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### CONTENTS FOR JULY

- **692** Suggested Circuits: Obtaining Low Power HT Voltages for Portable Equipment, by G. A. French
- **694** In Your Workshop, by J.R.D.
- **698** Club News
- **700** A Novel Proximity Relay, by R. Williamson
- **706** Converting the 182A Unit to a "Scope. Part 3, by A. Blackburn
- **711** Book Reviews
- **712** Chassis Construction, by Norman Castle
- **715** Can Anyone Help?
- **716** Frequency Modulation Tuner Unit, by W. Gordon
- **725** Electronics Exhibition
- **726** Radio Miscellany, by Centre Tap
- **728** Building the RCS Battery Receiver; Part 1, A One-Valver, by James Sinclair
- **733** Query Corner — A Service for Readers
- **735** Trade Review
- **736** Radio Control Licences
- **738** Relay Control Unit for Main Station and Portable Contest Operating, by John Pickard
- **740** From Our Mailbag
- **741** "Inexpensive" Telesisor — Modifications for Alternative Modulation, by J. Rodger

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THE EDITOR invites original contributions on construction of radio subjects. All material used will be paid for. Articles should preferably be typewritten, and photographs should be clear and sharp. Diagrams need not be large or perfectly drawn, as our draughtsmen will redraw in most cases, but all relevant information should be included.

All Mss must be accompanied by a stamped addressed envelope for reply or return. Each item must bear the sender's name and address.

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

No. 44: OBTAINING LOW POWER HT VOLTAGES FOR PORTABLE EQUIPMENT

THE POSSIBILITY OF OBTAINING HT voltages from low-tension DC supplies has always held a certain fascination for the amateur. Whilst such requirements are nowadays usually met by a dynamotor or by a vibrator and transformer, these devices can only work from a low-tension supply of comparatively high Ampere-hour capacity. In cases where only low HT currents are required, both the vibrator and the dynamotor become too bulky and take too much LT current to be an attractive proposition.

The Circuit
The basic arrangement is shown in Fig. 1. In this diagram an LT battery is connected to a conventional buzzer which operates in the normal fashion. At the moment of connecting the battery to the buzzer the contacts of the latter are made, whereupon the full battery voltage is applied through them to the coil and sets up a magnetic field. This field causes the buzzer armature to be attracted to the core; thus breaking the contacts and removing the voltage from the coil. The magnetic field then collapses, inducing a voltage in the coil of opposite polarity to that applied by the battery. As the collapse is quick, and as there is no load imposed across the coil during the formation of this second voltage, its potential may rise to many times the value of that of the battery.

The high voltage induced by the breakdown of the magnetic field is applied to a rectifier and a reservoir condenser; with the result that, during successive repetitions of the initial buzzer cycle, the condenser charges up to the peak value of the voltage appearing across the coil. The process is largely similar to that occurring in a flyback EHT system.

Typical Applications
It will be realised that, whilst the arrangement shown in Fig. 1 has the advantage of considerable simplicity and cheapness, the HT supply obtainable from it is capable of offering only a relatively small current.

A typical application is shown in Fig. 2. In this circuit the buzzer is used to supply HT for a neon bulb in an insulation tester. Such a tester may be used for checking leakage in wiring or in condensers. Thus, differing values of resistance applied between the two test prods would cause the neon to glow with different intensities. A leaky condenser would cause the neon to flash on and off continually. The sensitivity of a leakage tester of this type can be made better than 10MΩ.

Other applications will suggest themselves to the experimenter; and it should be possible, in some instances, to use the buzzer for supplying HT to low-consumption valves.

Practical Considerations
To check the possibilities of the circuit, the writer assembled several experimental rigs. These used the circuits of Figs. 1 and 2. The buzzer employed was a nominal 6-volt component (Osbourne Radio), the rectifier was a conventional HT model rated at 270 volts 30mA (Westinghouse type 1SC46); and the LT supply an ordinary 9-volt grid bias battery. It was found that a reservoir condenser of 0.5μF was quite adequate in this particular instance. Higher values may, however, give better results in some cases.

Using the circuit of Fig. 1 and the components mentioned it was found possible to obtain a peak voltage of about 95 volts off load, this dropping to approximately 60 volts for a current of 0.75mA. The input voltage was 6 volts, at a current of approximately 20mA. Input voltages in excess of 6-volts did not appreciably increase the HT voltage obtained. The setting of the buzzer contacts was not at all critical and could be varied over a considerable extent without affecting the output voltage.

For the circuit of Fig. 2 a miniature neon obtained from a surplus Bendix Radio Compass was available, and proved to be quite satisfactory. This has a striking voltage of 80. The series limiting resistance was 47kΩ. It was found that satisfactory operation of the neon could be obtained even when the LT battery voltage was as low as 4.5 volts.

Alternative Connections
Before concluding, it must be pointed out that similar results are given if the rectifier and reservoir condenser circuit is connected across the contacts of the buzzer instead of across its coil. In this case, however, the secondary voltage from the coil passes through the battery. Also, due to the varying methods used to mark rectifiers of different make, this component should be reversed if the circuit does not, at first, appear to be functioning.

JULY 1954
A THE TIME OF WRITING THE FLOWERS in the gardens around me are beginning to bud, and the sun shines brightly through my window. There is a sense of vitality in the air; birds are singing and building their nests, girls are parading in their new frocks and bonnets, and Wireless World has just published a limerick.

Spring is here, indeed.

Spring-Cleaning

In the palmy days before the war when radio magazines used to appear once a week, spring-time was always heralded by very seriously-written articles urging the enthusiast to overhaul his gear and his aerial system, and to clear out all the debris he had collected during the previous year. (Looking back, I am not at all certain that they didn't use the same articles, slightly re-written, each year).

Really, however, the spring-cleaning idea was not too bad at all. Unfortunately, the process of going through the old junk boxes usually revives so many memories that one rarely gets beyond the first layer and so before forgetting that one really intended to clean it all up this time, instead of merely pottering around. One of the phenomena of radio as a hobby is that if you throw something out, that is the thing which you will definitely need a week later.

Circuit Diagrams

I have recently been ploughing my way through a large number of fairly complex English, American and Continental circuit diagrams. Although these all applied to more or less the same sort of equipment, some diagrams were laid out sensibly and were consequently easy to follow, whilst others were laid out most illogically and could be read only with difficulty.

I realise that the professional draughtsman has his worries. Let us see what may happen if he is asked, for instance, to draw up the circuit of a television receiver. This is a typical example of a diagram which can be fairly complicated because, whilst such a circuit has several basic units, these are interconnected with each other and with the cathode ray tube to such an extent that the final layout employed for the drawing must inevitably result in a compromise. What is more, the draughtsman may be a busy man, who cannot devote as much time to the particular job before him as he would like to do. His prime responsibility is always to ensure that his drawing contains all the information needed by the engineer who is going to use it, and that it has no errors. The ease with which the drawing can be used then takes second place.

Nevertheless, the clarity of the drawing is still of considerable importance; and it is a fact that some drawings of such things as television receiver circuits are laid out in far better fashion than are others. The worst fault is that in which connections between different parts of the circuit are shown as a number of lines running closely parallel with each other over relatively long distances.

Tracing one of these lines through to its destination often necessitates considerable concentration if errors are to be avoided.

Another easily-avoided detail which often leads towards confusion is given by the habit of dropping the HT positive rail below the chassis line instead of keeping it above the valves and components where it logically belongs. This method of presentation is common to almost all American circuits and to many European and Continental drawings as well. On the other hand, the mainly-American custom (not normally used in servicing drawings, however) of dispensing with the HT rail line altogether, and of terminating all HT points wherever they appear in the diagram with an arrow labelled "B1", assists considerably towards the final clarity of the circuit.

My own private bugbear in circuit diagrams is the detail needed to show the connections to the screen-grids of pentodes. These electrodes are almost always connected to the HT positive rail via a dropping resistor.

Heaters. We nowadays omit the heater connections to valves in circuit diagrams, although we may put the heater wiring in a separate part of the diagram. Why not apply the same principle to pentode screen-grids?

As an example of what I mean, Fig. 1 shows an example of a typical IF amplifier stage. The screen-grid is drawn in normally. Fig. 2 shows the simpler version. In this diagram the screen-grid is omitted from the valve envelope and is placed above the HT line where it is out of the way, and does not interfere with the logical progress of the eye as it travels along the diagram. All the relevant data is still present in the circuit; we know, for instance, that the valve is a pentode, and we know the values of the drop resistor and the decoupling condenser. What is more, we can print these values near the components, as well as such information as the HT voltage to be expected at the screen-grid, without causing confusion in a crowded part of the circuit.

An alternative, and perhaps better, method...
I receive quite a few queries concerning FM receivers and discriminators, and so it might be of interest to give brief details here of some of the circuits most commonly encountered. One or two of these may be unfamiliar to the home-constructor.

Fig. 3 shows the well-known phase, or phase-shift, discriminator. V1 in this circuit is the limiter valve; this consisting usually of a sharp cut-off pentode run with purposely-lowered anode and screen-grid voltages. The function of the limiter is to ensure that no amplitude modulation reaches the discriminator; and this is normally achieved by over-driving its grid. Increases and decreases in amplitude at the grid cannot then appear at the anode, since the valve works at its maximum output all the time.

The limiter needs careful attention in practical design, so far as wiring is concerned. This is because its output can approach a square wave, with consequent radiation of harmonics. All signal and decoupling wiring must therefore be kept short. Suitable limiter valves are: 6AL6 (Brimar), Z719 (Osram), and EF85 (Mullard)

The amplitude-constant signal appearing across the primary of the discriminator transformer is applied simultaneously, and with the same polarity, to the anodes of the double-diode via C3 and the centre-tap of the secondary winding. At the same time two opposing voltages are applied to these anodes via the secondary winding itself. At the centre frequency, these voltages are 90 degrees out of phase with that applied via C3. When the frequency deviates this phase difference alters, with the result that...
differing voltages are built up across R4 and R5 according to the vectorial sum of the RF voltages applied to the diode anodes. The voltages across R4 and R5 are then passed, suitably decoupled, to the following AF amplifier.

It is usually considered that the phase discriminator of Fig. 3 offers the best performance of all the circuits available. It is capable of “following” a large frequency deviation with good linearity (e.g. up to ±350 kc/s and beyond with one 10.7 Mc/s discrimination transformer which I built myself). It is also very simple to align.

It has the disadvantage, however, of requiring the extra limiter valve, and its AF output for normal frequency deviations is not very large.

Fig. 4 shows a ratio discriminator. This has the advantage of not requiring a limiter valve and is, apparently, particularly popular in American television receivers, where the omission of this valve represents a saving in cost. The component values shown in the diagram are typical of those encountered in such receivers. The operation of the circuit is somewhat complicated, and, according to Henney (Radio Engineering Handbook, 4th Edition), design is of the cut-and-try variety. The AF output of the ratio discriminator, like the phase discriminator, is low for normal frequency deviations.

Fig. 5 shows a recommended circuit using the Mullard EQ80. This valve has been specially developed for the job, offers frequency discrimination with AF amplification, and does not need a limiter.

Another valve which performs a similar function is the General Electric (American) type 68N6. This is shown in Fig. 6 and it offers the same facilities as the EQ80.

Both these valves function by reason of the alterations in phase difference between two RF voltages when they are applied to two different electrodes in the electron stream. With the 68N6, the phase difference is achieved by feeding back the RF voltage built up across R3 to L5-C7, this being done via the Cag of the valve.

For effective limiting and discriminator action, both valves need an RF input in excess of 4 volts or so. Both are capable of working with frequency deviations of up to ±100 kc/s. The AF outputs of each valve may be taken direct to the grid of the subsequent output valve, as no intermediate AF amplification is required.

\[ \text{Details for insertion in this section should reach us not later than \ the 8th of the month before publication.} \]

\[ \text{During July it is proposed that the following meetings and events take place:} \]

\[ \text{July 2nd} \quad \text{Eurk Sale.} \]
\[ \text{7th} \quad \text{Constructional Evening.} \]
\[ \text{16th} \quad \text{Any Questions.} \]
\[ \text{20th} \quad \text{Constructional Evening.} \]
\[ \text{24/25th} \quad \text{Transmitting and Receiving} \]
\[ \text{Courses} \]

Meetings are held every Friday evening at 7.30 p.m. at the clubrooms, 225 New Cross Road, London, S.E.14. A warm and cordial welcome awaits visitors and new members.


\[ \text{NORWOOD AND DISTRICT R.S.G.B. GROUP} \]

The May meeting was attended by 14 members of the group, the primary object of the evening was to make final arrangements, as far as possible, for this year’s National Field day, during which the Group had two stations in action.

A Junk Sale has been arranged for the meeting to be held on July 17th, and all local members and non-members who feel interested, are invited to come along to Windermere House, Westow Street, Crystal Palace.

The meeting commences at 7.30 p.m.

\[ \text{QRP SOCIETY} \]

Arrangements are being made for the Society to hold its own exhibition next October.

The increased interest in V/UHF has warranted the formation of a special section to cater for those members who are active on 144 Mc/s and 70 cm. More Local Clubs have joined the Society’s affiliation scheme and it is proposed to run inter-club tests at the earliest opportunity. Full details of membership and activities are given in a Data Sheet which may be obtained by sending 1s for a limited number (perclub size) to the Hon. Sec., J. Whitehead, 92 Rydens Avenue, Walton-on-Thames, Surrey.

\[ \text{THE RADIO CONSTRUCTOR} \]

\[ \text{JULY 1954} \]

\[ \text{THE RADIO CONSTRUCTOR} \]
A NOVEL PROXIMITY RELAY

By R. WILLIAMSON

THE PROXIMITY RELAY is a comparative newcomer to electronics and is finding increasing usage in all branches of the industry. Basically, it is a device which is sensitive to changes in capacitance between the "probe" of the instrument and some other body, usually earthed. A typical application, for example, would be as a burglar alarm for valuable jewellery on open display. The "probe" would be connected to one of the pieces, and the relay adjusted so that should any attempt be made to touch the valuables it would operate and sound an alarm. Another application, and a typical example of its usefulness, is to prevent the accidental approach of any human being exposed to radio active materials to within the dangerous radiation area; a safeguard necessary in all branches of atomic physics.

Needless to say, such a device can be put to a number of uses by the radio enthusiast, and a description of a simple yet sensitive version follows. Primarily it consists of a Hartley oscillator working at some low radio frequency. By suitable choice of circuit values and including the "probe" in the tuned circuit, the output of RF becomes variable and dependent on the capacitance between the object connected to the "probe" and other objects in close proximity. This RF output is rectified, and the resultant DC fed to the grid of a single stage DC amplifier. The load of this stage is a standard PO relay.

Method of Construction

To preserve the sensitivity of the instrument, stray capacitance in the tuned circuit must be kept to a minimum, particularly the connection to the "probe" terminal (Fig. 3). The sensitivity control C1 must be isolated from chassis and adjustment made by an insulated extension (Fig. 1).
The “probe” terminal should be brought out as far away from the adjustment controls as possible. This ensures that the effect of hand capacitance is kept to a minimum whilst adjustments are being made. Wiring should be as rigid as possible and leads to the tuned circuit kept short.

Adjustments
Connect the “probe” terminal by a length of wire, say 3 or 4 feet long, to a metal object, e.g. a paraffin stove. Set R1 at maximum so that the full supply voltage is fed to the grid of the DC amplifier stage. Rotate C1 from minimum capacitance toward maximum. At some point the stage will begin to oscillate weakly, and this will be indicated by the release of the relay. R1 then should be adjusted until the relay just operates, and then rotated back till it releases again.

It will now be found that should an attempt be made to touch the stove, say by a young child, the relay will immediately operate.

And if the relay contacts are connected to close a bell circuit, a suitable alarm will be sounded. This, as well as many other applications, will become obvious to the constructor. By careful adjustment of C1 and R1, the “operating” distance from the object may be made as much as 3 feet. To ensure long term stability, all adjustments should be made after the unit has been on for at least 15 minutes.

Component List

<table>
<thead>
<tr>
<th>Component</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>V1</td>
<td>6SL7</td>
</tr>
<tr>
<td>R1</td>
<td>1MΩ pot.</td>
</tr>
<tr>
<td>R2</td>
<td>12MΩ 1W</td>
</tr>
<tr>
<td>R3</td>
<td>2.2kΩ 1W</td>
</tr>
<tr>
<td>C1</td>
<td>100pF variable</td>
</tr>
<tr>
<td>C2</td>
<td>100pF</td>
</tr>
<tr>
<td>C4</td>
<td>0.01μF</td>
</tr>
<tr>
<td>C5</td>
<td>0.01μF 35V</td>
</tr>
<tr>
<td>C6</td>
<td>60μF 35V</td>
</tr>
<tr>
<td>C7</td>
<td>0.5μF</td>
</tr>
<tr>
<td>T1</td>
<td>230V to 6.3V 1A</td>
</tr>
<tr>
<td>L1</td>
<td>200 turns, 4O, former, centre tapped, 22kΩ core.</td>
</tr>
<tr>
<td>GD</td>
<td>Germanium diode</td>
</tr>
<tr>
<td>Rectifier</td>
<td>230V 80mA</td>
</tr>
<tr>
<td>Relay</td>
<td>PO 3000 type, 5-15kΩ</td>
</tr>
</tbody>
</table>

SIR MILES THOMAS TO OPEN RADIO SHOW

Sir Miles Thomas, chairman of the British Overseas Airways Corporation, is to open the National Radio Show at Earls Court, London, on August 25. The exhibition remains open until September 4 and there will be a preview for overseas visitors and other special guests on August 24.

The exhibition for the first time is to include a demonstration by the BBC of outside television broadcasts as well as studio broadcasts on sound and television. Television programmes from seven different sources - six of them within the exhibition - will be seen continuously on the screens of several hundred domestic receivers. Cameras used will include the small industrial types and the “roving eye” which is a self-contained camera and transmitting unit, making it free of cable connections.

This year the Royal Navy rejoins the Army and the Royal Air Force in the Services section. Radio-controlled models will be among the electronic “slide-shows,” the stands of the receiver manufacturers again being a dominant feature of the exhibition.

The National Radio Show is organised by the Radio Industry Council under the patronage of H.M. the Queen.

THE MODEL ENGINEER EXHIBITION

His Royal Highness Prince Bernhard of the Netherlands has graciously consented to open the “The Model Engineer” Exhibition for 1954, to be held at The New Horticultural Hall, London, from August 18th-28th. Model Engineers will appreciate this honour that has been accorded to them, the more so as Prince Bernhard is flying to England specially to perform the opening ceremony.

One of two new cups being awarded this year, commemorates the opening of the Exhibition by The Duke of Edinburgh in 1952. To be known as “The Duke of Edinburgh Trophy” it is a magnificent silver tankard and will be competed for by prize winners of previous competitions. Professor Low, well known in almost every sphere of experimental engineering, has accepted an invitation to act as chief judge for this particular event.

The second trophy - “The Model Engineer Students Cup” for either individual or collective work, is to encourage schools, technical colleges and apprentices in the art of making models of engineering. Pioneer work in this field has been done at the 1952 and 1953 Exhibitions by the boys of the Cuckoo Hall School, and the organisers are hoping to receive other entries now that a special class has been created for this type of work.

REPRODUCING RECORDS

By O. J. RUSSELL, B.SC., A.INST.P., GBHJ

In the good old days (now, alas, gone for ever) it was simplicity itself to reproduce a gramophone record. Beyond placing the needle in the groove there was nothing else to worry about. Unfortunately, the pace of progress is such that this is no longer so. In fact, of course, even in the past the high fidelity enthusiasts did use “equalisers” in order to obtain correct reproduction. As high fidelity pickups are now available to all, the question of “equalisation” no longer crops up - we shall not get this state of affairs. This is because all gramophone records are made with a deliberately unflat response curve. In fact, there are at least three major characteristics employed for records commonly available. Moreover, unless these characteristics are corrected, the overall balance will be very poor. The usual tone control is, in fact, not suited for this task, as the requirements are often very different from the type of correction curve used in record manufacture. Moreover, the continual fading with both treble and bass controls to correct for several widely different record characteristics would be an intolerable business. This is where the “equaliser” comes in. Briefly, the equaliser is a fixed or switched circuit that corrects the gramophone record characteristic to a flat frequency response. This can be played into our HiFi amplifier, and no twiddling of the main tone controls is necessary.

Fig. 1, therefore, shows in block form the sort of set-up we need if we are to reproduce records without trouble, and with correct tonal balance. To illustrate this more clearly, consider Fig. 2, which illustrates the type of ideal record characteristic which is used. The equaliser clearly must have the inverse of this characteristic, so that the loudspeaker characteristics, the room absorption and so on. Once set, however, it is not likely that we shall often need to adjust it.

If we now wish to change over to “gramophone,” we obviously need a straight-line or flat frequency input characteristic from the record and pickup. If we have this desirable state of affairs, then we have no need of a change of our tone control settings. However, we believe it or not - even with a completely flat super-high-fidelity pickup - we shall not get this state of affairs. This is because all gramophone records are made with a deliberately unflat response curve. In fact, there are at least three major characteristics employed for records commonly available. Moreover, unless these characteristics are corrected, the overall balance will be very poor. The usual tone control is, in fact, not suited for this task, as the requirements are often very different from the type of correction curve used in record manufacture. Moreover, the continual fading with both treble and bass controls to correct for several widely different record characteristics would be an intolerable business. This is where the “equaliser” comes in. Briefly, the equaliser is a fixed or switched circuit that corrects the gramophone record characteristic to a flat frequency response. This can be played into our HiFi amplifier, and no twiddling of the main tone controls is necessary.

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overall combination is the required flat frequency response. Incidentally, in practice the curves are not made up of straight-line sections, but are actually more gentle curves, as shown in Fig. 3. These are, in fact, the typical curves obtained by suitable simple correction circuits, which can be produced without much complication. In fact, Fig. 3 is a fairly good impression of the Decca FFRR recording characteristic.

The curve of Fig. 3 illustrates the typical aspects of all gramophone record characteristics. There is always a considerable degree of low frequency cutting, and very often boosting in the upper frequency portion. Where different makes of record vary, however, is in the frequencies at which boosting or cutting occurs, and also in the amount of boosting or cutting, measured in decibels.

To illustrate this, Fig. 4 shows three main types of characteristic in outline. The HMV and EMI group of 78 r.p.m. records use only a bass cut, with a level top response. The Decca FFRR type of characteristic uses (for 78 r.p.m.) a bass cut and a mild top boost starting only above about 3,000 cycles. The USA records, 78 r.p.m., and the long-playing types of both English and USA records, use a violent bass cut starting at about 1,000 cycles, plus a violent degree of top boost also starting from 1,000 cycles. This USA and LP characteristic has in fact almost no straight portion at all. It is obvious that these three types of characteristic need very different degrees of correction, and that correction suitable for one type of record may be useless for another.

Thus a circuit giving an overall flat response with HMV and EMI Group records, will give a somewhat boosted top when used with Decca FFRR records. If we play EMI records with FFRR equalising there will be a slight deficiency of top. With either type of correction, however, the USA and LP records will give vastly exaggerated top and very little bass. If we play EMI or Decca FFRR records on USA equalising, the reverse holds—we shall have vastly accentuated bass and violent cutting of top. The term "violent" is no exaggeration, as on the USA recordings there is some 40db difference in recording level between extreme bass and extreme top!

The reader will thus appreciate that the question of correct equalising is of the greatest importance in the proper reproduction of all records. It should be noted, of course, that all these record types can be satisfactorily reproduced if the appropriate equalising circuit is used for the appropriate type of record characteristic. The dire results of using the wrong equalising have already been discussed. There is a warning, also, as in some cases records with USA type characteristics are issued by British companies. This applies particularly in the case of recordings actually made in the USA and issued here on a British label. In fact, an enquiry to one Company which specialises in records made by USA artists revealed that even the manager did not know what actual recording characteristics were used on their records! From later information it then transpired that a number of characteristics were used ranging from USA to FFRR types of recording curves, but even then it was not known which of the past records had a particular characteristic! This in fact may apply to other Companies as well! The extreme nature of the "USA" and "LP" type of recording characteristic makes this important, as this has extreme degrees of both cut and boost.

The above discussion of recording characteristics may be somewhat of an eye-opener, as for some reason record manufacturers are very loth to reveal their recording characteristics. Moreover, the very big differences between the British and the USA curves causes many record critics to discourse learnedly on "inferior balance," "accentuated top register" and similar matters. Unfortunately, in many cases this only means they are not using the correct equalising circuits. To save the earnest record enthusiast sleepless nights, however, we can reassure him that in practice only a three-position switch is necessary to give correct equalising for the recording characteristics mentioned. The circuits to enable this to be performed are also perfectly simple and will be discussed in the next issue.

[to be continued]

JULY 1954
CONVERTING THE 182A UNIT TO A 'SCOPE

Part 3

By A. BLACKBURN

Wiring
Some of the existing wiring, associated with the CRT, may be used without modification. The focus potentiometer $R_{62}$ and brilliance potentiometer $R_{59}$ are already mounted on the Tufnol bar on the underside of the chassis. The layout of the tagboard (above chassis behind $R_{54}$ and $R_{57}$ containing the remaining resistors in the EHT chain) is shown in Fig. 18. It is important to note that all EHT wiring be provided with adequate insulation.

The diode $V_1$ is mounted in its holder on the base of the CRT holder. A 16 swg wire, about 1" long, is soldered to pin 1 (G1) of the CRT holder, and another similar wire soldered to pin 4 (H). These wires which are sufficiently robust to support the diode and its holder, are then soldered to the anode and one of the heater pins of the diode holder, making two electrical connections at the same time. The holder should be of the cradle type in which the valve lies horizontally.

The heater wiring for the VR91 and the CV118 valves will be found to be complete. All that is needed is the connection to the power supply.

The Y amplifier wiring is perfectly straightforward. $C_9$, the input condenser, should be wired direct from the input terminal on the front panel to the tag provided (see Fig. 10). The positions and mountings of the gain control $R_{56}$, the compensating coil $L_1$ and bias potentiometer $R_{49}$, have already been described. Coupling condensers $C_{30}$, $C_{31}$ from the output anodes to the plates will be found mounted on a tagboard above the chassis just in front of the CRT holder bracket. All existing wiring should be removed from these components. Notice particularly that these capacitors are not connected directly to the CRT plates, but through links on the terminal panel at the side of the instrument.

The valve line-up from front to rear is: $V_5$, the input valve, $V_4$, sync amplifier, $V_6$ and $V_7$.

All leads should be kept as short as possible, particularly the resistors $R_{33}$ and $R_{34}$, which should be mounted as close to the valveholder as possible. The timebase wiring is safely wired direct from the switch to the appropriate pin on the valveholder of $V_1$. The larger values, $C_8$ and $C_9$, are held on tagboards. $C_2$ is the capacitor mounted

JULY 1954
above the chassis on the VR91 side, already mentioned in section 6 of the preliminary construction details. Cs is on the tagboard shown in Fig. 16. The large tagboard in the centre of the underside of the chassis contains the majority of the remaining time-base components. This tagboard is shown in Fig. 17. Some small components may be mounted direct on to the valveholder pins. The valve line-up from front to rear is: V1, the sawtooth oscillator, V2 cathode follower, V3 inverter valve. CRT plate resistors and the attenuator resistors may be mounted behind the CRT terminal panel, these components being supported by their own wire ends.

In the author's instrument the power cable was not fitted with plugs and sockets, and was, therefore, wired permanently at both ends. Entry to the instrument is made via a small slot at the front of the case. The cable then runs the length of the instrument and is finally anchored at the rear under the chassis.

Care should be taken to ensure that no wiring on components under the chassis stand proud of the edge of the chassis, otherwise they may be damaged when the case is fitted.

Some of the components required are already in the instrument or will have been removed in the preliminary dismantling.

The Case
Two holes have to be cut in the outer case. The small slot for the power cable entry and the hole to allow access to the CRT terminal board are shown in Fig. 19.

The gauge of the metal used in the case is sufficiently light to allow the use of tin snips to cut the holes if no suitable saw is to hand.

Setting-Up
No critical adjustments are necessary to any of the circuit except the amplifier. The bias applied to the output stages is adjusted by R40. The procedure is to apply a small sinusoidal signal to the amplifier input, say 6.3V from the valve heaters, and adjust R40 until the maximum undistorted deflection is obtained on the CRT screen.

There is, of course, no reason why the amplifier gain control should not be calibrated. A suitable method would be to apply a voltage of, say 50V to a potentiometer and measure the voltage from the slider to one end of the potentiometer with an ordinary AC voltmeter. This voltage should then be applied to the amplifier input. The output of the amplifier can then be measured by measurement of deflection voltage on the CRT, using the shift voltage as described under "Operation."

Now, the meter will read RMS (the waveform is sinusoidal, otherwise the method is inaccurate), but the voltage measured on the screen will be peak-to-peak. The output voltage should therefore be divided by 2 x 2. The formula for calculating gain is, therefore:

\[ \text{Gain} = 1.4 \times \text{Input voltage} \]

This procedure should be repeated for a number of settings of the gain control, and a dial marked with the results mounted behind the gain control knob.

No trouble should be encountered with the time-base if the wiring is correct. Full deflection of the tube will be obtained if the HT and EHT voltages are approximately those indicated. If the trace is very short, the inverter valve V2 should be removed. If no change in trace length is observed, it indicates a fault in the valve or a component associated with it.

There should be no trace of fly-back on any range except the fastest where, if the brightness is turned fully up, the fly-back may appear very dimly.

Synchronisation may be checked by applying a signal to the amplifier and the sync input terminal simultaneously. Operation of the sync switch SW.3/1 should hold the picture steady in either position, provided the signal has an amplitude of more than about 3V RMS.

Operation: Voltage Measurement
Small signals should be connected to the amplifier input and the gain adjusted to give a comfortable sized picture. Always operate the gain at as low a level as possible in order to avoid the risk of overloading the output stages. If the deflection is too great for the extremities of the sign it is observed, even with the gain at minimum, connection should be made direct to the Y plate. This involves removing the link from one of the amplifier output-Y plate terminals. If the signal is still too large, connection should be made to the attenuator terminal, and the attenuator output terminal linked to the Y2 plate. Any signal connected to the Y2 plate should not have DC superimposed upon it, otherwise the trace may be deflected off the screen, due to the DC coupling.

If either DC or AC voltages are to be measured, the following procedure should be adopted. The signal should be applied direct to the plate (Y1 for AC, Y2 for DC).

Connect an ordinary voltmeter to the plug on the front panel and set the Y shift until no voltage is indicated on the meter. Mark the vertical extremity of the waveform on the screen of the tube, then operate the shift control until the other extremity of the waveform coincides with the mark. The
The Time-Band
No sync phasing control has been incorporated in the time-band, but selection of phase, particularly on rectangular waveforms, is possible. The sync signal obtained from the amplifier is out of phase with the signal at the input of the amplifier. If the amplifier input and sync input terminals are connected together and the sync switch is set to external, the time-base will lock to one edge of the waveform. If, however, the sync switch is set to internal, the sync signal will be of opposite phase and the time-base will lock to the other edge of the waveform. The sync amplitude control should be turned (anti-clockwise) as low as possible, because too great a sync signal may stop the time-base oscillating.

The time-base output voltages are, of course, available at the rear panel. This may be useful if the oscillator was ever used with a wobbulator, as the sawtooth for the reactance valve is readily available. To use the X amplifier, connect the signal to the X amplifier terminal on the front panel, switch off the time-base (position with "nut and bolt" terminals for some plates but it was felt that Y1 and X1 plates would be required normally, and Y2 and X2 only occasionally. The latter plates have their connections made, therefore, to the nut and bolt terminals in order to save buying too many proper ones.

7 of SW2) and adjust the gain to provide a comfortably sized picture.

Final Remarks
The instrument has been used very successfully for various purposes, including TV and radio experiments. Probably the most interesting feature was that when the oscilloscope was connected to the grid of the IF amplifier, a set of TV pictures was produced. Six cycles of 465 ke/s signal were observed locked rigidly to the time-base, despite the presence of modulation. The receiver was turned on, thus defeating all the precautions of the BBC and putting the location South West of London. TV signals can be observed particularly well if the time-base is locked from sync pulses after separation. It was found that TV time-base waveforms associated with an electrostatically deflected tube were too large for direct observation and the attenuator had to be called into service.

BOOK REVIEWS

HOME CONSTRUCTOR’S HANDBOOK. Compiled by the technical staff of Roding Laboratories (Electro?) Ltd. 2nd Ed. Published by Roding Laboratories, Bournemouth Airport, Christchurch, who have not studied it or seen it before will find it of considerable help in obtaining a more up-to-date understanding of oscillator harmonics and/or second-channel responses. NORMAN C. TAYLOR

HOMERADIO, by F. G. Rayner. 33 pages, 19 diagrams. Price 2s. 6d. Published by Astral Radio Products, 138 The Ridgeway, Woodgreen, Brighton 7, Sussex.

Reprinted from a series of articles that appeared in Hobbs’ Weekly this booklet is admirably suited to the beginner who wants to construct simple apparatus that will give results right away. Commencing with a dual-wave crystal set, the book proceeds to a dual-wave single-valve receiver, a low-frequency amplifier and a high-frequency amplifier stage. The design of these is such that they can be added to each other as desired. The author has given all the essential information required to make the apparatus and ensure its correct operation. The wiring diagrams will enable the beginner to understand better the schematic diagrams given for each design. For the purpose for which it is intended this little book is quite good value. It should certainly appeal particularly to youngsters taking up radio as a hobby with one eye on restricted finances, for the components needed to make any of the apparatus described can be purchased readily and cheaply.


A term of television engineers has written the material for this compendium which contains a great deal of information often needed by dealers and service men. Although the book necessarily restricts itself to such specialists, its handy pocket size suggests that it is primarily intended to carry with one so that it is to hand when wanted. To coin a phrase, a book on a job is a job in the workshop.

It is not possible in this short critique to give a very detailed appreciation of all there is in this book, for much of it is written in a form that can best be described as elaborated notes. Some of the subjects dealt with were transmission standards, waveform, receiver installation and operation, basic circuitry, projection receivers, recent circuit developments, servicing of receivers and fault tracing, testing equipment, aerials and feeders, interference, receiver alignment, and so on.

There are some very handy tables giving intermediate frequencies of many popular receivers, details of picture tubes, equivalents, and replacement data. A number of tables of values used in the modern receiver are detailed in another table, and equivalents are also given for rear panel connections.

The book is well illustrated and the diagrams are clear and simple. The book should be a useful guide for a television engineer or enthusiast.

SECOND EDITION OF "MODERN SOLDIERS" BY HARRIS, W. F. Multicore Soldiers Ltd, Multicore Works, Maylands Avenue, Hemel Hempstead, Herts. 572 pages.

This takes the form of a second and larger edition of "Modern Soldiers" and is directed essentially to Manufacturers’ Sales and Technical Staffs. In addition to containing more than 50 illustrations, graphs and tables, it is a complete and up-to-date mine of information to Planning and Production Engineers.

Modern Soldiers gives precise information on melting points and characteristics of the various standard and non-standard alloys — table of gauges, even down to 34 swg., lengths per lb and tenfold strengths, specific gravity and electrical conductivity of the whole range of Multicore Soldiers.

Pages are devoted to full details of the many fluxes available, including the new A1D, approved ultra high speed Type 362 Flux, of live core solder, the new automatic soldering machine and many other special products.

Details of photographs show Erzin Multicore Solder being used all over the world in many vastly different forms and methods of use. "Modern Soldiers" is available to all Radio, Television, Electronic Equipment and other allied manufacturers, and it is hoped that the firm’s letterheading should be used when applying. Other points of interest are the supplementary copies of Notes on Soldering, and Multi- core Soldiers’ Technical Summary.
CHASSIS CONSTRUCTION

By NORMAN CASTLE

Almost everyone likes to turn out a professional-looking piece of equipment, but many find that chassis construction is something of an art to be acquired. Anything which enables neat workmanship to be obtained can usually be regarded as a boon to the constructor, so it is with this in view that this article appears.

The method to be described is most applicable to working in sheet aluminium, this being the material most favoured owing to its ease of working. However, due to its comparative softness, it is not always easy to get edges and holes which are free from burrs; these often spoil the appearance of the finished article and give it that "home-made" look. One way of getting a clean edge to sheet aluminium was mentioned by W. E. Thompson in his article on building a capacitance-resistance bridge, and to "shout" the edge with a plane as he suggests certainly seems to produce the desired effect. After trying his tip about shaving off the burrs round holes with a chisel, it occurred to me that there might be an even better method, for where a large number of holes has to be drilled, this involves quite a fair amount of work clearing up the edges. Furthermore, if several groups of holes such as would be wanted for mounting a set of tuning coils is required, much care in setting-out and actual drilling is necessary to secure a neat job. An instance of this is apparent in G. Blundell's design for a Quality Feeder Unit for FM, where the drawings for the chassis layout show that groups of holes of various sizes are required for mounting coils and providing entries for coil connections.

It was some time ago that I first tried a different method of chassis working, at a time when crowds of holes were required for mounting ten Aladdin coils for a television set that was being made. A trial of the method on odd scraps of metal gave encouraging results, so the idea was extended so that it could be used for practically all holes required in sheet aluminium. It has also been used on tin-plate with equal success.

Like most other home-constructors, I use No. 2, 4 and 6-BA screws and nuts for mounting components, and occasionally holes have to be made for access to tuning plugs, and the mounting of larger items such as Yaxell-type switches and variable resistors. For the screw sizes mentioned there are, of course, proper sizes of clearance drills, but for all except the most exacting work one can use clearance sizes of \( \frac{1}{8} \)" for 2-BA, \( \frac{3}{32} \)" for 4-BA, and \( \frac{1}{16} \)" for 6-BA.

Some trials were made using short lengths of silver steel rod of these sizes to punch holes in sheet aluminium instead of drilling them, and of course it was soon found that to produce a clean hole a clear space was needed in which the punch and blanked-out piece could enter. At the same time a firm base around the edges of the hole was required to prevent bulging. Trying to punch into a drilled hole in a piece of steel bar as a backing-piece did not prevent the work being distorted, since support on the upper surface is also needed. Finally, two pieces of steel bar were clamped together and a hole drilled through both. The work was clamped between them and the punch driven through, and the result was a clean hole without distortion of the surrounding metal. It became obvious that if a group of holes was needed one had only to make these holes in the bars, and use them as punch guides to produce clean-cut holes in the aluminium.

Two tons of bright mild steel were obtained, each 2ft long, 1" wide by \( \frac{1}{4} \)" thick. At each end, these were drilled through carefully so that the holes were on the centre-line. One piece was drilled 0-BA, the other piece 0-BA tapping, and an 0-BA thread was made in these latter holes. The holes were drilled through both pieces with 0-BA \( \times \frac{1}{2} \)" holes and the remainder of the drillings made were done with the pieces so clamped in order that all holes would be accurately aligned in each piece. Other holes for 0-BA tapping and clearing are required so that the pieces can be clamped at closer intervals for certain work, but these can be dealt with later.

One can now decide what sets of guide holes are needed for bench work, and these should be carefully set out with rule and scriber. The accuracy of subsequent chassis work will depend on the care used in this setting-out, so it will pay to spend some time and patience on it. Centres for holes should also be carefully popped with the centre punch, and with the two bars clamped together all holes should be drilled right through both bars using a \( \frac{1}{2} \)" pilot drill. If you have a bench drill, the job of drilling is a lot easier and far more accurate than doing it with a hand-drill. Drills of the correct sizes are used to enlarge the pilot holes to the diameters required, and this should be carried out with a slow feed on the drilling machine and a plentiful supply of lubricating oil. Do not turn the work over, but drill right through from the top-side — into a block of hard wood, of course — to prevent throwing a burr when the drill breaks through. By drilling right through like this, a perfectly regular hole is obtained; it might not be so if the wood block has a slightly sloping face. With some experience one soon gets adept at judging the "feel" of the drill when the hole is about to break through and this is the signal to increase speed a little so that the drill is actually rotated right out of the metal. This gives a clean exit, a condition almost impossible to obtain if the drill stops and a forced start has to be made to complete the hole.

When all these holes have been made, the additional 0-BA tapped and clearance holes mentioned earlier can be made. The bars can now be parted, and the surfaces carefully cleaned off using fine carburetted cloth wrapped round a flat file, to produce a smooth flat surface with no trace of burr round holes. This ensures that the edges of the holes shall be sharp, and enables the punching of holes to be done more cleanly and easily. Some suggestions for groups of holes are shown in the sketches, and these will be found to cater for most requirements, but if need is found for other groups of spacings it is a simple matter to make such drillings in the bars as they are required.

In the groups of holes for valve-holders shown in the sketches, no size has been given for the centre holes. It is left to the reader to make such holes the size to suit his needs. If a tank cutter is used for making the two holes, a \( \frac{3}{16} \)" hole will be required as a pilot, but if a tool like the Osborn chassis punch is to be used, either a \( \frac{1}{8} \)" or a \( \frac{1}{16} \)" hole will be needed through which to pass the draw tool. It would then be possible to make provision for such holes on the bars, it is perhaps better to make the centre hole \( \frac{3}{16} \)", and use the appropriate Osborn "Jiffy" punch to open it out to either \( \frac{3}{16} \)" or \( \frac{1}{8} \)".

JULY 1954
To produce the holes required in a chassis, it is necessary only to set out the work with rule, square and scriber, and using the chassis plan one can then position the two bars over the inter-sections of lines so that the group of holes required are located exactly over them, and then use short pieces of silver steel to punch out the holes. These punches can be lengths of rod 4" long, with one end filed at a slight angle as shown in the sketch. The other end is rounded. The sloping ends should be tempered by first raising them to cherry red heat and plunging them in oil, polishing with fine emery cloth, and then letting down the temper until a mid-straw colour appears, when the punch is again plunged in oil to set the temper.

The use of bright mild steel is much to be preferred for the work described in this article, since this material has sharp, square edges. Ordinary black mild steel has rounded edges, a rough surface, and is softer. Furthermore, it is often far from straight. Bright mild steel is more costly and may be less easy to get, but it is worth going to some trouble to procure some if only for its superior strength and surface finish. As in most handwork, good results come from the use of good tools, and in this respect bright mild steel for chassis work takes on the importance of a tool, since it directly affects the class of workmanship produced.

**CAN ANYONE HELP?**

**Dear Sir,** Can anybody supply me with any conversion details for the R.A.F. 1132A Receiver. I am willing to pay reasonably for same. M. Masel, 4 King Gardens, Waddon, Croydon, Surrey.

**Dear Sir,** Can anyone please inform me where I can obtain the circuit for the "Clifton Tape Deck M.Q.I." I will willingly pay for any expense involved. —E. F. Biddlecombe, 92 Cissbury Ring South, Woodside Park, London, N.12.

**Dear Sir,** I would be very much obliged if any reader could lend or sell me the circuit and alignment data for the Ferguson Model 904 AC. —J. A. Stephen, 18 Holehouse Drive, Knightwood, Glasgow, W.3.

**Dear Sir,** As a regular reader of *The Radio Constructor*, I wonder if any of your readers can give me any details regarding the Admiralty Receiver Pattern A2074, Receiver A/5324, Service No. G2232, made by C.R. Ltd. This receiver contains a 350 Volt output power pack with a 3U4G rectifier, also four 6K7G and a 6V6 output. I have the circuit but cannot understand whether it requires a further aerial unit or anything. I note that there are two small stabiliser valves in the input and a small rectifier in the output stage. Am urgently in need of this information and any expense borne by a reader will be fully reimbursed. —R. F. Smith, 7 Council House, Fivehead, near Taunton, Somerset.

**Dear Sir,** Could you please spare space to ask if any reader could lend or sell me a circuit for a timebase and CRT utilising the components as supplied by Messrs. Lasky. No. 2 Construction Parcel.—D. Barclay, 17 Richmond Road, Manchester 21.

**Dear Sir,** Can any reader please supply details of the Control Unit Mark 111 ex-WD Receiver and Transmitter Amplifier Modulator, which controls Tx79 and Rkx89. In particular, the ratio of the modulator transformer marked "161-37" and frequency covered together with any possible conversion details to the SEO zones on 70 cms.—John T. Hilton, 2 Junction Road, Bolton, Lancs.

**Dear Sir,** I have a Cossor "Melody Maker" TRF receiver using 4 Volt values. Can any reader please supply me with a suitable converter circuit using a frequency changer and AC mains operated which will enable me to receive the 15, 20, 40 and 80 metre amateur bands.—J. N. Rippon, 22 Allenby Road, Maidenhead, Berks.
FREQUENCY MODULATION TUNER UNIT

By W. GORDON

BECAUSE FREQUENCY MODULATED transmission is established as the system of modulation of transmissions on the 90 Mc/s VHF Band II, The Radio Constructor is featuring this article on a suitable tuner.

The construction and alignment of such a tuner is no more difficult than if it were a normal medium-wave tuner, and most of the coils are easier to make.

The same number of stages would be used, and in this case only three stages would be required - Frequency Changer, IF Stage, and Ratio Detector. This tuner uses two more stages - RF and Limiter, the purpose of which will be described.

Why VHF?
The medium waves are, of course, already overcrowded, and even with a limited audio range a whistle filter must be used to intercept the carrier of the adjacent stations. Also, the sidebands of the adjacent stations will be heard and the background can never be really quiet except under very favourable conditions. VHF was therefore the only choice, and this has the advantage that the range of transmissions is not much greater than line of sight, and so stations spaced 200 miles apart can use the same frequency with no danger of interference. This does not mean that the service area of the VHF station is less than that of a MW one, since the latter will not give a first class service area much greater than that covered by line of sight, although of course poorer signals can be obtained at much greater distances; this is what causes the whistles.

Why FM?
The decision to use FM was nearly unanimous by the committee set up to study the problem. One point made against FM was that it was more complex and difficult to align, and to ensure the life stability necessary to achieve the best results. This, surely, is a challenge which will be met by manufacturers, and is met in the tuner described in this article.

Pre-war life-stability of 465 kc/s IF's was something of a problem when almost universal use was made of compression condensers for tuning, but with the advent of dust iron cores this problem has nearly
The simplest possible FM set is more complex than the equivalent AM set, but when the latter is fitted with the necessary impulse limiting circuits there is not much difference.

A simple listening test, though, at almost any position except, perhaps, within a couple of miles of the station, showed the superiority of the FM signal as regards freedom from impulsive interference and far lower background noise. Complex limiters on the AM receiver could, of course, improve the rejection of the impulsive interference, but there is nothing that can be done about the background noise. This test could only be made when the BBC were radiating the same programme on both FM and AM.

It might be expected that the AM transmission would require a narrower bandwidth receiver and that there could be more transmitters in the same band. Unfortunately, though, the complex limiters used relieved, for optimum working, on having a wide bandwidth in the receiver in order to produce interference pulses with a sharply rising wave shape. When this is taken into account, and also one remembers that the stability of VHF oscillators is not so good as lower frequency types, one realises that the spacing could not be less than 0.25 Mc/s between stations. This is, in fact, the spacing chosen for FM transmissions.

FM transmission can use any nominal bandwidth; the choice of the BBC has been that ±75 kc/s deviation of the VHF carrier represents full modulation, and this happens at maximum audio amplitude at the frequencies normally encountered.

As Band II transmissions have approximately the same service area as Band I TV transmissions, it is interesting to note that most of the new TV aerials are fitted with slot aerials, which are capable of radiating three FM programmes simultaneously.

The service to be expected from Wrotham is shown on Fig. 1 by the thin black line. The receiver will now be described stage by stage.

The RF Stage
An RF stage is included for two main reasons, one being to prevent oscillator voltage getting directly into the aerial circuit and being radiated from the aerial to the annoyance of all local TV users. Another important feature is that the aerial circuit can be isolated from the frequency changer input, and optimum design achieved in each. The aerial coil is designed for maximum gain rather than selectivity. Both the aerial and grid circuit of the valve

Fig. 1
Map showing the range of the FM Feeder Unit. Two IF stages are necessary in the area enclosed by the dotted line. One IF stage may be employed in receivers to be used in the area enclosed by the solid line.
damp this coil, the two together being equivalent to about 800Ω across the coil. If the spacing of the aerial coil is set to minimise this damping, a loss in this coil of about 4 times would be found. In order to improve the signal-to-noise ratio, the maximum possible step-up is needed, since the valve is the first "noisy" item that the signal meets. The coil has been wound directly on the dust iron slug, and the aerial coupling coil wound as tightly as possible in the middle of this coil. This achieves a gain of about 3, and the tuning is so flat that there is no need to adjust this circuit. There is, therefore, no second channel rejection here, but this coil is very effective against direct IF interference. The coil in the anode circuit is not so heavily damped, and a fair Q can be achieved. The fact that the grid circuit is heavily damped makes this point ideal for the injection of the AVC voltage, since changes in the input capacity of the valve will have very little effect.

The Frequency Changer

The circuit shown was found to be the most effective ever tried at these frequencies. It may seem rather strange to mix in the oscillator valve and put the IF in its anode circuit, but it is really only the old hexode circuit brought up-to-date.

Various other types of circuit were rejected for the following reasons:

1. Normal triode hexode

The triode valve is usually on top of the hexode section and so the leads are rather long. The internal capacities are much higher due to the mixing electrodes, and these points all make for poor frequency stability. The gain is lower and the noise figure higher than the circuit chosen.

2. Twin triode frequency changer

This is a good type of circuit for these frequencies, and until recently was the most common type to be found in American TV receivers. Oscillator stability is good, and channel changing by switches is easy. Conversion conductance is poor due to the heavy damping on both the RF grid circuit and the IF anode circuit due to the Miller capacity between grid and anode.

3. Separate triode oscillator and pentode mixer

Approximately equivalent performance to the circuit chosen, but of course, the separate valve is a considerable extra cost.

4. Triode pentode frequency changer

Approximately equivalent performance to the circuit chosen, but the valve is more expensive. This type is best of all where channel switching is required.
The Circuit Chosen

This type would be unsuitable for channel switching since it is very important to keep the inductance of the cathode lead low, and switching is not possible. Otherwise, this circuit is probably the most stable of all, as well as giving equivalent performance. The anode circuit is well shielded from the input circuits by both g2 and g3, and so there is no damping on this circuit. Since for drift and ageing. Automatic gain control is not used here since the resulting change of valve input capacity would adversely affect the frequency response and cause distortion.

The Limiter Stage

This tuner will perform quite well without this stage; indeed, many sets do not use one. But the use of this stage considerably

the valve is oscillating, a voltage of about 5 is built up at the grid, and this is highly suitable for mixing. A gain of about 15 is achieved in this stage instead of about 5 if a normal miniature triode-hexode were used.

IF Stage

The intermediate frequency is 10.7 Mc/s, as this is becoming a standard IF for FM receivers. Coil winding is reasonably easy, and the frequency high enough to achieve a good second channel rejection in the RF stages. IF's of between 5 and 21 Mc/s have been used in the past.

The coupling is chosen to be slightly over-coupled in order to achieve a bandwidth of about 250 kc/s. This leaves ample margin improves the rejection of impulsive interference and also avoids the need for carefully balancing the ratio detector component values. Even when these components are carefully balanced the AM rejecting properties rapidly deteriorate as the set is detuned, and therefore frequency stability becomes more important. The use of this stage also makes the warming-up drift unnoticeable.

The Ratio Detector

The Ratio Detector was chosen in preference to the Foster-Seeley discriminator because of the better AM rejecting properties of the former. Winding instructions for this coil should be carefully followed as achievement of good balance and low capacities improve the circuit performance. The operation of the Ratio Detector is as follows:

Two voltages appear at the diode anodes which vary in relative phase as the signal frequency changes, and this results in the appearance of an audio signal proportional to the original modulation created across C18, which is, of course, made large enough to integrate it into a continuous wave, but not so large that the high frequencies are with cotton. After winding one turn of PVC the whole coil is “distressed.” The core is ½” long and is a normal core cut in half. This length should be carefully followed in order to make the coil tune in the correct part of the band.

The oscillator and RF anode coils are wound on a ½” mandrel in a clockwise direction. They should be mounted above this, and one lead left long

### COIL DETAILS

<table>
<thead>
<tr>
<th>Formers and Cans</th>
<th>3 Formers 3” square base × 2¾” high, Aladdin.</th>
<th>2 Cans to fit above.</th>
<th>1 Large Can 1½” square × 2½” high.</th>
</tr>
</thead>
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<table>
<thead>
<tr>
<th>COIL</th>
<th>CIRCUIT DESIGN</th>
<th>TURNS</th>
<th>WIRE SWG</th>
<th>SPACING</th>
<th>CONDENSERS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aerial</td>
<td>L1</td>
<td>4</td>
<td>24 DSC</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>RF Anode</td>
<td>L2</td>
<td>5</td>
<td>16 TC</td>
<td>28 swg DSC</td>
<td>—</td>
</tr>
<tr>
<td>Oscillator</td>
<td>L3</td>
<td>5</td>
<td>16 TC</td>
<td>Cathode tap one turn</td>
<td>—</td>
</tr>
<tr>
<td>IF1</td>
<td>L4</td>
<td>38</td>
<td>38 DSC</td>
<td>½”</td>
<td>C6 15pF s/m</td>
</tr>
<tr>
<td>IF2</td>
<td>L5</td>
<td>38</td>
<td>38 DSC</td>
<td>½”</td>
<td>C7 15pF s/m</td>
</tr>
<tr>
<td>Discriminator</td>
<td>L6 and coupling</td>
<td>29</td>
<td>40 DSC</td>
<td>½”</td>
<td>C11 15pF s/m</td>
</tr>
<tr>
<td></td>
<td></td>
<td>38</td>
<td>38 DSC</td>
<td>½”</td>
<td>C12 15pF s/m</td>
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<td></td>
<td></td>
<td>15+15</td>
<td>38 DSC</td>
<td>½”</td>
<td>C15 15pF s/m</td>
</tr>
<tr>
<td>Heater Choke</td>
<td>100</td>
<td>24 DSC</td>
<td>—</td>
<td>—</td>
<td>C16 47pF s/m</td>
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</tbody>
</table>

affected. This phase difference of the signals derives from the fact that the voltage/ current phase relationship in a tuned circuit varies as the frequency is altered, and are only in phase at the resonant frequency. Such a voltage is impressed on the diode anodes by the inductive coupling between the primary and secondary. Also impressed on the diode anodes is a reference voltage derived from a tightly coupled coil wound directly on the anode coil, and this is impressed equally on both diodes by being fed into the centre tap of the secondary coil.

Coil Winding

The aerial coil is wound in the screw thread of the core and the ends tied together enough to go through the chassis to the condenser. The spacing should be approximately ½”. The cathode tap should be soldered on before mounting, care being taken not to short turns of the coil.

The IF transformer calls for no comment except that the coils should be wound in the same direction, and the opposite ends are made ½” to the signal. Care should be taken that the condensers do not short to the can.

The Ratio Detector

The anode coil is wound normally, and then one turn of polythene tape or paper is wound over the coil. The coupling coil is wound at the earthy end of the anode

JULY 1954

THE RADIO CONSTRUCTOR
winding. Normal clear office tape should not be used since the sticky side absorbs moisture, and will also attack the copper wire.

The closely coupled diode winding is produced by winding 4 wires 24 long together, 15 turns being wound. The winding is fixed with polystyrene dope. After about 10 minutes two alternate wires are removed leaving a spaced bifilar winding. Do not lose patience with this, as a spaced winding is necessary to reduce the capacities.

indicator. The cores are then set to produce the required bandwidth of 250 kc/s. To adjust the ratio detector, connect a meter across C24 and adjust both cores for a maximum reading.

Transfer the meter across C19 and then finally adjust L6 secondary for zero reading, with the generator still set to the intermediate frequency of 10.7 Mc/s.

Care should be taken that too great a voltage is not impressed on the crystal diodes, as they may easily be damaged. Particularly, minutes of course, the set will be perfectly in tune.

Note that the resistor R5 is connected across the capacitor C5 to prevent the capacity of the resistance appearing across the tuned circuit, and possibly causing frequency drift. Also C15 and R10 are connected in the bottom end of the tuned circuit for the same reason.

ELECTRONICS

EXHIBITION

The ninth annual Electronics Exhibition, organised by the North-West Branch of the Institution of Electronics, will be held at the College of Technology, Sackville Street, Manchester 1, on Wednesday July 14th (12 noon to 10 p.m.), on July 15th, 16th, 19th and 20th (10 a.m. to 10 p.m.) and on Saturday July 17th (10 a.m. to 7 p.m.).

The Exhibition will be officially opened on July 14th, at 2.30 p.m., by Dr. B. V. Bowden (Principal of the Manchester College of Technology).

The Exhibition will consist of two sections, a Scientific and Industrial Research Section (composed of displays from the Universities, Research Associations, Hospitals, etc.) and a Commercial Section (devoted to Manufacturer's products). It will include displays from more than 50 exhibitors.

A wide range of electronic products will be shown that will be of interest to visitors from all branches of Science and Industry.

An extensive Programme of Lectures will be presented, dealing with topics from all branches of Electronics, and will include lectures of general interest as well as those of a highly technical nature. Film Shows, on subjects ranging from the First Principles of Electronics to the Manufacture of Radio Valves and Television Picture Tubes, will be presented three times daily.

Visits to the Manchester University Computing Department: Arrangements have been made for Visitors to the Exhibition to see the Manchester University Computer in operation. Visits (lasting about 1 hour) have been arranged for the afternoons of July 14th, 15th, 16th, 19th and 20th and for the evenings of July 16th and 19th. The Parties will be limited to 20 persons each and tickets for same (bearing the date and time of the visit) are obtainable as for the Exhibition Admission Tickets.

Exhibition Catalogues containing over 100 pages of illustrations and descriptions of the exhibits — together with Time Tables for the Lecture and Film Show Programmes, and a complete Guide to the Exhibition — will be available from the Secretary early in July (post free 1/6).

Lecture and Film Show Programmes were available (post free 4d) in June.

Applications for Exhibition Admission Tickets and for Lecture Admission Tickets should be made (enclosing a stamped addressed envelope) to the Honorary Exhibition Organising Secretary:

Mr. W. Birnstye, 78 Shaw Road, Thornham, Rochdale, Lancs., or, during the period of the Exhibition, by direct application at the Exhibition Reception Desk.

Among the many exhibits of interest to our readers, the following are included:

Radio Miscellany

Several times recently I have heard from readers about "dead spots" - areas where radio reception is poor. Such areas are rather more common than is generally believed, and in recent years the BBC have fitted out a number of relay stations to adequately serve them. The dead spots that readers refer to are, however, small local areas - their own particular areas in fact. True, there are instances where a small district is, for some reason, "bad" for reception, but often on investigation it is found that the chief trouble is nothing more than thoughtless aerial siting or an insensitive receiver. Listeners who move to fresh districts often find their reception is poorer than at their former homes and tend to blame the area if they are not so lucky as to find their best districts which might be blanketing them. Invariably their troubles are greatly mitigated by re-siting the aerial, or overhauling a receiver with a determined performance, but even so they still retain a suspicion that the soil, the presence of mineral deposits or some other factor, makes their reception sub-average.

Right Turn

These points may have some bearing on the question, and listeners in low-lying, badly screened districts often have to put up with an attenuated signal and the consequent poorer quality. In the early days of radio "dead" spots showed up more prominently than they do now. Receivers were then far less sensitive, and there was no AVC to compensate for the effects of fading. At one time, with a small group of others, I started on an investigation of such cases to see if a definite pattern of behaviour could be traced. Unfortunately, we never got very far; more exciting developments came along too quickly, and in any case none of us were in any state of mind to be very confused by muddled ideas about "earth" currents. In all cases we found that a little care in planning the aerial effected an enormous improvement. Quite a small change often makes a wonderful difference, and it is still by no means unusual to find someone with the aerial "end on" to the local broadcaster. Turned "broadside on", the signals often go up several hundred percent.

100 Watts (Dutch) - 1kW.

It is odd how long reputations for "blind" radio spots persist, and no doubt many readers have been told "This place is notoriously poor for reception." Often the residents see the first thing that comes to mind and imagine that they have picked up a very weak station, and it is not easy to break the idea that there is nothing more to be done. In the case of a station, the first thing to do is to change to another station, and if the problem continues for a number of weeks then the call should be made to the BBC. The first thing to remember is that the signal is not being picked up by the receiver, but by the aerial. To find out where the aerial is being picked up, it is necessary to go to the spot where the signal is strongest and then move off in different directions. It is not uncommon to find that the signal is strongest in the direction opposite to the station. The signal is not strong enough to be picked up by the aerial, but it is strong enough to be picked up by the receiver. If the signal is found to be strongest in the direction opposite to the station, then the aerial should be pointed in the direction of the station. If the signal is found to be strongest in the direction of the station, then the aerial should be pointed in the direction opposite to the station. The signal is not strong enough to be picked up by the aerial, but it is strong enough to be picked up by the receiver.

Take Your Pick

The enterprise of the non-GPO Hull Telephone Service in laying on a recorded football score for subscribers, serves as a reminder that despite the progress in other electrical applications, the telephone service remains virtually static. On the Continent there are a variety of services available with the BBC still denied U.K. subscribers. True, we can dial TIM, but in Germany you can get all sorts of services, including menus read at dictation speed, weather forecasts, news bulletins, programmes with times of last performance, etc., and an information bureau.

Visitors like myself merely dial the number and trust to luck that they can understand enough of it to make sense. I found it good fun, and no doubt other readers who have visited Germany will find the service on tap to be a pastime. A couple of years back I visited a Swiss enthusiast who had an automatic recorder attachment. If the 'phone remains unanswered, the caller hears a voice repeating that a message will be taken. On his return home he can play back the message, but the real novelty of it lies in the fact that he does not have to return home. He can 'phone back his own house and hear it from wherever he might be. Nor can anyone else get the message either by design or accident - a combination of numbers known only to the subscriber has to be dialled before it is repeated. It was an expensive gadget, mark you. When I worked out the cost in Sterling I reckoned it would keep me in cigarettes for the rest of my life. Quite apart from its gadgetry, it is a fine thing to show off to your friends - and one day it might come in for something really useful!

Most of the continental telephone systems have additional services, but the instruments themselves often look antiquated to us - those in Holland look almost Victorian. In several of the smaller countries the town (or Exchange) is part of the number. Sweden, too, has a similar service to the Swiss one I described, but it is not fully automatic. It is partly operated by "hello girls." You simply arrange to have your calls diverted, and they ring you back later with whatever message you have left for them. It is more suitable for those who like the sound of pleasant voices, but no fun at all for a true gadgeteer.

No doubt many of our readers could contrive some ingenious devices, but the Post Office take a dim view of anyone who does that sort of thing.

Thinking of telephones reminds me of an amusing experience told me by a reader. Every time he 'phones his girl friend, he gets the Light Programme. He may only imagine it is picked up from a Relay service wiring which might run parallel. I wonder whether he is entitled to listen to it without taking out a wireless licence!

Pulling Together

Twice recently I have found cases where a second loudspeaker has been added without checking that they were correctly phased. Two nearby speakers should always be arranged so that the cones move in the same direction at the same time. Out of phase, the sound waves set up by each tends to cancel out the other, and there is a marked falling off in reproduction, especially at the lower frequencies.

A simple method to ensure that this does not happen is to touch a 1.5V battery across the speech coil, when the cone will move either backwards or forward. Make the lead which connected to the positive of the battery bring the cones backwards (towards the magnet). The speakers can then be connected up properly phased in a matter of moments, even for occasional use. When used in parallel the two marked leads are joined together; and for use in series, one marked lead is joined to the unmarked lead of the second speaker. [END]

Centre Tap talks about 'Non-Enterprise' - Twin Speakers

Dead Shots - G.P.O.

Report Pads

Report/reply ratio low? Then send a report which contains all the information a station requires. Each pad contains 50 printed forms detailing the headings under which reports should be made. Your QSL returns will be much higher if you use these properly prepared reports. Printed on a high quality paper suitable for airmail transit they cost only 3/9 post paid. Orders with remittance to Data Publications, 57 Malda Vale London W9.
**BUILDING THE RCS BATTERY RECEIVER**

Part 1

**A ONE-VALVER**

By JAMES SINCLAIR

In this, the first of a series of articles, is described stage by stage how a battery receiver may be constructed by the home constructor. Most beginners in the art of home construction cannot read a circuit diagram, and have few workshop tools or equipment with which to carry out their plans. It is for this class of reader that this series is intended. The circuit diagram is included in order to familiarise such readers with this, with the help of the point-to-point layouts shown.

This first instalment features an O-V-O (one-valve) receiver with battery power supply. Following instalments will describe how to add two other audio stages, so that the final unit will be a three-valve receiver of pleasing appearance and design.

As a one-valve regenerative receiver, it is built on an aluminium chassis with all holes stamped ready for assembly. The panel is sprayed a dark battleship grey with a cal- brated dial – see illustration. As received, all major components are colour coded for connection purposes, so that construction is simplicity itself. The valve used is the 954 acorn type and the receiver power consumption is very low – 6 volt at 0.15 amps LT and 30 volts HT at 1.5mA.

**Assembly Instructions**

By means of the bandspread condenser C4, secure the panel to the chassis and then mount the reaction condenser C3, ensuring that no metal part of this component is in direct contact with the metal chassis or panel. This is achieved by having two paxolin washers in position on the condenser spindle when it is placed in position and a further washer on top of the panel before securing the lock nut. Next, the coil holder should be secured by means of two nuts and bolts. The red-coloured socket should be nearest the bandspread condenser. The condenser C2 (the largest condenser) should now be fixed to the panel by means of the lock nut. Both this and C4 must be earthed to the chassis and panel, and this is done simply by direct contact of the metal parts once they are mounted securely.

The next component to be fitted is the valveholder. This is fastened to the chassis by two nuts and bolts, and it should be noted that the valveholder itself is supported above the chassis deck by two small paxolin stand-off sleeves.

The paxolin phone socket strip should now be mounted on the rear chassis wall.

* See advert on page 743

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The blue and white tags should be nearest the bottom edge. The nut between the red and white connections should have a small soldering tag inserted underneath it before tightening, thus forming an earth connection in itself.

The other paxolin strip already in position as received is the external aerial and earth connections. The aerial terminal is insulated from the chassis, while that of the earth is, of course, in direct contact with the metal work. This latter connection, marked E in the photos, has a solder tag already in position. Lastly, the three control knobs should now be fastened in position; the larger one with the pointer attached should, of course, be secured to the spindle of C2. This completes the assembly for a one-valve receiver, and we now continue with the actual wiring of the circuit. The only tools required are a pair of pliers with wire cutters incorporated, a small length of three-cored solder and a soldering iron, preferably of the electric type.

**Wiring Instructions – Step by Step**

**NOTE:** All wires must be insulated.

**Step No. 1.** From Aerial Terminal to YELLOW on Coilholder.

**Step No. 2.** From Earth Terminal to BLUE on Coilholder.

**Step No. 3.** From WHITE on Coilholder to WHITE on Bandspread Condenser (C4).

**Step No. 4.** From RED on Coilholder to GREEN on Reaction Condenser (C3).

**Step No. 5.** One end of RF Choke should be soldered to RED on Reaction Condenser (C3).

**Step No. 6.** Other end of Choke to RED on Phone Socket.

**Step No. 7.** From WHITE on Phone Socket to earthed soldering tag.

**Step No. 8.** One end of BLUE Flex and one end of BLACK Flex are joined together and soldered to BLUE on Phone Socket, and then pass through rubber grommet.

**Step No. 9.** Solder one end of RED Flex to YELLOW on Phone Socket and pass other end through rubber grommet.

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**Circuit diagram of the RCS Battery Receiver**

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**JULY 1954**
STEP No. 12. From YELLOW on Valveholder through chassis to RED on Reaction Condenser (C3).

No 13. From RED on Tuning Condenser (C2) through Chassis to WHITE on Bandspread Condenser (C4).

No. 14. Join one end of Cl, and one end of R1 to RED on Tuning Condenser (C2).

The aerial should be about 25 feet long, erected as high as possible.

The power leads should now be connected as follows:—Orange wire to LT+, Blue wire to LT-, Black wire to HT- and Red wire to HT+. Some 30 volts HT will be sufficient for this receiver.

The headphones should now be inserted into the phone socket; the act of plugging

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Sketch showing the wiring of the phones — on/off plug and socket

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STEP No. 15. Join other end of Cl and R1 together and solder the Valve Clip supplied to this end of these.

No. 16. Connect Phones to Plug and join the other two pins, as shown on drawing.

Operating Instructions

The valve should now be inserted into the valveholder with the red end downwards, care being taken not to force the valve as it is easily broken. The clip connected to R1 and Cl should now be fastened to the pin at the top of the valve. Next, insert the coil into the coil holder and then connect the aerial wire insulated nut and bolt mounted on the rear chassis wall. The earth wire should be secured to the connection which is next to the aerial input. The external

in also switches on the power supply, and the set will not work until this is done. If connected correctly, the valve should now light up. The headphone plug should be withdrawn when the receiver is not in use, otherwise the batteries will soon run down.

With the set now working, the Reaction condenser (C3) should be rotated to the right until the set oscillates. This will sound as a gentle rushing noise in the headphones. C3 should now be turned back until it is just below oscillation point. The Tuning condenser (C2) should now be turned slowly until a signal is heard; the signal should be finally resolved by means of the Bandspread condenser (C4). The tuning is very critical and the controls should be rotated slowly for efficient operation.

[continued on page 731]

THE RADIO CONSTRUCTOR

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Query Corner

A Radio Constructor Service for Readers

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Gram Switch Suppressor

Having just completed a high fidelity record player, I am a little alarmed to find that if the volume control is left at its normal setting the motor switch causes a very loud bump from the speaker. I feel that this may damage the speaker in time and would like your recommendations on a suitable suppressor circuit.

D. Ainscombe, Barnsley

The gain of an amplifier which is employed with a high fidelity type of pick-up is of necessity high because of the relatively low output from this class of pick-up. Also, to obtain the most lifelike response the amplifier is constructed to pass the higher audio frequencies. These two facts combine to make the system particularly sensitive to impulse interference, it being possible to have a considerable amount of peak energy in the individual pulses. As our correspondent so rightly points out this may damage the speaker, particularly if the maximum output from the amplifier exceeds its handling capacity.

A simple surge suppression circuit across the gramophone motor switch is the solution to the problem. Such a suppressor consists simply of a resistor and a capacitor connected in series across the contacts as indicated in Fig. 1. The capacitor should have a working DC voltage of at least three times the mains supply voltage, it being usual to find a component of 1000V DC rating in this position. The resistor should be of the ½ watt carbon type.

To avoid interference radiation from the motor supply leads, the suppressor should be connected as close as possible to the motor switch contacts. Finally, do not forget that the minimum of interference can only be obtained when the motor housing and motor board are effectively earthed.

Transformer Lead Identification

I have a mains transformer having coloured flying leads. Can you help me to identify the various connections?

D. Chappel, Lancs.

Certain transformer manufacturers still employ the age code as a means of identification for radio type mains transformers. The code will be clear from reference to Fig. 2. Before connecting up the transformer it is, however, as well to check the windings by means of a simple resistance measurement, as this will be an added safeguard against incorrect wiring. Any wrong connection in this part of the circuit can have expensive consequences, and one cannot be too careful. The two windings which have the highest resistance are the primary and HT secondary, and of the two the secondary will usually give the higher reading. The centre tap on this winding will have a resistance of about half the total when measured from one end, and

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It is thus easily identified. Heater windings for valves have a resistance which is usually considerably less than one ohm, and if any doubt exists as to the voltage of such windings, it is advisable to make a direct measurement with the mains connected to the appropriate primary tap. When carrying out this test remember that the transformer is not on.

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JULY 1954
load, and the voltage readings may be some 20% up on the rated values. It is impossible to provide any accurate indication of the winding resistance which can be expected as this varies with the type and size of transformer, but the following should act as a rough guide.

Primary 20–150 ohms
HT Secondary 100–400 ohms
LT Secondary less than 1 ohm.

![Transformer Colour Code](image)

Arcing in CR Tubes
A television receiver which I built some two years ago has functioned very satisfactorily, but lately some quite severe arcing has developed in the neck of the 12 inch tube. Is this likely to be due to the use of too high an EHT potential?

E. Swalls, Andover

Internal arcing within the neck of a CR tube may arise from the use of too large a final anode potential. If a picture is still obtained, a very good idea of the EHT voltage can be derived from the size of the raster. Should the voltage be excessive, the raster will have decreased in size so that it is no longer possible to fill the mask. If, however, the voltage to be measured the use of a calibrated spark gap is recommended. This type of voltage indicator is relatively cheap and has proved to be both reliable and reasonably accurate.

We have so far assumed that the cause of the arcing is the use of too much EHT voltage; this is, however, unlikely to occur in a receiver which has been functioning satisfactorily, and it is regrettable to be assuming that the tube is defective. A tube is likely to suffer from this defect if the vacuum has become impaired. A small reduction in vacuum may simply result in a very occasional internal flash-over coupled with some slight loss of focus. In its more advanced state loss of vacuum may result in continual arcing inside the tube, with the result that no raster appears on the screen. The symptoms lead us to believe that this is the cause of the trouble, and it is advisable to have the tube tested.

IF Breakthrough
Several readers who have built the Inexpensive Television Receiver, which is described in our Data Booklet No. 4, have reported interference patterns arising from a signal at or very near the intermediate frequency. The unwanted signal is usually picked up on the aerial system and finds its way through the RF side of the receiver to the high gain IF amplifier. Here it causes a beat note with the receiver IF signal, this in turn producing a quickly moving vertical or diagonal line pattern on the screen.

A complete cure for this trouble has usually been obtained by the inclusion of a series IF rejector in the aerial lead to the vision unit. The rejector consists simply of a parallel L-C combination connected at a point where the aerial enters the receiver. Fig. 3 shows the method of connecting in the circuit. The single layer coil consists of 30 turns of 40 DSC wire wound on a standard 1" television coil former. The turns are wound close-spaced in the centre of the former, and a dust iron core is used for tuning. The shunt capacitor is of the silver mica type and has a capacitance of 50pF.

![IF Rejection in TV Aerial Lead](image)

Having connected up the rejector, it should be tuned to the interfering signal frequency (around 75 Mc/s) by means of the half-inch diameter iron core. This adjustment is made by tuning for a position at which the interfering pattern on the screen disappears.

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**TABLE 1**

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<thead>
<tr>
<th>Capacity in µF</th>
<th>Peak Working Volts</th>
<th>Dimensions in inches</th>
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*This condenser can only be supplied with wire terminations both ends.*

**Hi-K Miniature Lead-Through and Stand-Off Ceramic Condensers**
These new additions to the range of Hi-K Ceramic condensers have been designed for Television Receivers incorporating Band 3 and Band 4 tuners. Their outstanding features are: extremely small series inductance, enabling them to be inserted quickly and easily.

<table>
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The type number of this range is CC125S. Capacities in µF are 0.5, 1.5, 2.5, 3.0, 3.5, and 4.0. Working voltage, 500V DC. Test voltage, 1,500V DC. Insulation resistance greater than 10,000 megohms. Tolerance of capacity, Standard ±30% and Special ±15% for all values except 0.5µF where Standard is ±30% and Special ±15%. Dimensions, 12mm long by 5mm diameter (including wax coating). Terminations — Tinned copper wires, 38mm long (22 swg).

**Hi-K Ceramic Disc Condensers**
These Hi-K Discs are intended for decoupling purposes in Television Receivers and spark suppression in small electrical apparatus. In both applications their effectiveness is greatly enhanced by their extremely low inductances.

In common with other Hi-K ceramic condensers, variations in capacity due to temperature changes may be quite substantial; a fact that should be borne in mind.
in mind when selecting this type of condenser, and when specifying the capacity required for a particular application. Where such fluctuations of capacity are of no great importance, these Discs may be used as an alternative to condensers using other dielectrics.

Arthur Gray Ltd. (Arrows), of 150-152 Charing Cross Road, London, W.C.1, inform us that they are marketing the 6 Second Scope Soldering Iron, an Australian made quick-disconnect type which is claimed to have many good features and should become very popular.

Any supply between 2.5V and 5V AC or DC may be used with this iron, the heating-up time is 6 seconds, and the current drain is approximately 1.5 milliamps. This latter feature is one of the iron itself must never be connected directly to the mains supply.

With a voltage of 2.5 on load, the heating-up time is 15 seconds. With 6V, it is only 4 seconds.

The iron is very easy and comfortable to operate. The handle is tubular in shape, and the switch is worked by a ring on the handle which is pressed forward to switch on, by the thumb, using only a light pressure. On releasing the pressure, the switch automatically switches itself off.

Maintenance is simple, and all spares are available. Two spare elements and one spare tip are supplied with each iron, which is fully guaranteed for three months from the date of purchase. Agents will service after this period, of course, if required to do so.

The price of the iron is £1 19s. 0d. If the transformer is also supplied, it costs £1 17s. 6d.

A. T. Sallis, 93 North Road, Brighton, Sussex. This well-known radio firm have recently favoured us with the latest edition of their catalogue. This 76 page illustrated list is available direct from the above address, at 1/1 post-paid, and is therefore addressed to all readers who may be interested, the overseas postal rates being a little more than the domestic.

It is our conviction that this mail order list is a worthwhile addition to our views on account of the wide selection of models, and an excellent selection of spares, which is clearly indicated and the whole operating is largely illustrated.

A specialty is made of the supply of radio equipment for models, and an excellent selection of spares, which is clearly indicated and the whole operating is largely illustrated.

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RELAY CONTROL UNIT
for Main Station and Portable Contest Operating

By JOHN PICKARD

Nothing is more irritating in contest work than lack of speed in changing over the transmitting position to receive. With what the author believes to be the laxity in operating procedure which takes place in many contests (and the failure of many operators to observe the terms of their licenses), points are frequently lost by the inability to read the first call sign given by a station whom one has called in response to a CQ. Unless a station is compactly constructed and of a fixed design it is difficult to design a manual change-over switch which can—

1. change the aerial from receive to transmit and vice versa,
2. break the HT to the oscillator if amplifier keying is in use,
3. mute the receiver input, and
4. perform other operations which add to the ease of manipulating one's station.

Consequently, the simple relay unit shown in Fig. 1 was evolved. As will be seen, this consists of a fast keying relay passing a mA or two at 12-16 volts in parallel with a "slugged" relay. It should be noted that the only method of delaying the break of a relay which is satisfactory for this idea is that in which a heavy brass or copper collard is used to cause a slow collapse of the magnetic field. The well-known method of using a high capacity condenser across the relay is not satisfactory as it will, of course, also retard the operation of the fast keying relay which is used to key the transmitter. The delay timing may be usually adjusted by a turn of the screw at the head of the relay, although in practice this may be accomplished just as easily by altering the applied DC voltage. For Field Day operation a six volt accumulator is placed in series with one of the 12 volt accumulators which are used for transmitter and receiver power supplies to give a selection of up to 18 volts for the unit. The constructor can, of course, easily decide for himself the functions which he requires the unit to perform. In the case of NFD it is suggested that these may be—

1. changing the aerial from the receiver to the transmitter,
2. muting the input of the receiver on transmit or breaking the cathode circuit of the first RF valve,
3. turning on the HT to the oscillator, or, alternatively, swinging the HT supply from receiver to transmitter.

It will be noted that a lead is taken from the relay supply through the key, so supplying an HT voltage of up to 18 volts to an audio-oscillator, the output of which is permanently wired to the 'phones. In such circumstances, if the receiver is muted entirely, or if the receiver is tuned to a different frequency to that of the transmitter, a monitoring note is available. Many operators, however, prefer to listen to the signal actually being transmitted and this may usually be accomplished by using one pair of relay contacts to break the cathode of the first valve in the receiver on transmit, when a faint signal will be heard from the receiver if this is tuned to the transmitter frequency. However, the addition of a simple audio oscillator, adjusted to give a quiet note, enables the operator to hear something in all circumstances.

As a permanent home station unit, in addition to performing the functions mentioned earlier, additional relays may be brought into play and used, for example, as in the author's station—

1. to switch a red light on for "transmit" and a green light for "receive."
From our mailbag

Dear Sir,

The enclosed photograph was taken in the Malcolm Club No. 4 at Wahn where we have converted a spare attic-room into a "radio room." The radio and record programmes are relayed over loudspeakers from there to the club canteen and bar during the respective opening hours.

An old air-raid shelter door was used for the construction of the control desk, which is covered with hardboard taken from a disused partition screen.

The twin turntables and Vitavox 12/20 loudspeaker were purchased from the Decca Gramophone Co. The radio and combined

gram amplifier is an Armstrong R.F.104 chassis, but the moving coil mic. is of an unknown make. The microphone amplifier is a Pem 10 Watt. All necessary switching can be executed at the home-made control unit. The whole apparatus was wired by, and is being operated by myself and an assistant during off-duty hours.

Our record library consists of well over 200 labels, both in normal and long-playing records, lists of which are on show in the canteen. Requests are made from there direct to the radio room by means of a field telephone. Immediately the record number and title has been noted by the librarian, the record is selected from the rack and, together with the request slip, is handed to the turntable operator, who will announce and play the record over the network. When over six records are on hand a small red light fixed above the telephone can be switched on, indicating that no further requests can be accepted until those waiting are played. We have played as many as 30 record requests during one evening, which proves that the programme is indeed popular.

The station is in operation daily, including week-ends.

Cpl. N. SPARRROW R.A.F.
**FREQUENCY MODULATION FEEDER UNITS**

for studio quality, noise free reception of B.B.C.'s, experimental transmissions from Wretham. Tunable 50-100 M.c.s. Latest type valves used. Line up- 1-R.F. Frequency Changer, 2-IF. Ratio Discriminator. A.F. output to connecting equipment. Power supply needed: 250w at 50w, 6.3v heaters.

Kit less valves ... £17 0
Kit with B.V.A. valves ... £10 0

**NEW** 2 IF. Ratio Discriminator, 250w at 50w, 6.3v heaters.

These units use well-known manufacturers IF.'s and R.D. transformer and are built to their specification. Within 30 miles of transmitter good results are obtainable with 1-IF. stage. Prices then reduced.

Kit less valves ... £6 6
Kit with B.V.A. valves ... £9 6

Assembled and air tested

All with circuit, points to point wiring diagram and constructional details. Circuit only 1/8 post free, refundable if kit units are purchased.

C.W.O. please submit demonstrations given Monday to Thursday. Ring for appointment to.

**RADIO AND ELECTRICAL SERVICE**

7 PLENDER STREET
CAMDEN TOWN, LONDON, N.W.1
Telephone EUsion 3155.

**SMALL ADVERTISEMENTS**

continued from page 743

**WANTED** Telescope suitable for Astronomical observations. Please state details and price required. Box No. D124.


**ENTHUSIAST** has for sale tape and disc recorder and accessories, Mikes,blanks, cutters,otterhead, amplifier, feeder, record player etc. Box No. D117.

**FOR SALE** Experimental S.W. Receiver, 180-M, metres, band set and band spread dial, 2 valves, detachable "booster" stage, mains or battery operation, exollo. £18. Portable, in case, offers over £13 only. Box No. D121.

**TRADE**

"GLOBE KING" (Regd) Miniature Single Valve Receiver gets real Dr. Amateur Radio enthusiasts, should send for free copy of interesting literature and catalogue (enclose stamp for postage). Write to Mr. Johnsons (Radio), 46 Friar Street, Worcester.

**BLUEPRINTS** High Gain 10 Meter Converter, with a desk top type comprising EP91 RF stage. EC91 double triode mixer and oscillator, EF92 IF stage. Guaranteed high quality of parts and supplies at highest voltage supply via a 7475. 1st free post free with full instructions. A.S.W.P. 37 Malua Drive, London, W.9.

**KENDALL and MOUSLEY**. Manufacturers of Laboratory Equipment, chassis and instrument cases, also suppliers of B.V.A., valves, Radio and T.V. components, 99 Dudley Port, Tipton, Staffs.

**COILS, COILS, COILS**. We can supply coils for all frequencies, RF Chokes, Filters, etc. Coils wound to specifications and details for estimate. Send SAE for circuits and Data. The Teletron Co., 266 Nightingale Road, London, N.9.

**L.P.E. PUBLICATIONS** 5,500 Alignment Peaks for superhet 5/9. Sample copy The Practical Radio Engineer 2/-. Membership examination particularly 1/-. Syllabus of TV and radio courses free and post free. Secretary, I.P.R.E., 20 Fairfield Road, London, H.1.


**TELEKUT SUPPLY**

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**NEW** 150, 8/4 pair. **BUZZERS**, new (measured) $2.00 per box of 100.

**NEW EARRINGS**. 150 c&m, 8/4 pair. **COILS, COILS, COILS**. We can supply coils for all frequencies, RF Chokes, Filters, etc. Coils wound to specifications and details for estimate. Send SAE for circuits and Data. The Teletron Co., 266 Nightingale Road, London, N.9.


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**NEW RETAIL SHOP NOW OPEN AT**
104 HIGH STREET, BECKENHAM, KENT
SMALL ADVERTISEMENTS

continue from page 747)

METALWORK. All types cabinets, chassis, racks, etc. to your own specification. Philpott's Metalworks Ltd. (Dept. R.C.), Chapman Street, Loughborough.

OSMOR—for efficient coils, colpucks, etc. Send 5d stamp for FREE list of items and details. Dept. RCC, Osmor Radio Products Ltd., 415 Brighton Road, South Croydon, Surrey. Telephone Croydon 51489.

JOIN THE ISWL. Free services to members including QSL, Bureaus, Translation, Technical and Identification Dept. De certificates, contests, activities for the SWL. Monthly magazine "MONITOR" duplicated, containing articles of general interest to the SWL and League members. 10/6 per annum, post free. ISWL HQ, 86 Barringer Road, London, N.10.

ANNOUNCEMENT A. Jerome Alcock, Cheddle, Stoke-on-Trent reports that he is unable to accept orders for bookbinding until further notice, which will be published in this Journal.

VALVES FOR WALKER AMPLIFIER and "Simplex Two" transmitter. Four 2C34 valves and holders 15/- Suitable hefty mains transformer, 22/6. Henry, 220B Canterbury Street, Gillingham, Kent.


APPOINTMENTS

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