THE DAILY EXPRESS

半面在10月6日

现代实用无线电与电视

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

Each item must bear the sender’s name and address. TRADE NEWS. Manufacturers, publishers, etc., are invited to submit samples or information of new products for review in this section.


A COMPANION JOURNAL TO THE RADIO AMATEUR
Suggested Circuits for the Experimenter

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

No. 33: A Voltage Doubling Detector

This month's circuit illustrates an unconventional method of obtaining gain at the detector whilst using diodes. The circuit gives a theoretical voltage gain of two. Fidelity of detection should be equivalent to that offered by a conventional diode circuit.

Operation

The circuit functions in the same manner, largely, as does a normal voltage doubler. When the AC voltage supplied by the IF transformer secondary is positive with respect to chassis, V1 conducts. This causes C1 to charge to the peak value of the applied AC, its right-hand plate being negative and its left-hand plate positive. The voltage across C1 then acts in series with that supplied by the IF transformer secondary, with the result that the voltage applied to the cathode of V2 varies between zero and twice the peak value of the applied AC. V2 conducts and charges C2 to a similar voltage.

R1 and R2 are connected across C1 and C2 respectively in order to allow these capacitors to discharge slightly between successive peaks and thus “follow” the modulation envelope of the received signal. R2 can be considered as the resistive diode load.

In accordance with conventional detector practice the following grid leak should have a value at least four times that of the resistive diode load. In this instance R2 is 0.5 MΩ and R4 is 2 MΩ. Either R2 or R4 may be a volume control, but it might be easier to use R2 for this purpose since volume controls of this value are more readily obtainable.

Possibilities

As may be seen from the circuit, AVC is developed across R2; and it is here that the circuit will probably prove most useful. Whilst a voltage gain of two will give a noticeably increased audio output, with conventional receivers the effect will not be spectacular. On the other hand, a doubled AVC voltage should definitely give better control; as well as providing the incidental benefit of greater tuning indicator deflection.

Either V1, V2, or both, may be germanium diodes, if desired. Thus, when using conventional receiver design, V1 could be the diode section of a diode-triode or diode-pentode whilst V2 could be a germanium diode.

As Pretty as a Picture

This is an example of a picture which might have been taken by any of our readers. Why not go through your own snapshots?

Details of a new competition will be found on page 43—and the photographs need not have been specially taken for the purpose. Any picture of radio interest is eligible.

(Sorry—but we are as intrigued as you are about this particular picture. We just haven’t any information about it at all. Any clues?)

(continued from preceding page)

The Editor Invites

Articles from readers, of a nature suitable for inclusion in this magazine.

Articles submitted for publication should preferably be typewritten, but ordinary writing is acceptable if clearly legible. In any case, double spacing should be used, to allow room for any necessary corrections.

Drawings need not be elaborately finished, as they will usually be redrawn by our draughtsmen, but details should be clear.

Photographs should preferably be large (half-plate) but in any case the focus must be good. Much useful advice to prospective writers is given in our Hints for Article Writers, which will be sent free on request.
IN YOUR WORKSHOP

In which J. R. D. discusses Problems and Paints of Interest connected with the Workshop side of our Hobby based on Letters from Readers and his own experience.

Readers may remember my mentioning some time ago that I was away from this country and that there were liable to be some unavoidable delays with regard to correspondence. I am happy to say that I have now returned. In fact, the time this appears in print I shall have been in the U.K. for several months. I must thank all those who have been good enough to write to me during the last ten months or so for having put up so patiently with the annoying delays which occurred before I could reply. In order to keep in touch as well as I possibly could, I took the precaution of opening two Monogram addresses before leaving; one for air mail, and one for surface mail. It sounds a little complicated, but this system enabled letters to reach me much more quickly than they would otherwise have been the case. I shall, of course, be able to deal promptly with any letters I receive.

Impressions

Whilst I was away I spent some time in Singapore and Hong Kong and I was able to gain a few impressions of things out there from the radio angle.

Amongst other things I attended the radio exhibition held in the Happy World Stadium at Singapore last year. This contained several interesting exhibits, including a broadcasting studio in actual use; but the item which captured the Singapore imagination, almost certainly impressed by this demonstration equipment was used for this exhibit, the demonstration of closed circuit television. Exhibition held in the Happy World Stadium.

Without television, most radio interests are concerned with sound transmission and reception. So far as transmitted programmes are concerned, a large number of BBC recordings are used for English broadcasts both at Singapore and Hong Kong; these recordings consisting mainly of popular items such as "Take It From Here" and "P.C. 49." Radio Hong Kong caters for English and Chinese audiences, this being done fairly easily by using two separate wavelengths; but Singapore has to broadcast to a mixed audience of English, Chinese, Malays and Indians.

There is a fair amount of interest both at Singapore and Hong Kong in high-fidelity reproduction but very little home-construction is attempted, listeners being satisfied with commercial units. LP records seem to sell quite well.

Apart from the peculiar factors raised by the very humid climate in Singapore, servicing seems to raise no unusual problems. Quite a lot of servicing work is carried out by Indians or Chinese, usually under European supervision, and this system works quite well in practice. I was interested to note that the old enemy — "tuning capacitor howl!" on the short wave bands — hardly appeared at all; and when it did, only on the cheaper receivers. This trouble used to be a common complaint when I was in Southern Rhodesia fifteen years ago, and there was also a little intrigued at the comments of a friend in the trade at Singapore when he remarked that many Chinese are interested only in receivers which are simple to operate and give plenty of volume. They do not even want tone controls!

Aerials

One of the first things that caught my eye on returning to the U.K. was the vast array of TV aerials which have sprung up all over the country in the last year. Of course, TV aerials are going up continually all the time, but one needs to be a wary for a while to gain the full impression.

TV has now, fortunately, almost entirely overcome its early impression of being a "rich man's hobby." The initial cost of a commercial receiver is high; but to my mind such expenditure is an investment. Of course, the knowledgeable amateur can enjoy the best of both possible worlds, since he can gain pleasure from building his own receiver as well as saving money in the process. I do honestly think, however, that the quality of the programmes transmitted could still be considerably improved. So far as reception is concerned, a talk, for instance, is only slightly higher than that of a test card. The BBC has always had a penchant towards educating us ignorant types; but I do wish they would suppress their zeal, especially in the evenings.

TV From Batteries

I seem to remember describing, several years ago, a radio set I fixed up for some relatives who live in the country. The point of interest in this particular set was given by the fact that the only available supply was given by a 24-volt battery system. This receiver has been relegated to the background because my relatives now have TV — also supplied from 24-volt batteries!

The set-up they use is as follows: a small ex-W.D. dynamo driven by a paraffin engine gives a floating charge of approximately 10 Amps to four twelve-volt accumulators connected in series-parallel and having a total capacity of 200 Amp hours at 24 volts; these accumulators power a converter in the house (frequency conversion varying between 2 and 10 Amps), and, in addition, feed a rotary converter (ex-W.D. as well) which gives a nominal 24 to 110 volt DC output. The TV receiver, a conventional commercial model, then runs from the converter output. The converter is, of course, only switched on for viewing.

This arrangement has, to date, given no trouble. The converter and dynamo are sited about fifty yards from the set and the aerial is 100 yards away with no interference at all. Indeed, apart from the obvious measures of earthing the frames of the dynamo and converter, and of connecting a couple of 0.01 uF capacitors between the frames and earth, no precautions against interference from this source have been taken at all. TRS wire is used throughout for all connections and wiring. The converter is unregulated but, so long as the batteries are kept fairly well charged, the voltage supplied to the receiver remains quite stable enough for satisfactory viewing.

The only fault I have noticed on the equipment is a small frame "wobble" at the centre of the picture. The wobble occurs at a slow speed and the effect usually clears after half-an-hour or so.

This trouble is, of course, most probably caused by the frequency of the converter output varying from 50 cycles, with the result that the frame time base output is distorted at the "difference frequency," as it were. If this is the case it is quite fortunate that the converter output is a reasonably steady 50 cycles after half-an-hour's running!

For the sake of the record, I had better mention that probably the best method of running a TV set from battery supplies consists of using a converter with a DC output feeding an AC/DC receiver; and that converters of this type are designed for 50 or 110 volt DC inputs, are available commercially.

However, if any reader wishes to have more specific Information on the particular 24-volt installation I have just described, I shall be only too pleased to pass on any facts I know. I would also be interested to hear of any other power supply problems which have been solved by similar means.

Can Anyone Help?

Mr. E. C. Newshead, c/o G.P.O., Hunstanton, Norfolk, would be particularly interested to hear from readers who have converted ex-W.D. units to 'scopes using VCR-7 or CR-138. Information about such units which are still available on the surplus market will also be welcome.

September 1953

www.americanradiohistory.com
Valves and their Power Supplies

PART 10

BY F. L. BAYLISS, A.M.I.E.T.

Trouble Free Service

SO POPULAR is the mains-battery superheterodyne and so convenient and satisfying the facilities that it offers as a general purpose receiver, that, in discussing these receivers again, the writer can only offer this popularity as his excuse.

Moreover, at the present time, the supply of inexpensive metal rectifiers shows little signs of diminishing in the ex-WD markets.

Many of these rectifiers are highly suitable—almost ideal—for use in the power supply circuit of a mains battery superhet, and render the cost of the power pack so low as to tempt even those who require only a battery portable to go the whole hog, for a few extra shillings, and include the mains facility for possible future use.

To those contemplating the inclusion of such a power pack, then, the metal rectifier has much to offer. Simplicity of wiring, robust construction and a lifetime's trouble-free service place it in a class by itself. Even at double the cost it would be worth quadruple in usefulness.

The Circuit

The circuit of Fig. 32 is offered as an arrangement to meet the demands of the most exacting of constructors.

A high degree of smoothing, low power dissipation, maximum safeguard of the valves, ease of switching and accuracy of supply voltages and current, all combine with the inherent simplicity to form a most suitable arrangement.

The 4-pole, 3-way switch gives ‘‘MAINS,” “OFF” and “BATTERY” positions. The “OFF” position is central so that when switching from “MAINS” to “BATTERY” capacitors C2 and C3 are short-circuited to chassis in the central position, thus preventing high surge voltages from damaging the valves.

The switching arrangement has the slight disadvantage that the choke and capacitors C4 and C5 remain at mains potential in the “OFF” and “BATTERY” positions, but, in the writer’s opinion, this is no more inconvenient than the usual arrangement where S2 is placed directly in the upper mains lead. As it is, S2 performs the very useful function of disconnecting the large value electrolytics C4 and C5 when running off batteries, and prevents possible battery leakage.

HT smoothing is effected by the smoothing choke, C4 and C5. It is desirable to prevent too great a voltage rise when running off AC mains—to keep the voltage about equal to the input voltage, in fact, if at all possible.

To this end the values of C4 and C5 should each not exceed 8.0µF, the necessary degree of smoothing being catered for by a good quality choke having an inductance of not less than 20 henrys.

As the components used by constructors will doubtless vary, however, adjusting resistors R2 and R3 have been included to prevent too high a voltage being supplied to the valve filaments. A milliammeter may be inserted between pin 1 of V4 and chassis, and, with the receiver switched on, the adjusting plug inserted to give a reading of approximately 50mA through the valve filament chain. Alternatively, of course, a 500Ω preset type wirewound potentiometer may be used in place of R2 and R3.

The HT voltage is dropped to 90 volts by resistor R1, whilst capacitor C3 gives some additional smoothing to the mains HT voltage, but acts primarily as an HT battery bypass capacitor.

Resistor Rg is used to by-pass the combined anode currents of V1 and V2 and to prevent this current adding to the normal filament current of V3 and V4.

Resistor R7 performs a similar function in respect of V4 by bypassing the cathode current of the half of V4 between pins 5 and 7, i.e. of preventing this current from flowing through the other half of V4 filament.

Final smoothing of the filament current, mains working, is provided by C2.

The correct value of bias resistor with this valve arrangement is 820Ω, but, on mains, the filament chain current also flows through this resistor on its way to the return side of the mains.

An additional resistor, for mains working only, is connected in parallel with the 820Ω resistor Rg. This resistor, Rg, keeps the bias potential at its previous (battery) voltage.

Automatic Bias Voltages

By virtue of the series filament arrangement of the valves, the filaments of valves in the upper part of the chain will be positive with respect to chassis by the voltage across filaments of valves below them.

Thus, instead of returning valve grid leads to chassis, as usually, the grid return may be made to an appropriate point in the filament.
Circuit of a receiver suitable for use with the power supply shown in Fig. 32

List of Components for Fig. 33

<table>
<thead>
<tr>
<th>Component</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>R1, R11</td>
<td>1.0MΩ, 1W Watt</td>
</tr>
<tr>
<td>R2</td>
<td>100KΩ, 1W Watt</td>
</tr>
<tr>
<td>R3</td>
<td>27KΩ, 1W Watt</td>
</tr>
<tr>
<td>R4</td>
<td>47KΩ, 1W Watt</td>
</tr>
<tr>
<td>R5</td>
<td>62KΩ, 1W Watt</td>
</tr>
<tr>
<td>R6</td>
<td>6.8MΩ, 1W Watt</td>
</tr>
<tr>
<td>R7, R10</td>
<td>2.2MΩ, 1W Watt</td>
</tr>
<tr>
<td>R8</td>
<td>1.0MΩ Carbon Potentiometer</td>
</tr>
<tr>
<td>R9</td>
<td>470KΩ, 1W Watt</td>
</tr>
<tr>
<td>C1</td>
<td>0.002μF, Mica</td>
</tr>
<tr>
<td>C2, C9, C15, C16</td>
<td>500pF, Mica</td>
</tr>
<tr>
<td>C3, C4, C10, C12</td>
<td>100μF, Preset</td>
</tr>
<tr>
<td>C5</td>
<td>0.1μF, 1,000 Volts</td>
</tr>
<tr>
<td>C6, C7</td>
<td>500μF Two-Gang Tuner</td>
</tr>
<tr>
<td>C8, C14, C18</td>
<td>0.1μF, Tub., Paper</td>
</tr>
<tr>
<td>C11</td>
<td>500pF, Preset</td>
</tr>
<tr>
<td>C13</td>
<td>200pF, Preset</td>
</tr>
<tr>
<td>C17, C20</td>
<td>0.005μF, Mica</td>
</tr>
<tr>
<td>C19</td>
<td>0.01μF, Mica</td>
</tr>
<tr>
<td>C21</td>
<td>MW and LW Frame Aerial</td>
</tr>
<tr>
<td>C22</td>
<td>Or Osram Type &quot;B&quot; Coilpack</td>
</tr>
<tr>
<td>C23</td>
<td>One pair 465kc/ sec IF Transformers (RSGB, Semi-Midget)</td>
</tr>
<tr>
<td>C24</td>
<td>One Output Transformer Ratio 50:1</td>
</tr>
<tr>
<td>C25</td>
<td>One 30, M/C Loudspeaker,</td>
</tr>
<tr>
<td>C26</td>
<td>One 2-socket &quot;A&quot; and &quot;E&quot; Socket Strip</td>
</tr>
<tr>
<td>C27</td>
<td>One 4-pole, 2-way Rotary Wavechange Switch</td>
</tr>
<tr>
<td>C28</td>
<td>(Not required with Osram Coilpack).</td>
</tr>
</tbody>
</table>

The power supply circuit, as shown in Fig. 32 on page 15, allows some 220V to appear at the valve anodes in the event of one of the valve filaments breaking down.

By taking the HT+ load from a two-resistor potentiometer, as shown in the accompanying illustration, the HT voltage rise is considerably limited should there be valve failure. The mains bias resistor is reduced to 100Ω, to allow for the additional potentiometer current.

FOOTNOTE
The power supply circuit, as shown in Fig. 32, on page 15, allows some 220V to appear at the valve anodes in the event of one of the valve filaments breaking down.

By taking the HT+ load from a two-resistor potentiometer, as shown in the accompanying illustration, the HT voltage rise is considerably limited should there be valve failure. The mains bias resistor is reduced to 100Ω, to allow for the additional potentiometer current.

SEPTEMBER 1953
A CHEAP and EFFICIENT CAR RADIO

By A. Tiel

PART 2, continued from p.635, Aug. '53

The red indicator lamp holder was then wired up with a twisted pair from the heater connections of the RF stage. The white indicator holder should have one side earthed to the chassis and a long flexible lead soldered to the other pole, this lead being brought out at the rear with the other external connections. This lamp takes the place of the green dash lamp which indicates when the car side lamps are switched on, and can be dispensed with if the car is of a different make, or if the set is mounted elsewhere than in the Morris 8 dash. This completes the wiring and the set is then ready for alignment.

As mentioned earlier in this article, it is essential to have the use of a signal generator to align a superhet receiver. The 465 kc/s IF coils are accurately set up by the makers before dispatch, but need trimming when in position owing to additional capacity added by the various wires and components. If a signal generator is available, the technical bulletin from Denco (Clacton) Ltd. gives ample detail on the alignment of the coils. If the constructor has no access to one of these, then it is advisable for him to take the set to the local radio shop where this work can be undertaken for a small charge. The "hit and miss" method is most unsatisfactory and a great waste of time, besides giving disappointing results.

Car Compression

Before fitting any receiver into a car, it is essential that the various electrical components be suppressed, otherwise the noise transmitted from them would make listening impossible. The devices to be suppressed are as follows: each sparking plug, distributor, dynamo, electric pump and windscreen wiper. Not all will give trouble. In my series E Morris 8, the dynamo needed no suppression at all, but the wiper did. In this present car it is the reverse. The wiper gave no trouble, but the dynamo produced a whine which ruined the programme.

To start with, a complete set of plug suppressors are required. These, together with the distributor suppressor, are available at nearly every garage or electrical shop at a cost of around 12/6 a set. Fitting instructions are invariably included, and the fitting of these will also remove television interference.

Next the electric pump. Various values of condensers can be fitted to eliminate the "click" as the points make and break. A 0.01µF low voltage condenser is suitable, and same can be purchased for around 1/- from any shop selling surplus material. First secure the condenser by means of a clip or screw as close as possible to the pump, and take as short a lead as convenient from one terminal to a near point on the chassis, having first thoroughly cleaned the surface to which the lead is being secured. Take another lead from the other terminal and screw under the live terminal of the pump.

To suppress the dynamo, again fix as close as possible to it a 0.01µF condenser, preferably mica (this stands up better to the heat). As before, keep the leads short, fix one to an earth point, and the other to the live insulated terminal of the dynamo. Make sure this is the one connected to the brushes and not to the field. The brush terminal is always the larger or heavier one.

In the case of the wiper, if noisy, follow the same procedure as for the dynamo; a 0.01µF condenser usually being satisfactory.

It is also advisable to earth the engine back to the chassis by means of a piece of heavy flexible copper braid. Secure one end under the cylinder head bolt and the other to a point on...
was not sufficient to warrant it. As this only ever, noticed that interference was picked up when braking due to static electricity being tubes connected to the brakes. It was, how-
terference occurred during the braking periods no steps generated at the brake drums. As this only
be made by using about 20-ft. of VIR cable fixed by means of clips around the boards fixed panel in position by two self-threading screws and brace if necessary to the cross members of the scuttle below. Join the wire which was removed from the green indicator lamp to the lead connected to the white lamp on the panel, so that it lights when the car side and head lamps are switched on. Choose your own position for the loudspeaker, which may be in the hole under the dash or in the glove box, after removing the medallion, or mounted as in my own case under the lower tray behind the gear change lever. Do not use the small 2½" speaker, it will not handle the output comfortably and distortion will result. It was found that the 5" speaker gave good volume and quality. The writer uses a Goodman T27/470 Elliptical P.M. Loudspeaker 4" x 7" which sits comfortably behind the gear lever and gives pleasing quality. Connect the lead from the plate of the 12A6 to one side of the chassis, keeping the lead as short as possible. Allow sufficient slack for engine rock.
Always remember to thoroughly clean the chassis, i.e. scrape away any paint or oil from around the hole to which you are bolting the leads. This is essential, otherwise you may be wasting your time as suppression will not take place. Also keep all leads as short as possible. Aerials
There are two types of aerials available, the metal rod pattern (whip) which fits either to the roof or chassis of the car, or the under-board aerial which is fitted beneath the car chassis. In the case of the former, it may be necessary to screen the lead down to the set; earth the screening braid as close as possible to a point near where the aerial enters the car, and again adjacent to where it plugs into the set. M.B.C. screen plugs and sockets are ideal as connectors and can be purchased at most Radio Dealers.
Quite a satisfactory underboard aerial can be made by using about 20-ft. of VIR cable fixed by means of clips around the boards underneath the car, or as in my particular case by winding them around the hydraulic copper tubes connected to the brakes. It was, how-
ever, noticed that interference was picked up when braking due to static electricity being generated at the brake drums. As this only occurred during the braking periods no steps were taken to eradicate it, as the interference was not sufficient to warrant it.

Installation
This applies to the 1949/52 Morris 8. First remove the grille which, in the earlier models, is secured by three small nuts at the rear of the dash. The later type have pegs which are held in position by spring clips, so by gently pulling, the grille slides out. Next remove the dash indicator lamp which is secured by the locking nut on the choke control. It may be necessary to lengthen the leads to the wiper switch in order to have a clean entry into the dash. Gently slide the case through the hole and fix panel in position by two self-threading screws and brace if necessary to the cross pieces of the scuttle below. Join the wire which was removed from the green indicator lamp to the lead connected to the white lamp on the panel, so that it lights when the car side and head lamps are switched on. Choose your own position for the loudspeaker, which may be in the hole under the dash or in the glove box, after removing the medallion, or mounted as in my own case under the lower tray behind the gear change lever. Do not use the small 2½" speaker, it will not handle the output comfortably and distortion will result. It was found that the 5" speaker gave good volume and quality. The writer uses a Goodman T27/470 Elliptical P.M. Loudspeaker 4" x 7" which sits comfortably behind the gear lever and gives pleasing quality. Connect the lead from the plate of the 12A6 to one side of the Transformer. The other side of the transformer joins to the HT lead from the set (see connection diagram). From the power supply, whether rotary or vibrator, take the positive HT to the HT side of the speaker transformer and the negative HT to the frame of the set. Heaters are connected across the battery. Finally connect the aerial, which may be the roof or under-board type. The set is then ready for operation. Do not run the receiver with the speaker transformer disconnected, or damage will be done to the output valve.

Power Supplies
Either small Rotary Converters or Vibrator Packs with an input of 12 volts and an output of 250 volts 50mA. will be satisfactory as an HT supply. For the 12 volt car, a surplus rotary transformer type 104 Ref. 10K/238 gives ample output for the satisfactory operation of the set. It is rather a large unit, as there is an additional low tension output from a third 6 volt commutator. This is the unit which has been used consistently over the past 12 months with the prototype. The approximate current drain when running under load with a 12 volt supply is 3½ Amps, plus ½ Amps for the heater supply, giving a total drain of approximately 4½ Amps. There are available much smaller rotary converters with an output of 250 volts at 50mA, which draw just over 2 Amps from the battery. For 6 volt car owners, the dinghy rotary transformer type 1 Ref. 10K/13043, will be suitable. It is advisable to remove the handle and gear wheels from this boards. If 6 volts are fed into the low tension end an output of about 220 volts will be obtainable. Do not forget to close the shunt circuit, i.e. join LT "A" negative to the terminal marked " F " in the centre of the frame. Another useful rotary is the type 57 6 volt. Ref. 10K/706. All these units can at present be obtained from Messrs. Jobstocks, 91 Beulah Road, Walthamstow, E.17.
For further information, the total HT draw from the rotaries using the surplus 12 volt valves is approximately 47mA. In the case of the two 6 volt units already mentioned, these are without smoothing. Invariably, a 0.01µF
FOR BEGINNERS—Resistor Colour Code

Resistors are valued in ohms (Ω), and to denote this value each is painted in colours which are conform to a standard code. There are three arrangements, the first of which employs a body colour, a coloured end, and a coloured spot superimposed on the body colour. In the second method this spot is replaced by a coloured band. Where either the spot or end colour, or both is not apparent, then the appropriate colour is the same as that of the body. In the third method of marking, four bands of colours are used, grouped towards one end of the resistor. The innermost band of these, and any silver or gold band which may appear in the other two methods, are used to indicate the tolerance percentage and for the purposes of this article may be ignored.

The body colour, or outermost band, indicates the first significant figure of the value. The end colour, or second band, gives the second significant figure. The colour of the dot or band superimposed on the body, or that of the third band in the other method, gives the number of “noughts” to follow these two significant figures.

<table>
<thead>
<tr>
<th>Colour</th>
<th>Figure</th>
<th>Colour</th>
<th>Figure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Black</td>
<td>0</td>
<td>Green</td>
<td>5</td>
</tr>
<tr>
<td>Brown</td>
<td>1</td>
<td>Blue</td>
<td>6</td>
</tr>
<tr>
<td>Red</td>
<td>2</td>
<td>Violet</td>
<td>7</td>
</tr>
<tr>
<td>Orange</td>
<td>3</td>
<td>Grey</td>
<td>8</td>
</tr>
<tr>
<td>Yellow</td>
<td>4</td>
<td>White</td>
<td>9</td>
</tr>
</tbody>
</table>

Examples

First, in the parts list it will be noticed that some values are given in Ω (ohms), whilst others are in kΩ and MΩ. k and M are, respectively, abbreviations commonly used to denote thousands (kilo) and millions (Mega). Thus, R2, 33 kΩ, is 33,000 ohms and R12, 2 MΩ, is 2,000,000 ohms—which is more often called 2 Megohms.

Taking the colour code given above, R2 will in the first two methods be totally orange in colour (with perhaps a silver or gold marking to denote the tolerance) and with the third method will have orange for the three outermost bands. R18, on the other hand, will have an orange body and end with a brown spot or band superimposed on the body, or alternatively the outer two bands will be orange, and the third band brown. It also has a 1 Watt rating as against the ½ Watt for R2, and will thus be longer physically.

The “Inexpensive” Car Radio Receiver Cabinet, which may be mounted either vertically or horizontally, according to the space available.

Experimental Transmitter for Television Students

The Television Society has built an experimental 405-line transmitter to operate on 427 Mc/s with a peak power of 12 watts. The equipment is being installed at the Norwood Technical College, and in addition to providing a test signal for members interested in U.H.F. reception it will serve as a demonstration for students attending the television training classes in the College.

The call sign is G3CTS/T, and it is expected to put a signal on the air by the end of July.
WHEN THAT MIGHTY MIDGET, the transistor, was first announced in 1948, many constructors began to look forward to real breakaway in contemporary radio design. With the big American corporations eagerly competing to put it into harness, few guessed that to-day, five years later, transistors would still be beyond our practical experience. For us they are "just around the corner" and it seems it will be a year or two yet before we can use them in our circuits.

It is doubtful that, even in its perfected form, the transistor will supersede the thermionic valve. There are a lot of jobs the germanium valve can do that the transistor cannot do, for the uses of the valve have now become legion. Even in its present state of development there are many production snags to be ironed out before the manufacture of transistors on a large scale can be achieved, and Defence and National services rightly have priority. Germanium itself is plentiful enough but its refinement to a meticulous degree of purity has to be made before it is fit for use. Then impurities have to be introduced, with equally meticulous care!

Possibilities
The lack of access by British constructors has given rise to some doubt whether the transistor is all that it is cracked up to be. Early reports are invariably over-enthusiastic. Most of the apparatus described which incorporates them has come from American sources, and over there they are still in short supply and very expensive. The general impression in Europe is that, as a substitute for the valve, they are not yet the valve's equal, and this seems (at present) to fairly summarise the position. Thus interest in them is not so great as it might be if the transistors were as revolutionary as the early enthusiasts claimed. It is natural that constructors should ask themselves why pay a high price for a substitute of doubtful efficiency?

True, they require very little power — it is claimed that some of the later types will oscillate or amplify with a total power as low as 10 microvolts — but modern valves are economical and, after all, for most radio purposes we are able to draw our power from the mains supply. Their advantages for portable use are obvious. The power supply is the bulkiest, and by far the heaviest part of portable equipment. A little reflection, however, suggests a wide extension of many existing radio uses as well as new applications.

The transistor might easily make the battery TV receiver an everyday affair. We cannot have a germanium CRT, but a battery CRT combined with an all-transistor receiver, is a readily conceivable probability. When that becomes cheaply possible our present TV system may have become old-fashioned, but doubtless the transistor, once established, will keep pace with other developments.

Problems
Since the introduction of transistors it has seemed that as soon as the production of one type gets going a new model that greatly out-performs earlier patterns emerges from the laboratory. Thus we can console ourselves that our lateness in having them out-performs earlier patterns emerges from the laboratory. We can therefore console ourselves that our lateness in having them is a technical rather than a commercial advantage. A few years will see the transistor in full production and competitive with the valve.

Also in the Picture
The American periodicals have widely publicised the transistor and given much prominence to the development work carried out by their big radio corporations. The result has tended to produce an impression that it is an all-American device.

This is far from the truth. The extraction of germanium (from chimney soot) was a discovery of British scientists made before World War II — in 1937 in fact. We still produce all the pure germanium we need. Should they run short of raw material I can let them have a few bags of soot to go on with and no doubt many others will oblige in like manner. In exploring its possibilities a whole lot of other experimental work has been done in Great Britain, too.

One very useful feature of the transistor is the absence of a warming-up period, when valves need. It is of only minor importance for broadcast and communication uses, it is of great advantage in many electronic applications.

The economy in size, weight and power drain, are of paramount importance for many uses, and on these points it will score heavily over the valve. Its employment for deaf-aids, etc., are obvious. Less apparent are uses such as those in miniature transmitters and receivers. Such a transmitter attached to a roving microphone and fed back to the main transmitter or recording point would enable commentators, or actors on screen or TV studio sets, to roam about freely without the need for long wires to trip over, or microphone booms to clear the top edge of the frame.

Center Tap talks about

Wot! No D:F.?
The interference which marred TV reception over much of south-eastern England during the week or so prior to the Coronation fortunately stopped in time for the televising of that ceremony. It appears that the B.B.C. were inundated with complaints and enquiries. In fact they had to appeal to viewers to desist from "phoning them.

It was astonishing to hear the announcer, even after a week of the interference, refer to it as an "unidentified" signal being the cause of the trouble. Surely someone has some D:F. equipment? Even without, one might make a pretty accurate guess.

In my own locality it greatly varied from house to house, depending on the aerial sitting. At home, signals from A.P. are quite adequate with an indoor dipole stood on the floor at ground level, at the back of the house.

At the front, the dipole has to be at least twelve feet clear of the ground to pick-up a comparable signal.

At the time of the trouble the only other band I was equipped to check on was around 145 Mc/s. There the conditions were on the poor side and no DX at all was to be heard. So sporadic-E seemed the answer.

When the full number of transmissions between 40 and 60 Mc/s get on the air, what fun and games we are going to have with each time similar conditions occur.

No Names, No Pack Drill
Thinking of 145 Mc/s reminds me of a complaint by a reader regarding the failure of certain amateur users of this band to QSL.

Presenting a new angle, he says these most lacking in courtesy seem to rank in inverse proportion to their prominence in the hobby. QSLing on the V.H.F. bands has some additional importance in qualifying for awards, etc., apart from the question of good manners. This reader complains particularly of a number of prominent amateurs who had either requested a card from him or promised one and subsequently failed to respond. A check with a few others shows that they had not only been guilty of letting this reader down.

This column cannot normally concern itself with specialised interests, especially as there are periodicals devoted to transmitting affairs. As he points out, one of these has on several occasions vaguely threatened to "black-list" such offenders, but he believes they dare not do it. Perhaps the recently formed International V.H.F. Society will take a more courageous line in this matter through the columns of their lively paper The Upper Spectrum.

Among the absences common to several lists appear two members of the R.S.G.B., a regular writer of the V.H.F. column, and one or two others well known in amateur circles. It is a rather disturbing state of affairs when the chief offenders appear to be the very people who might be expected to best exemplify the amateur spirit.

K1.I, P2. Tog.3.
Last month's problem, No. 3, size referred to knitting needles which happen to be 1/2 inch diameter. As they are available in a wide range of plastics and similar insulating materials of all colours, they make excellent and cheap extension leads, etc. Those who didn't guess, please look back at the clue to check if it really helped to make it as easy as I thought.

24

THE RADIO CONSTRUCTOR

953

25

www.americanradiohistory.com
The “UNIVERSAL” Large Screen 

AC/DC Televisor

(by kind permission of IKOPATENTS LTD.)

Wiring of Components

PREVIOUS SKETCHES AND THE TEXT have explained the procedure for voltage selection, but the actual mechanical connections require special treatment. These should not be soldered to the tapping points anywhere. The wire-ends must be made into ringed shapes and tapping connections effected by nuts and bolts.

It sometimes happens that considerable heat is generated or dissipated in these components, and your writer has known soldered joints to melt. Subsequent damage can be caused by the solder falling on other parts.

Readers residing in AC areas may be dubious about building a receiver employing series-heater technique. Without discussing matters of economy, although quite a considerable saving is made in this TV, it is a fact that with a properly designed series arrangement the stability, regulation, and life factors of the heaters, both in the valves and CRT, are very high indeed.

In a parallel heater line-up, a considerable surge is experienced due to the transformer employed. In the series system this is easily controlled; in this case by the VA1800, and the A2/1 (7500 resistor). Evidence of this is given by the fact that the warming-up period of the “Universal” is approximately Two Minutes Before the Picture Appears. Readers should make a note of this lest they experience any apprehensions when switching on for the first time.

Photographs and Sketches

The “Universal” TV has been well illustrated and it was felt that with a point-to-point heater wiring diagram, and by showing the disposition of a reasonable number of resistors, condensers etc., adequate direction was available. Where a group of resistors shown are numbered, say, R3, R6, R7, quite obviously in that stage R4, R5 etc. would be present in the actual receiver, but perhaps not visible in the illustrations.

One such example; R4 and similar resistors throughout the receiver. R4 is soldered directly to pin 8 and to pin 7 of V1. Then from pin 8, R5 is soldered to the tag-strip where connection is made to the HT+B supply. The constructor, by
cross reference to the sketches and photographs and careful recognition of the valve internal parts seen in the valve base chart may, stage by stage, wire in the components, completing each in sequence.

NOTE—The Black Dot shown beneath each valve in the valve drawings is, of course, the equivalent of the recessed or missing pin hole seen in the valveholders. The CRT base is wired with the key or slot as guide.

Coils
Bolt into position the tuning coils in the order as shown and note carefully the coils shown in dotted lines, L4, L5, L7, L8. These, with L12A/L12B, are mounted on top of the chassis, the remainder underneath. Before wiring up, test L1 aerial coil (Red PVC) and grid-coil, and make sure no continuity is possible to chassis before proceeding. At the completion of the first stage connect the HT circuit and bring a connection to the tag-strip of this supply for joining to R5. In this way, each stage may be completed before moving to the next.

It should be possible to have really short leads by directly mounting to the valve pins the resistors and condensers associated with each valve. Notice that R24 and R25 are shown as the single 2-watt type, but this may be two resistors in parallel as described in the component list.

General Wiring
A solder tag is placed for convenience under one of the bolts near the Contrast, Brilliance, and Volume variable resistors. The leads for these controls may be brought through the two large holes provided on the chassis front. It is recommended that coloured PVC or sleevings be employed in the wiring-up. Thus, Black could be chassis, Red-HT, Green-Heaters, and so on. In this way final checking is greatly simplified. Coloured leads may now be attached to the deflection coils, to 4-6-1-3. These are brought down beside the Linearity and Width coils for subsequent attachment to Line-output and Frame-output transformers. (Make a note of the colours selected). The deflection coils can now be placed into position and lightly bolted to the support (Part D). A washer of insulating material is placed between the coils and focus unit to prevent shorting the deflection connections. The Line-output transformer may now be installed. This is drilled especially for small Parker-Kalon self-threading screws. The EHT rectifier is carefully soldered into position as shown in the sketch. The greatest consideration must be given to the soldering—sharp points should be avoided. The EHT lead is attached as shown.

Note Orientation of transformers on chassis. The frame transformer is positioned by the side with black-white leads. These are adjacent to the Line-output transformer.

Mains Connections
These are made directly to the two fuses (2A) and from there direct to one side of the double-pole switch. Check the switch with continuity meter to ascertain the correct contacts, thus avoiding a short when first switching on. Take a connection from the other side of switch to chassis on the adjacent solder-tag. Take a connection from the other side of switch to chassis on the adjacent solder-tag. The remaining contact is taken to "Negative" on the rectifier, which provides an excellent anchorage for connection to the Heater Dropper.

Note The power supply sketch has shown the switch in the wrong position. It should be after the fuse.

Testing Circuits
Make sure that the cans for L4—L5 and L7—L8 are not fouling the coils and condensers. Check the heater-chain again as outlined before. Ascertain that the voltage droppers are tapped to suit the local mains supply. Test mains input connections to make certain there are no dead shorts.

SEPTEMBER 1953
Test HT circuit to chassis to detect possible shorts.

(Readers not possessing a meter may improvise with a battery and bulb for continuity testing).

Installation Considerations

At this stage the constructor is virtually in a position to install the CRT and valves, and switch on. This requires carefully sliding the MW43-64 in from the front and bolting up parts G. When tightly bolted, it is possible to work with the “Universal” in any position. However, it is recognised that a great many readers may experience misgivings at this procedure.

A simple and easily made answer to this situation would be the creation of a temporary CRT mounting away from the chassis. Longer leads to the tube would, of course, be required. With such an arrangement the constructor would undoubtedly have greater access to the entire chassis, or alternatively may be planning a cabinet design in which this would be a permanency.

Measurements for this auxiliary mounting are taken from the chassis parts. When the receiver is properly lined-up, the CRT is restored to its proper place and the base connection shortened.

Note A temporary connection from the tube-coating is also required to chassis, to be made a permanency later.

(To be continued)

G.E.C.

GERMANIUM TRIODE GET 1

A GERMANIUM triode of the point contact type which has for some time past been exhibited by the Research Laboratories of the General Electric Co. Ltd. at the Physical Society and similar exhibitions, is now in pilot plan production in the Company’s works and is available to equipment makers in sufficient quantities for experimental work and prototype equipment. The triode uses single crystal germanium, and the unit is hermetically sealed in a metal can insulated from all electrodes. Flexible leads are provided for the connections. The triode is suitable for use in amplifiers, oscillators and for electronic switching applications. Its low power consumption and electrical characteristics make it ideal for digital computer work.

Technical Details

The accompanying diagrams illustrate a typical circuit employing the new transistor (Fig. 2) and also characteristic curves of the device (Fig. 3). From these the reader can see that the current gain is greater than 2, that the “knee” voltage is less than 3, and that the collector current at -30V for zero emitter bias is less than 2 mA. The maximum D.C. collector voltage is -50V, but normal operation is with much lower voltage, supplies of 224V being typical. Whatever the collector voltage used the dissipation should be kept below 100 mW.

The most reliable arrangement for the amplification of small signals incorporating G.E.C. point-contact germanium triode. A power gain greater than 17 dB can be obtained.

G.E.C.

GERMANIUM TRIODE GET 1

A GERMANIUM triode of the point contact type which has for some time past been exhibited by the Research Laboratories of the General Electric Co. Ltd. at the Physical Society and similar exhibitions, is now in pilot plan production in the Company’s works and is available to equipment makers in sufficient quantities for experimental work and prototype equipment. The triode uses single crystal germanium, and the unit is hermetically sealed in a metal can insulated from all electrodes. Flexible leads are provided for the connections. The triode is suitable for use in amplifiers, oscillators and for electronic switching applications. Its low power consumption and electrical characteristics make it ideal for digital computer work.

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Fig. 3.

"There’s a lot to be said for Steam Radio”

ERRATA

On Data Publications Order Form, page 53, under Miscellaneous Books, the third line should read Receivers (R.S.G.B.) 3/- postage 2d, and the fourth line Simple TX Equipment (R.S.G.B.) 2/- postage 2d.

SEPTEMBER 1953
SEMI-COCONDUCTOR

by A. L. PARDEW

A Survey of rectifiers, crystal diodes and transistors

ALTHOUGH devices relying on their special properties have been in common use for many years, semi-conductors have been very prominent in the technical news recently. This is largely because of recent developments which open up new fields of application. Most of the existing uses of semi-conductors are for rectification. New uses include amplification, and it is reasonable to suppose that we are on the threshold of development as fruitful as those which followed de Forest's introduction of the grid into the Fleming diode.

Semi-conductors are already developed to do many of the jobs which were hitherto the exclusive prerogative of thermionic valves, and their advantages over the latter are sufficiently indicated by the definition of two features, namely, the hot emitter and the vacuum which, whilst essential to the operation of thermionic valves, were also the main weakness.

Before considering individual devices, a few notes on their general mode of operation would be a useful preparation. This type of rectifier would have zero resistance in one direction and no current in the reverse direction, there would be no dissipation to cause heat and infinitely large powers could be handled. In practice, all rectifiers are imperfect to some extent, and the purpose for which they can be used and their ratings depend on the degree of imperfection. A detailed study of rectifiers, therefore, is chiefly a study of their limitations. The thermionic valve is included below for comparison since it is probably the type of rectifier most familiar to the majority of readers.

**Rectifiers**

Before considering semi-conductor rectifiers in particular, a few general words on rectifiers will be a useful preparation. The rectangular nature of the current-voltage characteristic of rectifiers is illustrated in Fig. 2 and 3 on pages 33 and 34.

**Vacuum Valve.** Because of the vacuum between its electrodes this type of rectifier will withstand high reverse voltage. Receiving types will work at over 1,000 volts and the largest X-ray types go up to 250,000 volts.

**Germanium Crystals.** In the search for a suitable Radar mixer, germanium was con-
Manium crystal is shown in Fig. 1. This is a general purpose type such as the GEX45/1. Back voltage types tend to fall in price. The lowest back resistance that the circuit will tolerate. The exact properties depend on the purpose it is usual to select the grade with the higher back resistance. The higher the back resistance the higher the capacitance, good high frequency performance, very long life and absence of a heater. The back resistance is, in present production, approximately 300 μΩ. No measurements of back current or limits are imposed at other values of voltage, but the back resistance will tend to increase with decreasing voltage, reaching a maximum at about -3 volts. This variation in back resistance with applied volts is sometimes overlooked, but it is very important to take the effect into account when designing circuits around crystals. At very small values of applied voltage the forward impedance rises and the back impedance falls, so that the front to back ratio falls to a lowish figure. The most widespread use of germanium diodes at the present moment is probably in the sound and vision detector stages of T.V. sets, but their small size and other convenient features have resulted in large numbers of miscellaneous applications in electronic equipment.

 Junction Diodes. The rectifier formed by a junction between 'p' and 'n' type material gives a power rectifier which is superior to either copper oxide or selenium. Efficiency is so high that size can be enormously reduced. Germanium junction rectifiers are in production in U.S.A., but are not yet available in this country. Silicon can also be used but, for this purpose, it has the advantage of giving better performance than germanium at higher temperatures.

 Point Contact Transistors. The action of the current in one whisker affecting that in the adjacent one is best explained by regarding the first whisker as injecting positive holes into the semi-conductor and making it more conductive. The whisker used for this purpose is known as the emitter, whilst the other whisker is called the collector. The 'n' type germanium which is the usual semi-conductor material employed in these devices is called the base. The device is shown diagrammatically in Fig. 2. Its family of curves shown in Fig. 3 bears some similarity to that of a thermionic pentode but this similarity does not extend very far. It will be noted that the collector current is plotted against collector voltage for various values of emitter current instead of voltage. The input impedance of a transistor is low and usually below 500 Ω. The output impedance is in the region of 20,000Ω. Circuits to use them have to be different in many respects from those which are familiar for thermionic valves, and a new approach is needed. It is better to regard the devices as current amplifiers rather than voltage amplifiers. No attempt will be made here to go into detailed applications, but it is thought that the most fruitful fields will be in computers and in Service equipment where space and ruggedness are at a premium. It will be noted that a negative H.T. supply is needed for point contact transistors, and that positive bias is applied. Input and output signals are in phase and, since there is a current gain within the device, negative resistance effects are readily obtained. The upper frequency limit of transistors at present is production is in the neighbourhood of 2 Mc/s, but by special techniques operation up to hundreds of Megacycles has been achieved. Two rather severe limitations of the point contact transistor are its high noise factor and its limited power dissipation. These devices are now available in limited quantities in this country at a price which at present is high but will fall as production builds up. More complex transistors using additional contacts are the subject of further experiments.

 Junction Transistors. The junction type transistor is more recent than the point contact type, and in some directions has distinct advantages over it. It is, however, not necessarily better in every case and does not render it obsolete. It can handle higher power, but has a lower limit of frequency. Its noise factor is appreciably lower. One method of producing the necessary junctions is by diffusing a metal called indium from both sides into a piece of 'n' type germanium. If properly controlled this produces two zones of 'p' type germanium separated by a thin layer of the original 'n' type material. The device is shown diagrammatically in Fig. 4. The junction transistor is capable of giving good amplification at extremely low values of applied voltage, as can be seen from the curves in Fig. 5; and amplifiers can be made with a high tension supply of 1.5 volts or less. Obvious applications for this device are in deaf aid amplifiers and local telephone amplifiers. A truly enormous field of application is available when these devices can be produced in quantity at a reasonable price. At present there is limited production in America, but none in Great Britain. Here again more complex devices with additional junctions are being explored.

 Photo Transistors. The reverse current in a point contact germanium diode can be increased by shining light on it. This is the basis of the photo transistor which gives a photo cell of extremely high sensitivity and excellent frequency response coupled with minute size. These devices are not yet in production, but an obvious application would appear to be in calculating machines using punched cards.

 An enormous amount of effort is being expended all over the world on the study of semi-conductors, and it is reasonable to suppose that the future holds the development of devices which will make those at present available just as crude, in comparison, as the early bright emitter values now seem compared with modern button based miniature valves. There seems no doubt that semi-conductors will remain in the news for many years to come.

THE RADIO AMATEUR

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THE RADIO CONSTRUCTOR
Stern Radio Ltd., of 109 and 115 Fleet Street, London E.C.4., have designed a Vibrator Power Pack which, apart from its other uses, is eminently suitable for the "Inexpensive" car radio receiver currently being described in this magazine.

The power pack is completely self-contained in its own metal case, and may thus be fixed in any suitable position, the input and output leads being screened to prevent any interference.

The accompanying illustration clearly shows that economy of space has been achieved without any undue cramping, and that the construction should present no difficulty at all to any reader.

The pack may be used with either 6V or 12V input, depending upon the type of vibrator and transformer which is employed. Either series or shunt types of vibrator may be used. The output is 220V at 50 mA.

A complete outfit of components, case, sleeving, wire, screws and everything necessary to build the power pack costs £3, but components can also be supplied separately. This is a useful point where the constructor may already possess some suitable items. There is also available, at 1s, a set of instructions with circuit and wiring/layout diagrams, and component price list.

Messrs. Radio Servicing Co., now of 82 South Ealing Road, London, W.5., have forwarded to us their latest catalogue No. 12.

This is a very well produced publication indeed; on art paper, and with a very durable cover, it will "last" well in the shack—and we can forsee it being used quite often for reference purposes. One useful item not always incorporated in catalogues is an index, but this has one which is also comprehensive.

All the items listed, by the way, are currently manufactured, not ex-WD, and they are well illustrated with, in many cases, such useful information as dimensions included. There are 70 pages and 250 illustrations—and the price is only 1s.

The Edison Swan Electric Co., Ltd., are now producing a Cathode Ray Tube with a 14" round bulb. Designated type CRM.141 this tube is fitted with an ion trap tetrode gun assembly and has an aluminised screen. The face plate is of clear glass and the tube has a B12A duodecal base. List price of this tube is £14 15s 0d plus £5 15s 1d Purchase Tax.

A further addition to the Ediswan/Mazda range is the 20P4, a new line time base output tetrode. This valve has a re-designed screen (G2) the dissipation of which has been greatly reduced, thereby enabling the valve to handle considerably higher current pulses on the active portion of the operating cycle. Owing to the improved mutual coupling figure the power sensitivity of the valve has also been increased. List price of the 20P4 is 17/6d plus 5/9d Purchase Tax.
THE "SIMPLEX" THREE

A Simple Gram Amplifier for the Beginner

by E. GOVIER

MANY beginners, at some time or another, have probably felt the need for a simple yet inexpensive amplifier for use with a gramophone pick-up, or even a one or two valve receiver. To judge from readers' letters in "Mailbag," many of them beginners in the art of radio construction, it would appear that the following specification would be most popular:—

Output 4 watts approximately, few component parts, cheapness, simplicity of construction and last but not least, availability of parts. All of these considerations have been complied with in the circuit presented herewith. No attempt has been made to provide negative feedback, and, being a simple amplifier, the only refinement incorporated is a simple top-cut tone control.

A good idea of the layout, both above and below chassis, will be obtained from the photographs and these, together with the circuit diagram, should present intending constructors with a clear picture of the unit—both theoretically and physically.

Circuit

This is shown in Fig. 1, from which it will be seen that it is a two stage amplifier with built-in power pack. The first stage comprises a 6J7 pentode with variable input circuit suitable for any high impedance moving-iron pick-up. Should a low impedance pick-up be used, a matching transformer will be required—in which case the manufacturers will advise the type of transformer and input impedance required. For those that have the valves at hand, the 6J7 could be replaced without circuit alterations by an EF36 or an ex-Government VR56. A simple top-cut tone control is incorporated in the anode circuit (C3 and R5) and this has been found to perform satisfactorily in the final design.

The output from V1 is fed into the grid of V2 via C4. This stage, comprising a 6V6 output pentode, is entirely conventional and should present no difficulty to the beginner. Provided the circuit values given are adhered to, and a similar layout used as shown in the prototype photographs, no trouble should be encountered. Again, for those with a stock of valves, most other pentode output valves could be utilised here, although the value of the bias resistor R7 may require modification in order to obtain the correct bias voltage.

The power pack is also conventional and any mains transformer capable of supplying 250—0—250 volts at 60mA may be used. The one shown in the photograph is an Ellison Type M.T. 162 (see component list). The rectifier valve is a 5Y3 although any similar type could be employed. No hum trouble was experienced in the original model, and the power pack layout should be closely followed in order to obviate any 50 c/s mains ripple being induced into the circuit. SI is incorporated in the potentiometer R5.

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THE RADIO CONSTRUCTOR

SEPTEMBER 1953

Showing that the "Simplex" is well named!
Delay Device

A COMMONLY used and easily made component is shown in Fig. 32 and this is a pneumatic device which actually receives its power from the movement of the selector armature.

The body is a small drum cut from an aluminium or tinplate can about 1" in diameter, about ½" being cut from the closed end. A small hole is made with a needle in the end, and a small scrap of balloon rubber is held over the hole by a ring of draughting tape as shown. This forms a non-return valve.

A piece of rubber is then stretched lightly over the open end and secured by rubber solution smeared on the edge of the can and by a thread binding. A small circle of aluminium or tinplate by a clip around its periphery in such a position that a striker on the armature depresses the diaphragm when the armature is attracted.

Owing to the flap valve preventing air from entering the drum except as a slow leak, the diaphragm with its contact will not immediately follow the striker when the armature returns, and if the selector is stepped immediately to the next position the delayed circuit is not energised. If a ½ second or so is permitted to elapse, the contacts close and operate the delayed circuit.

This device can be used in 'reverse' in one special case. Where a three-way steering selector is used (as in Fig. 23) it may be very desirable to avoid adding a separate motor control position (as explained in the next section). In this case the delay device can be used from the other side of the armature so that the contacts are held permanently open by the armature at rest.

When normal short steering pulses are sent, the delayed contacts never close; but if a long pulse is sent they operate the motor selector. Admittedly this long pulse will introduce a spurious steering step, but it can immediately be cancelled by the quick transmission of two short pulses, thus restoring the steering (but leaving the return stroke largely because the power then comes from the tension spring and is not subject to variation as the batteries run down.

Control Box for Selector Systems

All selector systems may be controlled by a simple rotary switch as described for escapements, and when the steps are limited to 3 the device shown in Fig. 33 can be used and is very effective. In this application, since the port and starboard positions of the control lever represent port- and starboard-going positions rather than definite angles, the control lever should be spring-loaded to the central position as shown in Fig. 33. This will be found more natural in use, since the knob is pressed over in the correct direction and when released springs back to central; this central position now means 'Hold' (whatever rudder angle is applied) and not necessarily 'Amidships.'

To operate the motor control in this system involves the transmission of one long and two short pulses. These can be sent by the manual microswitch, but more realism is obtained by fitting a separate knob having on the inside of the control box a wiper arm moving over three contacts, one long and two short. Fig. 34 shows the rear view, and it will be seen that by 360° rotation a suitable signal is sent for stepping the motor selector on.

To avoid having to remember the motor sequence, the wiper shaft can be driven by 4:1 gearing from another shaft which is rotated 90° at a time; its knob can then be marked out with 4 positions.

In either case a 'click' mechanism should be fitted, accurately to locate the knob after its travel.

Clockwork pulsing units (as in Fig. 17)

Radio Control Equipment

PART 7

By RAYMOND F. STOCK
The apparatus is divided into two parts. On the left is shown a pulsing disc having 8 contacts around the edge, working against a fixed contact. One keying lead goes to the latter and the other to a light brush bearing against the wheel to preserve continuity. A micro switch is in parallel with the contacts, for manual keying.

Rotation of the disc sends pulses, and the selector in the model follows the movements of the disc. The disc is mounted on a shaft geared down from an electric motor, and current goes to the latter via a metal wheel on the pulsing disc shaft and one of 8 brushes. A light copper foil brush is arranged to bear on the disc near the centre to make contact is supported on a perspex block which forms the base of the unit. 8 copper brushes are riveted to the base and press lightly on the disc near the edge. The insulating segment can be a simple cut-out in the disc, or a hole filled with some thermoplastic insulation filed off flush with the surface. It is necessary to arrange that the keying contacts 'make' about halfway through the travel of the disc from one position to the next.

8 small silver or copper rivets are soldered to the edge of the disc, and the static keying contact is supported on a perspex block which forms the base of the unit. These brushes are connected to the various operating circuits. The ratio should be such that the keying is carried out as fast as possible within the capabilities of the selector to follow signals.

Any number of separate control switches and buttons can, in this way, be used to transmit their orders through a single channel, and there is no theoretical limit to the number of complete sequence positions. A local power supply for the motor is required, of course, and a separate battery within the control box is a convenient source.

The shaft supporting the disc carries a worm wheel driven by a worm on the motor shaft, but a simple gear train from a clock can be used.

The output obtained is approximately 3 watts with good quality. With this inexpensive and easy to construct amplifier, the reader will find it comparatively easy to add further refinements at a later date as finances and time permit.

Radio Snapshots

There can be but few readers who neither own, nor have access to, a camera, and to encourage an increase of readers' photographs in our columns we have devised a simple contest.

Readers with inexpensive cameras will stand an equal chance with those possessing "all the gadgets," for the subject of the photograph—so long as it will reproduce satisfactorily—will be the deciding factor, and not the pictorial merit.

Many subjects suggest themselves; Ham Shacks, Listening Dens, home built equipment, novel tools and gadgets, field days, workshops—these are but a few.

There is but one simple condition. The photograph(s) must be the copyright of the entrant.

An award of three guineas will be made to the sender of the picture which, in the opinion of the Editor, is the best submitted. A reproduction fee of 6d will be paid to the sender of each photograph published.

In order to allow overseas readers to participate, the latest date for receipt of entries has been fixed at November 5th (easily remembered?)

A short description should accompany each photograph submitted.

SEPTEMBER 1953

VHF Amateurs leave their "calling cards" at Chessington Zoo, on the occasion of their annual outing, June '53
A MODERN
3-WAVEBAND SUPERHET
RECEIVER


An article on the construction of a receiver of conventional design using modern B8A valves. The construction of both AC and AC/DC circuits is described. There is nothing outstanding claimed over the performance but it is as good as most sets of the same type when properly aligned.

The basic circuitry of the superhet receiver has changed little over the last ten to fifteen years, but in this time there have been many changes in the valves. To-day on the market there are some very efficient valves with all glass bases, the B8A base as it is known. It is around these British types of valves that this circuit is designed. The valves chosen are the ECH42, EF41 or 6F15, EBC41, EL41 and EZ40. These are all 6.3 valves, including the rectifier which is 6F15, EBC41, EL41 and EZ40. These are the valves and the IF transformer. The way the coils had to be mounted under it. The coils chosen, although not a new type, were the Wearight "P" coils. The writer has used these coils on many occasions with great success. The ones used are PA1, PO1, PA2, PO2, PA3 and PO3, which cover the long, medium and short wavebands. Coils in this series are arranged so that the constructor can make a receiver that has a continuous coverage from 7 to 2,000 meters. It is only a matter of altering the switching of the wavebands to do this. If the chassis is 2½" or more in depth it is a simple matter to mount the 32uf smoothing resistor directly on the tags of the coils, with a spacing of chassis space. This system has the further advantage that one can see the coil to which the trimmer is attached.

The tuning condenser was left until last as the coils had to be mounted under it. The coils chosen, although not a new type, were the W.B. tuning condenser. The position of the tuning condenser was then chosen, and two suitable holes were made for the other valves and the IF transformer. The holes were made so that the four projecting wires can be passed through with a good clearance, then a 1½ hole drilled in the centre to take the bolt of the chassis cutter and a further 1½ taken out. This allows the tuning slug to be got at easily.

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The smoothing is simple. The anode of the transformer to the top of the chassis. If this is done, two holes should be made, either side, and grommets fitted so that the sharp edges of the chassis do not chafe the wiring. The rectifier valveholder was mounted at the side of the transformer can. A hole ½" diam. was cut with the aid of a "Q-Max" cutter, and two suitably placed holes drilled to take the fixing screws for the holder. The 32-32uf condenser was mounted over a 1½" diam. hole made with the aid of a cutter for octal holders; this allowed the tags to be dropped through the hole without letting the condenser dropper halfway through.

Next the holes were made for the other valves and the IF transformer. The way the IF holes were made may seem at first a little crude, but the holes, although an odd shape, are systematic and leave enough metal under the coil to act as a support. Four ½" holes were made so that the four projecting wires can be passed through with a good clearance, then a 1½ hole drilled in the centre to take the bolt of the chassis cutter and a further 1½ taken out. This allows the tuning slug to be got at easily.

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Full use should be made during the wiring of "Tag" strips, which can be obtained at the cost of a few coppers each and very greatly improve the standard of construction. This ensures that there are no bundles of poorly soldered wires suspended in space, ready to sag and short out on to some component that won't like the extra volts!

If a little thought is applied there should be no trouble with the wiring. A good solder of the 60/40 type is recommended, also the cleaning of the wires of all resistors and condensers with the aid of fine emery cloth. Emery cloth lasts longer than glasspaper.

Next the alignment has to be done. Here a signal generator is indispensable; suitable circuits have from time to time appeared in the pages of this journal, a particularly good one being described in the December 1952 issue. The method of alignment is to turn the volume control of the set to "full on," and with the signal generator joined to the grid of the IF valve, and tuned to 465kc/s (as low a signal as possible should be used), a maximum should be tuned for on both windings of the second IF transformer. As there is usually some interaction between windings it is advisable to repeat the process several times to ensure that correct tuning is obtained. The trimmers can then be sealed, or if slugs are used a mixture of candle wax and vaseline melted together can be smeared on. This mixture gives the necessary amount of "bind" whilst allowing enough ease of turning to facilitate tuning.

The first IF transformer is tuned at 470 and 460kc/s so that a good bandwidth can be obtained for broadcast listening. The short wave enthusiast will no doubt prefer to sacrifice fidelity for selectivity, and will tune to 468kc/s on both windings. The tuning is effected by moving the signal generator from the grid of the IF valve to that of the frequency changer, then setting the receiver tuning knob so that there is no "beat" from the oscillator section of the frequency changer, and with the signal generator set to the required frequency trimming the appropriate winding. Then set again, and trim the other to the correct frequency. Repeat several times until there is no change required to be made.

The various wavebands are aligned by setting the generator to a frequency at the high end of the scale and adjusting the trimmers on both the grid and oscillator coils, then repeating several times to get good tracking. This should be done for each waveband in turn. The signal should, of course, be fed into the aerial terminal.

No mention has been made of the tone control, but then there are so many and nearly every constructor has his own favourite circuit.

The AC/DC version is, in the main, the same, the difference being in the types of valve used. Again these are the 88A type, and of the 100mA type that are now so popular. A dropping resistor is placed where the transformer was in the AC version. If the receiver is to be used on 230 volt mains, the dropper can quite well be in the form of a 250 volt 40W electric light bulb. This will give a circuit that will ensure that the current through the valves does not rise to too high a value during the warming up period. If a lamp is not used it is advisable to insert a BRIMISTOR in series with the mains dropper resistor. The valves used are the UCH42, UF41, UBC41, UL41 and the UY41. These require a total drop of 117 volts, at a current of 100mA. It is therefore quite a simple matter to work out the value of the dropping resistor that will be required. The wattage required will be, in this case, one tenth of the voltage drop.

As the circuit is being fed direct from the mains, a resistor of 50Ω 1W should be joined from the cathode of the rectifier to the reservoir condenser. With the very few volts to spare, it is recommended that a good smoothing choke such as the Elstone SC/80 be used, and the anode and screen both fed from the smoothing condenser. The reason for this change in the circuit is that the UL41 is made to work with a lower anode voltage than the EL41.

The remainder of the circuit is the same as for the AC version, but this does not mean that the heaters are joined in parallel. As in all universal circuits they must be joined in series. Dial lamps should be of a max. current of 150mA—this prevents them from blowing during the current surge before the valves are properly warmed up. If a lamp is not used it is advisable to use a bulb. This will give a circuit that will ensure that the current through the valves does not rise to too high a value during the warming up period. If a lamp is not used it is advisable to use a bulb. This will give a circuit that will ensure that the current through the valves does not rise to too high a value during the warming up period. If a lamp is not used it is advisable to use a bulb. This will give a circuit that will ensure that the current through the valves does not rise to too high a value during the warming up period.
4: Valves as Detectors and Oscillators

BY A. BLACKBURN

Because there are some fundamental principles of radio which, although they have to be learned, do not make particularly interesting reading, I have ventured to talk first of those techniques which appeal more to the reader’s curiosity.

But the hard graft has to be tackled sometime—it is no good leaving things in mid-air purely because it is a dull subject. However, knowing as you now do, some of the more advanced aspects of radio theory, you should be sufficiently interested in the ultimate effect to want to know more of the cause.

In our last article we spoke of how we can select signals, but we did not explain how these selected signals are detected, which is the process coming between selection and amplification. Detection simply means translating a selected carrier into an audio signal.

Suppose you were blindfolded, handed an object and asked to describe it. You could either feel its shape, and so say whether it were a cube, a globe, a cone, etc., and give an approximate idea of its size. Or you could take the impression from your eyes and describe it more fully.

In either case you are using a sense as a means of detection in order that that sense may transmit its observations to your brain.

That virtually is what happens in radio. Once a signal has been selected, the detector picks it up and converts it into a form which can eventually become a recognisable sound.

Now the valve has been put to many uses, that is to say apply the input at the filament of the diode and take the rectified output from the anode, the waveform shown in Fig. 1c in last month’s article were applied to the diode in Fig. 1 below, the diode would remove one half of this waveform either above or below a horizontal line drawn through the middle of the waveform, leaving the waveforms shown in Fig. 1c.

The modulation has now been effectively separated except for the half-cycles of carrier which can easily be removed by connecting, between points A and B in Fig. 1a, a capacitor of such a value that they would be by-passed. Remember that the carrier frequency is very much higher than the modulation frequency. Therefore, a condenser of, say, 100 pF will have a very low reactance at carrier frequency and a very high reactance at modulation frequency.

This process of separating the modulation from the carrier is known as demodulation, detection or rectification of the signal, and is a very important application of the diode valve.

If we were to reverse the diode connections, that is to say apply the input at the filament of the diode and take the rectified output from the anode, the waveform shown in Fig. 1c would be upside down. The reason for this is that the diode would then conduct on negative half-cycles.

You might ask, why go to all this trouble when the audio-modulation still has some carrier associated with it even after detection? The point to realise is that (referring to Fig. 1c last month) the waveform is symmetrical and we were to apply it to headphones direct, the “bumps” on top of the waveform and the “bumps” underneath would cancel one another out. What the diode really does is to make this waveform asymmetric.

However, the diode is not the only device which will detect a signal in this way. In fact, the cat’s whisker and crystal so much beloved by the early amateur were amongst the first detectors in radio chronology. A crystal-cat’s whisker combination produces the same effect...
as the diode in that it tends only to pass current in one direction. In the last war the crystal detector returned to popularity with the advent of radar and it is now obtainable commercially.

Physically very small—it is normally about \( \frac{3}{16} \) in long and \( \frac{1}{8} \) in diameter—the crystal detector is very efficient. Fig. 2 shows a circuit of a crystal set, incorporating one of the principles we discussed last month of coupling the aerial to the tuned circuit. The crystal detects the selected signal operating the headphones, across which the 0.001 \( \mu \)F capacitor by-passes the carrier as described above.

As we already know, any small voltage change at the grid of a valve produces a magnified voltage change at the anode. If this magnified voltage were fed back to the grid an even larger signal would appear at the anode which in turn would be fed back.

With the grid signals being supplied from the anode, the voltages at the grid and anode would, therefore, go on increasing until a limiting condition were reached, when continuous oscillation would occur. The other condition for maintained oscillation is that the anode voltage fed back must be “in phase” with the grid voltage.

This means that the circuit which is connected from the anode to grid must be designed to automatically ensure that as the anode voltage becomes, say, more positive, the grid voltage must become more negative. And that involves changing the phase of the signal in the feedback circuit. If you examine valve action you will see why.

The Valve as an Oscillator

Basically, the oscillator is a device which produces a continuous train of waves. The simplest electric oscillator is the electric bell which, provided a battery is connected, will continue “oscillating” indefinitely. Obviously, the highest frequency at which such a system could operate is limited by the weight of the moving parts. In radio work, oscillations of millions of cycles per second have to be produced, and this is where the valve comes into its own.

One common method of ensuring correct phase between anode and grid is by coupling them with two coils as shown in Fig. 3.

Very often an oscillator is required to operate over a wide range of frequencies, and the best way of achieving this is to use a variable tuning circuit. Fig. 3 shows an oscillator using a triode valve, inductive feedback coupling and a tuned circuit to determine the frequency. We will assume that, upon switching on, a small disturbance occurs in the grid circuit which will cause a similar but larger disturbance to occur in the anode circuit.

The feedback coil, or reaction coil as it is sometimes called, will induce this larger disturbance back into the grid circuit in the correct phase. Oscillation builds up as we already know, and frequency will be determined by the tuned circuit. Thus we have an oscillator which, like the electric bell, will continue to run for as long as we require it, at frequencies suitable for radio applications.

The conclusions we have reached on the necessity for signals at the anode and grid to be in phase may be easily verified. Supposing that you have built the oscillator in Fig. 3, connected it to suitable power supplies and switched on, and also that the coil and condenser are suitable for tuning in the medium waveband.

There are three methods of discovering whether or not the oscillator is working. By placing a milliammeter in the anode circuit at the point marked \( X \) in Fig. 3, an indication of the current flowing in the valve will be obtained. If the grid is oscillating, shorting the grid to earth will cause a rise in the reading on this meter. However, if the oscillator is not working no change will be observed.

Another method is to remove the grid leak and connect a micro-ammeter between the free end of the grid leak and earth, the negative terminal of the micro-ammeter being connected to the grid leak. The meter will only give a reading if the oscillator is operating correctly.

The third method involves no meters, but an ordinary radio set only is used. For this system to be effective, the oscillator must be in close proximity to the aerial of the radio set.
programme has been ruined by neighbours producing this whistle in their sets.

If you have tried one or more of these methods, and components and valve are found to be in good order, but the indications are that the circuit is not oscillating, the most probable fault is that one of the coils is connected the wrong way round, i.e., the anode circuit and grid circuit are not in the correct phase. This is easily remedied by reversing the connections of one coil.

Should you have been lucky and the circuit worked first time, it would be interesting to deliberately reverse the connections to one of the coils, when the circuit will cease to operate. This demonstrates most effectively how important it is that the phase relationship between anode and grid should be correct.

Uses of Oscillators
Because it is possible to use a radio set to detect signals from an oscillator, it can be seen that the oscillator may be used as a transmitter.

An oscillator of some sort is used in every transmitter to produce the carrier, and in high powered transmitters the oscillator output is amplified before being fed to the aerial.

You have all seen those advertisements which, with discreet claims to supremacy, offer expensive “superhet” radio sets? Eye-catching word — superhet, although its actual implication may be lost on most people. But an oscillator is used in every superhet set.

Oscillators also find many applications outside the field of radio for producing high frequency voltages in many sciences, including medicine, metallurgy and atomic physics.

Further references to their uses will be made in subsequent articles.
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- Matching Transformer Type T1809 6/6

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(Temperature Range 60°C. Max.)

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SUPER TROPICAL "METALMITES"
(In Aluminium Tubes)

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No. 34: A method of altering effective reverberation

It is well known that the acoustic properties of a room in which sound-reproducing equipment is installed have a considerable effect on the impression received by the listener. Thus, a room which is heavily carpeted and contains a large amount of sound-absorbent furniture can give an apparent "deadening" effect to the reproduced sound. On the other hand, a large bare room with few furnishings can cause multiple echoes which may detract from the quality of the reproduced sound and cause loss of "presence."

This month's circuit shows an experimental method of increasing the apparent reverberation of a room or hall. Sound from the reproducing loudspeaker is picked up by a remote microphone and fed back to the amplifier, whereupon it is once more reproduced. The effectiveness of such an arrangement depends mainly upon the time spent by the original sound in reaching the microphone; and it may be found that best results are obtained when the microphone is mounted as far away from the loudspeaker as space limitations allow.

As may be seen, the effect given is, roughly, that of a "fixed echo." Whether an apparent improvement in reproduction results depends entirely upon the local conditions of the room in which the amplifier, loudspeaker and microphone are installed; the particular recording being played (or programme being received); and, finally, upon the tastes of the listener.

Practical Points

The circuit shown here depicts a pentode pre-amplifier which obtains its power supplies from the receiver or amplifier already installed. A moving-coil microphone is illustrated. This should give adequate results, although any other type of microphone with a reasonably good response should cope just as well.

In YOUR WORKSHOP

In which J. R. D. discusses Problems and Points of Interest connected with the Workshop side of our Hobby based on Letters from Readers and his own experience

On several occasions during the past few months I have heard rumours that government surplus wireless gear is at last beginning to run out. How true this is I don't know, but it is quite possible that many of the chassis which were most readily adaptable to civilian purposes have by now been snapped up. A short visit to Lisle Street some time ago showed me that plenty of business was taking place so far as components were concerned; but there were not many complete items of equipment on display. Less saleable items such as motor-generators and similar electrical gear also took up a lot of window space. Nevertheless, so far as components were concerned, trade was definitely brisk. A typical price was given by paper 0.01 µF capacitors being sold at a penny each.

In my own case, most of the purchases of surplus equipment I have made since the market came into being have consisted of small components, or of units bought expressly for stripping down. I have been lucky in my purchases and have been able to use to good purpose almost every item
The time taken for a resistor and capacitor in parallel to discharge to 37 per cent of the original charging voltage is the time constant of the combination. Thus, by assuming that the capacitor will give no spark, or a noticeably weak spark, when the voltage across its plates has dropped to 37 per cent of its original value, we may gain a rough idea of its leakage resistance by working out the time constant offered by the capacitor and its leakage resistance in parallel. The time constant, in seconds, of such a combination is given by multiplying the capacitance in microfarads by the resistance in Megohms. Thus, if a 0.1μF capacitor is found by the "spark test" to be capable of holding its charge for ten seconds, its leakage resistance should be greater than 100 Megohms. Similarly, a 0.01μF capacitor which holds its charge for five seconds will have a leakage resistance of at least 500 Megohms. Although the test is very rough and ready, it gives an approximate idea of minimum leakage resistance up to a surprisingly high value.

Electrolytic capacitors, and paper capacitors, having values higher than 0.1μF, may also be tested by checking the time constant. With these components, however, the "spark test" is not recommended, since it can harm the capacitor. Instead, a test for presence of charge can be carried out by connecting a voltmeter across the capacitor after the requisite number of seconds. If a value is obtained, resistors, especially the waxed paper type, are leaky. A quick check of such capacitors can often be made by measuring the length of time over which they can hold a charge. Apart from open-circuits or breakdowns, the results given by the test are approximate only, although they do give a good idea of the minimum leakage resistance of the capacitor. The figures in the horizontal columns give the time constant in seconds for individual values of capacitance. The figures in the horizontal columns give the time constant in seconds for individual values of capacitance.

A table of time constants for individual capacitors is given in Fig. 1. As was mentioned earlier, the results given by the test are approximate only, although they do give a rough idea of the leakage resistance of the capacitor. The figures in the horizontal columns give the time constant in seconds for each individual value of capacitance against the leakage resistance which are shown at the heads of the columns. Thus, a 5μF capacitor will have a minimum leakage resistance of 10 Megohms if it can hold its charge for 50 seconds. Time constants longer than 1,000 seconds (16 minutes) are not given as they will probably not be required.

What is the difference between the two regulator valves shown in Figs. (a) and (b)? It is usually safe to assume that the regulator shown in Fig. (a) is one having a definite cathode and anode (such as the VR150/30), in which it is important that the cathode (depicted by the circle), be connected to the negative side of the voltage source whilst the anode is connected to the positive side. The stabiliser shown in Fig. (b) would, in most cases, consist of a valve which has no definite anode or cathode and which may be connected either way round. This latter type is met fairly often and usually consists of a miniature bulb rectifier (or germanium diode) appears in a complicated circuit. It is often stated that the "arrow" represented by the symbol indicates the flow of "conventional" current; i.e. current from positive to negative. Alternatively, one may state that the straight-line part of the symbol represents the cathode of a diode.
Valves and their Power Supplies

PART II

By F. L. BAYLISS A.M.I.E.T.

Vibrator Supplies

The vibrator power pack is an important part of a car radio receiver, as it enables mains type valves to be used in that receiver.

Vibrators and vibrator transformers are readily available for both 6-volt and 12-volt car batteries, and the HT output is the same in both cases—usually 200 to 250 volts at 70 to 80 mA.

There is no basic difference in the circuit arrangements for the two voltages, the change being confined to the vibrator coil and transformer windings.

It is essential, however, that the correct voltage rating of these two components should be chosen to suit the car battery voltage, 6V types are not suitable for 12V batteries, nor vice versa.

In each voltage group there are two distinct types of vibrator pack, (a) the rectifier type, in which a full-wave or bi-phase rectifying valve is used to supply the HT voltage, and (b) the "self-rectifying" or synchronous type, in which a valve or other rectifier is not used.

The rectifier type

The circuit arrangements for both types have become largely standardised, and are governed to a great extent by the components used.

In Fig. 36 the circuit for the rectifier type is shown. Briefly, the operation is that closing the on/off switch allows battery current to flow through the vibrator coil, through the contacts shown closed, and via the armature to chassis, thus completing the circuit.

The armature is attracted to the core, makes contact with the upper of the open contacts, and allows battery current to flow through the top half of the transformer primary via the centre tap; this current also flows to chassis via the armature.

When the armature is attracted, however, the circuit for operation of the vibrator coil is broken, and, after a brief period, the armature falls away toward normal. It is spring loaded, however, and the spring tension carries it past the normal position to make contact with the lower open contact point.

Thus, current again flows through the transformer primary via the centre tap, but this time through the lower half, and via the armature to chassis. At the same time the vibrator coil contact is again closed, and the armature is attracted to the core once more.

The action repeats continuously and rapidly, whilst the on/off switch remains closed.

The transformer has a step-up ratio of about 1:40—sometimes higher—for a 6V component. 12V transformers are approximately one half of this ratio.

The primary voltage fluctuations are transferred to the secondary by induction, and, with the secondary centre tap connected to chassis, some 220 Volts is available at each end of the secondary winding, although in phase opposition one to the other.

The ends of the secondary are connected to the two anodes of a bi-phase rectifying valve, as in usual AC mains power supply circuits, and the rectified output is taken from the valve cathode.

Quenching.

The heavy current—5.0A is not an unusual figure for a car radio—and the inductance of the vibrator coil and transformer primary would naturally cause considerable arcing at the vibrator contacts. R1 and R2, together with C3, however, are inserted to counteract such arcing, and their values may be varied to suit the vibrator and transformer used. For instance, C3 may safely be increased to 0.25µF, in marked cases.

The abrupt nature of the primary voltage alternations induces very high back-EMF voltage pulses in the secondary, and to prevent damage to the rectifying valve these pulses must be absorbed. C4, 0.01µF, carries out this absorption, and to prevent damage to the rectifier and transformer C2, 200 microfarads, is included to limit the current to 50mA.

The danger of pulse feedback via the receiver valve heaters—and then to the cathodes—is still there, however, and will be until a complete set of cold cathode valves for car radio are marketed.

Smoothing

Notwithstanding the facilities offered by the use of the OZ4, good smoothing is an undeniable asset in a car radio power pack.

A high inductance choke—20 Henries, or even higher—will do much to iron out such arcings, and unwanted pulses, and to flatten the rather steep-sided curve of the ripple voltage. Such a choke, with C6 and C7, forms the HT smoothing.

The LT smoothing choke in the valve heater lead is helpful in keeping the heaters free of vibrator pulses. The resistance must be kept low, however, and the wire used of ample gauge to carry the total heater current.

Assuming a total heater current of 2.0A, 20 SWG enamelled copper wire would be suitable, and, since 1.0 Volt may conveniently be dropped across this choke, 200 turns of this wire wound on to a standard type output transformer bobbin and core would form a useful component. (The battery, on charge, normally gives 7.5 volts, and would thus allow a volt or so drop to 6.3 volts.)
and its aerial, chassis and battery leads, there is always a tendency for direct feedback to occur via the battery, particularly in cars using coil ignition systems.

The fitting of 15kΩ suppressor resistors in each sparking plug lead, close up to the plug, together with a capacitor of adequate value across the distributor interrupter contacts, does much to lessen the nuisance.

Further filtering in the vibrator pack itself is effected by the RF choke RFC1 and capacitors C1 and C2. This choke will have to carry a heavy current—some 3.0A or so—therefore, as with the LT choke, the resistance must be kept low.

Again, 200 turns of 20 swg enamelled wire may be used, but, this time, wound on to an air-cored bobbin; an old wire-reel would be very suitable. No iron laminations are required.

The use of RFC2 and C5, however, is optional and may depend upon the type of valve rectifier used. Their inclusion would be nothing but beneficial, in any case; RFC2 may consist of 3,000 turns of 36 swg or 38 swg enamelled wire, wound in six slightly spaced piles of 500 turns per pile, upon a 2" diameter air-cored coil former, some 2" long.

Looking at the circuit of Fig. 36, the constructor may consider it a little complex with the rather intricate filter and quench arrangements.

Interaction

If a programme is to be received which does not consist of 50% hum, mush, crackles and other noise, however, these filters must be included.

The writer, who has delved into the vibrator packs of many high class commercial car receivers, has found them to be all there—neatly packed away into an incredibly small space, and often exhibiting fine workmanship in wiring and manufacture, and considerable thought and care in component layout to avoid interaction.

This last point is important; an RF choke placed within the field of the transformer or one of the smoothing chokes may bring to naught all the good work done in making and including the filters.

Similarly, interaction between transformer and choke (LT or HT) may set up a vicious circle of feedback that will reduce reception to rags and tatters.

But, be careful in the layout, with iron-cored components at right angle to each other, and with the RF chokes, if not screened, then at a reasonable distance from iron laminations, and there is no reason why car radio should not equal the home mains receiver at its very best.

---

Can Anyone Help?

Dear Sir,

Can anyone assist me to obtain information on, or an instruction manual for, an ex-Govt. Trawler Wireless Set CNY2?—J. N. HOLDER, "Green Trees," Forest Road, East Horsley, Surrey.

Dear Sir,

In removing one of the Jones plugs from my R115S I unfortunately broke one of the shorting switch wafers of the master switch, the waffer being nearest the front panel, and although I have tried locally and at shops in London to obtain a spare waffer or switch, have been unable to do so.

Can anyone help, please?—E. J. WALTERS, 25 Fullerton Road, East Croydon, Surrey.

---

OSCILOSCOPE TRACES

by A.B.

Hum is generally introduced from one or both of two sources, i.e. pick up in high impedance circuits, or the HT line.

Trace A shows a hum-free audio signal, which is applied at point 3. If hum is present at the anode, point 2, the trace will take a form similar to that shown by B. If hum is present when the oscilloscope is connected to the HT the trace will look like C. Connection must be made via a condenser if one is not included in the oscilloscope input circuit. It is possible that the hum voltage shown in C may be considerably less than that superimposed on the audio (trace B), in which case the HT line can be exonerated.

A combination of pick up and HT ripple will give waveforms of unpredictable shape, particularly if the rectifier is full wave. In this case, pick up will be 50 c/s and the HT ripple 100 c/s.

To prevent hum voltages being induced in them, the oscilloscope leads should be kept as short as possible.

Have you entered our 'Radio Snapshots' Competition? If not, Remember that the Closing Date is November 5th

FULL DETAILS WERE GIVEN IN THE SEPTEMBER ISSUE

SHOW NUMBER 1953

www.americanradiohistory.com
A PORTABLE OSCILLOSCOPE

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

IN the design of a suitable oscilloscope for construction by the average radio amateur, and capable of covering almost all his requirements for test and experimental uses, several points must be borne in mind.

A Always the main item is, of course, cost, so that it is desirable to use as few parts as possible to cover the widest range of functions. All parts should, where possible, be standard types, as special items such as high voltage transformers, etc., are very costly.

B The unit should be small and light, as most constructors have only limited space and, also, this makes the unit portable.

C The screen size should be large enough for accurate analysis of the waveforms.

D Input impedance must be very high so that it does not in any way load the circuit under test, and there should be no timebase waveforms mixing with the signal (via sync, etc.) to cause distortion.

E An amplifier of wide frequency response and fairly high gain should be included. The gain control should not upset the frequency response. (This excludes the type of control normally used on audio work, as severe distortion occurs at mid-settings at frequencies having fundamental or harmonics above the audio range).

F The deflection (both X and Y) should preferably be derived from a low impedance source so that there is less possibility of stray pick-up in the wiring to the tube plates.

G The timebase should cover a range suitable for all amateur applications, be linear, have adequate scan and have a small flyback time compared to scan. Sync should be provided.

H The usual X shift, Y shift, brilliance and focus controls should be fitted.

The heater voltage should be brought out to the front panel, as this is useful for a 50 c/s reference and can also be used as a drive source, e.g. for checking transformer ratios on the scope.

The unit described comes up to all these requirements, will be cheap and easy to build, and will provide a most useful piece of test equipment for the home workshop and even commercial applications. The cathode ray tube, a VCR139A, is 2¼ inches diameter, which is quite adequate for general use. Apart from this tube, only two other valves are used. These can be either SP61 or SP41 depending on whether the mains transformer has two 4V heater windings or a 4V and a 6.3V one. (The CRT has 4V heater).

The complete unit is housed in a case 5½ in.

Circuit

The first valve is either a cathode follower or a wide range amplifier, these functions being selected by means of a two-pole two-way toggle switch on the front panel. In both roles, the "signal amplitude" potentiometer controls the Y deflection. In the cathode follower position the anode of the valve is connected to HT +150 to raise the cathode volts in order to allow maximum input swing; the signal amplitude control then selects the desired amplitude of signal off the cathode load. In the amplifier position, the anode load is then switched in and the signal taken from the anode; at the same time the signal amplitude control becomes a variable resistance in the cathode. This controls the gain by controlled negative feedback. The gain at minimum is about 1 and at maximum about 30, with no distortion introduced by the control.

The output in both conditions is of a low impedance, so that condition "F" is satisfied. The sync for the timebase is derived from this low impedance supply, so that any
timebase waveform feeding back looks back into a low impedance. After passing through the isolating resistor (250kΩ) into this impedance, the amount of feedback is negligible even with sync at maximum.

The CRT network derives its supply mostly from a S.T.C. K3/40 rectifier to give a negative supply for the tube. In addition to this, the anodes and the X2 and Y2 plates are returned to a positive voltage via a network across the HT supply. This gives extra voltage to the tube and simplifies the shift networks. If the tube is mounted with the spigot upward and the connections made as numbered, then the deflection will be correct. The 0.5µF EHT smoothing condensers are of 600V working 'bathtub' type. All potentiometers are the bakelite-cased carbon type. The Focus, X shift and Y stable.

Shift controls are a classical screwdriver adjustment type, as they seldom require altering and this prevents the small front panel being cluttered up with unused knobs. The mains transformer is a standard 250-0-250V with two 4V windings. Instead of connecting the centre of the HT winding to earth, however, one end is earthed and the centre unused. This makes it 500V overall, but if a very compact construction is required then it is necessary to take steps to prevent hum on the trace due to magnetic induction from the mains transformer. The tube itself should be enclosed in a mu-metal shield (several spaced mu-metal shields, if available) and the mains transformer kept to the rear of the Y input terminal, and a short lead taken to the top clip, which also holds the grid stopper.

The timebase is quite linear except for slight non-linearity below 25 c/s on the lowest frequency range. This is a characteristic of this type of timebase and, as the amount and range of the non-linearity is so small, it is not worth the bother of

Actual measured ranges are:
1. 11.5 — 130 c/s
2. 65 — 650 c/s
3. 270 — 2,800 c/s
4. 1,300 — 13,000 c/s
5. 5,500 — 54,000 c/s.

These will be found ample for normal use, as inputs in the region of 500 kc/s will only produce some 9 or 10 cycles, which is still easily discriminated. No amplitude control is fitted to the timebase, as the amplitude has been arranged to be constant on all ranges and to fully scan the tube. Silvered mica capacitors should be used where possible on the timebase ranges, as they are the most suitable.

The CRT network is derived from a separate isolating amplifier purely for sync. The actual amount of sync injected is negligible, even with sync at maximum. This arrangement eliminates the necessity of connecting the centre of the HT winding to earth, however, one end is earthed and the centre unused. This makes it 500V overall, but if a very compact construction is required then it is necessary to take steps to prevent hum on the trace due to magnetic induction from the mains transformer. The tube itself should be enclosed in a mu-metal shield (several spaced mu-metal shields, if available) and the mains transformer kept to the rear of the Y input terminal, and a short lead taken to the top clip, which also holds the grid stopper.

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AN INEXPENSIVE THREE VALVE DOMESTIC RECEIVER

By E. GOVIER

The need for a new domestic receiver having arisen, and the present high price of those on the market, decided the writer to cast around for a suitable cheaply constructed circuit. In common with many others, it was found that our listening pleasure was shared between two stations—the Home and the Light Programme, and therefore the three waveband type of set was definitely not required—both from the considerations of cost and non-usage.

Having decided on the foregoing, the next step was to draw up a circuit using as few parts as possible, and one which would give sufficient audio gain for the average living room. As a matter of interest, several circuits were hastily knocked together and tried out, but the most suitable was that shown in the circuit diagram. From this, it will be seen that use is made of the 6SN7 both as a leaky grid detector and as a triode first AF amplifier—a function which this valve performs extremely well. It has always been of some amazement to the writer that more use is not made of this type of valve in this country—at least in published circuits. In the U.S.A. much greater use of the 6SN7 is made than here.

The detector stage is entirely conventional—as is the whole receiver for that matter, and it is therefore capable of being constructed by the veriest beginner with little or no trouble. The coil used is the Osmor type QR11, which has proved to be eminently suitable for such a circuit. Output from the detector portion of the triode is fed into the grid of the following portion via C4, and thence from the anode of this half via C6 and R7 into the grid of the output stage, a 6V6 valve.

The output stage and the power pack (using a 5Y3 rectifier), needs little or no explanation, being entirely basic in design and with no frills. The whole receiver when completed may be fitted into a small cabinet about some 21 watts approx., although in the final set-up a 5J-inch speaker was used. Selectivity using an aerial some 25 feet long was found to be adequate, with no breakthrough noticeable. Any reader constructing this receiver will find that it conforms to the specifications as stated in the opening paragraph. Simple and cheap to build, it will give good service and performance to the user.

The “UNIVERSAL” Large Screen

AC/DC Televisor

Part 5: Described by A. S. Torrance, A.M.I.P.R.E., A.M.T.S.

(By kind permission of I.KOPATENTS LTD.)

Tube Handling

Readers are warned that the CRT is highly evacuated, and must be handled at all times with the greatest care. Never hold by the neck. Safeguard the EHT anode connector from accidental contact. Goggles should always be worn when working on exposed cathode-ray tubes.

Switching On

When all these tests are completed, the constructor may now prepare to switch on for the first time.

A WARNING MUST BE GIVEN

Do not work at any time on a bare concrete or cement floor. A well-covered lino or carpeted wooden floor constitutes the highest safety margin. This is even more important where D.C. is to be employed.

Place all knobs in position and ensure that grub-screws are below the surface. When the set is completed, the screw holes should be filled with wax.
brightness be sacrificed by a wrong setting of the magnet to overcome shadowing. This should be cured by ascertaining that the deflection-coils are as far up the neck of the tube as possible, and by careful adjustment of the focus unit.

Raster

In general, if the EHT rectifier heater lights up it is almost certain that EHT is present.

Set the raster by the controls at the rear. Turn the line drive control up until white upright lines are visible in the centre of the raster, and then turn the control back until these just disappear. Set “Height” and Focus unit for both focus and centring.

In general, if the EHT rectifier heater lights up it is almost certain that EHT is present.

Set the raster by the controls at the rear. Turn the line drive control up until white upright lines are visible in the centre of the raster, and then turn the control back until these just disappear. Set “Height” and Focus unit for both focus and centring.

Complete instrument as it will appear when finished.

Lining-Up Receiver

Secure a plastic knitting needle and file this to a screwdriver end which will fit the slots in the cores of the coils. This improvised tool makes a most excellent trimmer. On no account should a metal screwdriver be used for lining-up. Study the chart and ascertain that the cores are as laid down for the local transmitter. Thus, for example, readers desirous of tuning to Sutton Coldfield will use:—Iron-core for L1, Brass core for L2A, Iron core for L2B, and change C9 to 10pF (Silver Mica). All other cores would be iron.

The most important item, as mentioned before, is undoubtedly L12A/L12B. This transformer is pre-set and forms the entire basis of the tuning procedure. Quite obviously, with the sound IF set at the correct frequency of 23.25 Mc/s a datum-line is available for the entire lining-up. The component must not be interfered with. If the reader has accessibility to a signal generator, this transformer and the sound section may be checked by injection of 23.25 Mc/s into the grid of V9. With the Sensitivity, Contrast, and Volume controls at maximum, a crude setting of L1, L2A and L2B should make the sound signal audible. L2B should always be set for maximum sound. Adjust L4 and L5 for maximum sound. Varying the sensitivity control, adjust L1, L2A, L3, L4, L6 and L8 for the brightest picture.

(Note that the picture may not be synchronised at this stage, and constant adjustment should be made to the frame hold, and line hold. It is always possible that this fortunate condition may be arrived at very quickly). Readjust L5 until sound on picture is at minimum. Temporarily short to chassis the grid of V9 and adjust L7 until sound on picture disappears. (This symptom is recognisable by the picture jumping in step with the spoken word or musical notes). Minor inter-action would show horizontal black bars moving up the screen.

Readjust L1, L2A, L3, L6, and L8 until a picture is obtained at the lowest setting of the sensitivity control. If possible, utilise Test Card ‘C’ for the above. Last of all, but not until the test card is fully resolved, L12A/L12B may be given slight adjustment for maximum volume.

Notes

Readers tuning to the Alexandra Palace transmitter may experience difficulty in obtaining synchronisation. This is due to the fact that the Universal is a single-sideband receiver, and it is possible to be misaligned so that, although the picture and sound content may be good, no frame synchronisation is achieved. The remedy is to retune with the cores tending to be at the top end of the formers. The best resolution will be found by final and delicate setting of L1, L4, L6 and L8.

Linearity

At this stage, the picture may be badly out of linearity. Once again increase the line drive control and repeat earlier procedure, slackening off any contraction or white lines.

THE RADIO CONSTRUCTOR

SHOW NUMBER 1953
seen in the centre. Adjust the Width coil and Linearity coil. Find the centre of swing of the Linearity coil, i.e. where movement of core brings in or expands the left side of the picture. Now obtain best Linearity with the line-drive control, making final setting with the Linearity coil. Set vertical Linearity and Height. Obtain best focusing (incidentally, this should be done frequently during lining up).

Note: If the auxiliary mounting is employed, black perpendicular bars may be observed due to long leads. These will disappear when the tube is properly mounted and the leads are shortened.

Increase values to increase EHT. These may take a wide variety of values.

Remember, this receiver takes approximately two minutes for the picture to appear, and one minute for sound.

The following changes in values to those given in the Component List have resulted in greatly improved performance. R59 changed to 6.8kΩ results in better frame form. Excessive line scan may be obviated by reduction of C58 to 2000pF. Similarly, excessive EHT was experienced with the original values of the EHT peaking condensers C60-C61. These are now reduced to 47 pF each.

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### Channels

<table>
<thead>
<tr>
<th>CHANNELS</th>
<th>LI</th>
<th>L2A</th>
<th>L2B</th>
<th>AERIAL POLARISATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>birthday</td>
<td>iron core</td>
<td>do</td>
<td>iron core</td>
</tr>
<tr>
<td>2</td>
<td>today</td>
<td>iron core</td>
<td>iron core</td>
<td>do</td>
</tr>
<tr>
<td>3</td>
<td>tomorrow</td>
<td>Aerial end</td>
<td>iron core</td>
<td>do</td>
</tr>
<tr>
<td>4</td>
<td>Saturday</td>
<td>Grid end</td>
<td>brass core</td>
<td>do</td>
</tr>
<tr>
<td>5</td>
<td>Tuesday</td>
<td>do</td>
<td>brass core</td>
<td>Iron core</td>
</tr>
</tbody>
</table>

* Names likely to be changed

NOTES: Channels 3/4/5, L1 requires both iron & brass cores. Remaining cores L3/4/5/6/7/8 all iron. Aerial must be obtained to match local transmitter and mounted to suit polarisation.

Receiver Tuning Chart Including Proposed Transmitters

Component Effects

Severe non-linearity of the vertical time-base may be cured by varying the values of R59 (affects top of raster) and increasing R51. Readjust V. Linearity control at the same time. Variation of C58 will affect the picture width. C60 and C61 will vary the EHT.

Mounting Escutcheon and Perspex with Dust-Proofing Method

Study the photographs, and with long countersunk bolts secure the escutcheon and perspex to parts F. Hold in position at top with springs to the top bolts on parts G. With sticky tape, go all around the edge of

---

The "Universal" Radio-gram Unit to be described later in this series. Both units are complete in themselves, and may be built independently as desired. If amalgamated, they result in the striking instrument illustrated on p. 84.
the escutcheon and CRT, thus forming a dust-proof joint. Similarly, tape the perspex to the escutcheon.

Note. Remember to clean the tube screen and perspex before sealing up.

Precautions

The greatest caution must be observed at all times when operating DC or AC/DC equipment. The entire chassis is alive to one side of the mains and requires constant care. If possible, it is recommended that a neon tester be obtained and the set operated with the chassis connected to the negative side of the mains. The mains plug and socket should then be marked to ensure correct polarity, or preferably use should be made of a three-pin type. Once set, any removal of this latter type plug will be assured of proper replacement. Install the receiver into the cabinet as soon as possible after completion, and fill the grub-screw holes in all knobs with wax or shellac.

Do not use a metal grille for the speaker opening; fabric is highly recommended, for safety reasons.

The cabinet has been specially made by Lasky's (Harrow Road) Ltd. to take this set and no difficulty in installation should be experienced.

It is not intended to alarm constructors by the warnings given—in point of fact, all electrical apparatus under certain conditions may be dangerous. But we do implore readers to make a study of the contents and obtain a complete understanding of the points raised.

This receiver will finalise, as mentioned previously, in a complete TV—Radio-Gram, and articles on this will appear in future issues of The Radio Constructor.

THE "MAGNA-VIEW"

Further laboratory tests have been conducted on this new popular television, and two modifications have emerged, both of them well worthy of inclusion.

The first concerns the video stage (N78) and mode load resistor. This has been reduced in value to 3Ω 2W, with a subsequent improvement of HF response. The result is that clearer edges are noticeable, and the highlights become more pronounced. There is, however, a slight loss of amplification, and readers in fringe areas must decide for themselves whether or not they are in a position to forego some gain for an increase in quality. In areas of good field strength the modification is undoubtedly beneficial.

The second modification applies to any television, and will therefore be effective on both the "Magna-View" and the "Universal".

One annoying feature of TV programmes during the course of transmissions is the occasional appearance of flyback lines. These may often be seen during a film change-over; reduction of brilliance only means that this control must be set again to the original position when the original level is restored.

A simple method of overcoming this trouble is to connect a 0.002F silver mica condenser between the anode of the frame output stage and the cathode of the CRT.

The diagrams are particularly clear, and free from unnecessary components which might confuse the reader, but several of them would perhaps be more complete if component values had been given.

A snap check on the Index revealed that it refers the reader to page 188 for a reference to automatic grid bias, yet the page contains only a passing mention of the subject. Far more is found on pages 190 and 191, where the principle is discussed and a typical circuit is recommended constituting the best compromise between operating efficiency and complexity.

BOOK REVIEW


Nearly 20 years ago a series of articles appeared in Wireless World entitled The Radio Circle: For Beginners Only. Due to their popularity at the time there were many requests for the series to be made available in book form. The author, "Decibel," produced the book and Messrs. Pitman published it. As a result of the author's lucid style and the usual high quality of production on the part of the publishers, the book has been a standard primer for the novice.

This present new edition is based mainly on the previous one and the reprints, but it has also been brought up to date, and now includes additional material. It is entirely suitable for those who have only a little knowledge of radio and the electrical theory pertaining to it, for it is written in an encouraging as well as an instructive manner. There are not many parts where mathematics are used to a great extent, but where they are referred to it is essential for this form of explanation to be given in order to make things clear. Even so, the standard of mathematics does not demand anything more than an elementary knowledge of simple formula and their manipulation.

The book follows the usual pattern of such primers, taking the reader from simple electricity into alternating currents, capacitors, inductors, resonant circuits, electromagnetic waves, aerials and receivers. Other chapters deal with high frequency and low frequency amplifiers, decoupling circuits and push-pull output arrangements. The principles of superheterodyne receivers are discussed, and the last two chapters provide a useful insight into circuits for resistance capacity combinations, tone control, negative feed-back, automatic volume control, etc.

The diagrams are particularly clear, and free from unnecessary components which might confuse the reader, but several of them would perhaps be more complete if component values had been given.
The arrangement is very simple, and is shown in Fig. 1, the additional components being indicated by heavy lines. The video stage shown is a typical one such as is used to drive the cathode of the C.R. tube. This black spotter, for reasons which will be obvious after the following description, is only suitable for use where the video signal is fed to the cathode of the picture tube. The mode of operation is as follows:

An interference pulse whose amplitude exceeds that of the video signal drives the cathode of the spotter valve negative, causing a negative-going pulse to appear at the anode. This pulse is fed to the grid of the picture tube, causing the beam current to be cut off for the duration of the noise pulse. It will be appreciated that the effect of this interference suppressor is not to remove the unwanted pulses from the C.R. tube cathode, but to apply to the tube grid an amplified version of the pulse in the same phase. As the pulse on the grid is larger than that on the cathode, the tube is biased back causing a black spot to appear on the screen. Because the spotter valve is required to amplify the pulse without reversing its phase, the input is applied to the cathode of the valve whilst the output is taken from the anode. The bias on the valve is set so that under normal working conditions no anode current flows until the video signal exceeds the peak white level. This adjustment is made by means of the potentiometer whilst viewing the picture. The control is gradually advanced until the highlights in the picture start to darken; it is then slackened back just enough to restore the highlights. In this position the circuit will function most efficiently as a black spotter.

**TV Pre-amplifier**

_A friend of mine has a commercial TV receiver which, in this locality where the signal level is low, has insufficient sensitivity to provide a well contrasted picture. I have in mind fitting a pre-amplifier to boost the signal before it is fed to the receiver, and I would be grateful if you would recommend a suitable circuit._

G. Kempson, Salisbury

This type of request arises from time to time from different parts of the country, and we feel that it is time to modernise a circuit of a TV pre-amplifier which was first published in the August 1950 issue of the _Radio Constructor_. The original circuit has proved to be very satisfactory, and we do not hesitate to present it again using a more modern miniature valve and providing coil winding details for each of the channels which are now in use. The revised circuit is shown in Fig. 2, and it will be seen that the coil is modern made of the miniature low noise high slope pentode type 6AK5, which is also known as the Mullard EF95. The use of this type of valve enables the complete unit to be assembled on a small metal chassis 3×2×2 inches, which can be conveniently accommodated on the back panel of the receiver. No provision can be made on a chassis of this size for a power pack, and indeed there are few receivers where one would be necessary. The supplies required by the pre-amplifier are 6.3V at 0.175 Amps and 200 volts at 10mA. These can normally be tapped off the main receiver power supply. If, however, the valves in the receiver have series-connected heaters it would be advisable to feed the heater of the pre-amplifier valve from an additional 6.3V transformer.

Reference to the circuit diagram shows that a shunt resistance-capacitance combination is included between the outer conductor of the co-axial input cable and the chassis; these components are only necessary when the pre-amplifier is employed with a receiver which has a 'five' chassis. If the chassis is not connected to one side of the mains supply, then the outer of the co-ax may be directly connected to it. Both the input and output impedances of the unit are 80 ohms, so that the output socket may be linked to the aerial socket on the receiver by means of a short length of feeder cable. The gain is pre-set by means of a wirewound variable resistor in the cathode circuit of the valve.

The tuning coils are wound on standard Aladdin formers, and are fitted with dust iron cores. The coils should be mounted on either side of the valve, and each is fitted with a screening can. The table below indicates the number of turns required on the coils to tune to any of the B.B.C. TV channels.

<table>
<thead>
<tr>
<th>Channel</th>
<th>L1</th>
<th>L2</th>
<th>L3</th>
<th>L4</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. 1 London</td>
<td>14</td>
<td>8</td>
<td>8½</td>
<td>12½</td>
</tr>
<tr>
<td>No. 2 Holme Moss</td>
<td>14</td>
<td>7</td>
<td>7½</td>
<td>11½</td>
</tr>
<tr>
<td>No. 3 Kirk o’Shotts</td>
<td>14</td>
<td>6½</td>
<td>6½</td>
<td>11½</td>
</tr>
<tr>
<td>No. 4 Sutton Coldfield</td>
<td>14</td>
<td>6</td>
<td>6¼</td>
<td>11¼</td>
</tr>
<tr>
<td>No. 5 Wenvoe</td>
<td>14</td>
<td>5</td>
<td>5¼</td>
<td>11¼</td>
</tr>
</tbody>
</table>

Commencing next month

**THE “PATTERN-MASTER”**

By D. Allenden, Grad.I.E.E.

_A versatile TV Pattern Generator for serious work, covering 40-70 Mc/s._

The unit is very simply trimmed by turning the coil core until maximum picture brightness is obtained, then whilst viewing Test Card “C” some slight improvement in definition may be obtained by very slightly detuning each core.

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**Query Corner**

**RULES**

1. A nominal fee of 2/6 will be made for each query.
2. Queries on any subject relating to technical radio or electrical matters will be accepted, though it will not be possible to provide complete circuit diagrams for the more complex receivers, transmitters and the like.
3. Complete circuits of equipment may be submitted to us before construction is commenced. This will ensure that component values are correct and that the circuit is theoretically sound.
4. All queries will receive critical scrutiny and replies will be as comprehensive as possible.
6. A selection of those queries with a more general interest will be reproduced in these pages each month.

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**Show Number 1953**
Radio Miscellany

No doubt many readers make a point of watching the TV programme of the Inventors’ Club. Such a programme promises much interest in itself, and there is always the chance that a good idea for a radio gadget might be picked up, or some little point might inspire another bright notion. This column has previously drawn attention to what I have considered commendable ideas presented in this programme. Unfortunately, I have not yet seen any of the items marketed, although perhaps I have under-estimated the probable time for them to get into production. Maybe it has been a matter of the publicity. It seems to take something more than sheer merit to make a success of a good idea nowadays.

In the recent programmes there has been no lack of ideas ‘well-bedded’. In fact, the time allotted could well be expanded, and many of the prototypes could, with advantage, even from the entertainment angle, be more amply demonstrated. The fullness of the present programmes is something of a contrast to its early days, when only a few items were submitted. The ideas, too, seem more technical. I remember one of the early items particularly—an expanding collar stud to safeguard the wearer of shrunken-necked shirts. Some of the developments these days are of a much more serious nature.

I was rather fascinated with the cable stripper recently shown. Cable strippers are, of course, useful, and most of us have already tried out a number of types. Many of them seem to require pretty careful attention to what I have considered com-

If you are quite honest, you will probably admit that in your early days as a constructor you did the same thing yourself. I have never heard of anyone switching off the BBC allow a few “ads.” to creep in, and the TV side offends particularly in this way. The naming of plays, films, theatres, etc., has become almost a regular feature. The naming of plays, films, theatres, etc., has become almost a regular feature. The naming of plays, films, theatres, etc., has become almost a regular feature.

Those Naughty Sponsors

Sponsored TV, if it has achieved nothing else, has been responsible for the utterance of some of the silliest nonsense imaginable. It seems that, as ever, the people least qualified to air an opinion on any debatable issue are the readiest to do so.

On this question Lord Mancroft quoted one eminent divine who, having denounced the action of the honourable departments, was asked how many of them he had seen. It transpired that he hadn’t seen any TV at all. Perhaps, after all, that sort of thing was only what is to be expected. Busybodies always seize on the opportunity to prevent anybody else from doing anything.

The press generally, however, hostile they secretly felt at this threatened intrusion on their advertising revenue, generally refrained from partisanship, although much of the drivel talked and written by those who, either from self-interest, bigotry or sincere belief, opposed it was fully quoted. To be on the safe side more than one newspaper long since applied for licences. One of them in its Company Report warns the shareholder of the impact which sponsored TV will have on its advertising. It goes on to hastily assure him that they themselves intend to be in on the ground floor if and when it is permitted.

The entertainment world, already faced with diminishing receipts due to the rising popularity of TV, has long been a state of jitters. The threat of alternative and lively quality programmes has given them fresh cause for panic.

Don’t Mention It!

Much has been made of the advertising aspect. It seems that everybody overlooks the simple answer that if you don’t like the “ads.” you can simply switch off or look at what the BBC have got to offer. That is undoubtedly just what will happen if there is too much plugging or the advertising is put over in bad taste.

No-one objects to advertisements in newspapers and periodicals—in fact most people seem to like them, or at least they read them. Women, particularly, give as much attention to the advertisement pages of the glossy covered magazines as they do to the rest of the contents. You, gentle reader, can hardly derive any feeling of masculine superiority from that. How many hobbyists have you heard admit they only bought a certain radio periodical for the sake of the ads?

Centre Tap talks about

advertisements? If you are quite honest, you will probably admit that in your early days as a constructor you did the same thing yourself.

It is a pity never heard of anyone switching off the BBC allow a few “ads.” to creep in, and the TV side offends particularly in this way. The naming of plays, films, theatres, etc., has become almost a regular feature of interviews. Writers plug their books, and even the Zoo man tells you what books to buy and holds up copies to make sure you buy them. Film stars especially are asked by the interviewer for the name of their latest picture and even the date of release. Mr. and Madam Celebrity from What’s my Line are given the fullest opportunity of telling viewers “this is my last appearance on the air it would be after shop hours, and in any case it wouldn’t be easy to prove the weak signals in the headphones were not from Birmingham.”

Another get-rich-quick back-street firm boasted that New York could be heard with their crystals. Beautiful tone, too! Optimists sent in their half-crowns for the wonderful new crystal in the expectation of hearing real DX with it. In due course they received a shiny bit of silica that looked very much like any other crystal. In fact, it behaved very much like any other crystal; no worse but certainly no better.

When they explained to the advertiser they received a polite note saying that New York could most certainly be heard—if they took the set to New York!

Naturally the victims very nearly burst with indignation upon receipt of this. As this reaction subsided they generally had a wry laugh over it—those with the keenest sense of humour, anyway. When their resentment at being cheekily defrauded wore off, they re-read the advertisement and checked through the carefully selected references. As the silly side of the whole business became more and more apparent it seemed to them almost funny. In fact, it seemed to become funnier and funnier as the days passed, especially when they thought of all the other people who had also been so impudently swindled. As it occurred to them how come some of their pals’ faces would light up when they received that they, too, had been stung for half-a-dollar, they’d begin to do their best to induce them also to send up for one of these wonderful crystals.

But then, as I have already said, human nature’s like that.

INVENTORS’ CLUB—SPONSORED TV

thinking of advertisements reminds me of the earliest days of broadcasting. At that time the vast majority of receivers in use were crystal sets, and one occasionally saw some brazen claims for crystals with wonderful names. In fact, the names were the most wonderful part about them, and to give them just the right touch they were invariably suffixed with “-lite” or “-tone.” One firm claimed that Birmingham (STJ) transmitter was regularly heard in their London show-room on a set using one of their crystals.

In those happy days broadcast stations were on what we should now regard as flea-power, and it would be quite a feat. I imagine, if the air it would be after shop hours, and in any case it wouldn’t be easy to prove the weak signals in the headphones were not from Birmingham.

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The simple answer that if you don’t like the “ads.” you can simply switch off or look at what the BBC have got to offer. That is undoubtedly just what will happen if there is too much plugging or the advertising is put over in bad taste.

No-one objects to advertisements in newspapers and periodicals—in fact most people seem to like them, or at least they read them. Women, particularly, give as much attention to the advertisement pages of the glossy covered magazines as they do to the rest of the contents. You, gentle reader, can hardly derive any feeling of masculine superiority from that. How many hobbyists have you heard admit they only bought a certain radio periodical for the sake of the ads?
MOST of the photocell Units that the writer has seen previously have used Thyratron valves, but not having one available it was decided to see what could be done using components from the "Junk" box.

The following circuit was evolved using two SP61 valves. These were chosen as they have a steep slope, which is desirable for this purpose, and they are also readily available at low prices.

The HT supply is of the AC-DC type, but as there is no direct connection to the chassis the unit is quite safe to handle; for this reason the metalising of the valves was left unconnected. A transformer was used to supply the heaters, as the SP61 draws 0.6A, and a dropping resistor was not considered practicable as it would need to dissipate 130 watts. The relay was a Post Office type with a resistance of 6.2kΩ, but any type could be used providing it will close when a current of 3 to 4 mA passes through the energising coil. To operate the external appliance, two sets of contacts are used, one make and one break, so that one pair are made in either position of the relay. The photocell used is a caesium silver type, and it needs a polarising potential of 60 to 70 volts on its anode.

The Circuit

The polarising voltage for the photocell is derived from the chain R1 and R2. This voltage is also used to supply the screen and anode of V1 which is DC coupled to the grid of V2. This valve is normally held at cut-off point by virtue of the potential applied to the cathode, which can be adjusted by VR1.

When the beam of light on to the photocell is interrupted it causes the cell to cease conducting, the grid voltage on V1 falls and the current flowing through the valve decreases. This causes the voltage at the anode to increase, which makes the grid of V2 less negative. The current which now flows through V2 closes the relay, which is held closed until light falls on to the photocell again. The purpose of C1 is to bypass any AC that appears at the anode of V1.

With the unit in operation, the valves should not be removed without first switching off. It will be seen that if V1 is removed the grid of V2 will have a large positive voltage on it, and the valve will pass excessive current.

Construction

No special precautions are necessary in the construction of the unit, apart from short leads to the photocell and a screened grid lead to V1; a screened grid cap was not found necessary.

To set up the device, it only needs to set VR1 so that the relay is open when there is light on the cell. This position will be found to vary according to the amount of light that falls on to the cell.

One last word of caution regarding the photocell. Too high a voltage across it will result in ionisation or "blue glow," which if allowed to continue would ruin the cathode. Should this occur when switching on the completed unit, the resistor R1 should be increased in value.

A Noise Limiter

By R. G. YOUNG

This circuit is equally suitable for BC, SW and TV, and can even be used as a PA Limiter with success. It may preserve the ears of some of your long-suffering readers!

The distortion produced, even at "maximum clip level" (minimum pass), is remarkably low. The circuit is, as far as I know, completely novel and has never been published elsewhere.

Parts List

VR1 10 kΩ wirewound
C1 0.1 μF 150V wkg.
C2 4 μF 350V wkg.
MR1 40 mA metal rectifier
T1 6.3V 2A heater transformer
V1, V2 SP61
PEC Caesium silver photo-electric cell
Radio Control Equipment

PART 8

By RAYMOND F. STOCK

Control for Non-Electric Propulsion Systems

Steam and internal combustion engines are less easy to control than electric motors and usually require auxiliary equipment such as clutches, gearboxes etc., which are outside the scope of this article.

It is worth bearing in mind that such items as steam control valves, reversing levers and the ignition levers of petrol engines are all susceptible to control by an electric motor and gear train.

The actuators used for these purposes are similar to those described for steering, and may either be arranged for continuous cut-out or have cut-out fitted by the makers for stopping. This can easily be controlled by radio, and a small electromagnet or solenoid can be coupled to the lever (which requires only a light pull). When this is worked from a ‘stop’ position mixed in with a steering sequence, either on a selector or escapement, it requires no artificial delay, since the control does not generally respond inside a half second or more.

Non Sequential Systems

A very well known control system depends upon the transmission of a continuous train of pulses, at a fixed frequency but with a variable length of pulse. The pulse length is infinitely variable from 0% to 100% and is controlled by the position of the steering wheel in the control box. Several methods are available for generating these pulses, but the easiest one is depicted in Fig. 37.

The electric motor, fed from a local power supply, drives the contact drum through a step-down gear train. The drum is of insulating material but has on, or let into, its surface a conducting area which varies linearly from 360° at one end to 0° at the other. A light brush makes one keying connection to the conducting layer.

A second brush is moved along the surface of the drum by the steering control, and this is shown as being on the end of the lever A which moves with the control wheel (outside the control box).

When the wheel is centred, the brush is receiving current from the drum over 180° (or 50% of the time). It will be evident how the percentage pulse changes as the wheel is moved.

The operating gear for the model is often that shown in Fig. 38. In this diagram, back and front contacts of the receiver relay are wired to opposite poles of the battery and thus supply current to the motor in either direction.

When pulses are being received of 50% length, the motor is continuously caused to rotate back and forth an equal amount; the frequency of pulses is several per second and the final shaft of the motor reduction gear which carries the rudder moves only imperceptibly (if indeed at all, in view of the probable backlash in the gearings).

When the pulse length is changed, however, the motor moves more in one direction than in another and the rudder creeps over.

It should be stressed that this system is not a strictly proportional one, since the movement of the wheel is related to the speed at which the rudder alters, not to its position.

The construction of the operating gear and the control box is obvious in this case, except perhaps for the pulsing cylinder. This should really have a truly flush surface, best obtained by mounting together on one shaft a half-cylinder of insulating plastic and a half-cylinder of metal both split diagonally. These, however, would have to be skimmed up on a lathe when assembled; a fair solution is to use a length of plastic with a metal mounted on a shaft, and to wrap around it a diagonally-cut half-cylinder of copper foil bent from a triangular shape. This can be secured by soldering it to the heads of countersunk 8-BA brass screws in the plastic.

The operating gear described has its limitations, but using the same control box a similar system can be employed in a truly proportional device.

Fig. 39 shows a circuit where the receiver relay A applies a voltage (15 or 20) to a relay and condenser (and thus charges the latter) whenever a pulse is received.

This voltage is applied to the grid of a pentode and biases it to cut-off point, if sufficient.

This voltage is applied to the grid of a pentode and biases it to cut-off point, if sufficient. The valve can be an output pentode such as.

Included in the grid line is the potentiometer B across a source of EMF which opposes the other voltage. The voltage on the grid, therefore, depends upon the difference between the two opposite voltages.

In the anode circuit is a relay switching the steering motor C across two batteries to reverse its direction; the motor is geared down to the rudder and to the shaft of the potentiometer.

It will be seen that whatever pulse length is being transmitted, a certain balance will be achieved between the potentiometer-controlled source of EMF and the voltage across the condenser.

Whenever the pulse length is changed the charging period of the condenser will vary—and thus its voltage—and a state of unbalance is created which can be restored only by rotation of the potentiometer; this is done by the motor which carries the rudder with it. It is found that the armature of a suitable relay in the anode circuit can be made to float between the contacts during a state of unbalance; a Siemens relay is ideal.

The frequency of the pulses is increased to perhaps 50 or 100 per second with this gear, and the receiver relay must be capable of operation at this speed.

The values of the charging condenser and resistors are best found by experiment, since they will vary with several factors. The valve can be an output pentode such as a 354 in the miniature range.

A different type of equipment is also capable of giving proportional results, and with less expenditure of energy since continuous signals are unnecessary.

I originally developed this idea for use in a cabin cruiser, but have used it extensively since in other applications, and it has much to commend it; it requires, however, a more complicated mechanical side dependent.
upon obtaining the correct gears, so the construction will not be described fully.

The principle is shown in Figs. 40 and 41. Fig. 40 is the control box. When the knob A is turned, one or other of the two contact pairs close under mechanical pressure and further movement, transmitted through them, rotates the pulsing wheel B through a 40:1 gear train. The latter (B) carries a brush which rotates against two conducting segments, one short and one long. One or other of these is brought into circuit according to which contact pair was originally closed. The brush as it rotates keys the transmitter; the number of pulses sent depends directly on how many times the brush rotates, i.e. how far the knob is turned. The type of pulse sent (long or short) depends on the way the knob is turned. The type of pulse sent (long or short) depends directly on how many times the knob is turned.

It will be realised that a long pulse will operate both A and B, but this is overcome by making the teeth of the delayed magnet's ratchet twice as large (in an angular sense) as those used on the non-delayed gear. When a delayed pulse is used, therefore, one wheel moves forward by X° and the other backward by 2X°, the final result being X° backward.

The pulses used are in a ratio of 4:1, and to prevent too much variation the control knob is turned (to port or starboard). With this system a very long pulse can be used to control an engine selector; it will introduce a spurious 'delayed' pulse, but this can be cancelled by adding a short pulse immediately after.

Multi-Channel Systems

Most of the interest in these systems lies in the electronic gear and is thus outside the limits of this article. Briefly, the transmitter is modulated by either (a) a single power oscillator whose audio frequency can be varied or (b) a number of master oscillators on various audio frequencies which drive a power amplifier for modulation.

Generally the former system is used, as some of the signals to be transmitted are mutually exclusive (e.g. Port and Starboard) and therefore not required simultaneously.

The receiver, after detection and 2 stages of valve amplification, RC coupled, uses the signals to feed a discriminating device; this can be a purely electronic phase change circuit, but is more usually a multi-reed unit responsive to certain audio frequencies. The vibration of the reeds when resonating is used to make a physical contact and operate a relay. The receiver, therefore, terminates in 2 or more relays instead of one, and the operating gear following each relay is of simple electro-mechanical type such as has been described for a single channel.

One system peculiarly adapted to two-channel working is the last one described, and the short and long pulses are replaced by signals of one or the other frequency. The carrier current may or may not be continuous when audio channels are used. Better reception is afforded by the former case, but it should not be overlooked that a third 'channel' can be obtained by using the carrier in the normal way. Similarly, if two channels of audio are simultaneously available, yet another 'channel' is obtained by keying them together.

Tuned reed units are interesting to make, and they can also be obtained commercially.

Models for Radio Control

Model aircraft are sufficiently difficult to fly satisfactorily without control equipment, and the fitting of the latter does not, as might be thought, simplify the problem. Some little experience in the hobby is therefore essential before radio control is attempted, and in most cases there is sufficient complication to warrant a 'team' approach by an established aeromodeller and a radio enthusiast.

Land vehicles are less troublesome, as a failure of the control system is unlikely to produce expensive antics. Space is usually limited for the use of fast car models, and the most suitable prototype is therefore something like an armoured car or heavy
With modern miniature components, quite orthodox models no more than 18" long can be controlled, while a 40" cargo vessel would take any amount of operating gear and batteries. The most popular type of hull is the V-bottomed boat (motor cruiser, M.T.B., etc.), and this is easy to make, and has plenty of beam for stowing equipment.

Secondary cells and an electric motor are ideal for propelling the slower prototypes, and suitable cells are available cheaply from surplus stores. Local power for operating gear is no problem where electric propulsion is used, and complicated selector systems are in order here (with no damage done if they do miss a pulse once in a while!).

On the other hand, one of the most entertaining models is a fast 'diesel' powered vessel; unless a clutch can be contrived no control will be possible over the speed, but this is offset by the excitement of controlling a fast model. Fortunately a commercial fast model can nowadays be acquired, with no qualms and at little expense, and built straight into a hull (perhaps also from a commercial kit) in the knowledge that the combination is bound to succeed; and if radio is installed with an effective range of, perhaps, half a mile, a great deal of entertainment can be derived from trying different classes of control gear.

Even the simple three-position escapement will be found to work surprisingly well, and allow of a more compact construction than valve rectifiers.

The first circuit shown in Fig. 1 uses a transformer with two separate windings for the HT and LT supplies. Fig. 2 shows a circuit using a transformer for the heater supply only, and a required drop of voltage being obtained by means of resistance R4. These two circuits are suitable for sets operating with heater voltages of 1.4V. With sets having an LT supply of 7.5V it is, in general, more economical to bleed the HT supply. The circuits for such sets corresponding to those of Figs. 1 and 2 are shown in Figs. 3 and 4. It will be seen that the circuits of Figs. 1 and 3 use a transformer giving a complete electrical isolation of the set from the mains. The use of a transformer is better suited for tap changing, and has the advantage over a dropping resistor in that it dissipates only a negligible amount of power. It allows of a construction uncluttered by the necessity of keeping hot components (resistors R5 and R10 in Fig. 4) away from other parts and providing adequate ventilation. The disadvantages of a transformer are its higher cost, size and weight. It should be noted that Figs. 3 and 4 the LT and HT supplies have one common lead.

The approximate values of the components are given under each diagram, but these should merely be regarded as approximate values. Below is outlined a procedure for determining component values suitable for the particular set and for the transformer and rectifiers available.

To determine the best values of components, connect equivalent HT and LT resistances of the set across the corresponding output terminals of the chosen circuit. The smoothing and dropping resistors (R3, R4 and R5 in Fig. 2) can then be adjusted to give the rated voltages. The equivalent HT and LT resistances of the set can be obtained by dividing the two voltages by the corresponding currents taken. These currents can be obtained from the valve data, or measured directly by connecting the set to the battery. It can, however, be taken as a
List of Components referring to Fig. 5

A  Terry Clips
B  Brass Supports
C1 C3  2000µF electrolytic condensers
C2  20—30µF electrolytic condenser
D  Tap Changer
F  Switch fixing nut
S  Switch
W1  HT rectifier
W2  LT rectifier
T  Transformer
K  Cable Clp
L  Input and output cable
R1 R2  Smoothing resistors
I  Steel box
J  Aluminium chassis
H  Rubber feet
G  Chromium plated countersunk screws.

Typical Component Values for Fig. 1

R1  5kΩ 1W ±20%
R2  6Ω 1W ±20%
C1, C2  20–30µF 150V Elect.

Typical Component Values for Fig. 2

R3  15kΩ 2W ±20%
R4  5kΩ 1W ±20%
R5  6Ω 1W ±20%

Typical Component Values for Fig. 3

R6  470Ω 2W ±20%
R7  1.5kΩ 5W ±20%
C9, C10  16–16µF 150V Elect.

Typical Component Values for Fig. 4

R8  2kΩ 10W ±20%
R9  470Ω 2W ±20%
R10  1.5kΩ 5W ±20%

Typical Component Values for Fig. 5

R1  5kΩ 1W ±20%
R2  6Ω 1W ±20%
C1, C2  20–30µF 150V Elect.

Typical Component Values for Fig. 6

R3  15kΩ 2W ±20%
R4  5kΩ 1W ±20%
R5  6Ω 1W ±20%

Typical Component Values for Fig. 7

R6  470Ω 2W ±20%
R7  1.5kΩ 5W ±20%
C9, C10  16–16µF 150V Elect.

Typical Component Values for Fig. 8

R8  2kΩ 10W ±20%
R9  470Ω 2W ±20%
R10  1.5kΩ 5W ±20%

Typical Component Values for Fig. 9

R1  5kΩ 1W ±20%
R2  6Ω 1W ±20%
C1, C2  20–30µF 150V Elect.

Typical Component Values for Fig. 10

R3  15kΩ 2W ±20%
R4  5kΩ 1W ±20%
R5  6Ω 1W ±20%

Typical Component Values for Fig. 11

R6  470Ω 2W ±20%
R7  1.5kΩ 5W ±20%
C9, C10  16–16µF 150V Elect.

Typical Component Values for Fig. 12

R8  2kΩ 10W ±20%
R9  470Ω 2W ±20%
R10  1.5kΩ 5W ±20%

Typical Component Values for Fig. 13

R1  5kΩ 1W ±20%
R2  6Ω 1W ±20%
C1, C2  20–30µF 150V Elect.
The box was built of 

TRANSFORMER WINDING DETAILS

| Fig. 1 | Output 60V at 15mA and 2V at 250mA. |
|        | Core area = 0.2 sq. in. Window Area = 0.6 sq. in. |
|        | Primary winding 6,900 turns of 40 swg. |
|        | HT secondary winding 1,980 turns of 40 swg. |
|        | LT secondary winding 66 turns of 28 swg. |

| Fig. 2 | Output 2V at 250mA. |
|        | Core area = 0.2 sq. in. Window Area = 0.6 sq. in. |
|        | Primary winding 7,800 turns of 40 swg. |
|        | Secondary winding 72 turns of 28 swg. |

| Fig. 3 | Output 90V at 65mA. |
|        | Core area = 0.45 sq. in. Window area = 0.7 sq. in. |
|        | Primary winding 3,450 turns of 38 swg. |
|        | Secondary winding 1,480 turns of 35 swg. |

general guide that a battery set takes an HT current of approximately 10 mA and a heater current of 250 mA in the case of 1.4 V LT sets and 50 mA in the case of 7.5 V LT sets, will in the case of a 90 V HT and 1.4 V LT set the two equivalent resistances are 9000 ohms (1 watt) and 6 ohms (½ watt). In this procedure, considerable care should be taken not to over-run the rectifiers and electrolytic capacitors. Thus if condensers C1 and C2 in Fig. 1 are rated at 100 V, the voltage across either of them must not exceed this value. Also the voltage across C1 must not exceed the rated rectifier output.

The power pack built by the author was shown in Fig. 1, and the components quoted are those actually used. That circuit was chosen in preference to others due to the fact that the power pack was built for a regular traveller D. The physical arrangement of components is shown in Fig. 5. Only overall dimensions are given as the particular detail arrangement will depend in each case on the components available.

The box was built of 

exposing the tap changer to an easy interference by outside persons. The bottom of the box carries four Terry clips A which fit over four specially bent pieces of brass B fixed to the lower aluminium chassis. Thus the bottom of the box can be easily removed and replaced. The bottom also carries four rubber feet fixed by glue. The whole box can be easily removed for servicing by removing the switch nut F and unscrewing the adjusting screws C. The resistors R1 and R2 were suspended by the mains voltage varying between 200 and 250 V. The author, therefore, does not consider it essential to provide taps for the normal variations in mains voltage. Those constructors wishing to wind their own transformer will find winding details at the end of this article.

To deliver the power into the radio, the case containing the transformer has been designed for 230 V, no change in performance of the set has been detected with the mains voltage varying between 200 and 250 V. The author, therefore, does not consider it essential to provide taps for the normal variations in mains voltage. Those constructors wishing to wind their own transformer will find winding details at the end of this article.

To avoid an embarrassed silence or an admission of lamentable ignorance when asked: 'Of course, the output is pretty nearly sinusoidal,' I am going to briefly outline why this is the case containing the set has been fixed to the lower aluminium chassis. Thus the bottom of the box can be easily removed for servicing by removing the switch nut F and unscrewing the adjusting screws C. The resistors R1 and R2 were suspended by the wiring. It has been found that although the transformer has been designed for 230 V, no change in performance of the set has been detected with the mains voltage varying between 200 and 250 V. The author, therefore, does not consider it essential to provide taps for the normal variations in mains voltage. Those constructors wishing to wind their own transformer will find winding details at the end of this article.

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it will only cut two lines for 30° of rotation as it approaches the vertical, but 6 lines for 30° of rotation as it approaches the horizontal, I want you to notice particularly that, as one side of the coil moves from proximity with one pole to the other, the induced voltage 768 c/s (two octaves above), and so on.

It is the presence of these harmonics in varying proportions which give instrument or voice its particular character; in fact, if all instruments produced pure sine waves they would be indistinguishable from one another. In sound, therefore, non-sinusoidal waveforms are very important, and they are of interest in radio because amplifiers must be designed to reproduce them as accurately as possible.

In transmitters and oscillators, however, the story is very different. Consider a transmitter carrier tuned to 1 Mc/s. If some second harmonic were present in the carrier waveform, the transmitter would radiate on 1 Mc/s and (less strongly) on 2 Mc/s.

This means that some of its power would be wasted in radiating an unwanted frequency, and one which would probably interfere with that of another transmitter.

Summing up, two apparently conflicting requirements must be met in radio. One, that amplifiers must be capable of handling non-sinusoidal waveforms without distortion, and two, that oscillators—except in special cases—must produce as nearly as possible a sinusoidal waveform. Incidentally, the oscillator described last month produces a very close approximation to the sine wave.

**Measuring AC**

We all know that measuring DC is a comparatively simple matter. We connect our meter and as the voltage or current being measured remains steady, the needle of the meter takes up a fixed position on the dial and stays there. But with AC, we are measuring under changing conditions, the subject becomes more complicated.

As we can see from Fig. 3, the voltage—

or current is continually varying, so that, if the frequency were, say, 5 c/s, the needle of the meter would also vary five times a second. As the frequency is increased, however, the needle would not have time to follow rapid changes in the voltage or current.

We have assumed in the above remarks that we are always using a moving coil meter. However, if we were to use a rectifier to change AC to DC, and then apply it to a moving coil meter or, alternatively if we were to use a moving iron meter, the needle would take up a fixed position when the meter is connected to an alternating current or voltage.

I do not intend to go deeply into the subject of rectifiers here, as it has been dealt with in an article by Mr. T. H. Robinson in the April number of the Radio Constructor.

The question we ask ourselves now is, what part of the alternating current waveform is the meter reading? Is it indicating the points A, B, C or D in Fig. 3? Obviously it cannot be A or C, or these are at zero. As was pointed out in Mr. Robinson’s article, some meters read RMS values, some read average, and additionally some measure peak. The interpretation of these terms may possibly be unknown to you.

We will start with the simplest—the peak value. As you might expect, in Fig. 3 this is 100V (point B), i.e. the maximum value to maximum at D is 200V.

This means that some of the power would be wasted in radiating an unwanted frequency, and one which would probably interfere with that of another transmitter.

The voltage then changes direction and begins to go negative, until it becomes approximately 340V. Therefore, the peak value is 1.414 times this. So if your mains are 240V, the peak value is approximately 340V.

So far we have not mentioned the average value. The average value is .637 of the peak—so the average value of our 100V peak sine wave is .637V. Unfortunately, these figures—.707, 1.144 and .637—only apply to a truly sinusoidal waveform.

Normally voltmeters are calibrated in RMS. However, in some cases they actually read peak or average. To take a case in point, imagine that we are measuring the output voltage of an amplifier with a valve voltmeter, which actually measures peak but which is calibrated in RMS. If the output voltages were purely sinusoidal, the readings would be correct, but if distortion were occurring in the amplifier the peak value may not change very much but, due to the distortion, the RMS value may be quite different. The meter, therefore, would not be reading the true RMS value, and would not be giving a correct estimation of the amplifier performance. This is, of course, the advantage of an oscilloscope,

which draws a picture of the waveform, and if it is clearly non-sinusoidal, errors in measurement with meters can be detected.

Having briefly outlined this theoretical aspect of radio, we return next time to a more practical footing, and have a look at a TRF receiver.
THE 20th NATIONAL RADIO SHOW

EARLS COURT - LONDON

September 1st-12th 1953

FOLLOWING the very successful television broadcasts of the Coronation which were seen "live" in four Continental countries and in the form of telerecordings in many others, the British radio industry and the B.B.C. are intending to give, at the 20th National Radio Show, Earls Court, London, September 1 to 12, their best demonstration yet of how television programming can be seen and entirely visible to visitors through its exhibition on four Continents.

TV will be demonstrated. There will be over 100 exhibitors in all, including manufacturers of components, valves and batteries. Projection television receivers will be seen in the making. The Army and the Royal Air Force will stage large exhibits to show some of their latest equipment and the Ministry of Supply will show components of a guided missile. Other exhibits of technical as well as public interest, are the training display of flying bodies, including King's College, University of London, and the B.B.C. Engineering Establishment.

A central feature of the Show will be a large three-face clock controlled by radio pulses from Rugby, and specially arranged electronic attractions in operation will include:

- Industrial X-ray equipment;
- an auscultoscope for testing heart and lungs;
- a fibre screen microscope;
- an electronic office message-sender;
- a high-speed sorter of beans by colour;
- an electronically controlled oxygen cutter;
- the National Physical Laboratory's machine which plays noughts and crosses with visitors;
- a plastics welder;
- an electronic stencil cutter;
- and the "electronic commissionaire" which for the second year will greet foreign visitors in their own languages and give information about locations and times of demonstrations.

There will also be radio-controlled models of an army tank and an amphibious vehicle. Tuesday, September 1, is preview day and is reserved for overseas guests and other special guests, including Press. The Exhibition will be opened to the public on the following day, by Field Marshal Lord Montgomery.

PRODUCTION: David M. Hyde, Production Manager. Production Department, Earls Court Exhibition Centre Ltd.
SHOW NUMBER 1953

PETTER RADIO and ELECTRICAL SUPPLIES

This item has specialised in Radio Components and Accessories for the past twenty-five years, and hold stocks to fulfil almost every requirement of the trade. Included on their stand are the following:

- Eric Racing Speeds
- Multi-array Models
- Coaxial, Christian
- Coax, Frasemagnet Motors, and Auto Changers
- Amplifiers, Microphones, Pick-ups, Knobs, Meters, Signal Generators, Speakers, Pads, Fuzz, Loudspeakers, Soldering Taps, Western Electric, Rectifiers
- Soldering, Solon Irons, Car suppressors, Toggle Switches, Transformers, B.V.A., V.A., and all musical equipment.

The Petter stand includes a demonstration theatre that forms the centre section of the exhibition hall. In this theatre the General Public will be able to listen to many of the finest audio equipment, and be assured of the best standards of sound reproduction. The Axioms and Audiom range of loudspeakers have in the world of good quality and high fidelity reproduction.

For all purposes connected with Television, Radio, and Telephone, the telephone and the best quality, not necessarily the most expensive, equipment will be demonstrated and operated by skilled operators, and will give the public a good idea of the equipment already available to the public.

Microphones

A recently developed low impedance moving coil microphone, specifically designed for the Radio Show and will be on display for the first time. This microphone has the ability to be used as a hand microphone, desk,
virtue of having a tapped hole (ixzo T.r.l.) that
pocket attachment (that leaves the hands free for
will fit the majority of present day microphone stands.

Transformers, .

Which employs new features in picture focus and
will also be displayed for the first time. This unit,
associated with that type of unit. • •

An internal transformer for direct to Grid operation.

Representative range of output transformers which will
utilise the new Ferroxdure magnetic material that has
the advantage of high resistivity, enabling the units
to be positioned close to the deflector coil without
affecting the performance of the set.

Transformers

Amongst the loudspeakers displayed will be a rep-
resentative range of loudspeaker models which will
include the well known Hf 6e. The Hf 6 is an outstanding
30 watt unit, specially recommended for use with the
Aston 150 M.2 and 22 Mk. II. This transformer can be
wound to customers' specifications.

Vibration Generators

A range of Permanent Magnet Vibration Generators
will be on show amongst which will be-

Model V/47
Force factor 0.9amps
Model 390A
Max. continuous current rating of 1.0 amps
Max. continuous current rating of 1.5 amps
Model 790
Force factor 9.5amps
Model 8/600
Force factor 6.0amps
Max. continuous current rating of 0.65 amps
Max. on-air operation rating of 1.55 amps
Max. on-air operation rating of 1.05 amps

These instruments are of great value in the field of
Scientific Instruments for the investigation of vibration.

Public Address Equipment

Under this heading Goodman Industries will be
showing an Omniodirectional Sound Diffuser Model
CD/77. This unit houses a high flux P.M. 10" loud-
speaker and a 2 way crossover unit, and is suited to
applications where high quality, omniodirectional
coverage is required. There is also a smaller version of
the CD/77, Type CD/66, which has just been
manufactured and will also be on show. This unit houses a
high quality 3.5" loudspeaker and will be shown in a 15 watt Pressure
Unit Type T32.

ROYAL ERSIN HAWKES Ltd.
A tape recorder of unique design is making its
first appearance at the show on the stand of Boeing and
Hawkes Ltd. Electronik Division. It is called the
"Reportor" and, as its name implies, reports electrically
for use with all types of musical instruments. Intended
for professional use, it is small in size and weight
and complete independence of electric mains give it a
greater than 10000 hours. There is a choice of tape speeds—71/2" per second for
completely automatic reproduction or 15" for
high speed photographs (10 minutes).
In both versions there is a built-in rectifier which gives a
operating time of eight minutes. The standard
model will handle any playback song on twelve twobs but there is a de luxe
model (thirteen pounds) with a small built-in loud-
speaker. All models use standard torch cells for LT and
9V cells for HT, the standby time being reduced to one-fifth of normal.

Multicore Solder

There are a large number of output transformers which will be
be shown on the Mullard Stand of the enamelled
wire and solid electrolytic condenser, the emphasis is on
the progress made during the past year, the results
of which are summarised here.

In the Power Amplifier Circuit, the new High Voltage
Doubling Transformers Types 561.3 will be of special
interest to television designers. Their unique construc-
tion is exemplified by the absence of metal parts at
the terminals. They are well suited for use in hearing
aid and with transistors. Higher ratings and improved
performance will be obtained in the new "Peepack"
Tubulars to which has been added a new range for operation at 85%. The Type 528b
Chassis Module is being considered at present for use in the first time on an 80V electrolytic condenser
which can be used also in mains and battery
rectifier units.

Mullard Ltd.

Of particular interest to the public at the National
Radio Show to be held at Earls Court, from September
1st to 12th will be the new model 222 Mk. II Mullard Ltd., are providing on Stand 91. Here expert
demonstrations will be given of a new low-voltage
carrier circuit. These condensers are a noteworthy step forward in the design of valves for use in hearing
aid equipment. Consideration will be given to the
advantages of long life and reliability at high temperatures and the benefits gained by the absence of metal
parts. A special demonstration will be given of "Metalpack" and "Mullard Tubes" type VT 561, which will now
operate at 100%, without voltage over-rating.

There will be three of these Information Centres.
One of these will be the "Telegraph" information centre
in his choice of a set. Here he will be able to judge
for himself the comparative merits of the various
models. He will also have the opportunity of seeing the
television pictures TV, available and obtain useful
guidance on the selection of the correct visual aids
and aerial installations.

Another Information Centre offers advice on the
maintenance of Mullard Transformers. The regular
valve testing is given special emphasis, and the Mullard
Electronic Demonstrator will be used to show the
occupations of those interested in the method
Television Valve Test is demonstrated to the Trade
by using "Visconol-X" Impregnation for "Metalpack"
and with accuracy at this voltage, the
recorder may be used instead of a paper condenser at this voltage,
Ersin Liquid Flux, for dipping purposes and other-
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