Radio Constructor

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Editorial

WHAT did you think of Radiolympia this year? We have heard it said that, from the constructor's point of view, the show was disappointing and that the whole thing was rather in the way of being an anti-climax. The majority, however, seem to agree that the constructor was well catered for. Those whose view it is that the show was an anti-climax probably have themselves to blame for building up too many "castles in the air." When one considers that the things of main interest to the constructor (components and test gear) were on show at nearly two-thirds of the total number of stands, then that should surely provide the answer.

Not many really **new** components were seen, though existing types showed a great advance in design in many cases. It was obvious to all that war-time practices had made their mark on gear and assemblies. Notable in this category were miniaturisation and unit construction—both used extensively in Service equipment. Tropicalisation, though of little interest to readers of this journal, also took its place in the "new" developments. Various other hints at Service influence were seen in the valve retainers, coloured hand knobs and so forth.

How does all this affect the average constructor? After seeing the equipment on show at Radiolympia many constructors must have left in a rather thoughtful mood. We can forsee the more intrepid of these re-planning their gear to conform with modern standards, with the accent on smaller physical dimensions and greater versatility. In the latter field, we feel that we have shown the way by the introduction of the Versatile Transmitter and though this is only a beginning it will point the way to the possibilities of unit type con struction. The advantages of such flexible arrangements will be obvious to all enthusiasts who are not prepared to stick in the groove."

Miniaturisation can be a debatable point. Point out to a proud constructor that his 1-v-2 could be built into a unit of only half the existing size, and he would probably retort "So what! I have plenty of room." And for the normal medium wave or short wave receiver there would probably not be much advantage, electrically. If one likes a receiver of pretentious size, has the room to spare, and is not interested in portability, then by all means keep to the general practices. However, what happens when one starts dabbling on the higher frequencies, such as the new amateur bands now being allocated? Gear for use on these frequencies must be built with precision and compactness if good results are to be obtained. Therefore, why not make a start now so that you will be acquainted with this type of construction when the time comes to build your first VHF receiver?

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 re-draw 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.

Interference Suppression

A filter for use with either AC or DC mains

By Centre Tap

HAVING recently had occasion to fit an R.F. filter to suppress mains-borne interference, the conventional arrangement illustrated was successfully used, the form of which, it is thought, adapted to suit the particular conditions of any particular site may be of interest to many readers. A filter based on these lines is of value both to the transmitter and the listener as it will greatly reduce r.f. both from being fed back into the mains wiring and also eliminate, or greatly reduce, interference with reception. The most effective position for such a filter is at a point where the mains enter the building or beside the meter, but this is often impracticable as in the case of flat-dwellers, etc., and must in any case be cumbersome if the chokes are to be capable of carrying the heavy current borne in such a position.

All domestic sources of interference (suction cleaners, hair dryers, electric fans, etc.), should be first dealt with at source and a plain capacitor filter as in Fig. 1, connected across the mains input of such apparatus will normally effect a cure.

The choke-capacitor filter as shown in Fig. 2 can well be used in the mains wiring where it enters the Shack or Listeners' Den. It is built into a metal case which serves to totally screen it, and the insulation should be of the usual order when dealing with mains current. The capacitors are all of .1 μF capacity and in the interest of compactness or economy, it may be found that one pair only is necessary. Alternatively a single capacitor at each side of the chokes (with the earth lead omitted) could be used, but this is not advised unless fuses are incorporated owing to liability of breakdown damage.

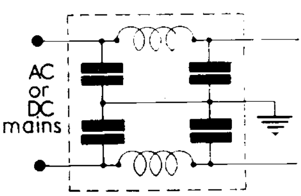


Fig. 2

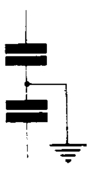


Fig. 1

The Chokes

The size of the chokes will depend on just what band of frequencies are to be rejected and the number of turns may be found to be anywhere between 60 and 250 turns if required to give optimum rejection to a particular form of interference. They must be wound with wire capable of comfortably carrying the maximum load which might be taken from the particular circuit they are to filter. Those used in the case described consisted of 160 turns of 20

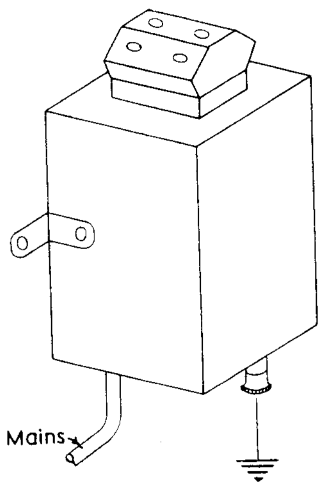


Fig. 3

double cotton covered S.W.G. pile wound on a ¾in. former, one inch wide and ¾in. deep, the whole assembly being mounted in a screening box 3½in. x 2½in. x 2in. neatly affixed to the skirting beside the mains point. The capacitors were of the tubular type with a cardboard cylinder fitted over the metal casing. As will be seen in the sketch (Fig. 3) a three-way adaptor was built on to the box as both TX and RX voltages were to be taken from it. Even in the case of the listener the three-way adaptor is a worth while fitment as often separate points are required for individually powered converters, pre-selectors, etc.

The choke formers were of 1in. lengths cut from wooden reels which conveniently have a hole through their centre, and the circular cheeks were of paxolin, bolted together with 4BA tapped rod with a sufficient length left at one end for bolting to the casing. A ¼in. bush is fitted over the extended end of the rod to serve as a stand-off (see Fig. 4).

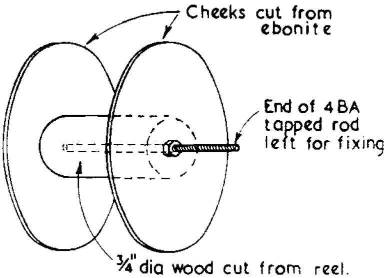


Fig. 4

Suitable Wire Gauge

The accompanying table should be used as a guide in choosing wire which will safely carry the maximum current to which the filter is likely to be subject, and as the side-by-side turns per inch for D.C.C. wire of each gauge are given, the former dimensions to hold the required number of turns can be quickly calculated.

D.C.C. S.W.G.	Turns pr in.	Ohms pr 100 yds.	Approx. curr. amps.
16	13	.746	3.2
18	17	1.327	1.8
20	21	2.36	1.0
22	26	3.90	.6
24	31	6.32	.38
26	35	9.43	.25

For the sake of the beginner a few words on ascertaining the current in amps. from a known wattage consumption. Watts are, of course, the product of volts and amps, thus current (amps) must be Watts divided by Voltage. To take an example—a 100 watt lamp at 250 volts

$$\frac{100}{\text{amps} \times 250} \quad \text{or .4 amps.}$$

The consumption of power transformers (as used in radio gear) is the total wattage from all the secondary windings, and as most transformers have only an efficiency of approx. 75 per cent due allowance for that fact should be made. In the case of DC. mains it is easy to calculate by simply totalling heater, H.T. and any other current drawn. With A.C. receivers, the wattage will vary according to size but will usually fall between 60 to 100 watts.

Having settled on the gauge of wire and the former dimensions, all that remains to be decided is the number of turns. As already explained this depends on the frequency of any particular interference which is to be suppressed and can normally only be accurately found by experiment. A choke can only be 100 per cent. effective over a narrow band of frequencies and a little experiment in this direction is well worth while if complete elimination is to be secured. In the particular case quoted it was found that R.F. feed back from the TX was practically eliminated from the house wiring and the exact number of turns was not particularly critical—160 being the final figure used.

(STRAIGHT REC.—Cont. from p.95)

inductance, so that it resonates at the frequency to which the input circuits are tuned.

In Fig. 7 the anode inductance L3 is tuned by C3, the constants being the same as in the input circuit L2-C1. It will be noticed that in Fig. 7b the anode decoupling capacitance C6 is effectively in series with C3 across L3, but as the value is comparatively large, the effect on tuning is very small. In addition to better and more even amplification, this system has the advantage of considerably better selectivity.

An RF pentode valve, or a tetrode as shown, is used to counter Miller Effect, or the tendency to self-oscillation by virtue of the anode/grid capacitance. The auxillary or screening grid potential is determined by a series resistance or potentiometer R1, and the value of this potential will be found to be fairly critical if maximum gain coupled with stability is to be obtained. The decoupling capacitances C2, C5 and C6 should have a low reactance at radio frequencies, some .01 to .1 μF being typical values for a receiver covering a frequency range of 3 to 25 Mcs. In practice the capacitors should be connected straight on to the valve or coil sockets, with as short leads as possible, as the impedance of an inch or so of wire can be considerable at high frequencies. The decoupling resistance R3 should have a high impedance, but a compromise will be necessary owing to the fact that this resistance fixes the DC anode potential. C4 is necessary in order to prevent a positive potential being applied to the control grid of the following valve, and where this is a leaky-grid detector, C4 can also act as the grid capacitance. The voltage drop across R2 provides standing bias for the valve, and here the value should be determined by the advice given by the manufacturer.

(To be continued)

Radio Conditions

A Survey of Conditions on the Broadcast Bands

By ISWL/G211 (Bristol) All times in GMT

Conditions over the past month have been somewhat erratic on most bands. On the 30 Mcs. band a strong harmonic of Moscow was heard at 1500 although activity on near frequencies appeared to be nil at this time on October 11th. On the 15 Mcs. band from September 23rd-25th very bad spells of fade-out were noted after darkness, and on 17 Mcs. the only signal was OTC5 Leapoldville Belgian Congo (17725 kcs.) whose signals were R7-9 at 1920! Best bets have been the following: "Radio SEAC" in Colombo, Ceylon, was heard with collosal signals on its 15120 kcs. frequency when transmitting its Sunday evening Broadcasts to the British Isles at 1730-1930. I cannot remember hearing such a very strong signal as that put over by Radio SEAC on October 12th . . . not even after 20 years of DXing! Their 17770 kcs. transmission was also heard in parallel with 15 Mcs. although not quite as strong . . . R9! On 11 Mcs. FZI Brazzaville has again topped this frequency with R9 plus signals around 1900 using 11970 kcs. The Belgian Congo station OTC2 9740 kcs. at Leopoldville has supplied R9 signals at 1845. FZI on its 9440 kcs. channel was logged R8 at 1900. Reports on reception conditions are needed for this column. Please address all letters to: ISWL/G211. "Radio Constructor," to reach me by the 5th of the month at the latest. Until next month . . . 73 and good listening.

DX PREDICTION FOR MID-OCTOBER TO MID-NOVEMBER

(7 and 14 Mcs. through courtesy of Geoff. Hutson G6GH, 28 and 60 Mcs. with acknowledgments to Denis Heightman, G6DH.) Times in GMT.

7 Mcs. Conditions

0700—0800—ZL, VK.
2000—2100—VK, ZS.
2200-2400—W1.

14 Mcs. Conditions

0700-0800—ZL, VK.
1300-1500—VK, W1.
1500-1700—VK, W6, W7.
1800-1900—W1, Africans.
2000-2200—W1, PY, LU.

28 Mcs. Conditions

Excellent DX conditions with increasing regularity. N. American signals should be very strong from 1200 to 1900. W6's etc., from 1600. The more distant Europeans, i.e., SV, YR and U will be audible at good strengths, peaking about 2 hours before until 2 hours after midday.

Asia, Oceania, etc., will be "in" most of the morning until early afternoon; with the nearer and more southerly Asiatics lasting until late afternoon.

African and S. American signals will be audible from 0800 to 1700, tending to drop in strength towards November, except those from N. Africa.

60 Mcs. Conditions

There should be some days when the F2 peak MUF reaches 50 Mcs. or higher for distances of 2000-4000 miles in directions from E. round to N.W., with peak time occurring when it is midday at a point halfway along the path. These frequencies should be checked for openings from Middle East and East Coast U.S.A. (50 Mcs. band). Slight possibility also to S. Africa.

On 60 Mcs., tropospheric contacts will still be possible up to 150 miles or so particularly when weather is settled. Daytime will often provide better conditions than night, but lack of activity will probably not make this apparent.

RADIOLYMPIA 1947

YOUR editors visited Radiolympia with a view to finding out exactly what was being offered to radio constructors in the way of new and interesting components. Whilst there was not much which could be described as new, we were agreeably surprised to find so many firms catering specifically for the constructor. The table shown on the following page will indicate exactly the general make-up of exhibitors with something to offer the constructing fraternity. Not only were there masses of components, of a great variety, but one firm **(Radio Kits Co. Ltd.)** was showing complete kits of parts, with all necessary diagrams, for building up various receivers and amplifiers. The completed models on show had an attractive finish to them and the prices for the kits were most reasonable. We learnt that a lively sale for these kits already exists and we were not surprised.

Test gear, much of it suitable for the amateur constructor, was there in profusion and the impression we gained was that the amateur was being well catered for in that direction.

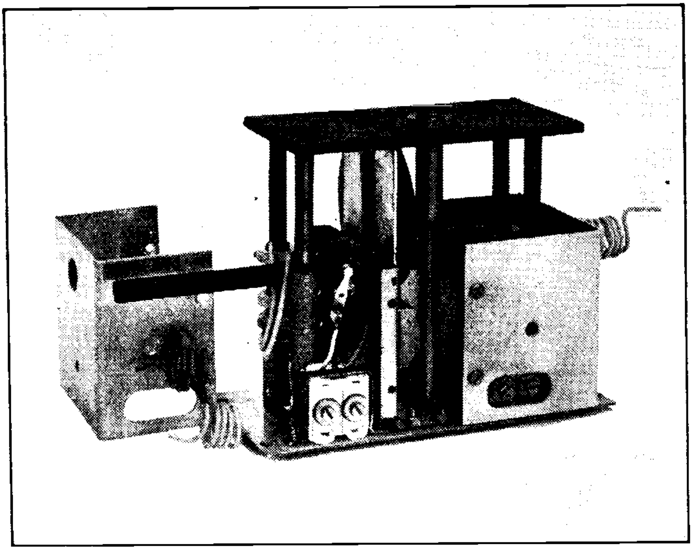
One of the most interesting components, or rather component assemblies, that we saw was the Permeability Tuning Unit marketed by the **Weymouth Radio Manufacturing Co.** This had integral waveband switching, and types are available for superhet and TRF receivers. Waveband coverage is 200-540 and 1000-2000 metres, and we are looking forward to seeing a short wave unit on similar lines. This is an entirely original component and it is one whch will be welcomed by those wishing to build high efficiency and compact broadcast receivers. The same firm also showed a good range of coil packs of more orthodox type, covering short wave as well as medium and long, available for superhet construction.

Another firm exhibiting a useful range of coil assemblies was **R.M. Electric;** who also had a useful IF transformer with a circular container and having a clip mounting.

The **Q-Max** stand was full of interest. Besides the communications receiver and 40 watt transmitter, perhaps the chief interest was the new insulating material "Polymax." This insulator is claimed to combine all the advantages and electrical properties of ceramic with the mechanical properties of light wood. The material is unbreakable, easily drilled and will not splinter or crack.

A feature of the **Q-Max** receiver and transmitter is unit construction. This is praiseworthy in itself but has the added advantage that the various units are available as separate items to the constructor. Samples are Driver Unit, Coil Turret, Pierce Oscillator, Crystal Calibrator Unit, etc. Other items on this stand were slow motion drives, cabinets, a VHF Converter and the new **Q-Max** chassis cutter, available in four sizes.

Just around the corner from **Q-Max** was the **Eddystone** stand. The usual range of high quality **Eddystone** components were on view, and it is worth noting that the trade



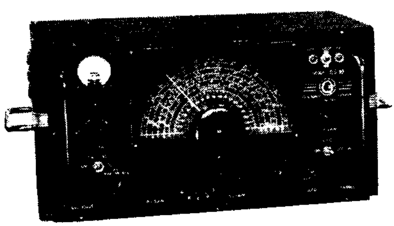
The Permeabilitity Tuning Unit marketed by the Weymouth Radio Manufacturing Company. A compact assembly that will appeal to keen experimenters.

mark "Eddystone" has been associated with high quality and outstanding reliability in short wave components since 1924. On sale at the stand, and now available from local **Eddystone** agents, we saw the new Short Wave Manual. This is a good buy for all constructors as it contains articles and constructional details of receivers, a transmitter, a preselector, aerials, and so forth. Though only 24 pages, this booklet, is well worth the 2/6 asked for it. Besides components, several receivers were on view, including the well-known 640 (reviewed in our August issue), the new general purpose communications receiver—the 680—and the new export short wave receiver, the Type 659.

This corner of the National Hall, with both the **Q-Max** and **Eddystone** stands, must have been one of the most popular spots of the exhibition as far as the constructor was concerned.

There seems to be a tendency to break away from the black or grey finish to radio gear, and we were interested to see on the **Bulgin** stand a complete range of knobs, pointers and sundry fittings in numerous colours. Many readers will have come into contact with coloured fittings on Service gear and for those that like a splash of colour here is a golden opportunity to brighten up that receiver or transmitter. For those that go for this sort of thing, this **Bulgin** range presents them with the chance to match their radio gear with the colour scheme of the room furnishings! Knobs were not the only components that appeared in exotic colours. Many extension speakers were housed in brightly cellulosed wooden or plastic cabinets in a variety of colour schemes. The **Celestion** CT117, a 2½in. speaker in a bakelite cabinet, was the smallest model shown on that particular stand and we were rather impressed by its neat and clean looking appearance. On the **Rola** stand, too, we met some attractive speaker cabinets particularly one model of black and white finish. By combining good workmanship in the design and manufacture of loud speakers with the more aesthetic considerations of cabinet design, these displays made one feel like fixing up radio extensions in all rooms!

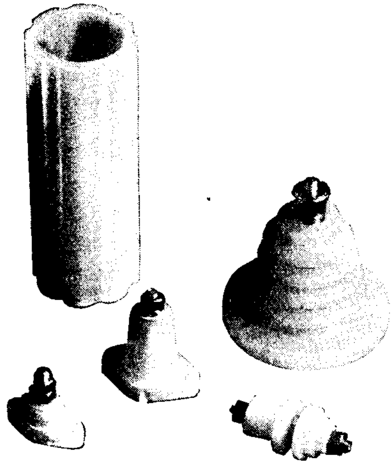
A number of firms were showing aerial equipment, as will be seen from the chart. A most useful, and unique, short wave aerial was to be seen on the stand of **Antiference Ltd.** Their "Arnine" short wave aerial is a folded dipole made up in a polythene moulding, with the aerial proper, the down lead, and the insulators supplied complete. The aerial span can be adjusted to the required length (frequency)



The Q-Max communications receiver

by cutting through the insulating material and joining the bared aerial wire to brass bobbins on the insulators. Invaluable to the prospective users of this aerial kit is the fact that the aerial is already calibrated and marked so that it may be cut to any amateur or broadcasting band required. The polythene web is calibrated for the 10, 20 and 40 metre amateur bands and the 11, 13, 16, 19, 25 and 31 metres broadcasting bands. This renders unnecessary the usual tedius measuring process needed to cut an aerial to resonate at a given frequency. Two types are available, Model FDA 20 for frequencies of 14 Mcs. and upwards and the FDA 40 for frequencies of 7 Mcs. and upwards. This aerial struck us as being an extremely valuable addition to equipment available to the SW enthusiast.

On the **Belling & Lee** stand, there was just about everything the constructor needs in the way of aerial equipment. Their L336 Balanced Twin Feeder is now well known as are their aerial kits for making up dipoles. A VHF dipole for 56-224 Mcs. is available, with reflectors, and other items, such as their Eliminoise anti-interference aerials, are well outlined in the Radio Amateurs catalogue available on request. In this catalogue will be found particulars of the firm's extensive range of multi-connectors, plugs and sockets, etc. Terminals, valveholders, fuseholders and insulators are also listed. We gathered from conversations with **Belling & Lee** representatives that an official drive on interference suppression is to be started soon by the Radio Industries



Samples of Polymax insulators

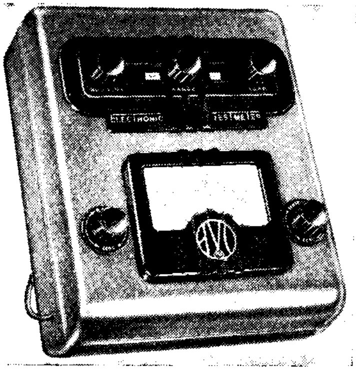
Council. This is indeed good news, and we trust that our readers will do all they can to pass on the word to people likely to be affected! **Belling & Lee,** of course, have the answer in regard to car interference with their ignition suppressors. An extensive range of interference suppressors for all types of electrical apparatus has been a feature of this firm for many years. Of interest to the radio enthusiast with a good "skywire" are the lightening arrestors we saw on the stand; components that we feel are worthy of more attention than they get at present.

CLASSIFICATION OF EXHIBITORS

Showing the number of exhibitors for various components

Aerials, etc.	11	Loud Speakers	25
Capacitors	16	Measuring Instruments	12
Cathode Ray Tubes	5	Recording Equipment	3
Chassis	3	Rectifiers (metal)	3
Chokes	9	Resistors	9
Coils, tuners, etc.	8	Solder, etc.	2
Components other than those specified	13	Switches	8
Connectors	9	Tools	6
Fuses	1	Transformers	15
Gram. motors, pick-ups, etc.	11	Transmitters and Communications Receivers	10
Headphones	2	Valves	8
Insulators, etc.	5	Wires, cables, etc.	13

Altogether there were 95 firms showing components, test gear and other accessories available to the general public.



The AVO electronic testmeter

Aerialite Limited showed their Mastatic Noisefree Aerial System which deserves consideration by those troubled with really severe electrical interference. This firm had on show a wide range of dipoles, wire, feeders, car aerials, earth rods, lead in tubes and other accessories for aerial and earth systems.

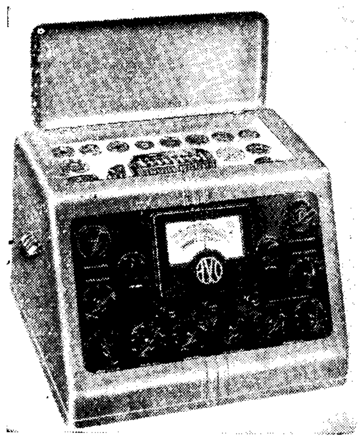
Visitors to the stand of **Haynes Radio Ltd.** will have noticed immediately the very smart 100 watt amateur transmitter which was on show. This transmitter was designed around the range of transformers and chokes made by **Haynes** and we were much impressed by the components which were exhibited. The Undulator, also on show at this stand, connected up so that those who wished could record their morse sending, amused many visitors and gave quite a few a surprise when they obtained visual evidence, on the tape, of what their "fist" was really like! **Haynes Radio** publish a most useful booklet (Technical Publication No. 23, 1947/8. Price 1/-) entitled "Transmitter Design and Circuits." It gives design data for a robust 100 watt and 150 watt transmitter. The booklet goes into circuit considerations and takes you stage by stage through the transmitters, including modulators and power supplies. Besides this, it is well illustrated with photographs and circuit diagrams and contains data on valve operating conditions and on coil winding. Altogether a most useful booklet for those interested in **transmitter design.**

On the **Rothermel** stand, this firm's well-known range of piezo-electric crystal pick-ups and microphones were to be seen. New models, designed for use with their products, Type VR/2 4½ watt amplifier and the Type HG/308 8 watt amplifier, were shown.

Sydney Bird & Co., Ltd., showed an amazing display of their well-known Cyldon transmitting and receiving type variable capacitors, from the smallest types right up to the very large one for high powered transmitters of the commercial type. Also on this stand we saw the Prestacon, which is ideal for the laboratory or the home constructor in producing small metal radio parts. It pierces round and square holes, cuts slots, bends metal up to 45 degrees and will cut rectangular and circular holes in metal plate or strip of any length up to 3 in. wide. A most useful piece of equipment.

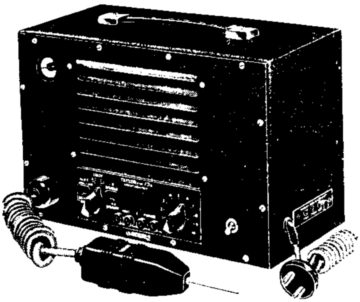
Electrothermal had on show various valve retainers, of the net types and strap types to suit the majority of medium sized valves. Though the idea is admirable, and was used extensively in service gear during the war, amateurs have not taken to the idea generally—probably because they like to be able to de-valve a set frequently and with the minimum of effort!

The test gear on show was extremely comprehensive and not only was there a noticeable advance in design and appearance, but most instruments showed more usefulness in their applications than their predecessors. On the **AVO** stand, the Electronic Testmeter was a noticable exhibit. This instrument has been developed to meet the demands of present day radio and television technique. It is robust and of attractive appearance, having 49 ranges covering DC volts, current, AC volts, AC output power, Decibels, Capacitance, Resistance and insulation. A very comprehensive Valve Characteristic Meter was shown, which will test any normal receiving or small power transmitting valves and incorporates many features directed towards greater ease of operation. The Model 7,



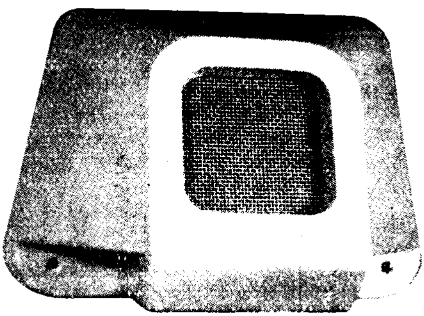
The AVO valve characteristic meter

Model 40 Universal Avometer, an All-Wave Oscillator in battery or AC mains types covering a fundamental frequency band from 95 kcs. to 40 Mcs., the Avo Valve Tester, the Universal and DC "minors" and the Avo Test Bridge were all on view.

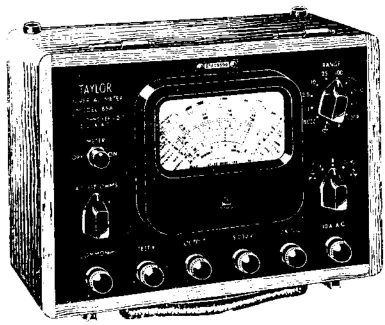


The Taylor circuit analyser

The exhibits on the **Taylor** stand included seven newly-designed instruments. The Model 20A Circuit Analyser is an AC mains operated unit for checking radio receivers by following the signal throughout the receiver. A probe fitted with a miniature detector valve is coupled to the instrument by a flexible lead. An audio amplifier and loud speaker is included together with a magic-eye valve for RF oscillator stage checking. The Model 30A is a Cathode Ray Oscilloscope with a 3½in. tube. Horizontal linear time base provides coverage from 10-10000 cycles and an amplifier for the vertical input is incorporated. Model 70A is a 50 range Universal Meter covering 1000 volts AC and DC at 1000 ohms-per-volt. Current ranges are from 1 mA- 5 A full scale. AC and DC. The resistance ranges are from 1 ohm to 1 Megohm, with internal battery, and a buzzer is fitted for continuity tests. The Model 75A is similar but voltage ranges are 20000 ohms-per-volt and resistance measurements can be made up to 10 Megohms. Another interesting exhibit was the Model 110B which is a resistance/capacitance bridge operated from AC mains. Seven ranges are provided covering 0.1 ohm to 12 Megohms, and seven ranges covering 10 $\mu\mu$F to 1200 μF. Then there was the Model 130A. This is an AC mains operated insulation and continuity tester, with a maximum test voltage on the high range of 500 volts DC. Finally, the Model 290A, which is a very high range Megometer covering from 20000-50000 Megohms in four ranges. This instrument is probably the only one of this stand that will not be of interest to readers.



The Celestion CT117



The Taylor Universal meter

On the **G.E.C.** stand, the instrument which attracted our attention, amongst all others, was their Miniscope. This is a miniature Cathode Ray Oscilloscope of a size and simplicity that will appeal greatly to the radio constructor. This, to our mind, was miniaturisation carried out to its best advantage. The instrument measures only 8¼in. x 6⅝in. x 2¼in., yet has a time base, signal amplifier and attenuator incorporated. The tube is one of 1½in. diameter. It can be operated from either 6 volts DC. using a vibrator, or from 200-250 volts AC mains. Various "add-on" units are available, and we feel confident that this little instrument will have a wide appeal amongst keen radio enthusiasts. Whilst on this stand, we were shown some very neat miniature moving coil meters. These were of 1½in. diameter and are ideal for building into home constructed gear.

The Straight Receiver

Part 4. *By H. A. Emm*

Choke-Capacitance Coupling

IN Fig. 5a the impedance in the anode circuit of V1 is shown as a resistance, but it need not take this form. In fact, one of the disadvantages of resistance-capacitance coupling is that there is necessarily a voltage drop across R1, caused by the DC anode current of the valve, so that with any given HT supply the voltage available on the anode is restricted to a comparatively low value. On the other hand, for maximum gain and minimum distortion it is necessary that the anode voltage should be relatively high. If it should be impracticable to increase the HT supply, this condition can be satisfied by substituting an inductance for R1, in the form of an AF choke. As so often happens, however, the removal of one disadvantage is offset by the appearance of another. The impedance of a resistor, providing that it is non-inductive, remains constant irrespective of frequency, so that with resistance-capacitance coupling it is possible to obtain equal amplification of all frequencies, at least as far as the valve and its impedance are concerned. The reactance of an inductance, and therefore a choke, however, varies according to frequency. It may, even, form a tuned circuit within the audio range, resonating at a frequency determined by the unavoidable self-capacitance of the winding, and in this case a portion of the frequency spectrum would be greatly accentuated, giving what is commonly known as "peaky" amplification. Another disadvantage, found when this system is used in mains receivers, is that the choke is very liable to hum "pick-up." To alleviate this, the choke should be so mounted that the axis is at right-angles to that of the mains transformer, and if possible it should also be enclosed in an earthed and heavy gauge iron container.

AF Transformer Coupling.

Fig. 5b shows a third method of coupling two audio frequency stages. Here the primary winding of an AF transformer serves as the anode impedance of V1, the AF potentials induced in the secondary winding L2 being applied to the control grid of V2. As there is no direct coupling from the anode of V1 to the grid of V2, there is no need to block off the DC voltage on the former, and the capacitance C1 is therefore omitted. If the magnetic field is concentrated by means of an iron core, and the secondary L2 is wound with a larger number of turns than L1, then the potential across L2 will be larger than that across L1, giving a useful amount of additional amplification. However, there are also some disadvantages.

As with the AF choke, the reactance of the windings will vary according to the frequency, and again there is liable to be peaky amplification. In practice, of course, results are quite tolerable, especially if the primary inductance is made sufficiently large, and the small loss in quality is more than offset by the extra gain where short wave work is concerned.

In Fig. 5b the input valve V1 is series fed, that is, the anode current passes through the primary winding of the AF transformer, the object being to make available a high anode potential, as in the case of choke-capacitance coupling. Unfortunately, the inductance of the primary winding will vary according to the amount of current passing through it, and if this current is sufficiently large, magnetic

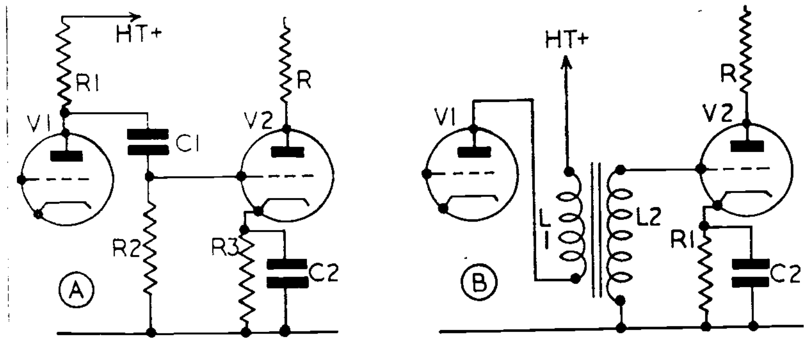


Fig. 5

saturation will also occur. In order to minimise this effect, the transformer has to be comparatively bulky, and this in turn gives rise to an increased likelihood of hum pick-up.

These disadvantages can be largely overcome by using the parallel feed system. With this, a resistor is used as the anode impedance of V1, and the anode is capacitance coupled to the primary of the transformer. In other words, we have a combination of resistance-capacitance and transformer coupling, retaining the disadvantage of the former in that the anode potential is lowered, but enabling the step-up effect of the transformer to be obtained. Moreover, as the primary winding does not have to carry any of the standing valve current, the wire used can be of very fine gauge, and in addition modern iron cores of high permeability materials can be incorporated. This results in a transformer of high primary inductance and exceptionally small dimensions. One point to be noted is that the frequency response, more particularly as regards the lower frequencies, will depend in large measure on the value of the coupling capacitance. For CW reception it is better to attenuate the lower frequencies, by using a smaller capacitance than that specified by the component manufacturer.

R.F. Amplification

We now have a stage or more of audio amplification following a detector. The input to the latter should be above a certain level if efficient rectification is to be achieved, and in order to obtain a good signal/noise ratio. In addition, the selectivity of a single tuned signal circuit leaves much to be desired, especially under modern conditions of high-powered stations and crowded bands. Thus the next logical step is to amplify the signal collected by the aerial, before it is rectified. Basically, the process is the same as in the case of audio amplification, but there are some important differences in detail , due to the much higher frequencies dealt with.

Consider the methods so far described from the angle of radio frequencies, starting with resistance-capacitance coupling. The anode load impedance needed for an RF valve is much greater than that for an AF valve, so that the first drawback is the low anode potential available. Secondly, the anode/cathode capacitance of V1 and the grid/cathode capacitance of V2, plus the stray circuit capacitances, are effectively in parallel with the anode impedance. Thus the effective impedance becomes smaller as the frequency increases, and the gain falls off. Miller Effect, with its subsequent

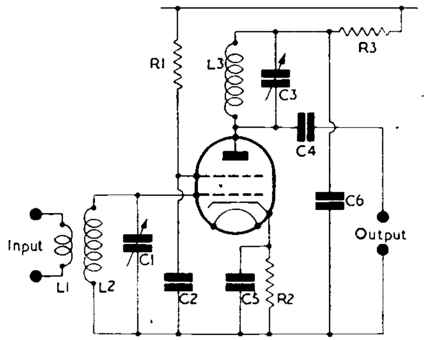


Fig. 7a

damping of the tuned input circuit, can be minimised by the use of a tetrode or pentode type valve, but in any case the absence of other tuned circuits means that no further selectivity is obtainable. The same disadvantages hold with choke-capacitance coupling, except that here the anode potential can be raised without any trouble. In addition, there is the old fault of 'peaky'' amplification.

Tuned Choke Coupling

More usually known as Tuned Anode Coupling, the circuit of this method is shown at Fig. 7a. In practice a slight variation is generally made, as it enables the moving vanes of the tuning capacitor to be conveniently connected to the HT— line, usually chassis, and this system is depicted in Fig. 7b. In choke-capacitance coupling the choke, in conjunction with self and circuit capacitances, formed a tuned circuit which caused the amplification to be greatest at the resonant frequency, and as this frequency was departed from the gain became progressively smaller. In tuned anode coupling, advantage is taken of this effect by tuning the anode

(Continued on p.87)

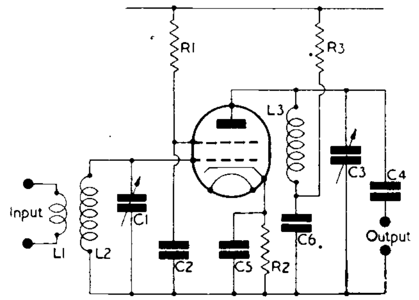
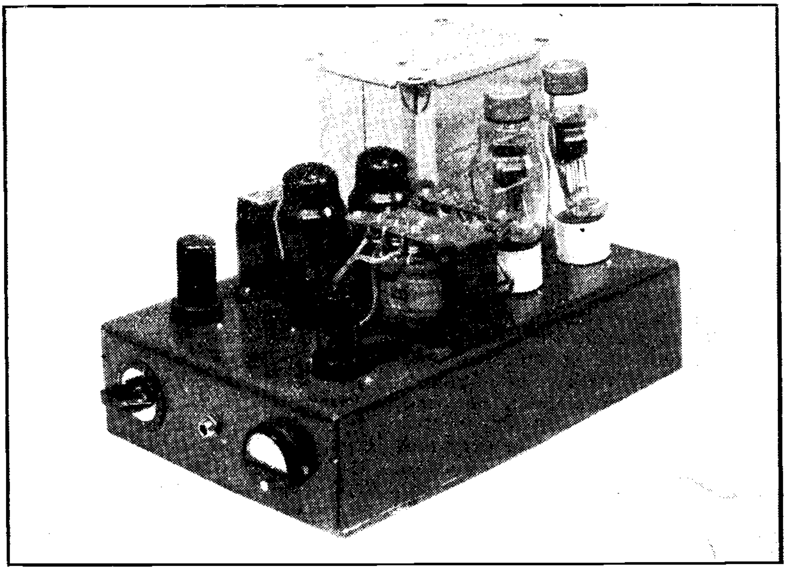


Fig. 7b



A Versatile 150 Watt TX

PART 3: THE MODULATOR

By G2UK

IT would appear to be worthwhile devoting a small amount of space to a consideration of modulation equipment and the principles of modulation, prior to describing the actual modulator used with the Versatile Transmitter. By doing so, a better understanding of the modus operandi of a modulator will be ensured and consequently those readers not already possessing this knowledge will be able to discover the various snags which arise without it being necessary to go into a lot of descriptive writing here.

So far, our transmitter radiates continuous waves, or CW. By chopping these impulses up into dots and dashes we are able to convey messages. But supposing we now wish to radiate speech? What steps are necessary to superimpose the speech to these waves?

The first step is to convert the sound waves of the voice into electrical energy, and this is done by means of the microphone. In this instrument, sound waves in the air produce mechanical vibrations which in turn are used to produce electrical energy of varying degrees. As this energy is extremely weak it must be amplified before it can be of practical value. The first requirement, then, is some form of microphone amplifier or "pre-amplifier" as it is usually called.

At the other end of the modulator we have to superimpose the electrical energy on to the carrier wave. This process is called modulation and the electrical gear required to perform the function is called a modulator. There are numerous means of producing this superimposition of sound waves upon the radio waves but one of the simplest is that of varying the anode current of the PA valve in such a way that its variations correspond with the variation of current produced by the microphone. This can be accomplished by passing the anode current through a transformer, the primary winding of which is carrying a current varying in a similar manner to that of the microphone current. Now a certain amount of energy is required to bring about this variation of the anode current—in actual practise about 50 per cent. of the energy being carried by the anode current. So if we wish to fully modulate the current supplying a radio frequency stage of 150 watts, we need about 75 watts of electrical energy from the modulator. As losses occur it is usually necessary to provide rather more than this figure.

Between our microphone current amplifier and our modulator valve, we have to build up the very weak microphone current to one of 75 watts. We therefore need one or more stages of amplification—speech amplification as it is called. So our modulator equipment can be divided into three distinct stages. (1) the pre-amplifier, (2) the speech amplifier and (3) the modulator stage proper. In passing, it should be noted that only the current generated in the microphone should be amplified. We do not want extraneous noises such as electrical hum. interference and noise. This point has a marked bearing on the design and construction of the modulator as a whole.

It will be seen that, if we are to use anode modulation, i.e. vary the anode current of the PA stage, we require at least 50 per cent. of the power in that stage. Thus for our 150 watts stage we need 75 or more watts of speech current, or audio. The most economical way of getting this large amount of power is to use a Class B type of speech amplifier. An amplifier operating under Class B conditions is one in which the output current is proportional to the amplitude of the grid voltage. The grid bias is so adjusted that, without grid excitation, the anode current is low. In grid excitation, the anode current rises to the level required to provide the necessary power. The anode current of a Class B amplifier, therefore, rises and falls in accordance with the speech reaching the microphone and the anode current meter therefore varies continuously in proportion with the speech current variations.

In audio frequency amplification, two valves must be used in Class B operation, each valve working in alternating pulses, so that both halves of the electrical cycle are present in the output. The requirements of our modulator unit are, therefore, a microphone, a valve to amplify its current, one or more valves to further amplify the current until it is strong enough to fully excite the Class B valves, and then two valves to form the modulator proper. Finally, we need a transformer—the modulation transformer—to transfer this energy to the RF stage anode current of the transmitter.

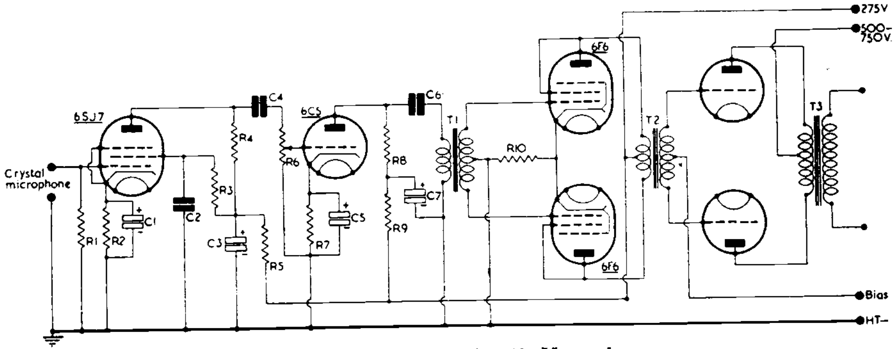
Now let us translate this elementary theory into practice and consider the modulator shown here. As is always the case, it is a little difficult to get exactly what theory specifies in actual practice and some compromise must be made to get what we need without insuperable difficulties and expense. The first difficulty is that of acquiring suitable modulation valves. Those used in our model are HY25's, as we happened to have a pair handy. Other types which could equally well be used are T20, TZ20 and 801. It is essential when building a modulator to acquire one's modulator valves first so that the rest of the unit can be planned round them.

The next consideration is the modulation transformer. This is the most expensive item of the unit—apart from the microphone—and it is worthwhile getting a reliable one of good quality. That shown is a *Woden* Type UM2, which is rated for 60 watts of audio, and has a maximum secondary current of 200 mA. Though we need 75-80 watts of audio to fully modulate our 150 watt carrier, it is extremely bad practice to overmodulate a radio transmitter and slight undermodulation is infinitely preferable. This transformer has proved quite heavy enough to provide adequate modulation for the valves specified in the RF section of the transmitter described in our August issue. The HY25's, with 700 volts on them, pass just over 100 mA. on peaks. This type of transformer has a primary winding with various tappings to give impedences from 2000-18000 ohms and a secondary winding with tappings from 200-20000 ohms, so that it can be matched into various modulator valves and RF stage loads. This point will be referred to again in greater detail.

Referring to the circuit diagram, many readers will recognise a conventional pre-amplifier and speech amplifier stages. The microphone used with the modulator is of the crystal type and feeds into the pre-amplifier valve—a 6SJ7. This valve is preferable to the 6J7 usually specified for this purpose as the grid connection is to a pin in the base, not to a cap on the top of the envelope, thus enabling a really short screened connection to be made between the microphone jack and the grid of the valve.

Sufficient amplification to drive the modulator valves is obtained from a 6C5 driving a pair of 6F6's strapped as triodes. The 6C5 is resistance-capacitance coupled to the 6SJ7. A volume control is incorporated in the grid circuit of the 6C5 by means of which the input to the speech amplifier can be varied. In this way, the output of the modulator as a whole can be controlled. The 6C5 is transformer coupled to the 6F6's, which are strapped as triodes, and these in turn are transformer coupled to the modulators.

The whole unit is built on a chassis 10in. x 8in. x 3in. The position of the various components is not critical and the general arrangement can clearly be seen from the photograph. At one end of the chassis are mounted the volume control,



R1 5 MΩ ½ watt
R2 2000Ω ½ watt
R3 1 MΩ ½ watt
R4 250000Ω ½ watt
R5 50000Ω ½ watt

C1 10 μF electrolytic 50 V peak
C2 0.1 μF 250 V wkg.
C3 8 μF 500 V wkg. electrolytic
C4 0.02 μF 500 V wkg.
C5 10 μF electrolytic 500 V wkg.
C6 0.1 μF 500 V wkg.
C7 8 μF electrolytic 500 V wkg.

R6 1 MΩ
R7 1500Ω 2 watt
R8 50000Ω 1 watt
R9 10000Ω 1 watt
R10 500Ω 1 watt

the jack for the microphone plug and a small milliammer reading 0-250 mA. (the one shown is from surplus gear). The 6SJ7 is mounted just above the meter and the 6C5 is mounted in the corresponding corner of the chassis opposite it. Transformer T1 is that shown between the 6C5 and the modulation transformer. Transformer T2 is that shown between the 6SJ7 and the modulator valves. The two 6F6's are placed between T1 and T2.

The modulation transformer is at the far corner and an oblong hole must be cut for the tappings as these come down through the chassis. This hole should be approximately 3½in. x 2½in. T1 is a driver transformer suitable for matching the 6C5 into a pair of 6F6's, as triodes. Transformers of this type can be obtained from our advertisers. Transformer T2 may present some difficulties because one having a centre-tapped primary as well as secondary is needed. Any radio dealer who handles transformer re-winds will be able to provide a suitable transformer wound to order, particularly if you are able to supply him with an old core from a burnt-out disused transformer. When ordering state that it is required to match a pair of 6F6's (as triodes) into a pair of HY25's, or whatever valves you propose using.

Construction

First space out the transformers and valve holders on the top of the chassis and mark their positions. Cut out the holes for the valve holders. The spaces for the transformer tags are best cut out by drilling a series of holes along the line marking the piece to be cut out, breaking them into one another and finishing off with a file. Having mounted the valve holders and transformers, wire up the filament leads—two sets of filament wiring being required (one supplying the 6.3 V valves and the other supplying the modulator valves, which in the case of HY25's is 7.5 V).

It is a good plan to use screened cable for all the wiring, and this was done on the original model with the result that no hum at all has been experienced. It is somewhat more difficult to wire up with screened cable, but the resulting freedom from hum is well worth the extra trouble and time involved. Where the wire is cut, bind the frayed ends of the metal screening with a few turns of thin wire and touch lightly with the tip of the soldering iron. A thin film of solder can be made to flow round the wire without burning the underlying rubber insulating covering, thus giving the leads a neat and tidy appearance. Each length of screened lead should be lightly soldered to the chassis to make good electrical contact between it and earth. It was not found necessary to screen any resistors or capacitors, but the lead from the microphone jack to the grid connected on the base of the 6SJ7 should be screened even though it is only very short. The microphone jack itself does not need screening.

The various capacitors which go to earth are all wired in, directly between the valve base connection, or resistor, and the chassis, the connection to the latter being made at the most convenient spot.

Coming now to the question of which tappings to connect up on the modulation transformer, we must first consider the load presented by the R.F. stage and the optimum load of the modulation valves. In the valve characteristics table of the modulator valves, there is shown the Effective Load Resistance. This for instance, for a pair of HY25's operating at 650 volts, is 7200 ohms. With each modulation transformer there is supplied a table showing the various primary and secondary wiring resistance presented by connecting different tappings together. In the case of the UM2 transformer, a connection must be made between tappings 3 and 4 and the anodes of the valves must be connected to tappings 1 and 4 to get an effective load resistance near 7200 ohms. Similarly, with the secondary winding. The load presented by the RF stage is arrived at by dividing the anode voltage by the anode current of the stage when loaded. The figure given by this calculation is the resistance required in the secondary of the modulation transformer and the tappings must be connected up accordingly.

Power Supplies

Filaments: 6.3 V at 2 Amp. for the 6SJ7, 6C5 and two 6F6's. 7.5 V at 4.5 A. for the HY25's.

H.T.: Two H.T. supplies are required, one for the pre-amplifier and speech amplifier stages and the other for the modulators. The first should give about 150 mA. at 250-300 V; the second 150 mA. at 500-750 V. Both supplies should be as well smoothed as possible.

Bias: Bias throughout the speech amplifier is automatic, but battery bias is required on the modulator valves unless they are of the zero bias type, when the bias connection is taken directly to earth. The HY25's require no bias if operated at 500 or less volts and TZ20's need no bias. The amount of bias needed by the other types suggested is shown in the characteristic tables and should be provided from a receiver-type H.T. battery as is usual practice for this type of bias in RF stages.

Operation

The completed modulator unit should be thoroughly tested on an artificial aerial before any attempt is made to put it on the air. An ordinary 100 watt electric light bulb, connected across the modulation transformer secondary to act as a load, is quite satisfactory. Connect up the filament supplies and check voltages before inserting the valves. Plug in microphone, set volume control at about mid-way, switch on HT and whistle softly into the microphone. If all is well, the bulb will flash on and off in accordance with the whistling and the modulator anode current meter should kick up and down. If the amplifier is perfectly stable, there should be no movement of the meter when there is no sound going into the microphone. Should audio feedback occur, the meter will indicate current flowing in the modulator valves and the bulb will glow. No such trouble should be experienced providing that the screening has been thoroughly done and the resistors and capacitors are all of the correct values. The amplifier described herewith worked perfectly first time, by the way.

Having checked the unit, we can now connect it up to the transmitter. The HT supply to the RF stage is connected up so that the secondary of the modulation transformer is in series with it. Having done this, switch on the transmitter and ascertain that it is functioning properly. Then switch on the modulator unit and see that everything remains stable. With no speech the RF stage current meter should remain steady and there should be no movement of the modulator anode current meter. If RF feedback occurs, this is an indication of a fault somewhere, but if screening is adequate and the HT leads from the modulator to the RF stage are kept short and well away from the microphone, no trouble should be experienced.

Assuming that everything is now well and stable, speaking into the microphone should produce a slight upward rise in the aerial current meter, though in actual practice there is usually a slight kick. Should the kick be downwards, all is not well; the phenomena being referred to as "downward modulation." There are numerous causes for this, the most frequent being insufficient grid drive to the RF stages, improper matching between modulator and the RF stages and bad aerial matching. A check on these points will usually indicate what steps must be taken to put things right.

It may be well to end with a request that those who do build up 'phone gear, should exercise rather more consideration for other users of the bands than is being shown by many amateurs today. So often one hears phone stations testing on the band and emitting simply dreadful noises. If a few tests are carried out first, as indicated above, one can soon tell whether the modulator is fit to put on the air. So let us try and refrain from the endless whistling, feedback and other unidentifiable noises we so frequently hear from stations getting phone gear working for the first time. Similarly, the station which is

(Continued on p.101)

HT-less Car Radio

For headphone reception, using a 12 volt accumalator for both L.T. and H.T.

By ROBERT DALY

USING indirectly heated valves it is possible to utilise the same power source for both L.T. and H.T., as a study of a typical AC/DC circuit will reveal.

With careful design, an H.T. supply of 12 volts can produce very satisfactory headphone reception results, and the outcome of experimenting along these lines suggested to the writer the possibilities of an "H.T.-less" car radio, for use when the car is stationary.

The ordinary car radio takes a pretty hefty drain from the accumulator, and it is not a practical proposition to use one for long periods unless the engine is running, but the small receiver described in this article consumes less than half an amp. and could be run off the car battery for several hours on end without any worry.

A 12 volt Anode Supply

The 2 valve circuit of Fig. 1 was first tried, using two 6J7's with heaters series connected for 12 volt battery operation, and this gave good headphone reception in the writer's first-floor workshop (approximately 12 miles from Brookman's Park) using a 6 foot aerial. Selectivity, with such a short aerial, was more than sufficient to separate the Light and Home stations, using the minimum amount of reaction. By pushing the reaction it was easily possible to overload the valves.

However, results were inferior when the receiver was operated inside the car, it being necessary to use a large measure of reaction.

The addition of a further A.F. valve, as in Fig. 2 made just the difference in signal strength. It will be noted that three 12 volt valves are used, but of course it will be obvious that any suitable combination of valves can be used, such as two 6.3 volt valves in series and one 12.6 volt in parallel.

Various types of valves were tried, 12J5, 12J7, 12SK7, 12A6, EF50, all triode connected, and there appeared little to choose between them as far as results were concerned. Evidently at such a low anode voltage the difference in mu is too slight to be of any practical value.

The Finished Receiver

For the ultimate receiver, a 12J7 was chosen for the detector, as the top grid can facilitate the grid connection from the tuning capacitor, and the two A.F. amplifiers used 12SK7's. Both of the A.F. transformers were 6:1 step-up parallel-feed type, the current passing through the primary being so minute that it can be safely

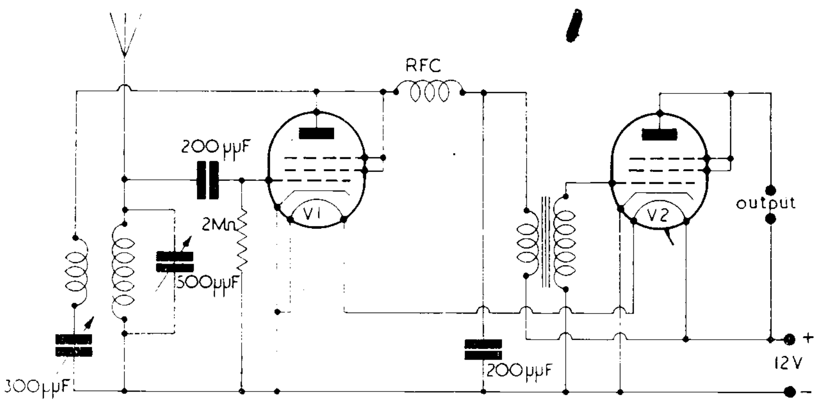
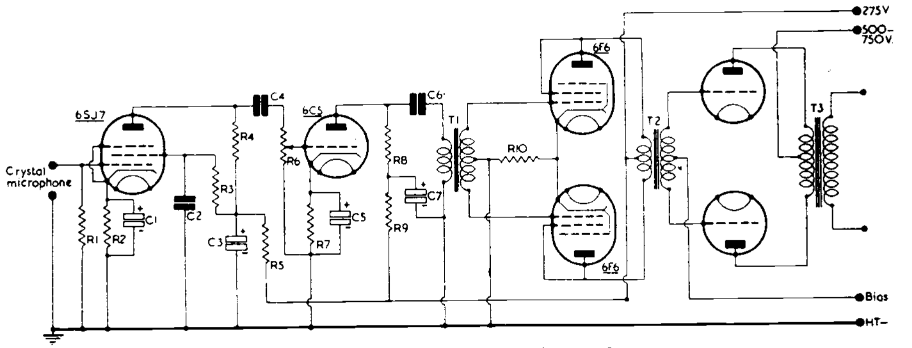


Fig. 1



R1	5 MΩ ½ watt	C1	10 μF electrolytic 50 V peak	R6	1 MΩ
R2	2000Ω ½ watt	C2	0.1 μF 250 V wkg.	R7	1500Ω 2 watt
R3	1 MΩ ½ watt	C3	8 μF 500 V wkg. electrolytic	R8	50000Ω 1 watt
R4	250000Ω ½ watt	C4	0.02 μF 500 V wkg.	R9	10000Ω 1 watt
R5	50000Ω ½ watt	C5	10 μF electrolytic 500 V wkg.	R10	500Ω 1 watt
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It may be well to end with a request that those who do build up 'phone gear, should exercise rather more consideration for other users of the bands than is being shown by many amateurs today. So often one hears phone stations testing on the band and emitting simply dreadful noises. If a few tests are carried out first, as indicated above, one can soon tell whether the modulator is fit to put on the air. So let us try and refrain from the endless whistling, feedback and other unidentifiable noises we so frequently hear from stations getting phone gear working for the first time. Similarly, the station which is

(Continued on p.101)

HT-less Car Radio

For headphone reception, using a 12 volt accumalator for both L.T. and H.T.

By ROBERT DALY

USING indirectly heated valves it is possible to utilise the same power source for both L.T. and H.T., as a study of a typical AC/DC circuit will reveal.

With careful design, an H.T. supply of 12 volts can produce very satisfactory headphone reception results, and the outcome of experimenting along these lines suggested to the writer the possibilities of an "H.T.-less" car radio, for use when the car is stationary.

The ordinary car radio takes a pretty hefty drain from the accumulator, and it is not a practical proposition to use one for long periods unless the engine is running, but the small receiver described in this article consumes less than half an amp. and could be run off the car battery for several hours on end without any worry.

A 12 volt Anode Supply

The 2 valve circuit of Fig. 1 was first tried, using two 6J7's with heaters series connected for 12 volt battery operation, and this gave good headphone reception in the writer's first-floor workshop (approximately 12 miles from Brookman's Park) using a 6 foot aerial. Selectivity, with such a short aerial, was more than sufficient to separate the Light and Home stations, using the minimum amount of reaction. By pushing the reaction it was easily possible to overload the valves.

However, results were inferior when the receiver was operated inside the car, it being necessary to use a large measure of reaction.

The addition of a further A.F. valve, as in Fig. 2 made just the difference in signal strength. It will be noted that three 12 volt valves are used, but of course it will be obvious that any suitable combination of valves can be used, such as two 6.3 volt valves in series and one 12.6 volt in parallel.

Various types of valves were tried, 12J5, 12J7, 12SK7, 12A6, EF50, all triode connected, and there appeared little to choose between them as far as results were concerned. Evidently at such a low anode voltage the difference in mu is too slight to be of any practical value.

The Finished Receiver

For the ultimate receiver, a 12J7 was chosen for the detector, as the top grid can facilitate the grid connection from the tuning capacitor, and the two A.F. amplifiers used 12SK7's. Both of the A.F. transformers were 6:1 step-up parallel-feed type, the current passing through the primary being so minute that it can be safely

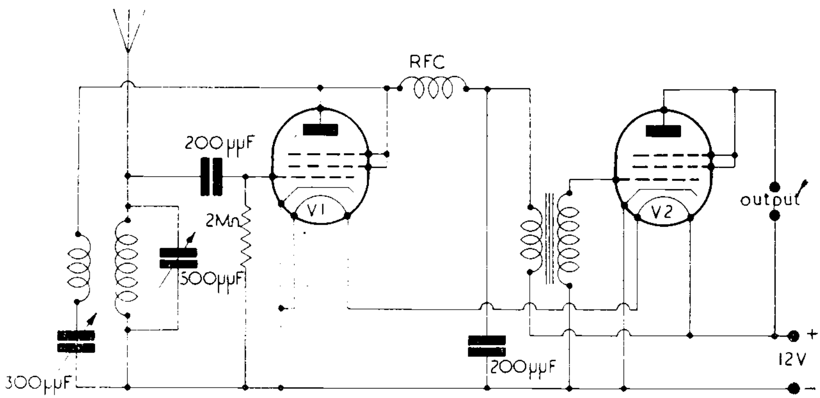

Fig. 1

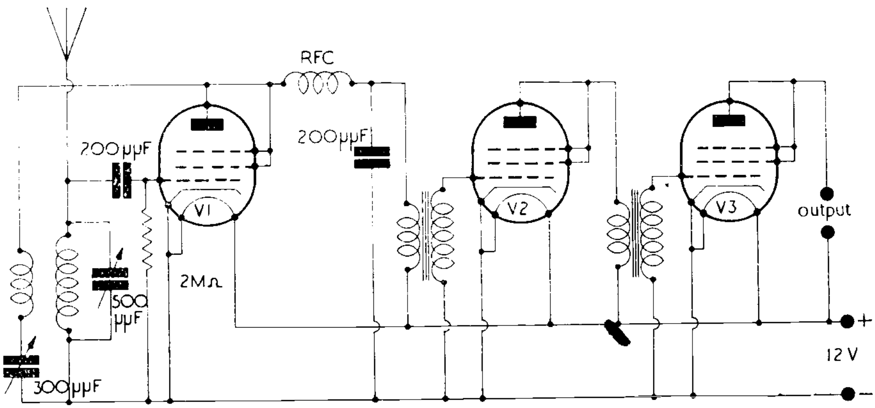

Fig. 2

handled by the primary winding. In fact, the total H.T. consumption measured for the three valves was 1.8 mA!

Layout

As the circuit is perfectly standard it is not proposed to give a layout diagram, as this can follow normal practice. The entire receiver can be made quite small; the only precaution to be observed is to keep "resistance" out of the circuit. A higher voltage receiver could use a resistor of say 10,000 ohms or so in place of the R.F. Choke. Such a value in a receiver of this nature would probably cut down the anode voltage to such an extent that the detector would fail to oscillate.

The Tuning Coil

A Wearite PHF2 coil was used for tuning. The PA2 is not suitable as the primary (which is in this case used for reaction) has too many turns and it would be difficult to get the detector **out** of oscillation. Fig. 3 shows the correct connections for primary in relation to secondary to secure regeneration. The writer had available a powdered iron tuning slug taken from an old I.F. transformer which he slid inside the tuning coil. This raised the Q of the coil and gave better results. It also increased the inductance slightly, but the two locals were still well within the range of the 500 µµF tuning capacitor.

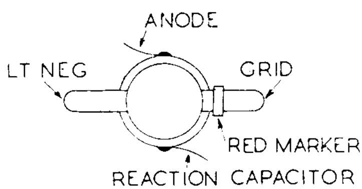

Fig. 3

The constructor may wish to experiment with different types of coils, as of course the entire sensitivity of the set is dependent on the efficiency of the detector tuning arrangements.

The aerial is quite a problem. The usual type of roof aerial, "buggy whip," and back bumper aerials all gave inferior results to a length of flex **laying on the ground.**

To the car owner possessing a 6 volt accumulator—well, 6 volts is just a little **too** low! But he can easily experiment along these lines with a receiver by using a small deaf-aid H.T. battery, or a handful of penlight cells series connected.

(MODULATOR—Cont. from p.99)

deliberately overmodulating is nothing but a disgrace to its operator and a nuisance to others—and moreover is likely to produce interference in neighbouring broadcast receivers, which a well designed and operated 'phone station will never do.

OUR NEXT ISSUE

The December number of this journal will contain a "mixed bag." Besides the regular series on The Straight Receiver, Making a Start and the increasingly popular Query Corner, there will be constructional articles on an AC 3-Valver, Resistance and Capacitance Boxes, A Voice-Controlled Transmitter, and modifications to the amplifier which appeared in our October issue. "Centre Tap" heads the list of general items with another contribution on Radio Miscellany in his own inimitable way.

Making a Start

No. 3 of a series of articles describing the progress of a newcomer to constructional work

By G3AKA

CAME the day when we said to George, "Tomorrow you start wiring up." On the morrow, our hope-of-radio-constructors called in ready for action. We noticed a bulky parcel under his arm and were much intrigued as to what its contents were. The mystery was short lived, however, as after much careful unwrapping had taken place, a glorious 140-watt soldering iron—a veritable giant—appeared! It was pointed out, as tactfully as possible, that for radio work an iron of about 60 watt rating is about the most suitable. A large iron is useful in such cases as when a connection has to be made direct to a chassis, but its very bulk and unwieldiness makes it unsuitable for ordinary wiring-up. George was showing his customary impatience to "get cracking," and we had to point out once again that forbearance must be exercised in all stages of building up radio gear. However, once the iron was hot enough it was handed to George with the instructions to make a sample solder joint so that we could see just what he was capable of.

We might have guessed! A dry joint, a perfect specimen, was the result of this test. It was evident, then, that before serious work could commence on wiring up the 0-v-2 some instruction on the art of soldering was badly needed. Actually it is simplicity itself once the principles are understood, and it is surprising the number of constructors who do not know these elementary points. In common with many others, George thought the idea of the "bit" was just to melt the solder. The real purpose of the iron is to convey heat to the required point, for the work to be joined must be at the same temperature as the molten solder. Working under the delusion that iron was just to melt the solder, George removed the iron before the temperature of the joining wires were of the correct temperature and thus produced a "dry joint." We tried again, but with no better luck. Our beginner had applied **too** much heat, thus "burning" the solder, and another bad joint came into being. After a little practice it is easy to judge the correct amount of heat required. George did it, and so we feel that anyone old enough to hold a soldering iron will be able to do likewise!

Before he was through, our would-be Marconi had a lot more to learn before we could trust him to start work on the receiver. In order to ensure a satisfactory joint, the wires or terminals concerned must be thoroughly clean and free from dirt or grease. A coating of flux is given to the joining wires and the soldering iron is brought into contact with the metal. Then, and only then, the solder is applied and left in contact until it runs freely. A joint made in this fashion will be electrically sound. When using resin cored solder no flux is necessary but it should be noted that the metal to be soldered must be scrupulously clean. After the soldering operation, the surplus flux or resin should be removed with a rag. George queried this latter operation as being a little "fussy." Actually, it is not merely a question of "cleaning up," though this is sufficient to justify it, but is a precaution against corrosion or leakage.

The importance of not carrying the solder to the joint is greater when resin-cored solder is used, because the resin will be burned up on the iron before it has accomplished the purpose for which it is intended. Lastly, we discoursed on "tinning." The soldering iron,in order to pass on heat to the joint efficiently, must not become oxidised, and a coating of solder on the bit will achieve this. Before any soldering operations commence, the iron should be cleaned with an old file, or a piece of emery paper, fluxed and then coated with a small amount of solder. When the solder becomes spoilt with burnt resin or is over-

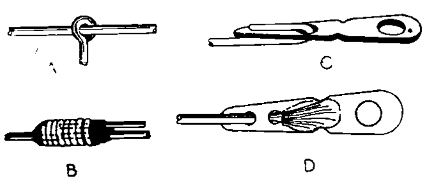

Fig. 1: Various methods of achieving a mechanical joint. (a) The butt joint. Close loop tightly with pliers. (b) A method for joining two or more wires. The main leads are bound with fine wire. (c) When fixing a wire to a soldering tag. Bend the wire over to fo m a tight joint. (d) Method recommended when soldering stranded wire to soldering tag. Lay strands flat to avoid unnecesary 'whiskers'

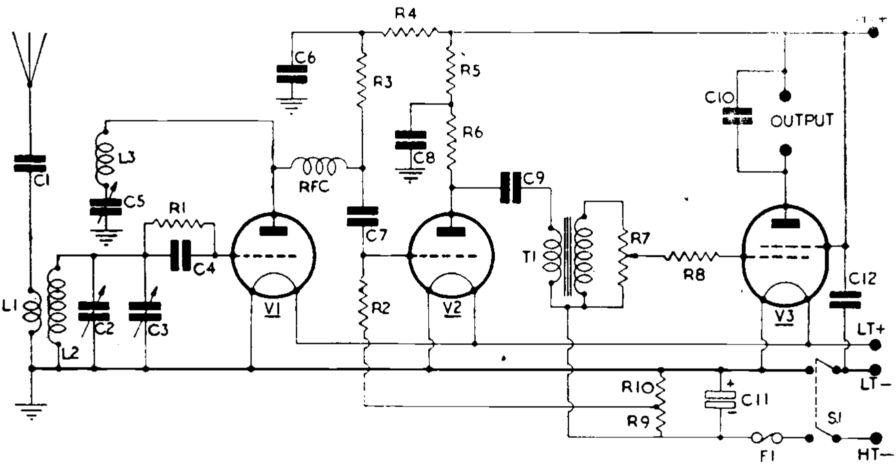

Fig. 2: The circuit of the o-v-2

heated, it will need re-tinning. By wiping the bit with a piece of rag after each joint has been made, the time between tinnings will be greatly increased.

Armed with the knowledge, George was all set to start wielding the iron. However there was still one point that needed clearing up— a point we had overlooked, or rather had taken for granted that it was common knowledge, even to beginners. This was the importance of making a good **mechanical** joint. The purpose of soldering two wires together is to obtain electrical continuity. The fact that a joint is produced is incidental in the electrical sense, and so it should be ensured that every joint, before it is soldered, must be sound mechanically. This is of prime importance and we show various methods of achieving this in Fig. 1.

The first step to be made in wiring up was the coil holder. As this was mounted above the chassis, with the leads coming through by means of several small holes, it was logical to get all the leads on to the tags before bolting the coil-holder to the stand off insulators. It had been decided previously to work to a colour scheme in the wiring. Though this means a little extra work and care it is well worth the trouble since "trouble shooting" at any time will be much easier when one can see exactly what leads are part of what particular circuit. In our case, we fixed on the following scheme: Earthy leads—black; Grid leaks—green; HT leads—red. This idea, though not original by any means, is rarely encountered and we feel that it could be used much more extensively with good advantage.

Starting with L1 (see circuit diagram: Fig. 2), that is pins 3 and 4, one green lead was soldered to pin 4 of sufficient length to pass through the chassis to the aerial capacitor C1, which in turn connects to the aerial terminal. The pin 3, which is the earthy end of L1 was connected directly to pin 2—the earthy end of L2, the grid winding. About an inch of wire was left over to allow fixing to be made to the earth tag already fitted to the chassis. The other end of L2 (pin 1) had two leads soldered to it. One of these was to pass through the chassis and the other to the bandspread capacitor C3. The remaining winding, L3, for the reaction circuit, had a red lead connected to both pins (5 and 6), one of which goes to the detector valve anode and the other to the reaction capacitor C5, both of which are beneath the chassis. When these leads had been soldered, the coil holder was bolted to the stand-offs, and the various leads pulled through the appropriate holes in the chassis. With the earth lead from pins 2 and 3 soldered to the tag on the top of the chassis, the coil assembly was completely wired up.

Next step was wiring up the filaments. This was carried out in stranded cotton covered wire, in our case that of the "push back" type. Since no RF current is carried in the battery leads this type of wire is quite satisfactory, and has the advantage of being more flexible than the wire used to connect up other parts of the circuit. Leads were taken from one filament pin of each of the three valves, in series, and a length of wire left over to pass through the rubber grommet. The second filament pin of each valve was dealt with likewise, but the lead from V3 was taken to one side of the on/off switch. From the other side of the switch another lead was taken and passed through the grommet. This was the LT— lead, the first wiring being for LT+. The negative wiring has to be earthed at some convenient point and we chose the actual earth terminal on the back of the chassis—(from the negative filament terminal of V1). George was getting worried about the stray leads protruding through the chassis from the coil holder and so, to obtain peace of mind, we next concentrated on the circuit around V1, the detector valve. The reaction capacitor, C5, was removed from its bracket in order to facilitate wiring up. The first lead we encountered was that from pin 1. This had to be connected to the grid of V1 via the grid leak and capacitor (C4/R1). To avoid any chance of vibration, it was decided to use a mounting bracket. This was fixed to the same bolt as was the earth tag, which meant undoing the bolt first to fit it. The green lead from pin 1 and the two ends of the grid leak and capacitor were fixed to one of the tags on the bracket and the other ends of R1/C4 were soldered direct to the grid pin of V1. The other green lead (from pin 4) was connected to C1 and thence to the aerial terminal. The red lead from pin 5 was then taken to the anode pin of the valve and the reaction capacitor re-fitted in its bracket. The final lead (from pin 6) was fixed to the stator of the reaction variable and then attention was turned on the output side of V1. Some time was spent planning the component disposition of V2 and the coupling from V1. A three-tag mounting bracket was obviously needed and this was fixed between the LF transformer and the earth terminal. The RFC was then fitted—one end to the anode of V1 and the other to one of the tags on the bracket. Also to the latter connection, the coupling capacitor C7 and resistor R3 were connected. The other end of the capacitor was taken to the grid of V2, to which one end of R2 was also fixed.

It was at this point where George began to worry about what had been wired and what had not. So we introduced him to a simple but effective way of keeping check of things. A copy of the circuit was laid in front of him and a pencil supplied. From this point, until the set was finished, each part was crossed through with the pencil as it was connected up. This is a tip that all beginners should remember.

The anode circuit of V2 was then dealt with. Another mounting tag was fixed next to the LF transformer, and on one terminal we fixed one end each of R5, R6 and C8. The other end of R6 was taken to the V2 anode, the other component ends being left for the time being. The other end of R5 was taken to the other outside tag of the mounting strip.

A third mounting bracket was fixed by the side of the reaction capacitor. To one tag of this we soldered the loose end of R3 and to the same point R4 and C6 were fixed. The other end of R4 was then taken to the tag on which the "HT" side of R5 was fitted. This point, the junction of R4 and R5, constituted the HT positive line. When using these three tag, or for that matter any other, mounting brackets, it should be borne in mind that the centre tags are, if used on a metal chassis, earthed. Non-observance of this point may result in the HT being shorted to earth! The convenience of the centre tag being earthed was made use of by connecting the loose ends of C6 and C8 to one of them.

At this point, we had now completed the wiring up to the coupling of V2 to V3. The coupling was effected by wiring in the capacitor C9—one side of which went to the V2 anode and the other to one of the LF transformer's primary windings. Now, as we were using an ordinary LF transformer and not a special "parafeed" type and the circuit was of the parallel fed variety, a few words on the correct windings to use will not be amiss. Some readers will do the same as George did (to use a transformer from the junk box) and they may find the markings vary on different types. On some the primary terminals may be marked "IP" and "OP," which mean Input Primary and Output Primary respectively. Others may be marked HT+ and P (or A), the P or A meaning Plate or Anode. The secondaries will be marked either IS and OS or G and GB— (Grid and Grid Bias). When using a transformer marked in this fashion in a parallel fed circuit, the connections are as follows:

OP, or P or A: Connect to Capacitor C9.
OS, or G: Connect to top end off R7.
IP and IS, or HT and GB: Connect together and take to bias line.

This will be quite clear on reference to the circuit diagram. Having joined together the IP and IS terminals of the transformer a further lead from this point was taken to one side of the potentiometer R7. The next

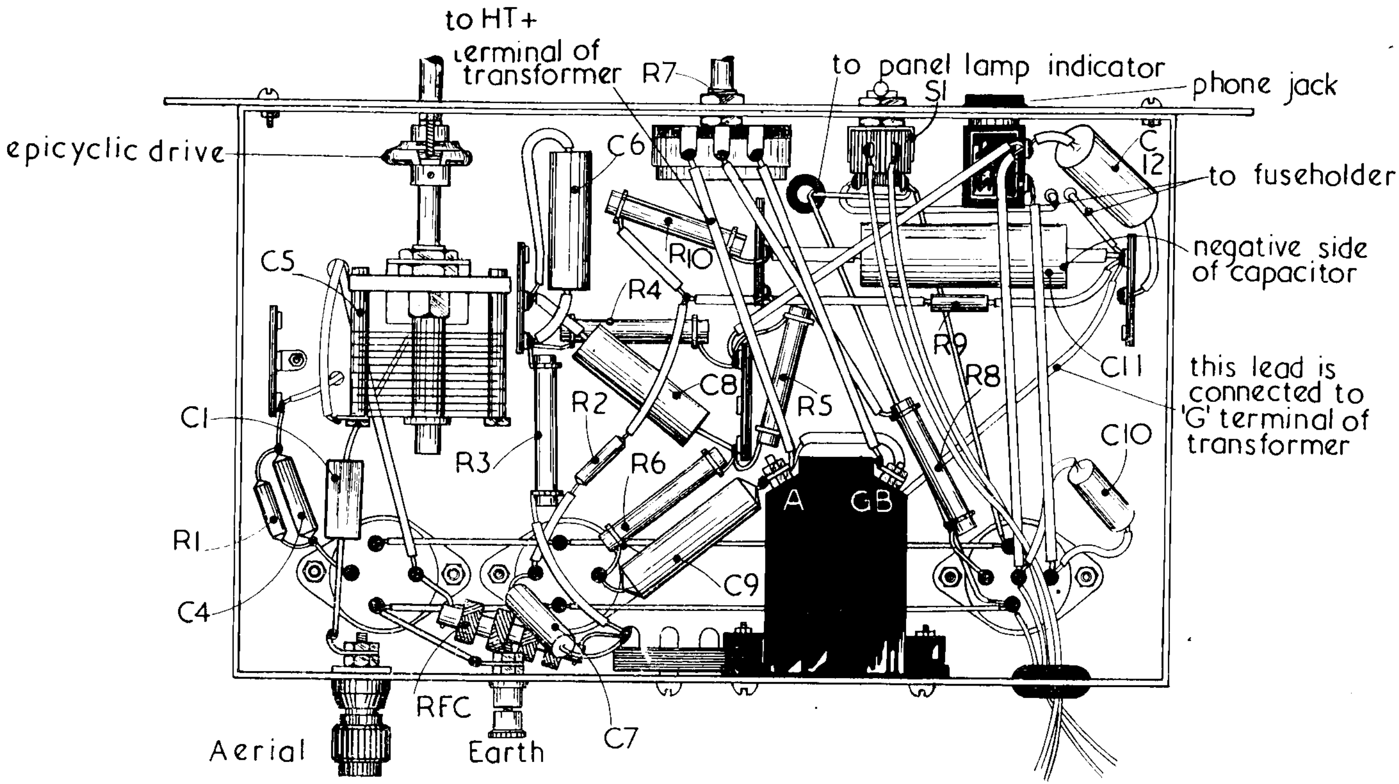

Fig. 3: Underchassis wiring

step was to wire up the automatic bias section. For this, two more mounting brackets were needed, and these were fitted near the potentiometer and the phone jack respectively. The positive end of C11 was connected to the centre tag (earthed) of the bracket near the potentiometer and the other end to one of the end tags of the other bracket. It is important to note the correct polarity of C11, for it is wired in circuit with the positive side to earth and not the negative side as is usually the case. From the negative contact of C11, three other leads were wired in—one end of bias resistor R9, one lead to pass through the chassis to the fuse holder and the third lead to the "earthy" ends of the LF transformer. The loose end of R9 was then soldered to the free end of R2 (which was connected to the grid of V2) and also at this point one end of R10 was fixed. The other end of R10 was then soldered to the earthy tag at the same point as the positive end of C11 and the bias circuit was then completed.

Going back to the grid circuit of V3, the remaining terminal of the transformer was connected to the outside tag of the potentiometer R7. The centre tag of R7 and the grid of V3 were then joined together through the grid stopper R8. All that remained to do to finish the wiring at this juncture was the output circuit of V3.

A lead was taken from the junction of R5/R4 to one side of the phone jack, the other side of the jack being connected direct to the anode pin of the output valve. From the screen grid pin of V3 a lead was taken to the "HT" side of the phone jack. From this same point, the capacitor C12 was soldered—its other end being taken to the centre (earth) tag of the mounting bracket directly beneath it. Capacitor C10 was fixed between the anode of V3 and the HT side of the phone jack.

Reverting to the top-of-chassis wiring, the green lead from pin 1 of the coil was

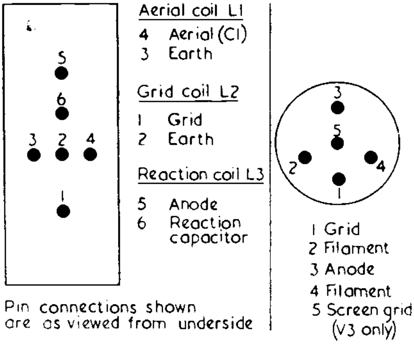

Fig. 4: Coil and valveholder connections

connected to one of the stator (fixed vanes) of C3. A further lead, from the other stator tag of C3 to the stator tag of C2, was then fixed. Two leads were needed for the panel indicator, one to the LT positive line and one to earth.

The remaining few wires consisted of the lead from the fuseholder to the switch and the battery leads not already wired in. With the spade terminals and wander plugs fixed to the battery leads the receiver was all ready for testing.

Although we, not to mention George, have had our fair share of "fan mail" regarding this series of articles, we would like to point out that beginners who are following this series are free to write to us on any points they may not be too sure of.

To finish up this month's instalment, here are a few points we feel worthy of mentioning. These have been prompted by carefully watching our protege at work!

Firstly, if the same type of coils are used as in our model—that is with polystyrene bases—extreme care must be taken when soldering. Polystyrene melts at fairly low temperatures and heat of the soldering iron on the pins is sufficient to melt it if of prolonged duration. Therefore, do not keep the iron on the pins for longer than is necessary for a good joint. Another point is that since the pins are spirally split, solder may easily run through to the inside of the pins, thus when one comes to plug the coil into the holder it is found that it will not fit properly. The simple solution here is to insert match stalks into the base pins; these fit nicely and will prevent any solder running in.

Rigidity is another factor. All wiring must be absolutely rigid, especially leads in grid circuits. To take a typical instance when a lead has to be taken from one point to another. First of all solder one end. Then cut the wire to the correct length and stretch tightly (holding with pliers if necessary). Only when the lead is nicely rigid should the second joint be made. As will have been noticed, extensive use has been made of "anchors" in the form of mounting tag brackets. This is to ensure that every component part is rigid. No component should be allowed to "float" or dangle about unsupported. Apart from the satisfaction of having a sturdily constructed receiver, the benefit of rigidity will become apparent when using the set. Above all, avoid the pretty artistically-bent leads so prevalent in years gone by (and in some current circles, too!). Make sure your leads are as short and direct as possible.

NEXT MONTH: Testing and Operation

Query Corner

A "*Radio Constructor*" service for readers

A Mains Operated 1-V-1 Receiver

"I wish to build a simple straight receiver of the 0-v-2 variety capable of providing good loud speaker strength. The type of receiver described in your September issue would appear to fulfil my requirements, but as I have a power pack, I would like to take advantage of it and construct a mains version of this receiver. Would you please let me know what modifications are necessary."

J. W. E. Harrison, Petts Wood.

A mains version of the 0-V-2 Receiver would not prove entirely satisfactory as, due to the high gain obtainable with mains operated valves, the output pentode would overload at quite low settings of the volume control. Thus the three valves would not be used to their maximum advantage. Because of this we suggest you use one of two alternatives.

(1) A mains operated 0-V-1 Receiver. This would provide a performance equal to that of a battery operated 0-V-2.

(2) A mains operated 1-V-1 (made by adding an R.F. Stage to the 0-V-1) providing better selectivity and smoother reaction.

The circuit shown in Figure 1 covers both these alternatives. The receiver may be made up according to the diagram as a 1-V-1, or by omitting the RF stage, and substituting a 0.5 Megohm volume control for R2 a two valve receiver may be built. The bias of V1 is varied by means of R1 to provide a smooth control of volume. All circuit values have been carefully worked out to give optimum working conditions for the recommended valves. The type of reaction chosen has been found exceptionally stable in action. Resistance/capacitance coupling is used between the detector and output stage, a transformer being unnecessary owing to the ample gain available. A word or two about the lay-out; The valves should preferably be mounted in a straight line in the order shown in the diagram. Grid leads should be as short as possible to prevent instability, the lead to the grid of V-3 being screened. If a three valve receiver is constructed it will be found most convenient to use a two-gang capacitor for tuning purposes. The tuning coils should be identical and may be wound to any standard specification but, generally speaking, ready wound coils will be found to cost very little more. Should the reaction prove to be too fierce, C1 should be replaced by one having a slightly lower value. The HT voltage should lie somewhere in the region of 250 volts, and one side or the centre tap of the heater supply should be earthed. The trimming of the

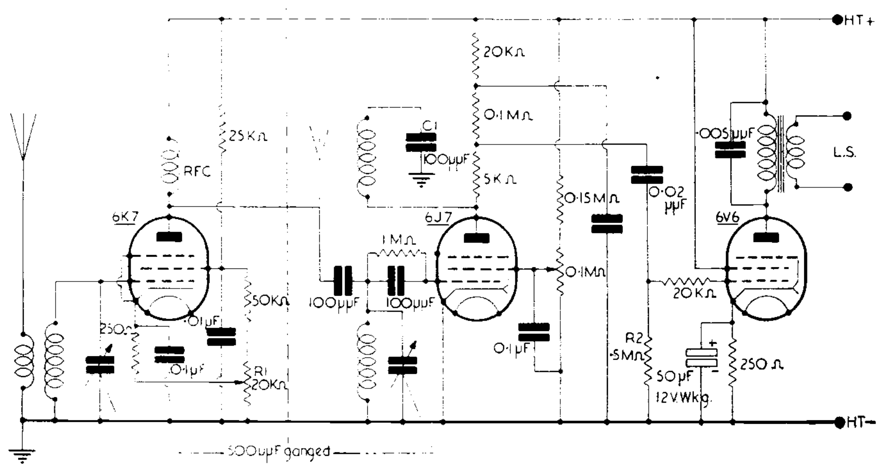

Fig. 1: Mains Operated 1-V-1

two tuned circuits will present no difficulty as, if the coils are identical, the trimmers normally fitted to a standard gang capacitor will be found to be sufficient to bring both the circuits into alignment.

Transmitter Interference

"I am anxious to reduce broadcast interference from my transmitter to a minimum and have fitted a mains supressor with good results. The key is connected in the cathode circuit together with a key click filter of the type shown, but only the capacitance resistance side appears to function. What value of inductance should the choke have to prove effective?"

E. B. Hardy, Burton on Trent.

In a key click filter of this type the choke prevents the sudden commencement of the signal when the key is closed. Conversely, the capacitor prevents the sudden interruption of the signal when the key is opened, whilst the resistor is for the purpose of preventing sparking across the key contacts.

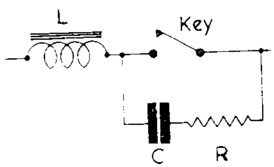

Fig. 2: Key click filter

As in this particular problem it is only the capacitor section of the filter which appears to function we assume that there is a click or chirp when the key is closed. This effect may be traced to one or more of the following causes:

(1) Too low a value of choke; approximately 15-20 H should prove ample in this transmitter.

(2) Poor H.T. regulation. If under key-up conditions the H.T. voltage is considerably higher than when the key is closed, the increase in voltage will produce a peak when the key is first closed. This trouble may be overcome by using a bleeder resistor across the H.T. supply drawing a current of about a quarter of the full load value. Also a 20 H choke in the H.T. Lead to the stage drawing the maximum current will assist in reducing this effect.

Should these "cures" prove ineffective, the trouble may be due to instability in the oscillator stage, a tritet or T.A.T.G. circuit is the most satisfactory for use in simple transmitters. An R.F. choke should be connected in series with the grid leak to prevent undue loading of the crystal. It is always advisable to use a keying relay in cases where interference proves troublesome, as a more positive make and break action is thereby obtained; also, the possibility of radiation from long leads carrying H.T. currents is eliminated.

Phase Inverter Heater Supply

"I have a home-constructed push pull amplifier using a phase inverter of the split load type which recently developed mains hum. This was traced to the phase inverter stage and the valve was replaced with good results. However, after a short period of use the trouble has re-appeared, can you suggest a reason for the short life of this particular valve?"

W. B. Saunders, Coventry.

It would appear that the mains hum experienced with this amplifier is due to the heater voltage of the phase inverter valve appearing across the lower half of the load resistor because of a breadown in the heater/cathode insulation of the valve. With amplifiers using an H.T. voltage in the region of 400 V. it is frequently found that the heater to cathode potential of a split load phase inverter exceeds that recommended by the valve manufacturer. The solution to the problem is either to employ a different type of phase inverter or to use a separate heater winding on the mains transformer to supply this stage. The separate winding may be connected to a positive voltage approximately equal to

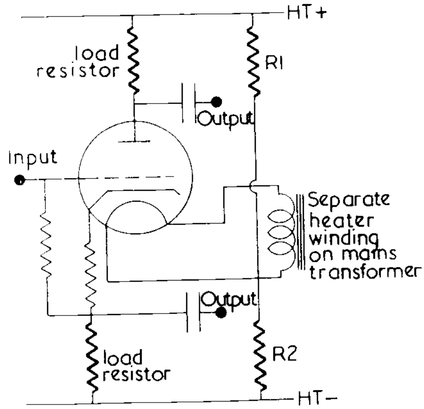

Fig 3: Phase Inverter

that of the cathode of the phase inverter valve, thereby reducing the heater to cathode potential and safeguarding the insulation. Reference to the circuit diagram (Fig. 3) should make the arrangement clear; the values of R1 and R2 are chosen so that the heater winding is raised to a positive potential equal to that of the cathode. The current flowing through R1 and R2 should be of the order of 1 or 2 mA.

"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.

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!**

- **Constructive criticisms and suggestions on the magazine. Let us know what you like and what you don't like.**

- **Details and, if possible, photographs, of your workshop or "den."**

Trade Notes

Denco: We have received a printed copy of the Denco Technical Publication No. 1. The price remains the same as previously, i.e. 3/-. Copies may be obtained from Denco (Clacton) Ltd., 355 Old Road Clacton-on-Sea, Essex.

The Electric Lamp House Ltd.: This firm, of Wellington, New Zealand, has just produced the 1947-8 edition of their famous "Lamphouse Annual." Generally speaking this annual is a catalogue of the stocks of the firm but it is of great interest to constructors by virtue of a large number of constructional articles contained in the books 224 pages. Amongst the articles are various types of receivers, including portables, amplifiers, test sets and so on. There is also a comprehensive section on interference suppression, a frequency/wavelength conversion table, data on flourescent lighting and many interesting "hints and kinks." For the short wave listener, there are 15 pages of short wave station lists, and a complete list of New Zealand amateur transmitters and their QRA's. Copies of the book may be obtained by mailing Postal Order for 1/3 to Arthur T. Cushen, 212 Earn Street, Invercargill, New Zealand.

Prefix Chart: G6MN, of QSL fame, has produced a list of International Amateur Prefixes on stiff card for the purpose of hanging on "shack" walls for easy reference. Priced at only 6d., these cards are a useful addition to the shack "wallpaper." Obtainable from G6MN, 268 Carlton Road, Worksop, Notts.

Amateur Radio Exhibition

An Amateur Radio Exhibition, the first of its kind ever to be held in this country, will be open from Wednesday, November 19th to Saturday, November 22nd (inclusive) at the Royal Hotel, Woburn Place, London, W.C.1. The Exhibition is being organised by the Incorporated Radio Society of Great Britain for the benefit of those interested in amateur radio. There will be 20 exhibitors, including Odeon Radio, Taylor Electrical Instruments, Measuring Instruments (Pullin), Stratton & Co., Denco, Mullard, Southern Radio, R.S.G.B. and Sir Isaac Pitman & Sons Ltd. Catalogues are available at 1/- at the exhibition or 1/3 by post from the Incorporated Radio Society of Great Britain, New Ruskin House, Little Russell Street, London, W.C.2.

FROM THE MAILBAG

*(We have had very many letters connected with the suggestions of Mr G. L. Macpherson published in our last issue. Here are one or two comments, a representative selection—*ED.)

"My ideal would be of 10-500m coverage and using a coil turret in place of plug-in coils. The diagram showing main components and wires to be used as a template and the chassis to leave ample room in case larger components than those specified have to be used."

G. Keith (Leeds, 9).

"I would not tie you to a design with 7 valves but would suggest up to 10 or 12 valves if necessary. If a converter is included perhaps two chassis would be more convenient. This would keep the converter well away from the power pack."

W. J. Norburn (Nottingham).

"I hope the receiver will resemble the average communications receiver, with all the 'trimmings,' i.e. S meter, large calibrated dial and all controls on the front panel. I would prefer a fully bandswitched arrangement rather than plug-in coils."

Stanley Foster (Reading).

"Would like to 'have a go' at making a coil turret with internal switching, or alternatively coil boxes that allow for the simultaneous changing of all necessary coils. If theoretical diagrams were rather small, they could be printed in sections, say RF stage, I.F's, and so on. Prefer some type of mechanical bandspread."

D. Stott (Urmston, Lancs.)

ADVICE

"If I may venture a word of advice, I would suggest that you omit such articles as "Radio Conditions," as interestetd DX-ers will get such information in other journals and I should think that such matter will have a rather limited appeal to the non key-bashing fraternity!"

F. Mumford (Liverpool, 10).

THE TRANSMITTING BEGINNER

"I have just obtained the current issue of the 'Constructor' and would like to say how pleased I am with it. I consider it has a good chance to become really popular provided you stick to the present style and, in particular, DON'T FORGET THE TRANSMITTING BEGINNER! My main grouse with some journals is that they appear to totally ignore the would-be operator and cater solely for the advanced 'hams'."

K. R. Gilbert (Yeovil).

● ● ●

MORE LETTERS NEXT MONTH

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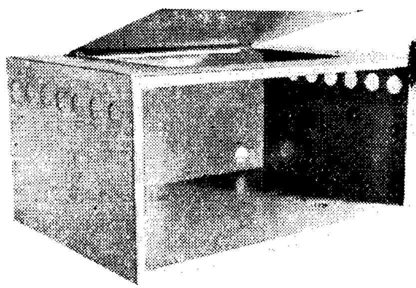

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