Radio Constructor

Vol. 1, No. 11 **Annual Subscription 16/-** **June, 1948**

Editors:
ARTHUR C. GEE, G2UK W. NORMAN STEVENS, G3AKA

Technical Editor:
LIONEL E. HOWES, G3AYA

Advertisement & Business Manager:
C. W. C. OVERLAND, G2ATV

Editorial

RADIO CONTROL OF MODELS

IT has always seemed to us that the radio control of model ships and aircraft has been ignored by most radio constructors in this country. Considering how popular the construction of working models of both ships and aeroplanes is nowadays, it does seem strange that one hears so little of radio control of these models. It is very difficult to meet anyone with first-hand experience of this subject.

There have been several descriptions of radio controlled models published from time to time. Ships, trains and aircraft have all figured in these descriptions, some of which have been rather more theoretical than practical.

The main difficulty in the construction of radio control equipment in this country seems to be that of finding a suitable relay, sufficiently sensitive to operate in the receiver circuits. In America, where most of the successful radio control work has been done, relays specially designed for this class of work are readily available. There does not seem to be anything similar available here; we should be very glad to hear from any of our readers who have had practical experience of overcoming this difficulty. Apart from this, little trouble should be experienced in getting some successful working models going over here. We have the frequencies, light weight batteries and components and we have plenty of keen model aircraft constructors who have all the necessary experience to produce petrol-driven flying models. We should very much like to hear from anyone who has a successful system going or who knows of any successful experiments in this direction.

A.C.G.

NOTICES

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

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

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

Thermionic Valves

By Kenneth R. Goodley

Part 3.—Inter-Electrode Capacity.

Inter-Electrode Capacity.

THE electrodes of valves, together with their leads and supporting wire, form capacitors. Although these capacities are small, they can sometimes be of very great importance. They are known collectively as Inter-Electrode Capacities, the most important being the capacitive effect between the anode and control grid—usually designated by Cga.

Due to the Cga, changes in the anode circuit will react on the control grid, that is, the capacity acts as a direct capacitor coupling between the output and input circuits.

Under certain conditions, this " back-coupling " may cause severe instability. For the more advanced reader, what actually happens is that the potential changes fed back from the anode, if in phase with the original control grid variations, will cause the valve to oscillate fiercely, producing distortion and making the circuits unstable. One method of minimising this feed-back is to use a tetrode (or screen-grid valve).

The greater the value of Cga, the tighter the coupling and, therefore, the greater the amount of feed-back. This is accentuated at radio frequencies when the reactance (the inherent property of a capacitor to reduce the alternating current passing through it by an automatic opposing force produced by the capacitor itself) is low.

In the tetrode, Cga is reduced from the 2-8 $\mu\mu$F of the triode to .001 or .002 $\mu\mu$F. This is done by inserting a second grid—the " screen " of close spiral of mesh construction—between the anode and control grid, which acts as an electrostatic screen and is maintained at a high potential, one-half or two-thirds of the anode voltage, and so its presence does not interfere greatly with the flow of electrons across the valve.

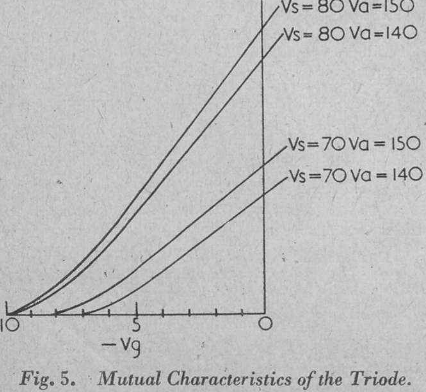


Fig. 5. Mutual Characteristics of the Triode.

The screen is also connected to earth via a large capacitor (about 0.1 μF) which, at RF has a negligible reactance (1.6 Ω at 1 Mc.) so that for high frequency AC it is virtually at earth-potential, though it is at a high DC potential. This means that the space below the screen is electrostatically shielded from the anode so that anode voltage fluctuations cannot affect the control grid to any appreciable extent.

Tetrode Characteristics.

The Mutual Characteristics, obtained by plotting Anode Current (Ia) against Grid Voltage (Vg) are similar in shape to those of the triode, but the curves are closer together, indicating a higher Ra. The relationship is calculated keeping the anode and screen voltages (Va and Vs) constant. Other curves, drawn with different voltages, show that 10 volts change on the screen has a greater effect on the anode current than a similar change in Va. The reason for this is, of course, that the screen is nearer to the filament than the anode and therefore has a correspondingly greater action (see Fig. 5). The grid potential has much the same influence as in the triode and so the Mutual Conductance is of the same order.

Since a large change in Va is required to cause the same alteration in anode current as is produced by a small Vg variation, the " μ " is high.

Anode Characteristics.

As the anode voltage is increased, the Ia rises steeply at first and then, in the region of 15 volts, decreases sharply due to what is known as Secondary Emission.

When the anode has attained this potential, the speed of the electrons passing across the valve is sufficient, on reaching the anode, to actually displace " secondary " electrons from the plate itself. The screen, being at a higher potential, will attract these electrons and so Ia falls and Is (Screen Current) rises. It is possible for this secondary current to exceed the Ia, if the screen potential is sufficiently high.

As the anode voltage increases and approaches that of the screen, the secondary emission is stopped since the screen no longer has a strong attraction for the anode-emitted electrons and they fall back into the anode again. This

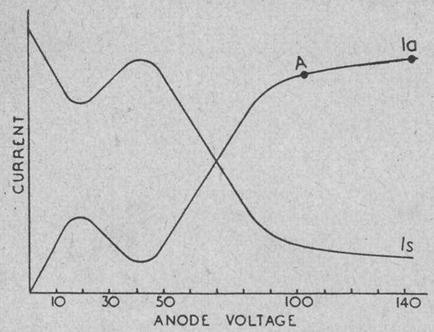


Fig. 6. Anode and Screen Characteristics of a Tetrode.

causes an increase in Ia and decrease in Is, and the anode current curve follows a conventional path thereafter. The useful part of the characteristic is limited to A-Ia (Fig. 6). If the anode voltage swing falls below "A," distortion is introduced.

Over the voltage range, during which the Ia decreases, the ratio $\frac{\Delta Va}{\Delta Ia}$ is *negative*, because as an increase in Va causes a decrease in Ia, the valve for this period has a negative Ra.

Finally, a comparison between the characteristics of a triode and a tetrode gave the following figures :—

Triode—Cossor 210HL Ra=22,000 Ω gm=1.1 mA/Volts μ=24.
Tetrode—Cossor 215SG Ra=300,000 Ω gm=1.1 mA/Volts μ=330.

The high Ra and μ makes the tetrode eminently suitable for use as a Radio Frequency Amplifier. Tetrodes are also occasionally used as Detectors or Mixers (in Superhets).

TRADE NOTES

Eddystone. We have received a sample of one of the new range of transmitting capacitors (Cat. 612) marketed by Stratton & Co., Ltd., under the well-known Eddystone trade-name. The sample under question is a split-stator type, having 50 μμF per section, with a spacing between vanes of 0.08in., and is of particular use in transmitters operating on the 14 and 28 Mcs. bands. The construction is really rigid and the vanes are of heavy gauge aluminium. The insulation is of ceramic (end plates). In the same range is a split-stator capacitor (Cat. 611) with 25 μμF per section. This has the useful idea of two neutralising capacitors, of 1.5-7 μμF, integrally built into the unit. For use in a medium-power VHF transmitter, using low capacity triodes in push-pull, this capacitor is ideal. The other two split-stators in the range are No. 476 (18 μμF per section) and 614 (100 μμF per section). All units in the range are constructed on sturdy lines and are a worthy addition to the range of Eddystone components ; a range which has long been associated with the words " efficiency and quality."

◆

Clydesdale Supply Co., Ltd. Every Clydesdale catalogue seems to get larger and more comprehensive. This is especially so of " List No. 4," which we have just received. Within its covers there are 94 pages, giving details of a wealth of components and surplus gear that will interest anyone actively engaged on radio construction work. It would be futile to try and list the various items—a copy may be obtained by writing direct to Clydesdale Supply Co., Ltd., 2, Bridge Street, Glasgow, C.5.

◆

Henry's Radio. The May Retail List is to hand from Henry's and it contains a fine selection of radio components. Those who are interested in receiving these monthly lists may do so by applying to Henry's Radio, 5, Harrow Road, London, W.2.

◆

Partridge Transformers, Ltd. This firm has now moved to Peckford Place, Brixton Road, London, S.W.9. The new telephone number is Brixton 6506.

Making Short-Wave Coils

How to Wind Transmitting and Receiving Coils for Every Circuit

Part 1

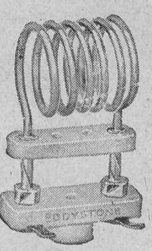
By W. Oliver, G3XT

OF all the components that can be made at home, short-wave coils are the easiest and most worth-while. With a little care and ingenuity, one can produce coils for both transmission and reception which are not only equal to their factory-made counterparts, but may even be better! This is because ready-made coils are generally mass-produced to meet average requirements, whereas the home-made equivalents can be "made-to-measure" for the particular needs of each individual transmitter or receiver. The windings can be "pruned" to the exact inductance needed to give optimum results over a given waveband in any particular circuit.

Not only in performance, but in finish and appearance, home-made coils can compete with ready-made ones if the suggestions in this article are followed. Before describing the methods to be employed, however, it might be as well to outline the ideals that should be aimed at in designing the coils.

An ideal short-wave coil would be one combining perfect electrical characteristics with perfect mechanical rigidity. As, however, these two ideals somewhat conflict in practice, a happy medium must be struck without going to the extremes of (*a*) the ultra-low-loss coil that is too flimsy to handle and too "wobbly" to give frequency stability; and (*b*) the ultra-robust coil with a very solid former that unduly increases losses.

Fig 2a. The Eddystone VHF plug-in coil; an example of a commercially made coil that could be followed by the home constructor.



One needs to minimise solid dielectric material within the field of the winding as much as possible, without any undue sacrifice of rigidity. A completely air-spaced self-supporting winding is the ideal from an electrical point of view. This type is normally found in the best ultra-short-wave coils for the very high frequencies, *e.g.*, 60 Mcs. For such frequencies one needs only a few turns anyway, so very thick wire (say 12 or 14 SWG) or copper tubing can be used, wound in a small-diameter spiral—say one inch diameter—thus combining low resistance, small physical dimensions and a perfectly adequate degree of rigidity. See Fig. 2a.

All that is necessary is to form the spiral (Fig. 1) and mount it on a plug-in base of low-loss material such as polystyrene, or even connect the ends (flattened and drilled) direct to the terminals of the tuning capacitors or other associated components. The ends of the thick wire can be flattened quite easily by hammering lightly on a small "anvil" consisting of a block of iron, or even *very* hard wood or concrete if no iron block is available. Fig. 2 shows the finished result.

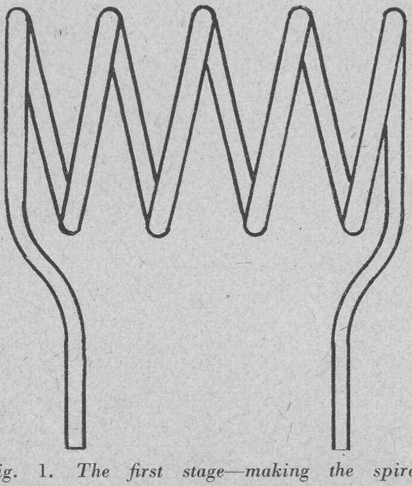


Fig. 1. The first stage—making the spiral.

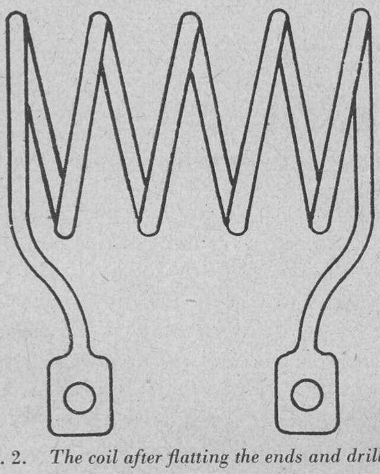


Fig. 2. The coil after flatting the ends and drilling.

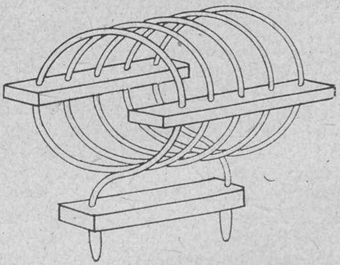


Fig. 3. An example of a home-made coil, self-supporting except for two polystyrene strips.

In UHF coils, therefore, the problem of combining efficiency with rigidity tends to solve itself very nicely! But on lower frequencies one finds more difficulty. To keep the coils within reasonable size limits, to maintain an ideal overall ratio of length to diameter to minimise losses, and at the same time to preserve sufficient rigidity, one must resort to some sort of compromise. Fortunately, the need for ultra-low losses and perfect rigidity both tend to decrease as the frequency decreases, and thus the problem again partly solves itself.

When fairly thick wire is used—gauges between 12 and 18 SWG, the coils can be almost self-supporting, the windings being held in place by being threaded through drilled strips of polystyrene spaced at intervals around the circumference of the coil and fixed with polystyrene solution (Fig. 3). Where thinner wire is used—18 to 26 SWG—the windings can be carried on tubular formers of ceramic, polystyrene or other suitable low-loss material, which may be of a ribbed type to increase the air-spacing effect. (Fig. 4).

You will have noticed that a first-class factory-made coil has neat, uniformly-spaced turns of wire formed into a perfect spiral. A similar result can be achieved by hand if one adopts the following method :—

The wire should first be straightened and *very* slightly stretched, then wound under tension. It is essential to avoid overdoing the stretching, especially when using enamelled wire, or the skin of enamel may crack. The best way to achieve the desired result is to fasten one end of the wire securely to some firm object (say a tree-trunk in the garden, or a stout hook in a brick wall), and the other end to a wooden rod which can be held in the hands and pulled so that the wire straightens and stretches just a little. (Fig. 5).

Very thick wire, such as 12 SWG, is not easy to stretch or straighten by hand, especially if it happens to be rather badly kinked. But if a car is available, the job can be done very easily and quickly. Fasten one end of the wire as before to a firm object (not the wall of a hastily-erected modern house!) and the other to the front of the car chassis. Put the car in reverse, let in the clutch very, very gently, easing the car backwards inch by inch until the wire is pulled straight and slightly stretched. Care is necessary, of course, to avoid breaking the wire—or straining the car! The job is not one for a jerky driver who reverses by leaps and bounds.

The next step is to form the spiral, and this also can be done very easily and neatly if one knows the way. Leaving the far end of the wire anchored securely (as it was for the stretching process), fasten the near end to a wooden rod, tin can or other cylindrical former (of a diameter very slightly less than the required size for the finished coil). Pull the

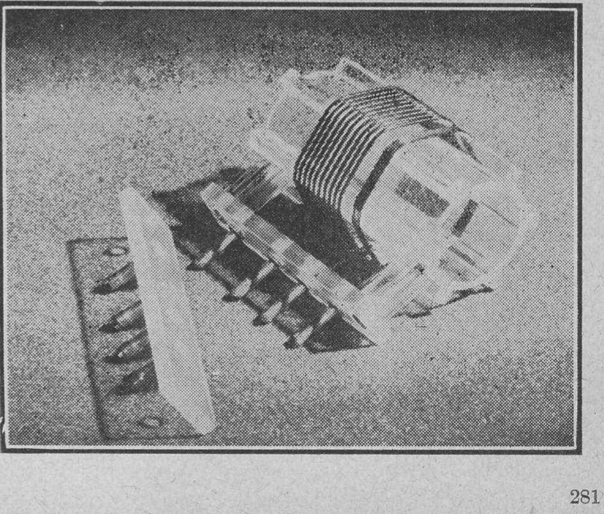


Fig. 4. A Denco short wave coil, made up on a polystyrene former, and holder. Home-made coils, patterned on this method are quite easy to construct. Blank formers are readily obtainable.

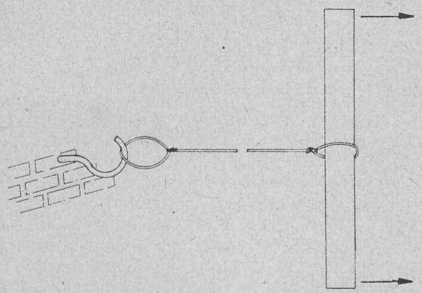


Fig. 5. Method to adopt when stretching coil wire before winding the coil. Pull taught but do not overstretch.

wire taut and keep a steady tension on it while you wind it on to the temporary wooden or tin former by slowly rotating the latter in your hands (yes, the latter is the former, in this case!) As you rotate it, (Fig. 6), walk slowly towards the anchored end as the wire is gradually taken up. On completion of the winding, release both ends of the wire, let the spiral expand (which it will do by its own springiness) and slide it off the temporary former, which is discarded.

Finally, take four strips of polystyrene, say half an inch wide, and about half an inch longer than the finished winding, and drill a row of holes in each strip, spaced one wire-diameter apart, and equal in number to the turns of the coil (except for one strip, which will need one extra hole). The holes should be just large enough for the wire to slide through them easily. Thread the wire through the holes by rotating the spiral while holding the strips.

Mount the finished coil on a low-loss base of polystyrene or ceramic, fitted with suitable plugs if the coil is to be one of an interchangeable set.

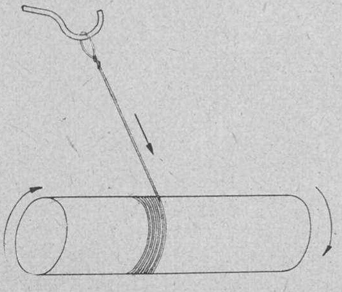


Fig. 6. When winding the coil on the former, keep taught by gently pulling and rotate slowly.

These semi-self-supporting coils are suitable for wavebands such as 7 and 14 Mcs. For the lower frequencies, such as 3.5 and the "top band," finer-gauge wire can be used and the windings put on a solid-walled tubular former of ceramic, polystyrene or other low-loss material, preferably ribbed. The turns can be slightly spaced, or wound with turns touching (assuming, of course, that the wire is insulated—enamelled, cotton-covered or silk-covered). These windings should be put on under tension, by following the procedure described for winding the self-supporting coils; but instead of the temporary wooden or tin former, you use a permanent one of low-loss insulating material, and secure the ends of the wire through a pair of small holes drilled through the wall of the tube near each end of it.

In the second part of this article, I shall give details of different types and sizes of windings for a variety of transmitting and receiving circuits, from which you can choose coils to suit your own particular needs.

WARNING !

Dear Sirs,

May I, through your columns, give a warning to users of MCR1's on mains ?

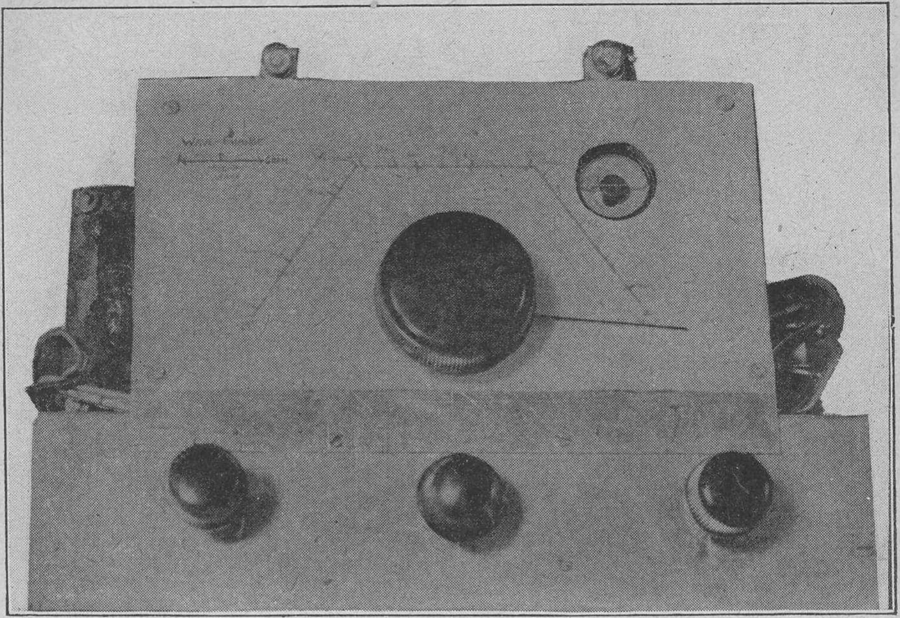
The power packs are very badly constructed, in that the cases of capacitors, at a high potential, occasionally touch the case when it is picked up; also one of the screws (middle of case) touches resistor R6/P, resulting in a 90 volt shock.

I would suggest that if no shocks have yet been felt, that precautions against the likelihood be taken, by the suitable application of insulation tape, and earthing the case, if possible by a three-pin plug.

These precautions will save the XYL from receiving a shock when dusting, also !

It is quite surprising that the power packs were built in such a manner; most Government apparatus I handled in the Signals was adequately protected.

Yours faithfully,
DAVID OWEN FRENCH,
ISWL/G426.



The Construction of a 6-valve Radiogram Chassis

By J. R. Davies

Introduction.

THE set described in this article was built for a relative who wanted a radiogram chassis that would give good quality reception on medium and long waves with plenty of volume and at not too great a cost. The writer decided to make up a four-valve superhet with a " Magic Eye " tuning indicator. The rectifier, of course, makes the sixth valve. Although the circuit is reasonably conventional the writer thinks that it is worth describing, as, in addition to using several " commercial " dodges with which some constructors may not be familiar, home wound coils are used and information is given on these. Instructions on winding short-wave coils are also included if the reader wishes to make the circuit all-wave.

The " Magic Eye."

The writer hopes that the editor and his readers will forgive him if he digresses a little and gives a short paragraph on the actual functioning of the " Magic Eye." So many constructors appear to be hazy on this point that it deserves a few words before going on with the description of the actual set. Fig. 1 (*a*) gives a cross-section of the " Magic Eye " valve and Fig. 1 (*b*) its schematic diagram and external connections. When the cathode of the valve warms up after the set is switched on it emits electrons which are attracted to the positively charged target, which being coated with a fluorescent material, glows green. At the same time, a current is also passed by the anode of the triode section. This flows through the resistance "R" (Fig. 1*b*) causing a voltage drop and making the anode " less positive " or " more negative," with respect to the target. A piece of wire is brought out by the target and is known as the " pencil." This is connected internally to the triode anode. Being negatively charged with respect to the target it repels some of the electrons attracted by that electrode and causes the shadow shown in Fig. 1 (*c*). The amount of " shadow " varies according to the potential of the " pencil." Now, if the grid of the triode section were made more negative, the triode anode would pass less current, less voltage would be dropped by the resistance "R" and the anode (and pencil) would have a higher positive potential. Its repellant effect on the electron stream would then be less and the " shadow " would become smaller. If the grid of the triode is connected to the AVC line of the receiver, the negative voltage on the grid would increase with signal strength and the shadow would " close " as the signal is tuned in. Thus, the valve would give an indication of the accuracy of the tuning.

The Bias Network.

And now let us get on with the set itself. As it is using a " Magic Eye," which requires a standing bias, it was decided to use bias obtained from the HT negative line (auto-bias). Cathode bias could be used on the " Magic Eye," but this would give an adverse effect. As the AVC increased, the triode section of the " Magic Eye " would take less current and the bias voltage developed by the cathode resistor would also decrease, (making the cathode more negative), thereby minimising the effect of the AVC. (This effect would also be noticeable in the AVC-controlled valve).

A bias network was made up as shown in simplified form (Fig. 2). Using valves type 6K8, 6K7, 6Q7 and 6F6 for the set, the total HT current will be approximately 50 mA. The 50 Ω resistors (Fig. 2) will each drop 2.5 volts, and the 80 Ω resistor 4 volts. The cathode of the 6F6 (output) valve is connected to point "A" and its grid biassed from " D," giving 9 volts bias. The cathode of the 6Q7 (double-diode-triode) valve is connected to point " X " as are all AVC and signal returns for the diodes, thus giving the AVC line a standing bias of —2.5 volts. The cathodes of the " Magic Eye," frequency changer and IF valves are then all connected to earth, their grids receiving this standing bias of —2.5 volts from the AVC line at all times. Bias for the triode section of the 6Q7 is obtained from "Y" which is 2.5 volts negative with respect to its cathode (connected to "X"). The cathode current of the 6Q7 will flow through the network from "D" to "X", but as this current is only of the order of 1 milliamp it will have negligible effect on the voltage divider. All bias voltages are, of course, suitably decoupled in the complete circuit.

It is of great importance to connect the negative side of the smoothing capacitors to point "D" (HT—) and not to chassis, as this would inject hum into the bias circuit. If the electrolytic capacitors used have a negative case, this must be isolated from the chassis when mounting.

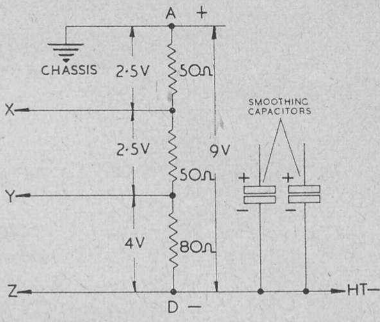


Fig. 2. Simplified circuit of the bias network. Note that the negative side of the smoothing capacitors are connected to HT—and **not** *to chassis (see text). Point "X" goes to cathode 6Q7 (no delay on AVC). Point "Y" goes to grid bias 6Q7 (cathode to point "X"). Point "Z" is connected to grid bias 6F6 (cathode to point "A").*

Detection and AVC.

Fig. 3 gives the circuit for the detector and AVC circuit. This is a circuit which the author thoroughly recommends. R1 is used for decoupling the IF frequency and is used in conjunction with C1 and C2. It should be about 10 k Ω in value. C1 is best omitted, if possible, as it tends to flatten the IF secondary. (On peak positive cycles it will come into circuit across the IF secondary via the diode valve). If fitted, it should have a value of some 200 μμF. C2 is essential and should be approximately 300 μμF in value. R2 is the diode leak resistor, and should have a value as high as possible, consistent with good quality. In the writer's case it is only 100 k Ω, but with different models of IF transformers, higher values may be used successfully. The higher the value, the greater the signal and AVC voltage, but, unfortunately, distortion may be introduced. AVC voltage is decoupled via a 1 Meg Ω resistor and a 0.1 μF capacitor, these two values giving a satisfactory time constant. The DC voltage on the leak R2 is isolated by a 0.01 μF capacitor before being applied to the volume control. All

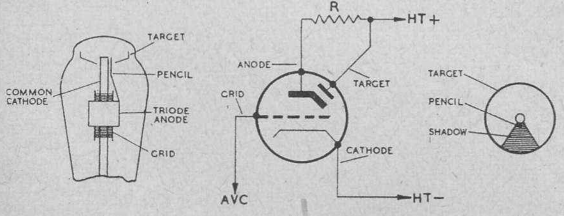
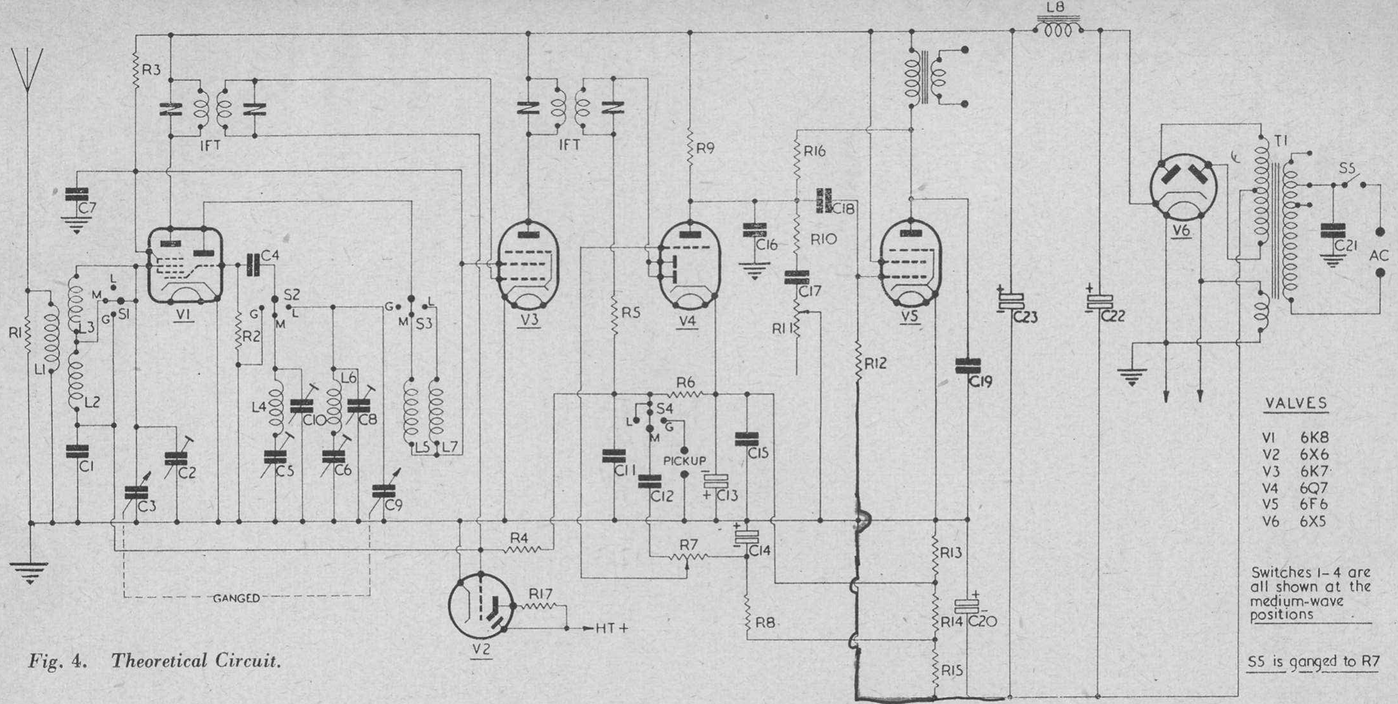


Fig. 1. (a) showing the cross-section of a " magic eye " valve ; (b) schematic diagram, showing external connections to receiver circuit ; (c) showing " shadow " on target caused by negatively charged pencil.



VALVES

V1	6K8
V2	6X6
V3	6K7
V4	6Q7
V5	6F6
V6	6X5

Switches 1-4 are all shown at the medium-wave positions

S5 is ganged to R7

Fig. 4. Theoretical Circuit.

COMPONENT VALUES FOR THE RADIOGRAM CIRCUIT

Resistors.

R1	3,000 Ω
R2, 8	20,000 Ω
R3	7,500 Ω 2 watts
R4, 16, 17	1 Meg Ω
R5	10,000 Ω
R6, 9, 11	100,000 Ω
R7, 12	250,000 Ω
R10	5,000 Ω
R13, 14	50 Ω
R15	80 Ω

Capacitors.

C1, 7, 15, 18	0.1 μF
C2, 8, 10	Trimmers.
C3, 9	500 μμF
C4, 16	200μμF
C5	approx. 290 μμF (MW padder)
C6	approx. 120 μμF (LW padder)
C11	300 μμF
C12, 17, 21	0.01 μF
C13, 14, 20	25 μF 25 v. wkg
C19	0.002 μF
C22	8.0 μF 350 v. wkg
C23	16.0 μF 350 v. wkg

Switches.

S1, 2, 3, 4 : Wave-change switches.

S5 : On/off switch (ganged to volume control R7).

Coil.

L1	Aerial coupling
L2	MW aerial coil
L3	LW aerial coil
L4	Oscillator Grid MW
L5	Oscillator anode MW
L6	Oscillator Grid LW
L7	Oscillator anode LW
L8	20 H 60 mA choke

IF transformers 465 kcs.

Transformer.

T1 : Input 230-250 v. AC. Output 250-0-250 v. and 6.3 v.

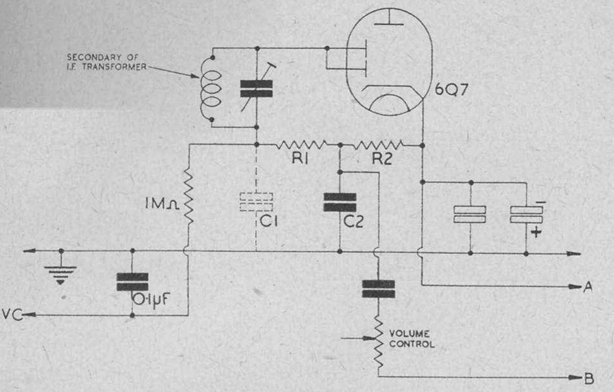


Fig. 3. Showing the double-diode-triode circuit in detail. Point "A" goes to 2.5 negative to chassis. Point "B" is connected to 5 volts negative to chassis (2.5 v. bias for triode).

leads in the grid circuit of the double diode triode valve were screened.

Decoupling.

Decoupling the valve anodes was the next point. Very little decoupling was used, all anode returns being taken to HT Positive. A 0.1 μF capacitor between HT Positive and earth is essential in most circuits of this type, as electrolytic capacitors are not good decouplers to HF. For decoupling the mixer and IF AVC returns one capacitor is quite sufficient provided that it is mounted close to the aerial coil. This is C1 in Fig. 4.

Only one dropping resistor is used for the mixer and IF screens and for the oscillator anode. Using valves type 6K8 and 6K7, the oscillator anode, mixer screen and IF screen currents are 3.8, 6.0 and 2.3 milliamps respectively. This adds to 12.1 mA and a 7,500 Ω resistor will drop 91 volts, which, with 230 volts HT, is just about correct. Fig. 4 shows this resistor as R3 and the capacitor as C7. The voltage on the screens and oscillator anode stays quite stable when the AVC voltage increases, because, although the IF screen current decreases with increased AVC voltage, that of the mixer usually tends to increase, thereby equalising matters to a great extent. One capacitor (C7 in Fig. 4) of 0.1 μF decouples all three circuits but must be connected direct to the screen tag on the mixer valve-holder.

Wave-Change Switching.

The wave-change switch connections are very simple and may easily be followed from Fig. 4. A 4-pole 3-way switch is used. On the "gram" position the mixer signal grid is shorted to the AVC line so that no signal may enter via the aerial coil. Also, on this position of the switch, the oscillator anode has no HT supply and the oscillator grid is shorted to earth. Just to make certain! No input filter, etc., is included in the chassis for the "gram" position, as this depends on the type of pick-up being used. Of course, the volume control and tone control on the chassis are operative on the "gram" position. If a switch with another pole could be fitted, this pole could be used to short out the MW oscillator grid coil on the "LW" position, and *vice versa*. It may be noted that, although the switch puts into circuit two separate grid coils for the two ranges in the oscillator circuit, only one coil is used for the aerial circuit, the long-wave coil being shorted on the "MW" position.

The Coils.

The coils, which are home-made, are the next components worthy of interest. All the information on the coils is given in Fig. 6. In the writer's case these were wound with wire of 32 gauge DCC, but any DCC or DSC gauge near this would do quite well. Feedback and aerial coupling coils could quite efficiently be wound with enamelled wire. The oscillator coils are mounted beneath the chassis, and the aerial coil above. The writer decided to use a relatively large aerial coil, as this would have a higher "Q" than that available with most

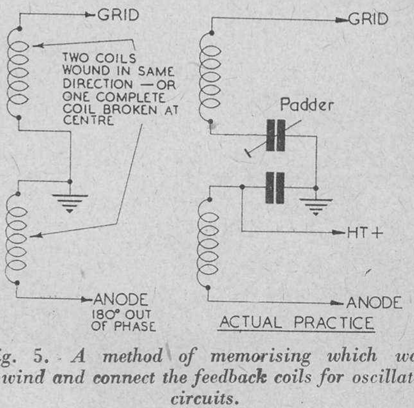
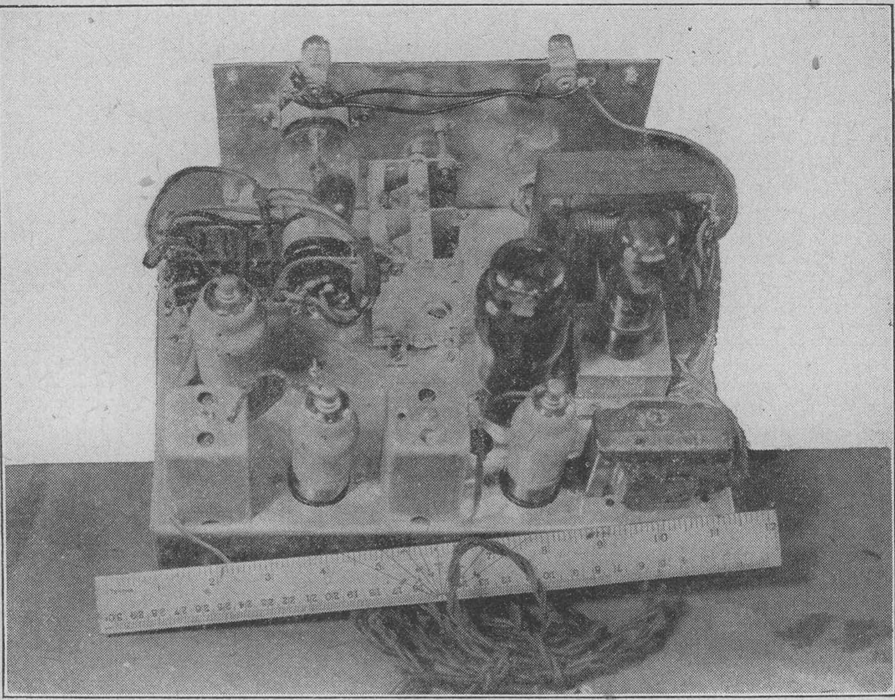


Fig. 5. A method of memorising which way to wind and connect the feedback coils for oscillator circuits.



The completed receiver as seen from the rear. The foot-rule gives a good idea of the overall dimensions.

commercial coils, thereby giving more sensitivity, better signal-noise ratio, and considerably less second channel interference. The coil used provides very sharp tuning and this necessitates very careful tracking. It is important to make certain that the medium and long-wave aerial grid coils are wound in the same directions ; and, that, with the oscillator coils, the feedback coils are connected the right way round. (When winding oscillator coils it is a good plan to look upon the grid and anode coils as one complete coil broken in the middle. As the grid should be 180 degrees out of phase to the anode, the grid is connected to one end of the complete coil, and the anode to the other. The two centres are then connected to earth, via decoupling and padding capacitors, if necessary (see Fig. 5). A damping resistor of some 3 k Ω was connected across the aerial coupling coil, just to stop any ideas that coil might have about being resonant to any local station! By reason of the circuit it is practicable to have only one trimmer in the aerial circuit for both medium and long-wave coils. It should, however, be quite easy to so adjust the oscillator trimmers that the aerial coil trimmer is at its optimum position for both bands.

The Power Supply.

The power supply circuit is quite straightforward, with the exception that HT negative is not connected to chassis, (as mentioned above). The 6X5 rectifier was used only because the mains transformer used by the writer had a new 6.3 volt heater winding put on it, and there was no room on the core for another winding for rectifier! A 5Y3 or other similar rectifier would do just as well, providing that a 5 volt winding was available. The HT secondary of the transformer gave 250-0-250 volts.

Layout.

The layout of the set may be seen from the photographs and is quite straightforward and conventional. The resistor and capacitor boards were made of paxolin sheeting, the components being anchored to 8 BA bolts mounted along the edge of the boards. Brass bolts were used for ease of soldering. These boards are well worth-while making, as they ease the wiring problem considerably. The speaker transformer is not mounted on the chassis, but on the speaker. It should be

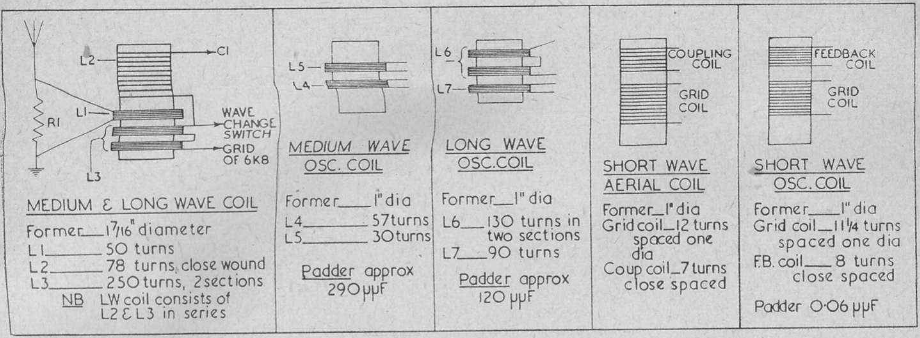
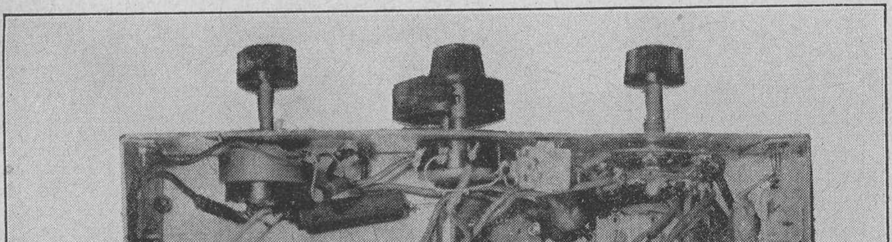


Fig. 6. Information on the coils. All windings were made with 32 swg DCC wire (see text). If a shortwave band is required, figures for suitable coils are given (from 5-15 Mcs.). These coils are wound with 20 swg enamelled wire for grid coils and 30 swg DCC for coupling coils. Value of Padder for Short Wave Osc. Coil should be $0.06\mu F$ and not $0.06\mu\mu F$ as shown.



Under-chassis view of the receiver from which the disposition of main components may clearly be seen.

connected directly by flex wire and not by means of a plug and socket on the back of the chassis. This is due to the fact that, if the plug gets inadvertently pulled out, the screen grid of the output valve would take an excessive current and the valve may be seriously damaged.

Tone Control and Negative Feedback.

Simple treble attenuation is used for the tone control circuit. The 5 k Ω resistor, R10, in Fig. 4, was needed in the author's individual case. This is because the lead from C17 to the resistor R11 (see Fig. 4) had to run near other parts of the circuit. As this lead was unscreened, the resistor R10 (Fig. 4) was put in circuit close to the double diode triode valveholder to minimise any instability that might result.

When the set was finally made up, it was found that there was plenty of volume to "play with," and a negative feedback circuit was applied. This consisted of a 1 Meg Ω resistor (R16 in Fig. 4) connected between the anodes of the output and double diode triode valves. This gives a small amount of simple voltage feedback on the output stage alone and tends to improve the quality, at the same time, of course, cutting down the amplification.

Conclusion.

In conclusion, the writer would like to state that this set has now been in operation for some time and has given no trouble whatsoever. Although the set was designed around American type valves, English types ECH35, EF39 and EBC33 as frequency-changer, IF amplifier and double diode triode valves respectively will work just as well, and have the same base connections as their American counterparts.

OFFERINGS

We frequently receive enquiries from readers asking about our other publications and this column has been slipped in with the object of giving some brief details of what we have to offer.

Short Wave News is the companion magazine to the *Constructor* and contains up-to-date news on amateur and broadcast band activities. Regular features include " My Favourite Receiver " (details of specific readers' pet circuits), "Around the Shacks " (visits to transmitting and listening stations), Monthly News of the International Short Wave League, and constructional articles on receivers, transmitters, etc. For the short wave fan—a must ! It is the same price as the *Constructor*, though just as difficult to obtain at present !

The Short Wave Listeners' Annual needs no introduction to the short wave enthusiast. This year's edition is now at press and will be available very soon. The price will be 3/6 plus 3d. postage. Amongst the host of data included in its more-than-one-hundred pages are items such as the most comprehensive short wave station list available, a chapter on propagation, details of how to identify stations, station addresses, when to listen, maps showing call areas, and so forth. A complete review will appear in these pages at an early date.

The Data Booklet Series is a new venture. The first of the series is a revised and enlarged reprint of the well-known " Basic Superhet " articles by Centre Tap. It describes how to build an efficient basic superhet receiver and how to add on such stages as the BFO, an RF stage, a Preselector and so on. Coil and valve data is included. The price is 1/- plus 2d. postage.

Report Pads. These are specially prepared pads containing 50 report forms and complete instructions for use when sending reception reports to short wave stations. Acclaimed alike by both the reporter and stations throughout the world. They will certainly bring you in more replies to your reports ! Price is 3/- post paid.

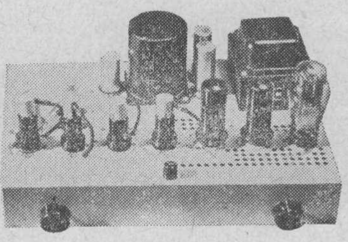
These You Can Hear. This booklet was introduced for those just about to embark on the hobby of short wave listening. It is printed throughout on art paper and has many fine photographs. The contents consist of tips on how to tune in short wave stations, descriptions of some of the most popular broadcasters throughout the world, times to listen to different bands and to various well-known stations, programmes in English, and so on. The price is 2/- plus 3d. postage.

Station Record Cards. These file cards, 6in. x 4in., are ideal for those wishing to keep a flexible record of broadcasting stations, in order of call-sign or frequency. They can be obtained at 4/- per 100, post paid. Similar cards for amateur stations are in preparation.

CLYDESDALE

GM3BL
GM3ASM

FOR BARGAINS IN EX-SERVIC



BRAND NEW—
IN MAKER'S CARTON

EX U.S. SIGNAL CORPS
WILCOX GAY SPEECH AMPLIFIER
for 200-250v. AC Mains

A 7 valve Push-Pull Mic. Amplifier, with negative feedback output of 12-15 watts, using 4/6 J7's, 2/6L6's, 5U4. Completely housed in metal case 11½" x 17" x 9", with two complete sets of valves, comprehensive instruction book, etc.

CLYDESDALE'S PRICE ONLY **£17 10s.** each. CARRIAGE PAID

BRAND NEW—IN MAKER'S CARTONS

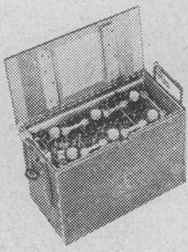
COMMAND RECEIVER
B.C.454.B

For 3-6 Mcs. 6 valve s'het. 12SK7, RF, 12K8 converter, 12SK7's 1st and 2nd IF, 12SR7, voltage amplifier, AVC det., 12A6, output 3½ watts, 3-gang tuning condenser, fitted with ADT's, controlled by worm-drive reduction gear. Complete Rx for 24v., less dynamotor and external drive, completely enclosed in metal case 11" x 5½" x 5".

CLYDESDALE'S PRICE ONLY **50/-** each

POST PAID

BRAND NEW—



12 Volts 75 AH ACCUMULATOR in Waxed Teak Box, with hinged lid, metal carrying handles at side. Wing nut terminals with connections brought out to 2 pin socket. Size 16½" x 8" x 11¼" high.

CLYDESDALE'S PRICE ONLY **£5**

PACKED IN A WOOD BOX.

CARRIAGE PAID.

BRAND NEW—

ACCUMULATOR CHARGING SWITCH BOARD

For up to 50 volts, 1,260 watts. Complete with circuit and connecting data. Contains: 6 meters, 4/0-20 amps., 1/0-40 amps., 1/0-50 volts. 5 heavy duty slider resistances, 4 charging circuit 12 amp., 1 voltage regulating, 5-way control switch, 3/circuit switches, 5/Slidelock fuse holders with fuses, 2/Cut-outs, 8/HD Terminals, etc. Enclosed in metal cabinet, with hinged doors and fixing feet, size 20" x 18" x 8".

CLYDESDALE'S PRICE ONLY **63/-** each

CARRIAGE PAID.

PACKED IN A WOOD CASE.

BRAND NEW—
IN MAKER'S CARTON.

ENGINE DRIVEN GENERATOR

Supplies 24 volts, 1,500 watts, at 5,000 r.p.m. Rotation of shaft clockwise, cooling air-ducts, four bolt fixing flange, totally enclosed in cylindrical metal case 13" x 6" diam., length of coupling shaft 1", weight 37 lbs.

CLYDESDALE'S PRICE ONLY **70/-** each

CARRIAGE PAID.

SEND NOW FOR NEW ILLUSTRATED LIST. *(Write Name and Address in BLOCK LETTERS please).*

CLYDESDALE SUPPLY CO LTD

● The Radioman's Shop ●

CES ELECTRONIC EQUIPMENT

BRAND NEW—
IN MAKER'S CARTON.

R.F. UNIT, TYPE 26

for 50-65 Mcs., condenser tuning. Makes an ideal 5 and 6 metre convertor. Act now, only a few available.

CLYDESDALE'S PRICE ONLY **35/-** each

POST PAID

FOUNDATION METER

Moving Coil.

BRAND NEW in maker's boxes.

Scale marked 0/5000 ohms.
0/60 ma.
0/1.5 Volts.
0/3 Volts.

5 ma Movement, resistance 250 ohms. 2½" Round white scale, flush mounting.

CLYDESDALE'S PRICE ONLY **17/6**

POST PAID. each

R.F. UNIT, TYPE 24

26-30 Mcs.

with switched position tuning. Brand New, in maker's cartons.

CLYDESDALE'S PRICE ONLY **19/6** each

POST PAID.

Used, good condition.

CLYDESDALE'S PRICE ONLY **12/6** each

POST PAID.

BRAND NEW—Ex R.A.F.

HIGH IMPEDANCE HEADPHONES

(S. G. Brown) total imp. 4,000.

Ask for—R.C.1.

CLYDESDALE'S PRICE ONLY **7/6** per pair.

Two pairs for 12/6.

POST PAID.

BRAND NEW—

CERAMIC WAFER ROTARY W/C SWITCH

3 Ceramic (Wearite type) Wafers. 5 positions Single Pole each. Overall length 8" x 2¼" wide.

Ask for—R.C.2.

CLYDESDALE'S PRICE ONLY **3/11**

POST PAID. each

CERAMIC COIL FORMERS

1¼" x ¾" serrated edge., diam. of centre ⅜".

Ask for—R.C.3.

CLYDESDALE'S PRICE ONLY **6d.**

4/6 Doz. each.

POST PAID.

MAGNETIC KEYING RELAY, TYPE 85

for T1154 Tx., operating speed in excess of 25 w.p.m. 3 solenoids, 6 pole c/o for 6 volts. 7¾" x 3½" x 3¼".

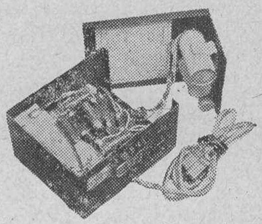
CLYDESDALE'S PRICE ONLY **5/6**

POST PAID. each.

BRAND NEW IN MAKER'S SEALED WRAPPER.

Ex U.S.A.A.F.

JEFFERSON-TRAVIS SYNCHRONOUS VIBRAPACK U.F.1



Complete and self-contained vibrator Power Unit for 12 volts input, outputs 150/120 volts 30/50 mA choke/capacity smoothed, LT and Bias, plus 4½ feet screened input lead fitted with crocodile clips, with circuit in metal case 7" x 4½" x 6", finish black.

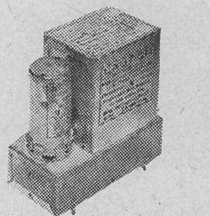
CLYDESDALE'S PRICE ONLY **19/6**

POST PAID. each.

BRAND NEW IN MAKER'S SEALED CARTONS.

EX U.S.A.A.F.

MALLORY SYNCHRONOUS VIBRAPACK



Input 12 volts. Outputs 150/120v., 30/50 mA. Complete unit, as illustrated, totally enclosed and fully screened. Dimensions 5½" x 2¾" x 5".

CLYDESDALE'S PRICE ONLY **12/6**

POST PAID. each.

Still available, as previously advertised.		£	s.	d.	
DST 100 Mk. III Receiver for AC Mains	at	37	10	0	each
BC348 Receiver for AC Mains	at	27	10	0	each
R1155 Receiver Unit	at	12	12	0	each
T1154 Transmitter Units	at	10	10	0	each
Power Units for T1154 or R1155	at		26	11	each
R1481 Receiver Unit	at	7	19	6	each
R1132 Receiver Unit	at	8	19	6	each
R109 Receiver for 6 volts	at	6	9	6	each
Ex R.N. Loud Hailer for 12 volts	at	25	15	0	each
AN/APA-1 Cathode Ray Indicator	at	4	17	6	each
Mic-Headphone Assembly	at		15	6	each

Also Condensers, Meters, etc., etc. All Carriage or Post Paid

2 BRIDGE STREET, GLASGOW, C.5

'Phone : SOUTH 2706/9

VISIT OUR BRANCHES IN SCOTLAND, ENGLAND AND NORTHERN IRELAND

Query Corner

A " Radio Constructor " service for readers

Voltage Doubler.

" *I wish to construct an amplifier having a voltage doubler type of power supply as I require a relatively large power output, to be obtained with a minimum expenditure. Can you supply me with a suitable voltage doubler circuit ?*

—*A. Hardy, Glasgow.*

It is true that the voltage doubler power supply enables a relatively high HT voltage to be obtained without the use of a high voltage mains transformer. Many constructors find that such a transformer is the most expensive item in the amplifier or receiver, and thus it is that the voltage doubler circuit has gained its popularity. There are several forms of doubler circuit but the most satisfactory is the full-wave type shown in Fig. 1.

The operation of this circuit depends upon the charging up of two separate capacitors to a voltage which is approximately equal to the peak value of the AC input voltage, and then discharging them in series into the load. During the positive half cycle of the input voltage the upper rectifier conducts and charges up the capacitor C1. Similarly, during the negative half cycle the lower rectifier conducts thus charging up C2 ; the voltage across both these capacitors in series is clearly approximately equal to twice the peak value (1.414 x rms value) of the input voltage.

Now for a few practical points which should receive attention if the optimum results coupled with long life are to be obtained from the voltage doubler. In order that the regulation of the supply should be reasonably good, the capacitors C1 and C2 should have a value of 16 μF and a working voltage which is at least equal to the peak value of the mains voltage. If the metal can type electrolytics are used the can is normally connected to the negative electrode or it may even form the negative electrode, and hence C1 should be well insulated from the negative HT line. The smoothing capacitor C3 may also have a value of 16 μF and a working voltage of at least twice the peak input voltage. In order to limit the peak anode current passed by the rectifier, 50 Ω resistors are included in each anode lead. This precaution ensures that the maximum life is obtained from the valve—an important point in these days of high purchase tax! The rectifier may consist of two separate valves or one double anode double cathode unit in one glass envelope, in either case care should be taken not to exceed the maximum permissible heater to cathode voltage.

It will be realised from the foregoing that the voltage doubler power supply is unsuitable for use on DC mains, but it is a real boon to those whose supply voltage is 110 volts, and also to those who required larger than normal output power with minimum expense.

Noise Limiters.

" *Can you recommend a circuit of a Noise Limiter ? I have tried several circuits without much success and would appreciate any advice you might be able to give me on the subject.*"

—*E. Bailey, Norwich.*

Before considering any particular form of Noise Limiter it might be as well to explode one of the myths which surround them. The

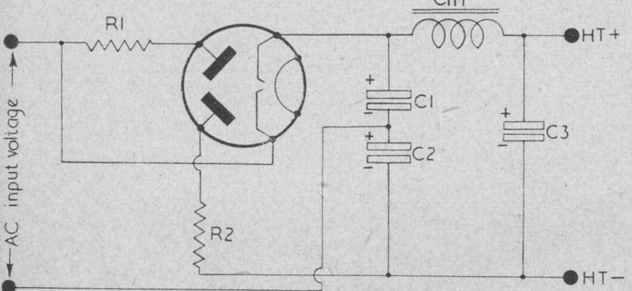


Fig. 1. Voltage doubler circuit. R1/R2 are the 50 Ω limiter resistors, C1/C2/C3 are 16 μF (see text). The valve is a 25Z6 or similar type.

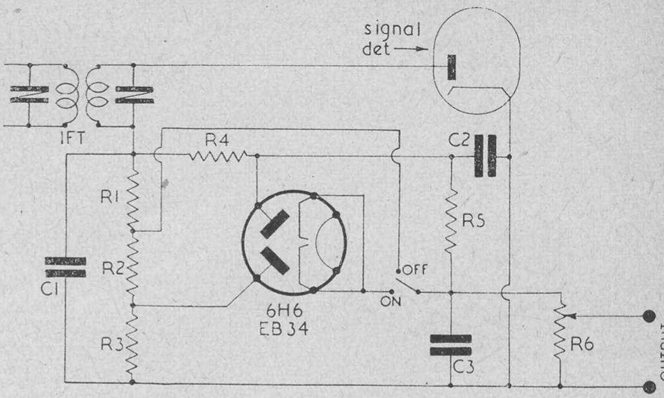


Fig. 2. Circuit of a self-adjusting series type noise limiter. Values are: R1, 2; 50 KΩ; R3, 100 KΩ; R4, 0.5 MΩ; R5, 1 MΩ; R6, 1 MΩ (volume control); C1, 100 μμF; C2, 0.5 μF; C3, 100 μμF.

function of a Limiter is to prevent noise pulses of large amplitude and short duration from reaching the 'phones or loud-speaker ; it is not capable of suppressing valve noise or that type of background mush which is so frequently found on the 20 metre band. However, it does limit that type of interference which is caused by electric motors and motor car ignition systems, and in this respect it is a real asset to the users of communication receivers. There are many different types of noise limiter, but the circuit diagram (Fig. 2) shows one which we have found to give the best results under all conditions of reception. It is of the self-adjusting series type, that is to say, it automatically adjusts itself to the signal carrier strength and chops off all noise pulses which rise above the 100 per cent. modulation level. The method of operation of this noise limiter is briefly as follows. The upper end of the diode load is negative with respect to the lower end due to the signal diode current, thus under normal conditions the lower half of V-1 is always in the conducting state. We may, therefore, consider the lower half as being temporarily short circuited. The cathode of the upper section is effectively tapped midway up the rectifier diode load so that its anode is normally negative with respect to its cathode and hence it is non-conducting. The time constant of R4 and C2 is high compared with the duration of the average noise pulse, so that the anode voltage of this section follows only the mean carrier voltage. However, should the modulation temporarily exceed the 100 per cent. level due to some noise pulse, the cathode will be driven negative but, owing to the long time constant of C2 R4 the anode will remain at the same potential. Thus, the valve conducts and the potential of its cathode becomes approximately equal to that of its anode, the noise pulse is therefore suppressed.

The lower half of V-1 is included in order to improve the general effectiveness of the circuit, normally this half of the valve is conducting as already stated. Upon the arrival of a noise pulse this section is rendered non-conductive due to the large negative voltage applied to its anode, its cathode being maintained temporarily at the same potential owing to the time constant C2 R4. When the lower half becomes non-conducting the upper half conducts and its cathode potential becomes approximately equal to that of its anode. It will be fully appreciated from the foregoing that this dual action circuit provides an effective quick acting noise limiter which is capable of completely suppressing all noise pulses which exceed the 100 per cent. modulation level of the particular signal to which the receiver is tuned. A switch is provided to cut out the circuit when not required.

The only drawback with this type of limiter

(*continued on page* 295).

"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.

Radio Simplified

Part 2. By A. J. Duley

HAVING seen how easy it is to obtain bias and electrode voltages by using ohms law, let us now see how the initial power is applied, and from what sources it is obtained.

Batteries.

This is a very common source of supply, and is invariably split into two parts, LT 1.4 or 2 volts, and HT 90 or 120 volts. Other voltages are used, but these are the most common.

When testing batteries, always have the circuit connected, as an open circuit test will show a different reading from that obtained on load. The reason for this is as follows: a voltmeter has a very high resistance and the current taken by it is negligible, therefore the current in the battery itself is negligible, too. When the circuit is connected, the full circuit current flows through the battery, and due to the internal resistance of the battery, a volts drop occurs.

Let us take the case of a set built by my pet nephew (PN for short). The total HT current taken by the set was 15 mA. We found later that the internal resistance of the battery was 4 k Ω. The circuit is shown in Fig. 1, a resistance in one lead representing the internal resistance of the battery.

Current flowing in the circuit was 15 mA, and although the HT battery was low, the open circuit reading was 102 volts, and PN thought that a minimum voltage of 102 volts would work his set. However, no signals poured forth from the small moving coil speaker.

The actual voltage being applied to the circuit can be found as follows :—

Volts drop across the battery = current x resistance:

$$= \frac{15 \times 4{,}000}{1{,}000} = \frac{60{,}000}{1{,}000} \text{ volts} = 60 \text{ volts.}$$

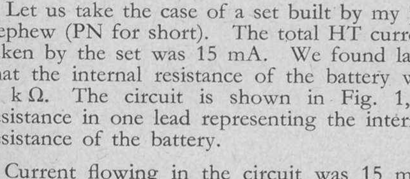


Fig. 1. *"R" equals the internal resistance.*

The voltage applied to the circuit, therefore, is 102—60 volts, that is, 42 volts.

When a battery is in storage, or is rather old, the resistance gets very high, and increases as the current is given, thus, a much lower voltage is delivered than that calculated.

Mains Supplies.

1—DC supplies. 2—AC supplies.

AC/DC (universal) and AC circuits only will be dealt with in this article.

AC/DC Heater Circuit.

The heater voltages of AC/DC valves are usually quite high, 13, 35 and 40 volts are common, the current being 0.2 or 0.3 amps; American valves of the 6.3 volt, 0.3 amps. type being also used. The essential thing about this type of heater circuit is that it is a series circuit and the current for each heater must be the same. In Fig. 2, the valves used are Mullard SP13C, VP13C, Mazda 3520, and Brimar 1D5. All these heaters need 0.2 amps., and the dropping resistor is calculated as follows (the heater voltages are found from the makers' data sheets) :—

SP13C heater voltage = 13 volts.
VP13C ,, ,, = 13 ,,
1D5 ,, ,, = 40 ,,
3520 ,, ,, = 35 ,,
Total = 101 volts.

The mains supply is usually 230 or 250 volts; in our case it is 230; the dropping resistor must drop 230—101 volts = 129 volts. The current in the circuit is 0.2 amps, so knowing this, we can use ohms law and find the resistance of the dropper needed. This is :—

$$\frac{129}{0.2} \text{ ohms} = 645 \text{ ohms.}$$

These mains droppers are manufactured according to the amount of current to pass through them, that is 0.2 amps. or 0.3 amps. The entire resistance is usually 1,000 ohms, with two brass sliders, which clamp in position with screws and these clamps being set at a certain distance apart, this distance being fixed by the resistance needed. The setting is usually found by using an ohmeter. Dial lamps can be lit by using another tapping and Fig. 3 will show the method of doing this. It is obvious that if 129 volts are dropped across 645 ohms, 6 volts are dropped across :—

$$\frac{6}{129} \times 645 \text{ ohms} = 29.9 \text{ ohms.}$$

Since the current in this part of the resistance is no longer 0.2 amps., the extra current will

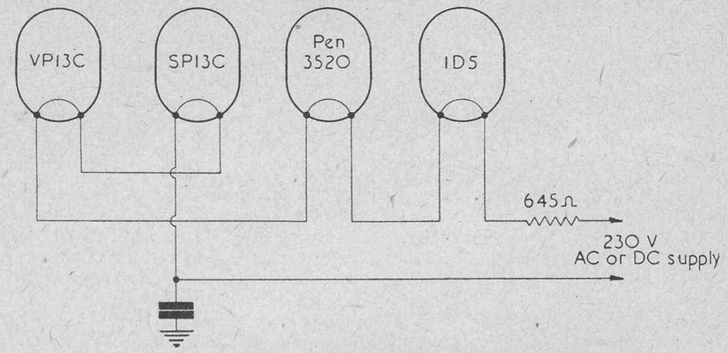


Fig. 2. Series heater circuit. Note that, in this case, the SP13C is used as a detector and this heater is connected to the " earthy " end of the chain.

have to be taken into account. The dial lamp current being 0.04 amps. Resistance to drop 6 volts can be found as before :—

$$\frac{6}{0.24} = 25 \text{ ohms.}$$

Once again this is found by the use of an ohmeter. No alteration is necessary to the main dropper circuit as this is a local circuit.

Rectification.

Alternating current (AC) is unsuitable for supplying operating currents to radio valves, for the simple reason that in an alternating current, the direction of flow is changing several times a second. The voltage changes similarly, in what is known as a cycle. Fig. 4 shows how the voltage changes with the time, from positive to negative, and then back to positive.

If we could wipe out the negative part and store all the positive parts, we could get a current very similar to a direct current. We can do this, and this process of cutting out half the cycle is called rectification. The ways in which this can be done are many and the most common method in a radio receiver being a valve rectifier, such as the Brimar 1D5 that we talked about in the previous example. Let us see how it works.

When a wire is heated, like a filament in a lamp, very small particles are given off at the surface. These are known as electrons. These electrons have a negative charge and, therefore, they are attracted to any positively charged body in the neighbourhood.

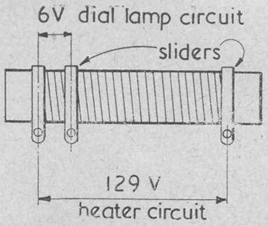


Fig. 3. Typical mains dropper.

We find, therefore, that a diode valve, as our rectifier is called, has a filament or heater, and an electrode enclosed in the same bulb, known as the anode. If a current is passed through the heater, and a positive voltage is applied to the anode, a milliammeter in the circuit will register a current. This is because a stream of electrons is passing from the heater to the positively charged anode. If, however, in similar circumstances a negative voltage is applied to the anode, no current will be indicated on the meter as no stream of electrons will be present. The negatively charged electrons are not attracted by the negatively charged anode. Fig. 5 will make this clear.

In most modern valves, the electrons are given off by the cathode, which is heated by a separate heater or filament. When our supply is AC/DC, the rectifier acts as such on AC, but as a low resistance to DC.

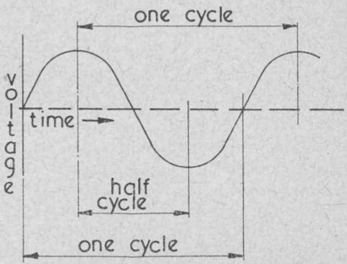


Fig. 4. The voltage/time curve for an alternating voltage. The usual time of one cycle for AC mains is 1/50th of a second.

To understand the action of the rectifier in this circuit, imagine that the point A in Fig. 6 is at a positive point in the cycle, that is a positive voltage is applied to the anode. The current will flow in the direction shown by the arrows, owing to the electron stream from cathode to anode. If point A is at a negative point in the cycle, that is at a negative voltage, no current will flow because there will be no electron stream.

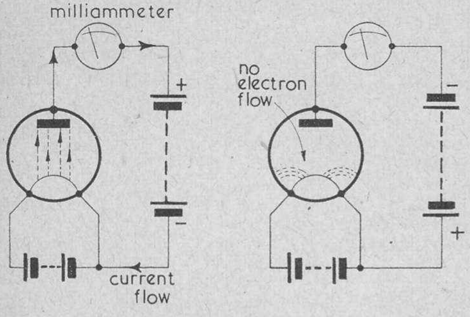


Fig. 5. Action of a diode valve. With a positively applied potential at the anode (left) a current will pass, but with a negative potential at the anode (right) no electron flow will occur and therefore no current will pass.

At this point it may be as well to dispel some illusions that some people may be labouring under, and, therefore, let us clarify a certain point. From the earliest times, certain things had to be assumed, as there was no proof that any particular law existed. One of the things that had to be assumed was the direction of flow of current. Pioneers had said that there were two kinds of electricity, positive and negative, and as they had to decide on something, they decided that current direction would be from positive to negative. Later discovery showed that in actual fact current flows from negative to positive, but so much basic electrical theory had been built upon the belief that the current flowed in the opposite direction, and it didn't really matter anyway, that the convention is still held. Everyone knows that the flow is in the reverse direction, and we radio chaps need to note it particularly. In Fig. 6, the line of the electron flow is seen to be towards the anode, that is, towards the positive electrode, which is the reverse of accepted views.

The large capacitors (8 microfarads or larger) are the store places for the surges of current. The choke, which may be a speaker field, also helps to smooth out the surges of direct current put out by the rectifier. When this circuit is used on DC only, the point A is connected to the positive of the mains supply, and a continuous current flows due to a constant electron stream.

AC Circuits.

When AC alone is used for supply, a different circuit is used. The main difference is the fact that a transformer is used. Let us investigate the way one of these components works.

If we take an ordinary nail, wrap some insulated wire round it, and connect the ends of the coil so formed to an accumulator, several things happen. Firstly, the wire gets hot; secondly, the accumulator runs down at an excessive rate; and thirdly, the nail becomes magnetised. The basic fact that appears from that experiment is that a current flowing in a coil of wire, causes a magnetic field to form. It can also be shown that a coil of wire moved in a magnetic field has a current induced in its windings. The essential point in the last fact is that it is only while the coil is in motion that the current flows, that is, when the coil is moving across the lines of force which make up the magnetic field. Now, if instead of moving the coil, we move the magnetic field, the same effect will be obtained. One method of doing this is to make and break the connections to another coil supplying the magnetic field. In this way, the magnetic field exists and then collapses as the circuit is made and broken.

In our previous investigations, we have seen that an alternating supply voltage varies from positive to zero, and then to negative every half cycle (see Fig. 4) in this way. If this source of supply was applied to our magnetising coil in the last example, the magnetic field would be constantly changing.

The commercially made transformer for radio use, consists of a coil to supply the magnetising energy, known as the primary winding, and several secondary windings to supply various voltages to the receiver. A typical example is as follows :—

> Primary : 230/250 volts. Secondary windings : 350-0-350 volts. 2 windings : 4 volt 2 amp., and 4 volt 4 amp.

The method of obtaining these different voltages is by varying the number of turns on the coil. It is obvious that the more turns on the coil, the greater will be the voltage across it.

The complete AC mains unit is shown in Fig. 7. The valve has two anodes, and is known as a full wave rectifier. The one we considered last time had only one anode and is known as a half wave rectifier.

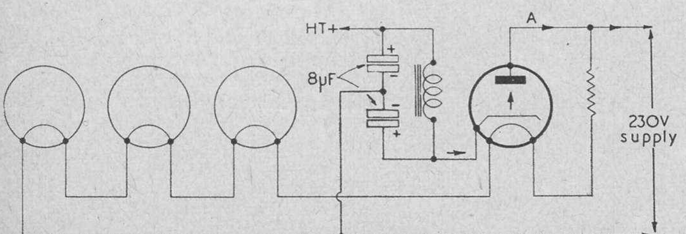


Fig. 6. The half-wave rectifier for AC/DC supply.

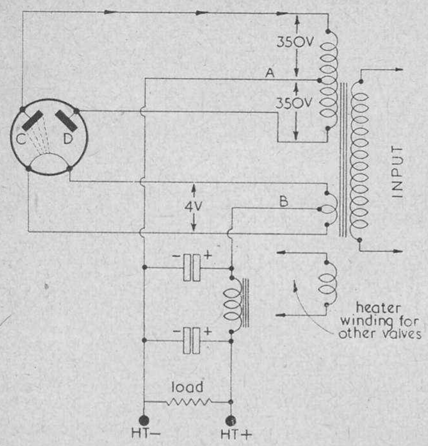


Fig. 7. Typical full wave rectifier circuit for use with AC mains. The load resistance shown represents the receiver load.

The method of operation is as follows: point A is the centre tap of the 700 volt winding, making 350 volts either side, hence the term 350-0-350. The filament of the rectifier is heated from the low voltage winding, and the centre tap of this winding, point B, is the point taken to the HT positive line through a smoothing circuit.

Let the anode C be positive, then a flow of electrons will start from the filament to anode C. We have already seen that the flow of electrons is opposite to the conventional direction of current, hence this means that the point B is positive with respect to point A, for A is connected to the earth line, and anode C is 350 volts positive, being connected to the end of the transformer winding.

When the other half of the cycle is in operation, point D becomes positive, and the electron stream flows to this anode.

In the next article, we will investigate various types of meters, and see how loudspeakers convert signal voltages into audio signals.

(*QUERY CORNER—continued from page* 291)

is that it results in a certain reduction in the wanted signal voltage due to the necessity of centre tapping the signal diode load; because of this it will be necessary to increase the gain of the receiver when the noise limiter is in use. In some receivers it may be possible to obtain extra AF gain by increasing the anode load of the first AF amplifier or by substituting the original valve by one having a higher amplification factor.

INEXPENSIVE TELEVISOR

G2ATV and G3AYA have been amusing themselves knocking up televisors from war surplus material, and the results are so promising that they have promised a series of articles in the near future. There are still a few bugs to iron out, but even so the pictures obtained already have definite entertainment value. Prices vary quite considerably in different localities, so that it is hard to give definite costs, but starting from scratch a complete vision and sound receiver should not cost more than £20. See you later . . .

ALL DRY SUPERHET.

We regret that a couple of errors appeared in this article (May issue). In the circuit diagram —page 271—the HT and LT negative connections are shown the wrong way round (LT negative should be at earth potential and not HT negative as shown). The polarity of C21 should be reversed.

On page 272, "Use a piece of wire" should read "Use a sheet of metal . . ." (Paragraph "Alignment.")

CONVERSION OF SURPLUS GEAR.

The articles recently published on modifying the R1155 receiver have proved so popular that we feel further data on the conversion of ex-WD equipment would be well received. We have several such articles already in preparation and we would greatly appreciate any further articles from readers. If you have successfully converted *any* surplus unit please contact us and give brief details. It is advisable to write us before preparing any articles, since we may already have a similar write-up "on the stocks."

A Simple Receiver for Television Sound

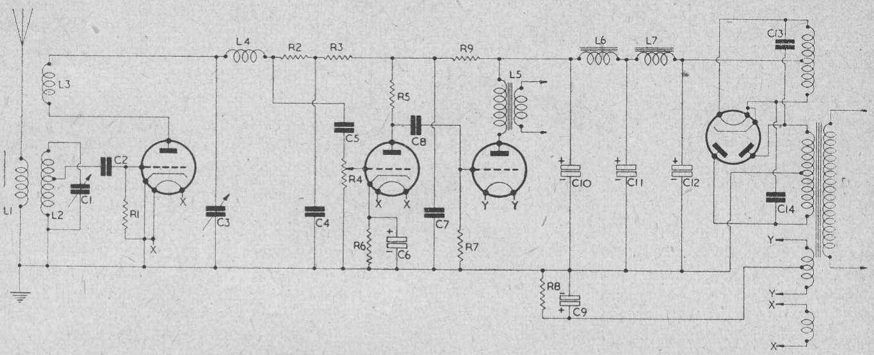
By G. W. DAVEY, (ex D2AH)

MANY amateurs are now considering building television sound receivers, either as a means of obtaining an additional programme or as part of a complete television receiver. Most descriptions of such receivers are rather complicated multi-valve affairs, but very satisfactory reception is obtainable with a simple detector-LF arrangement. The present receiver is in this form, and has been in consistent use at the author's home for some time. One cannot, of course, expect reception of television signals over very great distances with this type of receiver, but these signals are not in any case intended to be received outside the service area of the television transmitter. With the extension of television to other towns which the B.B.C. promises will take place soon, readers outside the London area may like to make up a simple receiver in readiness. It is only proposed to describe the detector portion here as the LF and power-pack sections are perfectly standard, and any which the reader has on hand may be utilised. Circuit diagrams are given for the sake of completeness, of the author's three units, and a few brief comments will firstly be made on the power-pack and LF amplifier.

The power-pack is the standard one used in the radio workroom and is, therefore, rather elaborate. A 350-0-350 volt transformer is used, as an LS field is energised by this unit, but those readers who use a permanent magnet loudspeaker can economise by making use of a 250-0-250 volt transformer. Similarly, two chokes and capacitors in the smoothing circuit are not really necessary with this receiver. It is recommended that the 0.1 μF capacitors between the anodes and heater of the rectifier valve be retained, as they " clean-up " the HF, which is liable to enter the receiver from the mains supply. These capacitors must be of 1,000 volt working type as they have to stand the full overload voltage when the apparatus is first switched on. Two such capacitors are connected in all the author's receivers—even for medium wave working—as experience has proved their worth in removing hum and instability due to HF wandering in from this source.

The detector unit has been used with the quality amplifier which is kept as standard (with which it gives superb quality and volume), but a special small amplifier has been made up and is included in Fig. 1. This is on a similar size chassis to the detector unit and stands closely alongside it. The valves used are AC2HL and PX4 and the overall amplification has been kept low. The receiver as a whole is perfectly stable and gives extraordinary good quality reception. The amplifier side, however, is easily dealt with by the reader according to his own choice. The whole receiver can also, if desired, be built up as a complete unit on a larger chassis. One small word of warning, however, may be given. The author's transformer has a 6.3 volt winding and the detector valve used, an EBC3, has a 6.3 volt heater, one side of which is earthed at the valve-holder. If the transformer it is proposed to use has only one winding, and this a four-volt one, a four-volt valve such as the ACHL DD, or HL41 DD, can be used for the detector. Where a directly heated output valve is used, however, the heater winding must not be earthed at the detector. Theoretically, this is unsatisfactory for a television receiver, but it has no ill effects in the present receiver. A glance at the circuit diagrams will show that if the detector heater is earthed the grid-bias resistor of the output valve will be short-circuited.

The detector unit is built on a small wooden chassis (actually a small box) six inches long by four inches wide and three inches high. The top of the chassis is covered with metal foil but, of course, an all-metal chassis can be used. The variable capacitors used in the original model are the chassis mounting pattern and are placed for the shortest possible wiring. As a receiver of this type is usually " pre-set " it has not been considered necessary to bring the spindles out to a front panel in the normal way. Extension handles, epicyclic drives or any other form of operating them, may be added according to individual taste. The position of the reaction capacitor has not been found critical and a panel mounting type has been used equally successfully, mounted on the chassis under the valveholder so that the spindle projects to the front of the receiver. The coils are very simply made of 18 SWG tinned copper wire. The grid coil has 5½ turns and the reaction coil 4½. They are firstly close-wound on a ½in. diameter tube, then slid off the tube and opened out so that each turn is spaced from the next by about the thickness of the wire. The half-turns are obtained by winding on six and five turns respectively and then cutting the coils at the required 5½ and 4½ turns. A short length of wire is soldered on from below for connection purposes. It is hoped that the sketches shown on page 298 will make this clear. The coils are both mounted with the turns wound in the same



COMPONENT VALUES FOR THE TELEVISION SOUND RECEIVER

Resistors.

R1	1 Meg Ω	R6	1,000 Ω
R2	30,000 Ω	R7	0.5 Meg Ω
R3	30,000 Ω	R8	900 Ω
R4	0.5 Meg Ω	R9	5,000 Ω
R5	10,000 Ω		

Transformer.

Output 350-0-350; 4 v. (points Y); 6.3 v. (points X); 4 v. (rectifier).

Valves.

V1	EBC3	V3	PX4
V2	AC2HL	V4	U12 or similar

Capacitors.

C1	75 μμF	C8	0.1 μF
C2	50 μμF	C9	50.0 μF
C3	75 μμF	C10	16 μF
C4	1.0 μF	C11	16 μF
C5	0.1 μF	C12	8.0 μF
C6	25 μF	C13	0.1 μF
C7	32 μF	C14	0.1 μF

direction. The grid coil is mounted as close to the tuning capacitor as possible with short, direct, leads. The reaction coil has somewhat longer leads which are taken straight down through the chassis (through short lengths of sleeving) to the valve-holder and HF choke. The latter, by the way, in the original receiver, is a six-ohm wire wound resistor which is very satisfactory, but a choke can be home-made by winding about sixty turns of 24 SWG enamelled wire on a short length of $\frac{1}{4}$in. rod.

The grid capacitor is a wire-ended component and is soldered to the top of the coil $2\frac{1}{2}$ turns from the "fixed plates" end. An ordinary bakelite-cased component has been used, of the "postage-stamp" type. No ill effects have been found from this, but no doubt a ceramic type would be even better. Before making final connections to the valve top-cap connector, try the valve in the holder in order to measure up the lengths of wire required. This will avoid an unnecessary extra length, as the aim is to make every lead short and direct. Do not, however, try to solder up whilst the valve is in place in case the heat of the iron cracks its glass. This might be an appropriate place to make mention of the need for good soldering in such a high-frequency receiver. "Dry" joints which might pass in a normal receiver can cause odd effects on 41 megacycles, and two such joints in the original receiver were responsible for a certain amount of trouble. One moment the receiver would oscillate satisfactorily and shortly afterwards become absolutely dead. Everything appeared quite in order on testing, and just as suddenly reaction would become normal again. It was eventually discovered that the joint to the top-cap connector was a "dry one." Cleaning-up and re-soldering, however, did not entirely eradicate the trouble until it was discovered that the connection of the 50 μμF to the tuning coil was similarly "dry." From then onwards the receiver worked perfectly.

It will be noticed from the circuit diagrams that the detector HT connection is taken from the junction of the 5 k Ω resistor and the decoupling capacitor. The latter, by the way, in the original was 32.0 μF, but 8.0 μF or 16.0 μF should serve just as well. The detector is then again decoupled by its own 30 k Ω resistor and 1.0 μF capacitor. The voltage on the EBC3 valve anode was 220 as it was found that it required to be rather high for satisfactory reaction.

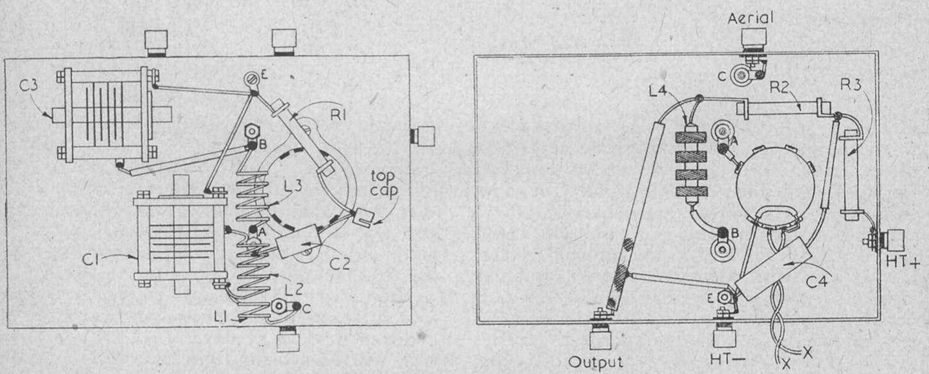
If such high voltages are not available, or difficulty is experienced in obtaining reaction, it is suggested that the reaction coil should be increased in size. Five or six turns would not be too many, and the coil should be coupled as closely as possible to the grid coil. It must be remembered, however, that the reaction coil is carrying the HT to the valve, and must not be allowed to short circuit to earth via the grid coil.

The foregoing details should have enabled the reader to construct the detector unit satisfactorily—the points to bear in mind are: short direct leads and good soldering. Connections may now be made to the amplifier—once again, leads should be short and direct as possible, especially that from the detector unit output to amplifier input.

It will be found that the receiver operates perfectly normally in the same way as any other detector-LF receiver. Reaction should be advanced to just below oscillation point, but the receiver must not be allowed to oscillate as it will cause interference with television receivers in the locality. The tuning control must be rotated extremely slowly and some form of slow-motion drive is very desirable. With the specified variable capacitors a high pitched " buzz " will be heard with the tuning capacitor enmeshed about half-way. This is the " vision " signal. Increasing the capacitance slightly should bring in the " sound " programme. It will be found that rather careful tuning and handling of the reaction control will be required at this point to locate the position of optimum signals.

As has been mentioned earlier, the quality of reproduction is extremely good, and the simplicity and ease of building of the receiver, makes it well worth-while as an addition to the workroom radio equipment.

A dipole aerial has not yet been used with the receiver. A short outdoor aerial has been tried with some success, but it was found that any slight swaying in the wind caused a form of fading (due to capacitance variation). So far, best results have been obtained with 22ft. of wire hooked round the room. The aerial is coupled to the receiver by a two-turn coil mounted at the " earthy " end of the grid coil. Alternatively, the aerial coil could be mounted between the grid and reaction coils. This coil is wound of thick insulated copper wire on the same ½in. diameter former. The wire must be insulated or the aerial coil is liable to touch one of the other windings. It is supported by taking one end direct to the earth terminal. The other end is taken via a " feed-through " insulator to an aerial terminal. A dipole could be connected by mounting two insulating pillars each side of the tuning capacitor and swinging the small aerial coil from them down between the other coils.



Sketches showing the above and below chassis views of the detector unit.

OUR NEXT ISSUE CONTAINS . . .

. . . A Three-band 150 watt transmitter, by G6DH; a mains 0-v-0; a useful Signal Generator and pointers on aligning and testing a receiver; Part 2 of Short Wave Coils. Also the " regulars " as Query Corner, Centre Tap, Thermionic Valves and Radio Simplified.

Coming Shortly !

Amongst the articles for your future reading are a Resistance/Capacitance Decade Box; The Design of Local Oscillators; Construction of Wooden Radio Cabinets; An AC TRF5; 8 valve AC/DC Communications receiver; General Purpose Amplifier and Modulator; A Versatile Push-Pull Transmitter; Reducing HT consumption; Biassing Problems in AC/DC gear; 3 valve Battery Straight for Portable Use; etc.

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.**

What You Want

Readers suggestions on the type of articles most popular for publication

THE Editorial in the June issue has brought forth many interesting points and the response has been such as to justify the publication of extracts of some of the letters received on the subject.

P. Todd, of Shepherds Bush, London, W.12, writes to say that the series " The Straight Receiver " was very clearly written and suggests a similar series on superhets. We have this in mind, OM, and hope to introduce a short series towards the end of the year. The same reader considers that there are too many articles on straight receivers and not enough on superhets. Well, there is a superhet in this issue and we have a few more already lined up, including a large communications receiver—hope this will satisfy your needs. In closing, reader Todd says, " Many thanks for the monthly chat by Centre Tap. They are very helpful as one tends to forget the functions of such components as chokes, capacitors, etc., in regular use."

One of our " regulars," Malcolm Mackenzie (London, W.2), says " congratulations on the way you manage to cater for many tastes within all too little space." Malcolm would like to see the publication of some basic data on certain *modern* valves, such as EF50, 1T4 and so on. A handy booklet of such valve data is suggested. Though not a beginner himself by a long way, he feels that this data would be most helpful to those new to the game.

A. W. J. Marsh, of Newport, I.O.W., thinks we should confine space exclusively to constructional articles and Query Corner—plus data on ex-WD circuits. He thinks that " Thermionic Valves," etc., can be read from text-books and should therefore be deleted. To Centre Tap he merely says " waste of space !" Miscellaneous items such as " The Fork Aerial," he suggests, should be confined to " Short Wave News."

Writing as a beginner, Frank W. Street, of Southport, puts forward his views, and agrees that there cannot be too much emphasis on practical matters. Frank finds that, after building a set which has a spot of trouble, all known dodges fail to effect a cure. Data on what to look for and how to cure these simple troubles would be most helpful. In passing, Frank says he is amazed at " the child-like faith placed in the markings of resistors," since he has often found them to be 50 per cent. out on the marked value !

A letter from Norman F. Webb (Hall Green, Birmingham) is almost worth quoting in full ; here, then, is the main theme :—" Why not publish a handbook on the lines of the ARRL one, but for receivers only ? Material already used in the *Constructor* could be utilised. Chapter 1 should contain a description of the various components and sufficient theory to enable the beginner to understand the workings of battery, AC and AC/DC sets—superhet, TRF, short wave and BC.

" Chapter 2 could be about workshop practice, on a similar basis to the series ' Making A Start.' Chapter 3 would contain full descriptions of a number of receivers, from an 0-v-0 to a large superhet, an amplifier and a signal generator. Chapter 4 could be allocated to such items as operating, fault finding and so forth.

" With such a publication, newcomers could be referred to the Handbook and thus release a certain amount of space in the *Constructor*, which is normally set aside for such material. I think *Radio Constructor* could do this job better than anyone else, because you have hit upon the right way to present the subject and the layout, etc., cannot be beaten."

Well, there is most certainly a good idea there, Norman, and the whole bug-bear would be, of course, paper ! However, you may rest assured that we will bear the idea in mind. Thanks for the most useful suggestions.

Frank F. D. Woods, of Wembley, is another newcomer and as such finds that many things baffle him. As an example, he is building the " Economy Two," published in the January issue. The chassis layout sketch shown is "meaningless" to him as he does not know which lead goes where. The suggestion of an occasional point-to-point wiring diagram is put forward. This brings us to a point well worth raising. A so-called " practical " layout sketch is in the long run useless, for by following faithfully where each lead goes the constructor will never get an insight into the theoretical side. Providing that a theoretical diagram can be followed, all the constructor needs is a rough idea of how the components (the main ones) were distributed on the original set. Once out of the beginners class, the layout sketch is no longer necessary. Reading a theoretical diagram is a relatively simple matter and it is *essential* to be able to do this if progress is to be made. If the receiver does not work, or " goes up the spout," the constructor is absolutely beaten if he has not a basis of the theory of the circuit. A follower of a point-to-point diagram is virtually a slave to the drawing—all he knows is that R1 is joined to chassis at one end and to a valve-base terminal at the other. He does not know *why*. In this respect we are soon to publish some articles that will put the newcomer wise to the whys and wherefores of reading a theoretical circuit diagram.

The favourite articles of Frank have been "Making A Start," and Centre Tap's contributions. On the "wanted" list are articles on VHF receivers. (Regarding aerials, you will be best advised to obtain a copy of the ARRL Antenna Handbook).

A new reader is F. E. Massey (Penrith) and he points out that as everyone has his own pet interests it would be an impossibility to please them all (don't we know!). He feels that some data on BCL interference from transmitters and electrical QRM to receivers would fill a need.

The above are a few typical extracts of letters received on the subject. We will do all we can to meet the demands. Taking a general view the top in popularity would seem to be Query Corner, Making A Start, Centre Tap, The Straight Receiver. In the way of constructional articles an even balance obtains between the very simple battery receivers and the larger ones, though many ask for more AC operated receivers. Several have written asking for details of DC gear since there is still much DC mains about and DC gear has its own peculiar problems for the constructor. With a sprinkling of transmitting articles, those on test gear and miscellaneous theory the average reader seems to agree that the balance is about right.

Many thanks to all those who have written in, the ones whose letters have not been published, as well as the ones mentioned, for the assistance. Your points have all been noted and we will do our utmost to please every one of you. A difficult proposition, but we can but do our best !

W.N.S.

WHAT SIZE HOLE ?

The following table gives the tapping and clearing drill sizes for the various threads usually met by the constructor.

Drill Size.	*Tapping.*	*Clearing.*
55	10 BA	
53	9 BA	
50	8 BA	10 BA
48	$\frac{3}{32}$ W	9 BA
46	7 BA	
43	6 BA	8 BA
40	$\frac{1}{8}$ W	$\frac{3}{32}$ W
39		7 BA
38	5 BA	
34		6 BA
32	4 BA	
31	$\frac{5}{32}$ W	
30		5 BA & $\frac{1}{8}$ W
29	3 BA	
28	$\frac{3}{16}$ W	
27		4 BA
25	2 BA	
19		3 BA
17	1 BA	
$\frac{3}{16}$		2 BA
12		$\frac{3}{16}$ W
10	0 BA	
4		1 BA
B		0 BA

MULTIPLES & SUB-MULTIPLES.

Ampere (A) = 1,000 milliamperes (mA).
= 1,000,000 microamperes (μA).

Cycle (c) = 0.001 kilocycle (kcs).
= 0.000,001 megacycle (Mcs).

Farad (F) = 1,000 millifarads (mF).
= 1,000,000 microfarads (μF).
1,000,000,000,000 micro-micro-farads ($\mu\mu$F) or picofarads (pF).

Henry (H) = 1,000 millihenries (mH).
= 1,000,000 microhenries (μH).

Ohm (Ω) = 0.001 Kilohms (K Ω).
= 0.000,001 megohms (meg Ω or M Ω).

Volt (V) = 1,000,000 microvolts (μV).
= 0.001 kilovolts (kV).

Watt (W) = 1,000,000 microwatts (μW).
= 0.001 kilowatt (kW).

Measurement of High Frequencies with a 2 to 4 Mcs Wavemeter

By R. Buckeridge, G3BZA

MANY amateurs use a Heterodyne Wavemeter covering 2 to 4 Mcs. or 3 to 4 Mcs. for frequency measurement (BC221 in my case), harmonics being used for higher frequencies.

Difficulty is often found in determining the correct harmonic, and the following are the systems I have successfully used, on frequencies up to 85 Mcs. (23rd harmonic).

First to identify the frequency of an oscillator, which need not be even roughly known :—

Starting at the HF end, swing the wavemeter until a beat with the unknown is found (F_1), then carry on lowering frequency until the next beat is found (F_2).

If F_1 beats on harmonic N, then F_2 beats on harmonic (N+1).

If the unknown frequency=F_x then

$$F_x = NF_1 = (N+1)\ F_2$$
$$NF_1 = NF_2 + F_2$$
$$NF_1 - NF_2 = \frac{F_2}{N}$$
$$\text{Harmonic } N = \frac{F_2}{F_1 - F_2} \quad \text{(smallest over difference)}$$
$$\text{Thus } F_x = NF_1 = \frac{F_1\ F_2}{F_1 - F_2} \quad \text{(product over difference);}$$

though it is usually easier to determine N first, then multiply by F_1.

Example 1.

To measure an unknown frequency, where beats are found with $F_1=3.357$ Mcs. and $F_2=3.133$ Mcs.

$$F_1 - F_2 = .224. \quad N = \frac{3.133}{.224} = \text{14th harmonic of } 3.357.$$

$$\text{Frequency} = 14 \times 3.357 = 47 \text{ Mcs.}$$

Secondly, to put a receiver or oscillator on a particular frequency for calibration purposes.

The two frequencies which each produce a harmonic on the required frequency are first determined (F_1 and F_2), the wavemeter set to F_1 and the apparatus tuned to give a beat at the estimated correct setting. On tuning the wavemeter to F_2 another beat should be heard—if not the wrong harmonic has been selected. If a beat is found on the high side of F_2, the estimated setting was too high—if on the low side, too low.

Example 2.

Required to set an oscillator on 30 Mcs. Convenient values for F_1 and F_2 would be 3.750 Mcs. (8th harmonic) and 3.333 Mcs. (9th harmonic). If by mistake the oscillator was set on the 7th harmonic (26.25 Mcs.) or 9th harmonic (33.75 Mcs.) the next beat would be on 3.28 Mcs. or 3.375 Mcs. and not on 3.33 Mcs.

These two systems may seem somewhat complicated, but a few minutes figuring with pencil and paper make it very easy, and they are only used for initial calibration.

As will be seen, the accuracy of the calibration of the wavemeter sets an upper limit on the usefulness of the system, though in the case of the BC221 the limit is not reached before the harmonics (above the 25th) are too weak to give a beat.

BOOK REVIEW.

"**Standard Valves**": Published by Standard Telephones & Cables Limited (Valve Division), Connaught House, Aldwych, London, W.C.2. 320 pp., illustrated, cloth boards. 15/6 post paid.

This handbook, intended primarily for equipment designers, is eminently suitable for the more advanced readers of this journal who are interested in the experimental side of the hobby. Details are given of special valves manufactured by STC and not of ordinary receiving types.

Sections are devoted to Definitions of Terms, Cathodes, Cooling of Valves, Water Jackets, Valve Bases, Commercial Codings, etc. The Data Sheets occupy the bulk of the book and they contain a wealth of information on Diodes, Triodes, Thyratrons, Pentodes and Tetrodes, and Special Types. Amongst the latter, Cold Cathode Stabilisers, Gas Filled Relays, Vacuum Capacitors, Pulse Modulators, Velocity Modulated Oscillators, Thermal Delay Switches and X-ray Tubes are dealt with most thoroughly.

The book is excellently illustrated, with scale drawings of each valve, curves and circuits. Much of the information is normally hard to come by, especially with regard to Repeater Triodes, Grounded-Grid Triodes, Double-disc-seal Triodes, Air-Blast-Cooled Valves, Coaxial Repeater Pentodes, and the like.

Though most definitely not for the beginner, this STC book presents in a compact form a mine of technical information for those interested in advanced radio. It is a valuable addition to existing literature on valve data.

Additional loose supplements will be issued periodically on application.

W.N.S.

SMALL ADVERTISEMENTS

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

PRIVATE

UNUSED MCR1 in original box, **£10.** 3PT15 unused, 30/-.—Bever, White Farm, Ilkley.

EDDYSTONE 6-pin coils, 9-14m, 12-26m, 22-47m, 41-94m, 260-510m—**3/6** each. Two Eddystone 6-pin coil holders—**1/-** each. Two Ferranti AF3 LF transformers—**2/6** each. Four baseboard type 4-pin holders—**1/-** each. One 6-pin ditto—**1/6.** Ecko Eliminator 110v. and various tappings—**5/-.**—E. W. Jordi, 103, Gloucester Road, South Kensington, London, S.W.7.

FOR SALE. Marconiphone 10″ mains energised speaker with power pack 230v. AC in strong cabinet—**£2.** Crystal Monitor Type 4A, 100-130 Mcs., with crystals, 230v. AC input—**£2/10/0.** 14-valve home-built communications receiver, in brand new condition and only needs realignment and wiring of tuning coils; 2 RF (956 acorns), Mixer, Osc., 2 IF's, Noise limiter, S Meter, Magic Eye, etc., 230v. AC input.—**£5.** Top-band crystals (ex-AM), various frequencies, new.—**7/6** each or two for **12/6.** 100 kcs. Bliley crystals, new, suitable frequency standard, in hermetically sealed mounting.—**15/-** each. Holders, **2/-.** 12″ energised speaker, good condition—**15/-.** VCR139A CRT (Mullard 4101), 2½″ screen, new—**17/6.** Osram "Music Magnet" battery receiver, needs repair, MW and LW only—**15/-.** Write ISWL/G15, 64, Cavendish Road, Kilburn, London, N.W.6.

TRADE

VALVES—10,000 in stock. Most types available. Send for valve list, enclosing S.A.E.: Ransom, Bond Street, Brighton.

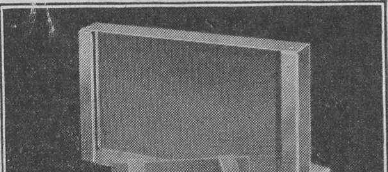
G6MN for the "best" QSL's and approved log books, send for samples: G6MN, Bridge Street, Worksop, Notts.

COPPER WIRE. Enamelled, Tinned, Cotton, Silk-covered. All gauges. Screws, nuts, washers, soldering tags, eyelets. Ebonite and laminated Bakelite panels. Coil formers. Covered wires, earphones, etc. List S.A.E. Post Radio Supplies, 33, Bourne Gardens, London, E.4

COILS, CONDENSERS, VALVES, RESISTORS, Etc. New Goods, also Surplus Stock. Any Component supplied. Quick service. Send stamp for list.—Smith, 98, West End Road, Morecambe, Lancs.

CANNY CONSTRUCTION

—BUT NOT TIN-CANNY



The studied design of the FB chassis ensures the utmost rigidity and convenience because it was developed by Radio Engineers for Radio Engineers

AND

at a price to suit the pocket of every Radio Amateur.

PERSONAL SERVICE. Send us details of your chassis problems, Our Designer is at your service.

17″ x 10″ x 2½″	...	**9/-**
10″ x 8½″ x 2½″	...	**6/6**
8½″ x 5″ x 2½″	—	**5/-**

Panel Brackets **1/3** pair

Chassis punched to your template at small extra cost.

Post and Packing, 1/- extra. Delivery by return of above sizes. Other sizes, prices in proportion. Delivery 2 to 3 days.

FB PRODUCTS

41 CARLISLE STREET,
BRADFORD, YORKS.