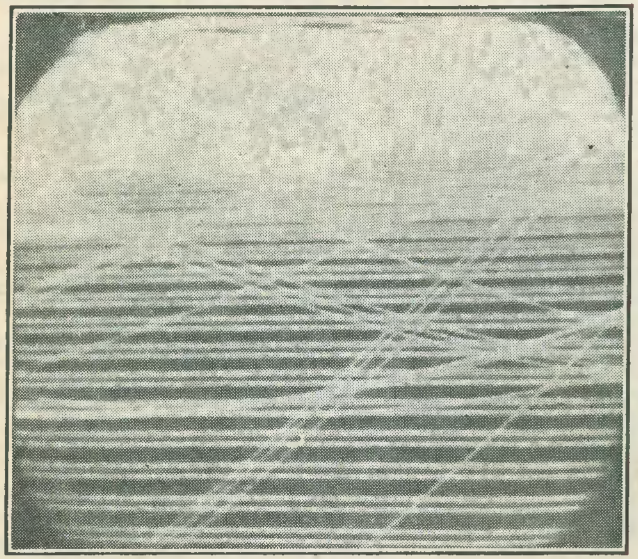

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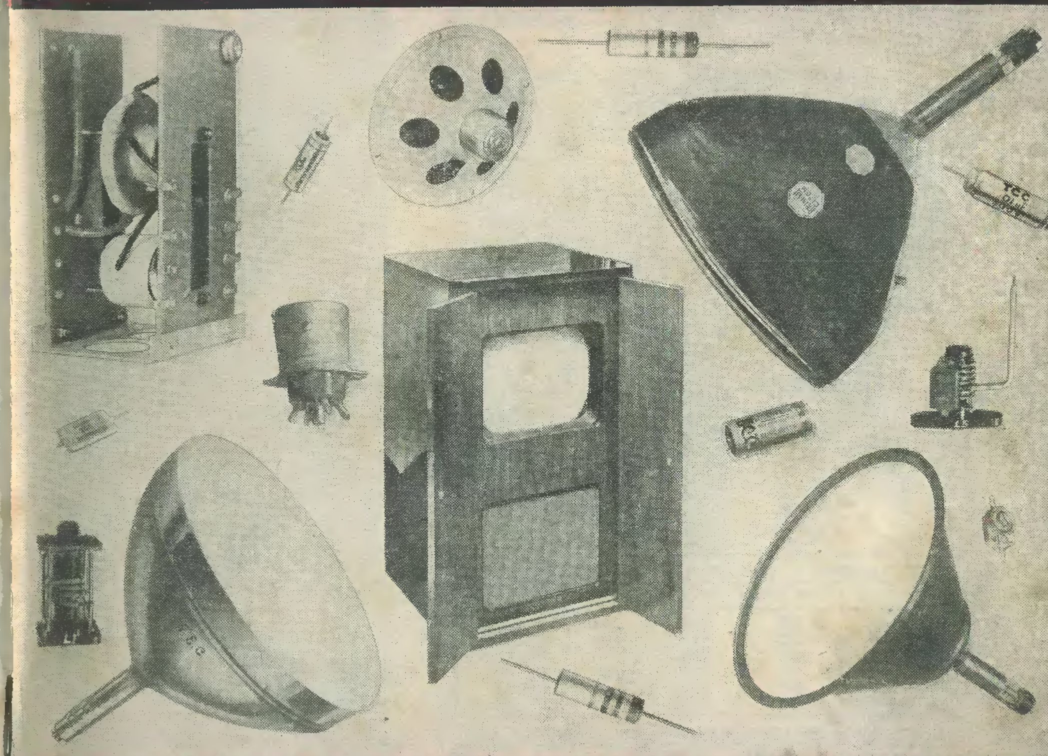
Vol. 6
Number 1
SEPT.
1952

The RADIO CONSTRUCTOR

for the Radio and Television Enthusiast



IN THIS ISSUE . . .

LARGE SCREEN TV · MAGNETIC TAPE RECORDER · REMOTE CONTROL BY RADIO · DESIGN FOR "ECONOMY" MAINS RECEIVER · TWO-STATION RF UNIT · Simple Long Wave Conversion · NFB Compensating Volume Control · Query Corner · In Your Workshop Mainly for the Beginner

etc., etc.

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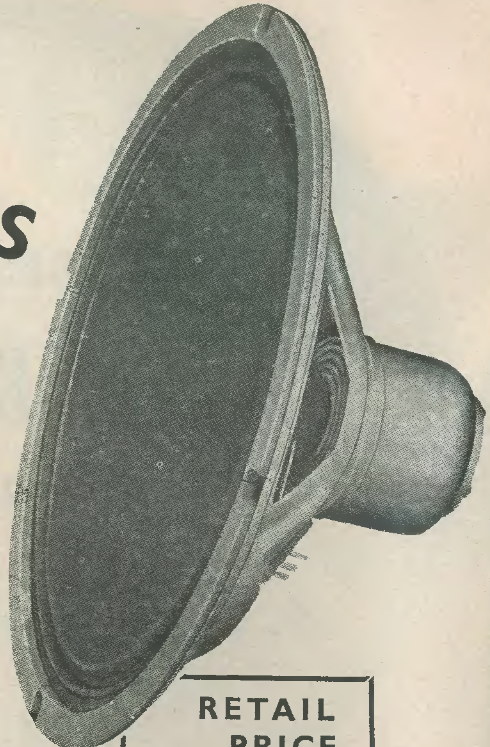

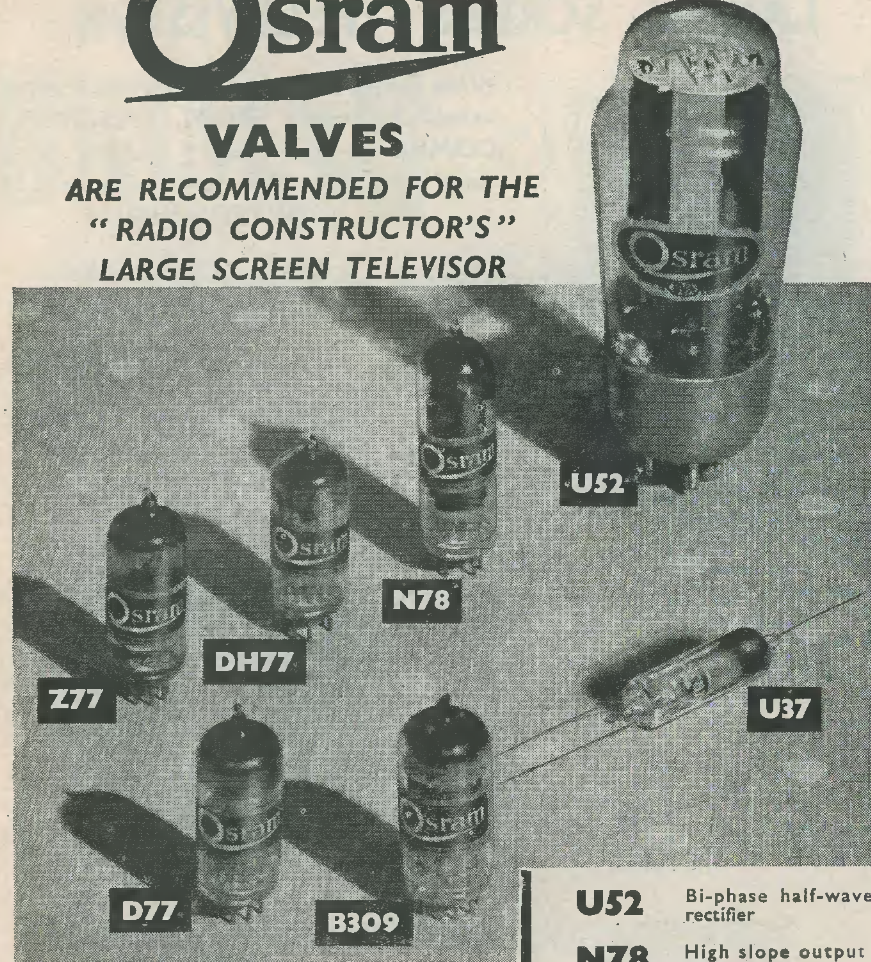
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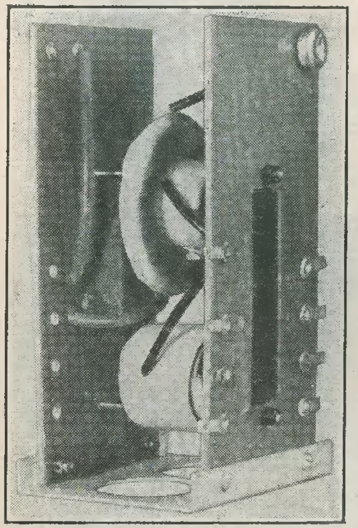
LARGE SCREEN TELEVISION



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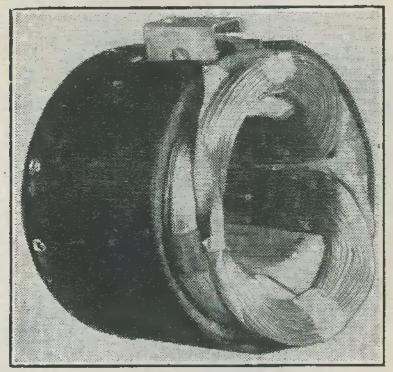

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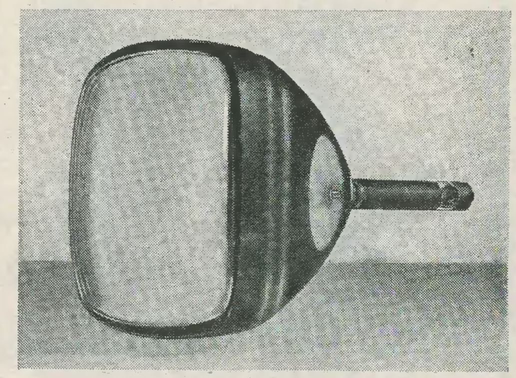


On the outside of the glass envelope is a conductive coating which, when earthed, forms with the anode the E.H.T. reservoir condenser, thus saving the cost of this component. The earthing of the tube exterior also reduces shock hazards and mounting difficulties.

CHARACTERISTICS

Heater Voltage 6.3 v.	Grid Bias (for cut off)—60V (nominal)
Heater Current 0.6A.	Overall dimensions:— Length 19$\frac{7}{8}$″,
Anode Voltage (nominal) 14kV.	Height 12$\frac{1}{4}$″, Width 15$\frac{3}{8}$″.

Picture size 140 sq. in.

This C.R. Tube can be used in the receiver described in this Journal without any additions to the circuit. The following Brimar Valves are also specified:—

6AM6	Miniature R.F. Pentode	6CD6G Line output Tetrode
6AL5	,, Double Diode	6U4GT Efficiency Diode
12AX7	,, Double Triode	1T2/R16 E.H.T. Rectifier
6AQ5	,, Output Tetrode	RM 4 Metal Rectifier
12AU7	,, Double Triode	

Standard Telephones and Cables Limited

BRIMAR VALVE WORKS, FOOTSCRAY, SIDCUP, KENT FOOtscray 3333

The Radio Constructor

Vol. 6, No. 1. Annual Subscription 18/- September, 1952.

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

Edited by C. W. C. OVERLAND, G2ATV

CONTENTS

Editorial

THE series of articles which we are featuring on the construction of a Large Screen Televisor seems to have aroused the interest of a good many readers, to judge by our correspondence. This is no doubt due to the fact that this periodical is the first in this country to deal with wide angle deflection on a practical basis; it also shows that the radio constructor, as hitherto, is not content merely to go on building the same old stuff.

We cannot, naturally, fill our pages with nought but the most modern techniques—there are all grades amongst our readers, from the beginner to those who can, and do, tell us a few things! We must, therefore, in all fairness include articles which are "kid stuff" to some, and others which cater adequately for the more advanced.

If you have a suggestion to make about a subject you would like covered, let us have it. If you can write an article about a subject which you think will be of interest to other readers, again, let us have it. A copy of the Index to Vol. 5, which is now available, will enable you to assess quickly the field covered by past issues.

Harking back to our Large Screen Televisor, readers will be interested to know that they will be able to see completed models at the National Radio Show at Earls Court — see announcement on page 47. We are glad to take this opportunity of expressing our thanks to those manufacturers who have assisted us, not only through their advertising support in these pages, but also with advice and practical help on the constructional and other problems involved.

Suggested Circuits for the Experimenter

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

No. 21: NFB COMPENSATING VOLUME CONTROL

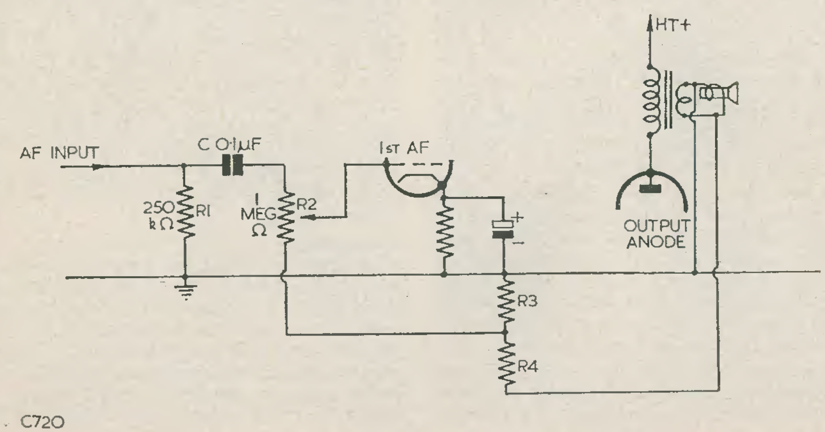
This circuit does not, as its title might perhaps imply, control volume by varying negative feedback. Instead, it controls volume in the normal fashion, with the difference that it also automatically increases feedback as volume is reduced. Thus, when the associated amplifier is working at a low level, a relatively large amount of feedback is possible; whilst, when the amplifier works at a high level, this feedback is reduced, allowing a greater degree of amplification to be obtained than would otherwise be the case.

Operation

In the diagram, negative feedback is obtained by applying the voltage appearing across the output transformer secondary to the potentiometer R3, R4, from which a suitable feedback voltage is obtained and applied to the bottom end of R2. Assuming that C has negligible impedance at audio frequencies, this feedback voltage can be considered as being fed to a potentiometer formed by R2 and R1 in series, the slider of R2 tapping into this potentiometer.

At the same time, the input voltage appears across R1 and R2 in parallel. Thus, so far as the grid of the first AF valve is concerned, the input voltage has its greatest effect when the slider of R2 is at the top end, whilst the feedback voltage has its greatest effect when the slider is at the bottom end.

This is, admittedly, a rather vague explanation of the functioning of the circuit, but it would be difficult to go into greater detail in a short descriptive text of this type. Mathematically-minded readers would probably find it interesting to undertake a more detailed analysis.



The Circuit in Practice

In practice, the circuit should be simple enough to bring into operation. After ascertaining which method of connection to the speaker transformer gives negative instead of positive feedback, all that remains to be done is to find experimentally suitable values for R3 and R4. It would be advisable to keep these values fairly low; together they should add up to a figure between 250 and 1,000 ohms.

The most suitable values for R3 and R4 will be those which cause a small attenuation for high volume settings and a relatively large attenuation for low volume settings. For comparative tests, the negative feedback can be brought in and out of circuit by interrupting the lead between the speaker transformer secondary and R4.

It will have been noticed that a capacitor has been connected between R1 and R2. This has been done in order to show how the circuit may be applied to practical use. In a receiver, for instance, R1 could be the DC load of a diode detector. Alternatively, with a slight alteration in value for matching purposes, it could be the anode load of a previous AF valve.

Before concluding, it must be pointed out that an increase in feedback will reduce the output impedance of the amplifier. This fact may limit the change in feedback which will be permissible, especially when certain types of output valve are used.

RADIO MISCELLANY

CENTRE TAP talks about

HOME-BUILDING—FIXATIVES—SOLDERING IRONS

I have been greatly pleased to see such widespread television constructional activity not only continuing, but expanding, despite the lack of realism among those who forecast that TV receivers would be beyond amateur construction and home adjustment. Oddly enough, few of the home-built sets I have seen worked properly straight-away, even in the kit and wiring diagram class! Perhaps that is simply my experience, and most of those I haven't seen needed only minor adjustment before as-good-as-a-bought-set performance was obtained. With the kit sets, no doubt, the little points which needed ironing out were the outcome of departures from specified parts. Who but a millionaire could afford to buy everything new? Perhaps even the millionaires would think twice about it while there are still plenty of ex-WD EF50's and a fair amount of manufacturers TV surplus being offered at tempting prices.

For my own part, since the War I have built four. Two were admittedly more or less experimental, but did the others perk properly when I first tried them? Not on your life! I suppose neither of them would have taken the intelligent constructor, armed with nothing other than a meter, more than a few hours to track down the faults.

This experience, and what I have seen among amateurs generally, almost convinces me that, even with detailed instructions, TV building is not a job for the beginner unless he has the help of a friend with a fairly good background of radio experience. By this I do not mean to imply expert knowledge of TV practice. The reader who can take most of the articles in Radio Constructor with reasonable understanding should be adequately able to methodically (if slowly) track down the little difficulties that inevitably seem to arise.

Perhaps my conclusions are also coloured by hearing much of those who do have trouble in getting proper results, or of the optimists who use the most unlikely parts without making full allowance for the differences. On the other hand, much of the fascination of constructional work comes from personal experimentation, and there is certainly no better way of acquiring practical knowledge. It would be a faint heart who took his set to a serviceman, instead of getting down to it himself—even if it takes him a half-a-dozen evenings.

Enterprise

On the other hand, one hears of constructors who make many of the more expensive parts themselves, such as focusing and scanning coils, frame and line transformers, etc. One constructor I heard of built a kit TV, and then proceeded to more-or-less duplicate it with home-made or modified parts, testing them in the working receiver as he finished them. When he completed the second set he sold the first to a ready customer, pricing it on a cost-of-the-parts basis. Actually, he made quite a useful profit as the first set had been built some twelve months ago. Nearly all the main parts, including valves, have gone up 33 per cent. or more in the last year.

The 16-inch receiver, currently being described in the Radio Constructor, offers the opportunity for readers to build a de-luxe class receiver at a very considerable saving. With home construction the bigger the tube, the bigger the saving. There is no doubt that this set is going to prove very popular in the coming Season. To an even more marked degree than most home constructed TV's, it gives one a very solid advantage over its commercial counterpart, inasmuch as it can be readily modified at a later date to meet each advance in TV technique.

I had been Warned

Every reader who has done any coil or transformer winding will have read warnings regarding the choice of fixatives for anchoring enamelled wire in position. Ironically, I have warned readers myself on more than one occasion. Now I have had a Horrible Example of what happens.

A few weeks back I used some wire and, to avoid the remainder slipping off the well-filled reel, I bound the end in position, as a temporary measure, with a short length of adhesive tape. I should, perhaps, point out that it was not electricians' insulating tape.

This week when I needed the wire, I stripped off the tape only to find, to my great disgust, that it had played havoc with the enamel. Not only on the surfaces it had touched, but even to a depth of a couple of layers down. The enamel had turned a dirty yellowish-white and it fell away in powder when touched. This happened in the course of a few weeks, although the chemical action may have been accelerated by the warm sunlight it received. The reel had been left standing on a shelf beside the window.

One cannot be too careful with enamelled wire. Even the methylated spirits used to dissolve the shellac in making up varnishes used to " set " windings, may contain injurious substances.

The " commercial " grade of meths is safe in this respect. Unless you have solid shellac in hand, the use of uncoloured French polish is to be recommended. This, of course, is simply shellac dissolved in commercial methylated spirits, and it is not only ready for use but is perfectly safe for reasonably high-voltage insulation and, more important, harmless to the enamel.

Versatility

Thinking still of TV construction reminds me that a couple of recent visitors congratulated me on the neat and clean soldering on one of my latest chasses. By careful planning and the use of specially selected components, I had managed to get everything into a compact space. With TV, of course, a tinned steel chassis (or one to which you can solder direct) is simply a " must." It's asking for trouble to use aluminium, except for the power supply and time bases.

The earth returns to this particular chassis had been soldered with an extra heavy bit and a little judicious " rubbing " with the iron, the easy (and only) method of getting the solder to run smoothly around the joint. Many of the ¼-watt resistors, B7G valveholders and small mica capacitors had to be wired with a bit scarcely bigger than a thick wire. Yet they were all made with the same electric iron; a standard model fitted with a pencil bit. One of the first things I did after buying it was to make a heavy bit to use in place of the pencil. It was cut from an inch diameter copper rod which I hammered slightly oval at the business end. It was not, however, until fairly recently (when an urgent need arose) that I thought of making a fine-point bit on the same lines. Manufacturers would do well to market interchangeable bits to cover the wider range of work modern constructional practice requires. True, one can get a fairly heavy bit by using the iron with the pencil point removed, but one often needs something heavier, and it is always possible to use a little supplementary heat on the heavy attachment by standing it in a gas-ring if one is impatient to get it thoroughly hot.

With mine, it is only the matter of a few seconds work to change over the bits, and the uses I have found for them have amply justified the time spent in making them. The extremely thin one is on the longish side, which not only enables tiny components to be soldered without overheating them while allowing time for neat joints to be made, but eliminates the risk of scorching the adjacent components or the nearby insulation sleeving.

Overdue Replies

An apology is due to readers who have received no answer to communications addressed to me. A package of correspondence forwarded to my home from Maida Vale has failed to arrive, and is now three weeks overdue. Readers who have received no answer or acknowledgment from me relating to letters etc., sent before the 20th June, are asked to be good enough to write again. Mention of the fact will ensure top priority attention.

REMOTE CONTROL BY RADIO

By F. C. JUDD, G2BCX

Applications of the Super-Regenerative Receiver and simple Self-Excited Transmitters for the Radio Control of Models, etc.

PART I.

Foreword

Many radio constructors have, no doubt, been intrigued at one time or another by the application of radio as the 'link without wires' in remote control systems. As is probably well known, Radio Control of models is an extremely popular hobby, especially among model aircraft and boat enthusiasts, and whilst articles have, from time to time, been written on the subject, little information has been given beyond descriptions of commercially made apparatus and very simple servo-mechanisms. To take into account actual working models, as well as radio control circuits and systems, is beyond the scope of this article which will be confined strictly to circuit design, but it may be mentioned that there are many commercial kits of model aircraft, and boats, which are not beyond the skill of anyone with average abilities to construct, and which are quite suitable for radio control work.

The writer, who had never previously constructed a working model of anything, has with little or no difficulty built two model aeroplanes, one with an 8 ft. and one a 6 ft. wing span; an R.A.F. launch and a model six-wheeled Foden lorry. The aircraft and launch were made from kits, and the lorry, with the exception of the model tyres, was for the most part constructed from scrap metal and bits from the junk box.

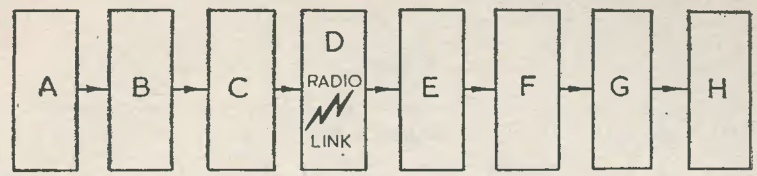
Just a word of advice with regard to models; choose one that is capable of carrying the equipment, *e.g.*, 5 to 8 ft. wing span for aircraft and 30 in. minimum length, with a 9 in. beam (min.) for boats. A model boat is probably the best type of vehicle for the experimenter to have, since aircraft have a nasty habit of either flying away or crashing when something goes wrong with the radio.

Other applications of radio control are many, but one or two examples are mentioned here which will no doubt appeal to the radio constructor. Radio control of other radio equipment, such as a distant receiver or transmitter, has in fact been carried out by the writer, who quite successfully controlled a 160 metre (fixed station) from a portable low power 10 metre transmitter which not only provided the control link, but carried the modulation for re-transmission over the main transmitter, through the medium of the remote control receiver. Another example of control of this nature was a system in which the carrier of an incoming signal, through the medium of the main receiver, switched on or off the main transmitter.

To enlarge on this a little, assume the writer to be in contact with another station on the same band but on a different frequency. The other station signs over, and directly his carrier goes off, the writer's transmitter comes on, the necessary switching being carried out by means of sensitive relays operated from the AVC circuits of the main receiver. All sorts of devices can be controlled by radio in the same way that control can be maintained over wires, for example teleprinters and facsimile transmission and even automatic morse recording systems are, in effect, remote control by radio.

Radio Control Systems

Before describing such circuits as are used in more simple systems, some information on Frequency allocations, etc., will be given. The two Frequency Bands allocated by the Post Office are *licence free*. Permission does *not* have to be asked for the use of them, and providing a careful check is kept on frequencies, equipment may be used anywhere



C741

Fig. 1. Block Diagram showing the various stages of a complete radio control system.

in the U.K. The power *input* to the transmitter *must not* exceed 5 watts. (Pw in = E × I) where E is the anode voltage, and I the anode current to the valve or valves feeding the aerial.

The Frequencies allocated are as follows:—

27 Mc/s band—26.96 to 27.28 Mc/s.
456 Mc/s band—464.0 to 465.0 Mc/s.

They must under no circumstances be used for communication purposes.

It is possible for both the transmitters and receivers, when on 27 Mc/s, to cause interference; to television especially. In the event of interference being reported or a complaint being made, the apparatus should be switched off immediately. You have no priority. Don't spoil it for others by abusing the facility. You would be very unpopular if it were lost through your negligence or failure to keep within the allotted bands and/or misuse of the frequencies.

There is at least one commercially made frequency meter available for 27 mc/s, which is an absorption type meter specially made for the band.

Tone modulation may be used on the transmitter and provides the basis of one system in which resonant reeds are used to select a number of control channels. For example, say three different audio tones are used and made to modulate the transmitter, usually to 100 per cent. These are demodulated through the receiver detector, amplified and passed to a tuned reed unit. The reeds are each tuned to the modulated frequencies, and each will vibrate in sympathy only with its own tone. Vibration is of sufficient amplitude to cause the reed to move far enough to make with a fixed contact. The frequency of vibration, even over the audio range, is sufficiently fast enough to make the contact continuous as far as DC is concerned. The reeds will, of course, only handle low current, and they are used to operate relays with heavier contacts.

The second system, and the one most used, is that of carrier control which, although only providing a single channel, is by far the most reliable. Here the receiver, usually a super-regenerative single valve detector with a relay on the anode circuit, is used with a simple self-excited transmitter (non-modulated). When a signal is present at the detector grid its anode current falls and allows the relay to open, it having been held closed by the steady anode current through the valve. Multi-channel operation can be achieved by a sequential selector system; this, in turn, switching power to the servo-mechanisms. The servos are, of course, mechanically coupled in the case of working models to the actual control, *e.g.*, the rudder for steering. All the components in a radio control system, right from the controlling switch or selector at the transmitter to the final servo-mechanisms following the receiver and its selector, have not only correct names, but follow a definite order. Most readers of this magazine will no doubt be familiar with the names given to a complete transmitting and receiving system for communication in speech, where the system is made up of the following components: The microphone, an amplifier, modulator, transmitter, and aerial—the radio link—aerial, receiver, demodulator (detector), amplifier, and loudspeaker. This makes a complete system, and radio control has a similar one with correct names for all the components that go to make it up. The block diagram of Fig. 1 may help to make this clear. The system is as follows:

A. The COMMAND source (The human operator).

B. The CODER (Can be a simple switch controlling the transmitter).

C. The TRANSMITTER.

D. The RADIO LINK.

E. The RECEIVER (Generally a single or two valve arrangement).

F. The DECODER (A relay only, or a relay and selector, or reed unit).

G. The SERVO-MECHANISM (Small motor-driven or electro-mechanical devices).

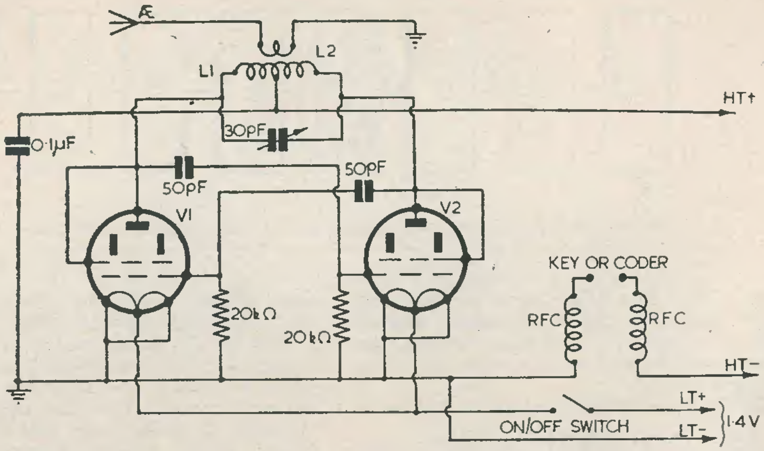


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Fig. 2: A push-pull Radio Control Transmitter for 27 Mc/s

The two RF chokes (RFC) may be wound on $\frac{3}{8}$" diameter formers with 36 swg covered wire, close wound.

Formers 2" long, winding $1\frac{1}{2}$" long. Tuning Coil L1: Former $\frac{3}{4}$" diameter, winding 1" long, 8 turns 22 swg wire centre tapped, or self-supporting coil 1" long with 8 turns 16 swg centre-tapped.

Tuning Condenser: 30 pF. Either Philips concentric type trimmer or suitable ceramic air-spaced.

BASE CONNECTIONS FOR THE BRIMAR 3D6.

1 & 8 JOINED FOR 1·4V FILAMENT. FIL−
7 FIL+
USE 1 & 8 ONLY FOR 2·8V FILAMENT
2 ANODE
3 SCREEN GRID
6 CONTROL GRID
4&5 NOT USED

C743

H. The CONTROL. The actual movement or operation (In the case of models this would be steering, engine speed, etc., etc.).

In some systems the DECODER, SERVO-MECHANISM and CONTROL may all be combined, and are sometimes referred to as ACTUATORS. Commercially-made devices are also called escapements, since they operate on the simple escapement principle through electro-mechanical methods. Generally, in simple systems, the relay is the DECODER followed by the combined SERVO-CONTROL or ACTUATOR.

A Simple Self-excited Transmitter

The circuit of Fig. 2 is that of a push-pull battery operated transmitter, and is one commonly used for radio control of models. Based on the Ultraudion Oscillator, it is quite suitable for 27 Mc/s and will run to a maximum input of 4.5 watts. Efficiency is good, considering that for all self-excited oscillators the efficiency is only 50 per cent. at the most. This means that for an input of, say, 5 watts, the RF power output will be approximately 2.5 watts. Greater RF efficiency could, of course, be obtained with an RF amplifier preceded by a master oscillator. This, however, for all normal control work is not necessary, since an average *control* range of half-a-mile or so is limited by the receiver rather than the transmitter.

The circuit is quite straightforward and construction follows normal radio practice. A metal chassis is recommended, and the only other points are short leads to anodes and grids of the valves and the tuned circuit. RF power may be checked in the usual way by

means of a low-current bulb in a small loop of stiff wire held over the coil. The aerial may be a quarter-wave long, which at 27 Mc/s is approx. 8 ft. 6 in., coupled to the tank circuit, and connected against ground.

Once checked for RF power, the transmitter should be tuned to the operating frequency and may then be coupled up to the aerial.

Keying is effected in just the same way as a normal transmitter is keyed for CW operation. In this case, the key is connected in the negative HT lead and in series with two RF chokes. These chokes prevent RF entering the keying lead (which may be two or three yards long) at the end of which is connected the CODER. This may be a simple micro-switch (fast make and break type) or a numerical switching device so arranged as to be able to key a fixed number of impulses, *e.g.*, a telephone dial. Such an arrangement is used by the writer in conjunction with a two channel system sequentially controlled from a four way escapement (used for steering), with a contact operated during part of the sequence for engine control.

The valves specified for the transmitter are normally limited to 135 volts at the anode, but since the screens are strapped to the anode and grid bias is provided through the grid resistors, a maximum anode voltage of 150 is permissible, with an anode current of 31 mA (maximum). This allows an input of 4.65 watts. The 3 D6 old types of which are also known as the 1299 can be obtained on the surplus market. These valves are loctal types with B8G bases. Details of the tuning coil are given with the circuit diagram.

(To be continued)

A Simple Long-Wave Conversion

by F. L. BAYLIS, A.M.I.E.T.

Commercial "Economy"

A few years ago, driven to a position midway between the devil and the deep blue sea in their costing arrangements, apparently, certain manufacturers proffered a compromise to the long-suffering public in the form of a receiver having only medium and short wavelengths as its tuning ranges.

The position was that the short waves were becoming increasingly popular with that same public, and the more expensive receivers now had at least one—and often two or even three—short wavelengths incorporated in them, besides the usual medium and long ranges.

Consequently, sponsors of the less expensive models—and who can blame them?—felt called upon to participate in this new popularity; to contribute their might—or would it be "mite"?—and proceeded blithely to market *their* version of an all-wave model.

The result, as we all know with a certain sadness, was a receiver with a quite negligible short wave performance and a medium waveband useless for the reception of anything but one's local Home Service.

The Light Programme on this type of receiver is a pure farce—a convulsing medley of crackles, whistles, shrieks, hooting, Morse and fading that were far better dubbed the "Lightning" programme and better left to the mercy of the atmospherics than listened to.

Enter the L.S. Public

Can it be wondered, then, that from time to time some member of the long suffering public—carrying one of these monstrosities under his arm, for the receiver is usually quite small in physical size as well as in performance—peeps coyly around the door of the writer's den and enquires hesitantly whether or not anything could be done about it.

"I should like the Light Programme on the long waves," he'll say, "and Luxembourg as well."

He'll probably add that the short waveband could be dispensed with altogether, as he's never received a station on it, and if I could extract some of the whistles from the medium waveband, he'd be much obliged. He'll pay, of course, and should the experiment prove successful my name will be lauded to the skies, bringing me endless more members of the L.S. public all with similar sets and similar grouses.

First Step

Of which, all of the latter, apart from the pay question, I ignore; for are not promises, like switch contacts, made merely to be broken?

So, I examine his receiver, before his eyes, and quote him an entirely inadequate figure for the benefit I am about to bestow upon him.

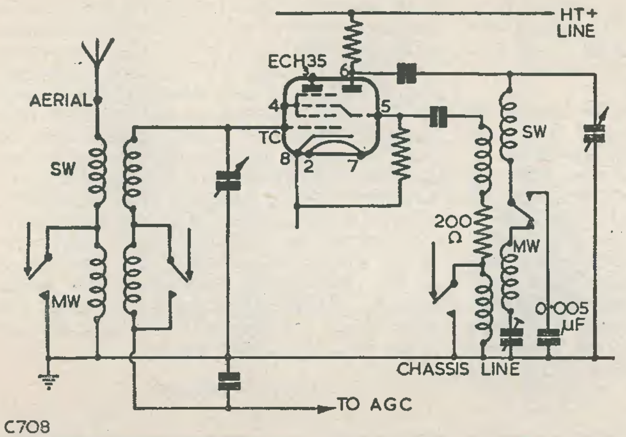


Fig. 1. The frequency—changer circuit before modification.

The receiver, in this case, is of a well known make—by a firm that originally invaded us from America—and seems to promise results from the modifications I have in mind. I carefully check the frequency changer wiring, drawing the circuit on paper as I trace every wire and component, and find eventually that I am presented with circuit of Fig. 1.

Now, apart from the fact that the designer has taken advantage of the very few turns of the short wave coil to wire both medium and short wave coils in series, there is nothing very remarkable about the circuit.

On short waves, the medium wave coils are shorted out of circuit (except the oscillator tuned windings) whilst on medium waves the short wave coil remains in circuit, since the inductance of these makes little difference.

Wave changing is effected by a four pole, two way rotary switch, only one pole of which is used as a full changeover, that serving the oscillator tuned winding.

Coils

As the coils were small, air-cored types having paxolin formers, they were easily

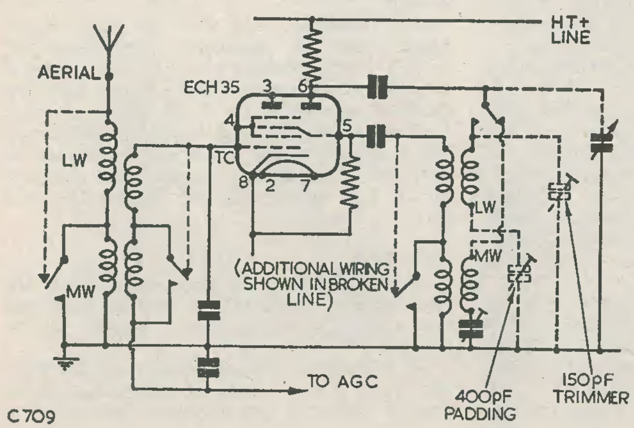


Fig. 2. The frequency—changer circuit modified for long wave working.

replaceable by Wearite "P" types—although Osmor "Q," Denco and others could have been used, with perhaps even better results. It was just a question of availability and cost. The use of the smaller iron-dust cored types is, however, well worth considering in such a conversion even if only on account of the restricted space available in such receivers. They may cost a little more, but results probably justify it.

Accordingly, the two short wave coils were removed altogether, and long wave aerial and oscillator coils fitted in their places. The inductance of the new coils, however, does not permit them to be in series with the medium wave coils when tuning the latter waveband. Consequently, additional wiring to the first three poles of the switch is inserted as shown in Fig. 2.

The fourth pole, that serving the oscillator tuned winding, was completely re-wired (Fig. 2) and the 0.005 μF fixed short wave padding capacitor replaced by a 400 pF ceramic preset for long wave padding.

A twin preset was available having sections of 400 pF and 150 pF, and this was wired into circuit, the 150 pF section being used as the new long wave trimmer.

The 200 Ω resistor separating the short and medium wave oscillator coupling coils was removed, its original function—the boosting of the valve oscillation on short waves—no longer being necessary.

Adjustments

No difficulty whatever was experienced in adjusting the padder and trimmer, the padder being first screwed in to bring in the Light Programme a little more than halfway round the dial (which, of course, was not marked for long waves). Then, both padder and trimmer were alternately set to receive Luxembourg loudly, clearly, and as free as possible from objectionable "off-tune" mush.

—And "Trimmings"

An old razor blade was used to erase "SW" from the cardboard dial, and "LW" was neatly scribed in its place with a Biro pen.

Finally, the Light Programme and Luxembourg positions were "Blacked-in" with a small square mark on the dial, and designated "Light" and "Lux'b'g" in readable capitals.

IT DARNED WELL DID, TOO!

by H. DUDLEY STILTON

A set came in the other day,
'Twas quite a good one in its way.
The fault was only something small,
A fault which could occur in all.
It crackled.

I stood it up upon the bench,
And prised the knobs off with a wrench;
I swept the chassis clear of fluff,
Switched it on, and sure enough,
It crackled!

I turned it o'er and cleaned the switch,
Thought perhaps that there's the hitch.
Although it looked too clean to blame.
I tried anew but just the same,
It crackled!!

The iron was hot, the joints looked dry.
I thought at least, I could but try
I soldered here, I soldered there;
I soldered damn near everywhere,—
It crackled!!!

I changed the valves; I tried the coil
And smoothed the gang with drops of oil;
I switched it on and probed about.
One thing sure, I did find out—
It crackled!!!!

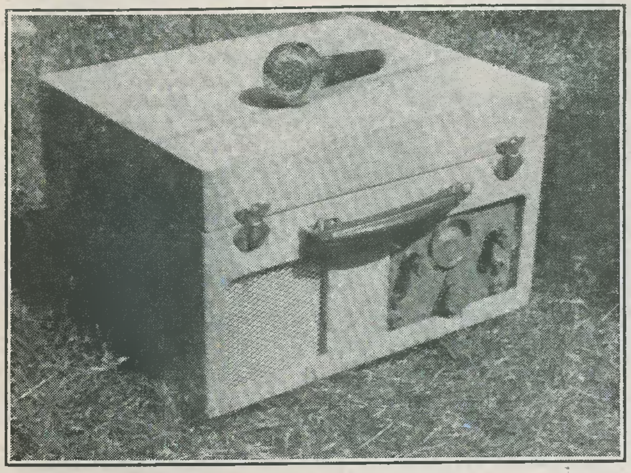
I changed the coils and I.Fs, too,
Tried some more of higher 'Q,'
Strapped the auto grid to ground;
Then the strangest thing I found—
It crackled!!!!!

I wracked my brains; I tore my hair;
I beat the bench in mad despair,
I screamed aloud and swore my fill;
I raved and cursed and stamped, but still
It crackled!!!!!!

I checked the wiring piece by piece,
And found a part all splotched with grease,
The joint had arced and dropped the fat,
So little wonder, was it, that
It crackled!!!!!!!

I took it back and plugged it in,
The owner turned and with a grin
Handed o'er a handsome fee.
I won't say what, but gosh oh gee—
It crackled!!!!!!!!

TV. See Page 30



A MAGNETIC TAPE RECORDER

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

Due to the lack of engineering facilities amongst radio constructors in general, it was decided to use a commercial deck as the basis of the unit described here. The 'Qualtape' unit was chosen on the grounds of economy.

Qualtape Unit Modifications*

Several mechanical modifications were made to the tape drive unit by the writer; these are optional improvements which may be incorporated as desired by individual constructors.

A. The switch was made to operate mechanically the motors, and to push them off the rubber drive wheels, with the object of preventing flats on the rubber, and eliminating adjustment of spool spring tension. In the 'forward' position, the Collaro motor is energised and lowered on to the capstan, the rewind motor is switched off and lifted away from the wheel. In the 'off' position, both motors are switched off and lifted away from wheels. In the 'rewind' position, the rewind motor is energised and lowered on to the wheel, while the Collaro motor is still switched off and away from the capstan.

To prevent the rewind spool being completely free, and so that the correct tension is given to the tape whilst recording, a felt pad is pressed against the rewind drive wheel in the 'off' and 'forward' positions.

B. The rewind spool is locked to the spindle by tapping a 4BA hole in the top washer, so that a 4BA screw engages in one of the spool holes.

C. To increase rewind torque and speed, a metal sleeve was fitted over the rewind motor spindle to increase the diameter to about $\frac{3}{8}$" (Torque is increased due to greater area of contact, as it was found that the spindle contact was slipping too much after some use).

D. As the rewind motor is used only for short periods, it was connected to the 220V tapping.

E. The complete recorder is so compact that air does not freely circulate around the Collaro motor. This tends to run hot, being a shaded pole type, so the metal below the motor was cut away to allow free passage of air over the coils, and a small fan was fitted on the motor shaft to increase air circulation.

F. A mumetal shield was made to enclose the head completely, with a $\frac{1}{4}$" slot to admit the tape. This also serves to keep the tape centrally located on the head.

G. A rubber sleeve was fitted over the bakelite pressure roller, to increase the grip. The edges of the rubber "give" to the thickness of the tape sufficiently that they touch the capstan.

H. Sponge rubber mounting pads were stuck under the Qualtape panel to absorb mechanical noise when mounted in the cabinet.

The Record/Playback Amplifier

This has been developed after some considerable experimental work to produce the best frequency response, maximum versatility and ease of construction.

Much of the input switching, with its attendant feedback troubles, has been eliminated by utilising the switches on the jack sockets. Four of the latter are provided, as follows:—

A. High Impedance Input

A crystal or other high impedance microphone (or an external high impedance recording head) may be inserted here and used for recording (or normal playback with ext. head) or for normal sound amplification purposes.

B. Low Impedance Input

Functions exactly the same as 'A,' except that inputs should be low impedance.

C. Radio or Gram Input

A radio or pick-up can be fed in, to be recorded or amplified direct, or mixed with inputs 'A' or 'B' to be recorded or amplified.

D. Extension Speaker Socket

An external speaker can be plugged in. This outlet is operative always, but to prevent acoustic feedback to microphone it is best not used whilst recording. For aural monitoring whilst recording, a pair of moving coil phones of some 50 Ω impedance can be employed. The output during recording will sound a trifle shrill, due to treble boost in this position, but it is not objectionable.

Input Transformer

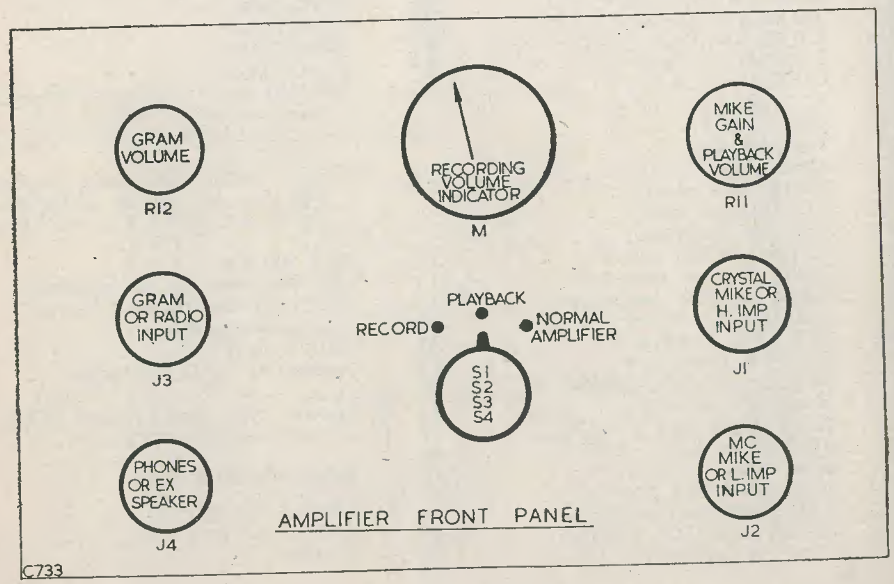
This was rewound from a miniature type with mumetal core, to give a ratio of about 45 : 1. The actual ratio is not particularly critical, and almost any ratio from 45 : 1 to 100 : 1 will do, if the transformer is of high quality.

As this component is mounted only a few inches from the mains transformer, rather elaborate screening is necessary. Altogether, three mu-metal cans were fitted (cut from CRT shields), with two intermediate copper cans. *The separate mu-metal shields should not touch each other*, hence the copper spacing cans which also act as shorted turns to any flux getting through the mu-metal. This may seem to make the transformer bulky, but the final overall size of the writer's unit was only $1\frac{1}{2}$" diameter and 2" long. The screening is so effective that with OC primary no hum is audible at full gain. A 47 kΩ resistor across the secondary correctly loads the transformer for matching purposes.

Input Valve

A pentode with top cap grid is required for this stage, and either 6J7 or EF37 will

*These modifications are incorporated in the Qualtape decks now being supplied.



do. In the writer's model, a metal 6J7 was used, as this is physically smaller than the EF37. The 15 kΩ stopper and 3.3 MegΩ leak are both mounted inside the screened top cap.

Frequency Compensation

To obtain maximum signal/noise ratio, it is desirable that the tape be magnetised by the head as strongly as possible throughout the range without, of course, going into magnetic saturation at any time. This means that constant current recording be used, but, as there are normally recording losses due to the "gap effect," etc., at high frequencies, some degree of treble boost is desirable. This recording characteristic is obtained by the network shown when in position 'R' (Record).

As the output from a magnetic circuit is dependent upon the rate of change of flux, if a constant flux density exists on the tape then the output, when played back, will fall as the frequency falls, like the fall when constant amplitude disc recordings are played with magnetic pick-ups. Thus, a loss of 6 dB per octave occurs towards the lower frequency end of the range.

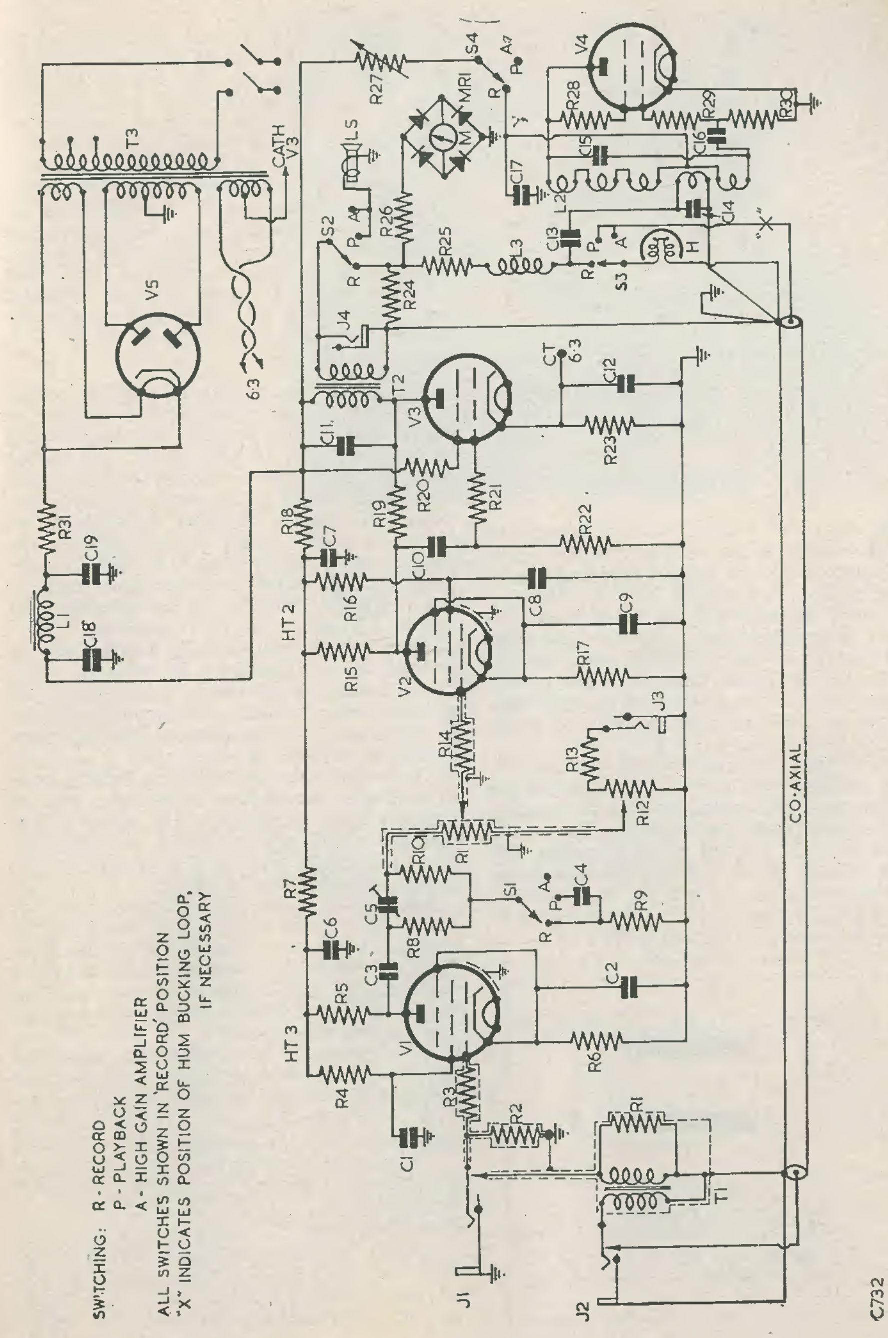
To compensate for this, it is necessary to boost the low frequencies by this amount during playback. Also, as the same gap losses, transfer losses, etc., which occurred on recording will also exist on playback, treble boost will again be necessary.

On the playback position (P), both bass and treble boost is incorporated.

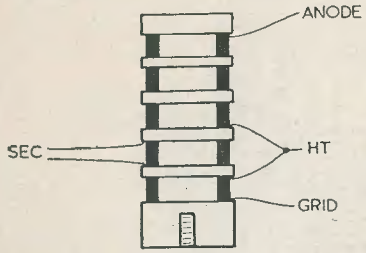
Parts List

R1	47 kΩ, ½W, Erie type 9
R2	3.3 MegΩ, ½W, Erie type 9
R3	15 kΩ, ½W, Erie type 9
R4	470 kΩ, ½W, Erie type 9
R5	100 kΩ, 1W, Erie type 8
R6	1 kΩ, ½W, Erie type 9
R7	20 kΩ, ½W, Erie type 9
R8	100 kΩ, ½W, Erie type 9
R9	15 kΩ, ½W, Erie type 9
R10	100 kΩ, ½W, Erie type 9
R11	1 MegΩ volume control, carbon
R12	50 kΩ volume control ,carbon
R13	220 kΩ, ½W, Erie type 9
R14	15 kΩ, ½W, Erie type 9
R15	220 kΩ, 1W, Erie type 8
R16	470 kΩ, ½W, Erie type 9
R17	1 kΩ, ½W, Erie type 9
R18	10 kΩ, 1W, Erie type 8
R19	4.7 MegΩ, ½W, Erie type 9
R20	100 Ω, ½W, Erie type 9
R21	1 kΩ, ½W, Erie type 9
R22	470 kΩ, ½W, Erie type 9
R23	300 Ω, 1W, Erie type 8
R24	3 Ω, 3W, wire wound
R25	47 Ω, 2W, Erie type 1
R26	1.5 kΩ, ½W, Erie type 9
R27	25 kΩ, 4W, wire wound pot.
R28	100 Ω, ½W, Erie type 9
R29	1 kΩ, ½W, Erie type 9
R30	27 kΩ, ½W, Erie type 9
R31	50 Ω, ½W, Erie type 9
C1	0.1 μF, paper, TCC CP45N
C2	50 μF, 12V electrolytic
C3	0.1 μF, paper, TCC CP45N
C4	0.005 μF, mica
C5	60 pF max. trimmer
C6 }	16 μF, 450V wkg, elect.
C7 }	8 μF, metal can, plain foil
C8	0.1 μF, paper, TCC CP45N
C9	25 μF, 25V electrolytic

C10	0.01 μF, paper, TCC CP45W
C11	0.002 μF, mica
C12	25 μF, 25V electrolytic
C13	0.03 μF—See text
C14	0.1 μF, paper, TCC CP45N
C15	? (0.002–0.005 μF—Osc. to be 45 kc/s)
C16	0.002 μF, mica
C17	0.25 μF, paper, TCC CP48N
C18 }	16 μF 450V wkg. elect.
C19 }	8 μF, metal can, plain foil
V1	6J7 metal
V2	6SH7 metal
V3	6V6GT glass
V4	6V6GT glass
V5	5Y3GT glass
T1	Shielded input transformer, mu-metal core, ratio 45 : 1—100 : 1
T2	Output transformer, 6V6 to 2½ Ω, ratio 45 : 1
T3	Mains transformer, drop through type with top shroud. 250/0/250V at 100 mA. 6.3V CT at 4A. 5V at 3A
L1	10H, 100 mA
L2	Osc. coil—See text and diagram
L3	RF Choke—See text and diagram
MR1	1 mA meter rectifier
M	500 μA meter
LS	Internal 6½" 2½ Ω PM speaker
J1, J2, J3, J4 }	Igranic type jack sockets. (Rear contact breaks on entry)
H	Record/Playback Head
S1, S2, S3, S4 }	Ganged switches 4 pole 3 way on 3 wafers



Complete Circuit of the Amplifier



HF OSC COIL (L2)
HALF SIZE SECTION EBONITE FORMER
TAPPED 4BA HOLE IN BASE ⅜" DEEP

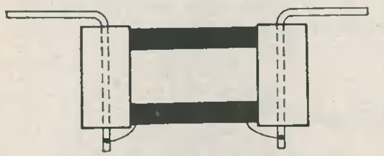
WINDINGS IN FIVE SLOTS ALL IN SAME DIRECTION. PRIMARY 4X200 TURNS (800 TOTAL) OF 32 SWG ENAMELLED. SECONDARY IN SLOT BETWEEN GRID & ANODE SECTIONS 80 TURNS 24 SWG ENAM.

C739

The degree of treble boost is determined by the setting of the 3-30 pF trimmer, and is adjusted to suit the type of tape and microphone which will be used.

In order to make full use of the high frequency compensation, the screened lead from the trimmer to the 1 MegΩ potentiometer and the screened lead from the slider of this potentiometer to the 6SH7 grid stopper must both be as short as possible, and of a low capacity type cable.

In the third position of the switch (A), as an amplifier, the compensation is cut out so that the unit works at maximum gain. It is true that slight low frequency loss occurs due to the 3-30 pF still being in circuit, but owing to the 100 kΩ and 470 kΩ now being in series and across it, and the higher circuit impedance, the network loss at low frequencies in this position is only about 4 dB.



RF CHOKE (L3)
EBONITE FORMER
20 SWG TINNED LEADS FIXED THROUGH ENDS. WINDING 8 LAYERS EACH OF 40 TURNS 32 ENAMELLED. TOTAL 320 TURNS.

C740

2nd Amplifier Valve

Due to the high overall gain required on playback, and the middle frequency attenuation of the network, the second amplifier must be a stage of very high gain. This is accomplished by the use of a metal 6SH7 and suitable circuit values. This valve is still in plentiful supply from ex-Govt. dealers.

The gram/radio input is mixed in at the grid. To prevent overloading of the 6SH7 from the input, and to reduce any effect which the 'gram volume' may have on 'mike volume' setting, the attenuator network has been included and the 'gram volume' control kept down to 50 kΩ. The total input resistance at the gram/radio socket is 270 kΩ.

Output Stage

The 6SH7 feeds into a 6V6GT output valve. An anti-parasitic screen stopper is fitted, also a grid stopper, the latter being in fact fitted to all the valves. As output pentodes tend to be very rich in third harmonic distortion, and to give greater stability, some degree of negative feedback is incorporated by fitting a 4.7 MegΩ resistor between the output valve anode and the 6SH7 anode. The 0.002 μF across the transformer primary has negligible effect in the audio range, but acts as a bypass to higher frequencies.

The transformer should match to the normal 2½ Ω speaker. In position 'R,' the secondary is switched to a dummy load of 3 Ω, and also fed to the record/playback head switch via a 47 Ω resistor to give constant current recording.

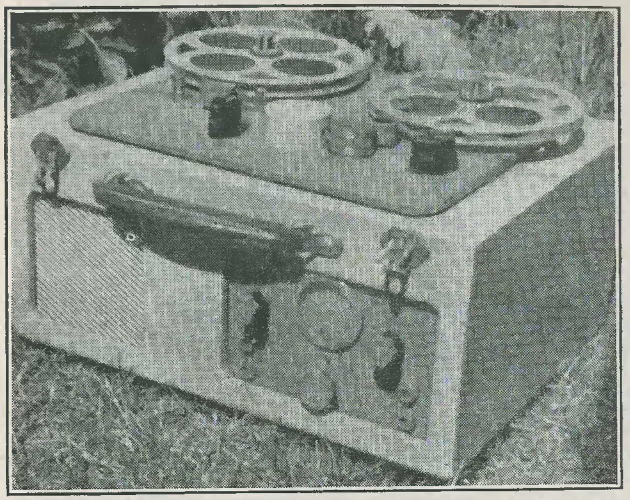
To prevent the bias oscillator feeding back and giving modulation distortion, plus a standing meter reading, an HF choke is also included. This should consist of 320 turns of 32 swg enam. wire on a ¼" former, with a ½" long winding (See drawing).

The values shown for the level indicator meter give correct recording level at an average of a third to a half full scale deflection. This will, of course, depend on the tape and bias settings but, after trials, the level at which saturation distortion does not occur can soon be determined.

At 'P' and 'A' switch positions the internal speaker is switched on, and the head switched back to the amplifier input for playback, with mike plugs out. It will be noted that, apart from the correct playback position 'P,' it is possible to play back on 'A' position, with increased gain but no playback frequency compensation.

Bias Oscillator

Several oscillator coils and circuits were built and tried in order to obtain the best efficiency, stability and waveform. The majority of commercial coils are too tightly



Three-quarter view of complete recorder, with lid removed.

coupled to give a good sinusoidal wave form (See coil data).

The circuit shown should work at about 45 kcs, and it may be necessary to alter the tuning capacity (C15) to obtain this desired frequency. The 0.1 μF across the secondary coil can be eliminated, if desired, as the output is still sinusoidal, but its inclusion boosts the oscillator output quite a bit, and it does make doubly sure of good waveform.

For high coercivity tape the grid leak can be around 27 kΩ, and for low coercivity tape around 47 kΩ to give similar results at similar bias control settings, but 27 kΩ can be used for both and the bias control adjusted to suit either tape.

Instead of the usual bias output control, the bias level is adjusted by varying the HT, as this also economises on HT current. The stability and waveform remain perfect at all settings. The head itself is series tuned by a 0.03 μF condenser, although if a head of different inductance is used this value should be changed.

Grid and screen stoppers are incorporated to prevent any possibility of parasitics.

The HT to the oscillator is switched off in the 'P' and 'A' positions to reduce HT current consumption, and to prevent any possible interference when using the high gain required for playback.

To be continued

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.

How many of the old hands are there who regret, just a little, the passing of the early days of radio? It is in human character to review memories of the past under a favourable light: we tend to remember the good things only, and forget the bad. Nevertheless, those early days had a charm which cannot perhaps be entirely recaptured at the present time. The first amateur constructors were fired with a pioneering spirit because they were experimenting with something new; they realised that, since there were so many potential discoveries to be made in the new science, such discoveries were just as likely to be found with an experimental kitchen-table rig as they were in a manufacturer's laboratory. Nowadays, when radio design has become stabilised, the field for experiment by the amateur is correspondingly more limited.

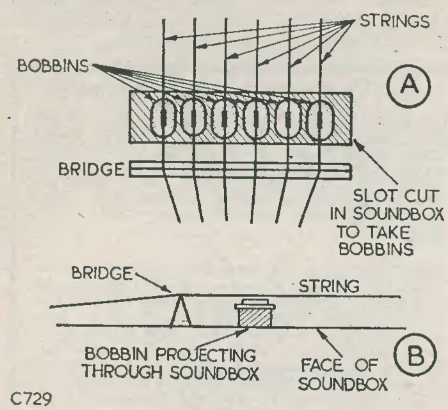


Fig. 1: Top view (a), and side view (b), showing how bobbins and cores may be fitted to an ordinary guitar to convert it to electrical working. The method used to polarise the cores is not shown here. The bobbins are fitted on the fingerboard side of the bridge

However, the amateur, like the Elephant's Child, has a 'satiable curiosity. If he loses a source of experiment in one direction, he finds another elsewhere. Nowadays much experimental work is being carried out in the search for really adequate high fidelity reproduction. This is an interesting branch of radio, and has the added advantage of not necessarily requiring the expenditure of an excessive amount of money. It is true that the prices of some high fidelity loudspeakers soar to almost astronomical heights, but it is also true that quite a few of the well-known units offered for sale are within the pockets of many amateur constructors. Record-playing gear can also be fairly expensive, particularly so when new equipment is being bought, as the buyer then has to pay the crippling Purchase Tax which is levied on such items.

Despite all this, high-fidelity reproduction still offers an attractive interest for the experimenter. The amplifier itself can be made at home using the constructor's own ideas, and being built to his own design and layout. Most of the components needed—resistors, capacitors, and so on—are cheap and easy to obtain; and even the valves need not necessarily incur too great an expense. Many amateurs, desiring a good and cheap amplifier, design one which, without any loss in performance, can still make use of components which they have already on hand.

Readers will have noticed that this growing attention to sound reproduction has been reflected in the space devoted to the subject in this magazine. The writer is, himself, keenly interested in high fidelity work and is always very pleased to hear from readers who are getting good results from interesting or unusual amplifiers of their own design.

Electronic Guitars

Several musically—but not very technically-minded—friends of the writer approached him recently for some information on the conversion of ordinary guitars to electrical working. Since nowadays, for certain reasons, such conversions are much easier than they used to be, it might be of interest to pass along the information here as well.

The simplest method of making an electric guitar consists of taking an ordinary guitar and mounting small bobbins wound on continually magnetised cores close to the individual strings. The vibration of these strings (which must be of steel, of course) is then changed to corresponding electrical currents by the magnetic variations induced in the bobbins. Two views of the scheme are shown in Fig, 1. Some people prefer to have the bobbin cores mounted progressively closer to the strings at the "bass end" to ensure that each string induces a similar voltage value, but this point is not necessarily of great importance.

To house the bobbins in the guitar it is necessary to cut an oblong slot in the face of the instrument close to the bridge (See Fig. 1). The tonal qualities of the guitar are of little importance once it has been converted, and so it is wise to alter only a very cheap instrument. An expensive guitar would, of course, be practically ruined after the slot had been cut. A friend of the writer who has built several electric guitars usually makes the whole guitar framework himself, using any suitable wood.

Electric guitar technique is a little more complex than is that needed for a normal instrument. A fairly sensitive amplifier and a volume control on the instrument itself are essential. A typical instance of what may be obtained is given by the fact that notes can be "held" for what is almost an amazingly long space of time. If a string is plucked with the volume turned down, the volume may be gradually advanced whilst the vibrations die away, giving the effect of a continuous tone at a constant audible level.

The reasons for stating that guitar conversions are nowadays very easy is due to the fact that most of the ex-RAF headphones now being sold as surplus contain bobbins which are ideal for the job. Previously, to ensure that the bobbin cores were magnetically polarised it was normal practice to use a single horse-shoe magnet to energise them all, with the result that construction was difficult and awkward. The bobbins used in the ex-RAF headphones have the construction shown in Fig. 2, the bottom member joining the two cores being also a magnet. This design allows the bobbins to be mounted side by side in pairs quite simply; and there is no need to worry about magnetising the cores as this is done automatically by their construction. Before mounting the pairs of bobbins side by side it will probably be necessary to cut off the small brackets shown in Fig. 2. The spacing between cores should approximate to the spacing between strings in most cases, but, if this does not occur, the bridge can usually be modified. Alternatively the bobbins can be "staggered" in pairs, or spaced out, as the case may be, to ensure that the cores fall more or less underneath the strings.

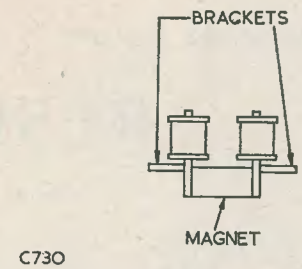


Fig. 2: The design of the core assembly used in the headphones mentioned in the text, illustrating how the energising magnet forms part of the construction

High-resistance ex-RAF headphone bobbins give excellent results when used in this manner. The bobbins should be connected in series; and the output, after passing through the volume control circuit, can be applied directly between grid and chassis of the amplifier. The writer has had no experience of low-resistance bobbins of the same construction but, if these were used in conjunction with a transformer, they would probably work just as well. If the pairs of bobbins were, in this case, connected in parallel they should match reasonably well into a microphone transformer. The transformer would need to be mounted in the guitar itself so that the volume control could be used in its secondary circuit.

The writer would like to state finally that it is, of course, impossible to guarantee that all ex-RAF headphones have the bobbin construction shown in Fig, 2. Nearly all those offered for sale use this design, but the constructor should try to make certain of this point before finally making his purchase.

Mainly for the Beginner . . .

RESISTANCE

By H. E. SMITH, G6UH

Resistance

Of the three components which are the main ingredients of all Ohms Law calculations, Voltage (E), Current (I), and Resistance (R), the latter usually presents more of a problem to the beginner and is fundamentally more difficult to grasp. A few basic facts, once assimilated, will make for easier calculation and a better understanding of the actual necessity for the use of resistors in all radio and associated apparatus.

Resistance of Materials

The resistance of any material is directly related to its "opposition" to a steady flow of electrons. In other words, if the composition of the material is such that it is easy to detach electrons from its atomic structure, its opposition to electron flow will be low and it can be said to have a *low resistance*. The actual amount of opposition present will also depend on the temperature of the material. With most *metals* the resistance increases with an increase in temperature. With other substances, including carbon, the resistance *decreases* with an increase in temperature.

Many of the small resistors used in radio and amplifier work today are of the carbon or carbon composition type, and it will be appreciated that any undue heating up during operation is undesirable because of the effect of heat on the resistance value. Special types of resistor have been developed in recent years. These are known as High Stability types and are, in the main, unaffected by changes in temperature. Another type of resistor is the Wire Wound variety. These will usually handle heavier currents and withstand higher temperatures for a smaller change in resistance value than the carbon and composition types. Wire wound resistors should not be used indiscriminately in the construction of radio receivers, however, because unless marked otherwise most wire wound resistors are *inductive*. Many cases have been known of such resistors causing instability and self oscillation, due to their being resonant at some particular frequency. If wire wound resistors must be used, especially in a part of the circuit where self-resonance might be expected (RF or Detector circuits) always specify *Non-inductive* types. If you are contemplating winding your own resistors, use a good make of double silk and enamelled Nichrome or Eureka wire and wind it to the method shown in Fig. 1(b). A point to remember regarding resistance wire is that if one yard equals one ohm, 1′ 6″ will be half an ohm and two yards will be two ohms. If you have a supply of resistance wire it is a good plan to cut off about a yard and get it measured up on a reliable bridge. You will then be in a position to wind up any value of resistor, as far as your stock will allow, to within less than 1 per cent. merely by using a rule.

In cases where extreme accuracy and stability is required, such as a meter shunt for a milliammeter, a wire wound type of resistor is a necessity. Many of the surplus 5 mA meters on the market are quite readily adapted to 50 mA by shunting directly across the terminals. The resistance value of the shunt should be one ninth that of the meter itself. The meter resistance is usually indicated on the lower part of the scale.

Voltage dividers

One of the most useful purposes for which resistors are used in present day design is as voltage dividers. The HT battery has a series of sockets providing a limited choice of voltage. With an AC power supply we can fit a voltage divider and obtain any value of HT voltage from zero to the full amount given by the unit. A simple method is to fit a string of resistors across the output and take a tapping from the junction of each, or we can use a potentiometer of the variable type in series with the whole or a section of the fixed portion. Remember that the *Wattage* rating of the resistors should be of such an order that they will withstand the current flow *through* them plus the current flow to the circuit being supplied from the tapping. Fig. 2 should make this quite clear. The total current drain through R1, R2 and R3 is approximately 10 mA. R1 must, therefore, stand 10 mA plus 20 mA for the 250 volt tap, plus 5 mA for the 100 volt tap. R2 has to stand 10 mA plus 5 mA for the 100 volt tap, and R3 the 10 mA of the divider network.

Suitable wattage ratings for the resistors would be:—
R1–10 watt, R2–2 watt, and R3–1 watt. If no resistors of such wattage are available, it is quite a simple matter to wire two resistors of lower wattage in parallel. The value of each would of course be twice the value of the required resistance. Where two odd value resistors are used in parallel, the following simple equation is used:—

$$R = \frac{R1 \times R2}{R1 + R2}$$

If the required resistor value is known, it is a simple matter to calculate what value is required in parallel with the existing resistor to produce the desired value:—

$$Rr = \frac{R1 \times R}{R1 - R}$$

Where R is total value required,
R1 is existing resistor value,
Rr is the value of the resistor required to produce R when paralleled with R1.

For *more than two* resistors in parallel the resultant value is equal to the reciprocal of the sum of the various reciprocals of the resistors used, or:—

$$R = \frac{1}{\frac{1}{R1} + \frac{1}{R2} + \frac{1}{R3} + \frac{1}{R4} \text{ etc.}}$$

A helpful point to remember is that where several resistors are used in parallel, the resultant resistance is always lower than the lowest value resistor used.

For resistors in series it is, of course, merely a matter of adding the various values together to obtain the total resistance.

The Anode resistor

No valve will operate effectively unless its anode circuit is "loaded" with the appropriate impedance or resistance as specified by the makers. This loading is necessary because the following valve requires an alternating voltage applied to its grid before it will operate, and it is across the anode load resistor that this voltage is generated. The data supplied with the valve should be carefully followed. Any major departure from the operating conditions as set down by the manufacturer will result in disappointment. If too high a value of anode resistor is used, distortion will result, due to excessive voltage drop across the resistor. If too low a value, there will be loss of gain, as the resistor is too low in value for the proper development of the alternating voltage to drive the following stage. In some special amplifiers, the gain is often deliberately cut by this method in order to keep the distortion percentage down to the absolute minimum.

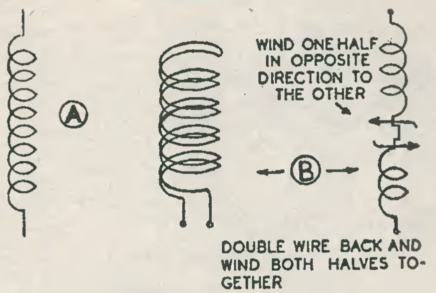


FIG. 1. WIRE WOUND RESISTORS
A = ORDINARY INDUCTIVE TYPE.
B = TWO METHODS OF WINDING NON-INDUCTIVE TYPES. C750

Cathode Resistors

The cathode bias resistor should always be of sufficiently high wattage rating to comfortably withstand the combined anode and screen current of the valve. If the anode and screen current and grid bias voltage requirements of a valve are known, the value of the cathode resistor may be calculated from the following:—

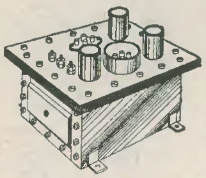
$$R = \frac{Vg}{Ia/s}$$

Where Vg is the grid bias voltage required,
Ia/s is the combined anode and screen current of the valve.

The cathode resistor method of biasing a valve is far more satisfactory than the battery method because the bias voltage varies with changes in HT voltage, thus tending to maintain the anode current at one level. Cheap resistors of unknown make are to be avoided, as not only are they probably nowhere near the indicated value but are often noisy in operation and responsible for intermittent operation and crackles.

ELPREQ PAGES

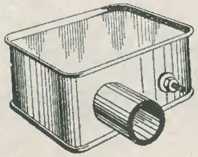
RADAR TRANSFORMER



For pulse work at 4 KV, this is Ministry style No. 224261 type 2. Oil filled and fitted with two valve holders and ceramic pillars. Internally it contains a pulse transformer, a choke and a filament transformer, all of which are designed to operate on 4 KV. Price on request.

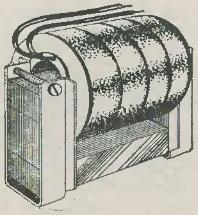
INDUCTANCE CONDENSER UNIT

TYPE 21



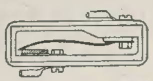
Intended to operate with the above pulse transformer Ministry No. 10C/11335. This again is made for 4 KV work.

HIGH VOLTAGE ISOLATION TRANSFORMER



Ratio 1 to 1 made for voltages up to 4 KV but probably would be safe on even higher voltage.

THERMOSTATS

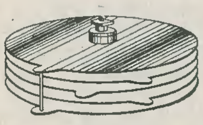


All thermostats are fitted with heavy silver contacts and can be adjusted to operate between 30° and 300°F. Suitable for use with aquariums, electric blankets, space heaters, greenhouse heaters, etc., etc.

A.C. rating 1 Amp 250v. **3/6d.**
A.C. „ 2 Amp 250v. **5/6d.**
A.C. „ 5 Amp 250v. **14/6d.**

Note. The two amp model is fitted with patent devices which gives it a quick make and break action.

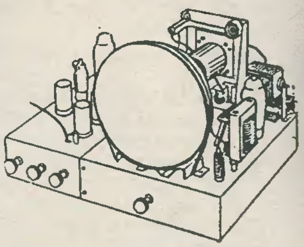
METAL RECTIFIER



The one illustrated is a special bargain being available at considerably below cost. It is a selinium type rectifier rated at 12v. 2½ Amp, it is of course a full wave type highly suitable for battery chargers Limited quantity. Price **17/6d.** each

Also available:
6 v. 1 Amp Type Price **5/–d.** each
12v. 1 Amp Type Price **9/–d.** each

TELEVISION CAN BE YOURS FOR ONLY £7



We offer Hire Purchase terms on two alternative sets:— **P.T. ARGUS.** This was described in three recent issues of *Practical Television* and we have had good reports about the quality of reception. This Televisor uses the Government surplus tube Type VCR97 which is now firmly established in the domestic T.V. field. The total price of all components and tube is approximately **£20** (list on request) or if you prefer send only **£7 deposit** the balance can be spread over 12 months.

VIEWMASTER. This set we need not describe, the name being almost a household word, the total cost depends largely on the type of tube used and as from time to time we have perfect tubes to offer at half current price due to the fact that they have had slight use, we suggest that you leave purchase of the tube until last.

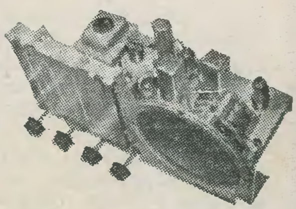
The total cost of the Viewmaster is approximately £35 plus the tube, but you only need send £12 deposit, the balance can be spread over 12 months.

If you would rather study the data then send 2/6d. for P.T. Argus or 7/6d. for Viewmaster, we are quite willing to refund your cash if you return the data within 7 days.

T.V. CABINET

This is a very handsome walnut finished cabinet ideal for Viewmaster or practically any other T.V. using up to a 12″ tube. A platform is fitted but it is a small matter to alter the position to suit your own chassis. Baffle board for 10″ loudspeaker is also included as is a hardboard back. Internal dimensions: 2′ 7″ high × 1′ 8″ deep. Price **£9.9.0d.** carriage and packing 10/– extra.

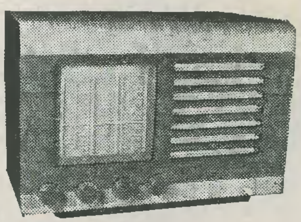
THE SUPERIOR FIVE



A.C. mains superhet built by one of our famous manufacturers — Covers long-wave 800-2200 metres, Medium-wave 200-500 metres and short wave 16-50 metres. Made on heavy gauge chassis, size 15½″ × 8″ × 2½″, edge-lit dial, printed and calibrated in three colours, size 7½″ square, 8″ P.M. speaker—two speed tuning B.V.A. valves types 6K8, 6V7, 6R7, 6V6, and 6X5. Pick-up and speaker sockets delayed A.V.C.—I.F. Filter—4 watts undistorted output — circuit diagram and 12 months' written guarantee. Price complete ready to work, **£10.19.6d.**

Hire Purchase Terms. £3.13.0d. deposit, then nine monthly payments of **18/9d.** Non-callers please add 10/6d. to cover carriage and insurance.

SUPERIOR CABINET



With beautifully veneered full grained and highly polished finish, dimensions 19″ wide × 10″ deep × 12½″ high. This cabinet will take our " Superior Five " also the set being advertised by Messrs. Lasky's Radio. In this cabinet the set will look well worth **£18 - £20.** Price 3 gns. each, post, packing and insurance 7/- extra.

ELPREQ TAPE RECORDER

£29 5s. CASH

or

£9 15s. DEPOSIT

Tape Deck. Fitted with 3 motors giving fast rewind/forward run and no friction. High fidelity record/play back giving approximately 1 hour playing from standard 1,200 ft. tape. Tape 35/–d. per reel.

Amplifier. High gain enables recording to be made from microphone, pick-up or loud speaker. Separate bass and treble lift controls.

Cabinet. Portable is rexine covered. Table model is polished walnut.

Constructor Envelope. Shows in close detail exactly how to assemble and operate the recorder, is free with kit or available separately at 5/–d. In which case it is supplied on the understanding that if after having 14 days to study it you decide against making the recorder send data back clean and we will refund your cash less postage

Price. Complete kit of parts including 6 B.V.A. valves, loudspeaker and cabinet (state whether portable or table model required). **£29.5.0d.** or **£9.15.0d.** deposit and balance over 12 months. If required we will assemble and test for £4 extra. Suitable crystal hand-table microphone **£1.15.0d.** extra.

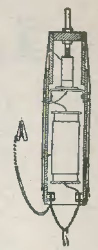
THIS MONTH'S SNIP

This month's snip is something for which many have waited a long time, further being a cancelled export order we can offer it at a special price due to saving of Purchase Tax. Of course, only a limited quantity is available so if you want one act quickly.

We offer the famous Garrard Auto Record Changer Radiogram unit, RC72, universally agreed to be the world's finest. It is a 3-speed model which in addition to the usual refinements has two GP19 precision pick-ups (with two adaptors to facilitate easy changing).

Special Snip Price **£15.15.0d.** complete, or if you do not want to lay out this all at once send a deposit of **£5.8.6d.** Non-callers add 7/6d. for carriage and insurance.

RADIO STETHOSCOPE

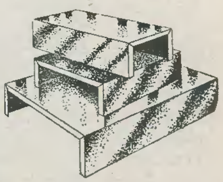


A novel device aptly called a Radio Stethoscope is described in a recent edition of the *Radio Constructor*, this is compact and can be slipped into the pocket rather like a fountain pen. With it in most districts a receiver can be checked from the grid of the first valve right through to the output without a signal generator, the stethoscope will operate in both L.F. and R.F. circuits without alteration. It is a complete fault finder.

The only parts needed to make the simple circuit tracer are a pair of crocodile clips, a germanium crystal, and a paper tubular condenser and we will supply whole outfit for **6/6d., post free,** and with each outfit we will give re-print of the article as it appeared in the *Radio Constructor*.

NOTE.—If you wish to make it up as a pocket unit then you will need a few other odds and ends, solder tags, etc., from your spares box.

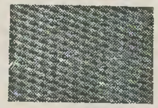
BLANK CHASSIS



Made of 18 S.W.G. Aluminium.

Size	*Price*
10″ x 8″ x 2½″	7/–
10″ x 5¾″ x 2½″	6/6
10″ x 9″ x 3″	7/3
12″ x 9″ x 2½″	7/3
14″ x 9″ x 2½″	7/6
14″ x 10″ x 3″	8/–
16″ x 10″ x 3″	8/3
16″ x 8″ x 3″	8/–
11⅞″ x 10″ x 3″	7/6
16″ x 12″ x 3″	8/8
19⅜″ x 8″ x 2½″	8/3
20″ x 10″ x 3″	10/–
21⅝″ x 9 5/16″ x 2½″	10/6

SPEMET



Made from polished aluminium, an excellent material for fronts of cabinets or for special cabinets you are making, and for air conditioners, etc.

Close mesh 8 holes to the inch, 24″ × 12″, 10/–, 12″ × 12″, 5/3, 6″ × 6″, 1/9.
Wide mesh 4 holes to the inch, 24″ × 12″, 9/–, 12″ × 12″, 4/9, 6″ × 6″, 1/6.
Postage and special packing 1/6 extra for any quantity up to 12 sheets. Over 12 sheets post free.

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

Except for heavy and delicate items where carriage charge is specified, orders over £2 are post free, under £2 add reasonable amount bearing in mind a 15lb. parcel costs 2/–. Postable items can be sent C.O.D. additional charge approx. 2/6. List 6d.
Early closing, Wednesday—Ruislip, Saturday—City.

ELECTRONIC
PRECISION EQUIPMENT
WINDMILL HILL, RUISLIP MANOR MIDDLESEX AND AT 152-153 FLEET STREET, LONDON E.C4.

LARGE SCREEN TV.

THE RADIO CONSTRUCTOR'S 16 inch TELEVISOR

PART SEVEN

No difficulty should be encountered in building the five-channel vision and sound strip. Cross reference to the photographs and lay-out guide will clearly give all the direction that is required.

Valveholder holes and fixing points are given and by studying the valve connections (see last issue), valveholders may be bolted into position to form a logical sequence as seen in the circuit. Thus, anode pin adjacent to grid 1 of the next valve, and so on. Readers should take careful note of the chassis drilling sketch. This is shown as the underside; perhaps a slightly unusual procedure, but it obviously maintains visual relationship to the photographs. R11, shown in the time-base picture (July issue), can be seen again here, and by placing these two issues side by side a composite layout can be achieved. Note that L7 and L8 are on top of the chassis, unscreened.

The aerial connecting coaxial cable under the chassis is not shown to avoid overcrowding the layout photographs, but this is simply taken round the inside of chassis to L1 at the rear.

Insulation of the aerial socket from the chassis is essential, and the end view shows a piece of paxolin mounted to carry the aerial input.

The McMurdo valveholders used in this receiver lend themselves to a fortunate component assembly.

Wire in the heater and heater/chassis connections first. It is advisable not to use too many valves in chain wiring. Narrow gauge wire is apt to drop volts, and this can cause foldover at the left of the picture.

Bring up a chassis connection to the centre spigot of each valveholder; all small condensers and resistors to chassis may then be nicely grouped to one point. Components to HT can be taken across to the tag strips provided.

The photograph will present this method of construction very graphically.

All coils will be suitably marked, and here again a thorough study of the circuit should be made to ascertain that wires from all components may take the shortest possible course. Note the clean uncrowded appearance of this chassis, and dispose all items in this fashion.

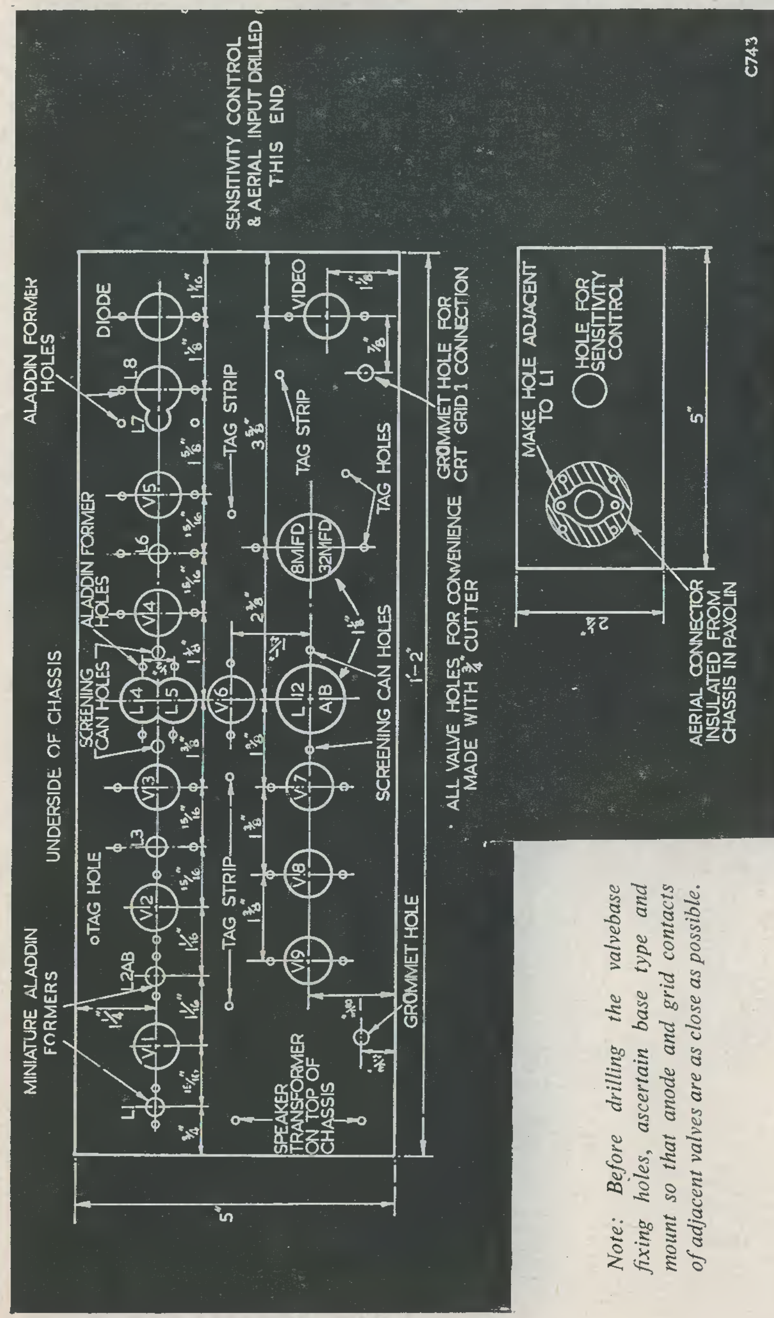
When mounting the focus coil, remove rubber grommet, which is supplied for fitting to 9″ or 12″ tubes, and ascertain that this gap, which is incidentally the magnetic gap, is adjacent to the deflection coils.

Some consideration must be given to setting up the tube, and reference must again be made to the May issue. Study the notes on the iron trap and focus coil. There will usually be some amount of wriggling with these components and if no raster is observed when switching on, the reader can be sure these two components are completely out of position, thus failing to bring the beam into true axis line. The line-output transformer is such that if the customary fly-back whistle is heard, and the EHT rectifier filament is heated up, one can be practically certain that the EHT is present on the tube. So don't test with your fingers!!

For this purpose there can be no better tool available than the "Kilovolter," a recent acquisition by your writer which has proved absolutely invaluable in setting up this receiver.

With a range of up to 30 kV, a complete reading of EHT voltages is available at all times during the setting-up period of this receiver.

The EHT lead is also not shown in the illustrations, but this is carefully soldered to the point provided on the line-output transformer and thus to final EHT smoothing.



Chassis Dimensions (F. J. Hill, 48 Baldwyn's Park Rd., Bexley, Kent)

Note: Before drilling the valvebase fixing holes, ascertain base type and mount so that anode and grid contacts of adjacent valves are as close as possible.

Several different types of CRT have been used with the prototype model, and to arrive at an average it has been found necessary to re-adjust the Brilliance network.

R9 is now 68kΩ, and R10 22kΩ. This is suitable for all makes (Page 403 June issue). One or two EHT rectifiers appear to heat up too brightly; should this odd occurrence happen with any reader's particular model, a 6.8Ω resistor may be placed in series with the EHT filament wire.

The original set has now been functioning for some considerable time trouble-free, and a successor model has now been built entirely to the description contained in the Radio Constructor.

The power-pack employed in this instance was the metal-rectifier type explained earlier, and as proof of the design it gives your writer some smug pleasure to say this model operated immediately on switching on.

Either the N78 or 6AQ5 produces a very high quality sound, even for a single ended stage. Thus, to do justice to a first-class TV receiver only a good speaker should be employed, and using the 10″ Goodman T47/1017/3 in the audio channel completed a set of which to be proud.

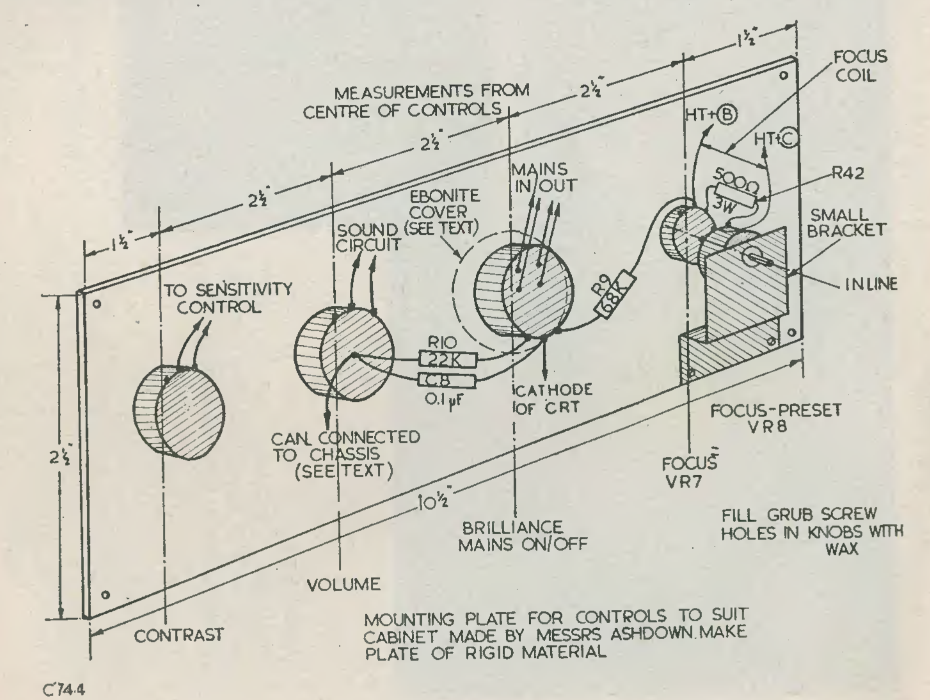
The TV sound bandwidth will definitely give high fidelity, and it was decided to take full advantage of this by using the speaker above.

Do not use a metal grille for facing the speaker, if the half-wave type of power-pack is to be constructed. There is always that odd possibility of a metal grille becoming common to the chassis which, of course, is one side of the mains.

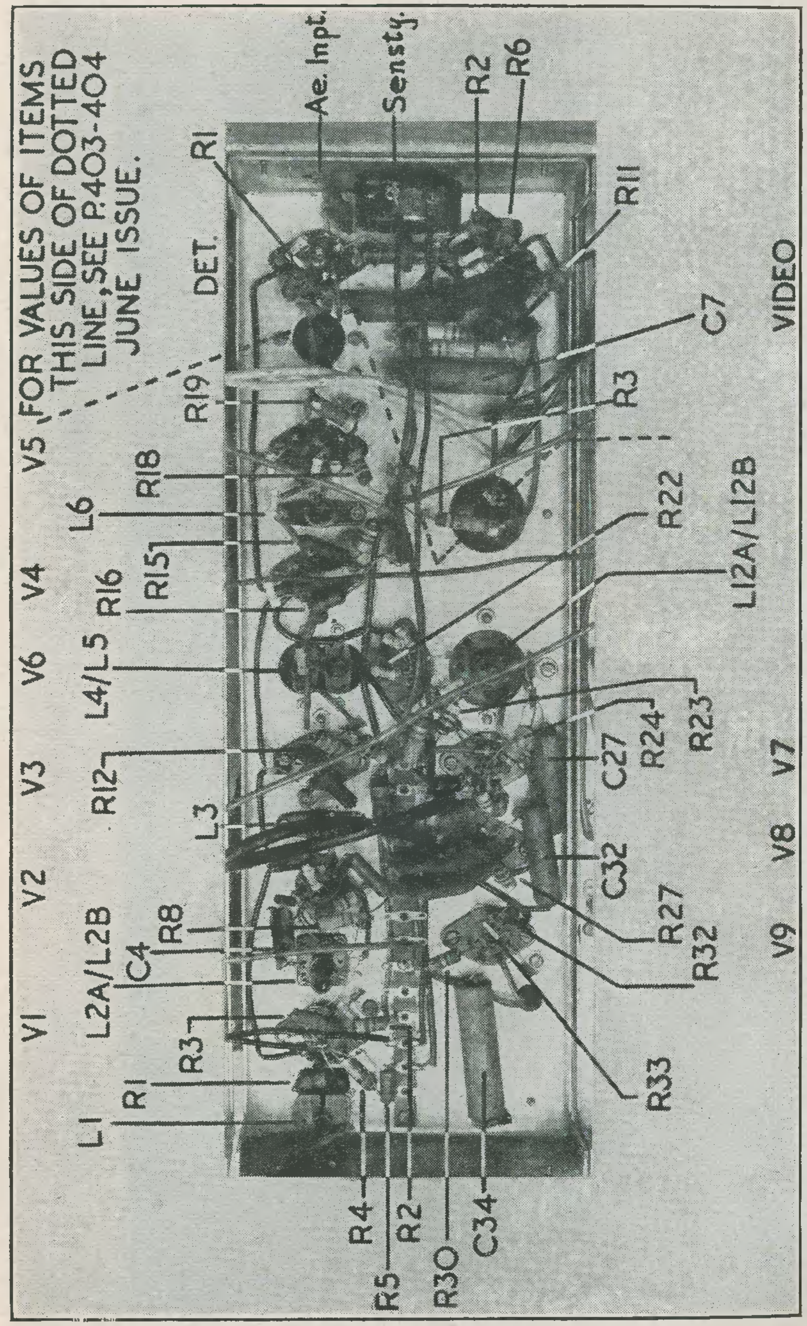
No Tone-control is included, but readers may, according to taste, employ some suppression of top frequencies by placing a small condenser across the primary of the speaker transformer.

The control panel is very easily made, and the dimensions given here are intended for the cabinet made by Messrs. Ashdown specially for this set.

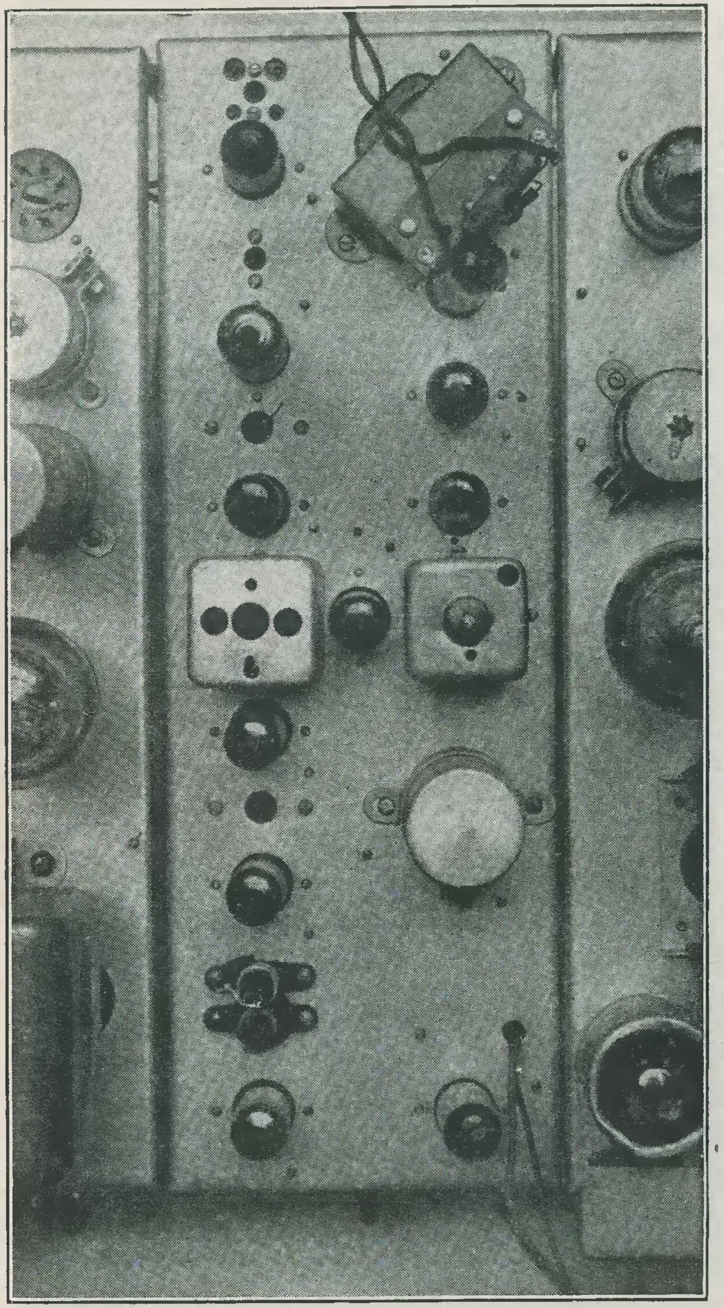
In the original design an ebonite junction-box was found in the junk collection, and by cutting out the interior it was easily altered to fit right over the top of the Brilliance on/off potentiometer and switch. In this way no unpleasant mains connections were exposed. This is shown by dotted lines in



MOUNTING PLATE FOR CONTROLS TO SUIT CABINET MADE BY MESSRS ASHDOWN. MAKE PLATE OF RIGID MATERIAL



View of Underside of Sound/Vision Strip showing layout and wiring.



Top View of Vision/Sound Chassis. Parts of the Timebase and Power Supply chasses will be seen on either side.

the sketch.

Note the convenient method of mounting the Focus pre-set and Focus control. HT + "B" and HT + "C" were soldered to a rigid tag board beside the line-output transformer, and thus these two voltages were available for the time-base and focus circuit. The deflection connections were also made to this tag-board, resulting in a tidy arrangement.

The revised voltage supply mentioned in the last issue for Grid 2 can be obtained from the seven-pin plug on the rear focus board, where the line deflection coils pick up No. 7 on the line-output transformer. Once again it was shown to be a wise decision to use paxolin or plastic for the rear board. Four bolts forming a solder-tag strip attached to this board supplied a simple means of connecting the 0.1 μF decoupling condenser and 470 kΩ series resistor. The other side of the bolts also carried solder tags, and connections for this to No. 7 (No. 1 of deflection coils) were found on the seven-pin connector.

The leads from this connector to the deflection coils should be long enough to allow of change-over, should the picture be incorrectly polarised. If upside-down, reverse the Frame leads; if mirror-wise, change the Line leads.

Returning to the vision and sound strip, component values for the detector and video stage are to be found in the June issue; in the underside view of the chassis these are enclosed in the small dotted-line area.

The Grid 1 connecting wire may be unscreened, but should be kept as short as possible and brought out at the rear well clear of the field created by the line-output transformer. The effect of such interference on the picture would be seen as a series of vertical black bars.

The connections to the Volume control are not likely to need screening, but a convenient method could be the use of standard screened two-way cable. The screening then forms the chassis connection.

NOTE: The Brilliance network is returned to chassis in this manner—see sketch of control panel. Unless this is done, the tube will be blacked out at all times. Before switching on, the drive control should be turned down and all controls should be adjusted to provide normal working conditions. Only then should the drive control be brought up to about half swing position.

Once again referring to power supplies, for the best average working the voltage at HT + "B" should be about 180V. The total current required is approx. 180 mA.

Thus it is probably the wisest course to include temporarily a large limiting resistor, say 1000Ω 20W working, from the power pack, and make several readings with a meter before taking the resistor out of circuit.

In actual practice, using the metal rectifier circuit shown from a 230V AC mains supply, 250V DC was obtained after the reservoir condenser. When passing through the Allen Components choke and the focus coil, the voltage at HT + B was, in fact, exactly 180V DC, which is ideal for large screen TV.

MOUNTING THE BRIMAR C17BM CRT

This 17" rectangular tube lends itself admirably to the installation design given in the Feb./Mar. and April issues.

These copies should be referred to, and with the information and illustrations given here a clear picture of the required constructional work will be seen.

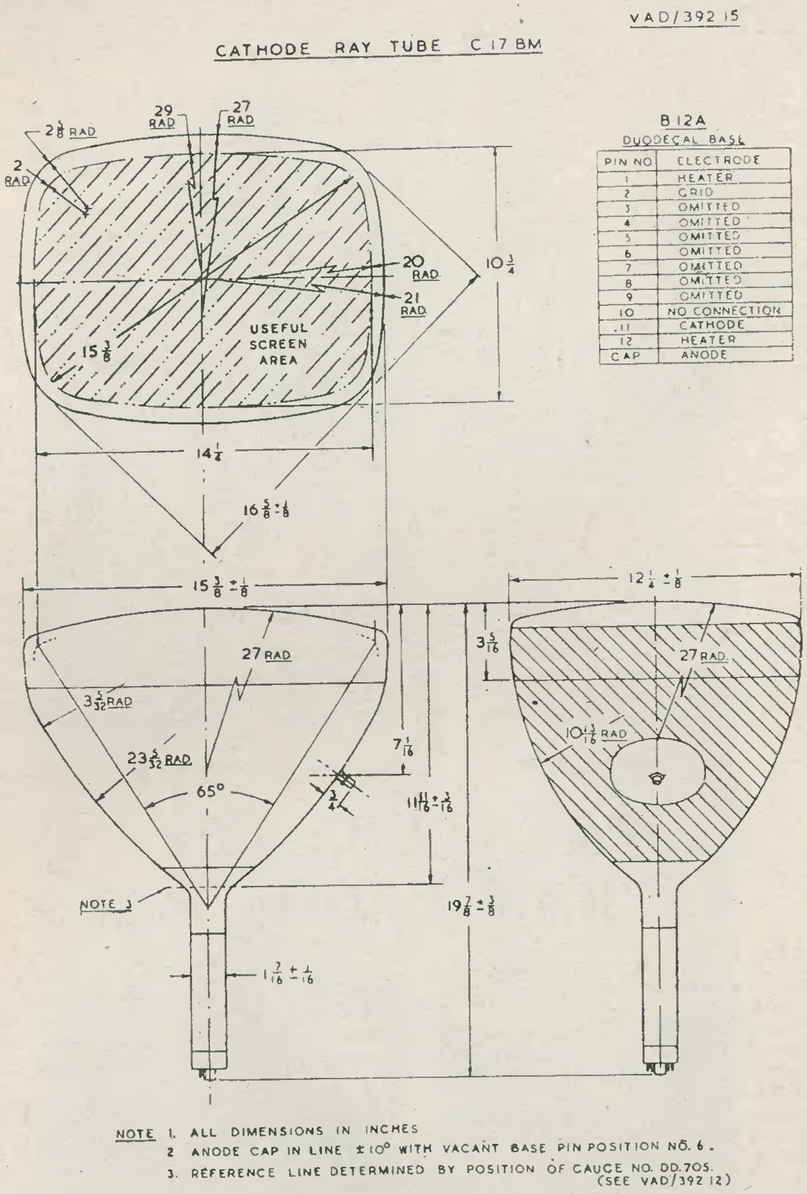
The cabinet specially made for the Radio Constructor's televisor is identical for all the variations of design given in these articles, and the tube screen opening in the front is also uniform. The battens inside the cabinet for supporting these installations are adjustable to cover any discrepancy which may occur during construction.

Note: There was an error in Fig. 4, April issue; the actual cut-out in the mask board should have been given as $14'' \times 10\frac{3}{4}''$. For the Brimar C17BM tube, this cut-out will be increased horizontally and vertically by $\frac{3}{4}''$, to $14\frac{3}{4}'' \times 11\frac{1}{2}''$.

Prepare the baseboard (Feb./Mar. issue) but increase in depth by $\frac{1}{2}''$.

Prepare focus board and drill hole $1\frac{7}{8}''$ diam. for the tube neck, exactly 10" up from the bottom edge. Also drill the hole for the 7-pin connector, and the holes for the focus coil fixing bolts.

Note the method shown in the photograph of obtaining HT+B and HT+C for the focus

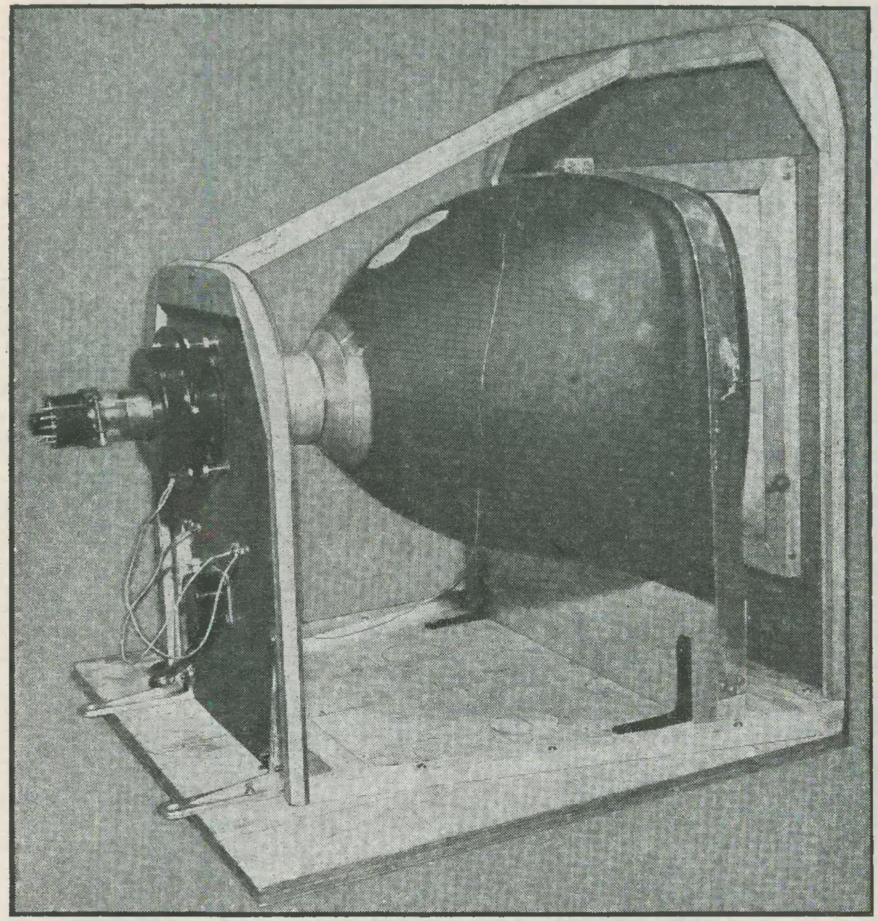


B 12A

DUODECAL BASE

PIN NO	ELECTRODE
1	HEATER
2	GRID
3	OMITTED
4	OMITTED
5	OMITTED
6	OMITTED
7	OMITTED
8	OMITTED
9	OMITTED
10	NO CONNECTION
11	CATHODE
12	HEATER
CAP	ANODE

Details of the Brimar C17BM Tube.



The C17BM Tube Mounted.

coil. Two 6-BA bolts are put through the paxolin board close to the 7-pin plug, where these two HT voltages may be carried from the chassis. Solder tags are placed both sides of the board, and thus the dust proof scheme is effectively maintained.

Now make the tube support as in the sketch (this issue) and screw down on the base, exactly 2″ in from the front edge of the base-board to the front of the tube support. Make sure this is parallel.

Enter the two 1″ 4-BA bolts into the dural straps at the top, and place the tube in position. Take care not to damage the EHT nipple. Slide on the deflector coils, which should have loose connecting wires, colour coded, all ready for connection to the 7-pin plug.

Gently slide on the focus board, and bring both deflector coils and focus board forward up the neck until the coils are firmly against the cone of the tube.

Screw down the brackets at rear of focus board.

Fix blanking-off fillets on the base board, as shown in the Feb./Mar. issue.

Make the mask board, and either mark out from the centre of the tube using paint spot as previously explained, or if the tube support and other construction is accurately carried out this can be done from the measurements shown in the small sketch of part of the mask board.

Construct the mask itself (April issue) and fit the safety glass.

Notes

The Brimar tube is longer than the English Electric one, and it may be necessary to fit a tube base protection, known as a " bowler hat," to the cabinet backing.

Considerable improvement was obtained over the method previously described for padding the hole for the tube neck. Some channelled sorbo rubber was discovered at Burleigh's Rubber Shop, 303 Edgware Road, London, W.2., and when this was cemented around the hole with Bostik a really good dustproof fit was obtained.

No air space is required between the tube and the mask, so that constructors may follow the screen contour exactly.

No final smoothing for the EHT is required with this tube. The tube coating should be connected to chassis (see photograph). This provides a condenser of approx. 0.0016 μF, which is just right.

The C17BM is a triode, and no connection is required for pin 10 on the base.

Full scanning and some slight additional EHT is obtainable by adjusting the width control and (VR5) the drive control.

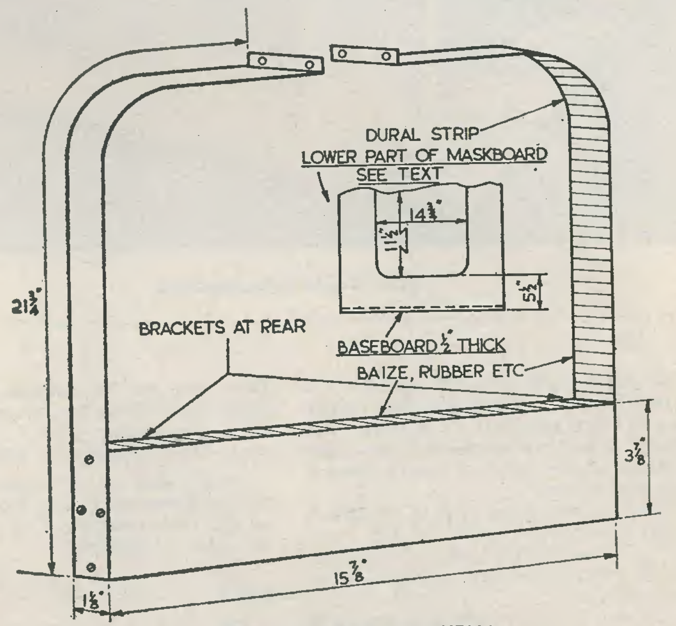
Should any difficulty arise in centreing the picture, a simple method of so doing is to fit a single-field ion-trap magnet and rotate in position as required for the English Electric tube.

Although the Brimar tube does not expose any area live to EHT, other than the connections, there is everything to be said for the dustproof design of installation given in this series. One of the annoying features of most TV sets, not excluding those of commercial manufacture, is the difficulty in maintaining a clean screen. Indeed, it often entails dismantling the whole thing to do so.

Occasionally, too, blow away the dust from the line output transformer.

You are again advised to wear goggles at all times when constructing; there is always an attendant risk when handling highly evacuated tubes.

Finally, we found the Brimar C17BM to be a most excellent tube, easy to instal and possessing a high degree of resolution and brilliance.



C749B

MOUNTING FOR BRIMAR C17BM

QUERY CORNER

A "Radio Constructor" Service for Readers

Sound on Vision

I have a commercial television receiver which has given a very good picture for over a year, but lately a fault has developed which is similar to the effect associated with sound on vision. However, with the aid of a borrowed signal generator the alignment of the vision and sound channels was checked but with no improvement. Is there some other fault which can cause the picture to be modulated from the sound channel?

E. Edwards (*Manchester*).

In view of the fact that the receiver alignment has been carefully checked it would appear that the cause of the trouble is microphony in one of the valves in the timebase unit. Microphony in the vision circuit of a television receiver usually manifests itself as a jitter on the picture, the affect only being apparent on loud sound passages from the speaker. The most likely valves to suffer from microphony are those in the frame timebase, the output valve being particularly susceptible. However, the check for microphony is a simple one as it is only necessary to remove the back of the receiver and very lightly tap the suspected valves in turn, whilst noting the effect upon the picture. If one of the valves is faulty a very pronounced jitter will be apparent on the picture during the tapping test.

If the trouble is traced to one of the valves it is always a good plan, if the receiver employs more than one of the faulty type, to change the valves around. For example, a valve which is slightly microphonic may upset the picture if it is used in the frame output stage; but in the sound output stage the same valve will in all probability function very satisfactorily.

AC Televisor on DC

Having recently removed to an area which is still on DC mains I wish to convert my pre-war AC television receiver for use on DC. Would you recommend any modification to the receiver, or is the best plan to purchase a DC-to-AC converter?

B. Mowlam (*London*).

Two factors have largely been responsible for making the AC/DC type of television receiver an economical proposition. The first was the introduction of a range of TV valves all of which had a common heater current, and the second factor was undoubtedly the use of the flyback method of obtaining the EHT voltage for the cathode ray tube. Whilst this latter feature can be incorporated in a receiver of pre-war vintage, it is a costly business to change the majority of the valves to more modern types having a common heater current to allow for series connection. Such a modification is also complicated by the fact that in many instances the newer valves will have rather different characteristics, which in turn will demand changes in some component values.

Thus the simplest, and in the majority of cases, the most economical plan, is to purchase a DC/AC converter such as is manufactured by Valradio Ltd. However, if there are others of our readers who are faced with this problem of running an AC televisor from a DC supply, we shall be pleased to advise them regarding the work involved in making a conversion to their specific set.

QUERY CORNER

RULES

(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.

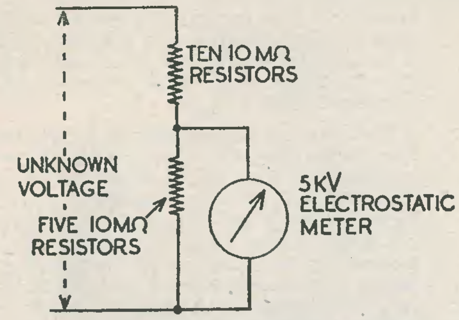


FIG:1A. ALTERNATIVE 15KV VOLTMETER ARRANGEMENTS. FOR DETAILS OF THE RESISTANCES SEE TEXT.

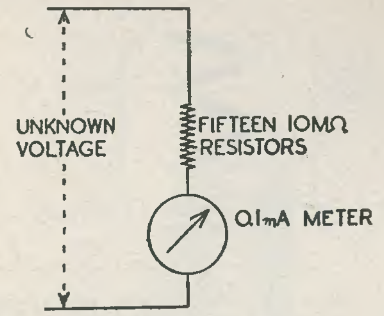


FIG:1B.

C752

EHT Measurement

I am frequently asked to repair television receivers, and have often felt the need for a voltmeter which is capable of measuring the EHT potential for the CR tube. A search of Government surplus stores has only provided one electrostatic voltmeter, which is capable of reading between 1 and 5 kV. Would you recommend me to extend the range of this meter, or is there some more suitable instrument which is available at a reasonable price?

D. Askwith (*Guildford*).

Ideally, a voltmeter which is designed to indicate EHT voltages should present a negligibly small load on the voltage source. This condition is fulfilled by the electrostatic voltmeter, and also by the calibrated adjustable spark gap. An example of the latter type of instrument is already on the market at a reasonably low price, but unfortunately the availability and cost of electrostatic voltmeters which are capable of measuring up to 15 kV puts them rather outside the grasp of many constructors. A compromise can, however, be made by using components which are readily available, this compromise being in respect of the impedance of the meter. For normal use in the design and service of TV receivers a meter which requires a full scale current of 0.1 milliamps is quite satisfactory, and such an instrument can be made using one of the 5 kV electrostatic voltmeter which can still be found in very limited numbers on the surplus market. The general arrangement is shown in Fig. 1A and can be seen to consist merely of a potential divider with the meter joined across the lower limb. The divider consists of fifteen 1 watt resistors each of 10 megohms, the meter being connected across the lower five resistors. The accuracy of the meter may be adjusted by slightly varying the value of the most earthy resistor. Adjustment is made by either shunting the resistor with others to decrease the value, or by adding additional resistances in series with it to increase the value. Such final adjustment can of course only be made where a known EHT voltage is available. If this is not the case, a reasonably good accuracy can be obtained by choosing all fifteen resistors to be of substantially the same value. The help of a local dealer can probably be enlisted in this connection when the resistors are purchased. It will be appreciated that within the normal manufacturing tolerances the actual value of each resistor is unimportant, but for the accuracy of the meter they must either all be of substantially the same value or some final adjustment made to one of them as already described.

An alternative arrangement which will appeal to those who possess a 0.1 milliamp meter is to employ a similar resistive network, but to connect the meter in series in the earthy end as indicated in Fig. 1B. With this circuit it is necessary that the total resistance in series with the meter be 150 megohms if the instrument is to accurately measure 15 kV.

Whichever arrangement is used, great care is necessary in constructing the resistive network. The fifteen 10 megohm resistors are mounted in ladder formation on a sheet of high grade paxolin as shown in Fig. 2. The spacing between resistors is 1 inch, and solder joints should be made at least ½ inch from the body of the resistors. To prevent trouble with corona all sharp points left on solder connections should be carefully rounded with a fine file. When the network is com-

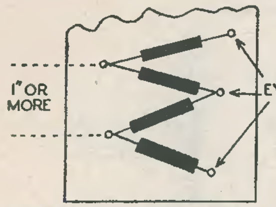


FIG:2. METHOD OF MOUNTING THE RESISTORS ON THE PAXOLIN PANEL.

C753

pleted and tested it should be dipped in high grade molten wax for several minutes, then removed and the wax allowed to harden. The resistors should preferably stand clear of the paxolin so that they are completely encased in wax. This clearance and adequate rigidity is obtained by making the solder connections between resistors on small eyelets stamped into the paxolin.

The meter is best housed in a case made from sheet paxolin. The resistance panel is supported from one side of the case by means of ebonite rods, a clearance of at least 1½ inches being left around the EHT end of the panel as a safeguard against corona. Connection is made to the instrument by means of a length of EHT cable terminating in a well insulated test prod; the earthy lead may be ordinary PVC-covered flex and is conveniently terminated in a crocodile clip for making contact with earthing points.

from our Mailbag

VOLTAGE REGULATORS

Dear Sir,

With reference to "Mailbag" in the July "Radio Constructor," Mr. Thompson discusses voltage stabilising tubes in a parallel circuit for DC operation; this circuit is seldom used for DC, for the reason outlined by Mr. Thompson. Two tubes can be parallel connected in the opposite sense to provide a regulated AC supply (Fig. 1), but for a stabilised DC voltage either series, or series-parallel, circuits are usually used (Figs. 2 and 3).

With the circuit in Fig. 2 a high voltage at medium current output is available. R1 is adjusted, before any load is put on the tubes, so that 30-40 mA is passing through them. R2 is approximately 100-250 kΩ, and is adjusted to ensure even striking.

In Fig. 3, four tubes are used in a series-parallel arrangement to give high voltage at high current, stabilised output. A low voltage tap is provided at the centre tap of the tubes. R1 and R2 are adjusted as before to allow correct working characteristics.

Hoping this information will be of use to the "Radio Constructor."—C. R. West (Derby).

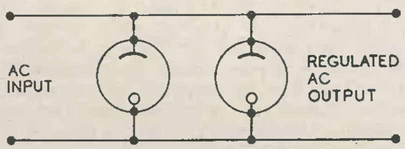


FIG.1

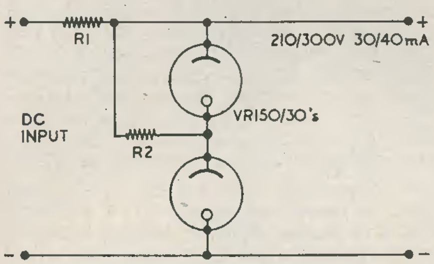
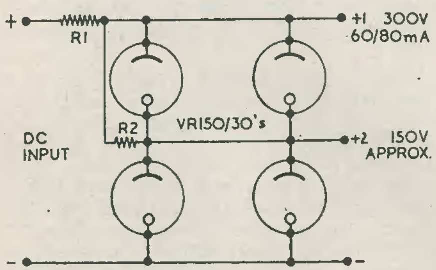


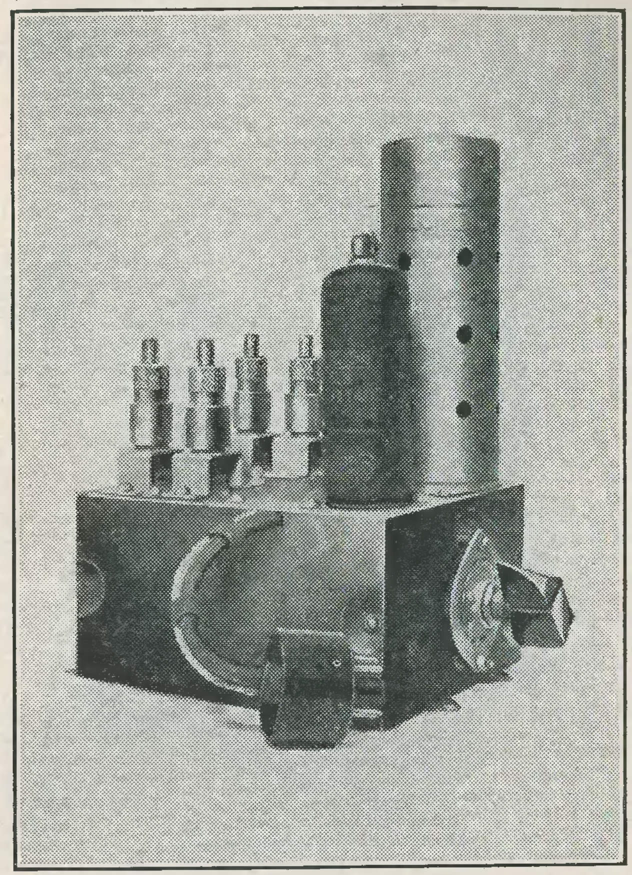
FIG.2



C747A

FIG.3

TWO STATION R.F. UNIT



by R. W. HILL

Constructional details of a useful local station tuner made from surplus TR1196 gear

Do you ever suffer from those pieces of ex-service equipment which lumber up the workshop, after having been stripped from a larger piece of apparatus? You know, those sub-assemblies which come away nicely in one piece and look too good to strip down into component parts; you show them to friends, and one and all agree that they will be very useful for something or the other, and back they go on the shelf again to wait for that something or other to turn up.

Now I have been haunted recently by one of these potentially useful bargains, for having done the right thing as expected of every keen Radio Constructor reader and converted the TR1196 to an all-wave superhet, I found that one of the pieces left over was the top deck tuning unit with the four pre-set air-spaced capacitors, coil and Yaxley switch, which had been tossed aside in the early stages of dismantling. This thing looked extra useful, and had been leering at me so hard from the shelf that it immediately sprang to mind when I promised to make an "Old Folks" local station receiver, and just right it proved to be.

Home and Light were the only requirements, and the four pre-sets were just right for an RF-Detector circuit. I made up the chassis as an independent RF unit, with the circuit

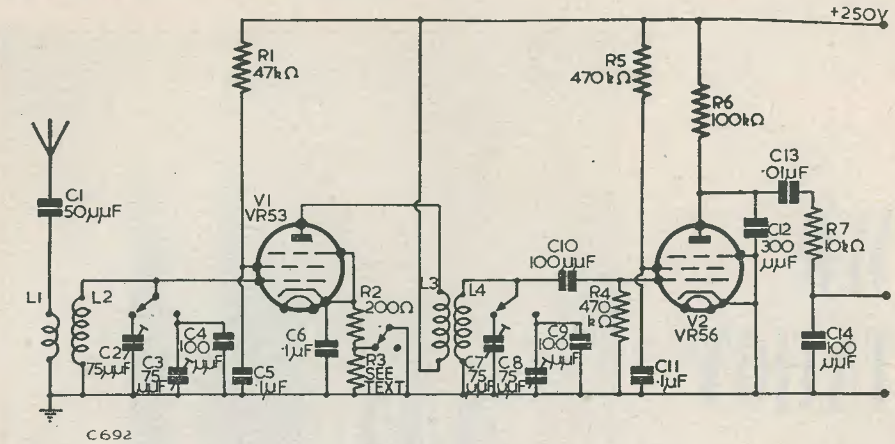


Fig. 1: Circuit Diagram.

as shown in Fig. 1; this gives the most flexible arrangement, as the unit can either be connected to a simple output stage and power pack as shown in Fig. 2 or, as I have tried to my own satisfaction, used as a quality feeder unit for a larger amplifier.

Cost should be very small, as the valves are spare from the TR1196 and extra components are very few. The performance is excellent; the quality of reception in the London area from a yard or two of wire promises good results over a fairly large region on any reasonable aerial system. An earth would seem to be preferable. Structural alterations have been kept down to a minimum, and the wiring can be very quickly finished. The components, being so few, are not specified in detail as the choice and assembly of these is within the capabilities of one who has made the original conversion, but attention is focused instead on the screening and the coil construction, this latest often proving a stumbling block to an otherwise experienced amateur.

Coils

These beastly "squiggles," as a recent contributor succinctly put it, tend to worry the life out of many a self-respecting constructor, and so often he takes the shameful (and expensive) way out by purchasing commercial coils. Now these coils are very good and the obvious procedure was to copy them as nearly as possible—short of wave

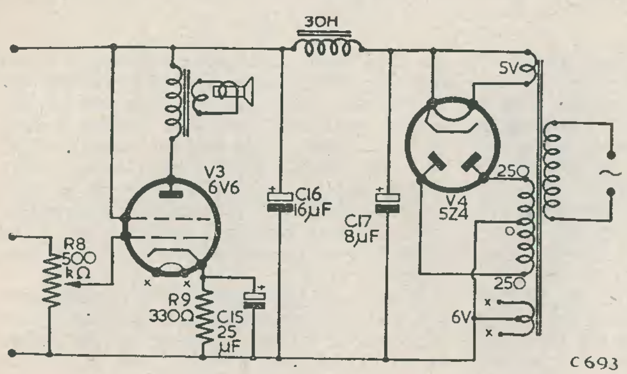
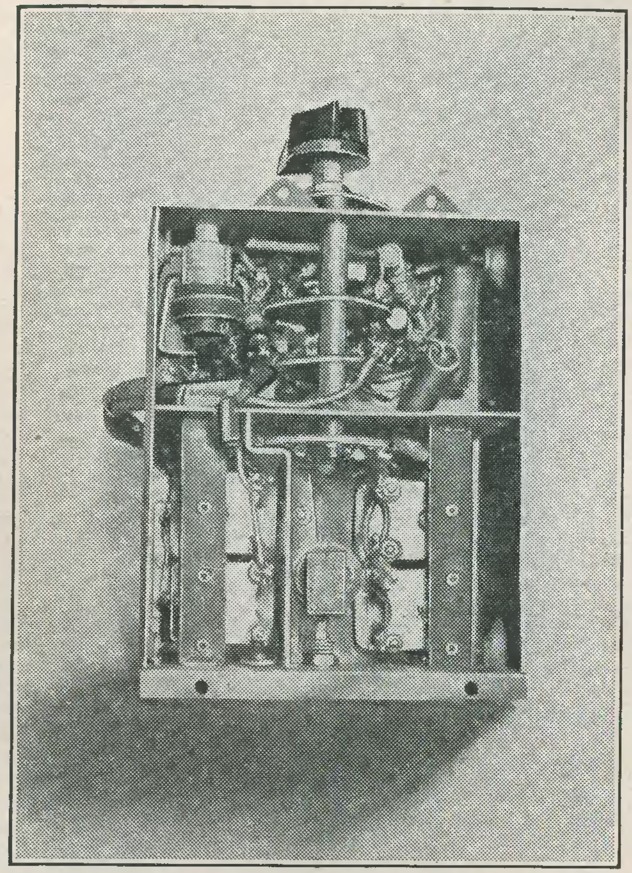


Fig. 2. Circuit diagram of a simple Output Stage



Underneath view of R.F. Unit.

winding—and so the chief characteristics were chosen:—small size for convenience, iron dust cores to minimise external field, polystyrene for low loss and litz wire because it is good for "Q." The ½ in. polystyrene formers shown are available on the surplus market for a modest sum. They have the same size core as the famous Aladdin formers, but seem more convenient in many respects; the fixing is by a single 6BA screw, and the shape gives easier fixing of spacers and connecting wires. Another influential factor in the choice of this type was the fact that I had a good supply of them on hand myself! Data on the winding of iron cored coils is sadly lacking from the usual literature, so construction was partly by trial and error, and while the design is probably not optimum, the results seem better than I can remember with any other similar circuit; proper comparison would demand large quantities of coils and test gear. The coil size and winding data is given in Fig. 3. The spacers are made from thin paxolin and are a push fit on to the former. Short pieces of 22 swg tinned copper wire pushed through the side holes will position the spacers and also act as an anchorage for the ends of the windings. A better material, such as Perspex, cemented on, would most likely make better and more rigid spacers. A supply of litz wire was ready to hand in the shape of the choke L1 from the TR1196; this was just sufficient for L3 and L4. The wire for the aerial coil came

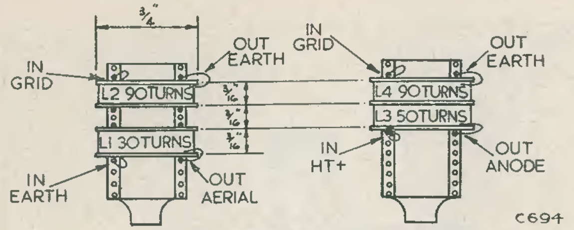


Fig. 3: The coils, giving constructional details and winding data.

from a very old 110 kc/s IF transformer and, despite the fact that L2 and L4 bulked to different sizes owing to the presence of wax on the wire for the latter, the difference in inductance was unimportant in this application —they both read about 150 μH and the Light on 1214 kc/s and Home on 908 kc/s are well within the range of the trimmers. The wire needs very careful handling as all strands have to be intact and bonded properly at the ends, otherwise performance will suffer. I don't know the professional method of cleaning the ends, but the easiest way I found was to pass the end through a match flame for a second and wipe off the burnt enamel with a cloth. If it is left too long in the flame there won't be any wire to clean, so it would be advisable to get the procedure right before trying it on the short end of a carefully wound coil!

The Chassis

Removal of the top paxolin panel will reveal two square holes, and amphenol valve-holders will fit across the corners of these with the judicious aid of a few washers. Next remove all unwanted components, the coil and the spindle of the switch. The switch is operated from the other end, as the space between the capacitors is needed for the aerial coil. A screen is needed in this compartment and the dimensions are given in Fig. 4; one of the fixing lugs from the original coil is retained and holds one side of the screen, the other side is bolted to the deck of the chassis. This leaves room for the aerial coil to be held through one of the existing holes and the late switch spindle hole will take an aerial socket nicely. While on the subject of saving the mechanical work, room for the wires going across the chassis and out the side can easily be made by snipping the edge of the chassis and bending a piece down; this saves drilling, and a small length of insulating tape will protect and hold the wires in position.

The switch is a bit awkward, as the movement between two contacts is 90° instead of the usual 30°, and there is no locator. On the aerial switch wafer the two contacts on the side nearest the aerial trimmers are used, and the rotating portions of the other two wafers are moved through 180° to bring the contacts used away from the rest of the wiring. As the locator needed is non-standard, an attempt was made to manufacture one from the original round disc, cut out and used with a few levers and springs. It worked well enough, but used though I am to Heath Robinson contraptions, this one frightened even me, so recourse was made to modifying a standard locator. This is mounted so that it comes outside the chassis. The spigot or spindle should be 2¾-in. and the 6BA fixing rods 3⅛-in. long; these can either be cut and threaded from the original rods or fresh screwed rod can be used. The locator is held away from the front of the chassis by two ½-in. spacers. The stops will probably be in the wrong position; they can be punched flat and replaced by small rivets. Flattening out the middle "click" also helps to give a positive location in the desired position.

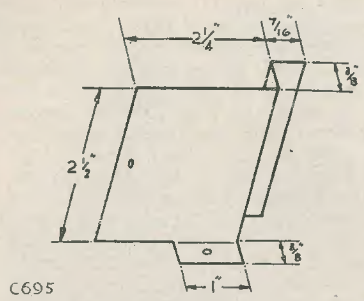


Fig. 4: The screen, made from 20 swg aluminium, or similar.

Screening

The use of a metal switch spindle gave rise to instability, due to coupling between the two adjacent switch wafers. This was cured by fixing the brass collar close to the centre screen and earthing it to the screen by a flying lead. Other precautions against instability were screened grid leads and a can for V1; the latter may not be necessary if the circuit is otherwise stable. The decoupling components R7 and C14 were needed to prevent RF feedback from the AF amplifier. L3/L4 is mounted below V2, and the earthing of the various components around this valve-holder is kept reasonably compact.

The value of R3 will need to be found on test; it is shorted out—giving full gain—on the weaker station, and left in circuit on the stronger station. This gives more pleasant listening by saving the listener from being deafened when switching over to the louder station. The value can easily be found after a few trials; I found 3 kΩ right for my locality.

In bad areas, a little fixed reaction could be introduced by means of a 40 pF trimmer slung in the wiring between the anode of V1 and the anode of V2. This would seem to be a little unorthodox as there is no mention of chokes or reaction windings, but it works surprisingly well, and the increase in gain and selectivity is very considerable.

OUR 16in. TV AT EARLS COURT

(August 26th to September 6th)

We are pleased to inform readers that visitors to the Exhibition will be able to see complete models of the Large Screen Televisor on the following stands:— Brimar (Stand 6), English Electric (Stand 67) and G.E.C. (TV Demonstration Room D6).

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.

DESIGN FOR AN "ECONOMY" MAINS RECEIVER

by R. K. VINYCOMB, B.Sc.

This set has been titled "Economy" for three reasons: Firstly, the design has been worked out so that the maximum efficiency can be obtained from two valves and the total mains consumption is only about 40 watts, although no transformer is used and the set will operate from either AC or DC mains. Secondly, the parts list has been chosen to include only components which are at present cheaply available. Thirdly, the construction of the set is simple; there are no tricky layout problems and beginner or old hand will find a real economy on labour when building this set compared to many others.

Now, what sort of performance can be expected from this set? Well, it is not intended to be fully portable and in most areas some sort of external aerial will be required. Except in difficult locations, however, an indoor one, round the picture rail, say, will be quite adequate. The original model was arranged to tune only two pre-set stations on the medium waveband—the Home Service on 908 kc/s and the Light Programme on 1214 kc/s. Operating fifty miles from London, the volume was more than adequate for bedroom and personal listening with a short indoor aerial. With an outdoor aerial, tests showed that the Third Programme on 647 kc/s and several Continental stations could be received at good strength. Although the set itself could be packed into a small space, this has not been carried to the extent where the result is a "midget" receiver. A set with a fairly open layout is easier to construct, has a longer life of components (because midget highly-rated parts are avoided and the heat generated is more easily dissipated) and enables a larger loudspeaker to be used. In all, this results in better tone and volume.

Having made this point about size, it is not proposed to give dimensioned drawings of the prototype receiver, since the layout is not at all critical. It will also depend, to some extent, on the actual components which the constructor buys or has available. Considerable latitude is allowable in most of the components, but any special points will be mentioned when we come to the business of discussing the design of the set. Instead of giving exact details, from which readers could make a "Chinese copy" of the original set, the purpose of this article is to give, as fully as is practical, the methods used in selecting the circuit, designing the set and choosing the components. Individual constructors can then design their own set on the same lines, making variations from the original where necessary. Firstly, then, we come to the choice of circuit.

Circuit

If loudspeaker results are desired, the minimum number of valves needed is two (excluding the rectifier). The detector-plus-output arrangement is the best one for local station reception and this is, in fact, the one adopted. The application of regeneration to the detector stage is almost a necessity, and there are several ways of doing this. Most readers will be familiar with the usual "reaction" circuits using an anode coil closely coupled to the tuning coil. These can be quite satisfactory with most triode detectors and with some RF pentodes used for detection. They all suffer to some extent from disadvantages. Changing the amount of "reaction" shifts the tuning (a serious difficulty with pre-set tuning) and a volume control is required in addition to the reaction control, since the latter is not able to reduce the gain to zero. Both these difficulties can be avoided by using the electron-coupled regeneration circuit, which has, in the writer's opinion, been sadly neglected in the past except for specialised short-wave receivers.

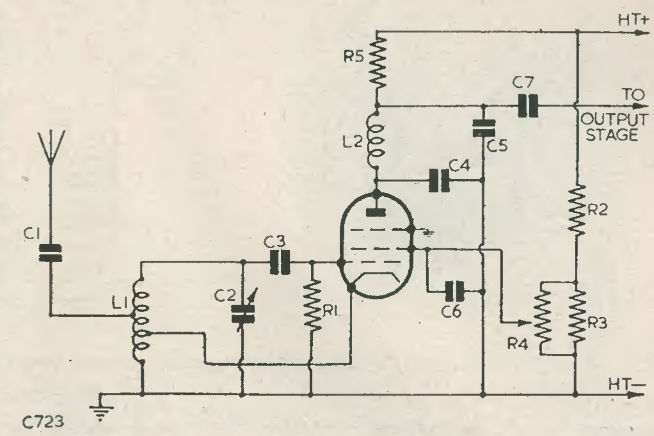
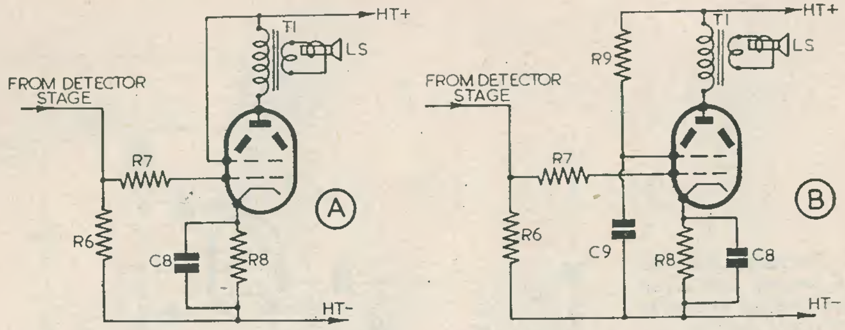


Fig. 1: The basic circuit for an RF pentode used as an electron-coupled regenerative leaky-grid detector.

It is shown in basic form in Fig. 1. A high-gain RF pentode with "sliding screen" characteristics is necessary for best results and, fortunately, valves of this type are readily available. The screen of the valve is fed from a potentiometer which acts as a combined volume and reaction control. It will be found that the volume can be gradually increased from nothing up to the point where the set slides smoothly into oscillation. As there is no "backlash," the control can be backed off slightly and the set operated at good volume without any signs of instability.

Suitable valves for the detector position are 12K7, 12SK7, 6K7, 6SK7, EF39, etc. Since an AC/DC set is contemplated, the valves will have their heaters in series and we should therefore choose, in the interests of economy, either the 12K7 or the 12SK7, having 12-volt heaters which pass only 150 mA. The 12K7 has a top-cap grid while the 12SK7 is single-ended. The latter was used in the original receiver. The electron-coupled circuit (Fig. 1) consists of a tuning inductance L_1 having two tappings. The variable condenser C_2 across the whole of the coil forms the tuning control. The aerial is connected through a small condenser C_1 to a tapping near the middle of the coil. This removes some of the damping effect of the aerial on the grid circuit without losing much of the signal voltage. The tapping near the "earthy" end of the coil is connected direct to the cathode of the detector valve. It is this that provides regeneration since the bottom of the coil is common to both the grid and cathode circuits of the valve. The amplified RF signals which appear between anode and cathode of the valve are thus fed back in positive phase to the grid. Whether this positive feedback is sufficient to cause oscillation depends on the amount of feedback and upon the gain of the detector stage. RF voltages at the valve anode are prevented from reaching subsequent stages by the choke L_2 and are bypassed to earth by the condenser C_4. Providing that the capacity of C_4 is adequately large, the amount of feedback depends on the position of the lower tapping on the tuning coil. For maximum efficiency, therefore, this tapping should be such that the stage just oscillates when the gain of the valve is at its maximum. Since the design must allow for variations in mains voltage, valve characteristics and aerial length, this ideal is not readily attainable, but it can be approached closely enough to give very satisfactory results.

The gain of the detector stage is varied by means of the screen voltage. This is obtained from a fixed potentiometer R_2 and R_3, across the HT supply. Across the lower half of the fixed potentiometer is a variable potentiometer, R_4; the slider of this is bypassed by C_6 and connected to the screen of the valve. It is important that R4 has a high-resistance, as that part of the potentiometer through which the screen current must pass has a valuable self-regulating effect on the gain of the valve. Since an RF pentode has a maximum gain as a detector when the screen voltage is less than that *actually at the anode*, the values of resistors R_2 and R_3 are chosen so that the optimum screen voltage is



C724

Fig. 2: Typical output stages using beam power valves.

obtained when the variable potentiometer slider is set about one-quarter of its travel from its high-potential end. The lower tapping on the tuning coil L_1 is then chosen so that oscillation occurs just as this position is approached. The gain of the detector stage may then be smoothly increased from a very low value (with zero volts on the screen) to the maximum obtainable (when oscillation just commences).

The operation of detection, or demodulation, is carried out at the grid of the detector valve by the conventional "leaky grid" system. C_3 is the grid condenser and R_1 the leak, which must be returned to earth, not to the cathode.

The AF load of the detector stage is provided by R_5. If unlimited HT voltage were available, this resistor could be made very large, with a consequent increase in gain. With a simple AC/DC power pack, however, the HT voltage is unlikely to be more than about 200 volts. The value of R_5 must not be great enough to reduce the voltage at the valve anode too much, as this would, in its turn, reduce the gain of the detector. R_5 must therefore be chosen to give the best compromise between high load impedance and high voltage drop.

Condenser C_5 ensures that any remaining RF signal is bypassed to earth rather than being passed on to the output valve. Condenser C_7 is the conventional coupling to the output stage. The latter stage may be quite straightforward, adhering to the operating conditions recommended by the valve manufacturer. No volume control is necessary, since complete control is achieved by the screen potentiometer in the detector stage. Since the detector valve is already chosen, we should pick an output valve with the same heater current rating. Output valves having 150 mA heaters are the 50L6, 35L6 and the 12A6. The latter is more readily available and, besides, has the advantage of being able to take up to 250 volts on the screen, whereas the 50L5 and 35L6 are limited to a screen voltage of 110 and would thus require a dropping resistor and decoupling condenser when used on standard British mains voltages. Typical output stages are shown in Fig. 2a and 2b. R_6 is the grid leak and R_7 a grid stopper to prevent parasitic oscillation. R_8 provides cathode bias and is fully bypassed by condenser C_8. The output transformer T_1 should match the loudspeaker to the output valve so that the recommended load is presented to the latter. The ratio, r, of the output transformer is calculated in the following manner.

$$r = \sqrt{\frac{Z_1}{Z_2}}$$

where Z_1 = optimum load of valve
Z_2 = Voice coil impedance.

Fig. 2a shows the simpler arrangement when the screening grid of the valve may be connected direct to the HT line, while Fig. 2b shows how decoupling components R_9 and C_9 are added when a lower voltage is required at the screen. The value of R_9 can be calculated from Ohm's law as follows, if the voltage to be dropped is known and the valve screen current is obtained from the makers' data:

$$R_9 = \frac{V_{ht} - V_s}{I_s} \times 1000 \text{ ohms}$$

Where, V_{ht} = HT voltage
V_s = required screen voltage
I_s = screen current, in mA.

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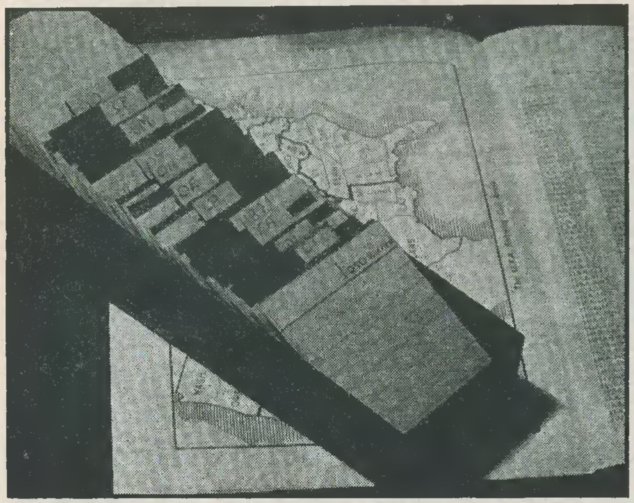
Continued from previous page.

The value of C_9 is determined by the fact that the "time-constant" of the decoupling circuit should be high enough to ensure adequate bypassing. The time-constant in micro-seconds is given by the product $R_9 \times C_9$. For normal applications this should not be less than 50,000. If, for example, the value of R_9 is calculated to be 20,000 ohms, then condenser C_9 should be at least 2.5 µF and would, in practice, be made 4 µF for safety.

(*To be Continued*)



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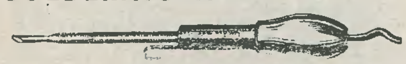

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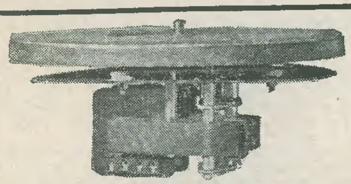

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