Radio Constructor

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NO APOLOGIES

COMES a time when one begins to consider the subject for the month's Editorial. The Editorial grey matter was stirred and a subject came readily to mind. This particular topic had previously been broached so we tried again. In the end there was no denying that there was but one subject which could be tackled this month. No apologies are offered for again subjecting to Editorial comment—Television Construction.

Television Construction as the theme is more than justified. The interest at the moment is staggering and shows no sign of early flagging. Take our Data Booklet " Inexpensive Television." The first copies were on sale on December 24th and since that day we have sold over 12,000 copies. Orders are still coming in unabated and the radio fraternity appears to have an unsatiable thirst for such information. The interest is increasing rather than slackening.

Why is Television Construction so popular? Many reasons spring to mind, two of which are cost and the fact that TV is a new field to conquer. Taking first the cost, it is a fact that most of the radio fraternity feel they cannot afford to buy a commercial receiver at the present prices. By constructing a surplus-gear receiver they can cut the price by about a quarter—our receiver costs between £15-£20. This figure is more within the reach of the average radio enthusiast and what is more, if the " junk box " is of any pretensions the price can be lowered considerably. We know of one constructor who completed his TV receiver for just under £10 by judicious purchases and by virtue of an investigation into the junk box for components.

Another factor is the ease of construction. A TV receiver built from war surplus gear is not too difficult a proposition, providing that a certain amount of horse sense is applied. Our booklet, too, describes what is possibly the simplest televisor yet described utilising war surplus units.

The components needed are easily obtainable, and several firms can supply a complete kit of parts and units. The Data Booklet itself is within reach of anyone's pocket, and we have been asked why the price is so low compared to the value of the information given. The answer lies with such things as printing costs, circulation, advertising support and so forth. Because the booklet is cheap it does not follow that the data is below par! Far from it—the televisors concerned, using the VCR97 and 5CP1 tubes, were both constructed, tested and the snags ironed out before the original articles appeared in print. And we know that consistent reception is being obtained on receivers built from the articles in areas far outside the accepted service area.

It may well be that 1949 will be the peak year for the construction of home built televisors.

W.N.S.

NOTICES

THE EDITORS invite original contributions on construction of radio subjects. All material used will be paid for. Articles should be clearly written, preferably typewritten, and photographs should be clear and sharp. Diagrams need not be large or perfectly drawn, as our draughtsman will redraw in most cases, but relevant information should be included. All MSS must be accompanied by a stamped addressed envelope for reply or return. Each item must bear the sender's name and address.

COMPONENT REVIEW. Manufacturers, publishers, etc., are invited to submit samples or information of new products for review in this section.

ALL CORRESPONDENCE should be addressed to *Radio Constructor*, 57, Maida Vale, Paddington, London, W.9. Telephone: CUN. 6579.

LOGICAL FAULT FINDING

By J. R. DAVIES

INTRODUCTION.

AN introduction is very necessary to a series of articles of this type. Owing to shortage of space, however, I must do my best to make that introduction as short as possible.

The theme of the articles lies in the art of fault-finding in the shortest space of time. I consider that the time spent in *finding* the faulty part of a circuit is the most important thing. It only takes a few minutes to replace a faulty component. It can take several hours to find which component is causing the trouble. It is impossible to cut down the time spent in *repairing* a set; but, very, very often, by use of a logical technique, the time lost in *finding* the fault can be shortened very considerably indeed.

This is the first of a series designed to assist the home constructor in tracing faults

It had been my original intention to confine the articles to fault-finding on commercial receivers, or on receivers which had been home-constructed successfully and had at some time since failed. Servicing in these cases would consist almost entirely of locating the faulty component or components followed by the necessary replacement. However, as the readers of this magazine would be, in the main, constructors of their own receivers, I have enlarged the scope somewhat, insofar as I have pointed out faults in *design* that can give rise to certain troubles.

This increase in scope makes for a corresponding enlargement of servicing technique. In the case of a faulty commercial receiver we are already possessed of one vital fact before we start. And that is that the set, when it left the factory, was in full working order. The repair of that set then consists of bringing it back to it's original state. The repair of a commercial set should not consist of *adding* bits and pieces here and there. The servicing of some home-constructed sets does, however, necessitate the addition (or subtraction) of a few components if the chassis is to work well.

In these articles I shall treat the case of the commercial or successful home-constructed set first, and, if necessary, then pay attention to faults in design when and where they occur. It should be realised that fault-finding in the first case is a purely logical affair, whereas, in the second case, it can often be a matter of experimenting and occasional guesswork.

These articles, therefore, are intended to point out the various tests—and the order in which they should be used—that need to be carried out in the repair of unserviceable receivers.

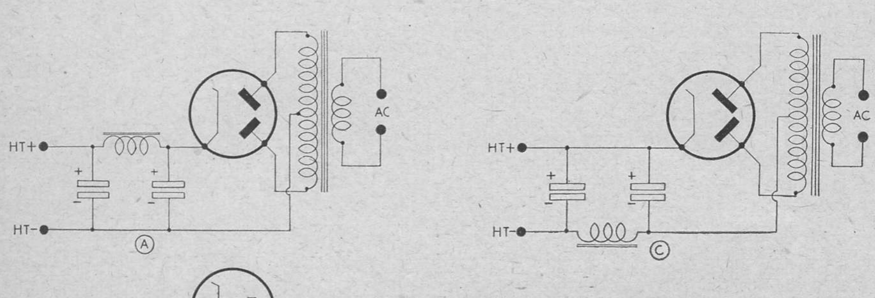
I have used enough words in this introduction to bring out the main points in the following articles. Let us now proceed to the various ills which can beset the radio receiver and consider their quickest diagnosis.

HUM.

Hum is one of the simplest snags to cure in the normal domestic receiver.

There are various types of hum:—

1. Hum due to bad smoothing in the power supply. This shows up as a continuous hum in the speaker, whether a station is being received or not.



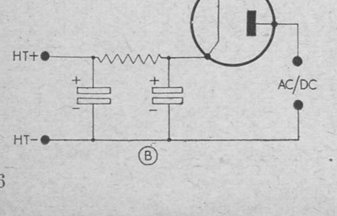


Fig. 1. (A) Showing the conventional fullwave rectifier circuit. (B) A typical AC/DC rectifier circuit. The resistor is used instead of a choke in order to save space and also for economy. (C) A fullwave rectifier circuit in which the smoothing choke (or speaker field) is inserted in the negative line. The voltage dropped across this component is often used for bias purposes in the receiver.

2. Hum due to grid or cathode pick-up in the A.F. stages of the receiver. This is not always distinguishable from the hum due to bad smoothing so far as an aural test goes, although it may sometimes have a higher-pitched note. It is easily traceable on the test-bench however.

3. Modulation Hum. This is a hum that appears whenever a station is tuned in. It may not necessarily appear on all stations.

4. " Oscillator Wobble." This is a fault due to frequency—modulation of the oscillator in a superhet at the mains frequency. The symptoms are somewhat similar to those of modulation hum, except that the trouble usually occurs on the short-wave band or bands.

5. Hum due to stray magnetic fields.

6. Hum induced mechanically.

Hum on Battery Receivers.

It is very rarely that any hum troubles occur in a battery operated set. If an H.T. eliminator is used, hum may be caused by this and the treatment is the same as that for (1) above. Hum may also be picked up on the control-grids of one or more of the valves, particularly if a pick-up is used. A good earth and appropriate screening should cure this. Mains modulation is very infrequent indeed, and may be cured by a good earth connection, or may need the same treatment in the aerial circuit as does a mains receiver (see below). A set of the car-radio type, using a vibrator supply for H.T. should be treated as a mains receiver.

Let us now consider the various cures for the faults enumerated above.

1. Hum Due to Bad Smoothing in the Power Supply.

Now, if we are to use a time-saving technique, so far as possible we must check the components in their order of unreliability.

The components in the H.T. power circuit most liable to give trouble are the H.T. smoothing capacitors. Fig. 1 gives a few typical arrangements often met in practise. In each case it is very probable that one or both of the electrolytic capacitors may have become " dry " or open-circuit. They may also have a partial short-circuit, but, unless this is excessive, the set will continue to play with reasonable volume.

The quickest check is to connect an 8 μF capacitor across each electrolytic in turn until

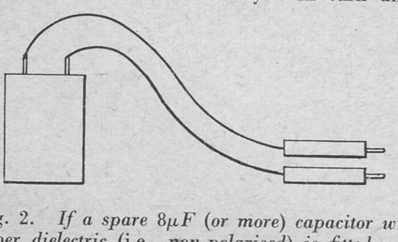


Fig. 2. If a spare 8μF (or more) capacitor with paper dielectric (i.e., non-polarised) is fitted with test prods as shown, it forms a useful accessory for the quick checking of faulty high value capacitors in the receiver.

the hum disappears or diminishes considerably. There is no need to waste time disconnecting the capacitor under test, unless it is considered that it has a heavy short-circuit. For this test, and for many others, it is very useful to have a paper (non-polarised) capacitor of at least 8 μF. capacitance and 350 W.V. fitted with a pair of test leads and prods. See Fig. 2. This capacitor can be used for checking all high capacitance components in the sets under test as well as for shorting control grids or anodes to earth without affecting bias arrangements or shorting H.T. supplies.

If more than two electrolytics are encountered in the power supply circuit, the extra ones should also be checked, as the set may have double smoothing. Always ascertain that the individual negative and positive of each smoothing capacitor is correctly identified for checking purposes, as the capacitor negatives do not always go to chassis. See Fig. 1 (c).

There are few other components in the power supply circuit that may cause trouble. The rectifier may be checked by substitution, and the smoothing choke or speaker field may just possibly have some shorted turns.

If there is a heavy consumption somewhere on the H.T. line due to a partial short-circuit or, say, an unbiassed output valve, hum may result due to overload of the rectifier. These faults, however, will cause weak signals and possible distortion, and their location is best dealt with under those headings.

In the case of newly-constructed receivers, hum will most probably be caused by insufficient values of smoothing capacitor or choke. In AC/DC receivers, values as high as 32 μF. may be used for smoothing capacitors, provided that the rectifier is rated to feed into these values.

2. Hum Due to Grid or Cathode Pick-up.

Should the tests mentioned in the previous section show that the mains unit is above reproach, it is very possible that the hum is being picked up by a grid or cathode.

Fig. 3 shows a typical A.F. section of a superhet, a double-diode-triode followed by a pentode output valve. To start our tests, we short-circuit the grid of the double-diode-triode valve to chassis. Should the hum cease the indication is that it is being picked up by that grid. The idea behind the test is to discover in which grid circuit the hum is being picked up. If shorting the grid of the first amplifier valve to earth does not stop the hum, and shorting the grid of the second does, then it is obvious that the hum is being picked up on the grid of the second valve. (If the amplifier possesses more than two valves, we start at the first and work on towards the output valve to discover in which stage the trouble lies). When we have located the faulty grid circuit, we then look for the particular cause of the trouble within that circuit.

If the lead to the grid in the faulty stage is screened, this screening should be checked;

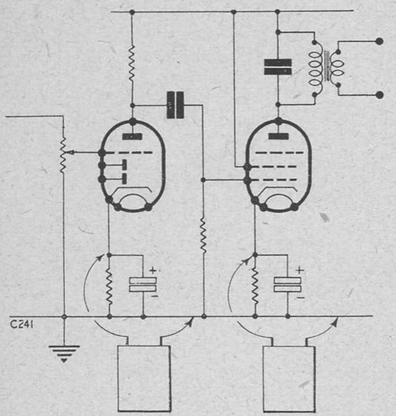


Fig. 3

attention also being paid to the screening of the top cap as well, if this is fitted. The metallising or screening of the valve should also be tested. Or, again, the metal case of any volume control in the circuit may have become disconnected from chassis. In fact, all the screening appropriate to the faulty grid circuit should be checked, and it can be seen that nearly all the faults may be laid down to bad screening. If a pick-up radio switch is used, ensure that the leads to this component are above suspicion. (It should also be remembered that an open grid circuit may cause hum, although distortion or loss of signal will usually accompany this fault).

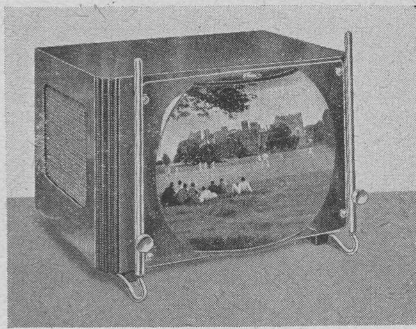
If it is decided that the hum is not being picked up by the grids, the next components in the chain of probability are the electrolytic cathode by-pass capacitors. Again our 8 μF test capacitor (Fig. 2), shows its uses. With one test lead to chassis, we can now " prod " the cathodes of the various valves. See Fig. 3. If a case is found where a cessation, or considerable diminumition, of hum is found, then the capacitor under test is undoubtedly the guilty component, having probably become " dry " or open-circuit.

(*To be continued*)

THE EDITORS INVITE . .

- **Constructional articles suitable for publication in this journal. Prospective writers, particularly new writers, are invited to apply for our " Guide to the writing of Constructional Articles " which will be sent on request. This guide will prove of material assistance to those who aspire to journalism and will make article writing a real pleasure !**

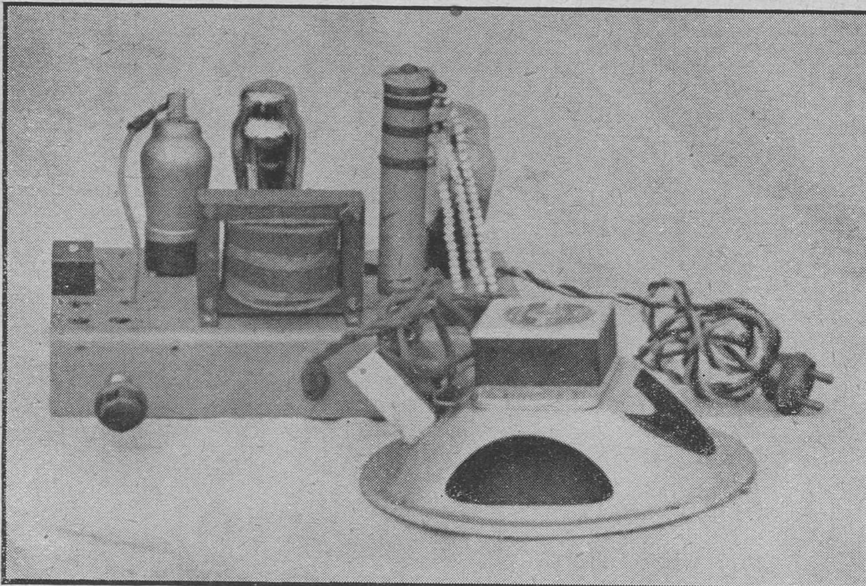
Televisor Lenses



(The Magnavistor A3)

Messrs. Duke & Co., of 219, Ilford Lane, Ilford Essex (ILF. 0295), have forwarded to us a sample of the MAGNAVISTA television lenses, suitable for use with either the VCR97 or 5CP1 cathode ray tubes (as used in " Radio Constructor's " Inexpensive Television). These lenses are also available in various sizes covering all types of television receivers and a descriptive leaflet may be obtained on request. The model A/7 (for 6 inch tubes) was fitted by means of four screws to a television receiver containing a 5CP1 cathode ray tube, and even when the screen was viewed at a variety of angles, no distortion was apparent in any form. Detail and contrast were excellent at all times, and it was quite easy to view the screen from a distance ranging up to 12-ft. The manufacturers give the magnification of the lenses at 2½ times. The price of this lens, model A/7, is £4/4/0. Another model available is the Universal model, fitted with a telescopic stand to enable the MAGNAVISTA lens to be fitted easily over the tube face, despite variation in the distance between the screen, and the base of the receiver. This model may be obtained to suit either a 9 or 10 inch tube, and the prices are £8/8/0 and £8/18/6 respectively. The Standard Flush Fitting model is also available for 9 or 10 inch tubes, and the prices in this case are £6/6/0 and £6/16/0. The latter is fitted by means of four screws directly to the cabinet. Another type of lens available, also suitable for the VCR97 and similar tubes, is a 5 inch model, which retails at 25/-. This is not one of the MAGNAVISTA products, however.

Messrs. Duke and Co. can supply any of these lenses by return of post.



Amplifier for AC/DC Operation

designed and constructed by

W. J. BALLARD

PROVISION for the connection of a pick-up is rare in AC/DC receivers, whether designed for home construction or commercially manufactured, and many constructors hesitate, for various reasons, to modify the latter ; a small AC/DC amplifier such as this, intended primarily for the reproduction of gramophone records at domestic sound levels, should meet the needs of many. Its output of two to three watts is ample for this purpose.

The unit comprises a triode and output pentode in cascade, the HT supply being derived in the usual way, by half-wave rectification of an AC mains supply, or directly from a DC mains supply, the rectifier, in this latter case, behaving merely as a low-value resistor.

The circuit, see Fig. 1, is straightforward and is designed around valves of the 0.2A-heater, " British " type, as these require relatively high heater-voltages ; with only three valves in circuit, the volts to be dropped by the ballast-resistor might otherwise be excessive for a normal type of component.

Safety Precautions.

In all AC/DC gear, certain safety precautions have to be taken, in addition to those required for AC apparatus, owing to the chassis being in direct electrical contact with one mains conductor which might not be the earthed one.

Since the pick-up is handled while the amplifier is switched on, C1 and C2 are provided to isolate it, and must on no account be omitted, unless the pick-up is to be connected to R1 via a double-wound transformer, so housed that its secondary-winding terminals cannot be inadvertantly touched while the unit is in normal use. The values of C1 and C2 are important. Being effectively in series with each other and with the pick-up, capacitances much smaller than those specified would reduce the input at the lower frequencies, whilst too large capacitances would, on AC mains, pass too heavy a current in the event of an accidental short-circuit between the input terminals and earth (*i.e.*, ground, not chassis). 0.1μF should be regarded as a maximum, normally.

The chassis is not earthed, and earthing was not found necessary for either AC or DC operation. Under no circumstances should the chassis be connected direct to earth ; if, for any reason, earthing is necessary, it should be done indirectly by means of a 0.01μF isolating capacitor.

Isolating capacitors should be rated to withstand at least 450V peak, and preferably 1kV.

Domestic radio apparatus is normally controlled by its own switch, the mains-plug being left inserted in a live socket-outlet. This fact is easily overlooked when making adjustments to the apparatus, and for this reason particularly,

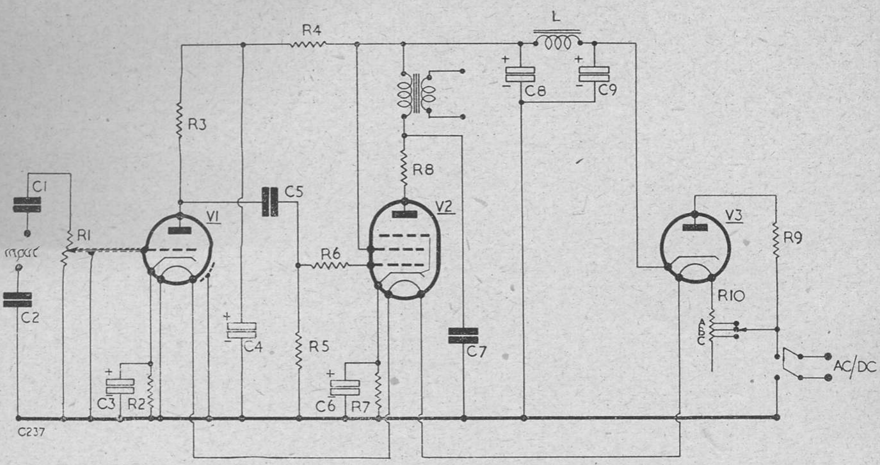


Fig. 1. Circuit of amplifier, and component valves, etc.

C1, Isolating capacitor, 0.1μF, 450V peak.
C2, Isolating capacitor, 0.1μF, 450V peak.
C3, Bias by-pass capacitor, 25μF, 25V wkg. electrolytic.
C4, Decoupling capacitor, 8μF, 450V peak electrolytic.
C5, Coupling capacitor, 0.05μF. 350V peak.
C6, Bias by-pass capacitor, 25μF, 25V wkg. electrolytic.
C7, Tone correction capacitor, 0.001μF, 350V peak.
C8, Smoothing capacitor, 8μF, 450V peak electrolytic.
C9, Smoothing capacitor 8μF, 450V peak electrolytic.
C9, Smoothing capacitor, 8μF, 450V peak electrolytic.
R1, Volume control, 0.5 M Ω, 1 watt (combined with Sw.)
R2, V1 bias resistor, 750 Ω, ½ watt.
R3, Anode load resistor, 33 k Ω, 1 watt.
R4, Decoupling resistor, 10 k Ω, ½ watt.
R5, Grid leak resistor, 0.1 M Ω, ½ watt.
R6, Grid stopper resistor, 4.7 k Ω, ½ watt.
R7, V2 bias resistor, 200 Ω, ½ watt.
R8, Anode stopper resistor, 100 Ω, ½ watt.
R9, Surge limiting resistor, 100 Ω, ½ watt.
R10, Heater ballast resistor, 810 Ω minimum, tapped 100 Ω (c), 100 Ω (b), 610 Ω (a)—0.2A type, 40 watt.
V1, V2, V3—see Table 1.
L, Smoothing choke, maximum resistance 500 Ω.
Sw, DP on/off switch (combined with R1).
Other components required : 3 valve bases as appropriate, chassis, loudspeaker and output transformer, terminals or socket-strips, mains plug, wire, sleeving and miscellaneous nuts, bolts and screws.

a double-pole on/off switch is specified ; with this in the "off" position, the amplifier is then isolated from the mains. A volume control with DP switch may not, however, be easily obtainable at the present time, in which case a SP type may be used, the switch being inserted in the lead to the ballast-resistor, but if so, the mains-plug must be withdrawn from the socket-outlet before making any adjustments—a wise precaution with any set.

Any screening of the pick-up leads should be "earthed" to chassis through a 0.01μF isolating capacitor. Even where the screening is electrically isolated from the pick-up arm and leads, direct earthing (to ground) is not recommended, as, being flexible, the screening may come into contact with the chassis.

In the original model, the pick-up leads were about 18 inches long, and no screening was found to be necessary, provided that they were kept clear of mains wiring, loudspeaker leads and the smoothing choke.

All grub-screws in control knobs should be recessed, and the recesses plugged with wax or similar insulating material.

To sum up—the chassis must not be directly earthed or handled while the amplifier is connected to the mains, and any apparatus (including the pick-up) used with the amplifier and earthed, or likely to become earthed or to make electrical contact with the operator, must not be directly connected to the chassis.

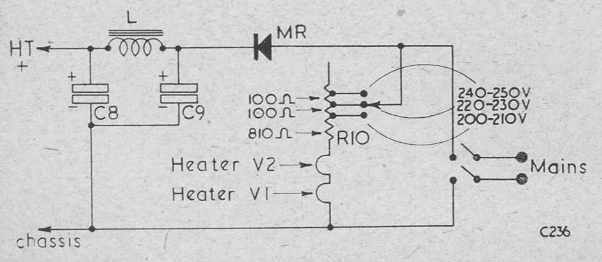
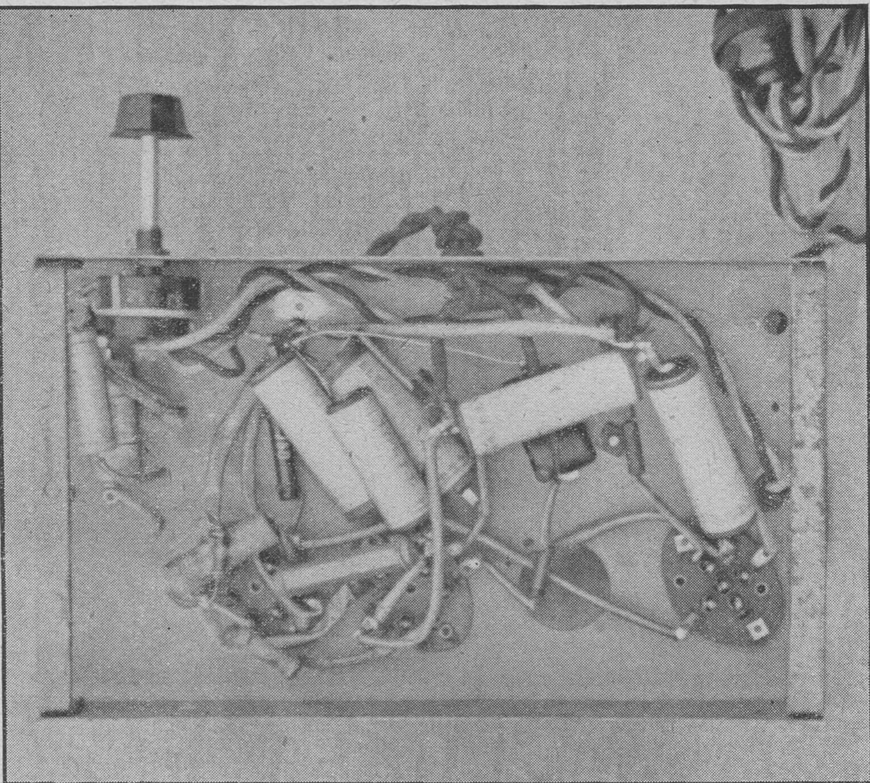


Fig. 2. Circuit of power pack, using half-wave metal rectifier in lieu of V3. R10 is 1010 Ω



Underchassis view of the amplifier. The wiring and position of the components may be clearly seen.

Construction and Wiring.

The construction presents no difficulties as the layout is not critical, save that the input lead to the control grid of V1 must be kept reasonably short to avoid instability and hum pick up, and, if the loudspeaker is to be mounted close to the amplifier, the choke should be so orientated as not to induce hum in the output transformer.

The chassis, measuring $10\frac{1}{2}''$ x $6''$ x $2''$, was purchased ready-drilled for valve bases, and is of the type intended for midget receivers. This size provides ample room for all components, and could even be a little smaller. Alternatively, there is room for the output transformer to be mounted on the chassis instead of on the loudspeaker frame.

The volume control should be located so as to keep the grid leak to V1 reasonably short, as indicated above, and the input terminals should be mounted nearby, preferably so that C1 and C2 may be wired directly, by their wire ends, between the terminals and the volume control. It will be observed from Fig 3 that the volume control is mounted near one end of rear flange of the chassis. This was done merely to avoid drilling the front panel of the cabinet before the location of the controls of a proposed tuner-unit was known. There is, of course, no reason why it should not be mounted elsewhere, if the location of other components permits.

The leads to the ballast-resistor are exposed to the considerable heat it dissipates and some sort of protection should be provided if possible. The author used 20 SWG tinned copper wire threaded through china beads. Children's glass or ceramic beeds are suitable and are usually obtainable at toy-shops and popular stores. Ceramic insulating beads specifically designed for this purpose are commercially manufactured but are not stocked by many retailers.

The voltage adjustment device is a four-section insulated wire-connector, as used by electricians, bolted to the chassis. It carries a flex loop, of which one end is permanently connected to one section, and the other free to be inserted into the appropriate section of the other three. Any type of insulated four-way connector may be used for this purpose.

Wiring is straightforward. Components are few in number, and resistors and capacitors are

Valve	Original	Alternatives					
		Brimar	Cossor	Mazda	Mullard	Tungsram	Service Types
V1	Mullard HL13C	4D1	—	HL1320	HL13	HL13S HL13	AR7, CV1109, CV3502, NR55, VR109
V2	Mazda Pen 3520	7D6*	—	—	CL33 Pen 36†	PP35‡	CV1401
V3	Mazda U4020	1D5	40SUA	—	—	—	CV764, CV1267

* 40V heater—decrease R10 by 25 Ω, change R7 to 150 Ω, output transformer ratio 65 to 55 : 1 for 2 to 3 Ω impedance speaker.
† Change R7 to 225 Ω
‡ Change R7 to 175 Ω

Table 1. Valves required and suitable alternatives.

suspended in the wiring. If the electrolytic capacitors are of the type in which a metal case is the negative contact, fixing clips making good contact with the chassis will be required.

R6 and R8, to be effective, should be wired close up to their respective valve-pins.

Components and Values.

The resistance specified for the input volume control is correct for most crystal pick-ups, and will usually be found satisfactory for other types, but the pick-up manufacturers' recommendations should be followed if known.

R10 is a standard 0.2A ballast-resistor, of at least 810 Ω resistance, with adjustable taps which have to be set to the values indicated. If no ohmeter is available, the dealer from whom the resistor is purchased will usually do this; it is the work of a few minutes only.

The smoothing choke L should be of low resistance, not more than about 500 Ω, and preferably less, to avoid excessive voltage drop. It must be rated to carry at least 60 mA, DC.

The output transformer ratio should be between 55 and 35 : 1, for a speech-coil impedance of 2 to 3 ohms, and the primary must have a minimum rating of 40 mA, DC. The loudspeaker in use is an 8″ PM type, and this size is recommended.

The amplifier has been used with both a Rothermel "Senior" crystal and a Collaro magnetic pick-up, and functions satisfactorily with either.

The valves used in the original, and suitable alternatives including service types, are listed in Table 1, while base connections are set out in Table 2.

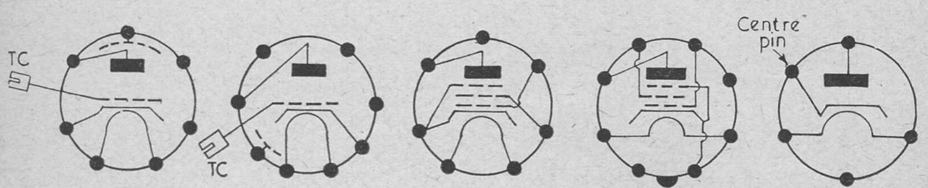
The specified values of bias resistors should be adhered to, but those of other resistors are not critical and near values may be substituted. Minimum wattage ratings have been given.

Capacitances specified should not be altered, and the voltage ratings given are minima, but C8 may be of greater capacitance (up to 32 μF) if additional smoothing is required, while C7 may be increased or decreased to provide tone correction to suit the user's personal taste. See also "Modifications" below.

Modifications.

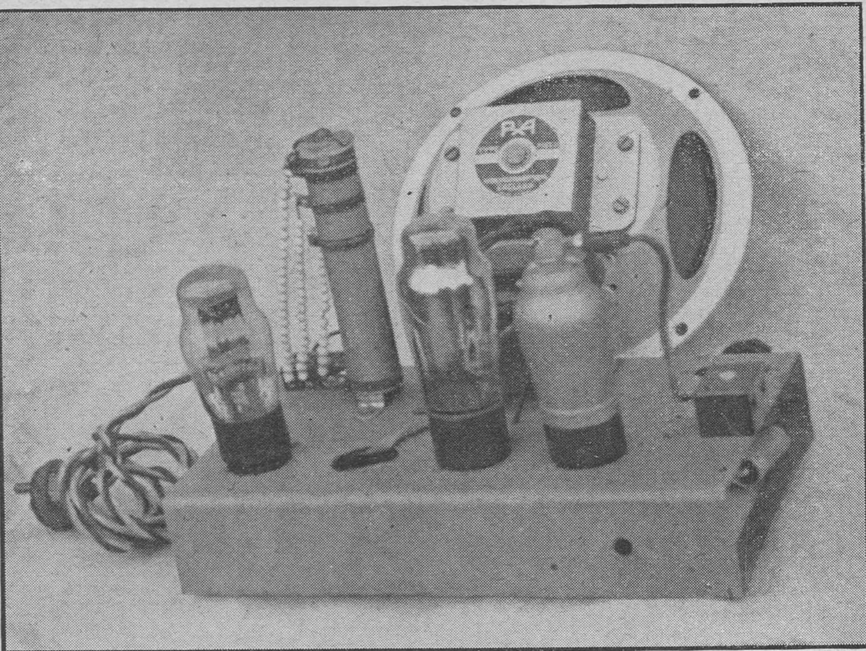
Constructors who wish to dispense with the mains-voltage adjustment may do so by permanently connecting the lead direct to the 810 Ω tapping on R10. Tests with the mains input reduced to 200V indicate that, for the purposes for which the amplifier is intended, there is no appreciable difference in performance, even though the 810 Ω tapping is appropriate to a 250V supply.

If it is desired to use a metal rectifier in place of V3, the resistor R10 must be increased to 1,010 Ω tapped (if the mains-voltage adjustment is required) to give sections of 100 Ω, 100 Ω and 810 Ω, and this may entail using two or more series-connected resistors of appropriate wattage-



HL 13C / 4*D*1 / *HL* 1320 / *HL* 13 — *HL* 13S — *Pen* 3520 / 7*D*6 / *Pen* 36 — *CL* 33 / *CV*1401 — *U* 4020 / 1*D*5 / 40 *SUA* / *CV* 764

Table 2. Valve-base connections (bases viewed from under-side).



View of the amplifier as seen from the rear.

rating (4 watts per 100 Ω) to make up the required value. The circuit, when using a metal rectifier, is sh wn in Fig 3.

A variable tone control may be arranged if desired, by wiring a 50K Ω variable resistor in series with, and on the " earthy " side of, C7, the capacitance of which may be increased to 0.1μF to provide more top-cut at the maximum. The fitting of such a control may be found useful to achieve a symmetrical panel layout when R1 cannot be centrally located on the cabinet front.

The smoothing choke, L, may be replaced by the field winding of a mains-energised speaker, provided that such a winding is not of appreciably higher DC resistance and does not require an energising current exceeding 50 to 60 mA.

The use of a 0.5A-fused mains-plug is well worthwhile.

Housing.

Any cabinet, other than a metal one, may be used for housing the amplifier, but adequate ventilation must be arranged. It is desirable to drill a hole, of the diameter of the ballast-resistor, or a series of small holes, in the chassis under that component to allow free circulation of air through and round the resistor. If the floor of the cabinet is clear of the surface on which it stands, a large hole should be drilled in it, in alignment with that already described, and plenty of holes drilled in top and bottom edges of the rear panel to allow free ingress of cold air and egress of hot. The holes may be covered with gauze to keep out dust. This amplifier is particularly suitable in size for converting an acoustic gramophone to electrical operation and will usually fit into the space formerly occupied by the horn, or used for storing records, leaving plenty of space around it for ventilation. Holes can be drilled in such a cabinet, in the bottom and back, which will not be visible in normal use. As acoustic-gramophone cabinets are often designed to boost the lower audio frequencies, some attention to the loudspeaker arrangements may be necessary to avoid cabinet resonance and booming.

Cost.

Using new components, the amplifier cost about £8, inclusive of speaker and pick-up in 1946 ; using " demobbed " components now available, it could cost considerably less.

Operating Notes.

As with all AC/DC gear, some 30 seconds or so must be allowed after switching on, before the valve heaters reach their working temperature. On AC mains, it is immaterial which way round the mains plug is inserted in its socket-outlet, but on DC it must be so inserted that the pin connected to chassis is in contact with the negative mains conductor. No harm will be done if the connections are reversed, but no HT current will be available, the rectifier being

(Continued on page 495.)

An Inexpensive Modulator for the "Tabletop Transmitter"

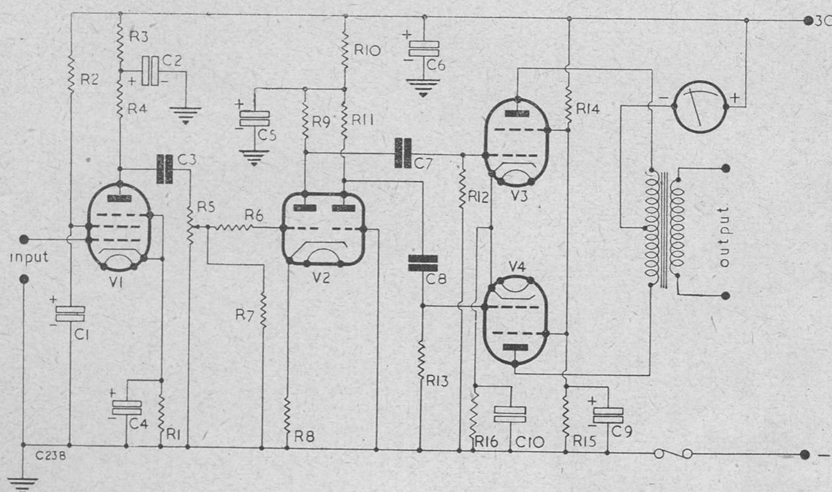
described by

Centre Tap

The amplifier described will be found well suited for use as a Modulator or as a small Public Address unit capable of giving a high quality output at a minimum of expense. The output will be found ample to fully modulate a 25-watt transmitter even from a crystal microphone, and, by substituting a heavy duty output transformer for the modulation transformer, will, without further alteration serve admirably for medium power PA work.

Until recently it has been more usual to see audio amplifiers using a pushpull input transformer to obtain the 180° out-of-phase voltages required for the grids of the output valves. These however, have three main disadvantages. Firstly, good quality push-pull input transformers are expensive, secondly, they have a tendency to pick up inductive hum, and finally, they are bulky.

By using a twin triode such as the **6SN7** instead of separate valves we can obtain still further economy of space as well as of expense. This end was in view when it was designed, particularly as this valve is readily obtainable in the surplus market being widely used in Service gear.



Component Values

Capacitors

C1, 2.0μF, 250V wkg.
C2, 8.0μF, 350V wkg.
C3, 0.05μF
C4, 25μF, 25V wkg.
C5, 2.0μF
C6, 8.0μF, 350V wkg.
C7, 8, 0.02μF
C9, 8.0μF, 350V wkg.
C10, 25μF, 25V wkg. (optional).

Resistors

R1, 15,000 Ω
R2, 1.5 M Ω
R3, 47,000 Ω
R4, 22,000 Ω
R5, 1 M Ω, Potentiometer.
R6, 47,000 w
R7, 470,000 Ω
R8, 1,000 Ω
R9, 27,000 Ω
R10, 10,000 Ω, 1 watt.
R11, 100,000 Ω
R12, 220,000 Ω
R13, 220,000 Ω
R14, 1,500 Ω, 1 watt.
R15, 50,000 Ω, 10 watt.
R16, 300 Ω, 5 watt.
(All resistors are half watt rating, unless otherwise stated).

Valves

V1, 6J7
V2, 6SN7
V3, 4, 6V6

Power Supply

HT necessary is 300V at 150mA and 6.3V at 3A.
Meter in anode circuit is 0-150mA.

Simplicity and Excellent Characteristics.

A system of "phase inversion" is required to excite the grids of the output valves with voltages of equal amplitude and opposite polarity, and of the many phase inverters which have been developed, the cathode coupled inverter has proved one of the most popular. Not only does it possess excellent characteristics but it is very simple in construction. It further demands a minimum number of components and because of this a very compact construction becomes possible—indeed the circuit is ideally suited to self-contained transmitter design.

The 6SN7 will be found to hold the amplitude of the two out-of-phase voltages with comparatively wide changes of the voltage applied or changes in the output valves employed.

Construction.

Regarding the practical side, the 6V6's will give an output of 13 watts with the anode voltages at 300 but bigger output valves with increased HT may be used if desired. As will be seen by the circuit diagram the wiring is quite straightforward and calls for little comment except perhaps the usual warning that grid leads, etc., must be kept short. If these are of any length they should be screened and the shielding connected to chassis potential. The input lead, whether from a pick-up or microphone, should be adequately shielded and if a crystal microphone is used the grid leak too, is better screened.

Actually no economy is effected by using the 6SN7 other than compactness and the saving of a valveholder. It is, in fact, two 6J5's in one envelope, and a pair of the latter can be used if already on hand and space economy no object. For the convenience of the constructor the valve base pin numbers are shown in the circuit. The accompanying photographs show the circuit built up as a separate unit which is fitted in a well ventilated metal case, and it will be noted that the power unit is built in. The latter, by the way, takes up more than two thirds of the chassis space so the possibilities of compact design if using GT type valves is self-evident.

The photographs also illustrate how one of the golden rules of speech-amplifier design is observed—all wiring is kept below the chassis to take advantage of the shielding afforded. Regarding the 6J7—it is always recommended to use a valve of this type with the grid connection brought out to the top cap rather than have it down by the heater pins and leads—the screening of the grid cap is a necessity and of increasing importance when low-level microphones are used. This lead is incidentally the only one above chassis. If a microphone transformer is fitted it is best accommodated above chassis and must, it need hardly be added, be fully screened.

N.B.—The "Tabletop Transmitter" appeared in the December, 1948, issue. (*Out of print*)

AC/DC AMPLIFER—(*contd. from page* 493).

non-conductive when the polarity of its anode and cathode is thus reversed.

On AC mains, there may be a noticeable difference in hum-level according to which way round the plug is connected. Normally, the hum is less when the chassis connects through to the neutral conductor.

If a sharp rise in hum-level is experienced when handling the pick-up, the leads to the input terminals should be reversed.

The output from a crystal or magnetic type pick-up is usually sufficient to overload a small amplifier of this type, and the maximum undistorted output of some 3 watts will normally be obtained with the volume control set well below its maximum. For normal domestic listening, the reserve of output power is sufficient to permit the use of fibre needles, if desired.

The following voltage and current readings were obtained with a low-resistance (200 Ω per volt) moving-coil meter, voltages being measured, from the points indicated, to chassis. Supply voltage was 240V, RMS.

	V1	V2	V3
Anode Volts ..	30*	150	—
Cathode Volts..	1	8	—
Screen Volts ..	—	180	—
Anode mA ..	2	38	—
Screen mA ..	—	5	—
Volts across C9	200		
,, ,, C8	180		
,, ,, C4	100*		

**These abnormally low figures are due to the relatively heavy current taken by the meter.*

BRITISH RADIO TELEPHONES FOR NETHERLANDS

PYE GET £10,000 CONTRACT

Another triumph for British radio technique abroad has been achieved by one of the leading British radio manufacturing firms, who have obtained and are carrying out a £10,000 order for VHF mobile radio telephone equipment for the Netherlands Government.

The firm concerned is Pye Telecommunications, of Cambridge, whose apparatus now so widely used by police, ambulance and fire services, as well as many industrial organisations.

Already a considerable part of the contract has been fulfilled, and the familiar whip aerial such as is seen on police and other vehicles equipped with mobile 2-way VHF radio telephones, is to be observed in the streets of Amsterdam, where, in the two cities, some sixty vehicles are already using their British radio telephone sets. These are in communication with a number of official fixed base stations.

Query Corner

A "Radio Constructor" service for readers

'Soft Valves.'

"What is meant by the term 'soft' when applied to a radio valve, and is it detrimental?"

C. Wood, Orpington.

A valve is said to be 'soft' or 'gassy' when its original high vacuum has become impaired. This reduction in the degree of vacuum within the glass envelope may be due to one or other of the following causes:—

(a) The glass envelope may have developed a leak, this sometimes occurs at the point where the lead in wires are sealed through the glass wall.

(b) The electrode assembly may, at some time or another, have been seriously overheated, thus freeing some of the gas which is occluded by the assembly. Valves which are capable of passing relatively high currents are particularly prone to this latter form of trouble should their grid bias be accidentally removed. The valve manufacturers take steps to remove the gas occluded within the assembly by heating it to a high temperature before the valve is finally sealed off. However, it is never possible to remove all traces of the gas and if the assembly is allowed to reach a bright red heat, there will be a possibility that the valve will become 'soft.'

The action, which the presence of this gas has upon the operation of the valve is interesting, providing of course that the valve is not your own. In the normal condition the majority of electrons which are emitted by the cathode travel through the vacuum at high velocity towards the anode. These electrons constitute the anode current. Now when gas molecules are present between the cathode and the anode, they will be in collision with the electrons. When an electron hits a molecule it will invariably dislodge from it an additional electron which will accompany the others and travel towards the anode. The molecule however, now minus an electron and known as a positive ion, will travel towards the cathode. Now a number of collisions of this nature will result in the bombardment of the cathode by positive ions and this in turn will dislodge the emissive material from the cathode, and it will be ruined. Thus it will be seen that when a valve becomes 'soft' its anode current may temporarily increase, but after a further short period of operation the emission, and hence the anode current, will become seriously reduced. There are several ways in which a soft valve may be identified. In bad cases the space between the anode and cathode will emit a bluish glow when the valve is operating. This glow should not be confused with that which may appear on the mica supports or glass bulb of some power valves. This is merely fluorescence caused by the bombardment of the glowing parts by stray electrons and it is not detrimental. By far the best indication of the degree of vacuum within a valve is the measure of its control grid current. When operated under normal conditions this current should be less than 1 micro ampere. A trace of gas will quite easily give a reading of several micro amperes. If a suitable meter is not available for the measurement of such small currents a milliammeter should be connected in the anode circuit of the valve under test, and the reading carefully noted. If the grid leak is short circuited no change in anode current should be observed. A change in anode current under these conditions is an indication that grid current is present.

Finally it must be remembered that apart from indicating softness grid current may be the result of poor inter-electrode insulation. This point was dealt with in a previous edition, in which a method of measuring the insulation resistance was described.

RF Instability.

"I have a 2-V-1 receiver which provides good selectivity and sensitivity, but which has recently become unstable. The trouble appears to be in the RF side as it is still apparent when the output valve is removed, and the detector stage coupled into a pair of headphones. Can you assist me in tracing the fault?"

E. Johnson, Ilford.

It is a truism that when instability is experienced there must be excessive coupling

"Query Corner" Rules

(1) A nominal fee of 1/- will be made for each query.

(2) Queries on any subject relating to technical radio or electrical matters will be accepted, though it will not be possible to provide complete circuit diagrams for the more complex receivers, transmitters and the like.

(3) Complete circuits of equipment may be submitted to us before construction is commenced. This will ensure that component values are correct and that the circuit is theoretically sound.

(4) All queries will receive critical scrutiny and replies will be as comprehensive as possible.

(5) Correspondence to be addressed to "Query Corner," Radio Constructor, 57, Maida Vale, Paddington, London, W.9.

(6) A selection of those queries with the more general interest will be reproduced in these pages each month.

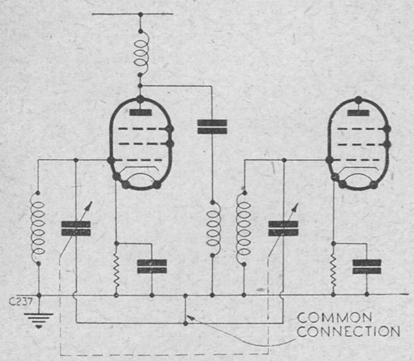


Fig. 1. The two-gang capacitor has an earth connection which is common to both tuned circuits —a possible cause of instability.

between circuits for the degree of amplification which is available. It is apparent, then, that either the amount of coupling or the amplification must be reduced, and it is always preferable to commence by tackling the former.

The cause of RF instability may be traced to one or both of two causes. Firstly, electromagnetic or electro-static coupling between components and their associated wiring, and secondly, to what is sometimes termed ' common impedance coupling.' This latter normally occurs at the low frequency end of the tuning range, although in severe cases it will persist over the complete range. The unwanted coupling in such cases may invariably be traced to the use of an impedance which is common to two or more circuits. The impedance may consist of a short length of wire which might be used to earth the rotor of a gang condenser. The impedance of such a length of wire, although small even at high frequencies is invariably sufficient to cause instability. This form of unwanted coupling may easily be reduced by the use of two or more earthing leads. Fig. 1. clearly shows the manner in which a single earth lead may be common to two circuits.

The former type of coupling mentioned earlier may be recognised by the fact that it generally occurs at the higher frequency end of the tuning range, this is because capacitative coupling increases with frequency. In a receiver which has previously been satisfactory the trouble may be traced to poor contact between metal screens and earth, or to faulty metalization of a valve. It is sometimes found that the zinc or copper metallizing applied externally to the glass envelope of a valve will crack or flake, thereby reducing its screening properties. In a newly constructed receiver, however, the trouble is traceable to lack of screening, possibly between input and output leads to valves, or between coils or chokes. A little experimental work with a small metal screen will normally indicate the components between which unwanted coupling is present. If this proves unsatisfactory, resort should be made to the use of screened cable for either grid or anode leads, only sufficient cable being used to produce the desired results.

This brief survey of the causes of RF instability should provide some indication of its causes, and the manner in which it is best avoided. Care must always be taken however, to ensure that the general component layout is the best possible before the construction of a new receiver is commenced, bearing in mind that leads carrying RF potentials should be as short as possible. It is even more important that the grid lead of one stage be kept well clear of the anode lead of the next or subsequent stages. This is most easily achieved by arranging the valves in a straight line.

TRADE NOTES

Taylor Oscillograph

An alternative to the Model 30A Oscillograph (a test report of which we published in our October 1948 issue) is now available, upon special request, incorporating a cathode ray tube with a blue trace and having a yellow-green after-glow.

The list price of this instrument is £33/10/0 and delivery can be effected in approximately three weeks from receipt of instructions. The new model will be known as "30A with Persistent Trace."

Taylor Model 70A

A new version of the popular Taylor Model 70A is shortly to be released, to be known as the 70B. The object has been, by means of mass production methods, to produce an instrument approximately to First Grade Standard and available at a popular price.

Model 70B will have a total of 50 ranges available and fitted with a Taylor moving coil meter. A mirror scale and knife-edge pointer will be fitted and the sensitivity on both AC and DC voltage ranges will be 1,000 ohms-per-volt. Provision will also be made for six decibel ranges and a self-contained buzzer will be incorporated for quick continuity tests. The price of this instrument will be £14/14/0.

(*continued on page* 508).

Transmitter Control Unit

devised by

J. B. BEDFORD, G3BIW

. . . . from G9??-K . . . . Switch off VFO; Switch off Doublers; Switch off P.A.; Switch over aerial; Switch on receiver. . . .

It was with the idea of reducing the work of operating numerous incidental switches that an effort was made to bring the whole operation under the control of one switch; such switching, if needed, to be remotely controlled as well as by local control.

Flexibility in order that such operations as netting with VFO, neutralizing P.A. and tuning-up etc., can easily be accomplished if desired.

Having on hand numerous relays, purchased from ex-government surplus, a number were sorted out, and put to work in a control unit. The relays chosen all have operate coils of 2,000 Ω D.C. resistance, and it was found, operated satisfactorily from a D.C. supply of 30 volts. Two of these relays had a pair of " make " contacts of a quarter inch contact surface. These were arranged to switch the mains inputs.

It is obvious that relays of lower resistance and consequent lower operating voltage could be used in place of those chosen.

It was decided to design the unit as a complete separate item, to fit in the transmitter rack as a panel and chassis assembly, with its own power supplies, and, also, to accommodate in the space available, power supplies for grid bias and a 250 volt high tension supply, as this would be found useful for running receivers or convertors.

Next step was to design a circuit which would give all the essentials of control and also give protection of apparatus from such faults as overload of power transformers, failure of grid bias, also cover delay period of mercury vapour rectifiers. Fuses are fitted in all mains supply leads, a relay is arranged to disconnect the whole supply of high voltage transformers in the event of grid bias failure, and a thermal delay tube is used to provide a delay period of 90 secs. for mercury vapour rectifier warm up. The delay tube has a variable resistance R1 in series with its heater supply, to regulate the delay period to a maximum.

A voltage stabilizer tube V4, VR150, is used to obtain grid bias supply of 150 volts, this could, with very little modification, be changed to 105, 75 or any other voltage.

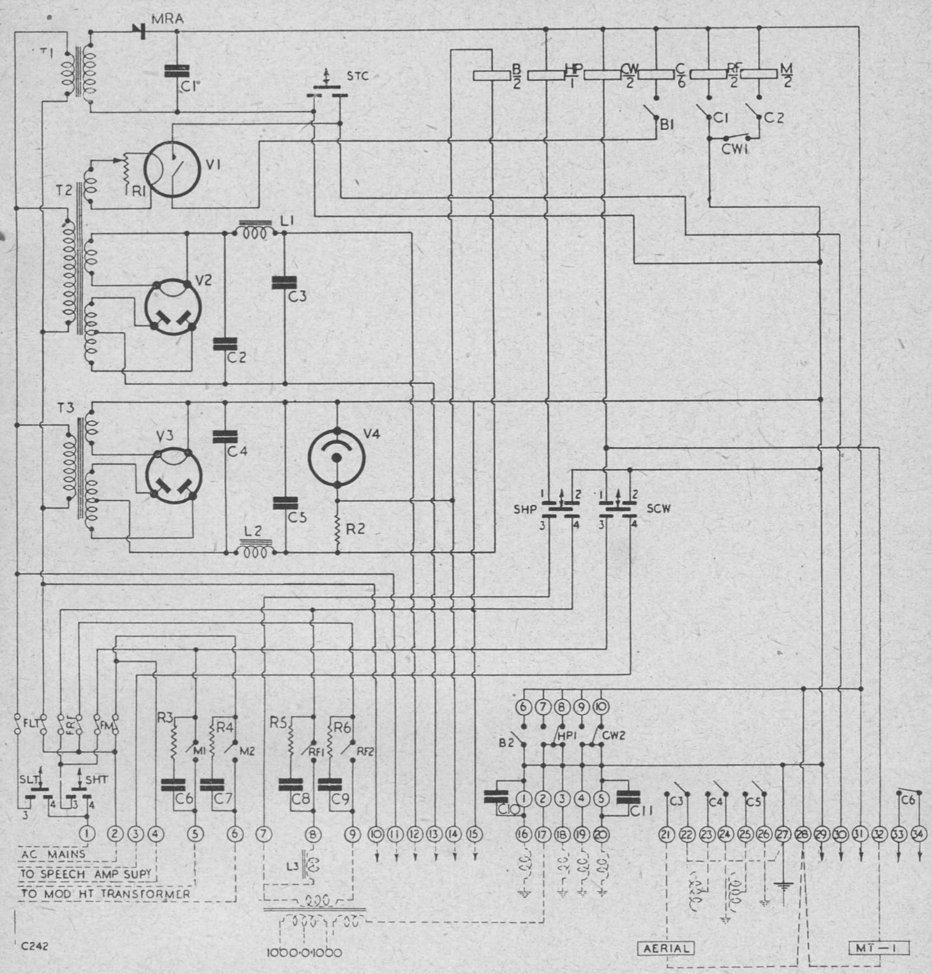
It was decided to operate a relay from this supply, to safeguard equipment in the event of bias failure. First tests were made with the relay wired in parallel with the stabilized voltage, but it was found to operate when bias was less than 150 volts, grid current would also hold it operated. The position was therefore, moved from stabilized bias voltage to a position in parallel with R2. The voltage drop across R2 when neon stabilizer has struck operates the relay. If the neon of the stabilizer tube is extinguished for any reason, then the relay releases and at its contact B1 opens the circuit of control relay C, the associated C contacts C1 and C2 cause the relays RF and M to release, and at RF1 and RF2, and M1 and M2, disconnect the mains supply to high voltage transformers.

Next step was to arrange a circuit to provide reduced power for tuning up, etc., and for QSO's where high power is not required. This is accomplished by an L.F. choke in series with the mains primary of the high voltage transformer which supplies the P.A. with high tension. Low power is obtained when choke is in series, and full power when choke is shorted out.

Circuit action—switch SHP connections 3 and 4 short circuit the choke when switch is in downward position. When the switch SHP is in the upward position connections 3 and 4 are open circuit, short from choke is removed. At connections 1 and 2 a circuit is completed for the operation of relay HP; from rectifier MRA; relay HP; switch SHP connnections 1 and 2 to C1 and transformer T1. At relay contacts HP1 an indication is given on lamps LP7 for low power and LP8 for high power.

Phone and CW are considered, the old crocodile clips short circuiting the modulation transformer secondary have no place in the rig now. Arrangements are made for this short circuiting operation to be done by a relay MT, fitted in the modulator. The relay carries a " make " contact, this is wired to short circuit the modulation transformer secondary. A standard relay cannot be used for this purpose, because of the high voltage to chassis present on the contacts, therefore, unless one has a relay fitted with contacts capable of carrying high voltage without breakdown of insulation, a relay with insulated contacts will have to be made up in much the same way as that described in the R.C. Vol. 1, No. 1. p. 18.

Circuit action—with the switch SCW in the downward or phone position a circuit is completed via connections 3 and 4 of switch SCW, to extend the mains to tag terminals 3 and 4, at the rear of unit, these terminals are cabled to speech



Terminals not labelled are as follows :—

10 and 11—To all LT and low power.
12—Positive, 13—Negative. 250V.
14—Negative, 15—Positive. 150V bias line.
16—LT pilot winding.
17—RF transformer pilot winding.
18—Mod. pilot winding.
19—Oscillator.
20—Speech amplifier.
23—Exciter trans and VFO.
25—Speech amp. trans.
29/30—To remote switch.
31—30V to keying relay.
33/34—To receiver trans. centre tap.

Capacitors

C1, 50μF, 50V wkg.
C2, 8μF, 500V wkg.
C3, 8μF, 500V wkg.
C4, 10μF, 250V wkg.
C5, 10μF, 250V wkg.
C6-C9, 0.01μF
C10, C11, 0.1μF (N.B.—A 0.1μF capacitor should be connected across each lamp for RF by-pass. These have been omitted from drawing for clarity.)

Resistors

R1, 30Ω, wire-wound, 2A
R2, 1,000 Ω, 10 watt.
R3-R6, 100 Ω, half watt.

Transformer Secondaries

T1, 30V, 2A
T2, 250-0-250, 100mA; two 4-volt windings.
T3, 170-0-170V, 60mA; one 5-volt winding.

Chokes

L1, 100mA, 20H
L2, 60mA, 20H
L3, 500mA, 100 DC resistance, 10H

Valves

V1, DLS1
V2, UU6
V3, U50
V4, VR150/30

Fuses

FLT, FRF and FM are all 1 Amp fuses.

Rectifier

MRA metal Rectifier to supply 30V at 2A amplifier power pack. Also at switch SCW connections 1 and 2 the operate circuit for relay CW is removed. Contact CW1 being normally made, prepares the circuit for the operation of both RF and M relays, when the transmit-standby switch STC is operated to the downward transmit po.ition. At contacts M1 and M2 the mains are connected to tag terminals 5 and 6, which are cabled to the high voltage transformer for the modulator. At RF1 and RF2 mains are connected to tag terminals 8 and 9 which are cabled to the high voltage transformer, and associated choke for low power, for the P.A.

With the switch SCW in the upward, or CW position, connections 3 and 4 are disconnected and mains to speech amplifier are disconnected from tag terminals 3 and 4. At SCW connections 1 and 2 a circuit is completed for the operation of relay CW, from rectifier MRA; relay CW; SCW connections 3 and 4; to C1 and transformer T1. Relay CW operates, contact CW1 opens the operate circuit of relay M preventing mains being extended to modulator by contacts M1 and M2. Thus the whole of modulation equipment is switched off when operating CW. At relay contact CW2 an indication is given on lamps LP9 for phone and LP10 for CW.

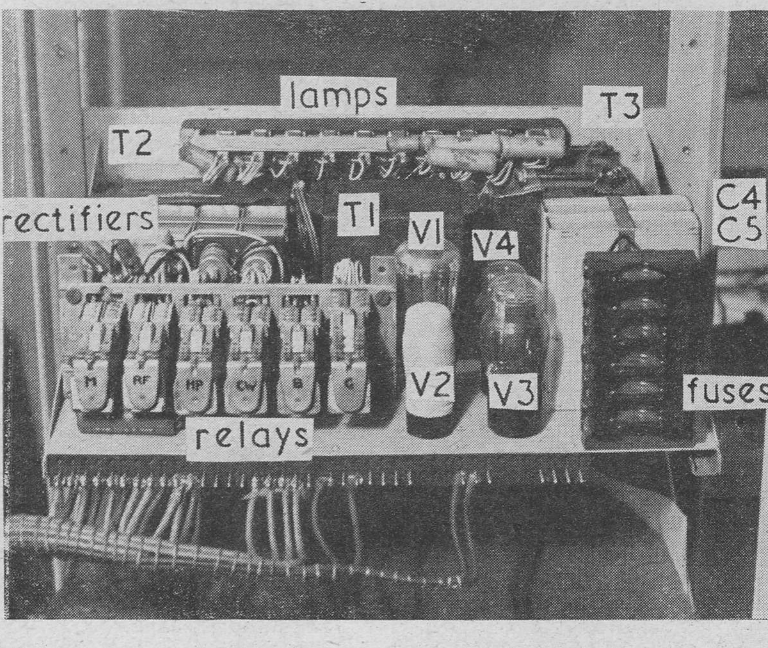
Switch SLT connects mains to transformers T1; T2 and T3, via fuses FLT. Also mains are extended to tag terminals 10 and 11, which are cabled to all low tension and low power transformers. Pilot lamp windings on low tension transformers are connected to lamp LP1 to indicate when alive.

Transformer T1 supplies 30 volts at 2 amps. via rectifier MRA, to operate all the relays in the transmitter. Transformer T2 provides L.T. for the heater of thermal delay tube V1, also via rectifier V2 a high tension supply of 250 volts. Transformer T3 provides a 150 volts for grid bias via rectifier V3 regulated by voltage regulator tube VR150, V4. Due to the rectifiers chosen being directly heated, voltage is available almost immediately. Relay B will operate and indicate on lamp LP6 by contacts B2, contact B1 prepares a circuit for control relay C to operate when transmit standby switch, STC, is in downward position for transmitting. If the voltage regulator fails to glow, relay B c nnot operate, contact B1 will prevent control relay C from operating.

Switch SHT is normally left in the downward position, closing mains to fuses FRF and FM. By switching to upward position mains are open circuit and no high voltage will be available. In this position the P.A. can be neutralized and also mercury vapour rectifiers may be cooked for a longer period that 90 secs., i.e., after transmitter has been QRT for a long time or when new mercury vapour rectifiers are fitted.

Lamps LP1 to 5 are wired to pilot windings on transformers in the transmitter as follows:—

LP1 to low tension transformer pilot;



General view of the transmitter control unit.

LP2 to RF high tension transformer pilot;
LP3 to modulator high tension transformer pilot;
LP4, to oscillator;
LP5 to speech amplifier.

All these lamps have 0.1 micro-farad capacitors wired directly across the lamp to prevent induced radio frequency currents from the transmitter causing lamp burn-outs. Contacts M1 and M2, and RF1 and RF2 are fitted with spark quenches to prevent excessive sparks caused by switching inductive circuits of transformers.

R1 is adjusted to allow thermal delay tube V1 to operate after a period of 90 secs. At the end of this period if the transmit standby switch STC be in the downward position, the circuit is complete for the operation of relay C. This relay has seven sets of contacts, all of which are wired to the tag terminals at the rear of the unit. Some are used to switch the receiver and aerial change-over relay as shown in the diagram, others being spare.

Switches SLT; SHT, etc., are single-pole double-throw toggle switches made by leading manufacturers and cost only a few shillings each. Fuse holders are slidelock, lamps and holders are from ex-surplus press button control boxes.

Procedure of netting is done by switching on the VFO at the VFO equipment and listening on the receiver for note, afterwards switching VFO switch off, the control unit will do the rest.

The transmitter being tuned-up on the required band to either phone or C.W. remote transmit-standby operation is carried out by extending tag terminals 29 and 30 to a switch situated in the desired position, and switch STC left in the standby position.

The extension by a pair of wires for keying leads or speech amplifier leads to the transmitter are left to the users discretion and not covered by this article.

Construction details:—Panel is a piece of $\frac{1}{4}$ in. ebonite 19 in. x $5\frac{1}{2}$ in. chassis is steel from a Roneo cabinet shelf, $17\frac{1}{2}$ in. x 13 in. by 1 in. deep, supported by triangular supports at each side. Heavier components are placed up to the front panel. Most of the components are easily obtained government surplus, the only non-surplus components being the switches.

The relays are mounted together on a specially constructed mounting, details are given in the sketch. The spark-quench capacitors are fitted below the relays, while the spark-quench resistors are wired directly to the relay contacts.

The chassis is punched for five valve holders, four are in use and the other is left available in case the 250 volt power supply is required stabilized. Tag terminals are made from a block of tags, recovered from ex-government equipment, by cutting into strips of twenty tags and mounting as seen in the photograph. Wiring is carried out in thin plastic covered wire for all circuits except the mains leads, these are wired in heavier guage plastic covered wire for its thicker insulation.

All the wiring is laced in a form under the chassis, coming up through holes, still in a form, to the lamps, relays and fuses. R1 is an old 30 Ω variable wire wound filament resistance fitted below the chassis.

The RF24 Unit

JOHN BORASTON

describes its conversion to 2 volt operation

IN company with many other battery users, the writer, who lives in a caravan, has long bemoaned the fact that the majority of the surplus equipment offered for sale requires either massive banks of batteries or mains equipment, for its power supplies, and when A. Hitchcock's article appeared in the October issue of "Radio Constructor," this world seemed a sad place indeed to live in, since no less than six of the variable capacitors used in this conversion lay unused in the spares box. However, a further search disclosed three ARP12 (VP23) valves, which have the same base as the original SP61s, and so a unit was purchased, nothing daunted.

> **Another of our Surplus Gear Articles**
>
> (The convertion of the RF24 unit was originally published in the October, 1948, issue)

With the help of the above-mentioned article, and a friend who possessed a lathe, A. Hitchcock's conversion was carried out completely, as a preliminary (*q.v.*). The remainder of the conversion as carried out by the writer, who, it is hoped, now holds your attention, was performed as follows :—

1. The Oscillator stage.

The Grid stopper was removed, and the grid lead soldered to a new grid clip ; the leak was then replaced by one of 47K ohms. The whole cathode circuit and its components, the screen by-pass capacitor and feed resistor, and T1 together with the resistor across its primary, were then removed ; the screen was now strapped to anode. After this, the oscillator coil was taken out and rewound with the same number of turns of 20SWG enamelled wire. Over this, starting at the earth end of the first coil, were wound two turns of 32 SWG double silk covered wire, in the same slots, to act as feed-back winding. The whole coil was put back on the chassis as before, and the grid winding reconnected. The use of enamelled wire is practically essential as it is extremely easy to break the silk cover of the feed-back coil on the sharp edges of the former and so short the HT to the valve anode to chassis, as the author found to his irritation and the detriment of the battery. The hole in the chassis revealed by the removal of TI was fitted with the rubber grommet which was in the hole, in the partition, farthest from the valve-holders, and which had been used as a feed-through for the secondary of T1. The upper end of the feed-back coil, in sleeving, was then passed through this hole, and connected to the anode end of the 2.2K decoupling resistor. The other end of the winding was pushed through the hole originally used for the cathode tap (also in sleeving) and connected to anode.

2. The Mixer Stage.

The screen by-pass capacitor was disconnected at its earth end from the suppressor grid pin, and soldered direct to chassis. The suppressor was then connected to chassis via a 58K resistor. With the sole exception of the 50$\mu\mu$F capacitor, the whole of the cathode circuit was taken out, and the free lead of the above capacitor soldered to the suppressor pin. The old cathode tag, now connected to the suppressor through the capacitor, was then connected to the anode of the oscillator valve, the lead passing through the other hole in the partition, using the original grommet. This hole is the nearer of the two which has been used for the secondary leads of T1. The 10K resistor across L3, the anode lead, was now removed, and the output capacitor (10$\mu\mu$F) replaced by one removed from the oscillator tuning circuit during the original conversion carried out in accordance with the October article.

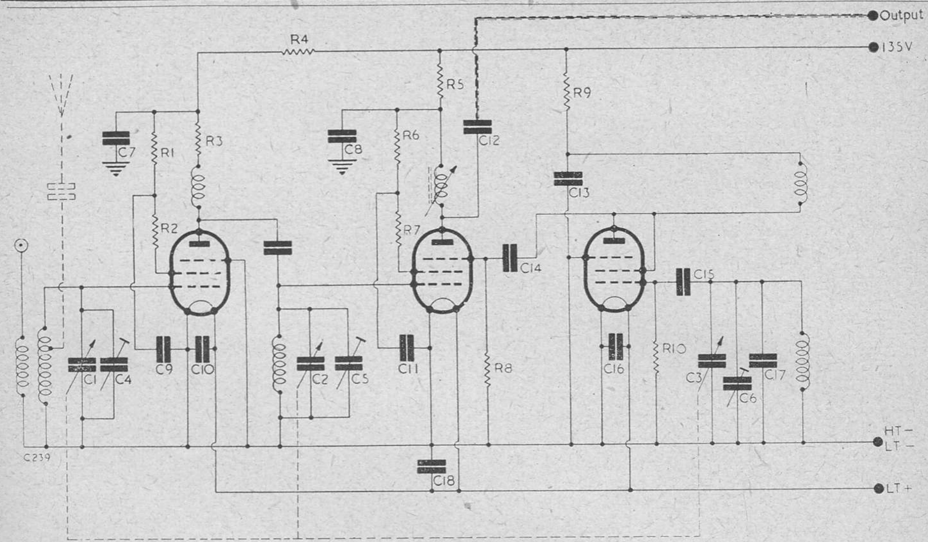
3. The R.F. Stage.

The bias resistor and its by-pass capacitor were removed from the cathode circuit, and the anode load disconnected at its anode end ; this was then soldered to the tag on the tag-board adjacent to the HT end of the resistor (this tag was originally connected to chassis). The anode stopper was removed and the coupling capacitor to the mixer connected direct to the anode tag. A VHF choke was then connected from anode to the new tag for the anode load resistor : the load is now, of course, the choke and resistor in series. The grid lead was shortened and soldered to a new grid clip, the grid stopper being omitted and, finally, the 10K screen resistor replaced by one of 78K ohms.

It was later found that the aerial was best connected via a 20$\mu\mu$F capacitor to a tap on the grid coil two turns from the "hot" end. This may not, of course, suit all reader's aerials, and the original connection may be found best with dipoles. The writer's aerial is a (roughly) 40-ft. end-on wire.

4. Lining up and performance.

Lining up may be carried out by any of the recognised methods, not forgetting the mixer



Component Values

Capacitors
*C*1, 2, 3, *three gang variable, or three separate variables of* 100$\mu\mu F$ *each.*
*C*4, 5, 6, 30$\mu\mu F$ *trimmers.*
*C*7, 8, 300$\mu\mu F$
*C*9, 0.001μF
*C*10, 11, 300$\mu\mu F$
*C*12, 45$\mu\mu F$
*C*13, 300$\mu\mu F$
*C*14, 15, 50$\mu\mu F$
*C*16, 300$\mu\mu F$
*C*17, 10$\mu\mu F$
*C*18, 300$\mu\mu F$
(*Optional aerial series capacitor is* 20$\mu\mu F$)

Resistors
*R*1, 70,000 Ω
*R*2, 10 Ω
*R*3, 3,300 Ω
*R*4, 5, 2,200 Ω
*R*6, 100,000 Ω
*R*7, 100 Ω
*R*8, 58,000 Ω
*R*9, 2,200 Ω
*R*10, 47,000 Ω

Valves
*V*1, 2, 3, *all ARP*12 (*VP*23)

Note.—If any difficulty is experienced in getting the oscillator to function, its gridleak may be returned to LT positive. Grid current should be 180μA, *approximately.*

anode load which will probably require peaking exactly to the output frequency of 7.5 Mcs.

The unit performs very well on the writer's set, which is a home-brewed nine valve battery-operated super-het. During the first two days of use "multitudes" of W's have been logged, together with two VK2's, several VE's, a CO, many continentals and G's, and one VS9. The signal to noise ratio is perhaps not all that could be desired, but this is in part due to the locality, which is very bad in this respect, and also to the main receiver, to which the same remark applies at present.

It is important to earth the unit, not only for the reasons given in the October article, but also because there is danger of break-through of 7.5 Mcs signals; main receiver oscillator harmonics will also be cut out by this means if troublesome.

The connection to the main set is made by means of a yard of co-ax pushed through one of the holes which were originally used for the spring-loaded pins at the rear; these were taken out and the "D's" sawn off. The Jones plug was also removed and replaced with a piece of aluminium bored with a half-inch hole and fitted with a large rubber grommet to carry the battery leads, which were also screened.

It will be found that the band-spread is most satisfactory, the 28 to 30 Mcs band occupying 160 degrees of the dial movement.

ROYAL NAVAL VOLUNTEER (WIRELESS RESERVE)

With the expansion of Territorial Recruiting, this reserve, which has been reconstituted, is anxious to recruit those who pursue radio as a pastime either from the technical or communication aspect. Training centres, ships and craft are in operation and those who like the sea and wish to combine it with an interest in radio will find their tastes admirably satisfied by service in this reserve.

Arrangements have been made for members to carry out transmission and reception in their own homes and facilities are available for courses and service afloat. A yearly bounty and expenses are paid. Those interested should write for further details to:—Admiral Commanding Reserves, Naval Reserves, Admiralty, Queen Anne's Mansions, St. James' Park, London, S.W.1.

A Broadcast-Receiver Remote Control Circuit

By C. W. CRAGG, G2HDU

SOME time ago a friend of the author's wished to add a remote control system to his broadcast receiver. His requirements were not as easy to fulfil as at first seemed probable, but the following scheme has been in operation for some time and has proved quite satisfactory.

Requirements.

The receiver was a 'quality' set consisting merely of an R.F. stage followed by an infinite impedance detector and the audio stages. It was required to operate the set from any room in the house by push-buttons. Two programmes only were required (Home and Forces), together with the gramophone. The receiver had to be switched on and off from any room, and the programmes changed as required, or the gram. placed in circuit. This latter was taken into the different rooms as required, and a speaker was left in each room. It was desirable that, having selected a programme in one room, it could be changed from any other room. This precludes the use of push-buttons which, once pressed, remain down until another is pressed, since in that case a button which was down in one room would have to be released before another operation could be performed. The buttons are of the type used on the ordinary door-bell, which make a contact so long as they are pressed, but break on being released If possible it was intended to use four button.s only, one each for Forces, Gram, Home, and one for the Off button. The set was to switch on when any of the first three was operated.

The use of push-buttons without holding-down contacts means that a circuit is only closed momentarily, and then broken again. Relays are required which remain operated after the initial circuit is made and broken therefore, this necessitates one extra contact on each relay. The relays used were of the post office type with approximately 200 Ω coils, and operated at 9-12 volts. The combinations of contacts on these relays are fairly easily changed to suit various circuits. At the present time these relays are being offered quite cheaply by a number of firms. (Govt. surplus). As the first button pressed was to switch on the receiver, via a relay, a relay power supply needed to be permanently connected. (It is not advisable to have the buttons in the mains circuit). There are several ways of doing this. One method would be to use a wet battery and recharge this at intervals. Since some of the relays draw current all the time the receiver is in operation this is not too satisfactory an arrangement.

The first idea tried was to arrange for the battery to be in circuit all the time ready to supply current, and once the set was on, a trickle charger was also switched on, so that the battery was charging all the time current was being drawn from it. The trickle charger was adjusted so that the charging rate was slightly greater than the discharge rate. In this way all that was necessary was to top up the battery when required. Although this method was satisfactory it was not kept for long, as an improved system was evolved. A dry battery consisting of three twin cell cycle lamp batteries (9 volts) was used. This was permanently in circuit whenever the set was off, so that it was ready to operate the relays. As soon as the receiver was switched on, however, the battery was switched off and the relays were then operated from a power supply. In this way the battery was only called upon to supply current for a few seconds each time the set was switched on, and a life almost equal to the shelf life of the battery obtained. This method was considered to be superior to that using a wet battery as the latter required more space and was hardly suitable to be installed near the receiver, but had to be placed in the cellar. The dry battery was fitted inside the receiver cabinet, and the power supply for the relays was the trickle charger which was previously used with the accumulator.

The Circuit.

The final circuit is shown in Fig. 1. A word or two of explanation may be necessary as the drawing differs slightly from radio practice, and is akin to that used in telephone circuits. When there are a number of relays it becomes impracticable to draw each contact near its own relay coil, since this would necessitate a large number of crossovers in the wiring. Instead, each contact is numbered as are also the coils. The coils are numbered thus: $\frac{H}{3}$ $\frac{F}{4}$ etc. The number refers to the total number of contacts operated by the coil, and the letters in our case have the significance as follows: F=Forces relay, H=Home, G=Gram, M=Mains, X=Off, B=Battery, and K is a subsidiary relay for de-energising the gram. relay when switching to radio. The contacts are distinguished by the appropriate coil letter, followed by a number for reference. All contacts are shown in the NON-OPERATE condition.

Operation.

In the non-operate condition contact B1 is closed so that the battery is in circuit. M2 is

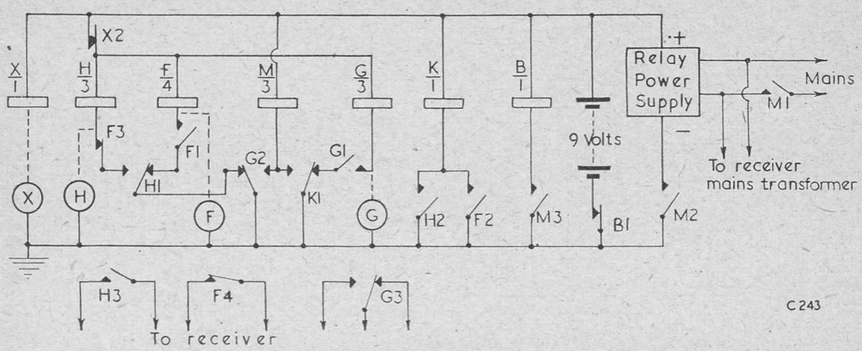


Fig. 1. Remote Control Unit. Line wiring to push-buttons is shown dotted. Buttons for each room are parallel (i.e., *all F buttons in parallel, etc.*).

Relay contacts:—X relay, one break.
H ,, two make, one change over.
F ,, two make, two break.
M ,, three make.
G ,, one make, one change over.
K ,, one change over.
B ,, one break.

open, preventing leakage from the battery back through the power supply. This latter consists of a transformer feeding a bridge type metal rectifier, with a single eight microfarad smoothing capacitor. Without the capacitor there might be a slight tendancy for the relays to chatter.

On pressing the F, G, or H buttons the appropriate relay is connected across the battery and operated. Consider the case when H is pressed. Contact H1 changes over and puts an earth on relay H via F3, H1, and G2. (X1 is closed). On releasing the button the relay remains operated. H2 closes and operates relay K. K1 puts an earth on the mains relay so causing M1 to switch on the receiver and the relay power supply. As M3 closes, the battery relay operates and so switches off the battery at B1. The relay power supply is now feeding the relays and the mains are connected to the receiver. H3 is closed, as is also F4. These latter two contacts are the ones which effect the actual frequency change in the receiver, by switching in and out padding condensers across the tuned circuit (see Fig. 3). H3 is in the R.F. stage while F4 is in the detector. With H3 and F4 closed therefore we have the padding condensers across each tuned circuit giving the lower frequency station. A superhet with two tuned circuits could also be controlled in this way, with H3 in the oscillator section and F4 in the frequency changer grid circuit.

If, now, we wish to change programme, the F button is pressed thereby causing F relay to operate. F3 opens and releases the H relay putting an earth on F relay via F1, H1, G2. F remains energised on releasing the push-button. Relay K also remains energised, via F2, thus keeping M operated. F4 and H3 are now both open so that the padders are no longer across the tuned circuits and the higher frequency station is received.

On pressing G button G relay operates and changes over G2, thereby releasing both H and F relays. H2 and F2 both open and release K. K1 changes over, and in conjunction with G1

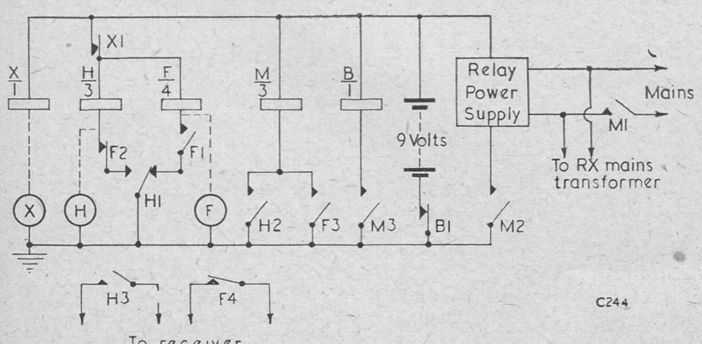


Fig. 2. Simplified Circuit without Gramophone Switching.
Relay contacts:—
X relay, one break.
H ,, two make, one change over.
F ,, two make, two break.
M ,, three make.
B ,, one break.

connects G relay to earth, thus maintaining G operated after the button is released. The Mains relay is still operative via G2. G3 effects the switching in the receiver. No break-through of the radio programmes is experienced on gram. operation since one tuned circuit is tuned to one station and the other is tuned to the other programme. (H3 is open and F4 is closed).

In changing back from gram. to radio, say Home, H is pressed, operating H relay. This relay is held down as before and H2 causes K to switch off the gram. relay at K1. G2 and K1 both change over so maintaining an earth on the mains relay.

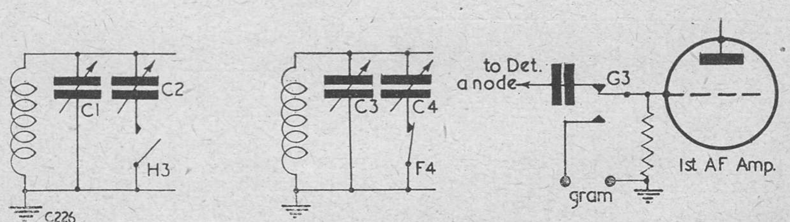
The X button effects the switching off by breaking X1. This de-energises H, F, and G relays so that the contacts all fall back to the condition in the diagram. M is therefore open circuited and the mains disconnected from both receiver and relay power supply. B relay is de-energised by M3 and B1 closes so putting in circuit the battery ready for the next switching on.

There are many ways in which the circuit might be modified of course. In some cases it might be necessary to use a special type of ‘ slow break ’ relay for M, although the normal type operated quite satisfactorily in the author's case. This is due to the fact that if both G2 and K1 happen momentarily to take off the earth from M during a switching operation the mains circuit will break and so switch off the receiver. If M takes a little time to break, however, the contacts will have time to change over before M1 is opened. In some cases also, B relay might be dispensed with. The contact B1 would then be operated by M relay, but would have to operate slightly after the other M contacts. This is due to the fact that if B1 opened before M1 was made the battery would be disconnected, and, having no power supply, M would break again so that a chattering of M relay would result. By using a separate relay it is ensured that B1 can never open until M3, and the other M contacts, have operated. Again, K relay can be cut out by using Two extra contacts on H. F. and G. X1 may be placed in series with M instead of in its present position, but X relay may be eliminated by using the X button as a break instead of a make. The button would then be connected between M2 and earth so that on pressing it the power supply would be disconnected from all the relays, causing them to fall back to the condition shown in the circuit diagram. The mains relay would then be de-energised and the power switched off. This would mean, however, that all the X buttons (one for each room) would have to be connected in series instead of parallel, and would greatly complicate the line wiring.

Figure 2 shows a simplified circuit without the gramophone switching. K and G relays are eliminated.

The number of leads required to each room from the relay unit is five. One is needed for each push-button, and a common earth. The buttons in each room are connected in parallel, so that any number of rooms can be used as control points without modification to the circuit in any way. The gram. input from each room to the receiver was screened, the screening acting as the common earth wire. One more lead was required for the speaker, the other speaker lead again being earthed. No instability due to feed back from the speaker leads to the gram. input leads was apparent. Each speaker was fitted with a volume control, and the receiver control was left at maximum volume.

One disadvantage with the system is that a person in another room can change the programme so that unless an agreement is reached in that direction some family QRM is likely to result. In the author's case this trouble was not serious as generally only one room was being used at a time. A method of obviating this would be to fit sockets in each room with the necessary number of contracts, and to build the button unit into the gram. A lead fitted with a suitable plug from the gram. could then be jacked in at the required room. The programmes could be changed from that room only and the number of push-button units would be reduced to one.



RF Stage tuned circuit. *Detector tuned circuit.* *Gram/Radio switching.*

Fig. 3. Connections of Relay Contacts in Receiver. C1, C2, C3, C4, preset trimmers.

"INEXPENSIVE TELEVISION"

PICTURE FAULTS

Illustrated by photographs taken from a televisor in which these faults were deliberately introduced, and photographed, by

JOHN CURA

1. Out of focus. Adjust focus and brilliance controls—may also indicate incorrect adjustment of vision receiver alignment. A small amount of oscillator detuning is helpful.

2. Showing diagonal lines caused by interference from the sound channel, or from other transmitting stations breaking through at the RF or IF stages of the vision receiver.

3. Too much brilliance produced by too high a setting of the brilliance or contrast controls. The fly-back lines can be faintly seen in this photograph, but are usually much more prominent.

4. Incorrect picture width—indicates incorrect adjustment of the line time base amplitude control.

5. Incorrect picture height—indicates incorrect adjustment of the frame time base amplitude control. These controls are best adjusted when the tuning signal is received at the commencement of each programme ; the circle in the centre of the signal should be a true circle when height and width are correct, and not elongated in any direction.

(more faults next month)

1

2

3

5

4

(*TRADE NOTES—continued from page* 497)

Mullard

A new and improved version of the Mullard Frequency Spectrum Chart is now available, at a greatly reduced price, from Mullard Electronic Products Ltd. (Century House, Shaftesbury Avenue, London, W.C.2.) This Chart is based on the decisions of the International Telecommunications Union Conference at Atlantic City in 1947. Printed in sixteen colours it measures 30″ x 40″ and, mounted on the wall, will be a ready and useful reference wherever it is required to know at a glance how the frequency spectrum has been allocated in terms of media and world zones.

So great was the deamnd for these charts after the first design was announced, that the new chart has been printed in larger numbers and the price reduced from 30/- to 6/6 (inc. postage).

* * * *

Philips' Amplifiers

In view of the record figures recently announced in connection with the national export drive, it is interesting to note that during the month of December, 1948, Philips Electrical Ltd. have exported to Belgium alone amplifiers with a total power of over 25,000 watts.

The standard range of Philips amplifiers for sound reproduction equipment includes instruments of 12½, 25, 50 and 100 watts. The Industrial Department of Phillips also announce that sales, up to the present time, of HF Generators total 5,000 kVA. The standard ranges of these generators are rated at 12, 45 and 100 kVA.

* * * *

Mullard Reference Cards

Mullard have published a complete list of all reference cards which have been issued, together with details of the valve types each card will test. Owners of Mullard Master Test Boards who would like a free copy should write to the address below mentioning the serial number of their instruments : Mullard Electronics Products Ltd., Valve Sales Dept., Century House, Shaftesbury Avenue, London, W.C.2.

CATALOGUES RECEIVED

Coulphone (58, Derby Street, Ormskirk, Lancashire) : We have received from this firm a catalogue which contains in its 32 tightly-packed pages a mass of items of radio components and equipment. The catalogue is listed in alphabetical order and includes sections on books, valves and television components. A further illustrated list is in the course of preparation and will deal with selected ex-Government radio surplus.

* * * *

Lasky's Radio (370, Harrow Road, London, W.9) : The latest duplicated price list from this firm includes a section on television components and units for conversion. Readers desiring regular bulletins from this firm may obtain them on request.

* * * *

Henry's Radio (5, Harrow Road, London, W.2) : The February Price List of radio components is now available. Its 18 pages contain items too numerous to mention. Like Lasky's, this cataloge includes a section on television publications and components and units for the construction of televisors. Copies of the catalogue are obtainable on request. A working model of the "Radio Constructor" televisor may be seen during transmission hours at the above address.

* * * *

Mail Order Supply Company: This firm is shortly opening new premises at 33, Tottenham Court Road, London, W.1.

* * * *

Woden: We have received a selection of catalogue leaflets from the Woden Transformer Company Limited, which are available on request (Woden Ltd., Moxley Road, Bilston, Staffs.).

These well illustrated leaflets show the wide variety of transformers and chokes which have achieved a name for workmanship and reliability. The leaflets give full details of ratings, dimensions, fixing, weight and fixing. Representative leaflets deal with Audio Transformers, Lighting Transformers and Chokes, Auto Transformers, De Luxe types, Multi Match types, Mains Transformers, Swinging Chokes, and so forth.

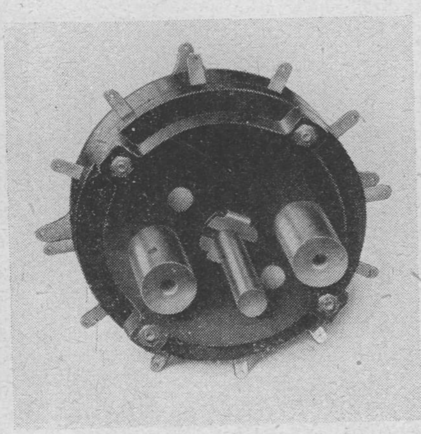
TRADE REVIEW

GENERAL ELECTRIC CO.

(Salford Electrical Instruments, Ltd.)

Resistance / Capacitance Bridge and Decade Switch

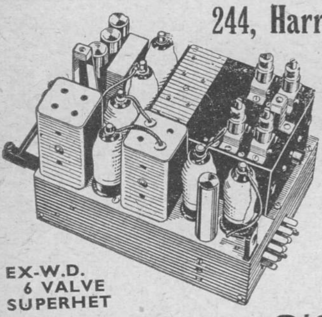
Our heading shows the General Electric Company's Resistance and Capacitance Bridge. This is a small portable bridge designed for the quick checking, with fair accuracy, of resistors and capacitors (including electrolytics). It consists of a pair of ratio-arms and a number of standard resistors and capacitors selected by a switch. The bridge is balanced by variation of the ratio-arms, a calibrated potentiometer. On the highest capacitance range, a calibrated power factor control is brought into circuit, giving a sharp balance and a direct indication of the "goodness" of the capacitor under test. Provision is also incorporated for checking the leakage of electrolytics. The leakage current is arranged to charge a capacitor which after an interval discharges through a neon tube. The rate of flashing of the neon is then a measure of the leakage current of the capacitor under test.



Our other illustration shows an interesting component—a decade switch. This is a high-grade component for use in electrical measuring apparatus. It has a very low contact resistance, sturdy action and positive location. Twelve contact positions are provided, giving 30 degree angular spacing, thus simplifying dial calibration and providing extra contacts. Shorting and non-shorting types are available and are listed as types 416A and 416B respectively. Further details may be obtained from Salford Electrical Instruments, Ltd., Publicity Dept., Peel Works, Silk Street, Salford, 3, Lancashire.

INSTRUMENT CO.

244, Harrow Rd., London, W.2.



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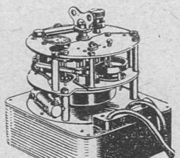

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SMALL ADVERTISEMENTS

Readers' small advertisements will be accepted at 3d. per word, minimum charge 3/-. Trade advertisements will be accepted at 6d. per word, minimum charge 6/-. If a Box Number is required, an additional charge of 1/6 will be made. Terms: Cash with order. All copy must be in hand by the 10th of the month for insertion in the following month's issue.

PRIVATE

WANTED. SX16 any condition cheap! With or without valves. Box 117.

WANTED. Eddystone coils for 358X. Want two of A and one each of B, C, D, E and F. Box 118.

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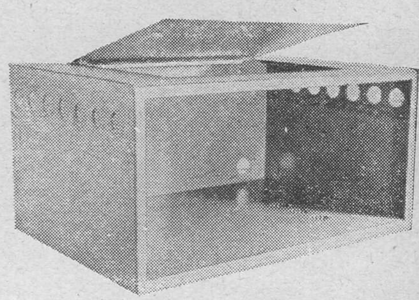

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