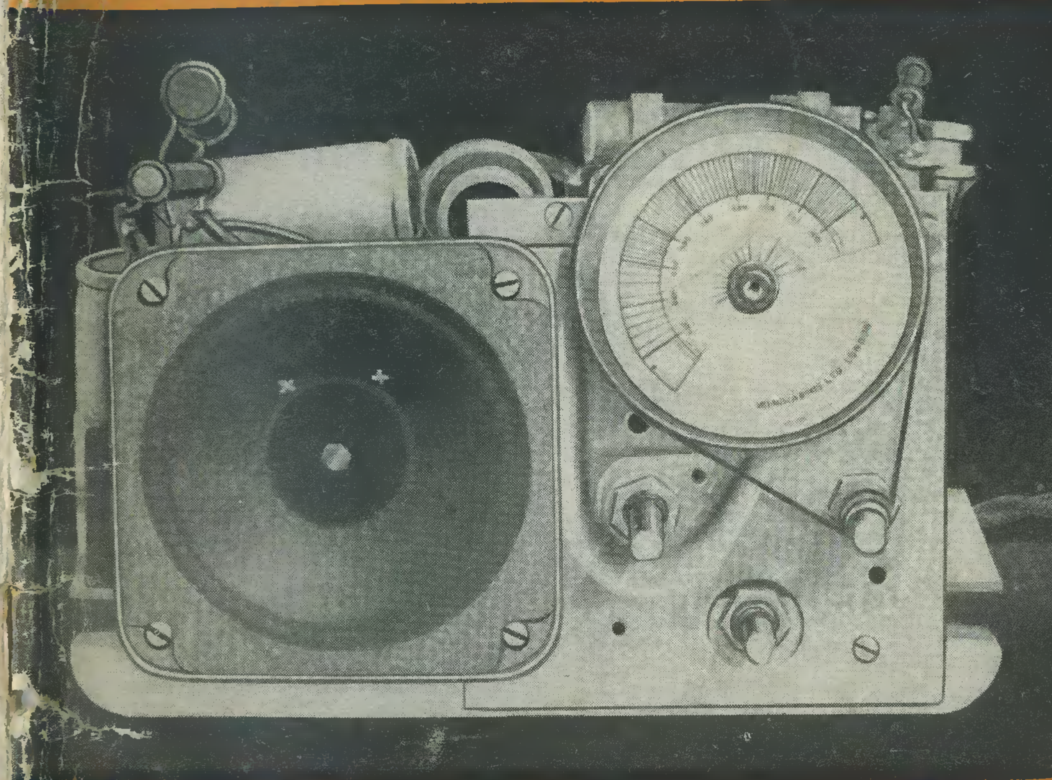
Published by Amalgamated Short Wave Press Ltd., 57, Maida Vale, Paddington, London, W.9.
Printed by A. Quick and Co. Ltd., Oxford House, Clacton-on-Sea

The RADIO CONSTRUCTOR

for the Radio and Television Enthusiast

Vol. 6
Number 2
OCTOBER
1952



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The
Radio Constructor

Vol. 6, No. 2. Annual Subscription 18/- October, 1952.

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

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CONTENTS

Editorial

We are in general agreement with the opinions expressed in the September issue of *Wireless World* regarding the imposition of Purchase Tax on loudspeakers.

How will this affect the radio constructor? Most of us are fixed up for the present, but speakers *do* break down or become damaged. The hi-fi fan, of course, is ever on the look-out for improvement in design, and will always be ambitious to possess the "very latest" model.

Articles on the construction of various types of loudspeaker were once a fairly regular item in magazines catering for the radio enthusiast. Will such features again appear? To make a modern type of speaker "from scratch" would be quite an undertaking for most of us, but the assembly of finished components is much easier and, given reasonable care and some patience, is within the scope of any experienced constructor. Those readers who have engaged in radio servicing will confirm this statement—the tricky part is centreing the speech coil in the gap, and this is a regular servicing job. A jig could easily be provided.

If a manufacturer were to market a speaker "kit of parts" or separate components, would the sales response be sufficient to justify it? Not, perhaps, as far as the cheaper models are concerned, but we do think the idea of a kit for "quality" types is worth investigation. The parts have to be produced, in any case, so a trial on, say, a "sale or return" basis to the retailer would not be an expensive matter and might well have encouraging results. "Sale or return" would encourage the distribution side, and should not prove any liability to the manufacturer. If returned unsold, owing to insufficient demand, the kits could be assembled and sold in the usual way.

Incidentally, we understand horn type speakers, and cone type speakers with a diameter greater than 12″ nominal, are not chargeable under the Order. Smaller cone speakers are not chargeable when supplied as part of a complete public address system.

A Companion Journal to THE RADIO AMATEUR

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 curcuit and the essential revelation data.

No. 22. A Warning Circuit for Intermittent Faults

One of the most irritating jobs which confront the service engineer is the repair of a receiver with an intermittent fault. Faults of this type usually make it necessary to keep the receiver switched on for long periods of time; the service engineer meanwhile maintaining a continual watch for the fault to appear. This month's circuit shows a device which gives audible warning when an intermittent receiver develops its fault.

Operation

The device consists mainly of a triode connected as leaky-grid detector, the coil of a sensitive relay being inserted in its anode circuit. The values of C3 and R1 are chosen to give a time constant suitable for audio frequencies. The transformer shown in the diagram is a normal output transformer, its original secondary being connected here to Test Terminals 1 and 2.

In use the warning device is connected to the output circuit of the faulty receiver. When it is possible to reach the speech coil connections, Test Terminals 1 and 2 are connected to these points. When only the primary circuit of the output transformer is accessible, Test Terminal 4 is connected to the chassis and Test Terminal 3 to the output anode.

A steady, modulated signal (as would be given by a signal generator), is then fed to the aerial input of the receiver. The resultant AF output causes the warning device triode to develop a proportionate negative bias; with the result that it draws a lower anode current. R2 is next adjusted until the relay just remains de-energised.

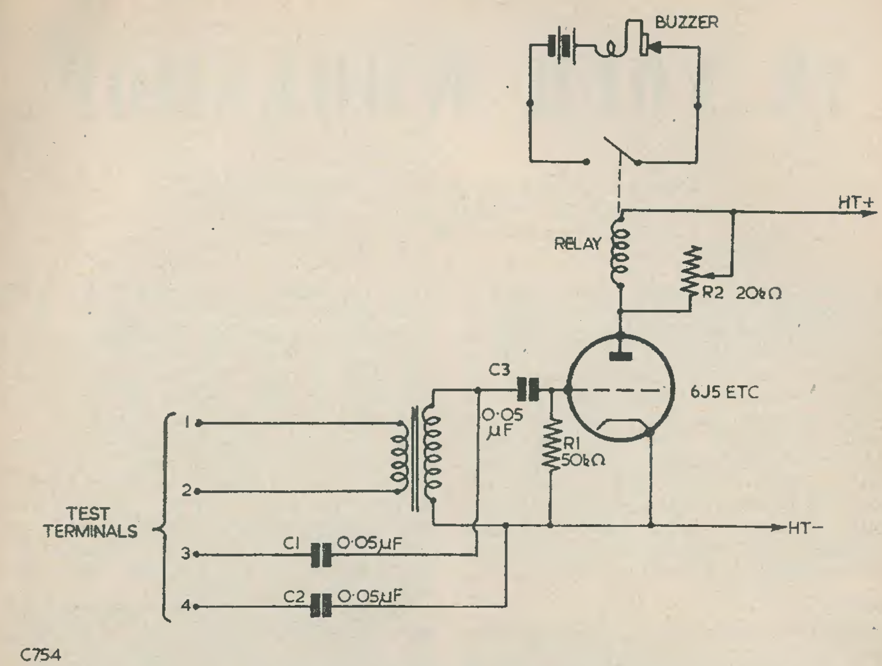
When the intermittent fault appears, the receiver AF output drops. This causes an increase in the anode current of the warning device triode and the relay energises, its contacts completing the external warning circuit.

Practical Use

In practice, it might prove helpful to add a single-valve modulated oscillator (tuned to, say, a mid-point in the medium wave band), to the warning device. This oscillator could then be employed in most cases to provide the modulated signal, and thus save the continual use of a signal generator during the waiting period.

The Editor Invites

articles from readers, of a nature suitable for inclusion in this magazine. Articles submitted for publication should preferably be typewritten, but ordinary writing is acceptable if clearly legible. In any case, double spacing should be used, to allow room for any necessary corrections. Drawings need not be elaborately finished, as they will usually be redrawn by our draughtsmen, but details should be clear. Photographs should preferably be large (half-plate) but in any case the focus must be good. Much useful advice to prospective writers is given in our "Hints for Article Writers", which will be sent free on request.



A warning circuit for intermittent faults.

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.

It seems that microphonic tuning capacitors are nowadays no less a source of trouble than they used to be before the war. Also, as before, they remain a very definite source of annoyance. Not only do they spoil the listening enjoyment obtainable from domestic all-wave receivers; they also produce problems in more specialised short-wave equipments which drive loudspeakers. In this and next month's articles I should like to discuss this subject fairly extensively; concluding in next month's instalment with a method of curing the trouble which, speaking for myself, I have not seen mentioned in print before.

Causes

Microphonic tuning capacitors are capacitors whose vanes vibrate in sympathy with any sound waves which impinge on them, causing thereby changes in capacitance which detrimentally affect the performance of the associated receiver. In the cases we shall consider here, the sound waves emanate from the loudspeaker. Microphony of this sort becomes troublesome when the receiver is a superhet, and it is the oscillator gang of the tuning capacitor which is microphonic. Microphony in the signal frequency gang or gangs is usually not quite so important.

When a superhet with a microphonic oscillator tuning capacitor is tuned to a carrier, sound waves from the loudspeaker cause vibrations in the vanes of the tuning capacitor with consequent variations in its capacitance. These variations result in corresponding alterations to the oscillator frequency, and, following from this to the intermediate frequency appearing at the anode of the frequency changer. Thus we have the sound waves from the speaker effectively frequency-modulating the intermediate frequency.

Because of the response curve of the IF stages (we shall refer to this point later) the frequency-modulated IF becomes amplitude-modulated as well; and it is then detected, amplified, and fed to the loudspeaker in the normal fashion. Thus the original sound from the speaker is fed back to the speaker once more. When the "gain" of this fortuitous arrangement is sufficiently high an oscillator is formed and the receiver breaks out into a howl, the frequency of which corresponds more or less to the resonant frequency of the tuning capacitor.

It will be seen from what has just been said that "tuning capacitor howl" may only appear when a carrier or signal of some sort is being received. This fact makes the fault very easy to diagnose, since it only appears when a station is tuned in. In some cases, the howl occurs more readily when strong signals are being received.

On the short wave bands, small deviations in tuning capacitance cause much higher variations in resonant frequency than they do on medium or long waves. Because of this, tuning capacitor howl usually occurs only on the short wave bands, and becomes progressively worse as the frequency of reception increases. Tuning capacitor howl is rare on medium waves and, when it does occur, usually denotes a very bad state of affairs that is correspondingly easier to cure.

When tuning capacitor howl appears in a receiver, the tuning capacitor should not itself be immediately condemned, as other components can also cause the fault. The most likely of these is the oscillator valve (or oscillator section of a single-valve frequency changer), which might, perhaps, have become microphonic with time or misuse. "Freak" conditions, such as loose turns or a loose core in an oscillator coil, can also be envisaged, but instances of this sort are rare.

Cures

When a cure is being sought, one of the first checks is to see that the tuning capacitor is not being excessively affected by the sound from the speaker. Sound waves from the loudspeaker to the tuning capacitor travel either through the air or are conducted mechanically through the cabinet and the chassis. Unless a fault of a different type has developed elsewhere, the sound waves travelling through the air do not appear to cause as much trouble as do those conducted mechanically. At least, looking at the subject in the light of what we learn from commercial receivers, manufacturers, who have always to guard against potential faults in their equipment, appear to pay less attention to the position of the tuning capacitor relative to the loudspeaker than they do to providing the capacitor with really adequate "floating" mountings. They rarely, of course, mount the capacitor of a short or all-wave receiver directly behind the loudspeaker, but, then, neither would anyone else.

When tuning capacitor howl develops in a previously trouble-free receiver the serviceman should, therefore, pay primary attention to the floating mountings of the tuning capacitor. These mountings usually consist of soft rubber washers, and it is possible that these may have become hard with heat and age. Alternatively, it may be found that they have been previously tightened by a meddler who has tried to reduce tuning backlash. (I once found a receiver in which small wooden wedges had been pushed in tight between the tuning capacitor and the chassis!) When something like this is found, the stiffness of the tuning capacitor spindle which originally caused the backlash should be cleared; whereupon the mountings can be returned to their former free condition. A too-tight tuning drive cord (when it pulls the capacitor out of position), may also occasionally cause tuning capacitor howl.

When an examination of the tuning capacitor mountings shows that these are satisfactory, the serviceman has to look elsewhere. A field of search which is sometimes profitable lies in the state of the IF stages.

The IF Transformers

It was stated earlier that, due to the response curve of the IF stages, the frequency-modulated IF from the frequency changer becomes amplitude-modulated as well. This change occurs, of course, when the frequency variation appears at a point where the IF response is not flat.

Fig. 1 shows the response curve of a fairly typical IF amplifier, the broad top and rapidly sloping sides being given by the couplings normally employed in the transformers. If we have a frequency-modulated signal appearing between the points A and B on this curve, its amplitude will remain unaffected. If, however, the signal appears between the points C and D, the change in amplitude becomes very noticeable. For instance, when the signal appears at point C the output from the IF amplifier is much higher in amplitude than when the frequency is at point D. Because of this, the frequency-modulated signal becomes amplitude-modulated; and is therefore capable of being detected by an amplitude-modulation detector.

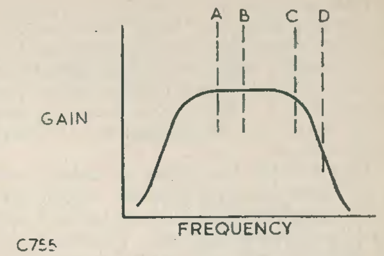


Fig. 1: A typical IF response curve. The points AB and CD refer to the limits of a frequency-modulated signal applied to the IF stages.

Now, one of the "links" in our unwelcome tuning capacitor howl "oscillator" is the formation of amplitude-modulated signals in the IF stages. If we could stop this formation we might be able to remove the howl. It is obvious from Fig. 1, however, that when the frequency-modulated IF signal is detuned by a certain degree on either side of the central IF frequency, amplitude-modulation must occur.

In practice, when the IF amplifier has the response curve of Fig. 1, tuning capacitor howl only occurs when a definite fault has developed elsewhere. If, however, the IF response curve happened to be something like that of Fig. 2 (which represents the curve of a badly-aligned or faulty IF amplifier), the trouble may very possibly lie in the IF amplifier itself. In this second curve the formation of amplitude

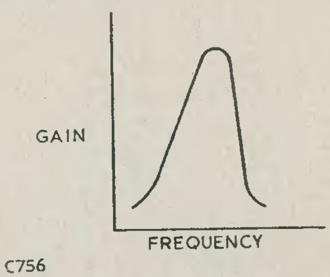


Fig. 2: A "peaky" and lop-sided IF response curve which may be caused by a fault or by bad alignment. A receiver whose IF response curve is like this is more prone to tuning capacitor howl than is one having the curve of Fig. 1.

modulation is possible at each and every point; and, in addition, the "peakiness" which is present can cause the gain of the amplifier to be considerably greater at the highest point than it would be if the amplifier had a correct response curve. This increased gain would further assist in the production of tuning capacitor howl.

It may be seen then, that a receiver with a bad IF response curve is more susceptible to tuning capacitor feedback than is one whose IF response curve is good. Practical experience supports this statement. Although it is by no means possible to cure all receivers by carefully re-aligning the IF transformers it is still possible to cure a fair percentage, this percentage being certainly large enough to merit investigation of the IF transformers before carrying out large-scale replacements elsewhere.

The response curve of Fig. 2 is usually caused by previous bad alignment, by near-instability, or by the normal falling off in trimming caused by the passage of time. Near-instability occurs sometimes when the receiver decoupling circuits become ineffective. A particularly suspect component in this connection is the single electrolytic capacitor which is often used to decouple all HT returns to the HT line.

Next Month. In next month's issue, we shall conclude by discussing yet another cause of tuning capacitor howl; this being one which is both easy to discover and to correct.

BOOK REVIEW

WIRELESS FUNDAMENTALS, by E. Armitage, M.A., B.Sc. 368 pages, 315 diagrams. Published by Sir Isaac Pitman and Sons, Ltd., Pitman House, Parker Street, Kingsway, London, W.C.2. Price 18s.

The author of this book states, in his Preface, that his intention in writing it is to cater for those who find the elementary books too simple, and the advanced text books too difficult. He therefore sets out to satisfy the needs of those who can benefit most from a book which deals mainly with a more-than-usual description of fundamental principles. There is no doubt that the author has kept this aspect clearly in mind, and has produced a book which is useful for reference and learning, yet at the same time is pleasant to read. The presentation of the subjects departs from the usual formula, and the author's originality in this respect is commendable.

A brief introductory chapter describes the nature of radio waves. Next, diode and triode valves and their characteristics are dealt with. This is followed by a chapter on resistances in wireless circuits, in which due attention is given to the precautions to be taken in the use of measuring instruments in order to avoid erroneous readings. After this, capacitors are discussed, both from the practical and theoretical aspects. The next chapter on alternating currents provides sufficient information to enable a clear understanding of later chapters to be assured. The description of the use of the cathode ray oscilloscope for obtaining visual display of AC waveforms avoids much written explanation and at the same time presents the subject lucidly.

Alternating current theory is enlarged upon in the chapter on simple harmonic motion; this introduces the reader to the uses of vectorial representation of current and voltage, and resultant phase angles. The behaviour of resistance and capacitance towards alternating current is discussed at this stage. Coils, and inductance, are dealt with next, first the principles of electro-magnetic induction, then the behaviour of inductance towards alternating current. The next chapter on power supplies, apart from giving a useful understanding of the process of mains rectification, brings together the previous discussions of resistance, capacitance, inductance and alternating current theory in such a way that the practical application of such principles is readily appreciated.

Further discussion on valves follows, in which the triode as voltage amplifier is discussed. In the earlier chapter on the triode the static characteristics were considered; in this present chapter the development of the dynamic characteristics is described, together with evaluation of stage gain. Use of the load line for finding optimum working conditions is touched upon; inter-stage couplings, and decoupling arrangements, are also described.

In the chapter on further AC theory, resonance circuits are dealt with at some length, and the author makes this important branch of radio theory easy to understand. The effects of capacitance, inductance, DC and RF resistance are well described, and the essential differences between series and parallel resonance circuits are given prominence; the damping of tuned circuits and derivation of formulae for evaluating the Q or magnification factor precede a short discussion on the application of the theories to practical circuits. The next chapter carries the principles to the valve oscillator; after showing the conditions necessary to maintain a circuit in oscillation, short descriptions of the variations of the Hartley, and the Colpitts, circuits are given.

A useful chapter on RF amplification sets out the disadvantages encountered due to the inter-electrode capacitances in the triode, and then describes clearly how these were overcome by the development of the tetrode (screened-grid) valve, and later improved upon by the RF pentode. The application of the valves in practical circuits, and stage gain, are also described.

Other chapters touch upon the nature and generation of the carrier wave, and methods of modulating it. Detection is also dealt with, and although this particular chapter is brief it makes the principles of various types of detector quite clear. Those described are the diode, anode-bend, grid-leak, and crystal or metal rectifier. AF amplification and the output stage come next, and optimum load requirements for triode and pentode valves are considered. The concluding chapter deals with the principles of the superhet, frequency changing, IF amplification, and ganging of tuned circuits.

Three Appendices give more advanced mathematical proofs of some essential theories. Some of the principles dealt with here are the energy stored in the charged capacitor, and the magnetic field of a coil; charging and discharging of a capacitor (i.e., time constants); derivation of the RMS value of a sinusoidally varying quantity; oscillation in an LC circuit; resonant frequency and dynamic resistance of a resonance circuit, etc.

There is also a series of Exercises, the questions being based on the fundamentals discussed in the various parts of the book. The questions are not difficult ones, but if the reader answers them conscientiously they will prove to him whether he has assimilated the knowledge that the book imparts. Answers to the numerical questions are given for checking purposes.

This book can be recommended as a means of obtaining a good understanding of radio principles, and as an introduction to more advanced or specialized studies. In keeping with many other volumes in the Pitman range of technical books it is well produced and offers good value for its price. It is pleasingly devoid of errors. The term "theoretical proof" used by the author twice on page 55 seems, on consideration, to be a trifle ambiguous, and one feels that "mathematical proof" would perhaps have been a better choice of words. Perhaps the author had similar thoughts when he penned the words "proved mathematically" on page 68!

REMOTE CONTROL BY RADIO

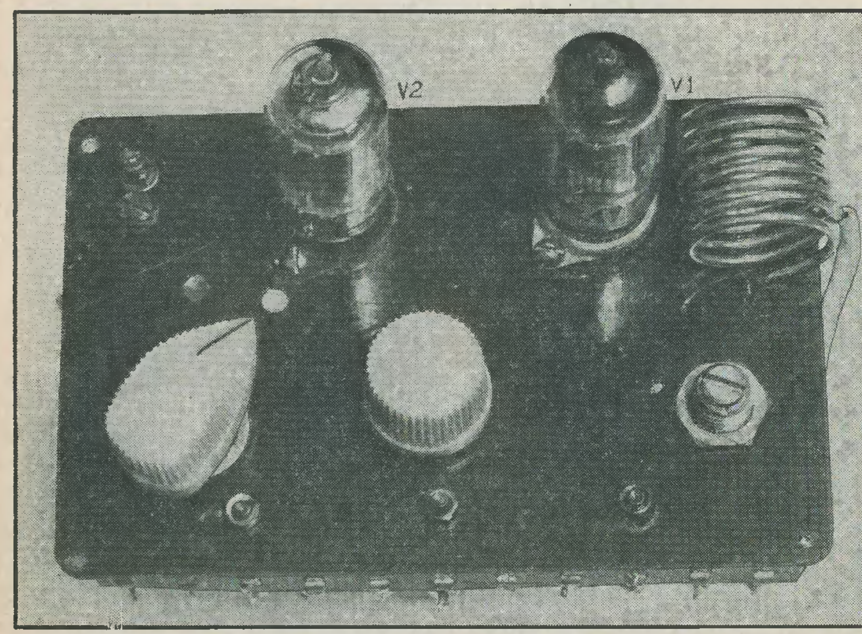
By F. C. JUDD, G2BCX

PART 2

The Application of a Direct-Coupled Amplifier and Super-regenerative Detector

Foreword

With simple single, or at least two valve receivers, for Radio Control, the difficulty has been to maintain high stability, together with sensitivity and ample control over the relay normally operated by a *decrease* in anode current of either the detector valve or a second valve controlled by fluctuation of the grid or anode current of the detector. With all single valve receivers the *only* change in anode current is a *decrease* on receipt of a command signal from the transmitter, so that the receiver is



Top view of Radio Control Receiver

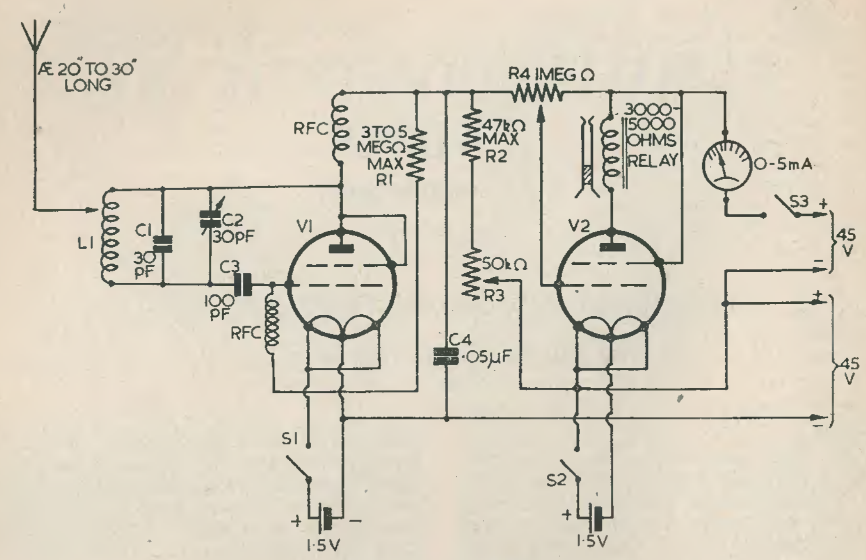


FIG. 1

CIRCUIT DIAGRAM 2 VALVE R/C RECEIVER

V1 & V2, BRIMAR 3V4 (FILAMENTS WIRED FOR (PARALLEL) 1·5V OPERATION.
S1 S2 S3, GANGED ON-OFF SWITCH.
L1, 10 TURNS 16 SWG ½" DIA 1" LONG TC WIRED, Æ TAPPED SECOND TURN FROM ANODE END.
IF DIFFICULTY IS EXPERIENCED IN GETTING V1 TO QUENCH, REDUCE R2 TO 20kΩ & R1 TO 2 MEG OHMS.

C760

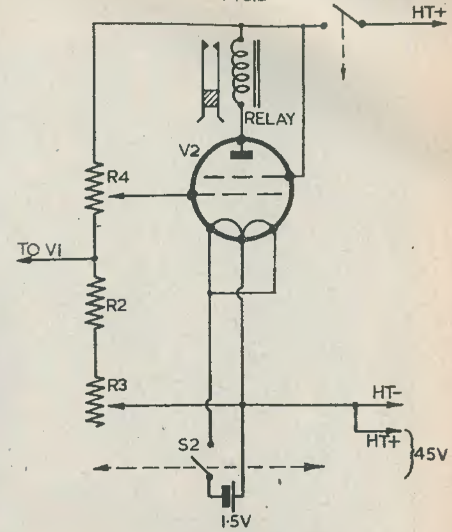
taking a comparatively high current during non-command periods. This means a continuous drain on the high tension supply, usually from small deaf-aid batteries which are expensive. A two-valve receiver, with the second valve providing the current control, results in a further drain on the HT battery because of additional current taken by the first valve as well. The following is a description and details of the application of a Direct Coupled amplifier so that a current *INCREASE* is obtained at the second valve anode. Other features also render the receiver desirable for Radio Control.

Technical Details

The first valve operates as a self-quench or super-regenerative detector, and is a Brimar 3V4 beam tetrode (1.4V filament). The valve is employed as a triode (screen and anode strapped) in a modified Colpitts oscillator circuit, with the grid taken to HT positive. *The whole of the filament circuit is isolated from the second valve*, which is also a 3V4. Radio frequency chokes isolate the anode and grid from the HT supplies and the second valve. Control over the frequency and amplitude of the quench oscillation is important, and is obtained by means of a 50 kΩ variable resistor in the HT+ supply (R3). The tuned circuit for 27 Mc/s is composed of C1, C2, and L1, the aerial being tapped into the tuning coil one turn from the anode end. It is important that both the amplitude and frequency of the quench oscillation is kept high. The optimum frequency is around 20 to 30 kc/s.

The anode circuit of the first valve is *directly coupled* to the grid circuit of the second valve, but is isolated as far as the filament supply is concerned. *The HT– and filament of the second valve is at 45V positive potential with respect to the filament and HT– of the first valve.* Care should be taken, therefore, when wiring the filament and HT supplies. The grid of V2 is taken through a potentiometer across the HT supply to that valve, and in series with the anode load of V1 (R3 and R2), the 50 kΩ variable and 47 kΩ fixed resistors. The relay is in the anode circuit of V2 (see circuit diagram, Fig. 1).

FIG. 2



CIRCUIT DIAGRAM

REDRAWN TO SHOW HOW R4 R3 & R2 BECOME A POTENTIAL DIVIDER TO PROVIDE VARIABLE CONTROL FOR THE GRID OF V2

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The circuit diagram of Fig. 2 has been re-drawn from the main circuit and shows more clearly how the resistors R4, R3 and R2 become a potential divider across the HT supply to that valve. It may be seen from this that the grid of V2 can be made positive by an amount depending upon the setting of the variable resistor R4. Also fed into this network is the quench oscillation developed by V1, which provides *bias* for the grid of V2 due to self rectification by that valve. The anode current of V2 may now be controlled by any change in amplitude of the quench oscillation or by variation of the HT+ potential across the network R4, R3 and R2. When the transmitter is keyed, a signal appears at the grid of V1 and the amplitude of the quench oscillation is reduced, resulting in an *increase* in the anode current of V2. With the controls set correctly, a change in anode current at V2 *from nearly zero to some 5–6 mA, or more*, may be obtained. The maximum to which the current will rise falls off as the distance between the transmitter and the receiver is increased, but at approx. half a mile distance, using only a 4′ 6″ aerial on the transmitter and a 20″ aerial on the receiver, which was located in a model boat *on the water*, a current increase of 3 mA was obtainable. A complete receiver with a 20″ aerial was tested in the boat mentioned above on the Round Pond at Kensington. The model was controllable anywhere over the length and breadth of the pond. The relay was set to close at 1 mA, the standing current being set at 0.5 mA. The current taken by the first valve (V1) is approx. 0.25 mA; it varies only a little from this with adjustment of the quench control R3. The transmitter used for the tests was run at 4.5 watts input, with a link coupled aerial 4′ 6″ long. With a longer aerial on both transmitter and receiver the range of control would probably be well over a mile.

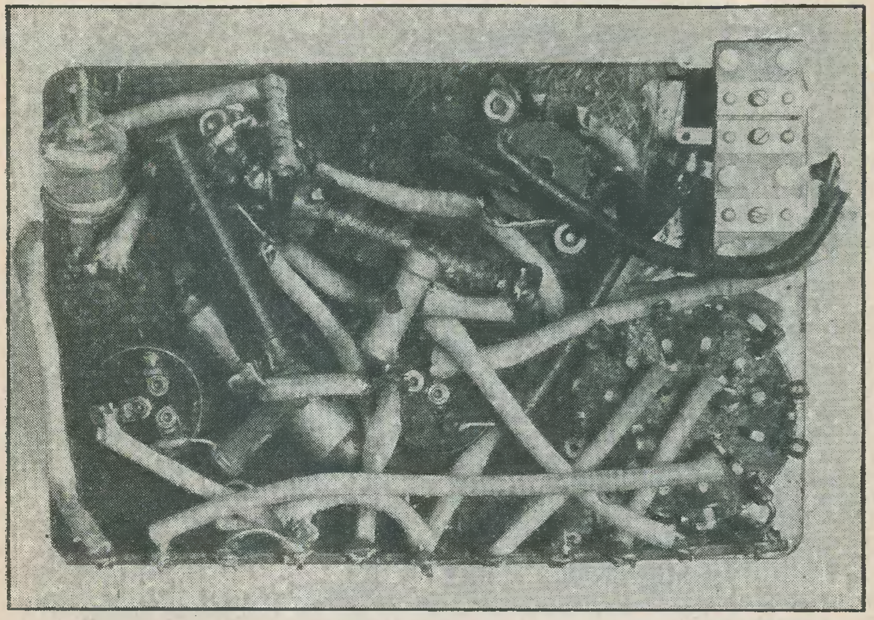
Valves, Components and Layout

For ranges of up to about 400 yards, and with a somewhat smaller average current rise at V2 anode, the HT may be limited to 30V to each valve. A current rise of up to a maximum of 3 mA is obtainable. It would be better, when using lower HT voltages, to use a longer aerial on the transmitter (a vertical quarter-wave, which at 27 Mc/s is approx. 8′ 6″ long). A slightly longer aerial on the receiver would also help increase the range. With 45V on V1 and 90*V on V2* a current rise to something like 10 mA is possible, with even greater range. It is strongly recommended that only the 3V4 valve is used, although the circuit would probably operate with other valves such as the 3S4 (DL92) as V2 and either a 1S4 or 3S4 as V1. Miniature or sub-miniature valves such as the Hivac XFY10, etc., have been tested with less satisfactory results, but the circuit could undoubtedly be developed to use these. The greatest difficulty is getting these tiny valves to oscillate *and quench* at 27 Mc/s.

Recommended batteries are the 45V flat deaf-aid type for the HT supply (Ever-Ready B109) and the 1.5V deaf-aid filament batteries for the LT (D18). For operation on 30V HT the Ever-Ready B123 is quite suitable.

Some details of the actual construction may be useful, and these should be carefully considered, because bad assembly and layout will have diverse effects on the final results. A paxolin or metal chassis may be used, and this should be large enough to accommodate both the variable controls and the relay. See photographs and Fig. 3, which show two different types of layout.

All wiring to the first valve (V1) must be as short as possible, particularly the anode and grid leads and the leads connecting the tuning coil and condensers. Remember that the filaments are isolated from each other, each having its own LT battery separately switched. Likewise, provision must be made to switch



Underneath of receiver

off the HT to the second valve (V2) either by a separate switch or by removing the milliammeter or its shorting plug. The current drain through the potential divider network is only about 0.01 mA, but if left on to run continuously it would drain the HT (to V2). A miniature type wavechange switch having, usually, 3 or 4 single-pole double-throw switches operated simultaneously can be used with very good effect. The smallest of these are about an inch in diameter and very light in weight.

Miniature variable resistors are obtainable in the values quoted and require very little adjustment once the correct settings have been established; in fact, the 50 kΩ quench control need not be touched at all once the final adjustments have been made.

The tuning coil and condenser must be mounted as rigidly as possible, with the aerial tapped on one turn in from the (anode of the valve) end of the coil. A suggested layout is shown in Fig. 3.

The Siemens type 73 (3400 Ω), type 85 (3400 Ω) or type 95 (2000 Ω) relays are quite suitable, since with such a large current change available it is necessary only to get the relay to close at 1 mA and operate the receiver with a standing current of 0.5 mA.

Conclusions

The advantages of this circuit as a Radio Control receiver are well worth consideration, and may be listed as follows:—

1. Great saving on HT batteries due to the low current drain (particularly if a 4-pawl actuator or sequential control is used).
2. The large *current increase* ensures certain operation of the relay.
3. Does not call for an extremely sensitive or very closely adjusted relay.
4. Uses hard valves, from which a normal life will be obtained.
5. Versatile and very easy adjustment, both in initial setting of tuning and quench control and normal adjustment during operation. (During a 3-hour run no adjustment whatever was made to the controls, although the boat was returned to the shore several times and taken out of the water (checking for weed in the prop, etc.))
6. Completely stable quench detector. No critical tuning.
7. Can be constructed so as to be fairly small and light in weight. The only disadvantage, if it can be called that, is the separate switching required for the filaments and HT to V2. Even this can be effected by one multi-way switch as mentioned above.

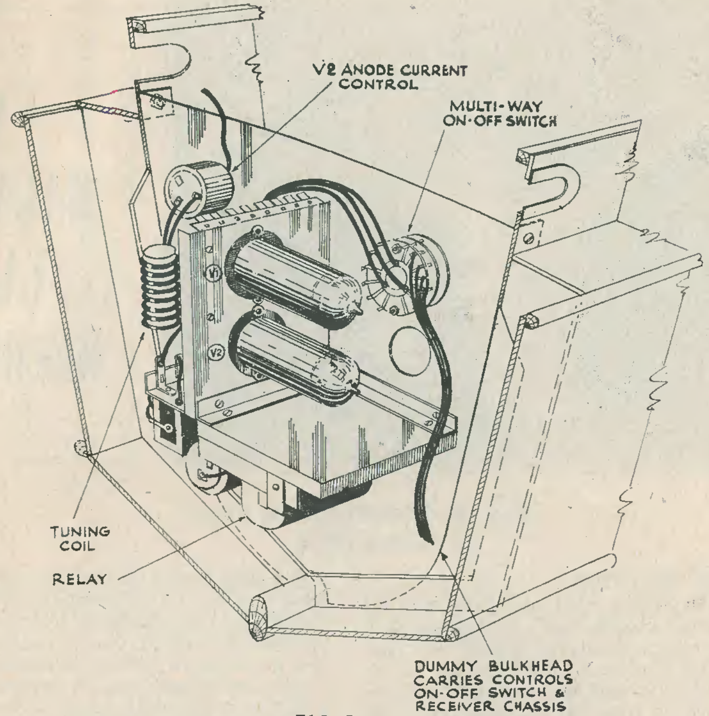


FIG. 3

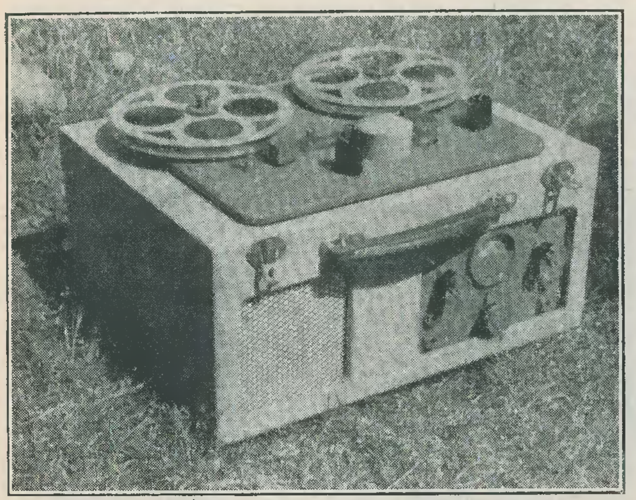
LAYOUT OF RECEIVER IN THE WRITER'S MODEL LAUNCH. THE DUMMY BULKHEAD IS ALUMINIUM AND FORMS PART OF THE RECEIVER CHASSIS. BATTERIES ARE MOUNTED FORWARD BEHIND THE FO'CSLE BULKHEAD.

C 762

A further advantage is its great range, which should be more than enough for all normal operation, but which may be increased should special requirements demand it.

The writer would like to mention that the direct coupled amplifier may also be used to provide multi-channel control, since additional valves could be employed in cascade, with delay constants introduced into the circuits. There is also the possibility of using a tone modulated transmitter and following the DC amplifier with a normal amplifier valve and a tuned (audio tone) reed or relay in its anode circuit, so providing two complete channels. In addition, a delayed relay (either open or closed) could be placed in the anode circuit of V2 (in series with the normal relay) to provide an extra channel for engine stop/start or reverse, a 4-pawl actuator being used for steering. In fact, the direct coupled amplifier opens up an entirely new field for experiment with, and possible future development of, Radio Control.

(*To be continued*)



A MAGNETIC TAPE RECORDER

By L. F. SINFIELD, A.M.I.P.R.E.

PART 2

Construction and Layout

The layout sketch must be rigidly adhered to for absolute stability, with the transformers and choke oriented as shown, also the switching wafers. The frequency compensation switch must be near the amplifier component panel, and be screened from the other switch bank. In the writer's model the whole of the fixed resistors and condensers of the amplifier strip were mounted on a tag board 6″ long (excepting, of course, grid and screen stoppers). The coupling and bypass condensers were all metal-cased tubular types, with the cases bonded to earth so that they acted as screens between stages on the panel.

It must be noted that the low impedance circuits are only bonded to earth at one point, the outlet socket for the head. This is to prevent loops formed by the chassis, and even the screening of the leads of these low impedance circuits must be insulated from the chassis at all other points. No heater current must flow through the chassis, so twisted pairs are taken to each heater. The centre tap of the heater winding is taken to the 6V6 cathode, to prevent heater-cathode emission of the 6J7 input valve injecting heater hum into the input stage.

Screened wire must be used at all the points indicated in the diagram; the screening around the 6J7 and 6SH7 grid circuit should be bonded to chassis at the nearest convenient points.

The electrolytics on the HT line must be of good quality and of ample working voltage, 450–500 V, with negligible leakage because of the voltage drop across the decoupling resistors if condenser leakage is present.

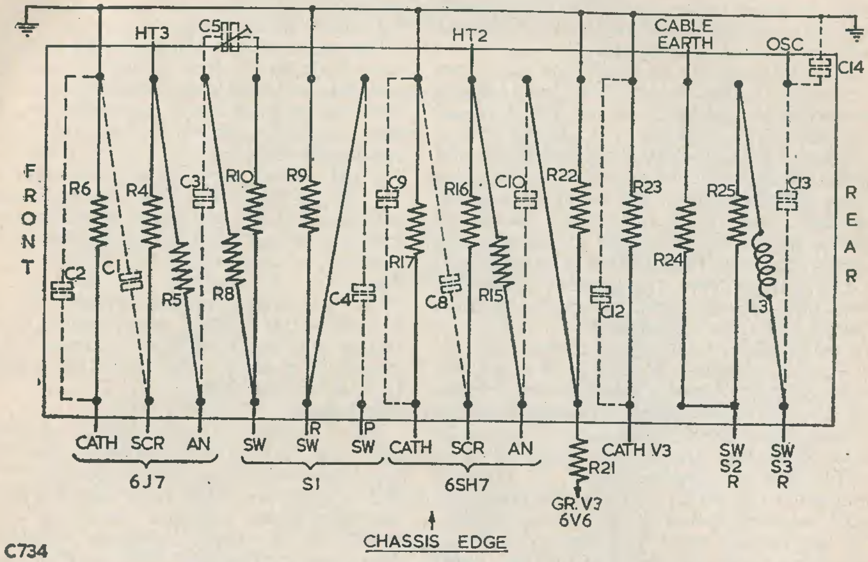
The power pack is quite conventional, with a 50 Ω surge limiting resistor added to reduce rectifier peak current. The rectifier is a 5Y3GT in order to conserve space.

The mains outlet of the amplifier comes through a grommet at the side. At the same point is a Belling Lee co-axial socket for the head leads, a two-pin socket for the internal speaker leads, and the bias control.

When assembled, the record motor locates near the centre of the amplifier chassis with about ¼″ to ½″ clearance above the chassis. A 6½″ speaker mounts at the front and occupies the whole depth under the tape mechanism.

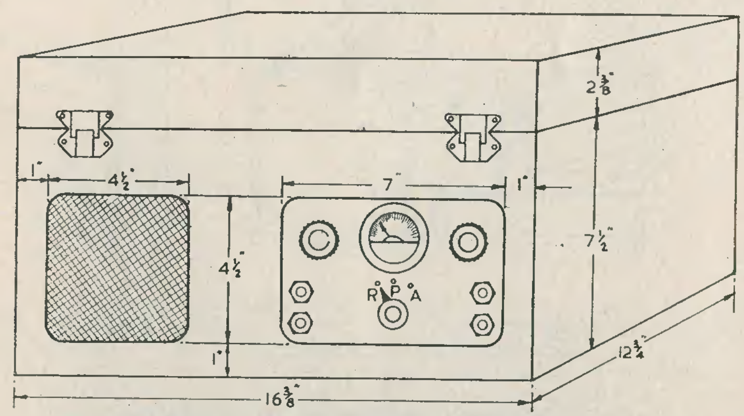
Hum

This is the chief cause of trouble in high gain amplifiers. In this model, hum due to heaters is impossible to detect. Hum due to inductive coupling from transformer and drive motor to the head, wiring and transformer can be reduced to negligible limits. If the input transformer has been screened, as suggested, hum from this source is virtually zero and can be ignored. Hum pick-up on the head must also be cured by mu-metal screening. The difficult item to cure is coupling to the wire itself with, say, the low impedance input wiring forming a single



C734

Tag Panel, looking at "R" side (away from valves). "C's" (shown dotted) on other side. All "C's", except C4 and C5, are metal cased with cases bonded to chassis. Wires to the valves to be as short as possible.



RECORDER CASE WITH LID. ALL DIMENSIONS ARE EXTERNAL. MATERIAL: ⅜″ THICK* MORTISED SCREWED GLUED & BRACED WITH WOOD FILLETS WHERE POSSIBLE. *LID TOP IS 3/16″–¼″ PLY LID IS FITTED WITH SLIDE-OFF HINGES SO AS TO BE COMPLETELY DETACHABLE. HANDLE NOT SHOWN. SPEAKER MOUNTED ON SEPARATE BAFFLE BOARD & SCREWED IN

C736

turn loop. To minimise this, the low impedance screened wiring should be brought right up to switch wafers, etc., and no unnecessary loops should be formed.

To cancel out any hum left, the wire from the switch wafer to the live head socket connection should be of 20 swg PVC covered with two turns of diameter 1″ at the centre. This forms a hum-bucking coil and is adjusted (when all the complete recorder is assembled in the proper position) for minimum hum on playback. Any hum on rewind should be ignored as the field from the rewind motor is large and hum on this position is unimportant.

If a less compact arrangement is desired, then hum difficulties will be greatly reduced.

Chassis and Case Construction

The amplifier chassis is a standard 12″ × 8″ × 2½″ amplifier chassis in 16 swg aluminium, with angle pieces riveted in the corners, and tapped bushes fitted for fixing into the cabinet. The front panel is 5″ high and 8″ wide, of 16 swg dural or aluminium.

The case is constructed of ⅜″ plywood (except the top panel, which is 3/16″), morticed, glued, screwed and with re-inforced corners. For the lower part, the required internal dimensions are: 7¼″ below Qualtape panel mounting level; internal width to be about ¼″ over the outer reel to reel dimension; front to back internal depth is 12⅜″, this being the length of the amplifier chassis; lid height to be enough to allow adequate clearance for the spool tension bolts. Care must be taken, if the machine is run with the lid down, that these bolts do not foul the top, or the take-up reel may be stopped and the tape thrown off. The lid on the writer's equipment was fitted with slide-off hinges so that the top could be completely removed.

Final overall case dimensions were 16⅜″ × 12¾″ × 9⅞″. The unit was fitted with a carrying handle to make it transportable, and has in fact been used considerably "on location."

Tape

As permanent magnet erasure is used, this does not present any problem, and to obtain the best frequency response a high coercivity grade of tape should be employed (*e.g.*, E.M.I. H.60).

Microphone

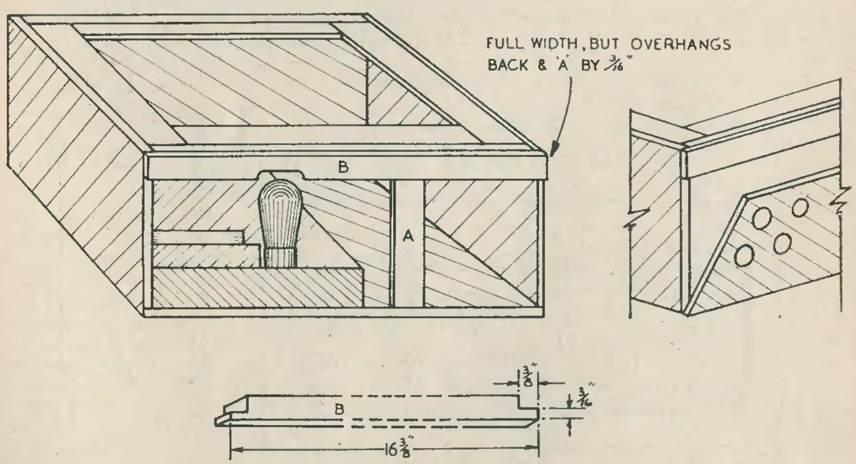
After testing a wide variety of moving coil and crystal microphones, the writer has finally settled on the Cosmocord "Filtercell" type for the best combination of sensitivity and response (and, of course, price). It is worth spending considerable time experimenting with different microphones and room acoustics, as these factors represent practically the whole loss of fidelity.

A good test for recorder response is to use a good high-fidelity pick-up input from good records, with the pick-up compensated for disc recording losses. Then record onto tape from this source, and play back the tape recording for comparison against the usual record player equipment. (The recorder itself may be used in position 'A' for playing gramophone records).

When crystal microphones are used, it is essential to have good low-loss screened cable, and this should not be of too great a length, otherwise the output from the microphone will be reduced by the capacity of the cable, and overall sensitivity be lowered.

If speech only is required, with maximum intelligibility rather than maximum fidelity, then the normal diaphragm type crystal microphone may be employed, as their high output and rising high frequency response makes them admirably suited to this type of operation. Also, the bass compensation can be eliminated on playback by playing in the 'A' switch position.

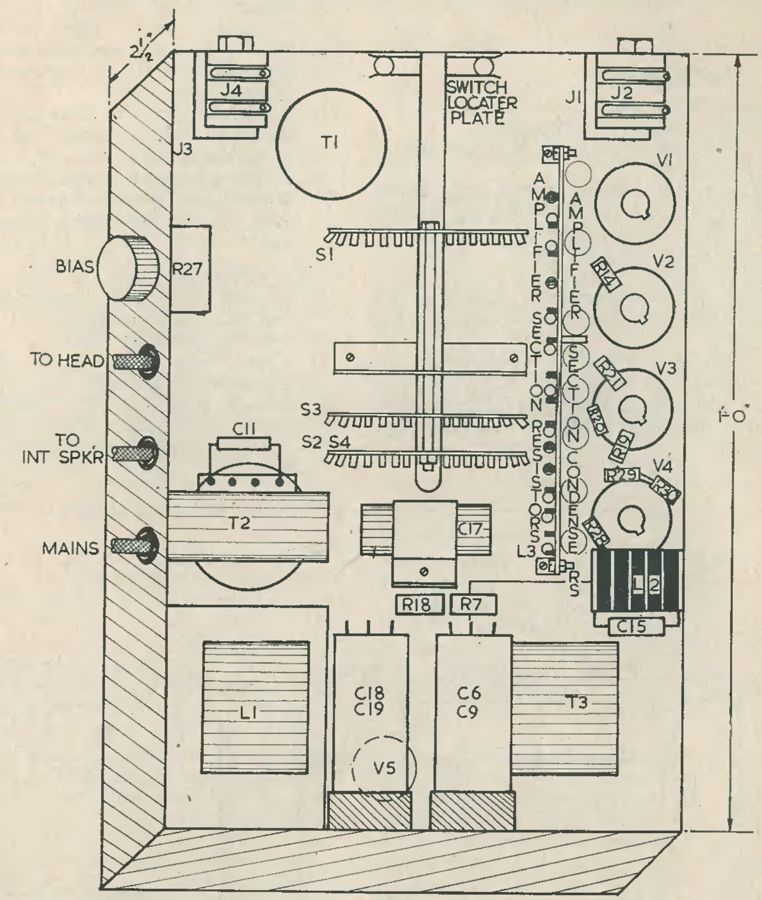
Adequate space exists in the back of the



REAR VIEW OF CABINET. 'A' & 'B' ARE BRACING STRIPS 1½"x¾"
NB. 1) ALLOW FOR KNOB ON BIAS CONTROL TO SLIDE OUT WHEN FITTING 'A'
2) CUT AWAY 'B' TO ALLOW SLIDING ENTRY OF 5Y3GT RECTIFIER.
A PERFORATED BACK OF ⅛" MATERIAL HAS BEEN ALLOWED FOR

C735

MAGNETIC RECORDER LAYOUT - UNDERSIDE
NB (OBSERVE CORRECT CORE DIRECTION OF T2-T3-L1)



C738

cabinet to allow the microphone, its leads, and mains leads to be stowed internally for transit.

Operations

(A). For Recording

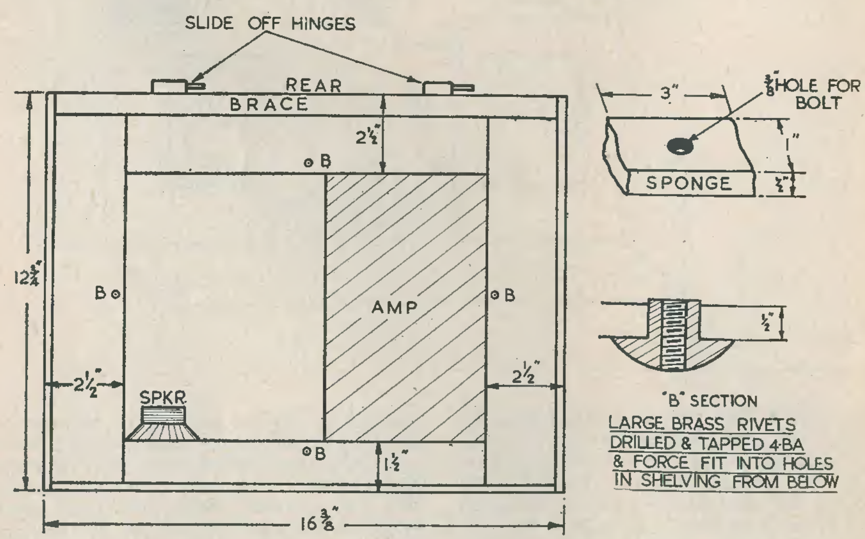
(1) Run the tape back on to rewind reel.
(2) Remove keeper from magnet.
(3) Thread tape over magnet, head and around the capstan.
(4) Snap pressure roller against the capstan.
(5) Mark the start of recording by slipping a piece of paper under the outer turn of tape on the take-up spool.
(6) Switch to 'R' (Record).
(7) Plug in microphone or gram and test, adjusting gain controls for correct signal level.
(8) Switch mechanism to "Forward," and proceed with recording. Keep adjusting the gain controls during the recording to maintain a relatively constant input level.

(B). Rewind

(1) Remove input plugs.
(2) Switch to 'P' (Play) and return gain controls to zero. There is then no bias field in case the tape goes near the head, and volume is at zero to prevent hum from rewind motor field.
(3) Unthread tape, but leave over one of the guides in order to steady the tape so that it rewinds evenly.
(4) Replace keeper on erase magnet.
(5) Rewind until marker for start of recording falls out, so indicating original starting point.

(C). Playback

(1) Thread tape over head and capstan, but NOT over magnet.
(2) Snap on pressure roller.
(3) Check that switch is in 'P' or 'A' position, as required.
(4) Switch mechanism to "Forward" and adjust playback volume control (the 1 MegΩ pot.) for the desired level.



C737

Plan of main unit showing support shelves and fixing holes for mechanism plate. Stick ½" × 1" × 3" sponge rubber strip under outer edges of mechanism for noise absorption. Fix with 4-BA bolts so that deck is ⅛"–¼" clear of support shelves.

RADIO MISCELLANY

CENTRE TAP talks about

"COIL BOX" COMPETITION RESULTS — SALVAGE

I have now had an opportunity, in collaboration with your Editor, of carefully examining all the letters received regarding Coil-boxes. We hardly dared hope for anything very revolutionary in design. Personally, I would have felt warmly disposed to anything that broke away from the conventional and, had the entries tended in this direction, I should have been inclined to award the highest proportion of points for originality and practicability.

Perhaps to criticise on the grounds of lack of originality would be unfair. It required someone with the gift of prophecy to assess the trend of future needs. Experts and statisticians can tell us what the constructor wanted yesterday. The problem of foreseeing what he will want tomorrow requires infinitely greater talent.

We looked in vain for ideas on semi-automatic ejection, but maybe this was asking too much. In fact, it could well be treated as a subject on its own.

One "unofficial" entry came along, in the form of a home-made coil box in itself. This was a very workmanlike job following conventional lines. It was designed around Denco Maxi-Q coils by Mr. C. H. Henderson, ex-G3CLB, a Dental Surgeon who, I understand, is now in South Africa and apparently QRT. Maybe in between spells of drawing the teeth of wealthy Johannesburg citizens he will find opportunities to again apply his marked constructional ability to the hobby. If this should come to his notice we should be pleased to have any subsequent ideas that may have come to him. It often happens when you have built a thing that ideas for improvements in subsequent models flow freely.

Readers' Ideas

Among the points common to most entries, the inclusion of broadcast band ranges featured prominently. While most readers favoured the idea of the calibration chart on the front of the panel, two or three ingeniously suggested the chart itself should be reversible. This feature would also facilitate easy access to the trimmers, which by popular demand would be mounted for front panel adjustment.

A number of readers expressed a wish to see the units marketed in kit form for home assembly, which would enable the box to be divided into several combinations of compartments and make possible double screening of the oscillator section. Several mentioned various forms of trigger release for easy interchangeability, but as no practical design was forthcoming it is felt that this refinement is a manufacturing problem and might well put the units beyond the popular price range.

Almost universal was the requirement for a low value tuning capacitor, 300 pF being the most popularly specified. There is some difficulty in obtaining ganged condensers of this size, although when production becomes more normal they should be readily obtainable, this capacity frequently being specified for commercial coils.

Type of Mounting

One new idea—although we had some doubts as to its practicability—was a coil box in cylindrical form.

Opinion was equally divided on the question of "across-the-chassis" or "along-the-chassis" mounting. The former has many advantages, avoiding the need for right-angle drives or elaborate tuning controls. "Across-the-chassis" lay-out also has the solid advantage of disposing the various sections closely adjacent to their associated valves.

On the question of contacts, all types seem to have been covered, knife, stud, pin and springy phosphor-bronze strips. Surprisingly, nobody mentioned Jones plugs and sockets. The eventual form the contact should take would, we felt, be a matter best decided by the manufacturer. Several readers felt there would be a need for extra contacts for purposes such as tuning range indication and bandspread change-over. On this point it occurs to us that some sort of HT safety device could profitably be incorporated.

More than one reader mentioned the difficulty that amateurs frequently find in neatly cutting square or rectangular holes in the panel, and we felt a front escutcheon would cover any such imperfections. To this we would add the suggestion that a guide frame incorporated with the escutcheon plate would solve the problem of alignment and avoidance of damage to contacts.

One or two readers suggested that in designing the coil box the need of its adaptability to existing receivers should be borne in mind. This, however, we felt is of minor importance as such alteration would inevitably necessitate a major rearrangement of the receiver.

There were many letters of considerable merit, and adjudging the best gave us considerable difficulty. We finally decided the winner to be R. A. Poole of 16 Newnham Road, Newark, Notts., but in view of especially meritorious entries from two other readers it has been decided that additional awards in the form of copies of *World Radio Valve Handbook* (value 11/6) be given to L. A. Chinnery, 180 Hermon Hill, London, E.18, and D. Heaton, 1 Jer Lane, Horton Bank Top, Bradford, Yorks.

Salvage Work

The decreasing quantity of immediately usable surplus gear becomes more apparent every month, and it seems we are approaching the point when the real " snips " will want careful searching out. There are, however, still plenty of bits and pieces at bargain prices, which can be bought for the sake of the parts. Recent years have tended to distort our sense of surplus values, particularly the Halcyon days of 1946 when you could pick up a B2 transmitter and receiver complete with valves for as little as two pounds. I remember, too, a dump where one could get as much dural tubing as you could carry away in your arms for ten bob. To-day you often have a job to get it, and it rarely costs less than 1/3d. a foot, while the cost of suitable packing to ensure undamaged arrival more than doubles the price.

For the recent constructional work I have had in mind, I found I had to buy many of the resistors and capacitors, let alone the major parts, despite the possession of several outsize junk-boxes and half-stripped chassis. Last night when sorting them over to denude them of any remaining serviceable parts, I had to smile at the thought that up and down the country hundreds of constructors are getting to the point where they find themselves carefully unsoldering resistors to salvage those they formerly despised. I mean, of course, those mounted on narrow tag boards with wire ends barely a quarter-of-an-inch long. When you are driven to it, this has to be done carefully. Excessive heat from the soldering iron is liable to lead to violent changes in the resistance value.

A good idea is to use a pair of home-made tweezers formed out of heavy gauge copper to absorb the heat and thus prevent it from reaching the resistor body.

To Make 'Em Come Clean

When dismantling components from old chassis, beginners often find difficulty in dealing with nuts and bolts which have been generously daubed with dope, shellac or other varnishes, which have been smeared on the threads to ensure they didn't rattle loose during the buffeting of their Service career.

The varnishes used on much of the British ex-W.D. equipment seems to be practically insoluble. The only successful way I have found of dealing with it has been a liberal dosing with methylated spirit. After a while, the varnish softens sufficiently to allow removal.

With the United States gear the nuts usually seem to be " fixed " with ersatz resins. These can be fairly readily dissolved with ethylene di-chloride to which a spot of castor oil has been added. The solution is painted on to the fixative and allowed to stand for a few minutes. A second application is then given before the nut is unscrewed. Ethylene di-chloride, by the way, should not be used near a naked flame, although it can be safely handled in a well-ventilated room, and its evaporation rate is considerably slower than methylated spirit.

DESIGN FOR AN "ECONOMY" MAINS RECEIVER

by R. K. VINYCOMB, B.Sc.

PART TWO

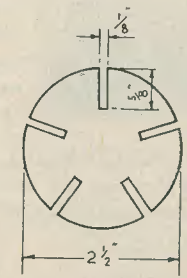
Tuning Inductor

The tuning coil is very easily made. Its former consists of a circular piece of stiff cardboard 2½ inches in diameter. Five radial slots, each ⅛ inch wide and ⅝ inch long are spaced equally round the former so that its finished appearance is in accordance with Fig. 3. The inductance of the original coil was designed so that the London Home Service and medium wave Light Programme could both be tuned in with a tuning capacitance of less than 200 pF. To duplicate this performance, proceed in the following manner, using 36 swg DCC copper wire: Make two holes near the centre of the former and anchor the wire, leaving about six inches for connecting up. Take the wire through the nearest slot and then wind it round the former by taking it through each slot, round the circumference so that the wire lies alternately on each side of the former, in " basket-weave " fashion. Wind on three turns in this way, then make a small loop in the wire and twist the loop so that it cannot come undone. Continue winding a further thirty turns and make a second loop. Finally add a further thirty turns. Make two small anchor holes near the outer circumference of the former and anchor the outer end of the wire, again leaving about six inches of wire for connecting up. Bare the insulation from the wire at the tapping loops so that soldered connections may be made.

The completed coil should be mounted, by means of a single 6BA bolt through the centre, on a piece of thin paxolin or Tufnol about 4 inches long and ¾ inch wide. This assembly can then be fixed, in a vertical position, to the chassis of the set by means of a small metal angle bracket. The paxolin support may also be drilled to take the aerial socket. The aerial condenser (C_1 in Fig. 1) can then be soldered in position between the socket and the appropriate tapping on the coil. The finished assembly is shown in Fig. 4.

Power Pack

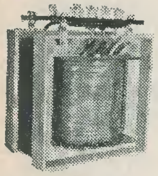
The power pack for a set of this type needs to be simple, and yet the smoothing has to be good because regenerative detectors are particularly sensitive to hum. This means that an iron-cored choke is preferable to a heavy-duty resistor for filtering purposes, since the latter will cause a greater voltage drop. Metal rectifiers are readily available and have the advantage over valves that no heater current is required. The simple half-wave circuit shown in Fig. 5 was therefore adopted. Condenser C_{10} in conjunction with choke L_3 forms the smoothing filter, while condenser C_{11} is the rectifier reservoir. The DC output voltage from the rectifier W depends upon the capacity of C_{11}. For a given AC



C725

Fig. 3: The coil former should be cut from a piece of stiff card to these dimensions

ELPREQ PAGES



HIGH WATTAGE AUTO TRANSFORMERS

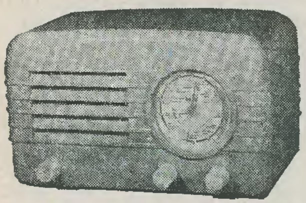
for working American equipment off our mains etc. Input tapped 200-240v. Output 115v.

Loading	Price	Carr.
1 KVA (1,000 watts)	£6.10.0d.	5/-d.
1.5 KVA (1,500 watts)	£7.17.6d.	5/-d.
2 KVA (2,000 watts)	£10.17.6d.	7/6d.
3 KVA (3,000 watts)	£12. 7.6d.	10/-d.
5 KVA (5,000 watts)	£19. 5.0d.	12/6d.

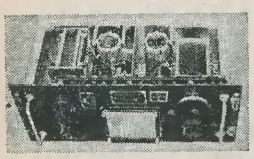
CONTINUOUSLY VARIABLE MAINS TRANSFORMER

As described in the August 1951 issue, this has a primary tapped at 81 v. and four secondaries of 1 v., 3 v., 9 v. and 27 v. respectively. By suitable selection of windings, voltage in steps of 1 v. up to 40 v. can be obtained with isolation from the mains at 100-watt rating, e.g., 20 amps. at 5 v. and 2½ amps. at 40 v. By adding the primary the voltage can be varied in steps of 1 v. up to 280 v.
This is undoubtedly an essential piece of equipment in all experimental laboratories. Price £3/10/- each.

CONSTRUCTORS' PANEL SPECIAL OFFER



Modern design, bakelite cabinet in ivory, blue or brown, complete with metal chassis punched out for speaker and 5 valves, etc. Parcel also includes moulded perspex windows, matched set of knobs, scale, and hardboard back. Price 27/6 carr. and pkg. 2/6.

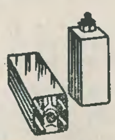


TUNING UNITS

American made units, available are TU5B, TU6B, TU9B, TU10B, TU13A, TU17A, TU25A, TU47, TU48, TU49, TU51, TU52, TU54, TU60. All 19/6 each, plus 3/6 carriage.

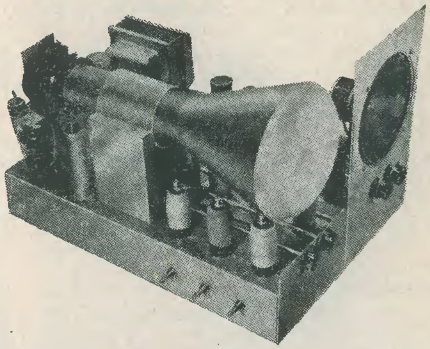
I.F. TRANSFORMERS

465 kc/s iron dust cores fitted in aluminium can size 1½in. × 1½in. × 3½in. Price 12/6 pair. Midget type, 465 kc/s size 1¾in. × 1¾in. × ¾in. (M400B). Price 17/6 pair. 465 kc/s. Ex-equipment in good condition fitted in standard size can, dust cored. Price 7/6 pair.



THE 'ARGUS' TELEVISION RECEIVER

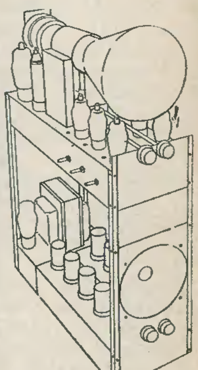
A 21 Valve 6in. C.R. Tube Unit-built Televisor for the Amateur



Although this televisor costs only about £20, it does not involve the conversion of ex-Government units, and has been designed for construction by the novice. The circuits have been kept straightforward and devoid of "frills," though nothing has been sacrificed which would assist in its efficient and stable operation.

The cathode-ray tube used is a VCR97. This 6in. tube was chosen as it is readily available at a low cost, and is capable of providing pictures of very good quality. The trace is green, but one soon becomes accustomed to the colour, and it is very restful to the eyes.
The chassis is divided into five separate units, which makes for ease of construction; the units are vision receiver; sound receiver; time base; E.H.T. Supply and C.R.T. network; and power unit. Each unit is complete on its own chassis, and when finished all units are bolted together to form the complete televisor.
We can supply all the parts for £20/10/-. H.P. terms are available, deposit being £7, balance 12 monthly payments of £1/6/- each. Carriage and packing 10/- extra.
A reprint of the data which originally appeared in *"Practical Television,"* together with some additional diagrams and notes produced by our Television engineers are available as a constructor's Envelope. Price 5/- post free.

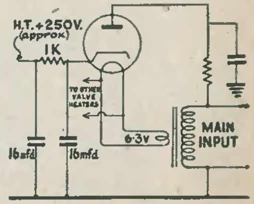
THE ARGUS ARRANGED AS A CONSOLE →



10,000 VALVES STILL AT PRE-'51 BUDGET PRICES

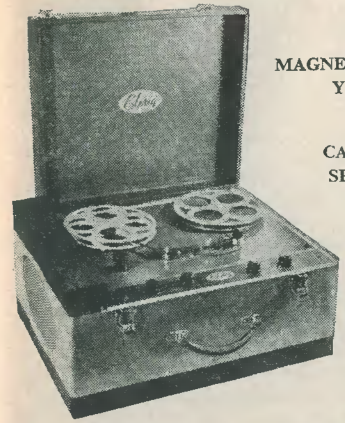
A POWER PACK FOR 15/-

Efficient power supply, O.K. for operating a receiver, amplifier, instrument or other device requiring up to 60 mA. at approx. 250 v. Parcel consists of filament transformer, rectifying valve, smoothing resistor and 16 × 16 mfd. 350 v. Electrolytic condenser. Note the filament transformer will supply enough current to operate 3 or 4 other 6.3 valves.



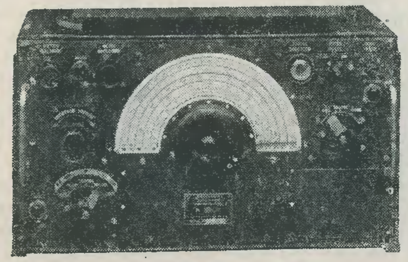
MAGNETIC TAPE RECORDER
YOURS FOR £9 15 0

CABINETS AVAILABLE SEPARATELY £4 17 6



Tape Deck. Fitted with 3 motors giving fast rewind/forward run and no friction. High fidelity record/playback giving approximately 1 hour playing from standard 1,200ft. tape. Tape, 35/- per reel.
Amplifier. High gain enables recording to be made from microphone, pick-up, or loudspeaker. Separate bass and treble lift controls.
Cabinet. Portable, is rexine covered, table model is polished walnut.
Instruction Booklet. Shows in close detail exactly how to assemble and operate the recorder, is free with kit or available separately at 5/- (credited if you buy kit or complete recorder).
Price. Complete kit of parts including 6 B.V.A. valves, loudspeaker and cabinet (state whether portable or table model required), £29/5/-, or £9/15/- deposit and balance over 12 months. If required we will assemble and test for £4 extra. Suitable crystal hand/table microphone. £1/15/- extra.

YOURS FOR £4. 17. 6d.
COMMUNICATIONS RECEIVER R.1155

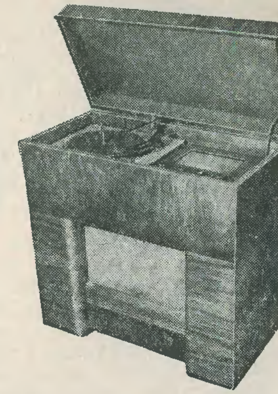


We have just bought a new consignment of these and can guarantee them to be absolutely unused (not just in re-crackled case).
This set as most will know is considered to be one of the finest communications receivers available to-day.
The frequency range is 75 kc/s to 18 Mc/s. It is complete with 10 valves and is fitted in a black metal case.
Made for the R.A.F. so obviously a robust receiver which will give years of service. The price is £14/10/- or will be sent against deposit of £4/17/6 and balance over 12 months. If you cannot call to collect please include an additional 10/- to cover cost of transit and carriage. This is partly returnable to you if and when you return the transit case.

MAINS POWER PACK FOR R.1155

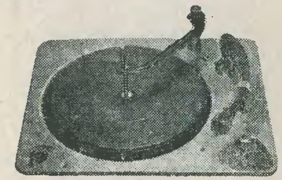
With Pentode output stage. Plugs into socket on receiver so no internal modifications are required. Price £5/10/- complete with 8in. speaker ready to work, carriage 3/6.

RADIOGRAM CABINET



Console Type Cabinet with full grained walnut finish, will take standard type auto change gram unit. Price £12/10/-, or £4/3/6 deposit.
Radio Chassis to suit, £10/19/6, plus 7/6 carriage and insurance.
Auto Change Units, three-speed, £15/10/-. Standard, £11/15/-.
Special Offer. Cabinet, Radio Chassis and Standard Changer, £34 or £12 deposit.

THREE AUTO CHANGER BARGAINS



Garrard RC72 3-speed with dual-purpose head, 15 gns.
Collaro RC511 3-speed with dual-purpose head, 11 gns.
Garrard R70B single-speed with crystal head, 10 gns.
Carriage and packing 7/6 extra.

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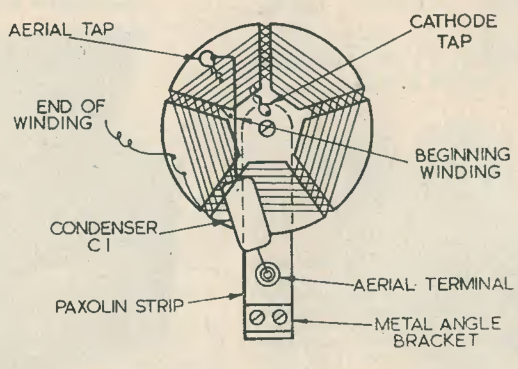


Fig. 4: The tuning coil assembly is shown here

input voltage and a given load, the larger the value of the reservoir condenser, the larger will be the DC output voltage. The effectiveness of the smoothing filter depends upon the product $C_{10} \times L_3$. Condenser C_{12} is a small capacity high-insulation component which will help to remove high-frequency interference and "hash" from the incoming mains. When plugged into AC mains, the rectifier will pass current on alternative half cycles and the reservoir will thus become charged so that its positive plate is the one connected to the smoothing choke. The output of the choke thus becomes the HT positive supply, while the HT negative is obtained direct from the mains. When plugged into DC mains, the rectifier will pass current continuously if it is connected to the positive pole of the mains. However, should the mains plug be inserted the wrong way round, so that the positive lead becomes connected to the HT negative line, the rectifier will pass no current at all and the set will not function. This also means that the reservoir and smoothing condensers, if of the electrolytic type, are protected from damage.

The receiver valve heaters are connected in series and so the total voltage required for them is the sum of their individual voltages. This sum will be less than the mains voltage by a considerable amount, and it is necessary to drop the excess voltage in a resistor, R_{10}. The value of R_{10} may be calculated as follows:

$$R_{10} = \frac{V_m - V_h}{I_h} \text{ ohms}$$

Where V_m = mains voltage
V_h = sum of heater voltages
I_h = heater current (Amps).

It will be noticed that both the valves take the same heater current, I_h. The dropping resistor, R_{10}, must also be capable of passing this current without getting too hot.

The Practical Receiver

A complete circuit of the writer's original set is given in Fig. 6. It conforms in nearly all details to the theoretical circuits given earlier and the labelling of the components is the same. The valves used are a 12SK7 for the detector and a 12A6 for the output stage.

Instead of a continuously variable tuning condenser, two 100 pF pre-set trimmers were used. One is connected permanently across the tuning coil while the other is brought into circuit by means of a simple on-off switch, S_1. With this switch open, the first trimmer is adjusted until the Light Programme is tuned in. The switch is then closed and the second trimmer adjusted to bring in the Home Service. A similar procedure may be followed for any other two stations on the medium waveband. For stations at the low-frequency (longer wave length) end of the band, the trimmers may have to be of greater maximum capacity. For instance, if it were required to receive the 1214 kc/s Light Programme and also the 809 kc/s Scottish Home Service, the second trimmer would probably have to have a maximum capacity of 250 pF. Of course, the twin-trimmers and switch could be replaced by a conventional variable condenser having a maximum capacity of at least 200 pF, if continuous tuning is required.

The choke, L_2, in the anode circuit of the detector must be an effective one. The small pie-wound type is currently available cheaply and may be suspended in the wiring. The

values given for the bypass condensers C_4 and C_5 should be adhered to. The load resistor R_5 is 100,000 ohms, which gives the best compromise for valves of the 12SK7 class. The fixed potentiometer supplying the screen current must itself pass a current several times that required by the valve in order to ensure stability. With the components shown, a current of about 6 mA passes through R_2 and this means that this resistor must have a 2-watt rating.

In the output stage, the screen of the valve is tied direct to the HT line. The total cathode current of this valve is about 28 mA, and therefore a cathode resistance of 330 ohms is required to give a bias voltage of approximately 9 volts. A 6 inch permanent magnet moving-coil speaker is used, with a 3 ohm voice coil. The optimum load for the 12A6 is 7500 ohms. Thus the transformer ratio is given by:

$$r = \sqrt{\frac{7500}{3}} = \sqrt{2500} = 50$$

Thus a transformer having a ratio of 50 : 1 is required for correct matching.

A 230 volt 60 mA half-wave metal rectifier is used in the power pack. Since the total HT consumption of the set is only about 35 mA, a midget smoothing choke, rated at 40 mA, is used. In conjunction with a 16-plus-16 μF condenser for the reservoir and smoothing, 200 volts HT is made available with a very low degree of ripple. The valve heaters are supplied through R_{10}, which has a value of 1370 ohms, calculated as described previously. In this set this resistor was made by winding 36 swg Eureka wire on to a 3 inch length of electric firebar former to give the required resistance. The Eureka wire was soldered at each end to an anchor of tinned-copper wire wound round the former. The whole assembly was bolted by means of a metal clip at the bottom to a piece of Tufnol. The latter could be bolted to the chassis so that the dropping resistor was mounted in a vertical position. Most commercial mains dropping resistors are not of high enough value, but for those constructors who do not wish to make their own dropper there is a simple alternative. For use with 150 mA valve heaters, resistor R_{10} may be made up from two 700 ohm 20 watt resistors connected in series.

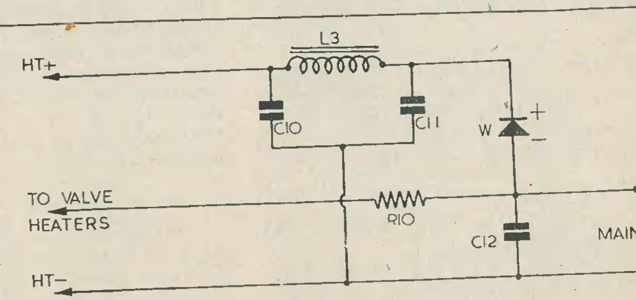
If EF39 and EL32 valves are used, their heater current is 200 mA, each at 6 volts. Therefore a 0.2A mains dropper would be required, having a resistance of 1090 ohms (say 1100 ohms) when the set was connected to 230 volt mains. However, the mains consumption in this case will, of course, be somewhat greater than with the 150 mA valves.

A double-pole mains switch, S_2, was used. It is recommended that this switch be a separate component, not one combined with the potentiometer R_4. Having the switch combined with the volume control results in unnecessary wear of the latter which makes for noisy operation.

Layout

Exclusive of loudspeaker, the receiver can be built on a simple brass, steel or aluminium chassis made from a sheet about 8 inches square. Two sides should be bent down to form runners 1½ inches deep so that the top of the completed chassis is 8 inches long and 5 inches from back to front. The only components mounted on top of the chassis are the valves, rectifier, smoothing condenser, mains dropper, tuning coil, trimmer condensers, and switch S_1 (or a continuously variable tuning condenser, if used). If a detector valve with a top-cap grid connection is used, the grid leak R_1 should also be located on top of the chassis. Holes in the chassis will be needed for sleeved wires

Fig. 5: An AC/DC power pack for supplying HT and heater current



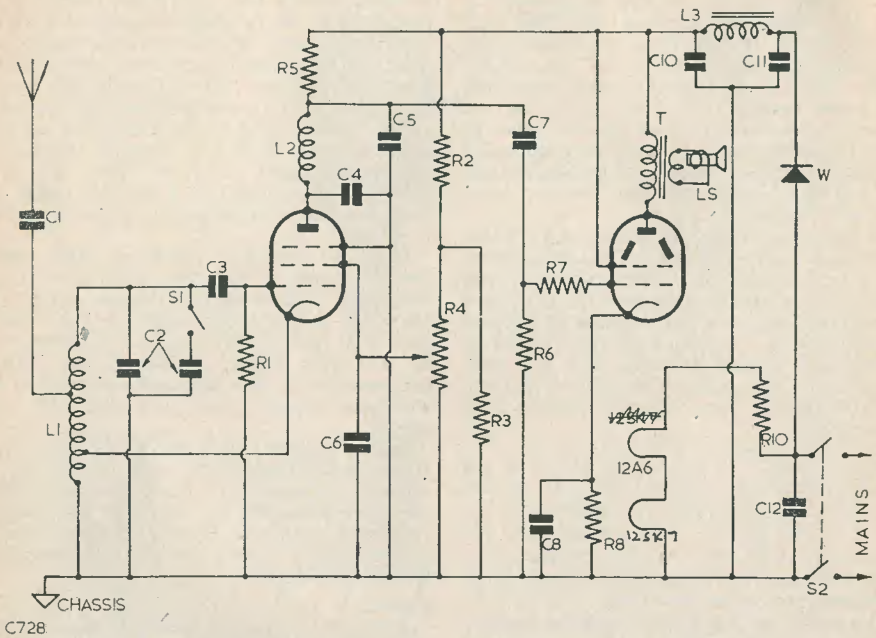


Fig. 6: The complete circuit of the prototype receiver. **Note:** *A direct earth connection* **must not** *be made to the chassis, which is at mains potential*

LIST OF COMPONENTS
for complete receiver

Condensers

350 volt mica: 100 pF (C_1); 300 pF (C_3); 250 pF (C_4); 400 pF (C_5)
350 volt tubular: 0.1 μF (C_6); 0.05 μF (C_7)
1000 volt tubular: 0.01 μF (C_{12})
Electrolytics: 25 μF 12 volt (C_8); 16 + 16 μF 350 volt (C_{10} and C_{11})
Trimmer: 100 + 100 pF mica or ceramic (C_2)

Resistors

½ watt carbon: 1.2 MegΩ (R_1); 7.5 kΩ (R_3); 100 kΩ (R_5); 1 MegΩ (R_6); 20 kΩ (R_7); 330 Ω (R_8)
2 watt carbon: 25 kΩ (R_2)
Potentiometers: 100 kΩ carbon (R_4)
Mains dropper: 1370 Ω (R_{10}), See text
Tuning Coil: (L_1), See text
RF choke (L_2), miniature pie-wound type
Smoothing choke (L_3), 40 mA type
Switches: low-voltage on-off (S_1); Mains DPST (S_2)
Rectifier: 60 mA, 250 volt, half-wave, metal
Valves: 12SK7; 12A6
Loudspeaker: 6 inch permanent magnet type with 50 : 1 transformer (3-ohm voice coil)
Two international octal valveholders, two control knobs, chassis, brackets, wire, sleeving, etc.
Note: Resistor R_9 and condenser C_9 are not required and thus are not listed above.

to pass through to the valve cathode, grid and from the metal rectifier.

The pin connections for the various alternative valves are given in Table I, which also lists the important characteristics.

The coil assembly should be mounted at the right hand end of the chassis, with the detector, output valve, rectifier and mains dropping resistance, in that order, along the rear of the chassis. Near the front of the

TABLE I

Valve pin connections viewing underside of International Octal valveholder. Pins numbered consecutively clockwise. Pin numbers 1 and 8 are adjacent to spigot keyway.

Valve type	12SK7	12K7	EF39	12A6	35L6	50L6	EL32
Function	Detectors			Output Valves			
Pin 1	"Earth"	"Earth"	"Earth"	"Earth"	"Earth"	"Earth"	—
Pin 2	Heater	Heater	Heater	Heater	Heater	Heater	Heater
Pin 3	Supp.	Anode	Anode	Anode	Anode	Anode	Anode
Pin 4	Grid	Screen	Screen	Screen	Screen	Screen	Screen
Pin 5	Cathode	Supp.	Supp.	Grid	Grid	Grid	—
Pin 6	Screen	—	—	—	—	—	—
Pin 7	Heater	Heater	Heater	Heater	Heater	Heater	Heater
Pin 8	Anode	Cathode	Cathode	Cathode	Cathode	Cathode	Cathode
Top Cap	—	Grid	Grid	—	—	—	Grid
Heater volts	12.6	12.6	6.3	12.6	35	50	6.3
Heater current (mA)	150	150	200	150	150	150	200
Anode volts	300 max.	300 max.	250 max.	250	200	200	250
Screen volts	125 „	125 „	250 „	250	110	110	250
Grid bias volts	—	—	—	–12	–8	–8	–18
Anode current (mA)	—	—	—	30	41	50	32
Screen current (mA)	—	—	—	3.5	2	2	5
Optimum load, ohms.	—	—	—	7500	4500	3000	8000

NOTES: "Supp." designates the suppressor grid, which should be connected to HT negative.
"Earth" designates the metal shell of the valve or the internal screen, which should be connected to HT negative.
"Grid bias" may be obtained from a cathode resistor (See text). If the anode volts are less than those quoted, the grid bias should be reduced in proportion.

chassis should be mounted the twin trimmer condensers and the switch S_1 on a bracket. In front of the output valve the smoothing condenser can should be fixed so that the connection tags protrude through a clearance hole into the underside of the chassis. Along the front runner, the potentiometer and mains on-off switch can be mounted. The potentiometer should be opposite the detector valve socket. The midget smoothing choke can be bolted to the underside of the chassis, near the rectifier. All the small condensers, resistors, RF choke, etc., can be suspended in the under-chassis wiring, which should be arranged to be as short and direct as possible. The only exception is the wiring to the valve heaters, which should be kept close to the chassis and out of the way of other wires and components.

Obtaining the Best Results

If the instructions given in this article have been carefully followed, little trouble should be experienced in obtaining very satisfactory reception. If results are not up to expectations, it is worth experimenting with the aerial coupling condenser, C_1. The operation of the electron-coupled detector depends on the correct amount of regeneration. It may therefore be necessary to change the value of resistor R_3 to obtain the correct screen voltage if a valve other than the 12SK7 is used. This may necessitate altering the position of the cathode tapping on the tuning coil by a turn or two one way or the other. If you *do* use a different valve, it is worth putting a few extra turns on the beginning of the coil when you first wind it. It will be found that turns can easily be removed from the inside of the coil when the set is completed, until the cathode tap is the optimum number of turns " up " from the earthy end.

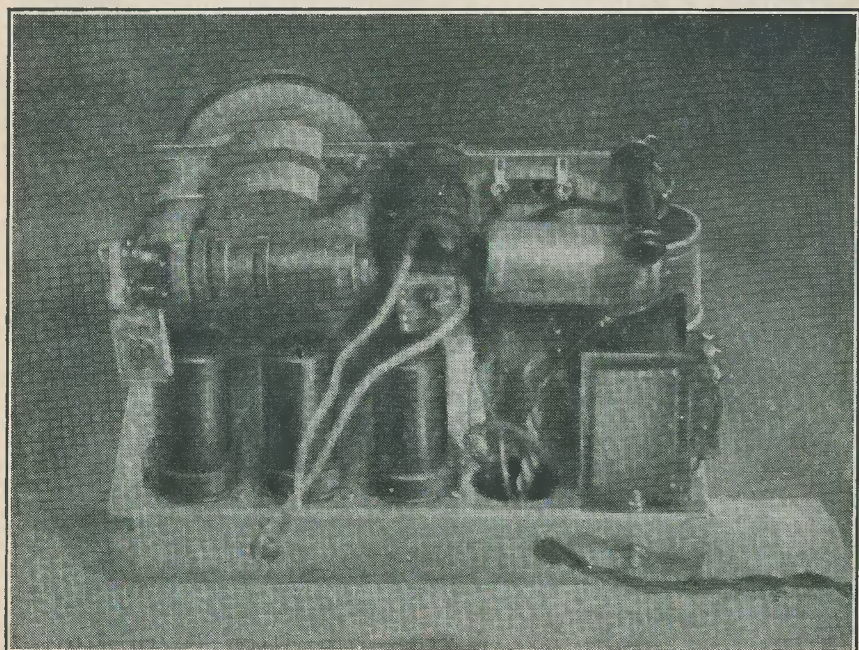
If pre-set tuning condensers are employed, the tuning will be very sharp and care should be exercised in adjusting the trimmers exactly to the desired station.

A PAIR OF MIDGETS

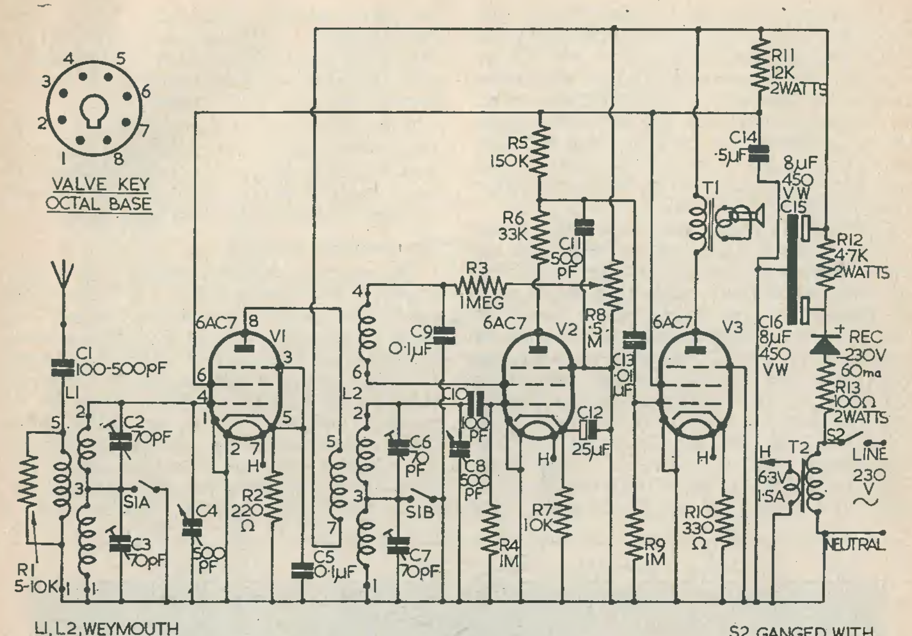
By EDWIN N. BRADLEY

The feeling of satisfaction at a good purchase experienced by the writer diminished rather sharply when the purchase actually arrived—a pair of midget cabinets, complete with chassis, which really were miniature. At first sight there appeared to be little room on or under the chassis for standard components, and since the cabinets had been bought solely for the purpose of using up spare standard equipment it was clear that some careful design work would be needed. The two resulting circuits, one a TRF and the other a superhet receiver, have given sufficiently pleasing results on all counts in the writer's very poor reception area to make a brief description of them worthwhile.

There would be very little point in giving chassis and layout dimensions, for the chassis employed were manufacturers' surplus and the circuits could be built onto much less complicated and more easily cut and drilled chassis, whilst it is probable that intending constructors will already have miniature cabinets of their own into which they wish to fit suitable circuits. Accordingly no chassis plans are



Rear view of TRF Receiver



THE TRF RECEIVER

given, though the accompanying photographs will give a good idea of the original arrangement of parts. Neither circuit is critical in any way—the only necessary precaution is to mount the TRF coils in the first circuit either at right-angles or, preferably, on opposite sides of the chassis. In the prototype the coils are very close together, with fairly long switch wiring, but feedback was still easily avoided.

Both receivers are for AC operation and small heater transformers are used, with half-wave direct rectification from the mains for the HT supplies. It must be remembered that the receivers are therefore earthed through the mains and no separate earth line should be added; at the same time the polarity of the mains connections shown in the diagrams must be observed and three-pin plugs and sockets are the only safe mains connections.

The TRF Receiver

The TRF Receiver is noteworthy chiefly for the fact that three high slope RF pentodes, type 6AC7, make up the valve complement, the 6AC7 being both highly efficient and widely obtainable on the surplus market. A normal RF amplifier feeds inductively into an anode bend detector which has reaction applied and controlled by the screen grid, the two stages tuning over both the medium and long wavebands. Weymouth CT2W2 coils were chosen for the original receiver, and whilst it is quite possible that other coils would give as satisfactory results no guarantee can be made to this effect—the original coils are recommended. A normal capacitive coupling carries the sound signal to the third or output stage, and the amount of volume to be obtained from the stage is quite surprising, bearing in mind the valve type used. Some experiment is desirable before the output transformer is finally chosen—in the prototype a small 50 : 1 transformer is used, but it is possible that a higher ratio might be even better. The relatively low valve current flowing through the primary assists matters, for the transformer core should be nowhere near the saturation point.

Simple resistance smoothing follows the SenTerCel selenium rectifier, with an 8+8 μF capacitor as reservoir and smoother. The rectifier is protected by a 100 ohms surge limiting resistor.

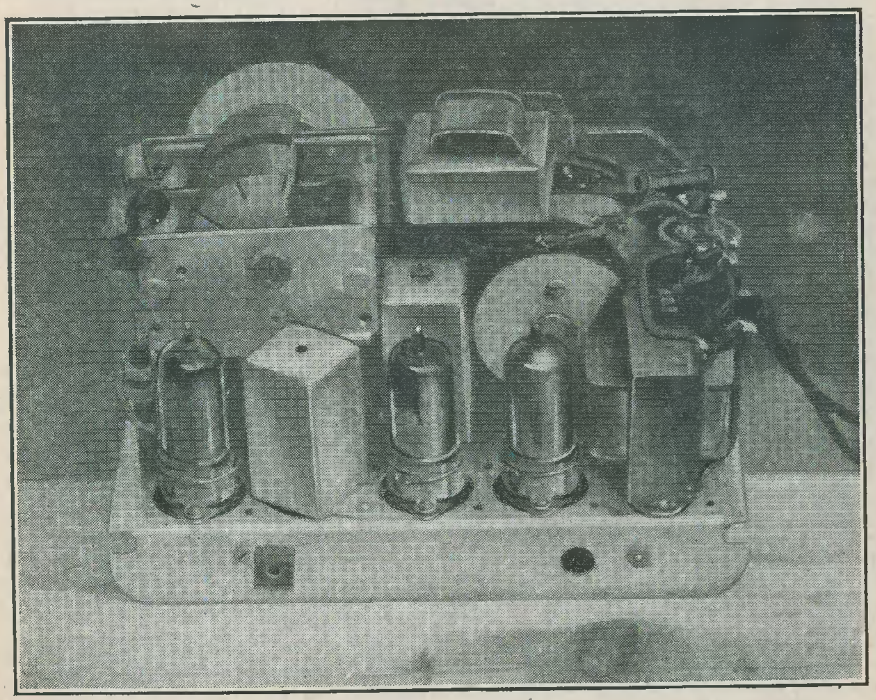
The screen voltage of the 6AC7 valve type should not be allowed to rise above 150 volts, and accordingly the screens of V1 and V3 are fed from a separate screen HT line, which also supplies the anode of V2. The screen of V2 has ample protection by the high value series resistor employed. It was found that adequate decoupling was provided by an 0.5 μF capacitor which can easily be fitted either above or below the chassis.

The original receiver was tested with a frame aerial, but the cabinet was so small and the frame, in consequence, so near to the chassis and other metal components that results were not satisfactory. A frame aerial could be used in a larger cabinet and should then be connected in place of the medium wave winding of L1—*i.e.*, the winding between connecting tags 2 and 3. On the long waves the original long wave winding of the coil is switched in as a 'padder' so that the circuit of S1a, the wavechange switch, remains unchanged. Naturally, the frame aerial must be wound to match the tuned circuits of L2, which calls for some patient experiment, but a good starting point is a frame made of 20 turns of 28 swg on a cardboard former 7″ long and 4″ wide, the corners being rounded off to semi-circular shape on a 2″ radius.

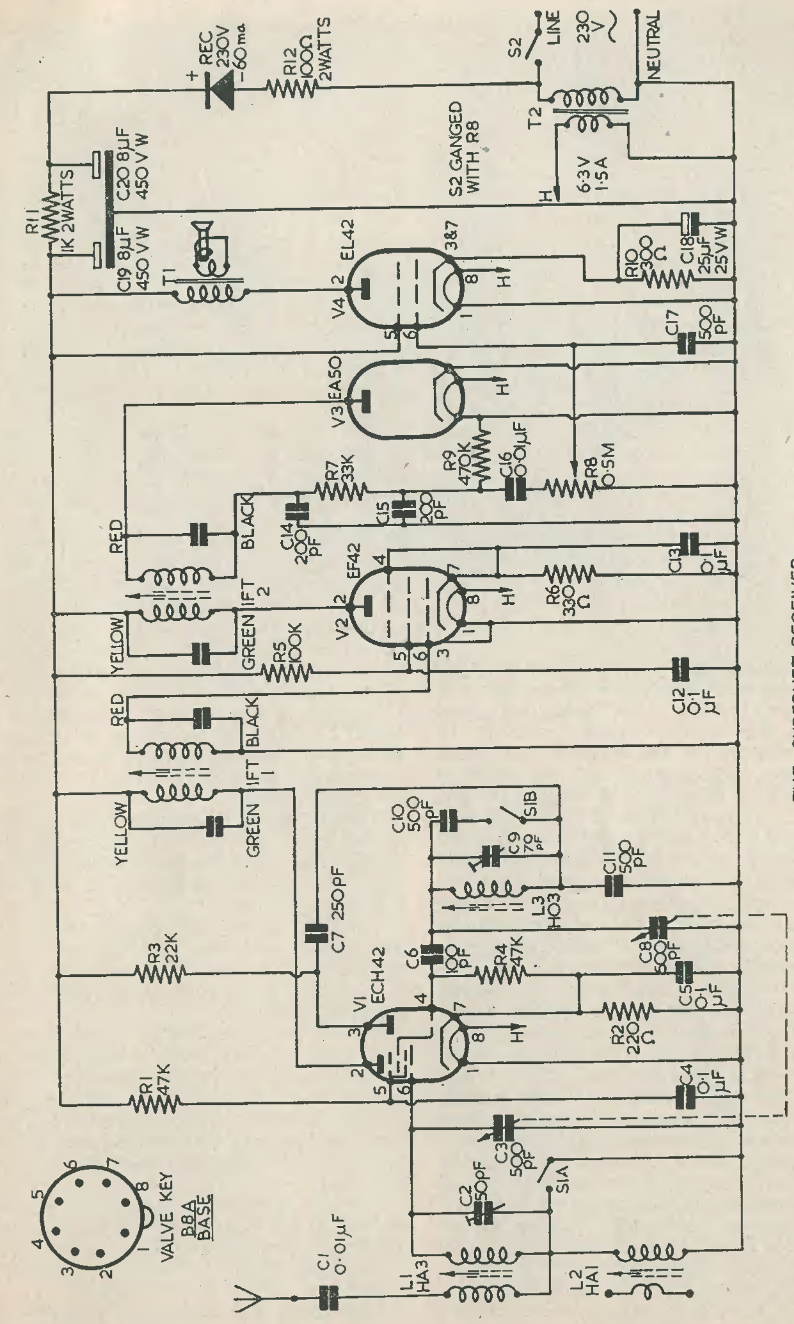
When the circuit as shown in Fig. 1 is used, a quite short aerial will be found sufficient for good signal pick-up. C1 must be chosen for best selectivity and the medium wave trimmers, C2 and C6, must be set with some care.

The Superhet Receiver

The superhet receiver contains many more points of interest than does the TRF midget and forms, besides, an excellent "trainer" for those constructors new to B8A based valves, as three of the Mullard E40 range are employed. The valve line-up was influenced to a considerable degree by the reception area, in this receiver, and as a result the rather clumsy device of a separate diode detector is introduced. The original plan was to employ three valves only, an EAF42 diode-pentode acting as both IF amplifier and detector, but in order to



Rear view of the Superhet



THE SUPERHET RECEIVER

obtain as much IF gain as possible a high-slope EF42 (9.5 ma/V) was finally decided upon, the screen grid resistor being chosen by trial to give both good gain and excellent stability. The value of R5 may therefore be varied by the constructor, by trial, should he so desire. The resistor can be omitted altogether as the limiting voltage on the EF42 screen is 300 volts—the HT line voltage should be of the order of 220–250 volts, depending on the local mains supplies.

The chief point of interest in the design, however, lies in the frequency changer stage which is unusually simple. Two small iron-dust cored coils, from the Weymouth H range, serve for aerial tuning, whilst a single oscillator coil has switched trimming to make it serve both wavebands. A fixed padder capacitor is also fitted so that alignment is very simple and can, if necessary, be carried out on signals, although a signal generator gives greater convenience, especially in the setting of the IF cores. Note that the two aerial coils are connected in series for long wave tuning, with inductive aerial coupling for medium and a tapped coupling for the long wavebands. The net result of this arrangement is to give approximately equal inputs from a really small aerial—an 8′ length of wire is used with the original.

The tracking on the long waveband very probably leaves something to be desired as it was set solely to bring in the Light programme which, in the writer's location, cannot be received reliably on the medium waveband. Nevertheless, Luxemburg can be received whenever it is wanted, and extra trimming across L2 (which is brought into alignment with its core alone) might improve matters still further, if more long wave stations are needed.

Two different IF transformers are employed in the receiver, a deliberate move to use up old stock and to assist the stability over the quite high gain IF stage. Nevertheless, two similar transformers, or a matched pair, could of course be used—a little care in finding the best mounting position and orientation would repay the constructor. The transformers in the original receiver are a Weymouth IFM2 for IFT1 and a P4(J) for IFT2. The IFM2 type are now out of production. Other suitable types include the well-known Wearite midget transformers, sometimes obtainable cheaply.

The separate diode detector was included after a crystal detector (silicon) had been tested with disappointing results; the valve, an EA50, leaves nothing to be desired. It takes up no chassis space since its small holder is sweated to the two heater socket lugs of the V2 valve-holder below the chassis, the EA50 thus lying horizontally below the chassis in a well screened and out-of-the-way position. Normal feed to the output valve is employed.

It will be noted that no AVC is provided for the first two stages, and this again is a direct result of the location in which the original receiver is operated. If AVC is required it can* easily be fitted as follows:— From the junction of R7 with C15 take a 1 megohm resistor. Disconnect the Black lead of IFT1 from earth, and take it to the free end of the 1 megohm resistor, bypassing this point to earth through 0.1 μF. This places AVC on the IF stage alone, and the control can be extended to the frequency changer simply by disconnecting L2 from earth and reconnecting the coil lead to the junction of the 1 megohm resistor with the Black lead of IFT1. The one 0.1 μF capacitor serves as a bypass for both the RF and IF stages.

The superhet is supplied from a simple power pack similar to that fitted to the TRF receiver, except for the fact that a smaller value of smoothing resistor is employed.

Aligning the Superhet

If a signal generator is available, commence by aligning the IF transformers. Switch on the receiver and generator, tune the generator to 465 kc/s, and inject a signal into the aerial socket of the receiver. There is no need to short out the oscillator coil in the frequency changer circuit if the receiver is set to a low frequency in the medium waveband. Tune the IFT's from the secondary of IFT2 to the primary of IFT1 in that order for best response, keeping the generator output as low as possible for good audibility.

Tune the receiver and generator to 1,500 kc/s (or, if the receiver has no marked dial, set the tuning capacitor to about one-fifth mesh) and trim C9 till the signal is heard. Trim C2 for maximum volume.

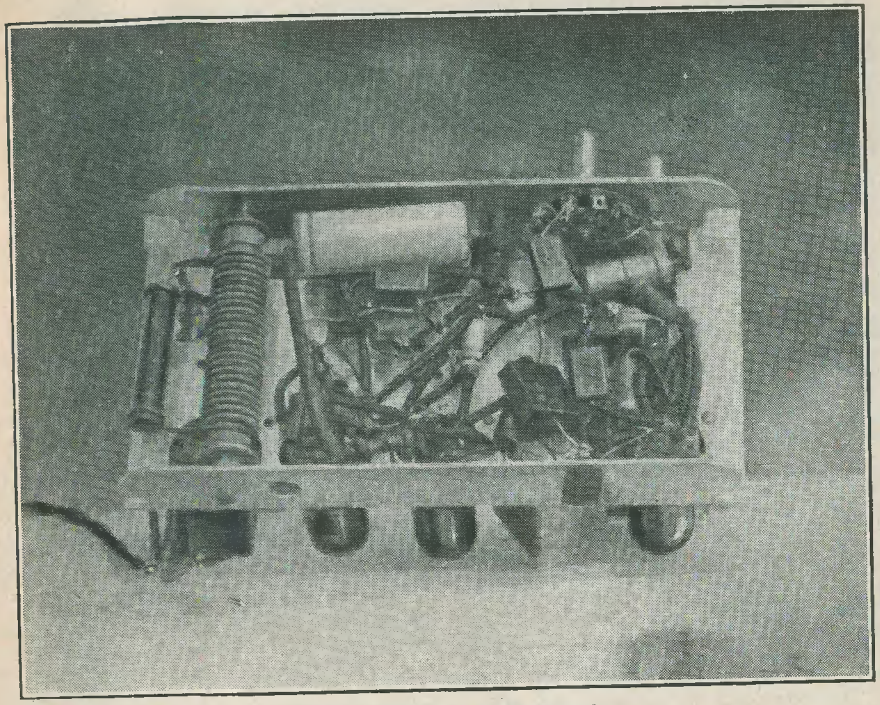
Tune the receiver and generator to 600 kc/s (or about four-fifths of full mesh of the receiver's tuning capacitor) and adjust the core of L3, whilst gently rocking the tuner, until the signal is tuned.

Return to the 1,500 kc/s tuning point on both generator and receiver (the point should be marked if the receiver has no dial) and retrim C9. Return to the 600 kc/s point and readjust the core of L3, and continue making these adjustments of trimming and padding, one after the other, until one has no effect on the other.

Retrim C2 for best volume at 1,500 kc/s and adjust the core of L1 for best volume at 600 kc/s, once again repeating these two adjustments until one has no effect on the other.

Now disconnect the signal generator and

*Use vari-mu (EF41, 6F15) if AVC required. JBS 13.v.06



Under-chassis view of the Superhet

plug in a small aerial. Tune to a high frequency station on the medium waveband and adjust C2 for best results on a received signal.

Switch to the long waveband and tune over the range until the Light programme is heard. Adjust the core of L2 for best results—there should be no trouble at all in obtaining good results; if the station is received poorly it is possible that the tolerance of C10 is too great. Before trying the effect of changing C10, however, test the effect of reversing the connections to the aerial coupling coil of L1 (*i.e.*, the green and blue leads of L1).

If no signal generator is available, the set must be aligned on signals. If new IF transformers are being used, leave their core settings as positioned by the manufacturer, and tune round the medium waveband with the core-screw of L3 protruding from the coil by about ⅛″. The local station should be received without too much trouble—if it cannot be heard it will be necessary to centralise the adjustments on the IF transformers and try again. If a station still is not heard, vary the core settings on one of the IF transformers and try again—some patience may be needed at this part of the alignment.

When a station is heard, tune it in and adjust the IFT's for best volume, then leave them set.

Identify the station—if at all possible a high-frequency signal should be chosen—and bring it to its correct tuning point on the dial by varying C9. Trim C2 for best volume. Tune up the band for a low frequency signal, identify it, and bring it to its correct tuning point by adjusting the core of L3. Bring up volume by adjusting the core of L1. Return to the high frequency station and correct the setting of C9, then retune to the low frequency station and correct the two core settings, repeating these adjustments until both stations are tuned in at their correct settings. Make any further slight adjustments to the IFT's which may be needed.

Switch to the long waves and bring in the Light programme as already described.

Both receivers have the same frontal appearance, which is illustrated on this month's cover.

THE "MAGNA-VIEW"

The Radio Constructor's 16 inch Televisor

PART 8

Before continuing discussion on the receiver section of this televisor, apologies must be made for errata which somehow crept into the circuitry published in the August issue. The connections to the screen grid and suppressor should, of course, have been made in V3 the same as in V4. The Contrast control is shown going to earth, but this should have been to chassis. To avoid any confusion regarding the heater connections of V2, reference should be made to the base connection diagram on page 487. The screen resistor to V9 is R30. The Contrast control VR2 shown as 25 kΩ should read 2.5 kΩ. R28 should read 2.2 MegΩ, not 220 kΩ as shown. In the event of motor-boating at high volume being experienced, this resistor (R28) should have a 47 kΩ connected in series at the HT+ end, decoupled at the junction by a 0.5 μF to chassis.

Readers may be confused by an obvious contradiction which appeared in the September issue in the chassis dimensions drawing. The error in this case is that the hole cut for the aerial input is not adjacent to L1, but is as shown on the main chassis adjoining the sensitivity control at the detector end of the chassis. The connection to L1 is made by a short length of co-axial cable. Many apologies!

It was stated earlier that by merely inserting brass slugs instead of iron dust cores into L1, L2A, L2B, all five channels could be covered. This is perfectly true. However, in subsequent receivers which have been constructed some variation of internal capacitance has been observed, no doubt due to variation of components. The effect of this has been to cause rather excessive staggering of the cores to achieve spot frequencies and accurate resonance points.

To obviate any possibility of this, the accompanying chart has been carefully prepared n the laboratory. The changes are not roublesome and incur no additional expense, with the possible exception of the 10 pF condenser.

One additional item now available which may interest readers is the auto-transformer, type T301, made by Allen Components Ltd. This has all the necessary windings required as shown in previous articles, and almost any tube from 9″ to 17″ may be put to use.

A considerable number of readers are apparently intending to use various sections of existing TV receivers in conjunction with the design given here.

This is quite a good idea and should prove quite simple. The points to watch are correct polarity of modulation signals and sync pulses, and the voltage and current required for the sections to be used. The constructor should make cross-reference to his own equipment and to the new.

The total current required for the complete televisor described here is 180 mA, and of this the timebase takes 100 mA and the vision/sound receiver 80 mA. With these figures known it should be quite simple to create a composite set. Nevertheless, your writer is certain that after a visit to the National Radio Show most constructors will have decided to build a complete five channel sound/vision strip, if not the complete receiver.

It is proposed in the near future to provide a high-class push-pull sound output, in response to those who obviously like this section to be hi-fi.

A few words for the constructor who is intending to use the cabinet specially made for this televisor by Messrs. Ashdown. The shelf should be removed and two pieces cut out. One of these is at the rear, adjacent to the neck of the tube, to enable connecting wires to pass below to the chassis. The other is cut out on the side near the control holes, and should be large enough to enable the control panel to pass through. This panel was described in the last issue.

The set may then be assembled in the following manner:—

FIVE CHANNEL VISION/SOUND RECEIVER TUNING CHART

CHANNELS	L1	L2A	L2B
1 Alexandra Palace	Iron-core	Iron-core	Iron-core
2 Sutton Coldfield	do.	do.	do.
3 Holme Moss	Iron-core Ae end Brass slug grid end	do.	do.
4 Kirk O'Shotts	do.	Brass slug	do. Change C9 to 10 pF
5 Wenvoe	do.	do.	do.

Screw speaker baffle into position after mounting speaker and facing baffle with fabric.

Place chassis in centre, fasten, and then pass up the control panel through the hole mentioned above and screw on to the inside of cabinet.

Place the tube assembly in position, and fix to top shelf.

Thread connecting wires into position, and fix.

Finally, make sure sufficient ventilation holes are cut in the cabinet backing.

MOUNTING THE G.E.C. 6901A CRT

This tube is a triode, and no connections are required to pin 10. All other base connections are as given previously.

Installation is easily carried out, and it will be found quite simple to adapt the design given in the Feb./Mar. and April issues. Reference to the illustrations in this number will also assist in clarifying the work required to be undertaken.

Procedure should take the following course.

Prepare the baseboard (Feb./Mar. issue), and make the focus coil board. It is again recommended that the latter should be of paxolin or other insulating material.

Measure exactly 10″ up from the top of the baseboard to the centre of the tube neck position on the focus board, and cut a hole $1\frac{7}{8}$″ diam. Drill holes for the 2-BA focus coil bolts, and make the hole for the 7-pin plug.

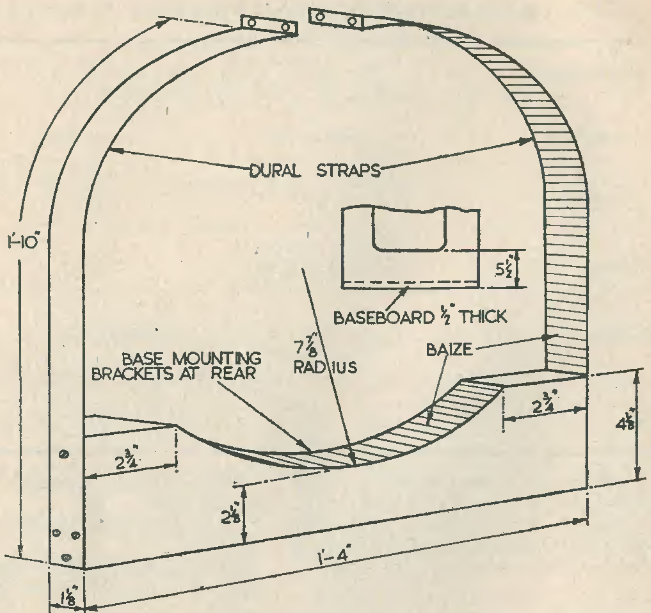
Note the method of attaching the focus coil connecting wires, which is well shown in the photograph. This is done by putting two 6-BA bolts through the board, with solder tags on each side. The inside tags provide connection points to be taken to the 7-pin connector. HT + B and HT + C may be carried to this plug from the chassis.

Fit sorbo rubber around the tube neck hole as described in the last issue. (This definitely assists our dust proof design, which has been thoroughly approved by the General Electric Co.).

Screw down the focus board exactly 1′-2″ back from the front edge of the baseboard.

Make the support for the tube as shown in the sketch and photograph accompanying this article. This support is then screwed down, $2\frac{1}{2}$″ from the front edge of the baseboard to the front of the support. The photograph clearly shows the brackets for fixing these parts.

Instal the tube, and gently tighten up the bolts in the dural straps at the top.



MOUNTING FOR G.E.C. TYPE 6901A

C745

From now on until the installation into the cabinet is completed, you are advised to wear goggles at all times. These tubes are tested to three atmospheres, which of course is 3 × 14.7 lbs. per sq. inch. Nevertheless, these odd occurrences do crop up, and no risks should be taken.

The mask board should now be prepared, and the cut-out part for the mask may be marked out either by finding the tube centre as explained in the April issue, or from the small sketch (current issue).

Please note: There was an error in the April issue. The correct size to cut out is $10\frac{3}{4}''$ × 14", and not as shown there.

The mask shaping may be allowed to follow the screen contour, as this carries no EHT.

NOTES

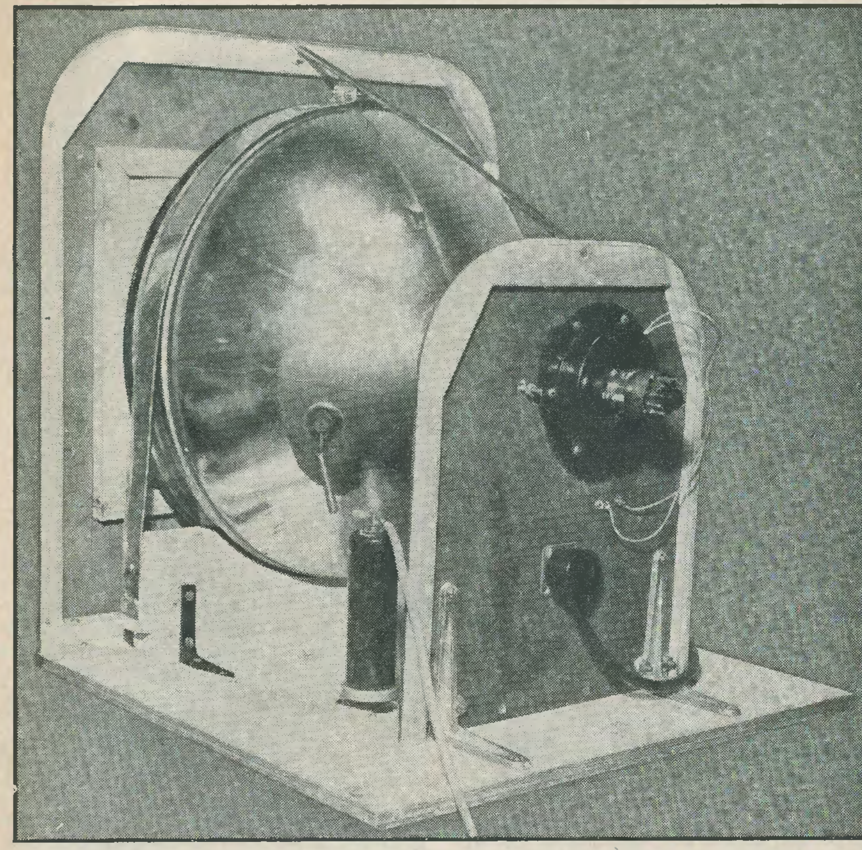
Measurements for the dural straps are taken from the baseboard to the bend of the joining angles at the top.

Baize or rubber is glued to parts of the supporting structure and straps. This ensures that any tendency to slip is effectively minimised.

It will be found necessary to make the top stay running from the mask board to the focus board out of tubing. This is caused by the rather bulbous shape of the 6901A tube. The stay is very simple to make, by bending the ends of the tube after flattening them, and it can be clearly seen in the photograph.

This CRT is capable of producing a slightly larger picture than the dimensions given will allow, but the diagonals must not exceed $14\frac{1}{2}''$.

The EHT required is 12 kV, the absolute maximum being 14 kV, so that our supply is absolutely right. The picture obtained is delightfully bright and sparkling, due no doubt to the aluminised screen.



Competition Result

We have pleasure in announcing that the title selected as being, in our opinion, the best of those submitted in the recent "Large Screen TV" competition was The "Magna-View" Televisor. Accordingly, the English Electric T901 16" CRT has been awarded to Mr. H. Weston, 16 Pitfold Road, Lee, London S.E.12., who submitted the first received entry of this name.

Two other readers later submitted the same title, and Allen Components, Ltd., have kindly awarded a set of their DC300 Deflecting Coils to the runner-up, Mr. D. H. Hawes, Four Winds, Trewetha, Port Isaac, Cornwall. We have ourselves sent a cheque for £1. 1. 0. to the third reader, Mr. J. A. Stringer, 28 The Green, Holywood, Co. Down, N. Ireland.

Our many thanks to all those readers who also sent us their suggestions.

QUERY CORNER

A "Radio Constructor" Service for Readers

Fluorescent Lamp Interference

I have a standard fluorescent lamp with choke and starter switch in my workshop, which generates a considerable amount of radio and television interference. What is the best method of suppressing these lamps?

E. Watkins (Barking).

Because of the increasing popularity of fluorescent lighting, particularly in workshops where the greater freedom from shadows is a very real advantage, we have received a number of letters regarding interference problems. Normally, these lamps produce a very slight 'mush' when a radio receiver is operated in close proximity to them, but generally the spacing between lamp and set is sufficiently great to render the interference of negligible proportions on all but the most sensitive receivers. There are some lamps, however, which generate a very severe form of interference, and curiously enough the noise is always accompanied by the appearance of a bright spot on one of the heaters. This effect is due to a form of oscillation within the tube, and can usually be temporarily cured by gently tapping the glass. The trouble generally reappears within a short time, the only permanent cure being to fit suppressing capacitors as described below. The interference radiated by lamps which exhibit the bright spot is of the impulsive type, and covers a very wide range of frequencies. The effect of the radiation on a television receiver is to produce stationary white horizontal bands across the screen. If the interference is very severe the television tube may be overloaded and the bands will then appear black.

The cure for this form of trouble lies in the use of capacitors to shunt the interfering signal across the lamp, as shown in Figure 1. The additional wiring is indicated in broken line form for clarity. The main shunt capacitor is C1, but because of the assymetrical nature of the circuit two more capacitors are connected one from each side of the tube and earth. In particularly stubborn cases of radiation it will be necessary to increase the value of the power factor correcting capacitor by shunting an additional component C4 across it. Each additional capacitor must have a working AC voltage of 300V, or a DC working voltage of at least 750V.

This method of suppressing fluorescent lamps will be found perfectly satisfactory on even the most severe cases of tubes which exhibit the bright spot phenomena described.

Photocell Relay

I wish to operate a small relay from a photocell by means of a valve amplifier. Will you please suggest a suitable circuit?

H. Beresford (Yeovil)

This query is included with a general answer which should have some interest for all those experimenters who have worked with photocell devices. No particular type of cell is recommended, as the choice depends largely upon the function which the device is to perform. However, the following notes on cells may be of assistance. A vacuum cell has a characteristic which is similar to that

QUERY CORNER

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(1) A nominal fee of 2/6 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.

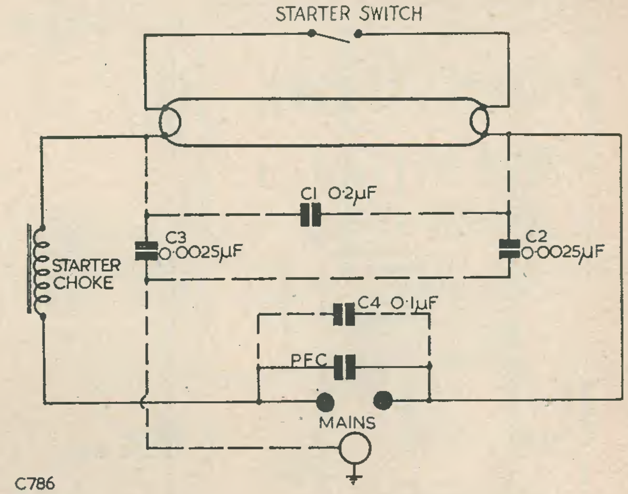

Fig. 1. Suppressing a Fluorescent Lamp.

of a thermionic diode, saturation occurring at an anode potential of some 30 volts. Thus, the sensitivity of the cell above this voltage is practically independent of its supply voltage. The gas-filled photocell, on the other hand, has a rather different characteristic, its sensitivity being dependent upon supply voltage. These cells are filled with a small amount of inert gas which increases their sensitivity some five or more times over that of the vacuum cell. Very great care must be exercised when using the gas-filled cell to prevent the HT supply voltage exceeding the potential at which the gas in the cell ionises. This state of affairs is recognised by a blue glow within the tube, but it is a very dangerous condition as the increased current which the cell passes may irreparably damage the cathode. It is therefore essential that the anode potential is not allowed to exceed the safe maximum. This maximum is usually in the region of 90 volts.

Another point to bear in mind when determining the requirements of the photocell is the spectral response of the cathode material. If the cell is to respond to light from an incandescent lamp, then the caesium-oxidised silver type of cathode will be most sensitive. If, however, the cell is to operate from daylight, or light having a predominence of blue or violet, the caesium-antimony cathode will be found to give the best response.

For any particular application the photocell can now be selected, and our attention turned to the circuit which operates the relay. The relay in turn can be made to ring a bell, open doors, switch on a light, or perform some other function which is required, when either a light beam is broken or light is shone in the cell. A typical circuit is shown in Fig. 2., in which a photocell is used to control a relay by means of a double triode. The anode potential for the cell is obtained from a potentiometer across the HT supply. As has already been pointed out, if the cell is of the gas-filled type its anode voltage must not exceed 90V, and the values of the resistors have been chosen accordingly. The load for the cell is provided by the resistor R1. When there is no light falling on the cell it will pass a very small current, about 0.1μA, and the upper end of R1 will be very slightly positive. However, when the cell is illuminated a current will flow through it and R1, the top end of which will increase positively in voltage. R1 is usually made fairly high in value in order that maximum sensitivity can be obtained. For this reason, the first triode is connected as a cathode follower, providing a very high degree of operating stability which could not be achieved if the valve were used as a conventional amplifier.

When the grid of the first valve is driven positive by the cell, the cathode also rises positively, taking the grid of the second section with it. This in turn allows the second valve to conduct and energises the relay coil. During the period when the cell is not conducting the anode current of the second valve is biased to cut-off by the current which flows

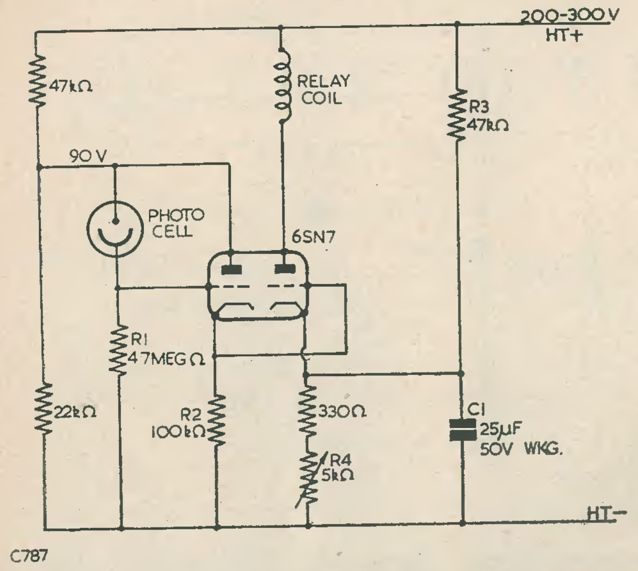

Fig. 2. Circuit of complete Photo-cell Relay device. The most suitable type of Cell is discussed in the text

in R4 from the HT supply via R3. This bias is adjusted by means of the variable resistor, and is set so that the relay is not energised when the photocell is not illuminated. The capacitor C1 is included as additional smoothing to prevent ripple from the HT supply reaching the cathode of the valve.

The relay should be of the type which requires an energising current of around 4 mA. These relays usually have a coil resistance of about 20 kΩ. The relay contacts must be chosen according to whether the external controlled circuit has to be opened or closed when light impinges on the photocell. The complete unit takes less than 10 mA HT and is conveniently fed from a half-wave selenium rectifier via a resistance capacitance smoothing filter.

from our

Mailbag

TV INTERFERENCE

Dear Sir,

As a service engineer employed in the trade, I would like to add a few comments on TV interference (F. J. Annal, August issue).

I feel that GPO engineers, having proved that the TV in question is the source of trouble, would not let the matter rest there if pressed, but would insist on action being taken to correct the trouble.

As to the owner of the TV set saying that it is too expensive to have corrected, I must add that most TV manufacturers, having produced a model which is later proved to radiate, will know of this fact and *if contacted* will usually supply free of charge modification information and kit, if needed, to overcome the trouble.

Added to this and to interference from other sources with radio reception is the fact that the average person, having purchased a sensitive modern superhet, then hooks it up on a few feet of wire (dangling behind the set or along the picture rail) and does not fit an earth.

A really efficient aerial and earth system can do a great deal to overcome many sources of interference by improving the signal to noise ratio.

My first advice, therefore, to anyone who complains of interference is to look to their own aerial and earth system; a lot, perhaps, can be achieved by putting them as they should be !—

E. MEREDITH (Gerrards Cross).

NEW FIELD

Dear Sir,

May I hasten to assure your correspondent "Miki cura futuri" that far from being a neglected aspect of electronics, the medical applications of this science has even now reached quite large proportions.

In many of the bigger hospitals the 'Department of Electrophysiology' is intimately concerned with the ways and means of applying electronic techniques to the investigation of a great number of biological problems. I can assure your correspondent that the technicians responsible have shown remarkable ingenuity, and have not been slow to make use of the latest advances in other branches of electronics as they become available. Within the last three years an association has been formed called the Electro-Physiological Technologists' Association to bring together the many workers in this field.

In this department we regularly record such variables as your correspondent mentions, plus a few more besides ! There are instruments today available to record Pulse, Respiration, Temperature, Arterial and Venous Pressures and more elaborate instruments to record muscular activity (electromyography), heart activity (electrocardiography) and electrical activity from the brain (electroencephalography).—

S. ABBOTT
(Electro-Physiological Department, Maida Vale Hospital for Nervous Diseases).

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(*Continued on page 104*)

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Small Advertisements

(*Continued from page 103*)

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