The Wireless Constructor

6D MONTHLY

EDITED BY
PERCY W. HARRIS. M.I.R.E.

VOL. V. JANUARY, 1928 No. 15

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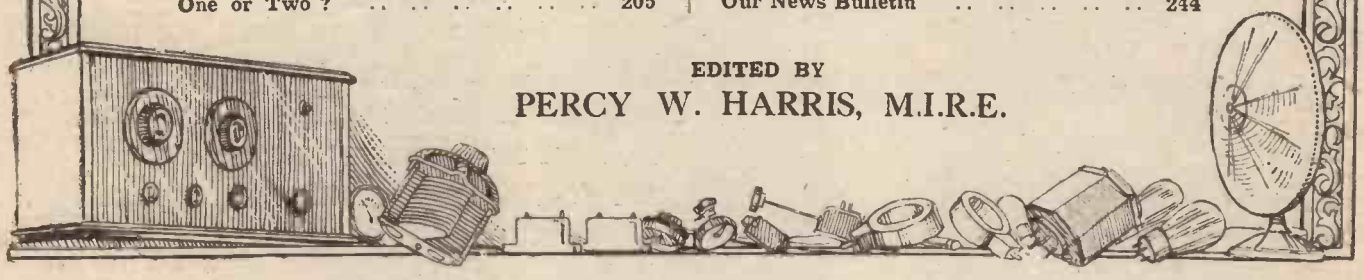

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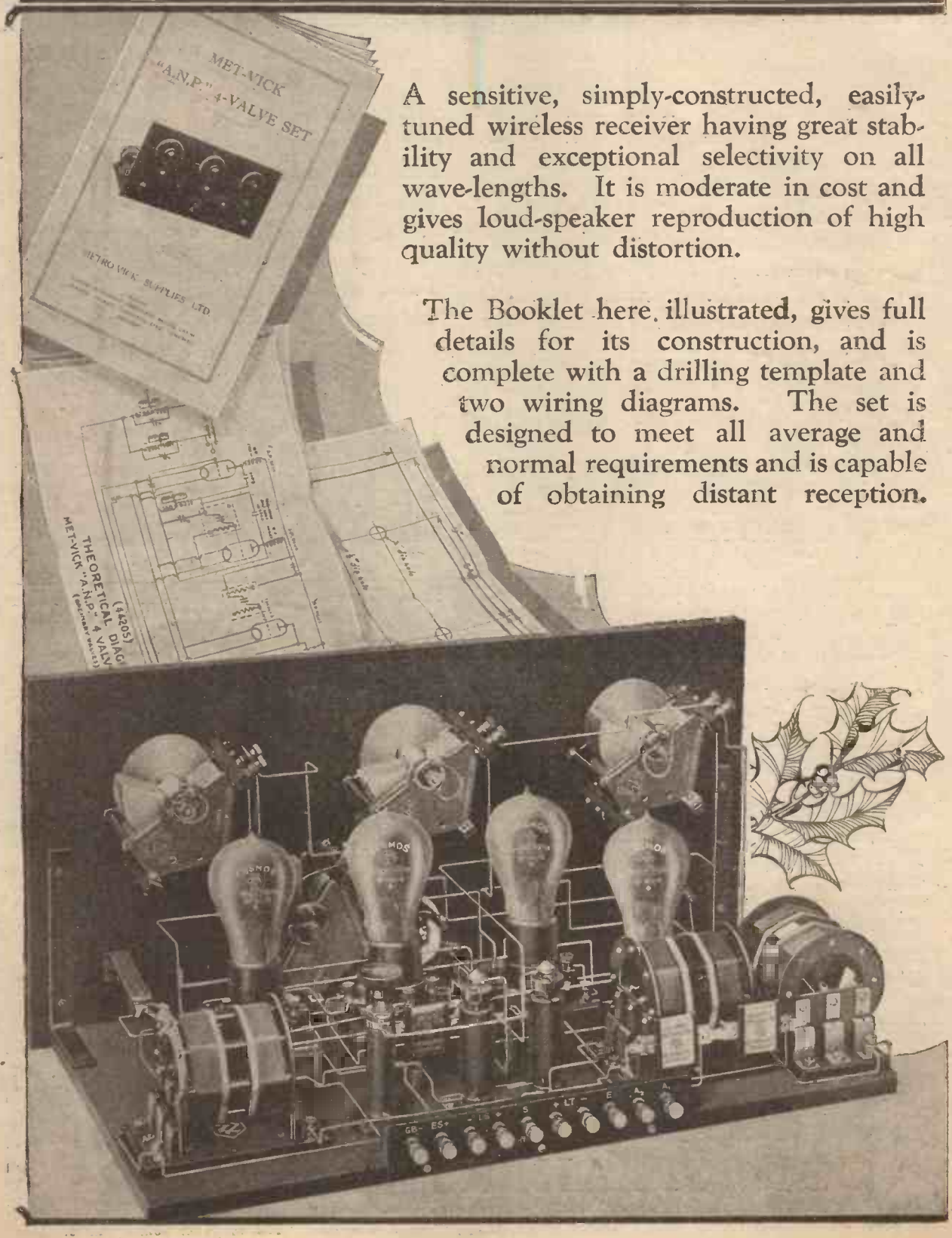
THE MET-VICK 4-VALVE A.N.P.



A sensitive, simply-constructed, easily-tuned wireless receiver having great stability and exceptional selectivity on all wave-lengths. It is moderate in cost and gives loud-speaker reproduction of high quality without distortion.

The Booklet here illustrated, gives full details for its construction, and is complete with a drilling template and two wiring diagrams. The set is designed to meet all average and normal requirements and is capable of obtaining distant reception.

CONSTRUCTOR SET

The components required are similar to those used in the Met-Vick 3-Valve Local-Daventry Set, and the principal units are listed in the adjoining panel.

The special characteristics of the set are obtained as follows:—

SENSITIVITY by *(a)* the use of a Cosmos H.F. Blue Spot Valve of High Voltage Factor and *(b)* Met-Vick Low-loss Coils (A.N.P.) & Condensers.

SELECTIVITY by employing a loose coupled tuned Aerial and Reaction.

ALL WAVE-LENGTHS by the use of the requisite number of Met-Vick Low-loss A.N.P. Coils which are readily inserted or withdrawn from clips.

GOOD QUALITY REPRODUCTION by the use of Cosmos Detector and Resistance Coupling Units.

EASE OF TUNING by employing *(a)* a 2-Control Circuit for normal work and *(b)* a 3-Control Circuit for selective work.

STABILITY by the use of *(a)* Cosmos A.N.P. Coils which are Non-parasitic and *(b)* a balanced H.F. circuit.

A Booklet is also available giving similar details of the "Met-Vick" A.N.P. 4-Valve Set embodying Cosmos A.C. Valves for working off the electric light mains.

COSMOS (MET-VICK) COMPONENTS USED

	EACH
3 VARIABLE CONDENSERS SLOW MOTION .0005	11 6
1 DETECTOR UNIT TYPE "V"	9 0
2 RESISTANCE COUPLING UNITS TYPE "V"	10 6
2 H.F. CHOKE COILS	6 6
1 PERMACON .001	1 3
3 " .0002	1 6
1 RESISTANCE	1 6
3 A.N.P. COILS [B.B.C.]	6 6
3 A.N.P. COILS [LONG WAVE]	10 6
1 BATTERY SWITCH	3 6
1 FILAMENT RHEOSTAT	2 6

"COSMOS" SHORTPATH VALVES EITHER FOR 2-VOLT OR 6-VOLT

3 BLUE SPOTS 10/6 EACH

1 RED SPOT 12/6 EACH

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(Proprietors: Metropolitan-Vickers Electrical Co. Ltd.)

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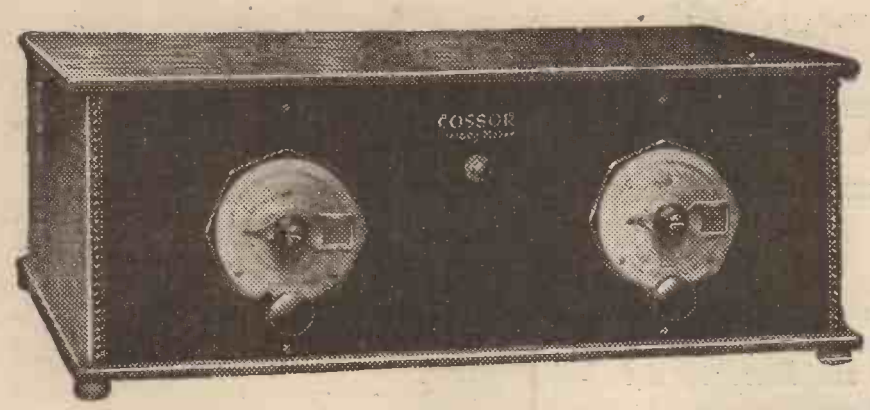

THE "Melody Maker" OWES ITS SENSATIONAL SUCCESS TO ITS Cossor VALVES

NOT since Broadcasting began has there been such an astounding success as the wonderful Cossor "Melody Maker." Tens of thousands have already been built—manufacturers of components specified are all working at top speed to keep pace with the phenomenal demand. Many shops have a waiting list of customers wanting to buy the parts for the Cossor "Melody Maker." It's the sensation of the season. And a large share of this success is due to its Cossor Valves. Without Cossor Valves there could have been no Cossor "Melody Maker." No matter which type of Set you are using you'll get better results with Cossor Valves.

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Send a postcard for a copy of the full size chart "How to build the wonderful Cossor "Melody Maker." As simple as Meccano. No soldering. Every wire shown full size, numbered and bent to shape. Impossible to go wrong. Success guaranteed. Build it in an evening. Gets Broadcasting from six countries. Mark your postcard Dept. W.C. A. C. Cossor, Ltd., Highbury Grove, London, N.5.

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CA 9902

The WIRELESS CONSTRUCTOR

Edited by
PERCY W. HARRIS,
M.I.R.E.

Published by the Amalgamated Press, Fleetway House, Farringdon Street, E.C.4.

THE EDITOR'S CHAT

Percy W. Harris, M.I.R.E., the Editor of "The Wireless Constructor," has something to say about short-wave reception and other seasonable topics.

IN order that the WIRELESS CONSTRUCTOR may be in the hands of all readers by the 15th, the articles have, of course, to be prepared some time in advance. Actually I am writing these notes just as the December issue appears on the bookstalls. For this reason it is not possible, save as "stop press," to publish further reports in the present issue from secretaries of wireless societies regarding the "Straight Line" Four. While it is most unusual to publish what may be termed a "star" set without a detailed test report by the designer, as explained in our last issue the powers of the "Straight Line" Four are so great that it calls for some different treatment from the conventional list of "stations received." The reports published in the December issue from the secretaries of the Luton, Thornton Heath and Wembley wireless societies, who were given advance invitations, must have already whetted the appetites of thousands. Next month a further selection of reports will be published. Meanwhile, further particulars regarding the receiver will be found on another page.

The Short-Wave Three

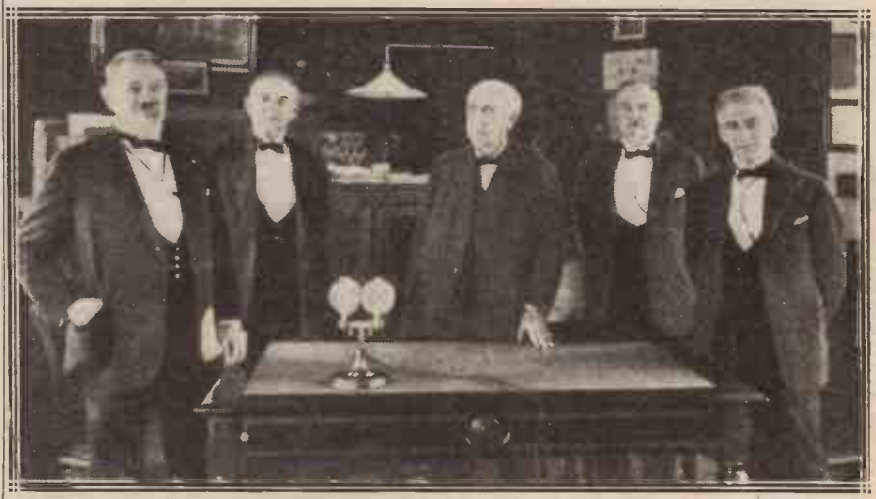
The astonishing popularity of the Radiano Short-wave set—I use the word "astonishing" because short-wave reception is a comparatively new field of endeavour for the average reader—has led to the demand for a more powerful "short-waver" capable of giving the range of long-distance reception for which the short waves are distinguished, but with real loud-speaker instead of telephone strength. The "Short-Wave Three," including two stages of note-magnification and sundry refinements and general improvements, has thus been designed, and is published in this issue. It is, in fact, a "short-wave de luxe" receiver, and will give, when conditions are reasonably favourable, loud-speaker results clearly audible anywhere in a large room from 2 F C, Sydney, Australia; 2 X A F and 2 X A D (the short-wave stations of the General Electric Company, Schenectady, New York, which relay the broadcast programme from W G Y); K D K A (the world-famous short-wave transmitting station of the Westinghouse Electric Co. at Pittsburg), and a number of others.

Although primarily designed for loud-speaker work, provision is made for plugging in a pair of telephones after the detector valve, thus converting it into a one-valve short-wave set; and, of course, for very weak stations telephones can be connected to the loud-speaker terminals.

Down to 15 Metres

Another interesting little point about this receiver is its extreme wave-length range, as it goes down easily to about 15 metres and can in addition be used for the reception of stations on the ordinary broadcast wave-length, provided an additional coil is obtained.

Regular listeners who are in the habit of using one of the many sets for long-distance reception described



T. A. Edison (centre), the world-famous inventor, broadcasting for the first time from his laboratory at West Orange, N.J.

The Editor's Chat—*continued*

from time to time in this journal are well aware of the multiplicity of stations that can now be heard every evening. At one time—and not very long ago—the general position on a dial would be a rough indication of the identity of a station, as we all knew that there was but one station near that particular tuning point!

What Station Is That?

At the present time conditions are quite different, and, save with an accurately calibrated set, it is impossible to identify stations by such a simple method. A wave-meter thus becomes a necessity to every conscientious experimenter, and I am pleased to be able to announce that next month I hope to publish a sound design by Mr. A. V. D. Hort which, incidentally, gets away from one of the chief troubles of home-made wave-meters — the Buzzer. There are, of course, good buzzers, but the great majority of these little devices obstinately refuse to function at the most important time.

The special method of obtaining modulation in the wave-meter designed by Mr. Hort removes the necessity for employing any buzzer, and has the distinct advantage that the instrument is silent as far as mechanical noises are concerned. There is thus no risk of confusing the outside sound of the buzzer with its electrical indication.

A Timely Tip

If you have any friends who are not yet regular readers of the WIRELESS CONSTRUCTOR, tell them to start buying it with the next issue, which will contain many new and specially interesting features, together with a very valuable free gift of the greatest use to every reader. I am not able to reveal at the present moment the exact nature of the gift, but when you see it you will agree with me that it is really a most valuable and important present for every home-constructor such as has never previously been offered as a free gift. The demand for this issue is sure to be considerably enhanced, and although provision is being made for a much larger number to be printed, I advise you not to take any risks, but to place your order at once with your newsagent to avoid disappointment.

Changing to a frame aerial on the "Straight Line" Four is but the work of a moment or two. Further notes appear in this issue supplementing the constructional details published last month.

A "THREE" FOR THE NEW VALVE.

Dear Sir,—As one who has followed your articles and designs in the wireless Press probably as long as anyone, I have invariably found that a receiver built from your design was a good one.

We have advanced considerably since 1902, and I have just finished your three-valver incorporating the screened-grid high-frequency valve. As usual I made a perfect copy, and got excellent results the first switch on. It is interesting coming straight off the detector on to a low-impedance valve (P.M.256) with 120 volts on the plate and the new R.I. transformer. This gives quite perfect reception on the local station, 5 X X, and when I tell you that I have a Rice-Kellogg loud speaker, you will realise how perfect the output from the set must be.

Yours faithfully,
"EAST ANGLIAN."

"IT STANDS ALONE."

Sir,—A few days ago I built the set described in the November issue of "Wireless Constructor," viz., "A 'Three' for the New Valve."

The results obtained are remarkable. Station after station comes in at enormous volume. Easy to build and operate, it is a receiver which should appeal to those who want really good loud-speaker results from both English and foreign stations. I have not given a list of stations heard as these are so numerous, in fact it would appear that only atmospheric conditions limit the set's capabilities.

I have had experience with many designs but this set in its class stands alone.

Just a little more selectivity and it could be aptly named the "Perfect Three."

Yours truly,
E. C. BARNETT.
Douglas, I.O.M.

The "SHORT-WAVE THREE"

by PERCY W. HARRIS M.I.R.E

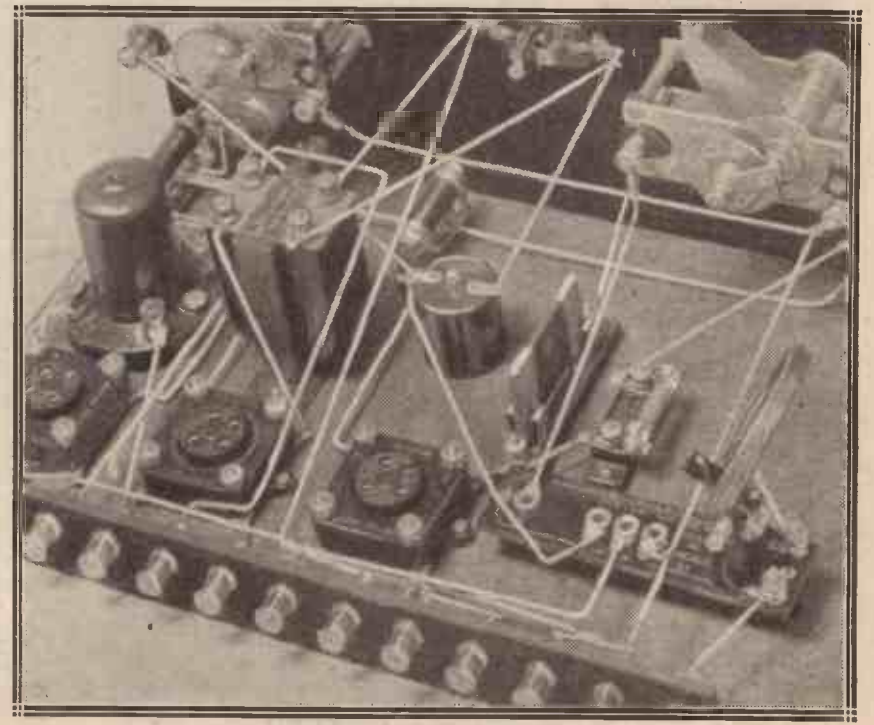
Receiving short-waves is one of the most fascinating branches of wireless. This set—which is easy to make up and to operate—will give American and Australian broadcasting direct on the loud speaker. By changing one coil it is suitable for the ordinary broadcast band of wave-lengths.

THE development of short-wave communication has been very rapid during the last few months, and at the present time there are, broadcasting on wave-lengths below 100 metres, more stations than could be received on the ordinary broadcast band with any but a very sensitive receiver for some time after the broadcasting boom began. The really astounding efficiency of short-wave transmission and reception makes it possible to receive signals over very long distances with a small number of valves, and without any high-frequency valve preceding the detector.

LIST OF COMPONENTS.

The components given below are those actually used in the receiver illustrated. Obviously most of the components can be chosen with equal efficiency from a number of makes.

1 Panel 16 in. × 8 in., mahogany finish (Ebonart).
1 Set of Aero short-wave coils, 1 Aero choke (Rothermel Radio Corporation, Ltd.). (A coil for the broadcast band can also be supplied.)
2 Variable condensers with verniers, ·00035 mfd. (Jackson Bros.). (Other makes of ·0003 mfd. would do.)
1 Potentiometer for panel mounting (Lissen).
1 Double-circuit jack (Lotus).
1 Plug for same (Lotus).
1 On-and-off switch (Igranic).
1 Cabinet to take 16 in. × 8 in. panel with 9-in. baseboard. (Cameo, Pickett, Arteraft, Makerimport, etc., all make suitable cabinets for this purpose).
3 Anti-phonic valve sockets (Benjamin).
3 Fixed resistors to suit valves used (Tempryte).
1 Grid-leak holder with 4-megohm leak (Dubilier, Igranic, Lissen, Mullard, etc.).
1 Fixed condenser with clips, ·0001 mfd. (McMichael).
1 L.F. transformer (Brandes).
1 R.C.C. unit (Mullard).
1 Terminal strip with terminals for aerial, earth, L.T.—, L.T.+, H.T.—, H.T.+1 and 2, grid bias +, grid bias — 1 and 2, and loud speaker + and — (Magnum).
Glazite wire.



A close-up of the wiring of the H.F. end of the receiver.

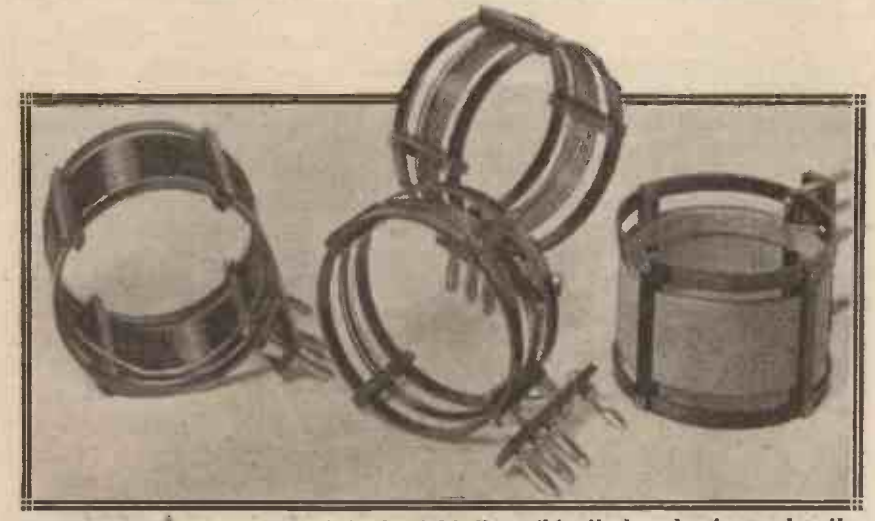
That short-wave reception is both simple and very popular is proved by the astounding success of the Radiano short-wave receiver, described in the WIRELESS CONSTRUCTOR for June last. Many appreciations of this set are published in the current issue, and, as reception has proved so exceedingly good on telephones with this set, there has grown up a demand for a receiver with one more stage of note magnification to enable the long-distance results to be turned on to the speaker, so that the family may share the experimenter's success. The "Short-Wave Three" is the result.

The "Short-Wave Three" uses the same circuit as the Radiano short-wave set, but utilises different coils which possess certain distinct

The "Short-Wave Three"—*continued*

advantages (which will be named later), a jack arrangement by which one can listen on one valve only for searching purposes, and an additional stage of low-frequency magnification to give much greater volume. There are also a number of minor yet important modifications in design and layout which experience has shown makes for increased efficiency, and which justifies the receiver being called a "de luxe" model. It is thus not merely an addition of a further stage of note magnification to the Radiano Two, but is a distinct improvement in several respects.

The chief improvements relate to the coils used. The design of these coils has been worked out particularly well by the makers. A single aerial coil is used for all wave-length ranges from about 15 to 130 metres, and the coupling of this coil to the grid coil is variable. The interchangeable portion is a combination of grid and reaction coils, the grid coil being a single-layer winding, air-spaced and with a very minimum of solid dielectric material in the field. The number of turns is arranged so that each range overlaps the previous one.



The three short-wave coils and, to the right, the coil for the broadcast wave-lengths.

The Coils Used

The chief merit, however, is in the design of the reaction winding. It has been worked out and spaced so carefully that one setting of the reaction condenser serves for a very wide band of waves, and, what is still more important, variations of the reaction condenser make a very slight alteration of the main tuning. On the very short waves, such as 2 X A F, Sydney, Australia, this advantage becomes very marked, compared with some makes of short-wave coils. For the benefit of those readers who would like to try their hand at the home construction of these coils, the turn numbers are given later.

Special Features

Most readers, however, will probably prefer to buy the ready-made set, owing to the facility with which they may be rapidly changed in passing from one wave-band to another. The makers also supply coils fitting into the same socket for the ordinary broadcast band, but not for the Daventry band.

In the theoretical circuit the high-frequency portion has been drawn slightly differently from the usual way, to show the relative positions of the grid and reaction coils. Those readers who care to turn to page 78 of the June issue and compare it with the short-wave Radiano set, will see that, theoretically, the arrangement of the aerial, grid, and reaction coils is the same; but, in practice, the dimensions of the grid and reaction coils are different.

In both the short-wave Radiano and the "Short-Wave Three" the radio-frequency choke is connected to the reaction condenser, and not the plate, as is frequently done in short-wave circuits; this arrangement, in both the Radiano short-wave and the "Short-Wave Three," being one which I have personally found to be particularly efficient. Another slight difference between the two circuits relates to the position of the grid leak. In the Radiano short-waver the grid leak is connected across the grid condenser and on the earth side to a slider of a potentiometer, a fixed condenser of ·002 mfd. being used to provide a high-frequency by-pass.

In the "Short-Wave Three" the grid leak is taken direct to the slider of a potentiometer, and the grid return from the coil and condenser is taken straight to negative L.T. This arrangement enables one to dispense with the fixed condenser, and thus slightly simplify the wiring.

A Universal Choke

The radio-frequency choke used in the present receiver is made by the manufacturers of the coils especially to go with them, and is certainly an excellent choke right down to the shortest waves for which it can be used. An unsuitable radio-frequency choke in a set such as this may give a good deal of trouble. In the short-wave Radiano set interchangeable plug-in coils were used, and in the present receiver the use of a single choke dispenses with the need of making any choke alteration when changing from one wave-band to another, even down to 15 metres. It is remarkably uniform in this respect, and shows no "bumps" or "flat spots"—no small advantage when general searching is taking place.

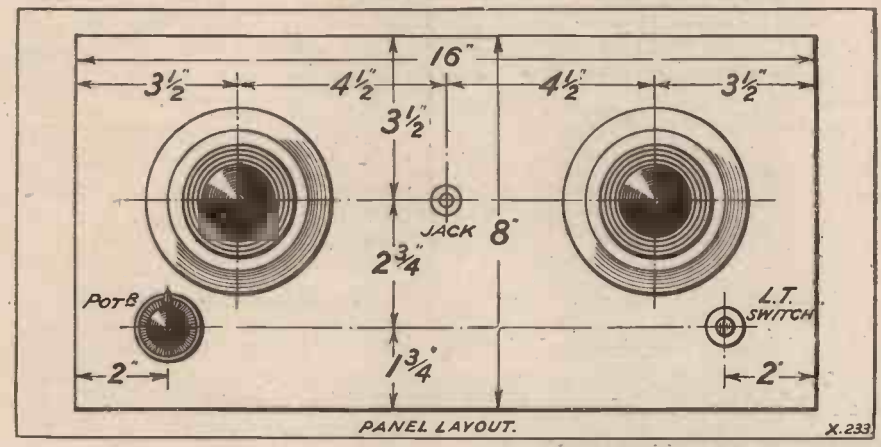
Following the radio-frequency choke a jack is seen, so that telephones can be plugged in immediately after the detector valve. The first stage of magnification is transformer-coupled, and the second resistance-coupled: rather the reverse of the usual procedure, for in most cases the resistance coupling follows the detector and the transformer coupling comes last of all. The reasons for the change in the present receiver may be of interest, and will be explained at once.

The L.F. Stages

In critically designed coils for short-wave work incorporating a reaction winding it is essential that they be used with either the valve for which they were designed or one having closely similar characteristics. In order to obtain the reaction effect, which is obviously partly magnetic, a certain current must flow through reaction winding.

The "Short-Wave Three"—*continued*

Now, if we were to use resistance coupling to join the detector to the first note-magnifying valve, it is obvious that the detector valve would have to be one suitable for resistance coupling, i.e. a high-magnification, high-impedance valve. Such a high-impedance valve passes a very small anode current, and it would not be possible to get satisfactory reaction effects with coils designed for a valve of medium or low impedance.



Plugging-in 'Phones

The second very important point relates to the plugging-in of the telephones. Telephones are of relatively low resistance, and if we substituted for, say, a 100,000 or 250,000-ohm resistance a pair of telephones of, say, 4,000-ohm resistance, the insertion of these telephones would completely upset the adjustment of the detector valve. By substituting the telephones for the primary of a transformer the change made by the insertion is very slight, and it is barely noticeable on the very shortest waves.

Practical Points

Usually a transformer coupling can deal with powerful signals with less distortion than a resistance unit (this is not always the case), but in the present case we are not likely to receive signals so strong that any trouble with the resistance coupling from overloading is likely to arise. There are thus no practical disadvantages, and many advantages, in making the transformer coupling first and the resistance coupling second in this particular set. While there is no reason why one should not use two transformer couplings, the combination of one transformer and one resistance coupling makes for excellent purity, and very largely reduces the risk of audio-frequency howling which occasionally occurs when two transformer couplings are used.

So much for the theoretical circuit and the reasons for the arrangements made. Let us now consider a few practical points, and see how they work out.

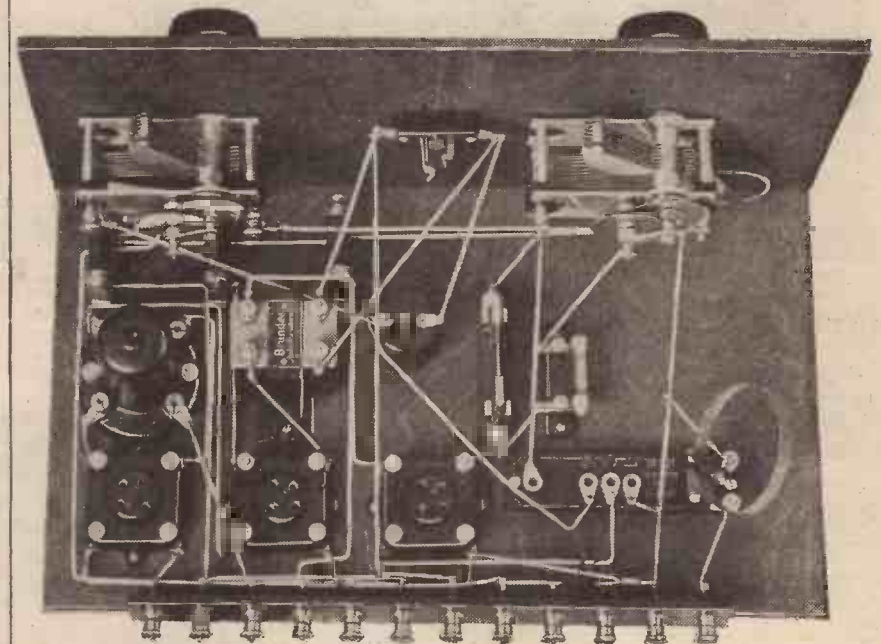
Although a number of readers have received Sydney direct on the Radiano Two, a certain amount of skilful manipulation is necessary with this receiver in order to obtain such results. On the "Short-Wave Three," Sydney can be received direct on the loud speaker with much greater ease than can KDKA on the Radiano Two.

The particular coils used, of course, account for this to some extent, and the choice of suitable vernier condensers for both tuning and reaction condensers also contributes. As there is a complete absence of hand-capacity effects in this set, it does not matter whether one uses condensers with exterior vernier dials or, as in the actual instrument illustrated, condensers with built-in vernier arrangements. All condensers, however, are by no means equally suitable for short-wave work.

Variable Condensers

There are a number of excellent makes available, however, and if one chooses a condenser of the modern low-loss variety, in which the moving plates are connected to the metal end-plates and the fixed plates supported on good insulating material in such a way that the solid dielectric is out of the concentrated field, you will not go far wrong. The Jackson condensers used in this set are very good examples of really efficient condensers at quite modest prices, while the vernier arrangements on these condensers are particularly suitable for short-wave work.

Another refinement in this receiver is the provision of an interchangeable



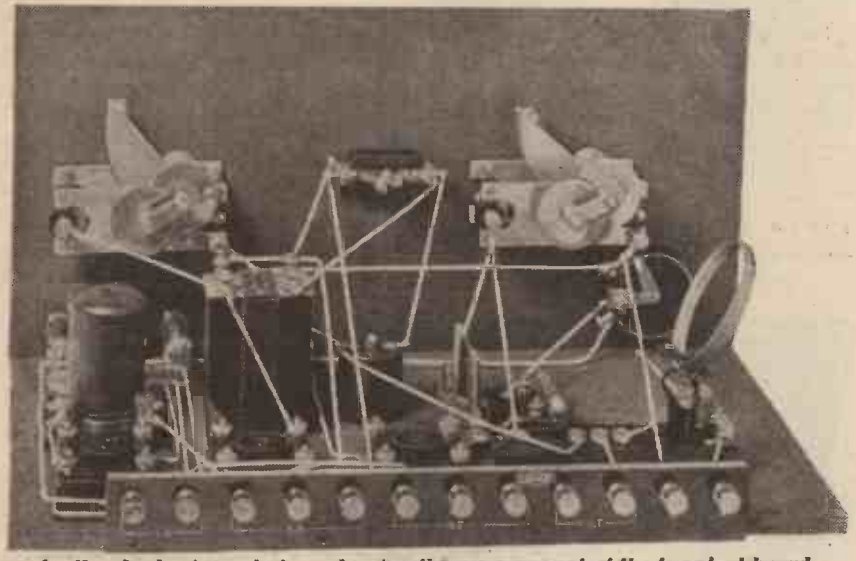
A plan view of the wiring of the "Short-Wave Three."

The "Short-Wave Three"—*continued*

grid condenser. On the very shortest waves a ·0001 mid. is often the most suitable value, while on longer waves a ·0002 or ·0003 mfd. is quite suitable. It is just as well, too, to carry out a few experiments with grid leaks, for while a 4-megohm leak will serve in practically all cases, it is interesting to try the effect of a 3- or a 2-megohm at times.

The L.F. Components

So far as the general choice of components is concerned, any good low-frequency transformer and any good resistance-capacity coupling unit can be chosen. The new Mullard R.C. unit functions very well in this set. The valve sockets must be of good quality, and of the antiphonic type. As much of the battery wiring has been deliberately "bunched"



Another back-of-panel view, showing the arrangement of the terminal board.

(these leads are all at earth potential so far as radio-frequency current is concerned), it is highly advisable to use insulated wire, such as Glazite, or to use Systoflex sleeving over the bare wire.

Positions of Components

While the layout of the low-frequency side can be slightly varied, the relative positions of parts on the high-frequency side, i.e. the first half of the baseboard looking from the front, should be rigidly adhered to, for if a narrower baseboard is used the coils will be brought too near the tuning condenser, and a deeper baseboard would make the leads too long, In order that the wiring at this end of the set may be carefully copied, this section has been separately photographed.

Dial Readings

As calibrating a short-wave receiver is rather a laborious task, a few calibration points are given at the end of this article, so that if the reader uses the actual coils specified and the particular make of condenser and follows the layout carefully, his readings should be practically the same as those given. What variations do exist will be so slight that the station aimed for will be found in a few seconds after setting each tuning dial to the figures given.

Valves Recommended

The first valve should be one having an impedance of about 8,000 to 10,000. Typical and suitable valves in the 6-volt class are (in alphabetical order): B.T.H. B.4., Cossor 610 L.F., Ediswan E. S.5 L.F., Marconi D.E.5, Mullard D.F.A.1, Osram D.E.5, Six-Sixty S.S.4. The nearest equivalents of these valves in the 4- and 2-volt classes will also work well, while quite satisfactory results are obtainable on a number of valves somewhat outside the rating given.

Valves given above have been chosen among the makes as those comparable in general characteristics with the American valve for which the coils were designed. If you do not happen to possess any of the valves named, try your own in the set. If you obtain a perfectly smooth control of reaction the valves will quite probably be satisfactory.

So far as the second and third valves are concerned, the second should always be one of the R.C. variety, and the third an ordinary power valve. There is no need to use a super-power valve in this output stage, as normally the set will not be used for the reception of very loud signals on the local station, and the small-power valves have a higher magnification factor than the super-power valves. Thus they will give you a stronger signal provided you do not get a very great volume.

The constructional work should be begun on the baseboard, and, indeed, most of the wiring can be carried out before the front panel is attached. The wiring of the front panel to the baseboard components is quite open, and there are no awkward parts to get at. Clean sound joints should always be aimed at in any short-wave receiver. A good, clean pressure joint under a terminal is much preferable to a badly-made soldered contact.

Operation Notes

Join up your batteries but do not switch on, connect aerial and earth and loud speaker. H.T.+2 should have the maximum potential of your high-tension battery up to 120 volts. I do not recommend the use of less than 100 volts, as a resistance-capacity valve is being used. H.T. + 1 will have to be varied by trial, and generally will be found to be most satisfactory between 30 and 45 volts. One and a half volts will be ample grid bias for G.B.—1. G.B.—2 should be chosen according to the maker's specification for the valve used in the last stage and the voltage applied to its anode from the H.T. battery.

Set the potentiometer slider fully to the negative side (this means when the slider is nearly to the terminal connected to the moving plates of the variable condenser). Insert a ·0002-mfd. condenser in the clips and a 4-megohm grid leak in the proper place. Insert the coil with eight turns, adjust the aerial coil at a slight angle to the interchangeable coil, set the reaction condenser to zero, the tuning condenser to zero, and switch on.

Now turn the reaction condenser slowly upwards from minimum and you should hear the set going into

The "Short-Wave Three"—*continued*

oscillation, this state being indicated by a slight rustling in the loud speaker. It should not go in with a "plop," nor should you hear what is called a "threshold howl"—that is to say, a grunting or squawking noise just as the set starts to oscillate. To obtain smooth reaction you may need to move the slider of the potentiometer and also to try the most suitable voltage on your H.T. battery for H.T.+1.

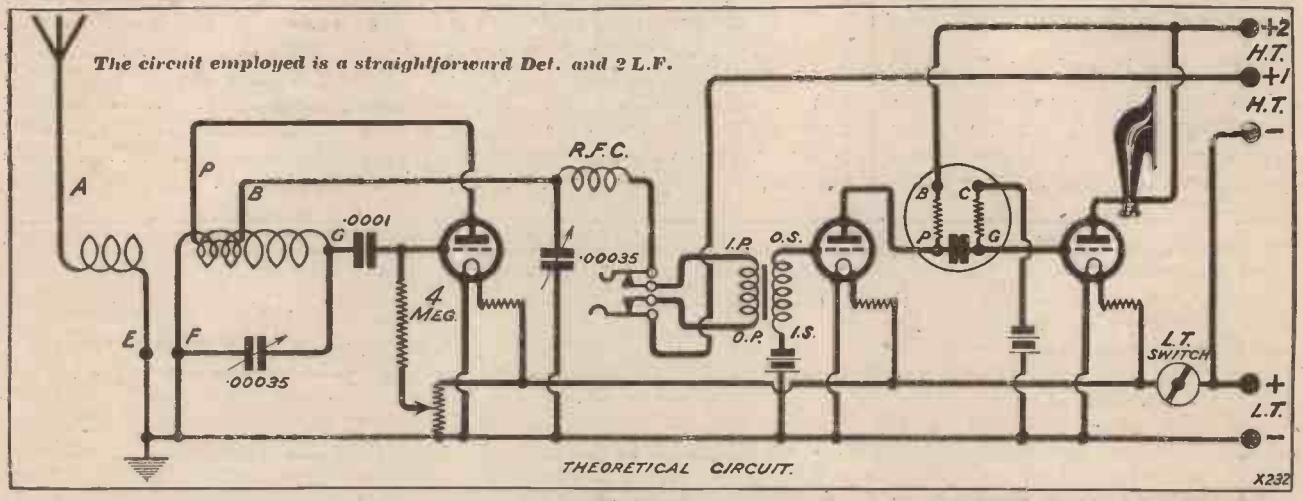
Tuning-in a Station

As indicated above, somewhere between 30 and 45 volts will suit, and, provided you get smooth reaction and no threshold howl, the higher the voltage the better. Try the adjustment of reaction for various settings of the tuning condenser up to about 140 deg. It is not necessary to use this condenser at higher readings than that, as you will come well within the overlap of the next coil. By suitably adjusting the potentiometer and H.T. + 1 you should obtain a delightfully smooth reaction—so smooth, in fact, that you will scarcely hear when the set goes into oscillation.

The coil with eight turns should tune from just below 2 X A F (32·77 metres) up to well above K D K A, which works on a wave-length of about 62 metres. You will find 2 X A F, when it is working (nearly every evening after about ten o'clock it will come in well), within the first few degrees of the tuning condenser. Actually on my set it is found at 9 deg. Pick up the carrier-wave by oscillating slightly, and directly you hear it and have reached the zero point slacken back the reaction until you are just below the oscillation point.

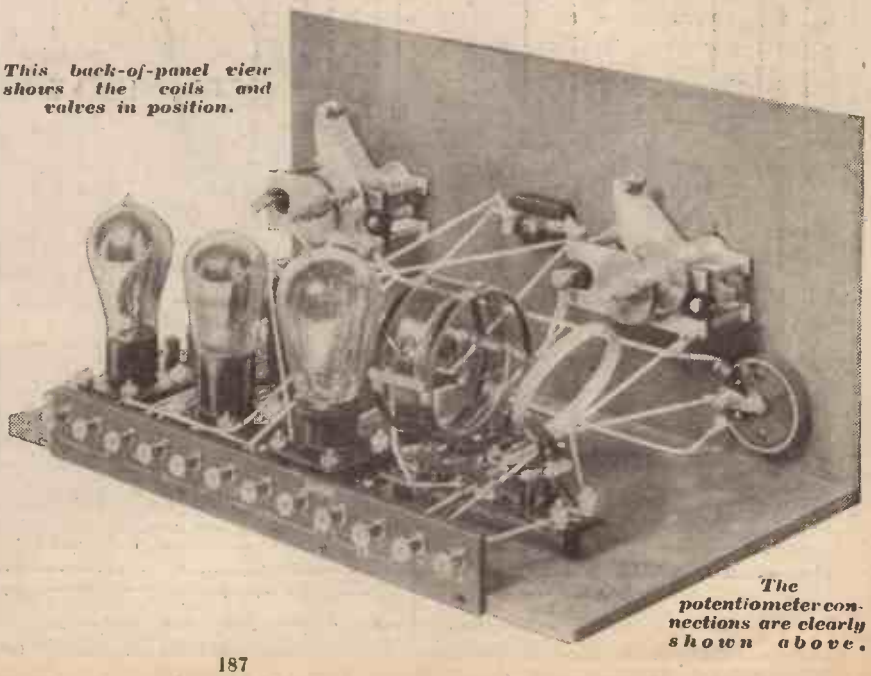
A very slight re-tuning will then bring in this station quite clearly. Fortunately they announce themselves very regularly as the General Electric Company, Schenectady, New York, often giving W G Y as their call, so that you will have no difficulty in identifying the station. Similarly, K D K A will be found about 131 deg. on this coil, and, of course, a whole host of amateurs working either 'phone or continuous-wave signals come in. You will also find K D K A on the next larger coil at the lower end.

Sydney will be found on the three-turn coil at about 110 or 115 deg. This station was picked up within five minutes of trying, the strength being slightly less than is generally obtainable on 2 X A F. On numerous occasions 2 X A F can be heard on the loud speaker at such a strength as to be followed outside the room when the door is shut. K D K A will be similarly loud at times.



Of course, it is not necessary to use the telephones and many readers will care to operate the set entirely without resorting to this form of reception, but it is useful when one is searching round for distant stations and it is not desired to disturb the other occupants of the room.

Immediately on withdrawing the 'phone plug the set is automatically switched on to the loud speaker, only a very slight adjustment of tuning reaction being made necessary, and that not always, by the change.



This back-of-panel view shows the coils and valves in position.

The potentiometer connections are clearly shown above.

The "Short-Wave Three"—*continued*

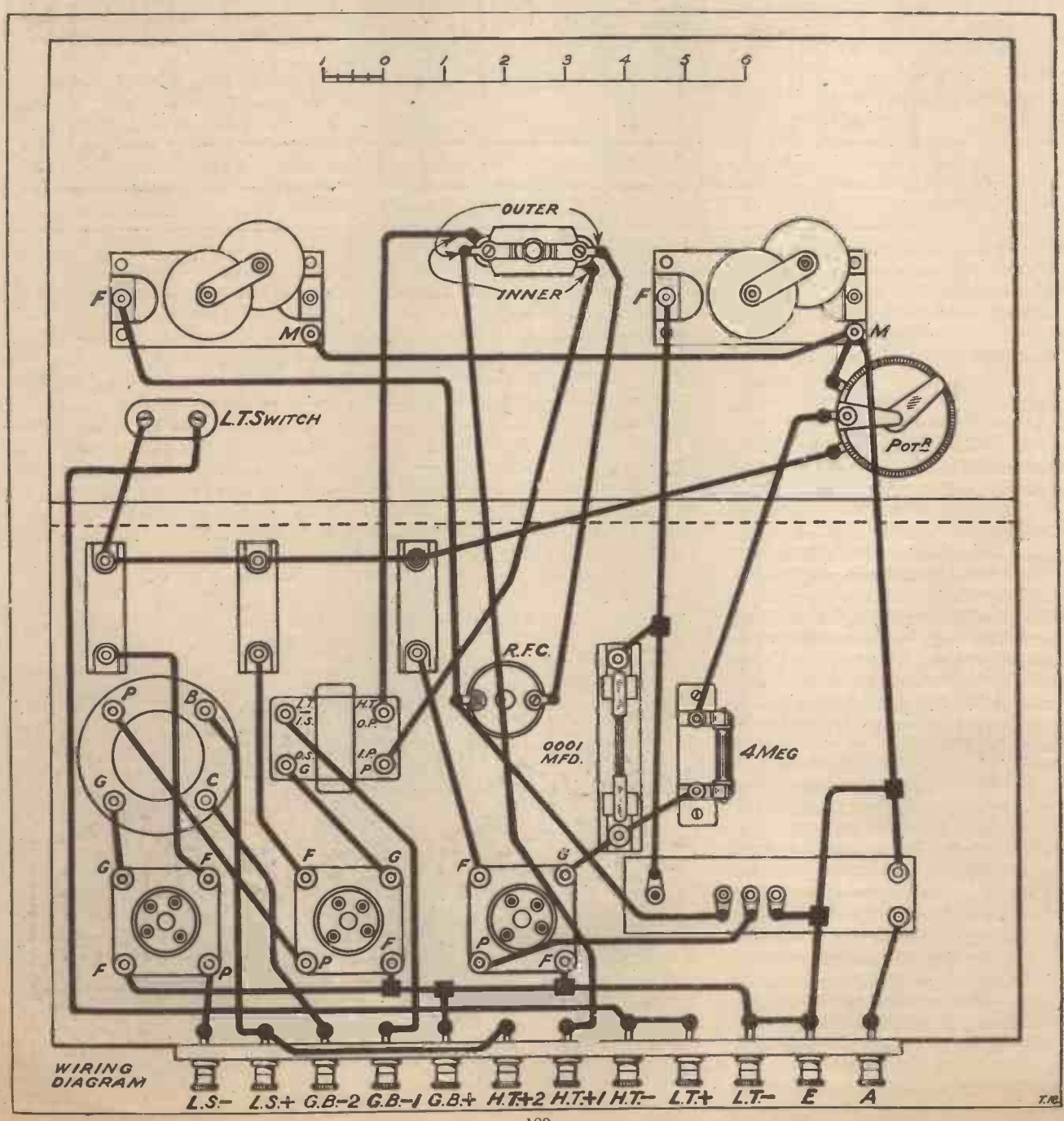
On the three-turn coil several of the beam stations will be picked up. Their high-speed Morse gives a continuous "burr-r-r" with occasional slow-speed hand signalling between long stretches of "automatic."

On the Broadcast Band

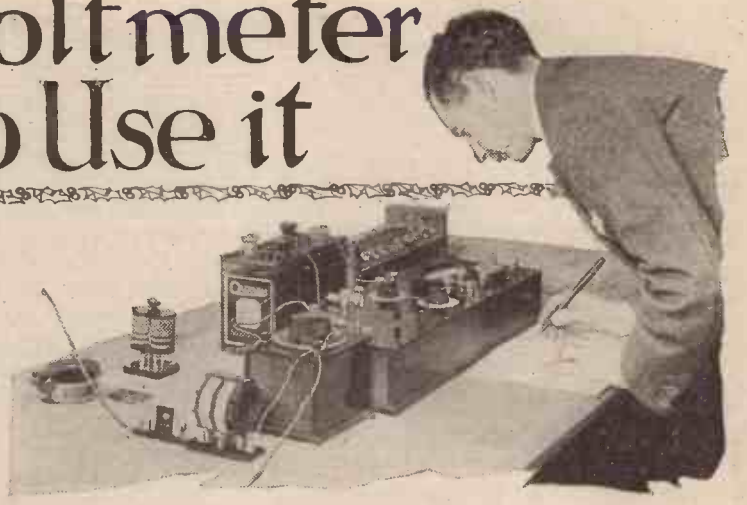
The best stations to practice on are KDKA and 2XAF, as they both come in on the same coil, and are both very regular in their transmissions. Of course, conditions vary, but these stations will practically always be heard on the loud speaker, at times their strength being really tremendous.

If, of course, the reader has a knowledge of the Morse code he will derive great interest from the reception of signals from the numerous American amateurs who are working regularly. One of the fascinations of short-wave reception is that the strength of signal is no indication of distance.

Operation of this set on the ordinary broadcast band is, of course, extremely simple, but it will be necessary to make the coupling of the aerial coil to the grid coil as tight as possible, in order to get adequate strength. Owing to the very loose coupling used, the selectivity is very high on the broadcast band, at some sacrifice of signal strength.



The Valve Voltmeter and How to Use it



With this fascinating instrument it is possible to measure the aerial's input to the set, and to trace the amplification of the receiver stage by stage.

By W. JAMES.

IT is fairly safe to say that very soon after a man installs a valve receiver he buys a voltmeter. He knows that the safest way of finding whether his H.T. battery is run down or his filament heating accumulator is discharged is by measuring its voltage. To do this he must have that simple and inexpensive instrument known as a voltmeter.

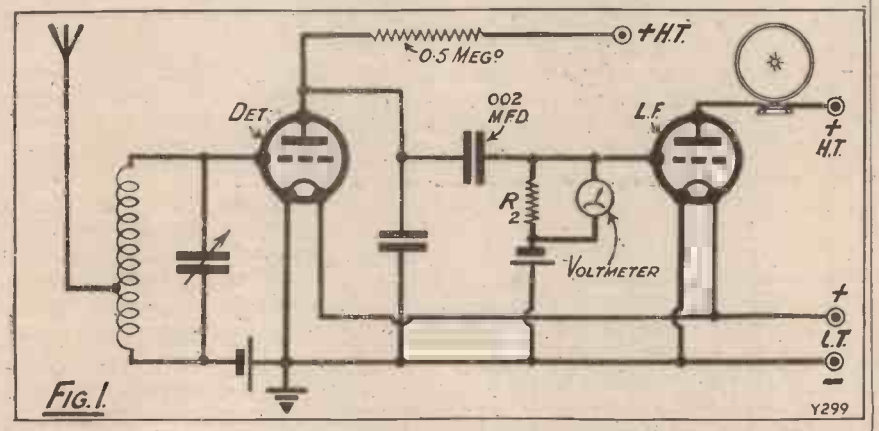


FIG. 1.

The Misleading Reading

Probably he does not know a thing about the instrument except that to find the voltage of a battery all he has to do is to connect it to the battery and read the figures to which the needle points. But an observant reader may have noticed a slight spark as he removed one of the voltmeter wires from the battery, showing that it takes a certain amount of current. This Current is required to move the pointer against the force which tends to hold it at zero, and as a matter of fact, the cheaper instruments take quite a considerable current, which in some instances may amount to more than the H.T. current taken by the anodes of the valves themselves.

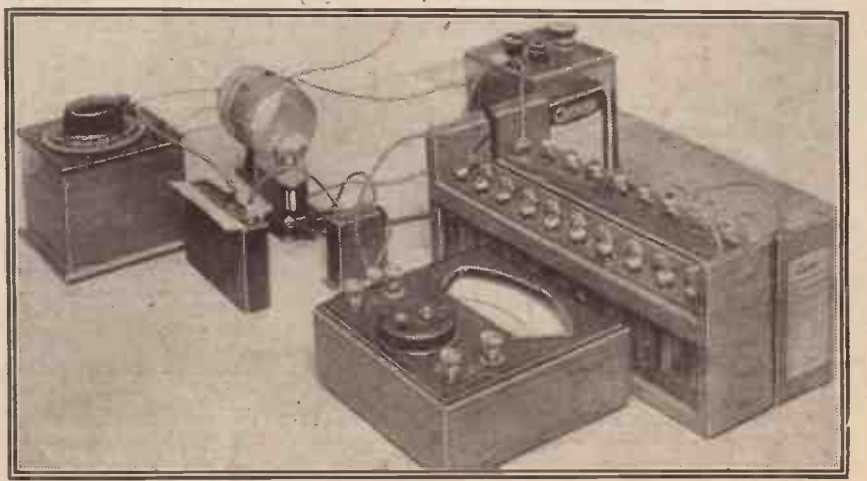
It therefore follows that the voltmeter may not give a true indication of the battery's voltage under working conditions. This is because the battery itself has resistance, with the result that a certain amount of voltage is "lost" in the battery itself. Thus, the voltmeter may read 55 when the actual voltage is 60.

This difference between the actual and working voltage is of no great account, but serves to bring out a most important point, that when the voltage across the ends of a battery or of a piece of apparatus carrying a current is to be measured by means of a voltmeter, the instrument itself will cause the actual voltage across these points to fall, with the result that the instrument indicates a voltage which is lower than the voltage between the two points before the instrument was connected. This is because the instrument takes current, and the supply from which the current is obtained has resistance.

Better-class instruments take quite a small current, so that when one of these is used we can be sure that it is practically the actual voltage of the battery which is being indicated.

A Point to Remember

We meet with this difficulty in all sorts of ways. But usually we can say that provided the resistance of the measuring instrument is high compared



A typical layout for measuring—when the instrument is calibrated—or comparing H.F. voltages across aerial coils. *(See Fig. 3A.)*

The Valve Voltmeter and How to Use it—*continued*

with that of the battery, or between the two points where the instrument is to be connected, then the reading obtained is practically the true voltage between the two points. This is a most important thing and has always to be borne in mind when about to measure the radio- or audio-frequency voltages set up across the various components in a wireless receiver.

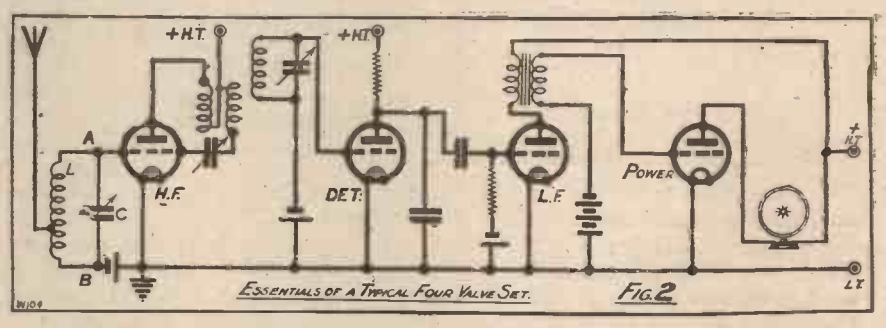
A Reduction of Resistance

As an example which will readily be understood, we will take the case of a resistance amplifier. We will suppose that we wish to measure the low-frequency voltage set up across the grid leak R_2, Fig. 1. Grid leak R_2, we will assume, has a value of 2 megohms, the coupling condenser a value of ·002 mfd., and the anode resistance of 0·5 megohm. These values are normal in every respect.

Now let us suppose that we have an instrument which reads alternating voltages. This we propose to connect across the grid leak R_2, as in Fig. 1. Remember that R_2 is of 2 megohms; our voltmeter we will suppose has a resistance of 500,000 ohms. What will be the effect of connecting it? It will certainly indicate a voltage, but it will not be the voltage which was set up across the grid leak before the instrument was connected, because the voltmeter has had the effect of changing the conditions of the circuit.

The voltmeter, with its resistance of 500,000 ohms, has reduced the resistance between the grid and the grid-bias battery from 2 megohms to slightly less than 500,000 ohms, whereas before we connected it the resistance was as high as that of the grid leak. In fact, the act of connecting the voltmeter has reduced the amplification very considerably, for the reason that the effective resistance connected to the anode circuit of the valve has been reduced, which in turn has cut down magnification.

We therefore see that our voltmeter is of very little value, because the voltage which it indicates is much less than the *actual* working voltage between the points when the voltmeter is not connected.



ESSENTIALS OF A TYPICAL FOUR VALVE SET. FIG. 2

Suppose now we connect a voltmeter of different design, having a resistance of 2 megohms. Even then the result of connecting it is to reduce the effective resistance of the grid circuit from 2 to 1 megohms (two 2-megohm resistances in parallel is equivalent to a single resistance of 1 megohm), which in turn effectively reduces the anode resistance connected to the valve. This in turn reduces the amplification, and so the effect of connecting a voltmeter of even this high resistance is to lower the amplification immediately.

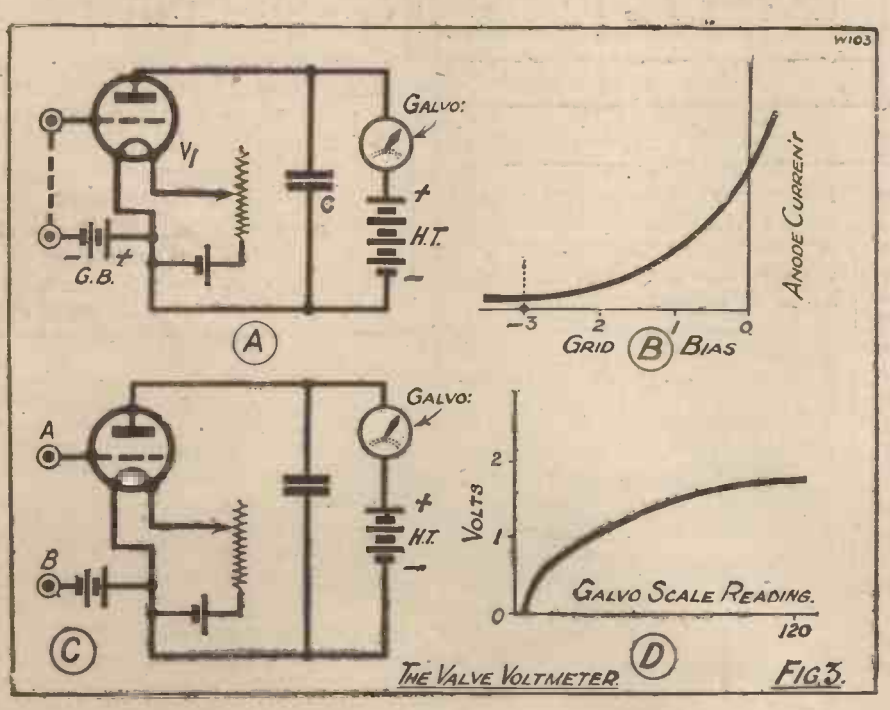
Thus, even a voltmeter of very high resistance is not suitable for measuring the audio-frequency voltages set up across the grid leak, for immediately we connect it we so alter the effective resistances in the circuit that we lower the amplification, and our voltmeter may read, for instance, 0·9 volt, whereas when the voltmeter is not connected the voltage across the grid leak is 1 volt.

Under Working Conditions

Now a voltmeter resistance of 2 megohms is quite considerable, but it is clear that even this admittedly high value of resistance is not enough. It would in fact appear that an instrument which takes no current at all, i.e. has an infinitely great resistance, is required for measuring the voltage across the grid leak.

At this stage it must be pointed out that not every part of a wireless receiver has so high a resistance. Let us therefore look into this a little more closely so as to be in a position to form a clear opinion as to the values normally met with.

We will take as our example a typical four-valve set, Fig. 2. It has one stage of radio-frequency amplification, a detector which is resistance-coupled to the first L.F. valve, and a low-frequency valve which is transformer-coupled to the power



THE VALVE VOLTMETER. FIG. 3.

The Valve Voltmeter and How to Use it—*continued*

stage. What we have to do is to estimate the resistance or, to be more precise, the impedance of the various circuits under working conditions.

First we have the aerial coil L tuned by C; we are interested in the voltage actually set up across the ends of the circuit, at points AB, for this is the voltage of the signals applied to the grid of the valves. What will be the effective resistance of this circuit at the frequency of a signal? When the coil and condenser are good ones, it may be of the order of 250,000 ohms. Using ordinary coils of solid wire it will be less, falling still farther when some ordinary makes of plug-in coil are used for L.

Some Typical Values

For this circuit, then, we require a voltmeter having a resistance large compared with 250,000 ohms. A resistance of 0·5 megohm, for instance, would immediately reduce the voltage across the tuned circuit by an appreciable amount; so would a resistance of 1 megohm, and in fact here again we require a voltmeter of practically infinite resistance.

It has also to be noted that if the voltmeter has capacity it will not matter, because all we shall have to do is to reduce the capacity of the tuning condenser C by a slight amount in order to restore the circuit to resonance with the incoming signal to be measured. If it so happens that the capacity of the voltmeter has a bad dielectric, in other words, if the condenser formed by the voltmeter absorbs power, then this may reduce the voltage of the circuit, but usually it will be by a negligible amount.

The next circuit which we are interested in is the secondary of the high-frequency transformer which is connected to the grid and filament of the anode-bend detector.

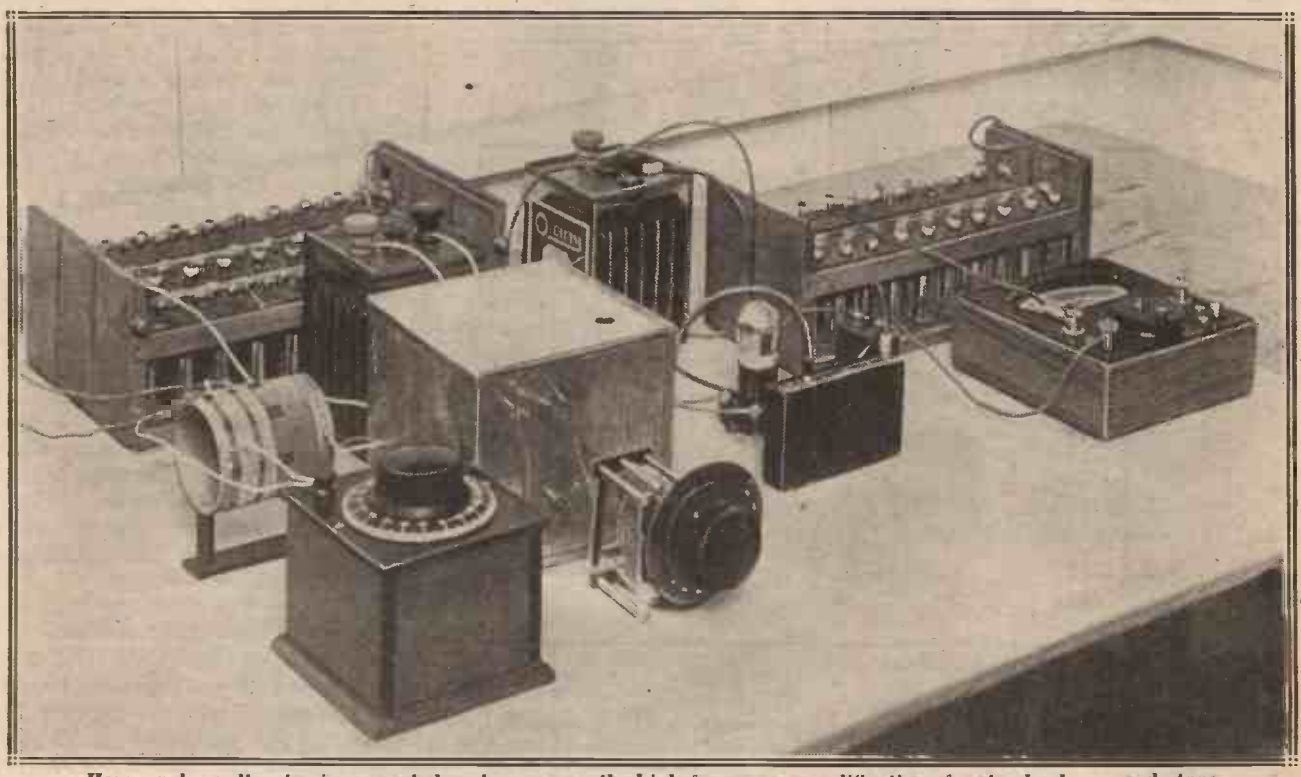
The effective resistance of this circuit under usual working conditions will approximate to that of the aerial coil so that the remarks made with regard to that coil apply equally well for the H.F. transformer. These two circuits are, of course, dealing with radio-frequency currents.

We now have to pass to circuits which should have audio-frequency currents only flowing in them. We have first of all to deal with the resistance stage and we will assume the voltmeter is to be connected across the grid leak in order to measure the audio-frequency voltage set up between the grid and filament of the first L.F. valve. Here we shall require an instrument having almost an infinitely great resistance as we explained above.

Finally we come to the grid circuit of the power valve which includes the secondary winding of an audio-frequency transformer. Everybody knows from practical experience that to connect a resistance of 0·5 megohm across the secondary winding of a good audio-frequency transformer will usually have the effect of materially lowering the signal strength. If therefore we were to connect a voltmeter having a resistance of this order across the secondary winding in an endeavour to measure the voltage, it is quite evident that the act of connecting the voltmeter would so lower the voltage as to render the reading of the voltmeter quite inaccurate.

An Essential Requirement

In this position, then, we should



How a valve voltmeter is connected up to measure the high-frequency amplification of a standard screened stage

The Valve Voltmeter and How to Use it—*continued*

use a voltmeter having a very high resistance, i.e. one which takes practically no current at all.

We therefore see that in the case of the particular four-valve receiver described, it is practically essential to use a voltmeter of the electrostatic type if accurate readings of high-frequency and low-frequency voltages are to be obtained. For when an electrostatic voltmeter is used the only effect of connecting it to a circuit will be very slightly to raise the capacity of the circuit, which in the case of high-frequency circuits can be compensated for by retuning.

There can be no doubt that the simplest form of electrostatic voltmeter which can be used for measuring the voltages met with in the ordinary wireless receiver is of the kind which includes a valve, and the principle of operation of this form of instrument will readily be understood by referring to Fig. 3. Here we have a valve V_1, with a grid bias (G.B.) of 3 volts. Connected to its anode is a galvanometer and a small battery (H.T.) which may be of 40 volts, for example, and a by-pass condenser C.

Fig. 3B is a characteristic curve for this valve. It will be seen that when the grid bias is fixed at −3 volts the valve will rectify high- or low-frequency voltages which may be applied between the points A and B shown in Fig. 3C.

The normal reading of the galvanometer may be 5 divisions. If we apply an alternating current of, say, half a volt the anode current will increase and the galvanometer reading will rise from the 5 division to, say, 10 divisions. If we apply a larger A.C. voltage to the grid, the anode current will further increase and, in fact, we can calibrate the instrument to work as a voltmeter by applying a series of known A.C. voltages and noting the reading of the galvanometer.

A typical calibration is given in Fig. 3D, and within its limits this instrument is an electrostatic voltmeter, in that its grid circuit does not take any current at all (beyond the charging current due to the very small capacity of the grid to filament). But we must be sure that the instrument is always used in such a way that grid current does not flow. For if grid current flows we should have, in fact, a resistance between the grid and filament which would result in inaccurate readings being obtained, as explained above.

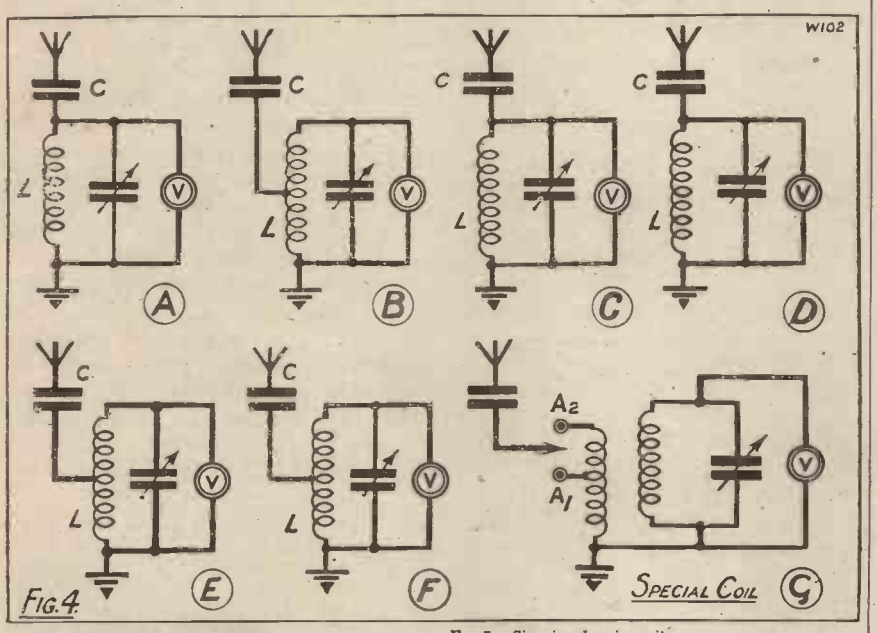


FIG. 4.

The values in the above figure are as follow :

A L=Good-make No. 60 coil.
C=·0001 mfd. Volts=0·55
=·0002 „ „ =0·4

B L=Good-made No. 60 coil, with centre tap.
C=·0001 mfd. Volts=0·55
=·0002 „ „ =0·55
=·0003 „ „ =0·5

C L=Good-make No. 40 coil (Plug-in).
C=·0001 mfd. Volts=0·4
=·0002 „ „ =0·35
=·0003 „ „ =0·3

D L=Good-make No. 50 coil.
C=·0001 mfd. Volts=0·5
=·0002 „ „ =0·4
=·0003 „ „ =0·35

E L=Six-pin plug-in coil.
C=·0001 mfd. Volts=0·25
=·0002 „ „ =0·32
=·0003 „ „ =0·5
C cut out „ =0·6

F L=Commercial single-layer interchangeable coil (200 μH).
C=·0001 mfd. Volts=0·62
=·0002 „ „ =0·62
=·0003 „ „ =0·55

G (Special coil.)

	A1	A2
C=·0001 mfd.	Volts=0·4	Volts=0·65
=·0002 „	„ =0·62	„ =0·8
=·0003 „	„ =0·73	„ =0·85
C cut out	„ =0·9	„ =0·75

Preventing Grid Current

The point at which grid current commences to flow depends upon the valve used. Most valves commence to pass grid current at round about zero grid bias. The instrument as described may therefore be used to measure A.C. voltages having a peak value of not more than 3 volts.

We can calibrate it with a larger grid bias, however, for then we shall be able to measure larger voltages, and in practice what one does is to provide the instrument with a grid battery of, say, 12 volts. The instrument would then be calibrated for grid bias values of −3, −6, −9, and −12 volts grid bias.

With this instrument, then, we shall be able to read A.C. voltages having a peak value of not more than 12 volts, although it is, of course, simply a matter of providing additional grid bias and making a further calibration from a series of A.C voltages of known value when we wish to use the instrument for measuring larger voltages.

For Accurate Work

The instrument which is used to measure high-frequency and low-frequency voltages is therefore nothing more than a calibrated anode-bend rectifying valve, and, as such, the amount of power it consumes is extraordinarily small—so small, in fact, that it can be neglected except when very accurate work is being done in connection with coil resistance, and so on. In this connection the anode by-pass condenser C is of great importance. It should have such a value that the impedance of the anode circuit to alternating currents is very small and a normal value is one or two microfarads.

In practice such an instrument would be provided with a filament rheostat and a potentiometer for adjusting the normal filament temperature and anode voltage to the

The Valve Voltmeter and How to Use it—*continued*

precise values which obtained at the time of calibrating, for these values determine the reading of the anode-circuit galvanometer when the grid is joined direct to the grid bias.

Such an instrument is very easily constructed; the difficulty is to calibrate it. This can be done from a source of more or less pure alternating current of known voltage, but the work is best put in the hands of an expert. The instrument is extraordinarily easy to use, as we shall see. It is reliable and safe. Overloads will not harm the valve but may damage the galvanometer by causing the needle to strike hard against the stop.

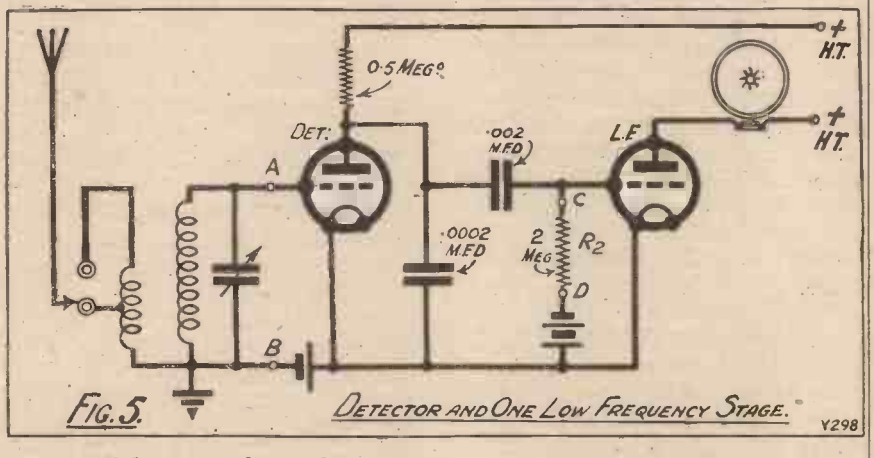


FIG. 5. DETECTOR AND ONE LOW FREQUENCY STAGE.

The first series of experiments were undertaken to show what effect the tuned circuit connected to an aerial had on the voltage applied to the grid of the first valve. But before describing these experiments we must explain that the aerial consists of a single wire, 100 feet long and about 30 feet high, with an earth connection made to a sheet of copper buried in the ground. The tests were made at a place approximately twelve miles from the London broadcast transmitter.

The Series Condenser

It is generally known, of course, that signals are weaker when you put a poorly constructed coil in the aerial circuit, but it is interesting to find the exact effect on signal strength by using coils of different construction.

The circuits were arranged as in Fig. 4. In circuit A we have a good make No. 60 centre-tapped coil joined to the aerial through a condenser C. The coil is tuned with a ·0005-mfd. variable condenser, and the valve voltmeter is connected across the ends of the tuning condenser. This circuit was tuned to 2 L O, and the voltage set up by the signal from the London station was noted.

As the coil is a fairly large one for direct connection in an aerial circuit, it was found necessary to use a fixed condenser. When this had a value of ·0001 mfd., the voltage developed was 0·55 volt, while increasing the value of the series condenser C to ·0002 mfd. and retuning by means of the ·0005 mfd. variable condenser gave a voltage of 0·4. The aerial was then connected through condenser C to the centre tap of the coil, and further readings were taken for three values of the fixed condenser. The values are those quoted for Fig. B.

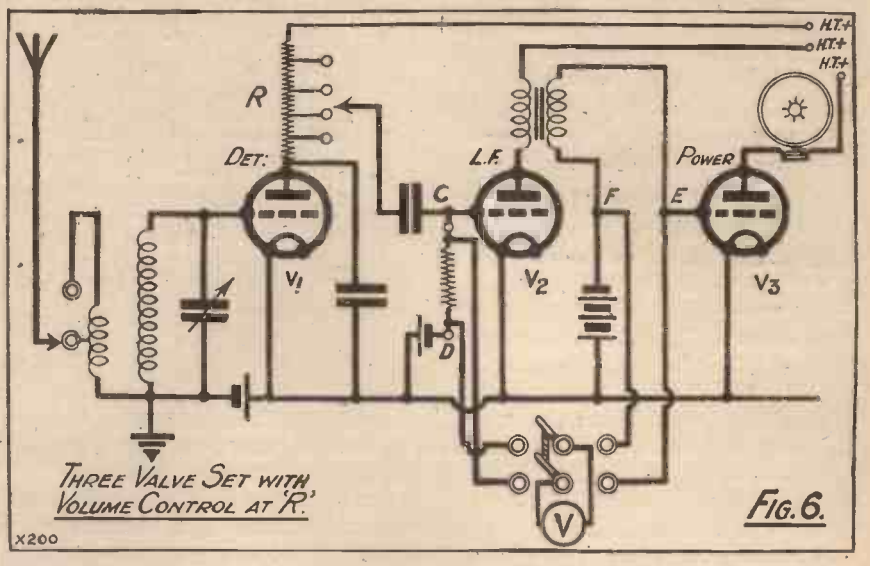
Condenser C is clearly shown to have very little effect on the signal strength, so that in practice with a coil of this sort we would use a ·0001 fixed condenser at C, as this would enable us to cover a much wider range of wave-lengths with the one tuned circuit. The centre-tapped coil was now removed and in its place an ordinary plug-in coil, marked No. 40, was included, Fig. C.

For Strong Signals

When tuned to the London station the voltage was found to be less than with arrangements A and B, varying from 0·4 volt depending on the series condenser C. A No. 50 coil of the same make was now connected to the aerial circuit in place of the No. 40, Fig. D, and the voltages measured varied from 0·5 to 0·35. We therefore see that with the two ordinary plug-in coils the loudest signals will be obtained when a series condenser of ·0001 mfd. is included in the aerial circuit. This may seem contrary to previous statements which have been made, but yet there is no doubt that a smaller value of condenser gives much stronger signals.

This is due to the fact that the coils used are good ones; they are certainly the best plug-in type coils tried. In addition, the tuning of the circuit is much sharper.

Next a single-layer plug-in coil of the type having six pins was tried. The coil was wound with Litzendraht wire, and the aerial tapped at a point a few turns from the earth



THREE VALVE SET WITH VOLUME CONTROL AT 'R'. FIG. 6.

(*Continued on page 250.*)

Remarkable Radiano Results

Some readers' experiences with the 'Radiano Short-wave Two-valver.

American Stations Received

SIR,—I must congratulate you on this set and now report to you my experience with it.

I must confess I have not kept to your specification as I am using Microstats to control the filaments, and using home-made coils wound with No. 22 enamelled wire. My aerial is not of the best, and my earth consists of a piece of expanded metal about 10 in. by 6 in., buried 18 in. in a wooden box filled with earth and placed on the blue-brick path outside my window, as I cannot drive a better earth through the hard blue bricks.*

However, under these conditions I received W G Y on Thursday and Friday night last about 11.30 p.m. with the greatest of ease, at powerful strength and without atmospherics or fading, the speech and music being very clear. I also picked up at good strength a station in Buffalo, and I believe the announcer gave his call sign as W M A K. I believe W G Y and other American stations were taking his programme, as when he closed down he mentioned these stations, and W G Y came on with a radio talk. I have logged the items heard from the Buffalo station for confirmation.

I have made several short-wavers, but without a doubt this one is "it."

Yours faithfully,

Cardiff. P. C. L.

[*This acts as a capacity earth.—Editor.]

With Indoor Aerial

SIR,—May I offer you my congratulations on publishing such a splendid circuit? In giving below my results since constructing this receiver, you will see that it more than justifies the claims made for it. Using as an aerial a short single wire slung across the room (which proved more efficient than the outside aerial) the following results were obtained:

S.W.1 Coil.

K D K A—Regularly every evening after 11 o'clock or so. Occasionally at medium loud-speaker strength.

P C J J—At good 'phone strength.

A German station above K D K A, believed to be the new short-wave transmission of Langenberg, and three amateurs.

S.W.2 Coil.

2 X A F (relaying W G Y).—At excellent strength on loud speaker.

2 X A D.—At good 'phone strength.

2 N M (Mr. G. Marcuse) relaying 2 L O to India, etc., at excellent loud-speaker strength.

All the above stations can also be obtained without any aerial at all, with very little loss of strength, and once K D K A was received without either aerial or earth. I might mention here that I use as the detector a Mullard S.6 and a P.M.4 in the L.F. stage.

Trusting above information may be of use to any of your readers who contemplate constructing this receiver.

Yours faithfully,

Croydon. P. MCALLAN.

Sydney Again

SIR,—The following may be of interest to users of the Radiano short-wave two-valve receiver. The set was made to specification and diagrams; Cosmos 2-volt valves being used.

As I am a reader of Morse, scores of amateur stations have been logged, but the main D X results are as follows: 2 X A F, W G Y, K D K A and, last but not least, I have picked up 2 F C Sydney twice, and this seems to be stronger than the above-mentioned American stations.

Yours faithfully,

S. C. TERRY.

Belvedere, Kent.

Down to 14 Metres

SIR,—It may interest you to know that I have received station 2 F C Sydney, Australia, on two occasions on a set using the Radiano short-wave set circuit. It has been coming in here at about R.5 to R.7 strength.

It is possible to walk about near the set without affecting the tuning. I have also received K D K A on 14 metres, 2 X A D, 2 X A F, P C J J, and a host of English and Continental amateurs. The valves I am using are the P.M.1 H.F. and the P.M.2.

The set works very well on the long and normal wave-lengths, loud-speaker reception being very good from Daventry. It is certainly a very good all-round receiver.

Yours faithfully,

E. B. STEAD.

Lancing, Sussex.

2 F C on One Valve

SIR,—It may interest you to know that I have just built the Radiano short-wave set (at present less amplifier). On testing same out one Saturday night about 12 p.m. I was astonished to tune in a station at good 'phone strength, which turned out to be W G Y on 33 metres, reception being very clear and free from atmospherics. But, better still, on the Sunday after listening to 2 F C Sydney rebroadcast through Daventry, on an ordinary O-V-2 set, and after the B.B.C. stopped relaying same, I thought I would see what could be done in the way of D X with the Radiano short-wave set, and was, to put it mildly, highly delighted to be able to tune in 2 F C broadcasting various items. Signal strength was weak and troubled with atmospherics, but sufficiently clear for me to get their call sign, especially the three coo-ees.

Is this a record for the Radiano short-wave set, detector valve alone? I might mention I was especially interested in getting Sydney (although an old hand at radio, having been experimenting since 1921–22) as I was born and brought up in Brisbane, Queensland, but have been resident in England since the latter part of 1919.

Yours faithfully,

C. S. R. A.

Liverpool.

In Lighter Vein

By WIRELESS WAYFARER.

THE Mudbury Wallow Wireless Club was holding one of its weekly meetings when our eminent president, Sir K. N. Pepper, rose to his feet and, puffing out what probably was his chest before it slipped, began in slow and pompous yllables :

" Speaking as an Ass——"

" Here, here ! " I yelled.

"——ociate of the Science Society (he froze me with a glare), it has

This picture has nothing to do with this month's story, but it illustrates an unfortunate Christmas incident which occurred to poor Primpleson and Sir K. N. Pepper. You will see exactly how the thing happened and—

occurred to me that there is not in the Mudbury Wallow Wireless Club sufficient opportunity for ventilation——"

" Bravo ! " I cried, making a dash for the window.

"——of opinions (I got another glare) by members. At the Science Society weekly discussions are held which are most valuable to all concerned. I propose that in future similar informal discussions should take place at this club. We might assign topics to various members. They can give us their views upon them, and when they have finished the rest of us could—er—er——"

An Interrupter Silenced

" Show 'em what goats they were," I suggested brightly. " I see just what you mean. Professor Goop, let us say, gives a bright little talk proving that transformers transform."

" They do not," said Professor Goop.

" Of course they do ! " cried Tootle.

" Nothing of the kind," screamed Professor Goop, bending down to remove an elastic-sided boot.

" I've never heard such nonsense," blustered Tootle.

Whack came the boot on the top of his head, and that was the end of that discussion.

" I think," I remarked, " that my demonstration has proved what an excellent idea our chairman's is. Let us by all means carry on the good work. I propose, however, that we make a rule, just as a precaution, that all knuckle-dusters, life-preservers, shillelaghs, lengths of gas piping, and so on, are left in the cloakroom by members as they enter the meeting."

Tootle proposed as an amendment that elastic-sided boots should also be left in the cloakroom, but did not go on with the matter when he observed the professor once more bending down.

" The next thing," said Sir K. N. Pepper, " is to choose a list of suitable subjects for coming weeks, and to assign these to members."

I put up my hand and flipped my fingers.

Snappy Titles

" Please, sir," I cried.

" Well, what *is* it ? " said Sir K. N. irritably.

" There is one rather bad snag. Mr. Hercy Parris seems to have cut the ground from under our feet by having chosen already all the snappiest and most likely titles. You may remember that he wrote but recently, ' At Home With the Ohm,' or was it, ' Ohm, Sweet Ohm ' ? I really forget. Do you think that he would consider it an infringement of his rights if we adopted such subjects as *Hampered by the Ampere, Revolted by the Volt, Half a Mo with the Mho, What is a Watt? or My Crow Over the Microfarad, or Mocking the Mic.?* "

After a long discussion it was decided that these should be adopted and copyrighted by the club. In order, however, that Mr. Parris's style should not be cramped by any such action of ours we have presented him with a further list for his own use, which includes, *Fooling the Joule, When Coulombs Cool Off, Harrying the Henry, and A Lectur' On Electrons.*

Sir K. N. Pepper said that the best plan would be to write the selected titles on slips of paper, subsequently placing them in a hat and asking members to draw them out. The slips were shaken up in his own shiny topper and passed round. All went well till the tile rested on the table in front of Professor Goop. Awakening from the reverie in which he had been plunged, the professor sat for some moments gazing at it in wonderment, when a smile slowly spread over his face.

Prof. Goop Forgets

From his pocket he produced an egg, which he broke into the hat; announcing that he would now perform his well-known trick of making an omelet. Or, if the company preferred it, he would produce goldfish or rabbits or ribbons or flags. Whilst thus speaking, he had emptied upon the egg the contents of the large inkwell which stood before him upon the table, and was stirring the mixture with Miss Worple's lorgnette.

Sir K. N. Pepper, meantime, was battling for words. There seemed to be so much that he wanted to say that he could not say anything at all. At last he found his voice " What the blanky blank blue blazes do you think you are doing with my hat ? " he yelled.

—here you see the innocent Primpleson receiving the full measure of Sir K. N.'s wrath with the cause of all the trouble disappearing round the corner.

Professor Goop, who was by this time busily stirring in the contents of a flower vase, looked up from his task.

" Have no fear," he remarked genially, " your hat will be returned to you every bit as good as new when I have completed this interesting little experiment."

In Lighter Vein—*continued*

The professor continued to stir. The smile slowly left his face. He fumbled in his pockets, scattering upon the table a weird collection of B.A. screws, fixed condensers, grid leaks, odds and ends of wire, old envelopes, a mouse-trap, and other bric-a-brac.

"Where is my notebook?" he breathed. "I have forgotten what comes next." Suddenly his face lit up, showing that an inspiration had come. He bent down again. Tootle shuddered and drew away. From the boot which had not been removed the professor drew a note-book.

Professor Goop passed me in a great hurry the other day and I presumed that he was hurrying to an appointment with someone, but—

Flicking over the pages he came to a section which I saw was headed "Conjuring Tricks." This he perused with a wrinkled forehead. "Tut, tut," he said at length, "how foolish of me. I am afraid I've begun all wrong. Now, if somebody else will kindly lend me another hat I will show you how it's done."

"Yes, but how about mine?" bellowed Sir K. N. Pepper.

Professor Goop rose and advanced towards him beaming amiably and bearing the topper between his hands.

"Of all the infernal scoundrels!" roared Sir K. N. "Of all the——!"

He got no further, for the professor very neatly placed the hat upon his head, and with one sound whack upon the crown rammed it firmly down to his chin.

The First Discussion

"My latest invention," said the professor, wreathed in smiles. "The Goop Silencer for Obstreperous Chairmen."

Sir K. N. having vacated the chair, I voted myself into it by the simple process of getting there first. There were no other candidates for the chairmanship, possibly because I had picked up the poker on my way and sat toying with it as I gazed upon the assembly. "Let us begin right away," I said, "with one of these informal discussions. As nobody else seems to wish to start a topic—" several members leaped to their feet and sat down again hastily as I brought the poker down upon the table with a whack—"I myself will be responsible for leading off with the first little talk, and when I have finished the discussion will begin, and if any member then does not jolly well discuss I will give him a practical demonstration of the way in which Chicago's tough babies carry out their dirty work at the cross-roads. I am taking as my subject *Revolted by the Volt*."

Elementary Knowledge

Everyone, I proceeded to tell them, knew what a volt was. It was discovered by Volta, the inventor of the first layer-built battery, just as Columbus discovered the coulomb. Such was his devotion to the study of volts that in later life he developed the *volte face*, which is a far worse affliction than the bridge face or the cycling face, or the motoring face, or the dog-racing face.

"To find the volt's pushing current through any circuit all that is necessary is to divide thingmejigs by whatyoumaycall'ems, or else you multiply them, I really forget which. It is no use remembering because you can always turn it up in a book. As every broadcast listener knows the service area of a broadcasting station depends upon the micro-volts per metre."

If anybody present wanted to know what that meant, I remarked, he could jolly well go and ask Captain Chuckersley, because if he thought of asking me he had better remember first that I never miss my man with a poker. In the wireless set, I explained, we are concerned mainly with volts, milli-volts, and wobbly volts. The latter are provided by the high-tension battery, and produce the phenomena known as atmospherics, fading, deadness of the ether, and short-waver's deafness.

Goop's Law

It was altogether a brilliant disquisition, and I covered the ground so thoroughly that when I came to an end nobody seemed to have anything to say. After a short spell of silence, however, Primpleson rose to his feet and asked how one could measure the voltages set up across the grid-tuning condenser of the rectifying valve. I was just thinking of putting in some rather pretty work with the poker when Professor Goop stepped in to pour trouble upon oiled waters.

"It would appear," he said witheringly, "that you are ignorant of Goop's Law."

Primpleson and the rest assumed what they imagined to be a look of intelligent interest.

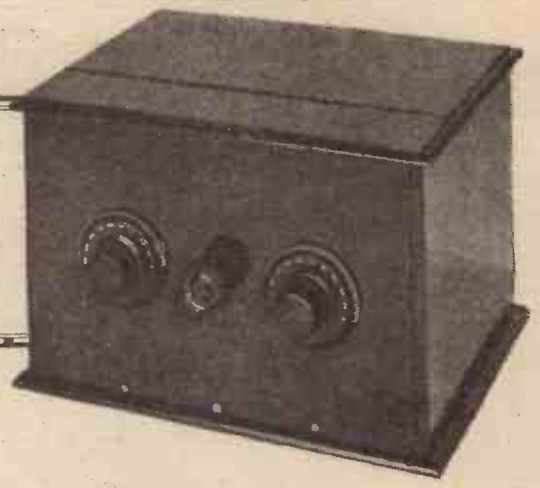
"Goop's Law," said the professor, "shows us that the answer to this or any similar fatuous question is readily obtained by working out the product of self-inductance, voltage, mutual

—later on I caught him up and this is what I saw.

inductance, ohms and number. If you will take scraps of paper and pencils I will give you the algebraical proof." Everyone took the required implements and strove to look bright. "My formula," said the professor, "is this: L, the self-inductance, is multiplied by E, the voltage, and the product is multiplied by M, the mutual inductance. This is multiplied by O, the ohms, and again by N, the number. If you will kindly write down the result you will find that it comes to LEMON."

Hastily switching off the lights and diving under the table I declared the meeting at an end.

A Short Wave "Superhet" Adaptor



The description of an intermediate amplifier and second detector which, with the unit previously described, comprises a complete and efficient super-heterodyne receiver.

By L. H. THOMAS.

IN the November issue a simple short-wave oscillator was described, its uses being various—it could be placed in front of a receiver employing H.F. stages, thereby enabling the user to receive the short wave-lengths on the super-sonic principle, or it could be used in front of an ordinary L.F. amplifier, or even by itself, telephones being connected at a suitable point. The unit described this month consists of three stages of "intermediate-frequency" amplification and a second detector, which may be used in conjunction with the previous unit to form a complete short-wave super-heterodyne.

As the photographs and wiring diagram show, this unit is even more simple than the oscillator, and the entire construction of it only took the writer about two hours. Considering that four valves are used, this is really quite quick work!

Fig. 2 shows the theoretical circuit diagram. The first three stages of amplification are all exactly alike,

COMPONENTS REQUIRED.

- 4 Anti-microphonic valve holders (Lotus, Benjamin, W.B., etc.).
- 3 Remler type 600 I.F. transformers (Rothermel).
- 1 Remler type 610 tuned-stage transformer (Rothermel).
- 1 ·0001 fixed condenser (Atlas, Dubilier, Lissen, Mullard, T.C.C., etc.).
- 1 ·0003 fixed condenser with 3-megohm leak (Atlas, Dubilier, Igranic, Lissen, Mullard, etc.).
- 1 Rheostat, baseboard mounting, of resistance to suit valve (Lissen, Igranic, Bowyer-Lowe, G.E.C., etc.).
- 1 Potentiometer (C.E. Precision, Lissen, Peto-Scott, etc.)
- 1 Three-terminal strip.
- 1 Two-terminal strip.
- Baseboard about 16 in. × 6 in. × $\frac{3}{16}$ in.
- Wood-screws and tinned copper wire, Junit, Glazite, etc.

the same value of H.T. being used throughout, and control of oscillation being arranged by means of a potentiometer. The output transformer for the last stage is different from the others, and a small condenser is placed across its secondary winding. This practice of placing the filter at the end near the second detector is often queried, and there seems very little to choose between this position and that in the first stage.

A Geometrical Layout

The layout is not exactly symmetrical, but might well be termed "geometrical," and the majority of the leads are no more than 3 inches in length. It was not thought worth while to build the set up on a large panel and baseboard on account of its essentially simple character, and the cost is therefore kept down. Only five terminals are needed, two

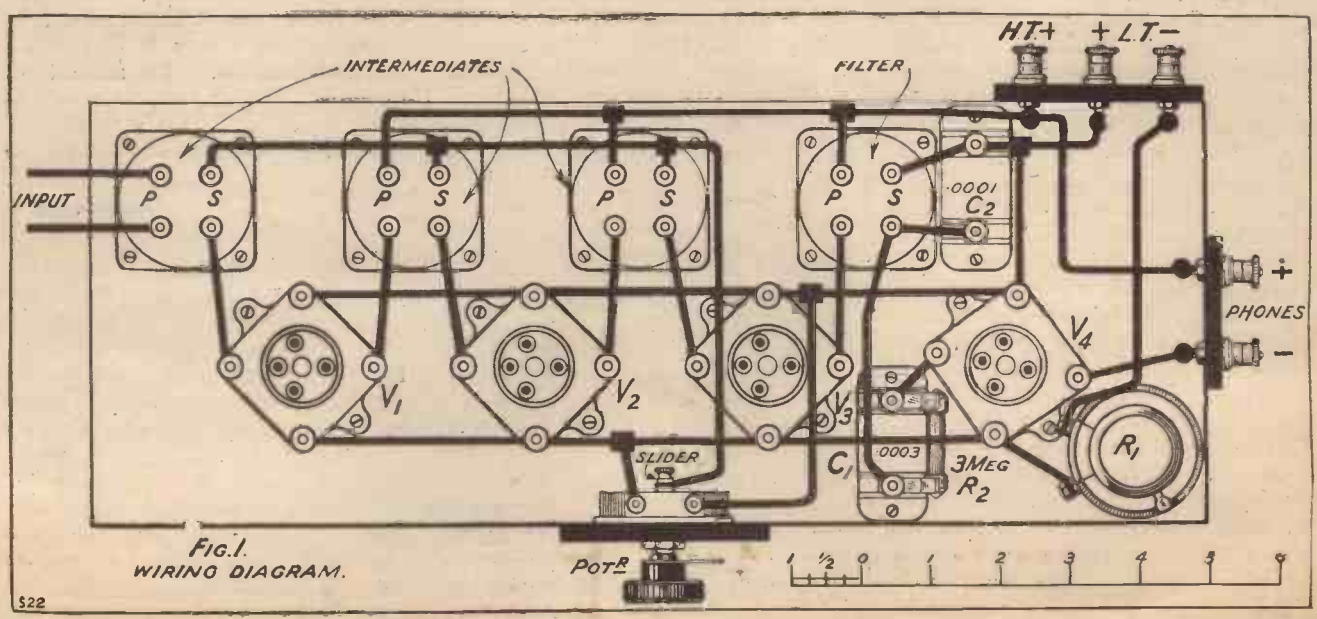


FIG. 1. WIRING DIAGRAM.

A Short Wave "Superhet" Adaptor—*continued*

accommodating the telephones, one the positive H.T. and the other two the L.T

No separate H.T.— terminal has been provided, as this might lead to complications when the set is connected up with another unit already having this connection made. If, however, it is used with the unit previously described (which has no H.T.— terminal) the negative H.T. lead should be connected to the L.T.— terminal on the "super-het." unit.

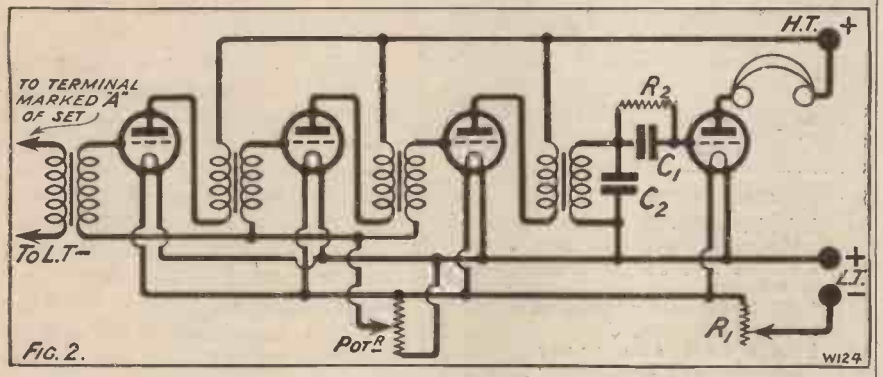


FIG. 2.

The second detector is provided with a grid condenser of ·0003 mfd. and a leak of 3 megohms. The value of the leak did not seem to be at all critical on test, but if anything the 3-megohm leak was preferable to one having a lower resistance.

The condenser across the secondary of the filter, or, as the manufacturers term it, "tuned stage" transformer, has a value of ·0001 mfd. The manufacturers recommend a ·00025 condenser in this position, but better selectivity, as far as short-wave work is concerned, was obtained by the writer with a ·0001 condenser in use.

The Grid Return

Only one rheostat has been provided, since individual filament control is not usually necessary with modern valves, especially in an amplifier of this type.

There is really little more to be said regarding the construction of the unit, all the wiring being quite clear from the photographs and diagram. A point which should be watched is that the grid return lead from the second detector (i.e. the side of the last transformer secondary remote from the grid) should be connected to L.T. positive and not to the potentiometer, as are the grids of the amplifiers.

Regarding the method of coupling this unit to the short-wave oscillator already described, this is made clear in the diagrams, but a few words are probably desirable.

Connecting Up

The primary winding of the first filter is left with no connections at all on this unit. It is connected to the oscillator by the "parallel feed" method simply by taking one side to the terminal marked "To A of set" and the other side of the winding to L.T.—. The H.T. is still applied to the oscillator through the H.F. choke, simply by leaving it connected to the terminal provided.

If this supersonic unit is to be used in conjunction with a single-valve receiver already constructed (and there is, of course, no objection to this), the two blank terminals of the first transformer are simply connected to the telephone terminals of the receiver. All the tuning and searching is still done on the original receiver and the supersonic unit requires hardly any more operation than would an ordinary note-magnifier following the receiver.

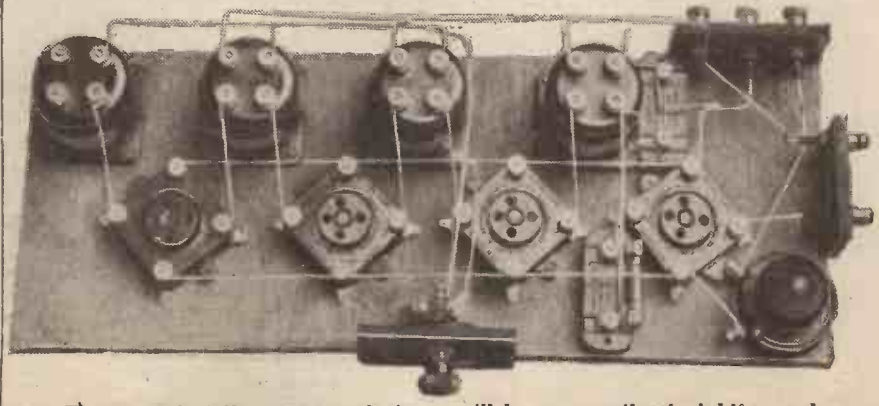
The principle of operation is, of course, that the ordinary short-wave oscillator or short-wave single-valve receiver produces a heterodyne beat with the incoming signal, and this beat (at a frequency above the audible range) is amplified in the highly selective "intermediate-frequency" stages and detected again by the second detector. No note-magnification after this should be necessary, as short-wave signals are usually reasonably powerful in the first place, and the signals put out by the second detector are nearly always of sufficient volume to operate a loud speaker.

Telephony or C.W.

It is, of course, impossible or impracticable to use so simple an oscillator for a supersonic receiver on the broadcast band, since the amount of de-tuning necessary to produce a beat note of the required frequency with the incoming signal would be enormous, and would render the set very inefficient. The relative amount of de-tuning on the short waves, below, say, 100 metres, is, however, so slight as to be almost negligible, and nothing is to be gained by using a separate oscillator or Tropadyne.

When telephony is to be received the grids of the I.F. amplifiers are given a slightly positive bias by means of the potentiometer to prevent them from oscillating, but when C.W. signals are to be tuned in it is, of course, necessary to make the amplifier oscillate. It is understood, naturally, that the short-wave oscillator is oscillating all the time.

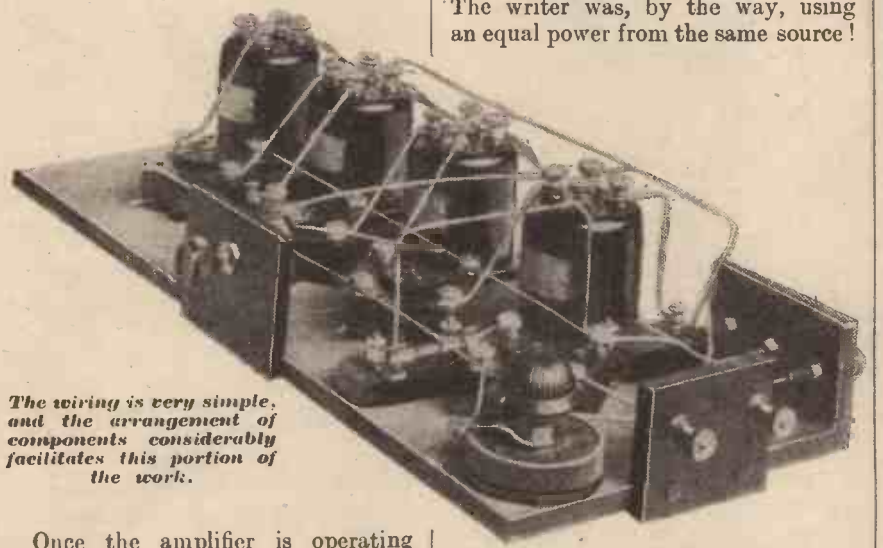
There is no reaction control on



The lay out of the components is, as will be seen, quite straightforward. Note the small terminals and control panels.

A Short Wave "Superhet" Adaptor—*continued*

this, and one control is, therefore, dispensed with. The whole thing is, in fact, a "one-knob" set. The only reason for the provision of the reaction condenser on the short-wave oscillator is that it is necessary to have recourse to an easy means of stopping the audible howl which occurs when the short-wave set oscillates very fiercely, and the capacity control of reaction is probably the most straightforward method.



The wiring is very simple, and the arrangement of components considerably facilitates this portion of the work.

Once the amplifier is operating properly, "short-wave reception" consists simply of searching round the dial of the main condenser, with the amplifier oscillating, and when a telephony station is heard one simply turns the potentiometer knob until the amplifier stops oscillating!

Surprising Strength

The reception of telephony is rather surprising, for a telephony station tuned in with the set in an oscillating condition may seem to be about R.5, and when the amplifier stops oscillating the speech or music seems to take a sudden leap to the heights of R.8 or so! Similarly, quite weak C.W. stations may easily be read by their "key-clicks," by suitable use of the potentiometer.

With regard to the results obtained with the combination of the previously described unit and this "supersonic unit," stations all over the world using C.W. have been logged within a week or so, all at strengths above R.5! Telephony has been received several times from Australia, including the broadcast on about 29 metres, which was put on the loud speaker when a note-magnifier was added, and was almost up to loud-speaker strength without it!

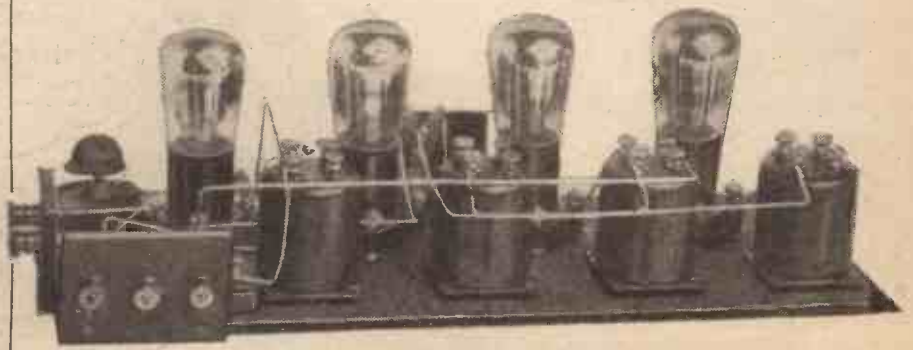
Simple Tuning

The set has been used in conjunction with a 10-watt transmitter, and very strong signals were received one morning from 8 W G, the Second Grenfell Station in North-west Labrador, who informed the writer that he was using an input of 7 watts only from an M-L converter. The writer was, by the way, using an equal power from the same source!

The "super-het." is invaluable for "certainty," and if there are any signals to be heard it will get them.

Tuning is, moreover, so absurdly simple that one cannot lose a station once it has been picked up. One can listen to the weakest telephony and fiddle with the leads inside the receiver or at the back without causing a severe fading effect.

The writer would be glad to hear from any who construct these two units, particularly with regard to results obtained, but would also willingly give any help in cases of difficulty. Although the whole set may seem of a somewhat complicated nature its construction and operation are really of the simplest character, and any little trouble spent on it will be amply repaid.



Here is the complete instrument with valves in position, all ready to be connected to the previously described unit.

WORKING MOULDED EBONITE

MOULDED ebonite is tricky stuff to work at the best of times, and when it comes to drilling it, it is particularly apt to be troublesome.

Sharp drills are essential for mouldings, and you must use the very least pressure possible. When you need to make a hole through a thin moulded flange or through one of the ribs of a ribbed coil former, you will find it safest to make a preliminary hole without a drill. Take a fairly stout needle (it need not be sharp), heat it red hot and push it through the ebonite, holding it in a pair of pliers.

For Small Holes

You will need to draw out the needle and heat it again several times before the hole is complete. This makes a convenient hole for threading a fine wire through, for example. If you want a larger hole, start with the needle and then enlarge the hole slowly by gradually increasing the size of your drill.

Finally, if you are screwing a moulded component to the baseboard of your receiver, avoid giving that extra half turn at the end with the screwdriver which will crack the lug off the component. Moulded ebonite sometimes behaves like porcelain, splitting if the least bit too much pressure is put on a weak point.

A. V. D. H.

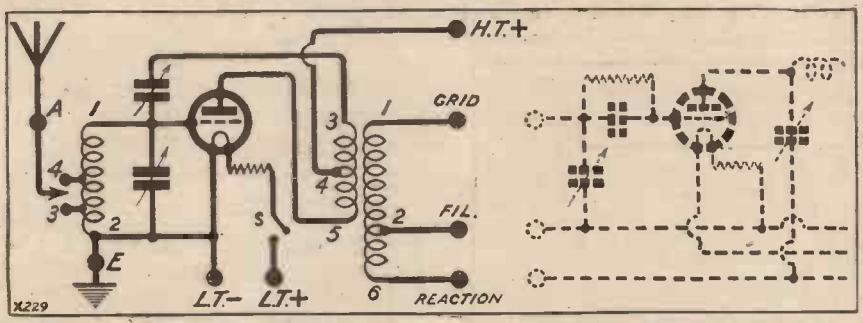
CAN YOU "BEAT" IT?

A Neutralised H.F. Unit

by HARRY. P. WOOTTON

An amplifier which can be added to a number of receivers and which is especially suited for those in which Reinartz reaction is employed.

THE unit about to be described was made by the writer for use in conjunction with a number of sets—principally with those which use Reinartz reaction with the standard six-pin coils, although it is adaptable to a number of other circuits. It consists, as will be seen from Fig. 1 (the theoretical diagram), of a tapped aerial coil, tuned by a ·0005-mfd. variable condenser. This feeds the high-frequency valve, in the anode circuit of which is the split-primary of a transformer coupled to a secondary winding similar in proportions to the tapped aerial coil.



The Circuit Employed

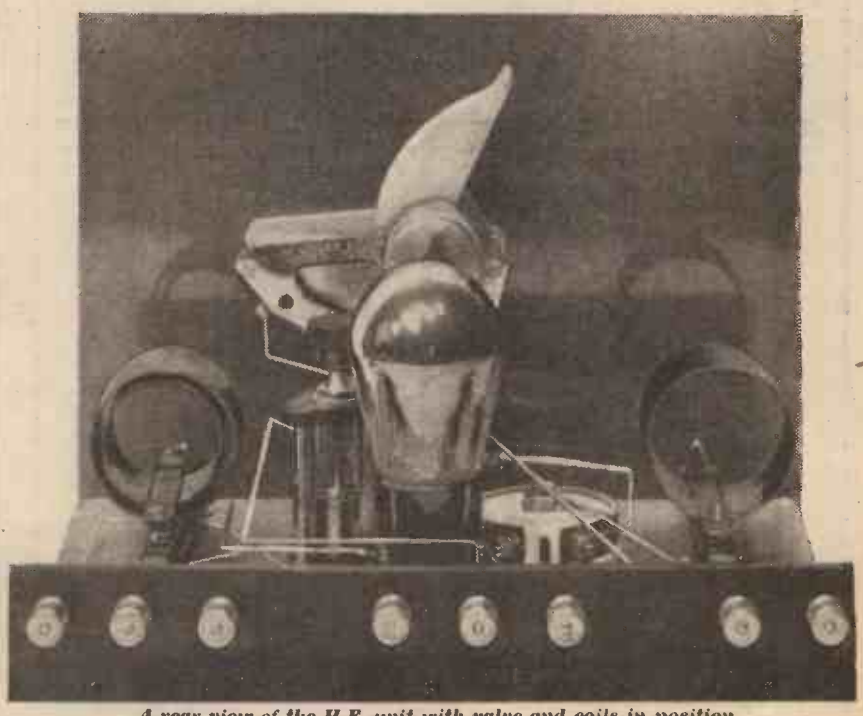
Neutralisation is effected in the standard split-primary way by means of a small neutralising condenser connected to one half of the primary winding and to the grid of the high-frequency valve. The tuning condenser for the secondary of the high-frequency transformer is *not* included in the unit. It is intended that the six-pin coil on the set with which the unit is to be used shall be withdrawn, and leads from the unit (marked grid and filament), terminating in plugs, taken to the six-pin base of the set.

In this way the tuning condenser on the set tunes the secondary of the high-frequency transformer in the high-frequency unit and, if as is so frequently the case, a Reinartz coil has been used, a further lead from the terminal marked "reaction" can be taken to socket No. 6, which enables the reaction condenser in the set to be used as formerly.

As all the essentials of the high-frequency unit are included in this box, many other adaptations will suggest themselves to the more experienced home constructor. In the future, it is hoped, the Editor will allow the writer to describe a second unit to go with the present one, making a detector and reaction unit. This will be useful for those who want a small set of unit design. Following this, of course, any standard note-magnifier can be used, either with or without jack control.

Many Applications

The circuit, then, is quite conventional and well tried out, but the make-up is somewhat different from the usual, and the arrangement of a transformer to utilise the first condenser of the existing set is, the writer thinks, quite novel. It is surprising how many applications can be found for this unit, quite apart from general



A rear view of the H.F. unit with valve and coils in position.

A Neutralised H.F. Unit—*continued*

experimental work, which it suits admirably.

In order that the unit may be reasonably compact without giving harmful interaction between coils, and in any case to reduce unwanted magnetic interaction, special small coils have been chosen and mounted in a manner which causes very little interaction between them. These coils are made by the Formo Company, and while mechanically different from the ordinary six-pin coils, have six connections and a special six-pin base which enable them to be used in any of the standard circuits in which the standard six-pin coils are used.

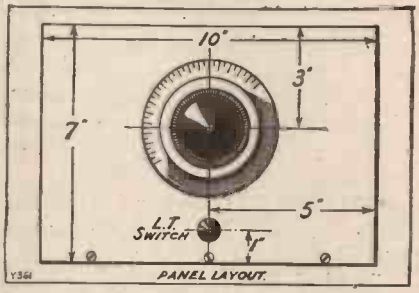
Efficient and Convenient

These coils are very efficient electrically and even more easily interchangeable than the standard six-pin coils.

Standard Coils Possible

The list of components, then, is as under.

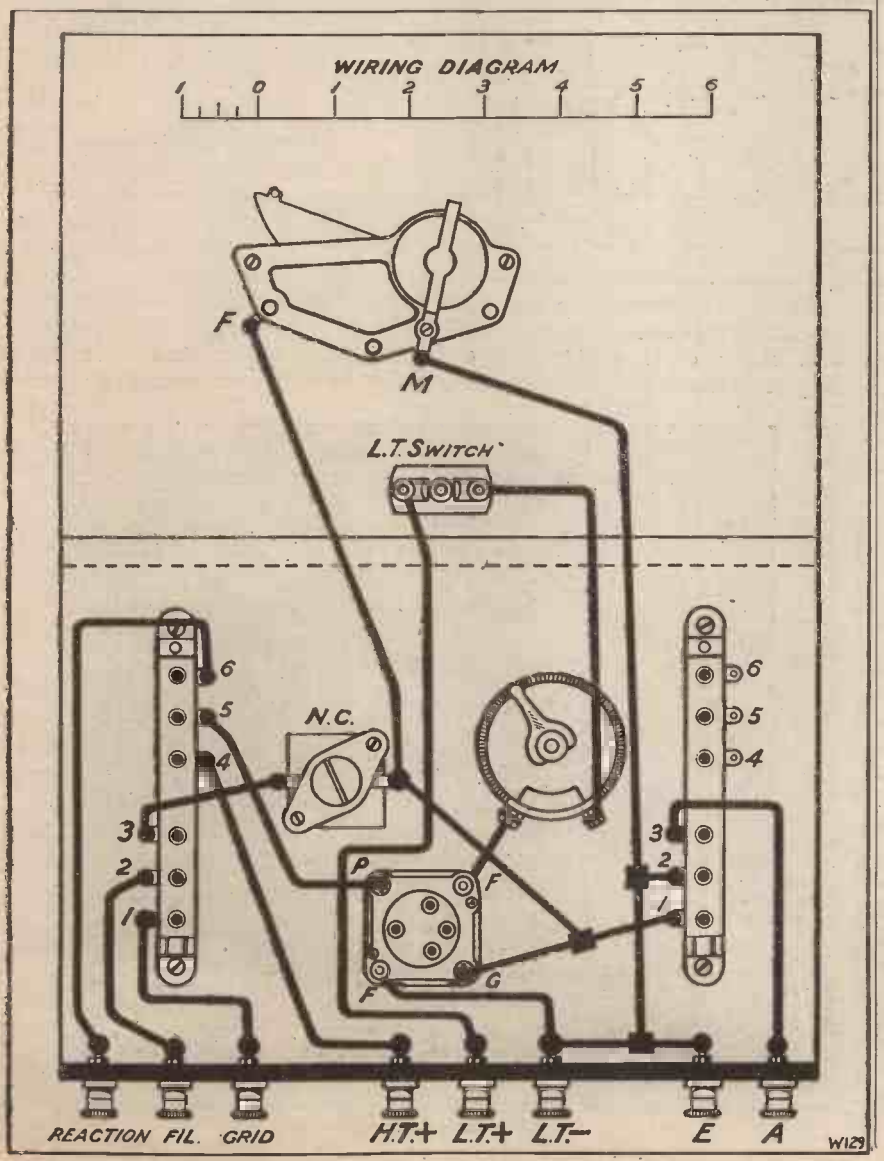
As this unit is not intended for the absolute beginner, very little explanation is required regarding the constructional work. The layout shown must, of course, be followed, particularly in regard to the relationship of the two coils. While there is nothing in the circuit preventing the use of the ordinary six-pin coil on a standard six-pin base in this unit, and although possibly the spacing would be sufficient to prevent unwanted reaction effects between the two coils, the writer has not actually tried the layout as shown with the standard six-pin coils. The experimenter who has these coils handy may like to try them out, however. There will only be a slight



difference in the wiring-up as the same numbers are used on both the Formo base and the standard base.

Connecting Up

The method of using the high-frequency unit is simplicity itself. It is stood alongside any receiver using a six-pin Reinartz coil, aerial and



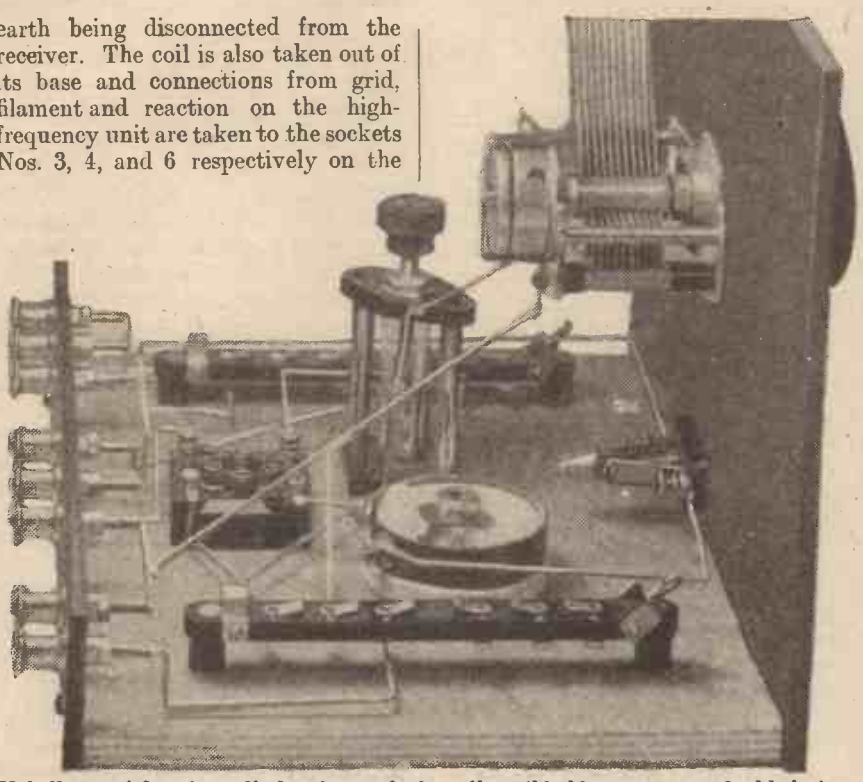
COMPONENTS REQUIRED.

- 1 Panel, 10 in. × 7 in., of any suitable material. For appearance one of the many excellent mahogany finished ebonites can be used, such as Ebonart, Radion, Becol, etc., or brown Paxolin or Micarta panel.
- 1 Cabinet to take same with 7 in. baseboard.
- 1 Terminal strip as illustrated, to carry eight terminals, for aerial, earth, L.T.−, L.T.+, H.T.+ (no H.T. negative is used here), "grid," "filament" and "reaction" respectively.
- 1 Anti-phonic socket (Bowyer-Lowe, Benjamin, Lotus, Redfern, W.B., etc.).
- 1 Filament resistance to suit valve used for baseboard mounting (Igranic, Lissen, etc.).
- 1 Neutralising condenser (Gambrell, Polar, Jackson, McMichael, Peto-Scott, etc.).
- 1 Aerial coil with special six-pin base (Formo).
- 1 Split-primary transformer with special six-pin base (Formo).
- 1 ·0005-mfd. Variable condenser. Any of the good makes can be chosen, but owing to sharpness of tuning they should be fitted either with a vernier arrangement or with a good vernier dial. The condenser used in this set is the new Dubilier which has a particularly slow vernier movement.
- 1 On-and-off switch (Benjamin, Igranic, L. & P., Lissen, etc.).

Junit self-soldering wire has been used for joining up. This makes the soldered joints particularly easy. Any suitable alternative wire can, of course, be used.

A Neutralised H.F. Unit—*continued*

earth being disconnected from the receiver. The coil is also taken out of its base and connections from grid, filament and reaction on the high-frequency unit are taken to the sockets Nos. 3, 4, and 6 respectively on the base of the receiver. Aerial and earth are connected to the high-frequency unit, and the L.T. battery joined up.



Note the special spring self-cleaning contacts on the coil holders—a very valuable feature.

You will notice there is no H.T. negative on the unit, as this connection is already made on the receiver with which it is to be used. H.T. positive on the high-frequency unit goes to a suitable tapping on the H.T. battery, say, 60 or 80 volts. Neutralisation is carried out in the usual way as follows:

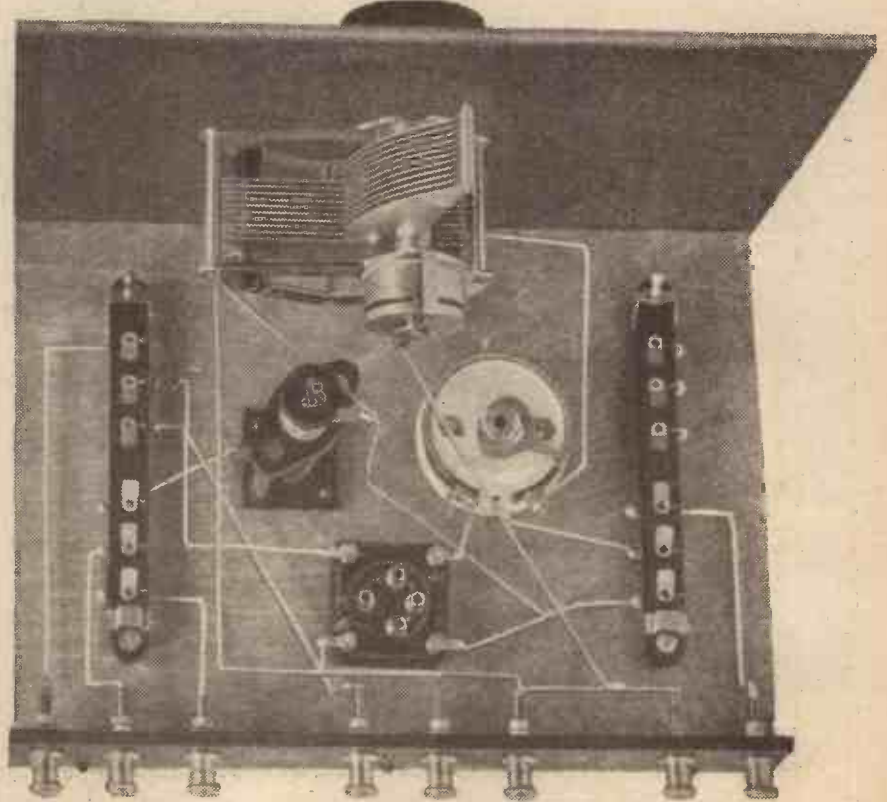
Neutralisation

Set the reaction control at minimum and likewise the neutralising condenser. Now, on setting the tuning condensers so that the two tuned circuits are in step with each other, it will probably be found that the set is oscillating. To test for oscillation touch one or other of the sets of plates of the tuning condensers. You will probably find that the set will only oscillate under the above conditions when the two circuits are in tune with each other, and this can be used as an indication. It is convenient to perform the operation at some point near the middle of the tuning range. Now, increase the capacity of the neutralising condenser.

Test at intervals for oscillation as this is done, and you will presently find that the set has ceased to oscillate and will not recommence even when the tuning dials are slightly re-adjusted. Now increase the reaction a little until the set once more oscillates, and again increase the neutralising condenser setting until oscillation ceases. Slightly readjust the tuning condensers again to make sure that the set is completely stable once more. Proceed in this way until it is found that the correct adjustment of the neutrodyne condenser has been over-shot. Once this point has been passed it will be observed that further increases of the neutrodyne condenser no longer stop oscillation but cause it to increase.

The object is to find such an adjustment of the neutralising condenser as will permit the greatest setting of the reaction condenser to be used without producing oscillation. It will then be observed that when the two tuned circuits are in step and the set is brought to the verge of oscillation, a slight movement in either direction of the neutrodyne condenser will cause the receiver to oscillate.

Further notes on this unit used in conjunction with a receiver will be given in an early issue.



The simple layout and ease of wiring are clearly shown in this bird's-eye view of the amplifier.

Comments from Constructors

A Home-made Cone Loud Speaker—"Four-Valve Family" Again—Radiano in Australia.

A Home-made Cone Loud Speaker

SIR,—As I had a Lissenola Unit, I was attracted by your loud speaker described in September WIRELESS CONSTRUCTOR, and set out to make it.

I therefore hasten to thank you for the article, as the result of following the description has given me a splendid loud speaker, perfect in its reception from a two-valve Hale Circuit (low-frequency) using Cossor valves 210 and 220 P.

I did not put any back to the case, but fitted a brass tag at the back and hung the case against the wall above the set.

With many thanks of appreciation from a

"REGULAR SUBSCRIBER."

Ilford.

"Four-Valve Family" Again

SIR,—I am sending herewith two photographs of my set taken by flashlight. You will no doubt recognise it as your famous "Four-Valve Family" receiver, and declared the finest they have heard by all who have heard it, and I have worked it at two of our Church bazaars on an indoor aerial, and on no occasion has it let me down.

I constructed the set from your first R.P. envelope, and have since added the many refinements you will notice.

I made all the alterations shown before your article appeared and I was very pleased to find that they followed very closely those mentioned by you in your article, and I have no hesitation in saying that I have still to hear a better receiver, and I have heard many since I was bitten by the germ of our huge fellowship, which was in the far-off days of experimental licences.

Trusting this communication, with the photographs, will prove of interest.

I remain,

Yours sincerely,

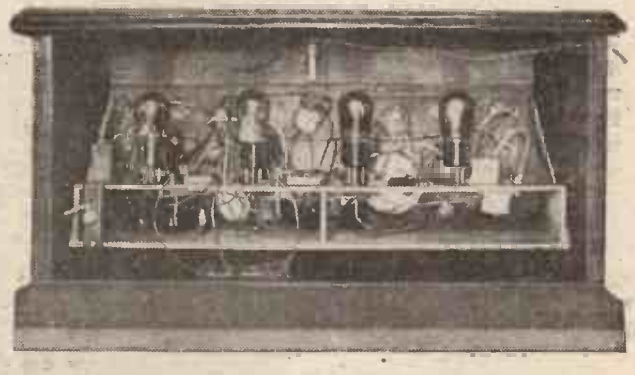
J. B.

Lancashire.

The "Four-Valve Family" set referred to above.

An Australian Reader's Experiences

SIR,—A point I would like to raise in connection with the Radiano short-wave receiver (June, 1927) is the size of the tuning condenser. I have been experimenting with short-wave receivers, using this circuit (throttle regeneration control), for some time, and have found that a condenser of ·00025 mfd. makes the tuning very difficult below 75 metres.



A view of the interior of "J.B.'s" set, showing the alterations.

Reducing this condenser to seven plates, having a maximum capacity now of ·00015 mfd., made the tuning down to 30 metres fairly pleasant so long as a 15–1 vernier dial was used.

Desiring even easier tuning I further reduced the tuning condenser to three plates (two moving, one fixed), now having a maximum of about ·000065 mfd., and used a 12–1 vernier dial. Tuning is now considerably easier and it still covers the desired wave-band.

Allowing 20 m/mfd. for the capacity of the wiring, condenser at minimum, valve, and coil, and 65 m/mfd. as maximum with condenser all in, the capacity ratio is about 3–1, and wave-length ratio about 1·7–1 (wave-length being proportional to the root of the capacity), an 11-turn grid coil was found to tune from 30 to 52 metres. This made P C J J on 30·2 metres appear in the first five divisions of a 100-division scale, which was not desirable. So I reduced it to 10 turns and this gave a minimum of 27 metres and a maximum of about 46 metres, and this proved ideal. P C J J appeared at about 25 divisions and 2 X A F (W G Y) at 32. Australian amateurs between 30 and 35 metres spread from 20 to 50 on the dial, and U.S.A. amateurs on 37·5 to 42·5 were found from 60 to 85 on the dial.

Of course, a greater number of coils are required to cover the whole wave-band from 15 to 120 metres, but the ease of tuning amply repays the inconvenience of often changing coils.

P C J J is audible here any Wednesday or Friday morning at good 'phone strength, and is pleasantly audible in the next room when an extra stage of amplification is added and a speaker plugged in. Eindhoven is 10,600 miles from Adelaide!

Hoping this may lead somebody to experience the delight of easy short-wave tuning, and wishing the WIRELESS CONSTRUCTOR every success.

Yours, etc.,

S. Australia. J. W. C.

A Radiano Success

SIR,—I would like to join the "ranks" of the many others who have written to you to thank you for the excellent Radiano system. I have had splendid results from the three-valve set, and hope you propose putting forward further sets made under the same system.

Thanking you in anticipation.

Yours truly,

A. W.

Co. Wicklow,
Ireland.

Don't forget that the next issue of the "Wireless Constructor" is a Special Gift Number.

ONE OR TWO? TAKE YOUR CHOICE!

by A. S. CLARK

A specially designed general-purpose, "'phones or speaker" set, capable of good local and D.X. reception.

THERE are many wireless enthusiasts who, for various reasons of which the question of expense is very often one of the most important, decide that a two-valve set is just what is required. Being really keen on wireless, they not only desire to get one or two stations on the loud speaker for entertainment, but also want to be able to do some "D.X." work. They hope that when the set is completed they will be able to tune in quite a number of continental stations as well as British, and perhaps occasionally to be able to put some of the more powerful continental stations on the loud speaker.

Selective Arrangement

The set to be described in this article has been especially designed to meet the needs of those who come under the above category. The set is a two-valver consisting of a detector and transformer-coupled low-frequency valve, and is sufficiently selective to allow other stations than the local to be heard while the latter is working, and without the use of a wave-trap.

The degree of selectivity has not been carried too far, however, as, without any high-frequency amplification this would be inclined to produce a marked drop in signal strength. By a special arrangement it is possible to use the telephones after the first valve, while the loud speaker is being worked off both.

Not only is this an advantage when tuning in weak stations on the loud speaker, but anyone who is somewhat deaf and therefore cannot follow the programme properly without telephones, can do so without inconveniencing others.

The set is built in the usual baseboard style with upright panel, the latter being 12 in. by 8 in., from which it will be gathered that the set is fairly compact. All terminals, including the aerial, earth, and those for the loud speaker, are arranged on terminal strips at the back of the set. This makes it possible to keep the set neat-looking even while connected up, since no wires need be seen from the front.

The panel layout has been kept very simple, the two condenser knobs, one for tuning and one for reaction, are at the top. Below these, in the centre, is a potentiometer, the use of which is described later. To the right of the potentiometer is the on-and-off

The baseboard layout is so arranged that the wiring is made as direct and simple as possible.

One or Two?—*continued*

switch, and to the left the jack for the telephone plug.

A special type of home-wound coil, which has certain advantages over commercial ones, is employed for the aerial tuning circuit. This is mounted on an ordinary plug-in coil mount, and thus makes it possible to use an ordinary plug-in coil if desired.

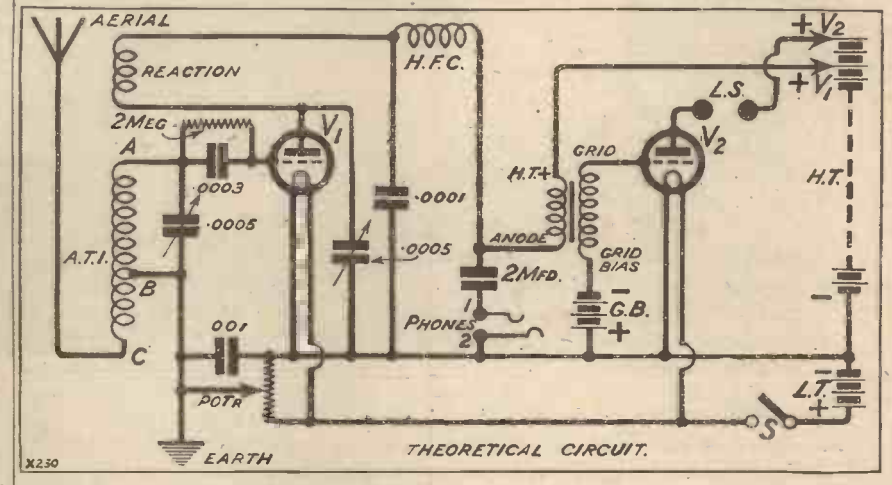
Plain dials have been used for the condensers, since slow-motion control was not found to be really necessary. However, if desired, geared dials may be fitted as a refinement, and one is more likely to be found of benefit on the tuning condenser than on the reaction condenser.

Special Points

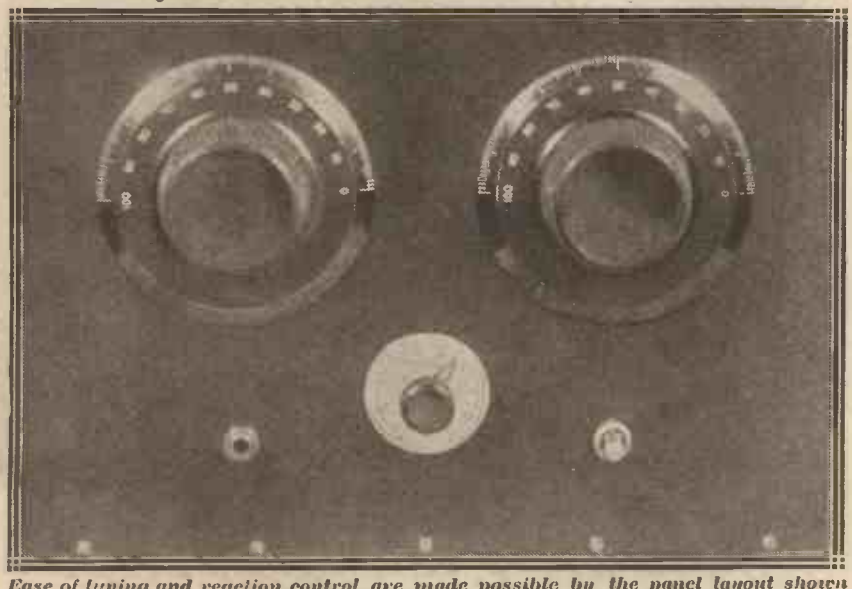
In order to avoid having too many external wires the grid-bias battery has been arranged inside the cabinet, and may be seen to the left of one of the back-of-panel photographs. With the size panel employed, and with a ¾-in.-thick baseboard, panel brackets were not considered to be necessary, and therefore are not employed.

The theoretical circuit is shown in one of the diagrams, and there are several points worth particular mention. There is an aperiodic aerial circuit which is closely coupled to the tuned secondary, or grid coil. Although this aerial circuit is joined to one end of the secondary, and is wound as one coil with the latter, it differs from the usual auto-coupled arrangement in that the turns used for the aerial coil are not common to the secondary.

In auto-coupled circuits, when a reaction coil is coupled to the aerial coil, although the fed-back impulses are in the right direction in the secondary coil, they more or less oppose those in the aerial turns, thus a small loss of signal strength is experienced. Ordinary centre-tapped or "X" coils may be satisfactorily used in this set, but a slight, though definite, advantage is obtained with the special coil described.



It will be seen that the potentiometer slider is connected to the earth side of the grid coil and condenser, so that it is possible by adjustment of its position to alter the potential on the detector valve. Although it is usual to connect the grid-leak return to the positive filament leg of the detector valve, it is sometimes found that with modern valves a much smoother control of reaction may be obtained with the grid slightly negative.



Ease of tuning and reaction control are made possible by the panel layout shown above.

COMPONENTS REQUIRED.

Ebonite panel 12 in. × 8 in. × 3/16 in. (Radion). (Any good material.)
Cabinet with 8 in. deep baseboard for above (Camco). (Artcraft, Bond, Caxton, Pickett, Raymond, etc.)
2 ·0005 Variable condensers (Cyldon). (Any good make.)
Potentiometer (Precision). (Lissen, or other good make.)
"On-and-off" switch (Igranic). (Benjamin, Bowyer-Lowe, L. & P., Lissen, Lotus, etc.)
Single-circuit open jack (Lotus). (Ashley, Bowyer-Lowe, Igranic, etc.)
Telephone plug for same (Lotus). (See above.)
2 Anti-vibration valve holders. (Ashley, Benjamin, Bowyer-Lowe, B.T.H., Burndept, Burne-Jones, Igranic, Lotus, Precision, W.B., etc.)
2 Single-coil mounts
High-frequency choke (Colvern). (Bowyer-Lowe, Lissen, Ormonde, etc.)
2-mfd. Fixed condenser. (Clarke, Dubilier, Efesca, Ferranti, G.E.C., Lissen, Mullard, T.C.C., etc.)
·0003 Fixed condenser and grid-leak clips or separate grid-leak holder. (See above.)
·0001 Fixed condenser. (See above.)
·001 Fixed condenser. (See above.)
Low-frequency transformer (R.I.-Varley general-purpose). (Any good make.)
9-volt Grid-bias battery. (Lissen.)
2 Wander plugs for above.
2 Terminal strips (7 in. × 1½ in. and 2 in. × 1½ in.) and 9 terminals.
Small quantity of 24 D.C.C. wire and 28 D.C.C. wire.
1 Plug for ordinary plug-in coil (Lissen).
Quantity 16-gauge tinned copper wire.
Actual components used are mentioned separately. A few other suitable makes follow in most cases.

One or Two?—*continued*

The advantage of the potentiometer will immediately be appreciated when it is realised that for satisfactory long-distance reception, smooth reaction control is absolutely necessary. It is, however, advisable to work with the potential of the grid of the detector valve as near to fully positive as possible consistent with satisfactory reaction control.

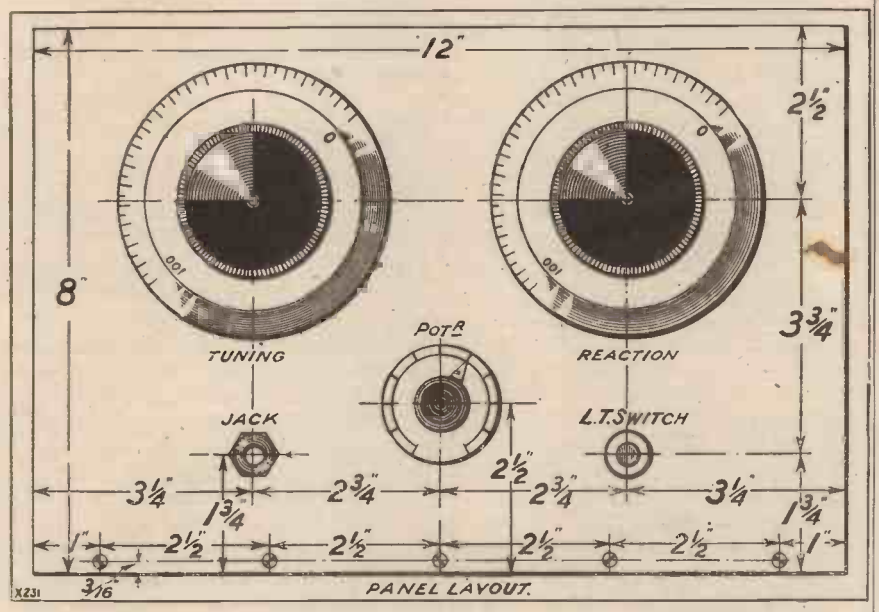
Most readers will be familiar with the usual arrangement of loud-speaker output filter circuits, and will, therefore, recognise a similar arrangement for the telephones. The primary of the low-frequency transformer is used as a low-frequency choke, and thus enables the telephones to be inserted into circuit while it is being used to transfer potential variations to the secondary winding.

Inserting the 'Phones

There is no reason why the telephones should not be inserted at any desired time, since it is very difficult to tell from the loud-speaker reproduction, even on the local station, whether the 'phones are in circuit or not.

The strength of signals in the telephones is just as loud as though they were inserted direct into the plate circuit of the detector valve. Therefore, if it is desired to use the set as a one-valve receiver only, all one has to do is to remove the second valve and plug the telephones into circuit in the usual manner.

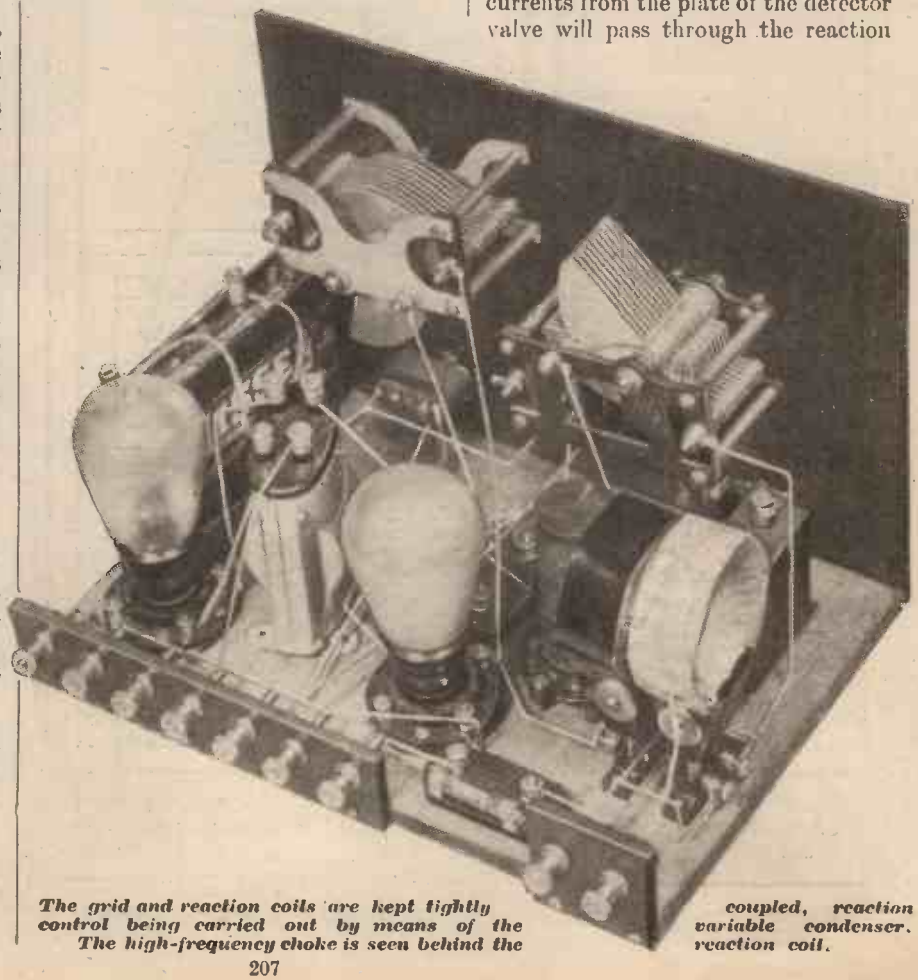
Transformer coupling was chosen for the L.F. stage for two reasons. Firstly, because it is desirable to get the maximum amplification possible from the L.F. valve if satisfactory loud-speaker reception is to be obtained from two valves. Secondly, because with only one stage any distortion which might be present due to the L.F. transformer could hardly be noticed in comparison with a resistance-capacity-coupled stage.



Reaction Control

In another part of the article a complete list of the components required to build this set will be found. The actual makes of parts employed do not matter so long as they are reliable, and the parts are of suitable types. It will be noticed that two ·0005 variable condensers, instead of one ·0005 and one smaller, as usual, are employed. This is because a special arrangement for reaction control is employed, which gives a very gradual build up, even on weak and distant stations.

From the circuit diagram it will be seen that with the variable reaction condenser at zero, the high-frequency currents from the plate of the detector valve will pass through the reaction



The grid and reaction coils are kept tightly coupled, reaction control being carried out by means of the variable condenser. The high-frequency choke is seen behind the reaction coil.

One or Two?—*continued*

coil and back to the filament, via the ·0001 fixed condenser. As the capacity of the reaction condenser is increased these currents will pass straight to filament through the reaction condenser, and thus stop oscillation or reaction effects.

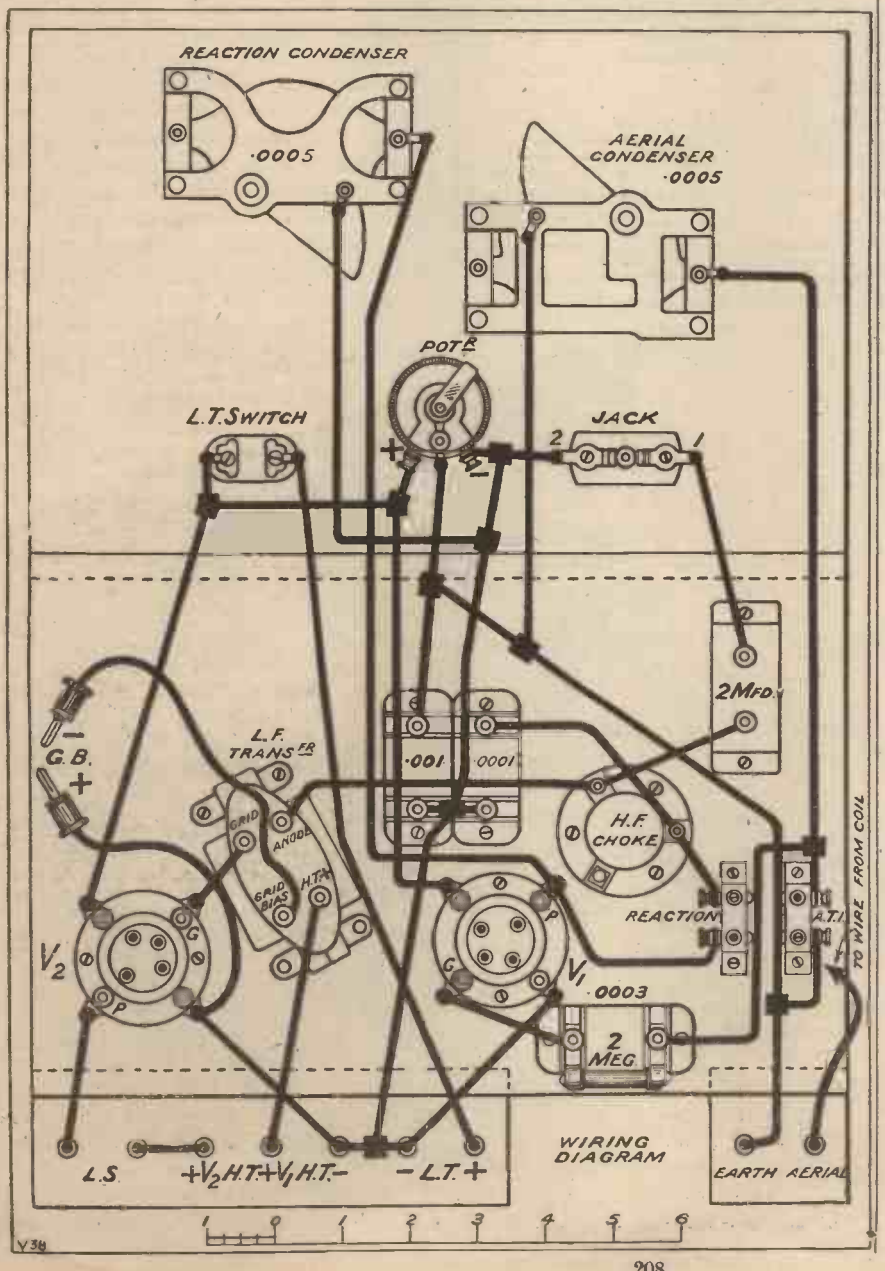
Easily Constructed

As soon as all the required components are obtained the construction work, which is quite straightforward, may be commenced. First mark out the panel in accordance with the dimensions given in the drilling diagram. This should be done on the back with a sharp scriber. Centre-punch all points to be drilled before doing the actual drilling.

The terminal strips should have holes 1 in. apart drilled in them, two in the smaller strip and seven in the larger. These holes should be an inch from the bottom of the strip. Several holes must be drilled for fixing to the baseboard.

Now mount the components which go on the panel and also the terminals on the terminal strips. Before proceeding any farther it is as well to tin all points to which wires are to be soldered, not only on those already mounted, but also on those which are to be fixed to the baseboard. When this is done, screw the panel and terminal strips to the baseboard, and mount the remaining components. The disposition of the components on the baseboard is clearly shown in the wiring diagram, and this layout should be followed as nearly as possible.

All that now remains to be done is the wiring. The wiring diagram shows all the connections which have to be made, and must be followed very carefully. A list of point-to-point connections is given above, and will serve to check the wiring over when it is completed. Incidentally it will also be found useful when wiring as an indication of which wires to put on first, since the least accessible ones are listed first.



POINT-TO-POINT WIRING INSTRUCTIONS.

Join earth terminal to pin of aerial coil mount, moving vanes of tuning condenser, slider of potentiometer and one side of ·001 fixed condenser.

Join L.T.— to H.T.— and one filament tag of both valve holders, also join to remaining side of ·001 fixed condenser, one side of ·0001 fixed condenser, moving vanes of reaction condenser, one end of potentiometer winding and contact 2 of jack.

Join L.T.+ to one side of low-tension switch.

Join the other side of low-tension switch to remaining filament tags of both valve holders and remaining end of potentiometer winding.

Join contact 1 of jack to one side of 2-mfd. fixed condenser. Join other side of 2-mfd. fixed condenser to one side of high-frequency choke and anode terminal of transformer.

Join socket of aerial-coil mount to fixed plates of tuning condenser and one side of ·0003 condenser and grid leak.

Join other side of ·0003 condenser and grid leak to grid of V_1.

Join plate of V_1 to fixed plates of reaction condenser and socket of reaction-coil mount.

Join pin of reaction-coil mount to remaining side of high-frequency choke and remaining side of ·0001 fixed condenser.

Join H.T.+ terminal of transformer to H.T.+ V_1 terminal.

Join grid terminal of transformer to grid of V_2.

Join plate of V_2 to one loud-speaker terminal.

Join other loud-speaker terminal to H.T. V_2 +terminal.

Join flex wire to grid bias terminal of transformer for G.B.—.

Join flex wire to L.T.— terminal of V_2 for G.B.+.

This completes the wiring.

Neat Wiring

The wiring has been carried out as far as possible so that the shortest possible lengths of wire are used between the various points. This method of wiring is undoubtedly efficient if correct spacing is employed, and with a little care can be made to look quite neat.

(*Continued on page* 248)

WITHIN THE VACUUM

Three new two-volters—Frequent causes of distortion—Tracing overloading.

By KEITH D. ROGERS

(*Assistant Technical Editor of "Popular Wireless"*)

THIS month I first of all want to mention some new valves which I have just received. These make up the new 2-volt series by the B.T.-H. Co., Ltd., and consist of the B.210H., the B.210L., and the B.215P. The special features of all these valves depend upon the adoption of nickel for the filament, which is claimed to enable a longer filament to be used, resulting in increased emission, low internal resistance, and a longer life. With regard to the long life, of course, I can say nothing, as the valves have been in my possession only a few days. The low internal resistance seems to have been accomplished, and there is certainly quite a good emission, though whether it is greater than that obtainable with filaments of different construction I cannot say at present. Let us take the valves in order.

Three New Two-Volters

The B.210H. is, contrary to what one would expect by the nomenclature employed, *not* a high-frequency valve but an R.C. valve, that is for resistance-capacity coupling. This is a pity, because the letter H rather denotes that the valve is suitable for high-frequency amplification, whereas its characteristics make it inadvisable to use it in this capacity in anything but a special receiver. In other words, a receiver which would have to be either of the tuned-anode or resistance-capacity coupled type before this valve is used really successfully in a high-frequency stage.

It takes 2 volts on the filament and ·1 amp., while the maximum anode voltage is 150. The amplification factor is 35, and its A.C. resistance is 87,500. Thus it will be seen that mutual conductance is approximately ·4. On test as an R.C. valve this gave quite good results. I do not know what anode resistance the makers prescribe, but I found that 250,000 ohms worked best when purity of reproduction was taken into account as well as amplification.

The B.210L. is quite a useful little valve. It can be used as detector, a high-frequency valve, or for low-frequency, and I think that as the former and the latter it is really best. The mutual conductance is approximately ·9, the valve having an A.C. resistance of 14,000 ohms and an amplification factor of 13. It also takes 2 volts and ·1 amp. Altogether, it is quite a useful general-purpose valve.

The last of the series, the B.215P., is a useful little last-stager provided it is not asked to deal with too much input. It has a mutual conductance of 1, having an A.C. resistance of 7,000 and an amplification factor of 7. It takes ·15 amp. at 2 volts, and is quite a useful low-frequency valve. Although it is designated as a "P" valve, it must not be mistaken for that type of valve having a low impedance and lower amplification factor, and usually termed a super-power valve. The 215P. can be called a power valve, but it must not be expected to carry any very big grid swing, otherwise overloading will occur.

Causes of Distortion

And now I want to answer in a general way one or two correspondents who have written to me recently concerning distortion in sets. In most cases apparently the apparatus employed is quite all right, the best grid leaks, the best transformers, resistances, etc., have been used, and the valves have been chosen to the best of the constructor's ability. And yet there is distortion, especially on low notes, and I have received a number of letters asking me whether it is likely to be due to the valves being overloaded, or whether it is necessary to look for some other cause.

In several cases circuits have been given, and in many of them I must say it does not look as if the valves should be overloading. They may be, of course, and the only test for that is to detune the receiver and see if the distortion disappears. If it does then you can be reasonably sure that some of the valves, if not all, are being overloaded.

Tracing Overloading

To find out which are being overloaded, the only test is a milliam-

The peculiar internal construction of the Cossor screened-grid valve is shown above. Note the rectangular slot in the screen with its mesh "grid." So far we have been unable to give this valve a thorough test.

meter. This should be placed, as you probably know, in the plate circuit of any circuit suspected and watch must be kept upon the needle to see which way it kicks on the loud passages, especially on the bass notes. If the kick of the needle is upward, then

Within the Vacuum—*continued*

you probably need less grid bias on that stage, while if it is downwards a little more grid bias is nearly always required.

Battery Faults

Variations of H.T. will also have an effect, but it is hopeless to expect any valve to carry a good volume if it has not sufficient H.T. Other causes will give rise to distortion and apparent valve overloading, but there is no time to go into those here. I may say, however, that possibly in some cases where resistance-capacity coupling is employed a lower value of the grid leak in any or all of the stages may be necessary before the blasting is got rid of. Sheer overloading can only be avoided by altering the tuning so as to cut down the signal strength, or by using bigger valves with a consequent increase in H.T. A valve will only handle a certain grid swing, and it is hopeless to expect it to handle more than its appointed voltage.

But there are other causes of distortion which are really simple and which often pass unnoticed. One of these concerns the grid-bias battery. I often hear it said that the grid-bias battery does no work if the set is properly adjusted, and therefore it should keep its voltage. No current is taken from it, so there is no reason why the voltage should drop or why the battery should wear out. That would be all right if the construction of the battery were perfect, but it is *not* perfect and a certain amount of leakage always occurs across the battery, a certain amount of chemical action is taking place inside all the time and a certain amount of drying up of the electrolyte is also taking place. Consequently the battery will "age," and it is not safe to trust any grid-bias battery, or any dry battery, for that matter, after a period of about six or nine months.

Side-band Cut-off

Personally, I test my batteries at least once a week. This may be rather overdoing it, but it is better to overdo such a thing than to neglect it and wait till trouble makes itself evident in the form of distortion. A high-resistance grid battery may do as much harm as a run-down H.T.; which may sound exaggerated, but is really true. H.T., of course, is such a well-known form of trouble that we need not go into that very far. I should remark while dealing with the subject of batteries that all tests of voltage should be made while the battery is under load, that is, while the set is in operation. Otherwise a false idea of the voltage may very easily be obtained and the constructor may be led right up the garden.

Another point concerns the tuning, for it is well-known that if the tuning of a receiver is too sharp there is quite a considerable cut-off in the side bands of modulation of both the high and the low notes; consequently, whenever a loud passage and the low notes are predominant, or, rather, *should be* predominant, they are "mutilated" and distortion takes place. Flat tuning

A neat and compact short-wave set.

The R.I.-Varley short-wave portable receiver, which operates from a collapsible vertical aerial.

should always be employed when a set is tuned to the local or any powerful station, especially for loud-speaker work.

Unfortunately, flat tuning on distant stations is impossible owing to the interference which may be encountered, but the ideal receiver would be almost infinitely flat in its tuning to give pure local reproduction. That is the reason why very many instruments now designed employ what is known as "lossers" in the grid circuits of the high-frequency and detector valves, so that, when required, a certain amount of damping can be introduced which will flatten the tuning and enable the side bands to be adequately amplified.

Unfortunately, a good set is often spoilt by higgledy-piggledy wiring, so that should you suffer from distortion which appears to be due to none of the causes so far mentioned, you should have a good look at your wiring and see that none of the grid and plate leads run parallel for any distance, or in any way near together. Feed-back in the high-frequency or low-frequency stages may cause distortion, and without rewiring the set it may be very difficult to remove this trouble. Adequate screening of high-frequency stages assists tremendously in preventing distortion due to a certain amount of feed-back, and the consequent uneven amplification or instability.

H.F. "Interference"

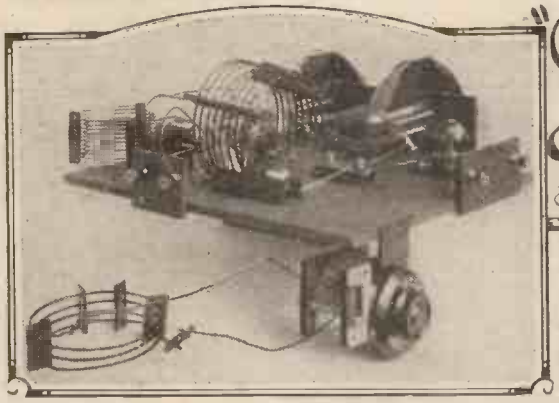
Another form of distortion which occurs in big sets, especially on the long waves, is due to the high-frequency component getting through the detector into the low-frequency stages, which, if resistance-coupled, may quite easily amplify the high-frequency still further and cause peculiar results. It is difficult to describe this distortion, but once you have heard it you will never forget it. The only way to eliminate this is to employ high-frequency "stoppers," and by-passes in the various stages, and make sure that the high-frequency component has no chance of getting into the low-frequency side. This is more likely to occur on the longer waves, because the high-frequency is more readily amplified when the frequency is lower. It is on the Daventry range that the high-frequency getting into the low-frequency may quite easily cause trouble if adequate measures are not taken to prevent it. By the way, the Mullard R.C. coupling unit incorporates a special stopper in the instrument itself.

A Further Trouble

A further cause of trouble is that of bad emission. I have occasionally been let down in this way, and after thoroughly testing a receiver—H.T., L.T., grid bias, and everything I could think of—I have suddenly decided to test the valves themselves. Having taken them out, I have often found them all right, but once or twice there have been valves which have lost their emission.

This does not often occur, but when it *does*, short of taking the valve out and testing it with a milliammeter, it

(*Continued on page 254.*)



My "Fly-Power" Transmitter"

The author has communicated with America on the set described below, which he built up from ordinary components used in his receiver.

By L. H. THOMAS (6QB)

ABOUT two months ago the writer decided that it would be rather interesting to see exactly what could be done with a transmitter that incorporated receiving parts only, worked from a dry-cell supply such as any receiver needs, and operated in conjunction with a very ordinary receiving aerial.

There is, of course, nothing very new in the idea of transmissions with extremely low powers, such as were used in this case, but in the entire range of components used it was decided that nothing should be incorporated that was not readily obtainable at the average wireless shop or could not be made at home in the course of half an hour or so.

Made in 2½ Hours!

The little transmitter shown in the photographs is the result of these labours, and considering that the said labours only occupied a matter of two and a half hours the writer considers them amply justified.

A perfectly straight receiving circuit was employed, the chief deviation from normal being that both the grid and anode circuits were tuned. (See Fig. 1.) A few slight modifications were later introduced, but as these were not found necessary until the transmitter was used for slightly higher-power work, they have not been shown in the circuit diagram.

Choosing the Condensers

The circuit as shown is commonly known as the "tuned grid—tuned anode" arrangement, and for efficiency on the shorter wave-lengths is certainly hard to beat. Its beauty is, of course, its simplicity, and it is so "flexible" that it is equally suitable for a midget transmitter such as that seen in the photographs, or a mammoth affair with an input of thousands of watts. It is also suitable for use on any wave-length simply by plugging in coils of suitable sizes.

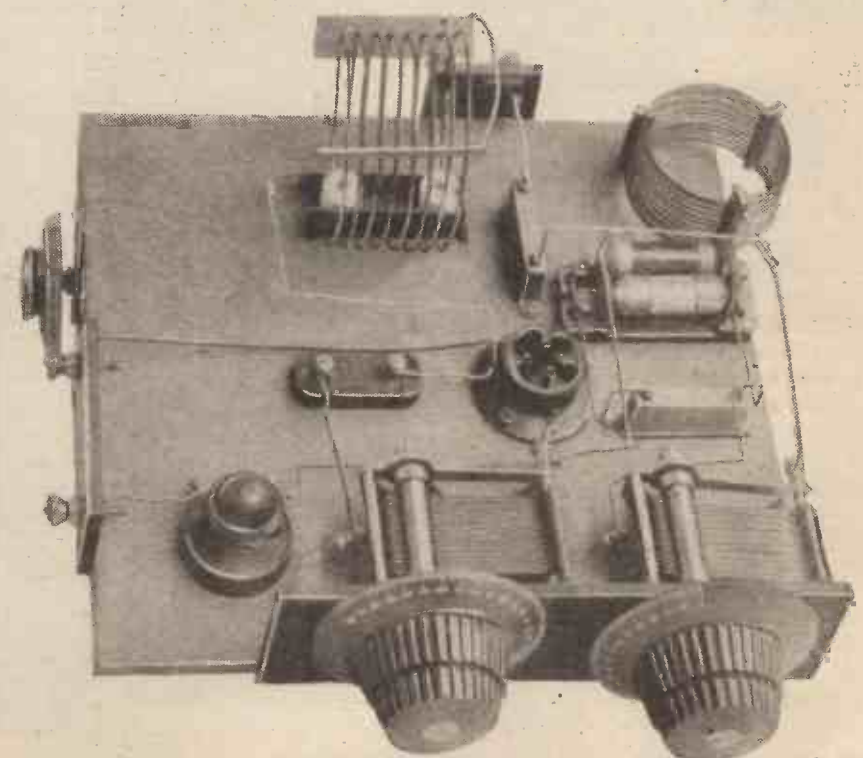
The components that should be chosen with special care are the valve holder and the fixed condensers. The actual valve holder used has not only a very low self-capacity but extremely long leakage paths between the pins, both very desirable features. The two most important fixed condensers, that across the H.T. supply and the grid condenser, are Dubilier Type 577 condensers, intended either for low-power transmission or for use in receivers employing voltages rather higher than those in common use.

These, again, were not absolutely necessary at first, but as the transmitter has constantly been in use with an input power of 10 watts (at 600 volts) since the conclusion of the tests on very low power, it was thought advisable to include them. It should be understood that ordinary receiving condensers of good manufacture would be perfectly suitable and beyond reproach.

Short Grid Wiring

The coil on the right, as seen from the front of the transmitter, is the grid coil, tuned by the right-hand variable condenser. It has been placed in such a position that the associated wiring is as short as possible; the grid leaks are in front of it and the grid condenser still farther forward. The "grid leaks" comprise two 100,000-ohm anode resistances connected in parallel, giving, of course, a value of 50,000 ohms. The grid condenser is the conventional ·0003, and no variation from this value was found to yield any advantage.

The central coil is the anode inductance, to which is coupled the



A photograph of the "'Fly-Power' Transmitter" with the aerial coil removed. The grid coil and condenser are those to the right.

"My 'Fly-Power' Transmitter"—*continued*

small aerial coil. In one of the photographs the latter has been taken away from the baseboard, and the position of the aerial condenser may be seen. The reason for taking this away from the top of the baseboard was to allow sufficient space for very loose coupling to be used, and also to keep the condenser well out of the magnetic field of the aerial and anode coils. The whole transmitter when in use is supported some six inches above

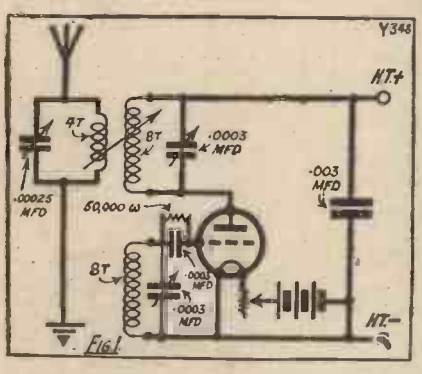


Fig. 1.

the bench by ebonite strips. Valve boxes are eminently suitable for this.

Nothing more need be said about the constructional details and layout of the set.

As it stands, the transmitter was intended for use on the wave-bands of 44–46 metres and 90–100 metres. On the former band both condensers are set in the position in which they are seen in the photograph below, and on the other both are set very near their maximum. The setting of the aerial condenser, of course, depends entirely upon the type and length of aerial in use.

Reducing Key-Clicks

When the transmitter was first rigged up, the grid and anode circuits were tuned accurately to 45 metres, and a key, shunted by a 40,000-ohm resistance (to reduce "key-clicks"), was inserted in the negative H.T. lead; 100 volts, obtained from ordinary receiving batteries, were connected up, and the input current was found to be about 1 milliampere, the valve used then being an L.S.5B. The aerial coil was then coupled-up fairly tightly, the end nearest to the anode coil being taken to a 36-ft. aerial and the other end to direct earth. On rotating the aerial condenser slowly distinct signs of resonance were noticed on one wave-length by the sudden rise in the input.

At the correct setting the input was 3 milliamperes with the aerial and earth connected, dropping to 1 milliampere with the aerial coil removed. The current obtained in the aerial was too minute to be detected by means of a hot-wire or thermo-ammeter, so that the method described above was always used and proved quite satisfactory. If the input could be doubled simply by coupling the aerial coil and tuning it carefully to resonance good results were always obtained without difficulty.

Glasgow First Time!

With the set adjusted in this manner a station in Glasgow was called, and he at once replied and reported the signals as "R.4–5." Telephony was attempted, the method of modulation used being described later in the article, but bad interference and atmospherics rendered this test a failure. The power in use was exactly ·3 watt (3 milliamps at 100 volts).

A few adjustments were then made, and an hour or so after a good report was received from 5 X D, at Douglas, Isle of Man. An interrupter was then used, giving a modulated note instead of the pure D.C. note in use previously, and this station reported reception as "R.3 without receiver oscillating." Since this particular note was rather more difficult to follow when there was any serious jamming, it was not employed after this, and the pure D.C. was retained for future tests.

Several more reports were obtained from British stations, all of them reporting signals as being dead steady and very easy to read. On one day seven stations were worked and five of them asked whether crystal control was in use.

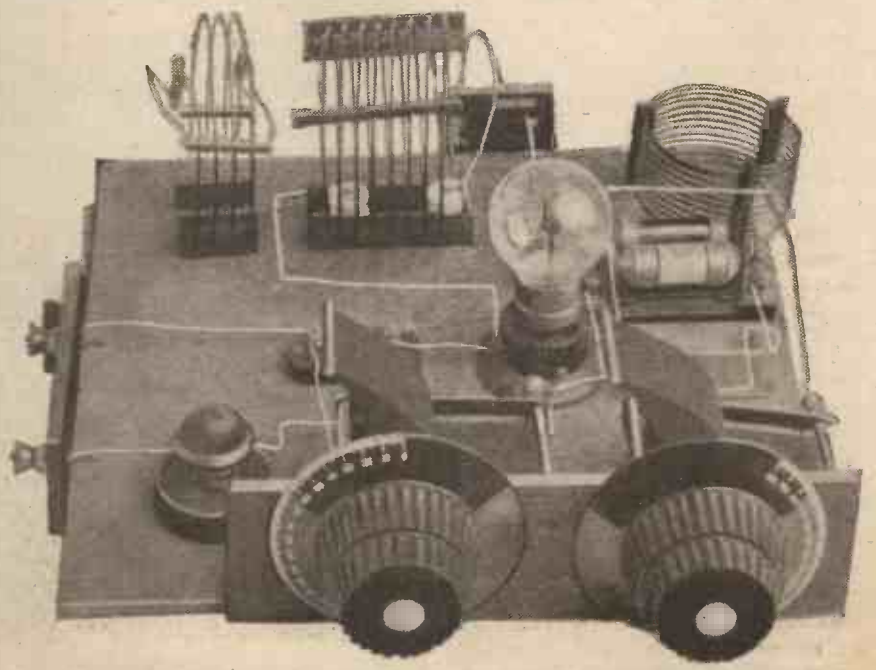
A Continental Tour

Some days later, S M X V, in Sweden, was called, without very much hope of a reply, but one was forthcoming immediately, and signals were reported as R.4 and steady. On the same night they were R.5 in Berlin and R.3 in Copenhagen, and three nights later F M–8 V X, at Oran, French Morocco, reported them as steady R.5 on two valves.

It was particularly noticeable that of all the stations from whom reports were obtained, not one complained of any difficulty in reading the signals. The absolute purity of the note and the ease of keying a transmitter with such low power without producing a "chirpy" or "bubbly" note probably accounted for this.

French Morocco at present is the most distant country reached by these "one fly-power" signals, the distance being about 1,300 miles, the

(*Continued on page 252.*)



Here the aerial coil is shown in position, together with the valve that was used during some of the tests recorded in the accompanying article.

MORE ABOUT THE "STRAIGHT LINE" FOUR

Further interesting details concerning the operation of the extremely sensitive four-valver described in last month's issue of THE WIRELESS CONSTRUCTOR.

By PERCY W. HARRIS, M.I.R.E.

READERS who have already built up the "Straight Line" Four will have found no difficulty of operating it, as the usual and rather tedious process of neutralising, which has heretofore been necessary in a really efficient receiver embodying high-frequency stages, is entirely abolished. The most noticeable feature of all when operating the set is the remarkable purity and "nearness" which characterises the transmissions from distant stations, if they are not heterodyned by one another.

No receiver, of course, will get rid of that trouble, and the Geneva scheme does not seem to have been so effective as was first expected. At the same time, there is a very large number of foreign stations that can be received free from interference, and these give a very wide range of programmes.

It is particularly interesting to notice how many stations are now receivable on what was called the "Daventry Range." Of these (of course excluding Daventry), I receive Hilversum by far the loudest. The transmissions from this station are really excellent in quality and variety, and offer a very useful alternative programme on Sunday afternoons.

Königswusterhausen also comes in very well and, of course, we have Daventry and Radio-Paris. It is rather remarkable that a long series of tests at Wimbledon show that Radio-Paris is always louder in daytime than after dark. The lunch-time transmission has been particularly clear and of very considerable volume. After dark, so far as the conditions at my laboratory are concerned, the strength of Radio-Paris drops to about half.

Frame Aerial Reception

The biggest surprise of all is Moscow, which I frequently hear at midday quite as loud as after dark. The strength of Moscow in daytime seems about the same as that of Radio-Paris after dark.

An excellent proof of the great sensitivity of the "Straight Line" Four is given by its use with a small frame aerial. Using the frame such stations as Rome, Milan and Dublin are brought in at loud-speaker strength after dark, and anything from fifteen to twenty stations can be picked up in

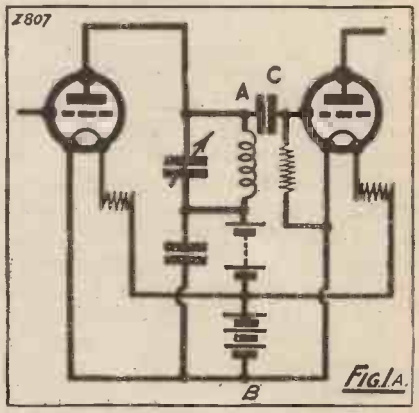
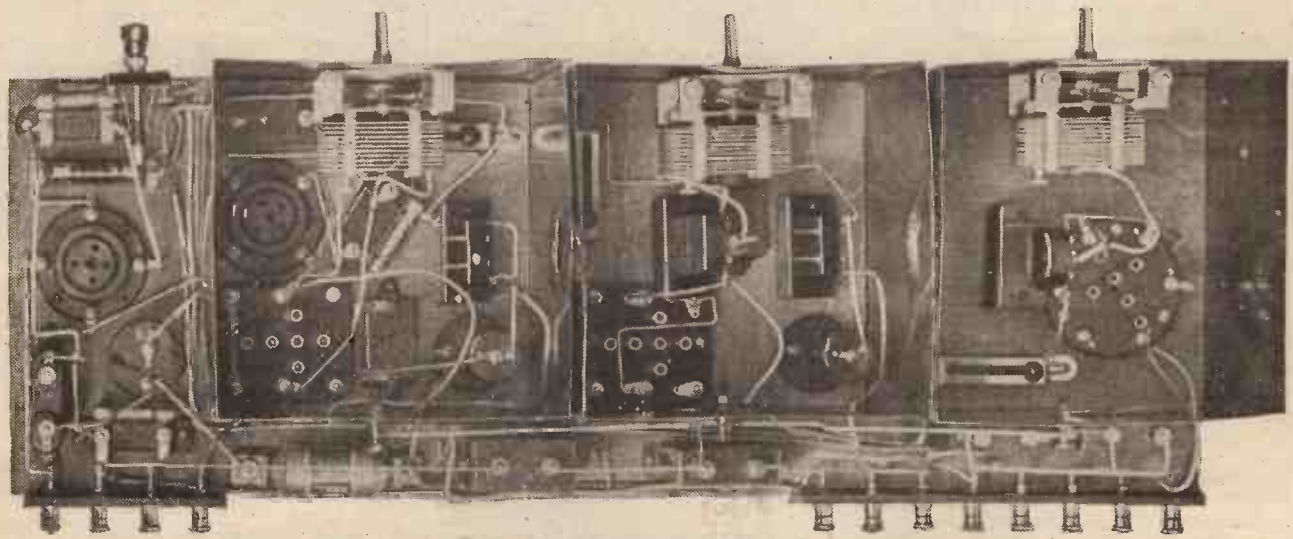


FIG. 1A.

this way on a reasonably good night.

The connection to a frame on this set is particularly simple and does not involve any constructional changes. It is only necessary to disconnect the aerial and earth leads from their normal terminals, connect the frame to these two terminals and remove the binocular coil from the first socket. It is then necessary



A general view of the "Straight Line" Four, showing the disposition of the components and the arrangement of the three screening boxes.

More About the "Straight Line" Four—*continued*

to unscrew the terminal No. 3 to which the flexible lead from the aerial is attached, remove this wire and attach it to terminal No. 1. The set is then operated in the usual way, but, of course, tuning will be very much sharper.

In normal working the set will be comparatively stable when the lids are removed from the boxes, but when using a frame aerial, all three lids should be in position, otherwise the field of the frame aerial may interact with the receiver and cause oscillation.

The Output Stage

If you are using a super-power valve in the output stage, I would strongly advise you to use some form of filter to prevent the direct-current supply on the last valve plate circuit from passing through the winding. There are several excellent output transformers sold for this purpose, among which may be named the Ferranti, 1 to 1, the R.I.-Varley, and the Pye.

Or one can use a choke coil of, say, twenty or thirty henries and a pair of Mansbridge condensers to form a filter output.

The method of connecting such a choke to the filter is very simple. First of all, the terminals of the choke are joined to the terminals marked loud speaker on the "Straight Line" Four. Each choke terminal is now connected to one terminal of a Mansbridge condenser, the remaining terminals of the Mansbridge being connected respectively to the loud speaker itself. Two mfds. is not too big a value for each of these filter condensers. They should not be less than one mfd. each. The output transformer, however, is the simpler of the two schemes as it saves condensers and is a thoroughly efficient way of achieving one's object.

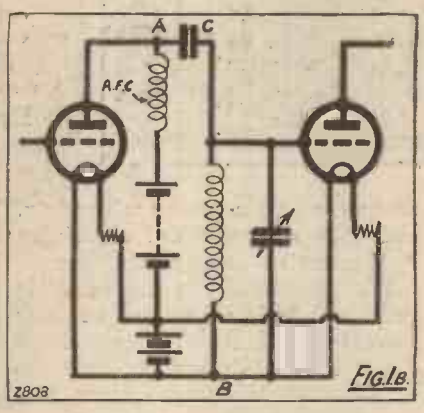


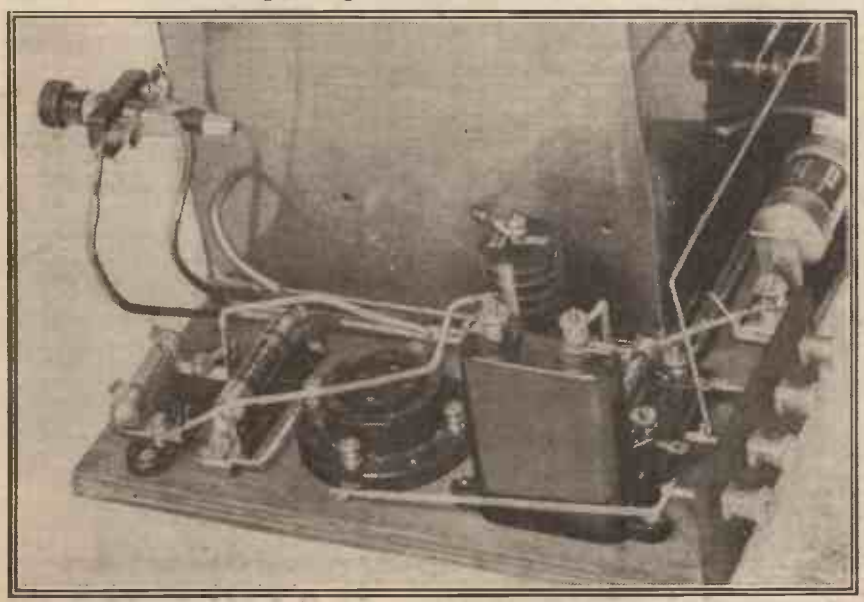
Fig. 18.

Several other makes of holder for the screened-grid valve have been submitted to the WIRELESS CONSTRUCTOR for test and report since the last issue, but so far the Parex is the only one which enables the valves to be passed through circular holes of little bigger diameter than the valve itself. A really excellent holder has been submitted by the makers of the Colvern components, and this can be used in the "Straight Line" Four, provided, however, that the boxes are slotted from the top.

This slot will slightly reduce the screening, but this can be immediately compensated for by placing small strips of metal (copper or aluminium) across the slots as soon as the valves are in place. When using this type of holder the screening boxes must be placed as close together as possible as it is not intended that the partition between the two halves of the valve holder should be double or thick.

Binocular Coils

Owing to the very small space available in the second and third screening boxes there are comparatively few binocular coils which can be used here, but the comparatively large space in the first box enables you to use practically any make of coil for the aerial.



The L.F. end of the set before the panel was mounted. The L.T. switch is shown "in the air" ready for mounting on the panel.

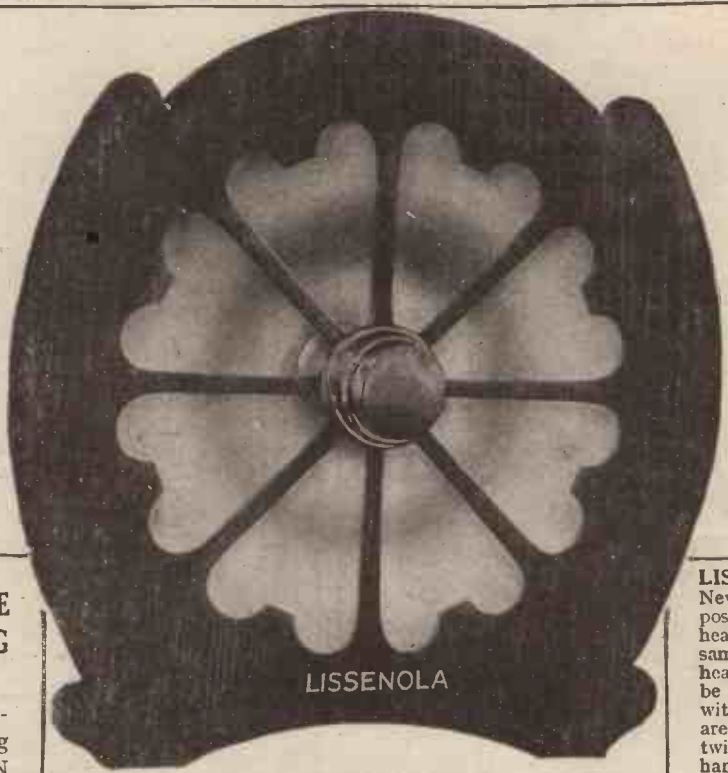
It is, indeed, quite simple to use the ordinary six-pin coil, but, personally, I prefer the binocular for this purpose as the restricted field of the binocular prevents some losses by eddy currents in the special screening boxes.

H.T. Consumption

A very important point, particularly for those who are embarking upon the construction of a multi-valver for the first time, is the high-tension consumption of this set. It is one of the advantages of the screened-grid valve that its high-tension consumption is reasonably low, and, of course, the use of an R.C. valve as a detector means that this stage itself has a very small high-tension consumption.

In practically all multi-valve sets capable of long-distance loud-speaker work, two note-magnifying stages are in use, and these, of course, are the

NEW LISSEN LINES



LISSEN REVOLUTIONISING CONE

A combination of horn and cone in the same loud speaker.

29/6

Fills in the missing note.

LISSEN RESISTANCE CAPACITY COUPLING UNIT

Provides a complete Resistance Capacity Coupling Unit. Includes two LISSEN Fixed Resistances and one LISSEN Mica Condenser. Values incorporated have been selected as the most suitable for general use, but the resistances are easily interchangeable. May be mounted upright or flat.

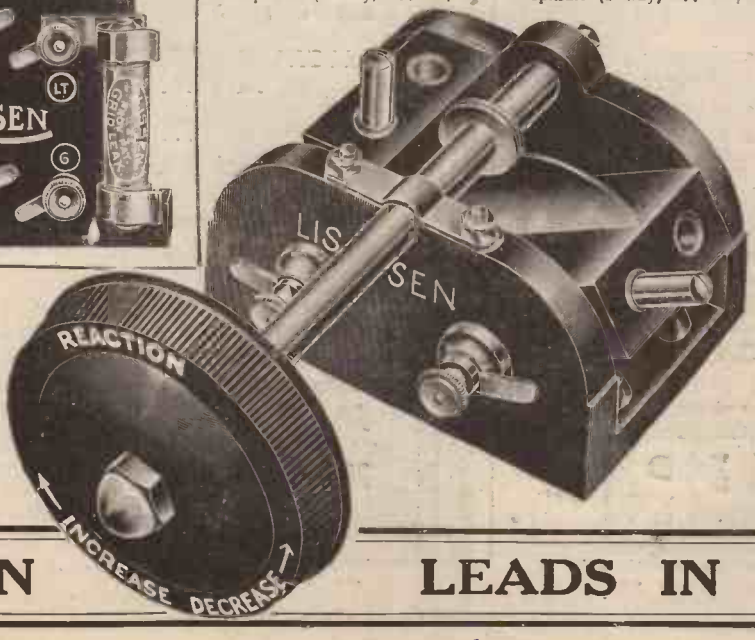
4/-

LISSEN COILHOLDER

Fine degree of control to permit of extremely selective tuning. Gear ratio selected as the best for all practical purposes. Big knob for comfortable finger grip and wide range of movement with one turn. No slip or backlash, coils will not move as the result of their own weight. No flexible connections to break. Moving block on the right-hand side, but may easily be changed over to left-hand side by following the simple instructions enclosed with each coil holder.

Model A. With 2 in. spindle (2 way) .. **4/6**

Model B. With 5-in. spindle (2 way) .. **5/6**



LISSEN HEADPHONES

Never before was it thought possible commercially to make headphones so light and at the same time so sensitive. These headphones are so light they may be worn throughout an evening without the wearer realising they are on the head. Cords will not twist or tangle but will always hang straight down no matter how the head may be turned, moved or twisted. The two earpieces are extremely sensitive and both are exactly matched in impedance. They settle at once into comfortable positions and may be secured there by the single movement of a special ball joint .. **8/6**

LISSEN LIMITED,
26-30, FRIARS LANE,
RICHMOND,
SURREY.

Managing Director: Thos. N. Cole.

L. 417

LISSEN LEADS IN RADIO PARTS

More About the "Straight Line" Four—*continued*

biggest consumers of the current supply from the high-tension batteries. In the present set, owing to the great magnification given by the high-frequency valves, only one stage of note magnification is necessary—indeed, everyone who has heard the set agrees with me that the addition of a second note-magnifying stage would hopelessly overload both output valve and loud speaker, save, of course, when one is listening to very weak distant stations.

Super-Power Advisable

At the same time, the high efficiency of the receiver makes it really advisable to use a super-power valve in the output stage if one desires to get the very best quality, and such valves require a good deal of high-tension to operate them efficiently. For those who are interested in figures, I may say that the total high-tension consumption of the "Straight Line" Four, using a super-power valve in the output stage (a maximum of 120 volts is used), is in the neighbourhood of twenty milliamps.

A much better way of giving the reader a good idea of how the demand will affect his own source of supply is to say that, excluding the last stage, the set takes only five and a half milliamps. This figure will be increased by a figure depending upon the particular output valve used. If, for example, a good super-power valve is used, your total consumption is bound to go up fifteen or twenty milliamps. Do not imagine that a super-power valve will give you stations any *stronger*—this is a mistake which has led many to disappointment. A super-power valve will handle strong signals with practically no distortion, whereas the ordinary small-power valve, given strong signals, invariably distorts considerably.

Large H.T. Required

This distortion is generally attributed to the loud speaker, but practically every loud speaker—and there are dozens of excellent makes on the market—will handle without overloading far more energy than you will ever want to put into it. Many people who have *not* heard a super-power valve working under good conditions are inclined to deny that their present ordinary power valve distorts, just because they have not been able to make the comparison. No one who has ever used a super-power valve with a good modern loud speaker ever desires to go back to the older type if he is able to satisfy the rather extravagant demand for high-tension.

This, of course, is the great worry in modern sets giving good reproduction. The most satisfactory way of all of supplying super-power valves is from the mains, but mains units of good quality and reliability are still expensive. The next best is the high-tension accumulator, then a good type of wet Leclanche battery, and then the largest types of dry cell. Large dry cells (by this I mean large capacity, not merely high voltage) are expensive, but are very satisfactory on the whole. My suggestion for operating this set, if you must rely upon dry batteries and are using a super-power valve, is to use three 45-volt units such as the very excellent Columbia 45-volt battery, No. 4486, for H.T.2 and 3, with a separate tapped high-tension battery of smaller size (the Lissen 100-volt serves excellently) for H.T.1, so as to enable you to adjust the 80 volts on the screening grids accurately.

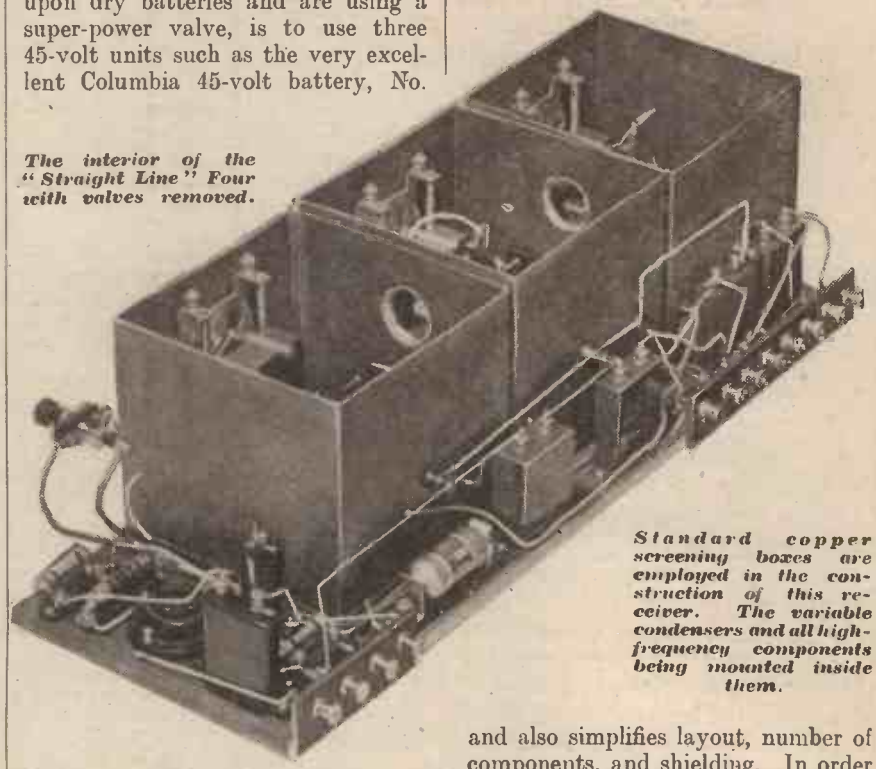
A good high-tension voltmeter is often an advantage, although not strictly necessary. Very excellent makes recently tested in my laboratory are the Weston, Jewell, Ferranti, Hunt, Sifam, and Dixon One-Meter. This last is a general utility instrument.

The new Ferranti meters reviewed on another page in this issue are also particularly good. There is one model which can be obtained for either panel mounting or use on the bench. It has three scales, one reading up to thirty milliamps, another to seven and a half volts, and the other to 150 volts. This one meter thus enables you to measure your high-tension and low-tension voltages, and also the current consumption of the set.

Battery Coupling Obviated

Much of the success of the "Straight Line" Four is due to the choice of the "parallel tuned-anode circuit," which enables the battery to be effectively isolated from the high-frequency circuits, thus avoiding noxious battery coupling and also simplifies layout, number of components, and shielding. In order that the difference between the ordinary tuned anode and the parallel tuned anode can be more clearly understood, I have prepared two illustrations, Fig. 1A and Fig. 1B, in simplified form.

Fig. 1A represents the ordinary tuned anode, from which you will see that the path from the plate of the valve back to the filament goes through the tuned-anode circuit A, and through two parallel paths of different impedances, one through a Mansbridge condenser on the left,



The interior of the "Straight Line" Four with valves removed.

Standard copper screening boxes are employed in the construction of this receiver. The variable condensers and all high-frequency components being mounted inside them.

MORE ABOUT THE "STRAIGHT LINE" FOUR

—continued.

which is across the batteries, and the other through the battery itself. If the condenser is suitably chosen the path through it is far easier than through the battery, but there is always a proportion of the high-frequency current passing through the battery itself.

Above Earth Potential

You will notice that the variable condenser for tuning the anode coil is above earth potential on both sides, the fixed plates connected to the plate of the valve being at high-frequency potential to earth and the moving plates, while at practically earth potential, so far as high-frequency is concerned, are kept at a voltage above earth potential equal to that of the high-tension battery. This means that the moving plates cannot be connected directly to earth on the screen. The voltages which are set up across A and B are impressed upon the next valve through the coupling condenser C.

Now take Fig. 1B, which shows the parallel tuned anode. The passage for the high-frequency current from the plate of the first valve to the filament is through the coupling condenser C_3 and through the tuned circuit on the right down to the filament. The D.C. high-tension supply, you will notice, does not pass through the tuning coil at all, but from the battery through the radio-frequency choke to the plate.

Simplified Wiring

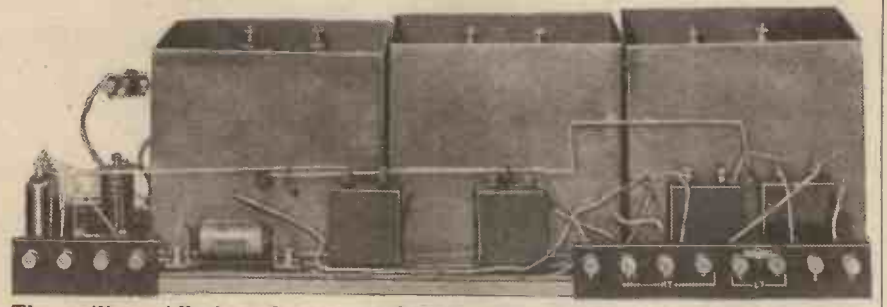
The battery and the radio-frequency choke are, it is true, in parallel with the tuned circuit, just as the Mansbridge condenser was in parallel with the battery, but the impedance of the path through the radio-frequency choke and the battery is extremely high if the choke is suitably chosen, whereas in Fig. 1A the impedance of the path through the high-tension battery is relatively low, although not so low as that of the Mansbridge condenser.

Notice, however, that in Fig. 1B the moving plates of the variable condenser are at the same high-frequency and low-frequency potential as the negative end of the filament, which is earthed.

This means that low-tension negative, the moving plates of the condenser and one end of each of the tuning coils, can be connected directly to the screen, thus greatly simplifying wiring and screening.

It must not be imagined, of course, that the ordinary tuned-anode method cannot be satisfactorily used for sets using two stages of screened-grid valve. In fact, the commercial sets are, I believe, using this method; but in order that it can be used a radio-frequency choke and sundry by-passing condensers have to be inserted in additon to the gear shown in Fig. 1A.

By using the circuit in Fig. 1B no special precautionary methods are necessary, and the radio-frequency choke necessary for the parallel-feed method automatically performs the function of isolating the battery.



The positions of the large by-pass condensers can be clearly seen in this photograph.

SHORT-WAVE SUCCESS

SIR,—Having built your Daventry to Pittsburg receiver and many others I thought that I would let you know of my splendid results with it. I am now only fourteen and was naturally delighted when on the first night of completion I received P C J J on the loud speaker.

I have built over a score of your sets, and I have never had one to fail.

In addition to P C J J, I have had amateurs from all parts of the globe.

Yours sincerely,

Hull. J. W.

MILLIAMPS ON A VOLTMETER

WHY not alter your present voltmeter to read milliamps as well? It is not difficult to convert a good voltmeter so that it serves two purposes; but the meter must be reliable to begin with, and it should be a moving-coil instrument. The basis of the voltmeter is simply an instrument for the measurement of current, modified so that it takes very little current.

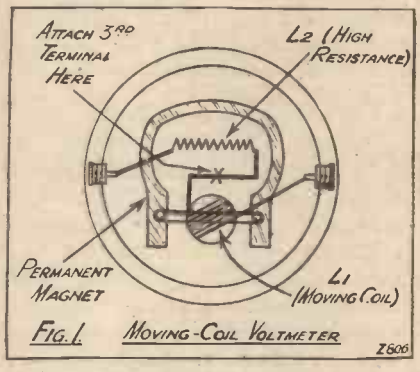


FIG. 1. MOVING-COIL VOLTMETER Z606

The schematic diagram of a moving-coil voltmeter is shown in Fig. 1. L_1 is the actuating coil, pivoted between the poles of a permanent magnet so that it swings round when a current is passed through it. In series with this is L_2, a coil of high ohmic resistance. The resistance of L_1 is made as low as possible.

Easily Converted

In a milliammeter the high-resistance coil is omitted. All that you have to do therefore to convert the voltmeter to read milliamps is to make one of the connections between L_1 and L_2, instead of to the ordinary terminal. The best way to do this in practice is to fix a third terminal on the case of the meter, connected to the common ends of L_1 and L_2. Be careful to see that this terminal is insulated properly from the case, if this is of metal, and take particular care not to disturb the moving-coil mechanism.

To calibrate the meter you will have to borrow a milliammeter. Connect the two meters in series in the anode circuit of a valve receiver, and check the readings on your own meter against the scale readings of the other meter. You may need to make new scale marks on the dial of your meter. In a 0-30 voltmeter which I recently altered in this way, each division of the volts' scale records ½ milliamp.

HAPPENINGS AT SAVOY HILL

By
OUR SPECIAL COMMISSIONER

Broadcasting in 1928

THERE is no doubt that 1927 saw a marked improvement in the average B.B.C. programme. The range of material was considerably widened, while more discrimination was shown in the construction and selection of programmes. The running commentaries, the increase in controversy and the improved news bulletins are welcome additions. As for 1928, those who are watching carefully the growth of the new art hope that we shall see an early restoration of some of the "peaks" which were so attractive during the days of the old company.

During 1927, right up to and including Christmas, the B.B.C. pretended that it was providing the customary special programmes on the appropriate occasions. But those listeners who compare this year's Christmas programmes with those of preceding years will find a curious decline in distinction. This is a pity, and should be remedied. If the B.B.C. will consult its own interests, it will arrange during 1928 at least three really outstanding programmes, including artists of the calibre of Chaliapine and Sir Harry Lauder.

New Blood for Savoy Hill

The new Governers have now been at work for a year. Apart from some changing about, they do not seem to have undertaken any reorganising of the staff of the service. It is believed, however, that important changes will be made in the New Year. For instance, rumours about Sir John Reith are so persistent as to give the impression that there must be some small residue of truth in them.

Those who know him declare that Sir John had no intention of remaining with the B.B.C. after he had set the new Governors on the right course. He is only happy when he is retrieving an apparently desperate situation. The control and management of an established public service merely irritate his restless ambition. There is a substantial possibility that Sir John Reith will not be with the B.B.C. at the end of 1928.

This, of course, will be a great loss, and one which the Governors will have difficulty in making good. It has been stated by at least one Governor that their present intention, in the event of Sir John going, is to split up the work into five parts, each Governor accepting complete responsibility for his or her section. For instance, Lord Clarendon would look after administration, Mrs. Snowden programmes, Dr. Rendall religion and education, Lord Gainford publicity, and Sir Gordon Nairn finance and accountancy.

The theory upon which these proposals are based is that the Governors are paid for full-time service, and should really work as hard as any of the staff at Savoy Hill.

The Dick Sheppard Fiasco

I regret to report the failure of my effort to secure the appointment of the Rev. H. R. L. Sheppard to some appropriate post at the B.B.C. The influence of ignorant reaction and ingratitude was too strong for the moment. "Dick" Sheppard was just the man for the B.B.C., either to run its religion or to help it with programmes generally. But after months of negotiation, marked by misrepresentation and shuffling, nothing has emerged.

There is some mystery behind it. Every official at Savoy Hill with whom I have discussed it seemed keen on the idea. It is known that Sir John Reith is a personal friend of "Dick" Sheppard. What sinister influence intervened? The B.B.C. has suffered a very serious set-back, which can only be repaired by the reversal of the decision.

Mr. Percival Westerman (right), the well-known author, tours the rivers of England in his private barge, which is fitted up with a wireless receiver and loud speaker.

Empire Broadcasting

The B.B.C. deserves congratulations for taking its medicine so well in connection with Empire Broadcasting. The transmissions from 5SW are already a great success. The next

Happenings at Savoy Hill—*continued*

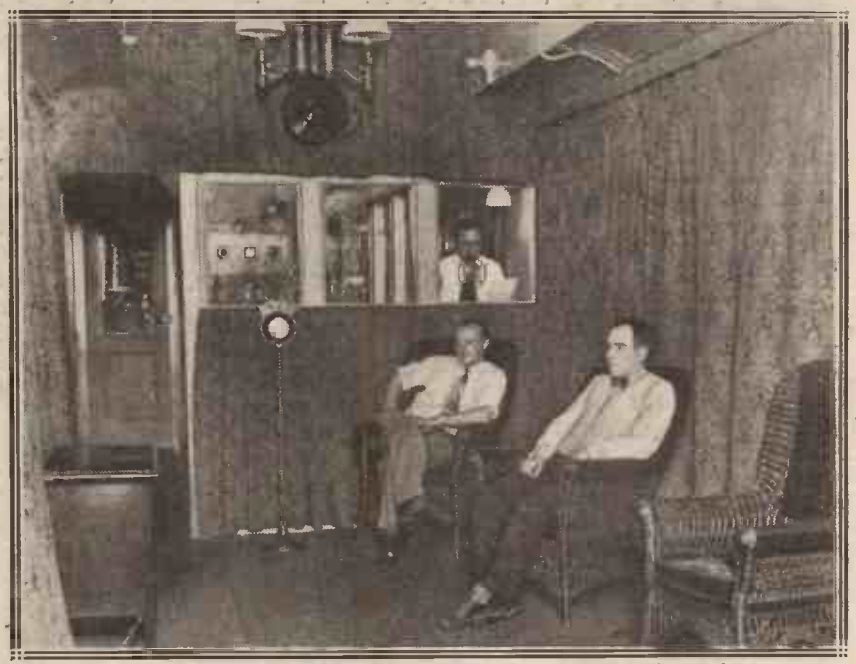
stage is to put these transmissions on a service basis. So rapid has been the progress lately, that this should be possible as early as March.

European S.B.

Second only in importance to the advent of Empire Broadcasting in actuality comes European S.B. The B.B.C.'s repeater stations are now installed right across Europe, and, before long, certainly before the beginning of next season, listeners in Great Britain will receive relays of Berlin and Vienna as easily as Manchester listeners now receive relays from London. This is an important step and another subject of congratulation to the B.B.C.

Facing the Music

B.B.C. finances will be subjected this year to ruthless scrutiny. For the first time, Parliament will have a chance of considering a B.B.C. balance-sheet. Under the charter the Postmaster-General is required to make an annual statement to Parliament at the time the Post Office Vote is taken. To what extent details of finance will be communicated remains to be determined. It will be interesting to know whether the promise given by Lord Gainford two years ago has been carried out. The then chairman of the B.B.C. said in 1925 that the administrative charges had stabilised and would not be increased either actually or in proportion to income.



A travelling broadcasting studio used on the Chicago-St. Paul railway during recent tests in broadcasting.

Inquiries at Savoy Hill on this point have elicited no definite replies. It is understood, however, that the position is virtually the same. If so, it reflects the very greatest credit upon the ability, foresight and acumen of Sir John Reith.

Making adjustments on the nineteen-valve receiver and amplifier installed in the Lambeth Hospital. It supplies 2,000 headphones and 80 loud speakers with either broadcasting or electrically reproduced gramophone records.

Another "Constructor" Success

SIR,—I wish to let you know that I have built your New Family Four. I have had a few sets, but this one tops the lot. As you will note I am only *one mile* from the Manchester station, but I can tune out 2 Z Y *without* a trap, and receive at full loud-speaker strength: 5 G B, Frankfort, Dublin, Newcastle, Liverpool, Leeds-Bradford, Sheffield, and four more foreign stations, without any signs of Manchester.

Respectfully yours,

Salford, Manchester. H. L.

The HIGH-POWER SCHEME — WHERE ARE WE?

By a Correspondent.

EVERYONE has heard of the Regional Scheme. It has been talked about and written about more than any topic of wireless policy during the last year—with the possible exception of Empire broadcasting.

The scheme, in brief, deals with the reorganisation of the present means of distributing programmes, and the general modernising of existing methods of transmission. On paper the scheme has been worked out in detail, and Captain Eckersley and other prominent B.B.C. officials have explained it in almost as much detail—even to the extent of a long article in the B.B.C. Handbook.

It is that article, however, which has drawn the attention of many readers to the fact that, in spite of much explanatory matter, the scheme still remains—or appears to remain—in a very nebulous state. This impression seems to be widely held; it may, of course, be due to the obscure way in which the author of the Handbook article has handled his subject, for there is no doubt that the article is worded in such a way as to leave the average reader in a highly befogged condition, and with the view, rightly or wrongly, that the B.B.C. is rather puzzled itself as to the *modus operandi* to be adopted when putting the Regional Scheme into actual practice.

Several Variations

The latter does, not unnaturally, present problems. The trouble is that there are several variations of the scheme; and the one chosen should, from the ideal point of view, fulfil certain fundamental conditions. But when those conditions are examined, in conjunction with the Regional Scheme and its variations, it will be found that no one variation of the scheme can be made to fulfil all the fundamental conditions.

Now these essential conditions may be briefly set out as follows:

1. Ten wave-lengths alone are available (nine medium, one long).

Three "Service Areas"

2. The whole country must be covered by such a field strength that it can be considered to lie within a B service area. A "B" service area is one within which a listener can be guaranteed crystal reception with a good outdoor aerial, but will be at the mercy of the worst types of interference which occur in, perhaps, five per cent of the cases normally met.

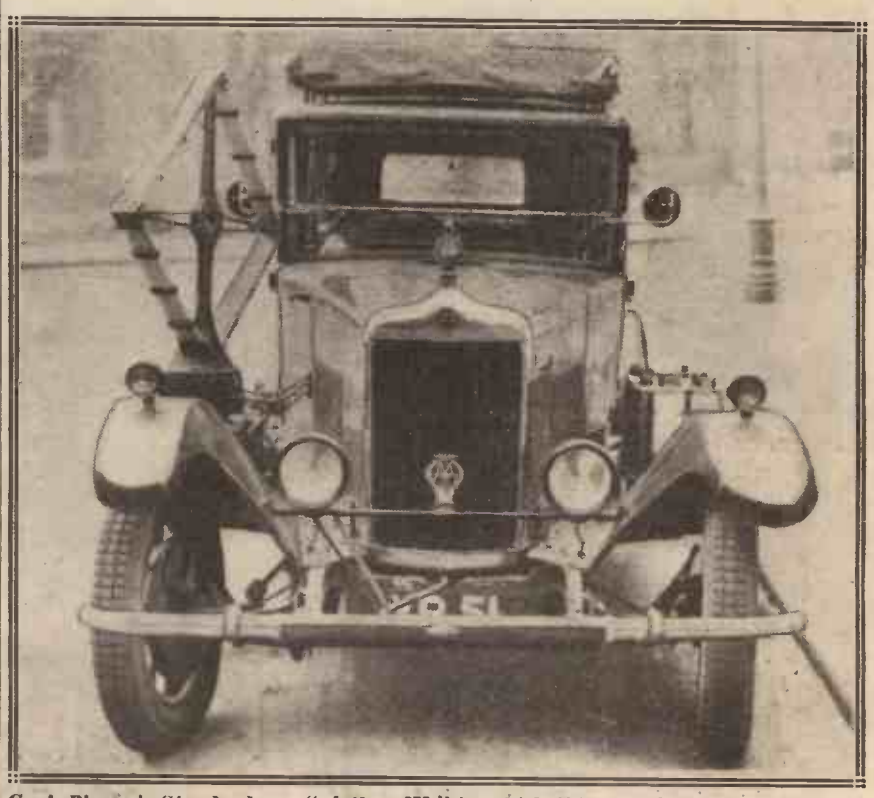
3. The fewest number of persons, seeing that requirement (2) is probably impossible, must be found in C service area, or in "wipe-out" zones. A C service area is one in which a listener will be subject to interruptions from spark sets, trains, atmospherics, etc., but in time should be assured of an eighty per cent service because it is hoped that much interference under the above categories will be eliminated at the source.

Question of Interference

Listeners within a "wipe-out" area can be absolutely guaranteed a service from the local station whatever (within obvious limits) the sources of extraneous electrical interference, but will find a difficulty in hearing foreign stations unless equipped with the more complicated forms of receiver.

4. Densely populated areas should lie within an A service area. A listener within an A service area can be guaranteed service even if he lives near the usual sources of electrical interference—namely, trains and medical apparatus, etc.—and he will have a good chance of reception with properly designed apparatus.

5. There should be a minimum of change of existing field strength in changing from the old to the new;



Capt. Plugge's Standard car "Aether III," in which this well-known experimenter recently toured the Continent. The car was fitted with an elaborate radio outfit (note the frame aerial) and much data regarding reception conditions on the Continent was obtained.

The High-Power Scheme—Where Are We?—*continued*

that is to say, there must be a minimum change in signal reception strength.

6. The maximum number of persons must be able to receive alternative programmes on the simplest and most easily-handled apparatus.

7. The scheme must be efficient and economical.

8. There shall be a minimum of interference with existing wireless services.

It is upon these conditions—which may be likened to the essential foundation stones—that the Regional Scheme must stand or fall. But the reader will at once note that if conditions 1, 2 and 3 are to be observed, then the stations must be few in number and of high power, and they must be built in lonely parts of the country. Yet, in accordance with item 4, they must be erected in large cities.

No Definite Plan?

The Handbook article above referred to deals at some length with various alternative schemes, but there is no indication that the B.B.C. has, as yet, any definite plan in mind. And if there does exist a definite plan, does it fulfil the eight essential conditions set out above?

Question of 5 G B

It is quite likely that the answer to that question is in the negative; but in any case it is obvious that, while ideal on paper, the Regional Scheme in actual practice will differ—perhaps considerably—from the scheme as set out on paper.

The Scheme has been approved, in principle, by a Committee of Independent Experts, and by the Post Office. The result of the latter's approval was 5 G B—generally thought to constitute the first of a limited number of high-powered stations which would eventually replace the present low-powered local stations.

5 G B, although termed "Experimental," is likely to continue to function indefinitely. Its *raison d'être* was, according to the B.B.C., to obtain data for the ultimate reorganisation of the B.B.C.'s transmitting system on modern lines; but, although 5 G B has been in operation for some time now, the author of the Handbook article states:

> "It is impossible at present to state definitely what will happen either to stations or transmitters at existing B.B.C. centres."

This seems to indicate pretty clearly that the Regional Scheme is still very much in the air, and that a definite and practical plan has not yet been decided upon. We suggest that the B.B.C. should issue for publication a straightforward and completely candid statement on the whole subject.

Statement Required

Listeners—and especially members of the trade—find this indecision about the Scheme very disconcerting. A definite outline of policy—even if it means a drastic revision of the Scheme—would be welcome, so long as it does *definitely* clear up present misapprehensions as to the B.B.C.'s attitude to the scheme.

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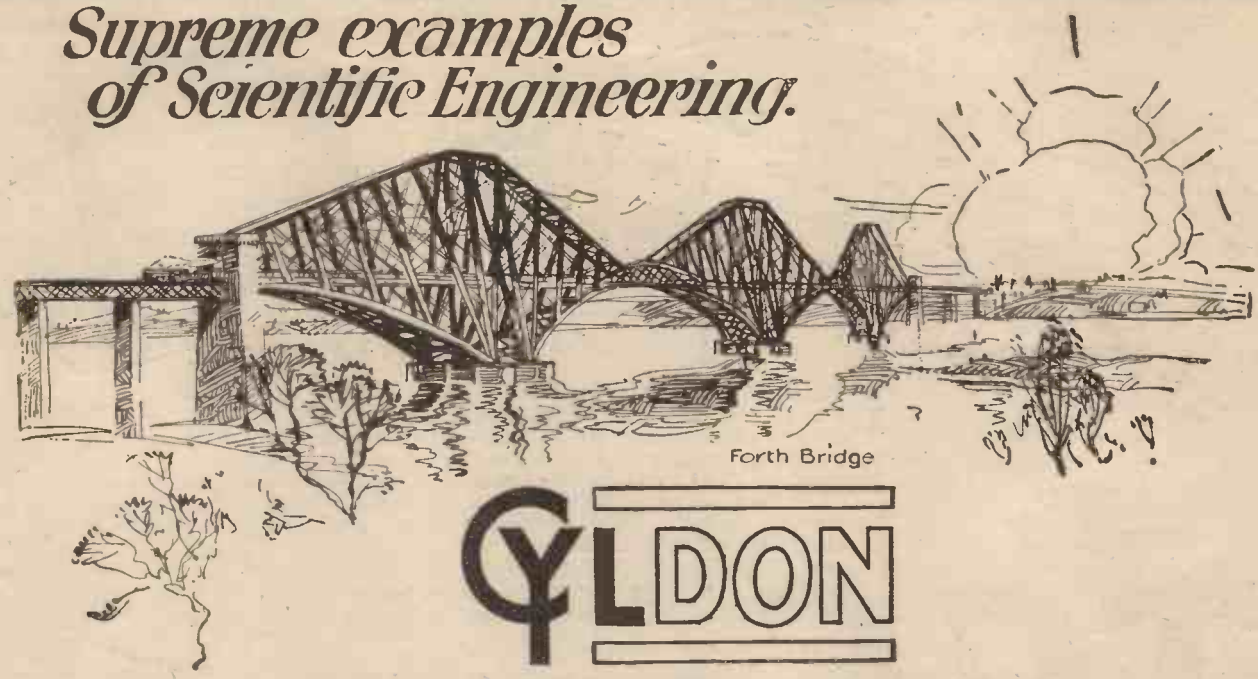

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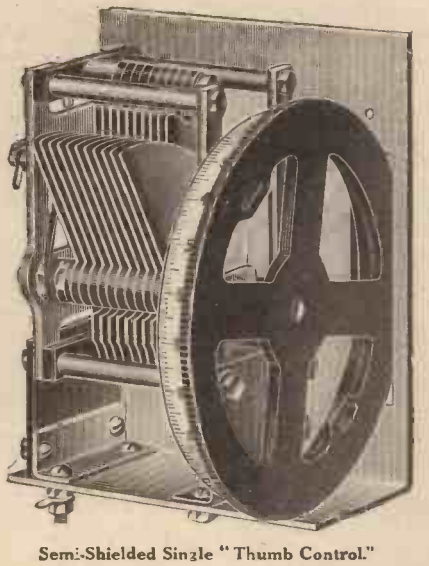

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Type	Catalogue No.	Price £	s.	d.
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2 ,,	·0003	2	5	0
3 ,,	·0005	3	9	6
3 ,,	·0003	3	6	6

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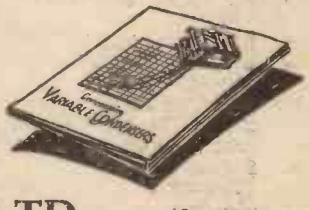

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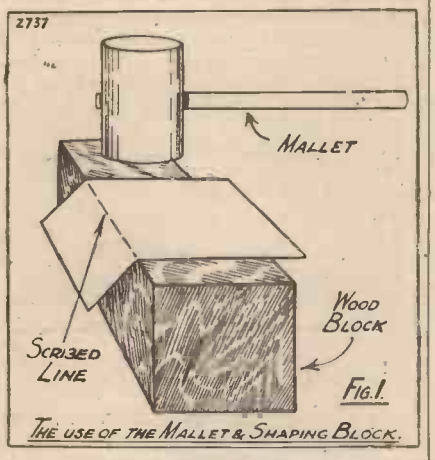
CHATS AT THE WORK-TABLE

Some easily made screens for H.F. stages.

By R. W. HALLOWS, M.A.

Providing Adequate Screening

THE provision of effective screening, especially in circuits which incorporate the new four-electrode valves, has assumed such importance of late that I make no apology for devoting the whole of this month's



"Chats at the Work-Table" to constructional problems that arise in connection with it. It is now realised that to screen coils or transformers alone is not sufficient.

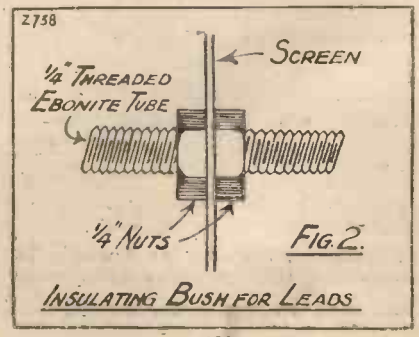
Aluminium or Copper

In order to avoid stray couplings and to ensure the proper working of high-efficiency radio-frequency circuits it is desirable to enclose the whole of each such circuit in a compartment of its own, containing the valve, the coils, the variable condensers, and other components. Where only one high-frequency circuit is used a simple partition may suffice, but should there be two or more, the compartments had better take the form of carefully made metal boxes completely closed at top, bottom, and sides.

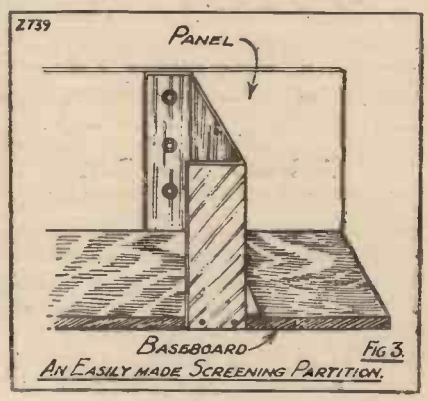
First, as regards the question of suitable metals. There are two which will especially commend themselves to the home constructor. These are aluminium and copper. The advantages of aluminium are that it is exceedingly light, and that it is very easy to shape or to drill. On the other hand it cannot easily be soldered. Copper is almost as easy to work, and if a suitable iron is used there is no difficulty about making soldered joints.

The Tools Required

If, then, simple partitions are to be used, aluminium of about No. 20 gauge will be found excellent for the purpose. Where, however, it is a question of more elaborate screening, I would advise the use of copper of No. 12 gauge or a little thinner. Probably the most economical way of purchasing sheet metal is to obtain it locally from a manufacturing ironmonger. It can then be bought by the pound, and no charge is usually made for cutting out pieces to the sizes required by the purchaser.



For working sheet metal the tools required are a pair of tinsman's shears, a large soldering iron, a sharp scriber, a set-square, a wooden mallet, and a block of wood for shaping purposes. This block, whose use is illustrated in Fig. 1, may be a piece



of deal or similar wood four or five inches square in section and about twelve inches long.

Any fairly light hard-wood mallet will do, but it is important that its faces should not have been badly dented by previous misuse. When it is desired to bend a piece of sheet metal at right angles, the method is as follows:

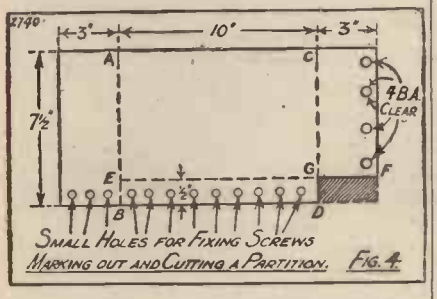
Preliminary Preparations

Begin by flattening out the sheet by tapping it with the mallet. Then make a deeply scribed line at the place where the bend is to be. Lay the sheet upon the shaping block so that the scribed line coincides, as seen in Fig. 1, with one of the upper long edges.

Now bend the metal gently round

Chats at the Work-Table—*continued*

by means of the mallet, and finally square up the bend by beating until the sheet lies evenly upon two faces of the shaping block. Before you undertake any job of shaping I would recommend you to have a little preliminary practice with some pieces of



SMALL HOLES FOR FIXING SCREWS MARKING OUT AND CUTTING A PARTITION. FIG. 4.

scrap metal—odd pieces cut from old tins will do very well for this purpose.

It is not the slightest use to attempt to solder sheet copper with a small, light iron. Such is the thermal conductivity of the metal that it draws heat from the iron with amazing rapidity. Unless, therefore, the latter is of largish size it becomes almost instantly too cool to allow proper work to be done. The solder refuses to flow properly, merely forming unsightly blobs and lumps.

A Heavy Iron Best

I would recommend that the iron should weigh not less than six or eight ounces, and it must, of course, be kept clean and properly tinned. If you can use a still heavier iron, so much the better. For soldering the joints of screens a flux that will make solder flow easily is essential, and it does not greatly matter if it has

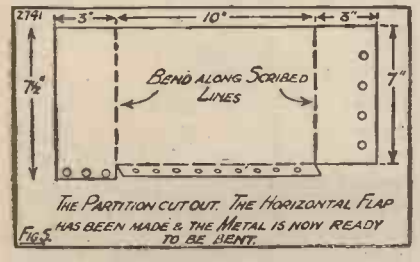


FIG. 5. THE PARTITION CUT OUT. THE HORIZONTAL FLAP HAS BEEN MADE & THE METAL IS NOW READY TO BE BENT.

slightly corrosive properties. For this reason we can use fluxes that are not permissible for making connections between leads or between leads and terminals in wireless circuits. There is actually nothing better than killed spirits or one of the ready-made liquid fluxes, such as Baker's Soldering Fluid.

Sheet copper when bought is nearly always dull and oxidised. It is essential that all parts that are to be soldered should be thoroughly cleaned before the work is attempted. Nothing is better for this purpose than fine emery cloth used in one of the holder-pads previously described in these notes.

Both sheet copper and sheet aluminium are exceedingly easy to drill, so far as the actual getting of the tool through the metal is concerned, for they are both quite soft. There is one trouble that does arise, and this is that the drill is apt rather to tear its way out on the exit side, leaving a raised rim. This kind of burring can be minimised by using a piece of hard wood, such as teak or mahogany, as a drilling block, and also by the use of really sharp tools that do not require excessive pressure in order to make them cut. Nothing blunts steel tools like ebonite.

Separate Drills

I would recommend, therefore, that separate drills should be kept for work on sheet metal. After all, not more than three or four will be required, so that the expense is small. The drills needed are No. 25 morse for making 4 B.A. clearance holes, ¼ in. for making holes for the insulating bushes that will be described later, and ⅜ in. for making the holes for variable condenser bushes, etc., where complete screening boxes are used. To these may be added a No. 30 morse drill for making holes for wood screws.

An Effective Insulator

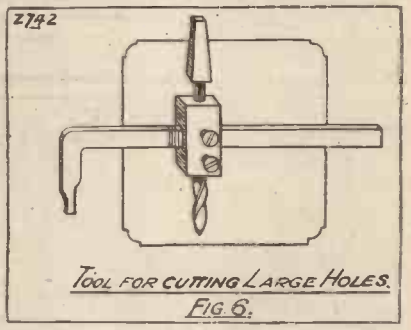
Fig. 2 shows an easily made but very effective insulating bush for passing leads through metal screens. It consists of a piece of ¼-in. ebonite tubing ⅝ in. or ¾ in. in length, screwed externally with a ¼-in. Whitworth thread. There is no difficulty about putting on the thread if the job is undertaken in the following way. First taper off the tube slightly towards one end with a fine file. Next insert into it a piece of ebonite or metal rod which is a good push fit. Clamp the tube up in the vice—the rod inside will prevent it from splitting.

Use a die with a good "let in"—i.e. well tapered at one side—and expand it as widely as possible by means of the adjusting screw. If you have a die holder that will take a collet guide the job will be still further simplified. Turn the die on, taking care to go straight, and seeing that the holes in it do not become clogged with ebonite chips.

A Simple Method

There is a still simpler method which can be used quite well. Let the tubing be ¼ in. as before, but use a $\frac{9}{32}$-in. die. This will go on quite easily, and though it will not cut a full thread, it will still make one that will suffice for the purpose. Since standard Whitworth dies cut forty threads to the inch in both ¼-in. and $\frac{9}{32}$-in. sizes, ¼-in. nuts will go on quite well. Ordinary brass or steel Whitworth nuts may be used for clamping the insulating bushes to the screens, or ebonite nuts can be used by drilling and tapping ¼-in. holes in a piece of ebonite ¼ in. thick, and then cutting out squares with ½-in. sides.

Fig. 3 shows a simple partition in position in a receiving set. The partition is secured to the rear edge of the



TOOL FOR CUTTING LARGE HOLES. FIG. 6.

baseboard by screws or small brass nails driven through holes drilled in the overlapping flap. It is fixed to the upper surface of the baseboard by means of another flap turned up at right angles, and it may be secured to the panel by three or four 4 B.A. bolts.

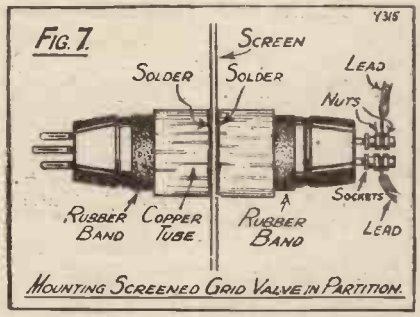
Cutting the Screens

Fixed in this way it is perfectly rigid, and acts as a support for the panel. In Figs. 4 and 5 are seen the ways in which the metal is cut out and shaped. The dimensions given are suitable for a baseboard 10 in. in width and for a panel rising 7 in. above it, but they can, of course, be altered to suit any particular requirements. Cut out (or obtain ready cut) a sheet measuring 16 in. by 7½ in.

With a scriber and a set-square mark deeply the lines AB and CD, which will be at the corners of

Chats at the Work-Table—*continued*

the partition when finished. Half an inch from the bottom scribe the line EF. With the tin shears cut from B to E, from D to G, and from F to G. Drill the holes for the fixing screws and 4 B.A. bolts, as shown in Fig. 4. Make also any other holes that may be required for insulating bushes or



MOUNTING SCREENED GRID VALVE IN PARTITION.

possibly for mounting a four-electrode valve. The method of making this latter hole will be described in a moment.

Now turn up the horizontal flap along the line EG by means of the shaping block and mallet so that it assumes the position seen in Fig. 5. With the block and mallet again bend the metal along the lines AB and CD. The partition is now ready to be fixed in position.

For making large holes in screens I can recommend the handy little tool shown in Fig. 6, which costs only eighteen pence. Mark the centre of the hole, lay the sheet on a thick block of wood, and drill through the metal and deeply into the wood with a ¼-in. drill. Now fix a piece of ¼-in. round rod into the cutter and insert this into the chuck of the hand or bench drill.

No Valve Holders Required

Put the rod into the hole made through the metal, and bring the cutter to bear. Fig. 7 shows an effective way of mounting one of the screened-grid valves. A hole of suitable size having been made in the partition, a piece of copper sheet, 1½ in. in width, is rolled round a tool handle or a piece of wood of suitable diameter so as to form a tube into which the valve will just slide. This is thrust into the hole made in the partition, and is soldered as shown in Fig. 7.

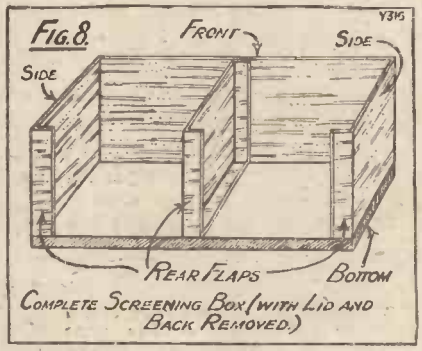
The valve is placed in the tube and is held firmly in position by means of stout rubber bands placed round it just in front of each of the caps. No valve holders are required with this kind of mounting. Instead, Lisenin sockets may be used, the leads being clamped between the two nuts with which each is provided.

Figs. 8, 9, and 10 show the way in which complete screening may be done. Fig. 8 shows only two compartments, but the design is adaptable to include as many as may be required. The front, sides, and rear flaps are made from a single piece of sheet metal of suitable dimensions.

Completing the Screen

When this has been shaped it is placed inside the upturned rim of the bottom piece and the joint between the two is soldered for its whole length. The layout of the bottom piece is given in Fig. 9. The scribed lines are made about ¾ in. from each edge, the squares at the corners (shown shaded in the drawing) being cut out with the tin shears. The lid is made in exactly the same way.

The back consists of a simple flat piece which is eventually soldered to the rear flaps of the sides and of the partitions. This job, however, should not be undertaken until the greater



COMPLETE SCREENING BOX (WITH LID AND BACK REMOVED.)

part of the construction of the set has been finished. The way in which the partitions are made is shown in Fig. 10. Scribed lines are made about 1½ in. from the sides and bottom of a piece of metal cut to suitable size.

The shaded portions are cut out and the sheet is then bent to the shape shown in Fig. 8. Each partition is soldered to the front and bottom of the complete shield, and eventually a back piece is soldered to its rear flap.

Riveting

It is quite possible to make complete screens on the lines described from sheet aluminium, though, as previously mentioned, the joints in them cannot be soldered. A very good job can, however, be made by using small aluminium rivets instead of soldering. These are obtainable from most tool shops or metal shops, and they are sold by the pound.

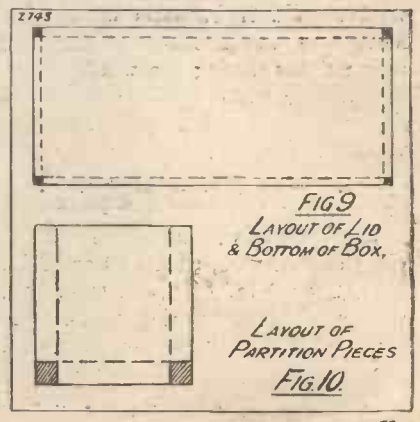
The price charged may at first sight seem rather high, but it must be remembered that aluminium is an extremely light metal, and that a very large number of these little rivets go even to the ounce. If riveting is decided upon, do not make the holes for the rivets too large. It is best to discover by means of the drill plate what size of drill will make holes that are a good fit for them and to use that.

To burr over the ends of the rivets use a light hammer—a four-ounce is quite heavy enough—of the ball-pane type, and remember that many light taps are much more effective than a few heavy blows. If riveting is carefully done quite good screening will be obtained, though screens made in this way are not so completely effective as those constructed of copper with every possible seam soldered.

To Avoid Mistakes

It is by no means a bad plan when designing a completely screened receiving set to make up full-sized cardboard patterns of the parts that will afterwards be made from sheet metal. The exact dimensions of the portions to be cut away can thus be determined without any possibility of error and the positions of all holes required can be located.

Drilling should always be done before shaping is taken in hand if a really good and well-finished job is desired. The cardboard patterns enable this to be done, and if, once made and used, they are put safely away they will save a very great deal of time and trouble if a screening job is undertaken at some future time.



A GOOD GADGET FOR HOME CHARGING

Some straightforward details for making a simple time- and trouble-saver.

By D. CHARLES.

EVERY accumulator user is not aware that the liquid he knows by the polite name of "electrolyte" is merely a diluted form of the vitriol that some people, before the enlightening days of wireless, were in the habit of throwing at one another as a means of permanently recording their affection. Even in the comparatively weak form used in accumulators it is decidedly unpleasant to get a drop of the liquid into a cut or scratch. Moreover, when using a hydrometer it is quite difficult to prevent drips from falling around where they may do harm. Furthermore, superfluous liquid may lie on top of the accumulator itself and cause corrosion to terminals.

To prevent acid from dropping on to carpets, etc., the whole gadget is mounted over a jam jar, so that there is no danger of damage being done by stray drops of the electrolyte.

The little gadget illustrated in this article will save much trouble. With the addition of the little wooden clip it has proved still more serviceable, as with its aid it becomes possible to leave the tester inserted into the accumulator during the whole charging period, without the necessity of lifting it in and out every time one wants to take a reading.

Few Materials Required

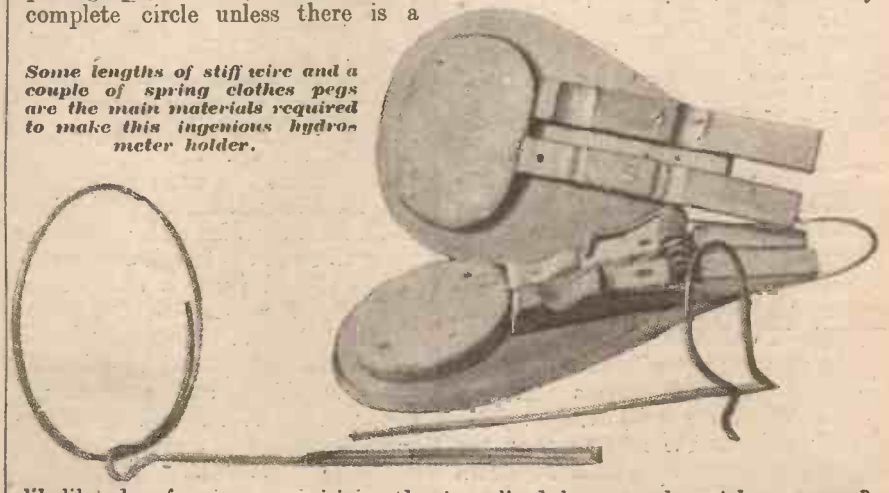
The materials required are few. A piece of stiff wire, about 20 or 30 in. long, 2 or 3 in. of metal tube that will accommodate the same, odd scraps of three-ply wood for the clip, a couple of spring clothes pegs, and a glass jar complete the list, except for a few screws and seccotine for fixing together the parts of the clip.

The loop at the lower end of the wire is required to grip around the neck of the jam jar. In order to provide a good springy clip it is desirable to bend the wire around something smaller than the jar it is destined to fit. It is by no means easy to get a good circle starting right on the end of the wire, but if bent well round the mandrel with a little overlap, the little straight end can be nipped off afterwards. A sharp right-angle bend is then taken in the length of the wire directly away from this loop, and with a pair of round-nosed pliers the wire is curved so as to clear the lip of the jar. From this point it travels straight upwards.

Arranging the Height

It is necessary at this stage to place the jam jar alongside the accumulator and to hold the hydrometer therein in the usual position for taking tests, with the end of the rubber tube well below the surface of the electrolyte. It will now be quite clear at what height upon the vertical wire the upper loop should be made. There is no particular need to bend this loop in the form shown in the photograph, for it can be made a complete circle unless there is a likelihood of your requiring the hydrometer at frequent intervals for testing other sizes of accumulator.

Some lengths of stiff wire and a couple of spring clothes pegs are the main materials required to make this ingenious hydrometer holder.

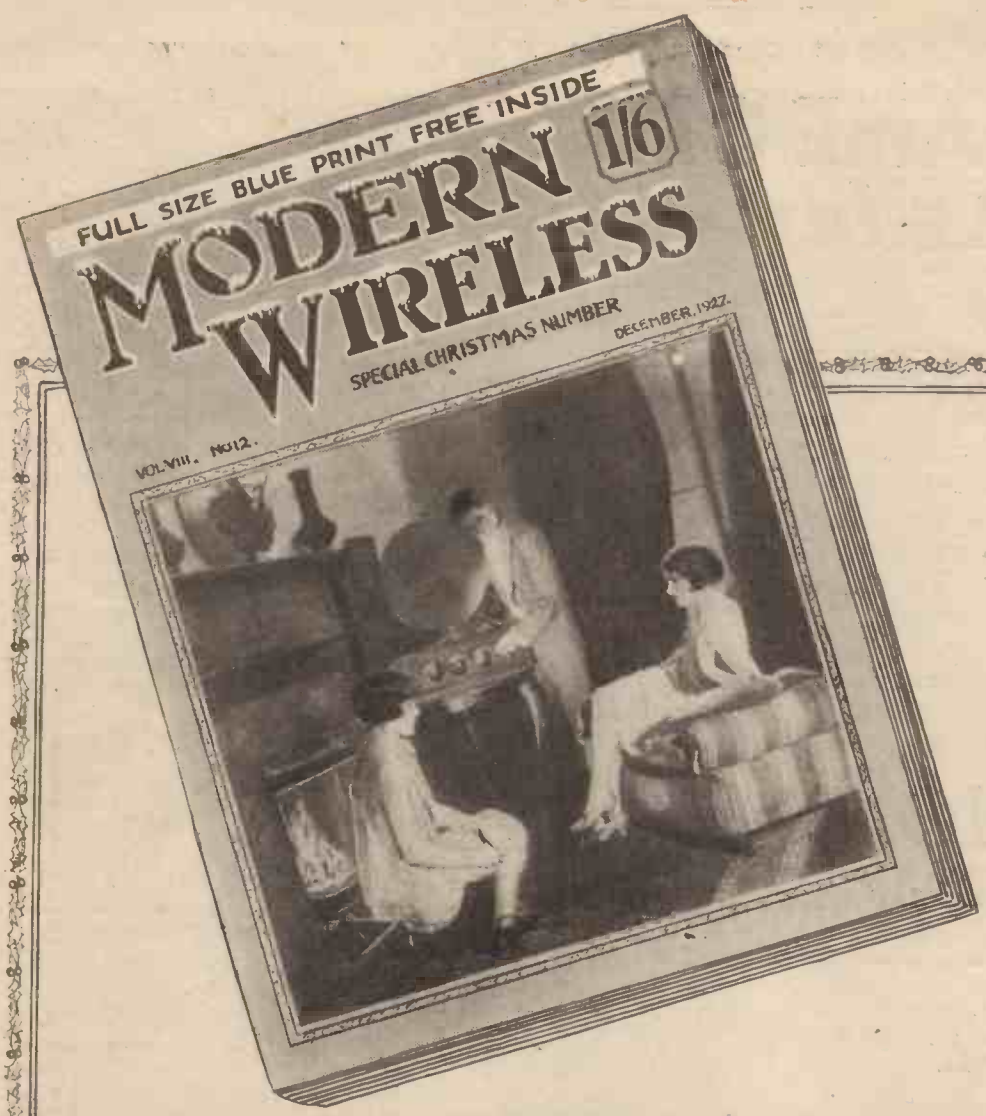


The upright is nipped in half, and the little length of tube pushed on to the lower piece. In the case of my own gadget the wire and the tube were such a very good fit that one or two pinches with the cutting portion of the pliers served to clinch the two firmly together.

Simple in Operation

Those who prefer soldering, however, can very quickly make a still more secure job. The upper half of the wire, being then dropped into the upright projecting tube, is free to swivel round either over the jar when not in use, or into the accumulator for testing purposes. The little play that there is sure to be around the neck of the jam jar allows the wire to swing just sufficiently out of the upright to hang in the correct position in either case.

As soon as one has made the preliminary reading to see how the accumulator stands at the beginning of the charge, the wooden clip is pressed over the knob of the hydrometer, forcing the electrolyte back into the accumulator. For successive observations all that it is necessary to do is to give the clip a squeeze, this releasing the bulb and giving a further reading. Releasing the clip squeezes the solution back again as before. It will be immediately realised how much quicker, as well as how much cleaner, it is to be able to keep the tester in sight throughout the charge. On completion the gadget is swung round so that the



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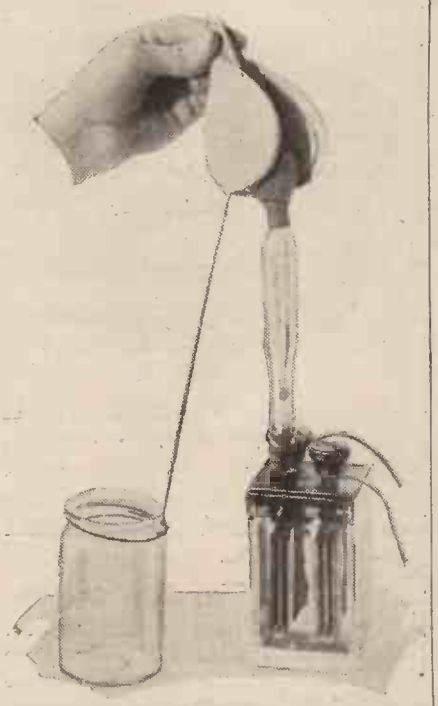
Purchase your copy NOW and avoid disappointment.

A Good Gadget for Home Charging—*continued*

rubber tube drips into the jar, and one takes off the clip so as not to deform the ball during storage.

There is very little that can be said in amplification of the illustrations to assist the reader in constructing this very simple clip. There is just this point, however, that the wood of which the spring pegs are made is very liable to split easily, and the holes for screwing them to the bits of three-ply should be carefully done with a sharp bradawl or a fine drill. Two clips are used because the spring of one is not sufficiently strong to keep the bulb



The hydrometer can be left in position during the process of charging. To take a reading all that is necessary is to compress the clip, which releases the bulb and allows the glass tube to fill.

of the syringe deflated during the charging process. When not in use these clips can be hung on the little hook which is to be noticed on the upper end of the wire support, by means of a loop of thin wire run through the springs.

Just about the time that I had completed this gadget an inquisitive friend picked up the hydrometer, withdrew the rubber stopper, and allowed the little float to drop to the floor. On my way home the next evening I bought a new float, with little pips of glass blown on to the outside so as to prevent it sticking to the inside of the syringe tube. When I came to insert the float into the tube, these little projections proved to be over-size, and engaged in various curvatures in the outer glass tube so that it would not float properly. Not wishing to wait a further day, I selected a flat, smooth file, and, getting a large basin of water, I submerged the float and filed the little protuberances in the manner which I have illustrated by the fourth photograph. The submersion has the effect of deadening vibration from the filing, which, if done in the air, might split the glass. Under water the filing process is quite smooth, just as though one were filing a piece of metal.

FROM OUR READERS

The "Signal Box"

SIR,—Having been for the last four years a regular reader of the WIRELESS CONSTRUCTOR, I am going to sing the praises of the "Signal Box," full details of which appear in the May issue of the CONSTRUCTOR. After having built many other of Mr. Harris' sets, I have no hesitation in stating that the "Signal Box" is by far the best receiver I have ever heard, and, considering I've tried out a large number, it must be good. For three valves it has, in my opinion, no equal.

My aerial is 35 feet 7/22 single wire L inverted, *only* 3 *ft. above roof*, and clean along the roof, although 40 ft. high is really only 3 ft., I consider, from earth. (I may be wrong here, but I do not call it high when earthed bodies are below it the whole length.)

Well, to name all stations tuned would fill a column, but Berlin, Moscow, Rome, Madrid, Glasgow, Cardiff, Langenberg, Dortmund, Brussels, and a couple of dozen other continentals are sufficient to show its range. I get several regularly on speaker, especially Frankfurt-on-Main and Langenberg. And for selectivity —well, I live a few miles direct from 2 L O, I am backed by Clapham Junction station and its electric trains, which I do not have any *difficulty in cutting out* by using C.A.T. condenser. I can tune out London at this distance, and receive Bournemouth on speaker with *not* the slightest sound of London. Cardiff I consider is a test for any set at this distance from 2 L O, but I can tune in Cardiff by using C.A.T., and, as to quality of reproduction, this is really where it excels. It is to my mind the living artiste one hears when listening. I use a cone speaker.

Wishing Mr. Harris and CONSTRUCTOR the best of luck.

C. MISELDINE.

Battersea, S.W.11.

Should it be necessary to file the glass float, this should be done under water in the manner shown above.

A Queer Fault

SIR,—Many thanks to the WIRELESS CONSTRUCTOR and the correspondent who wrote "The Queerest Fault Ever." After testing all my condensers, fixed and variable, H.T. batteries and L.T., also transformers, thinking I could stop the distortion which I have been getting the last month, I was still "out of luck."

But when reading the article the good correspondent wrote, it brought my attention to my 12-point switch, which I found was causing the trouble.

The insulating washer was cracked, so with repairing the same the results were fine.

Yours truly,

J. B. HOWARD.

Bolton.

Good Single-Valver

SIR,—I feel compelled to write and express my appreciation of "A High-efficiency Single-Valver" in your April number. The range and tone (i.e.—distance range) are truly remarkable.

Every success to your magazine.

Yours truly,

Nottingham. ROBT. E. JAMES.

Excellent Meters

From Messrs. Ferranti, Ltd., of Manchester, well known in wireless circles for their low-frequency transformers, we have received a range of meters designed for the use of all set owners and experimenters. The meters are made in two forms—the "flush" type with back connections, and the "portable" for use on the table. The general appearance, finish, and the performance of these meters are exceptionally good.

The actual instruments submitted to us for test were as follows: A 0 to 15-milliampere moving-coil milliammeter, flush type; a 0 to 15-milliampere, 0 to 7·5 and 0 to 150-volt,

The Ferranti portable combination meter.

three-range instrument of the flush type with switch; a 0 to 30-milliampere, 7·5 and 150-volt, three-range portable instrument; and a 0 to 10, 0 to 50, and 0 to 150 voltmeter.

A Safety Fuse

On testing these instruments two features impressed us at once. The first is the fitting of a fuse, which safeguards the windings in case of accident or careless handling. An extra fuse is supplied with each instrument, and further fuses are obtainable at the very low price of 6d. each! Even the most careful of us occasionally make mistakes and with a double or triple-range instrument it is very easy to connect the high-tension battery to the low-tension terminals. Indeed, this test was applied to one of the triple-range instruments, and the fuse replaced with the greatest ease. This is a most valuable feature and will commend itself particularly to overseas readers who, when using an instrument without such a device, may be put to inconvenience and loss loss of time when sending it for repair.

"Dead Beat" Movement

The second feature which commended itself to us was the "dead beat" movement, making it possible to take a number of accurate readings within a very short space of time. The accuracy of the meters, tested against our laboratory standards, was excellent on all types and the makers claim that the series has a guaranteed

A MONTHLY REVIEW OF TESTED APPARATUS.

(NOTE: All apparatus reviewed in this section each month has been tested in the Editor's private laboratory, under his own personal supervision.)

accuracy of one per cent. The voltmeters are available in two types, having resistances respectively of 200 ohms and 1,000 ohms per volt. The 1,000 per volt type are special instruments for checking high-tension eliminators or mains units, where the ordinary type of voltmeter is useless. The ordinary range of voltmeter with 200 ohms per volt is a very useful instrument for battery testing and will not give a false high-tension battery reading through too high a current consumption.

The prices of all of these meters are exceptionally low for high-grade instruments. Take, for example, the 0 to 7-milliampere, 0 to 7·5-volt and 0 to 150-volt three-range portable instrument with switch. Here is a general-utility meter by which the experimenter can check the high-tension consumption of his set, and high-tension and low-tension voltages. Three separate meters of comparable quality would cost a good deal of money, but the price of the combined instrument is only £2 7s. 6d. The 0 to 15-milliamp., 0 to 7·5-volt and 0 to 150-volt, three-range flush type instrument with switch is the same price, and the 0 to 15-milliampere

A good investment—the Ferranti flush-mounting meter.

flush-type, 30s. We congratulate Messrs. Ferranti for making available such a useful range of meters at such reasonable prices.

Useful Plug Sockets

From the Brownie Wireless Co. of Great Britain, Ltd., we have received a sample of the Brownie

A useful 'phone-extension socket.

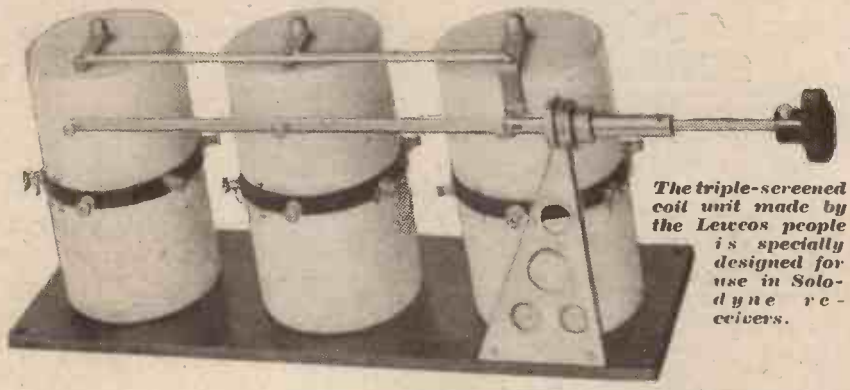
Tag Socket, a small moulded device which can be screwed on to a table or cabinet with one fixing screw. The general appearance of the socket can

What's New—*continued*

be gathered from the accompanying photograph. Underneath are two terminals to which leads from the set are attached, while four holes at the side of the moulding enable two pairs of telephone or loud-speaker tags to be inserted as required. It is, of course, a very simple matter to place one of these tag sockets in each room, or in each point where it is required to use wireless, when plugging in telephones or loud speaker will automatically connect the set, the telephones or loud speakers being connected in parallel.

For Quick Comparisons

The experimenter will find these sockets very useful for general work, as in many cases they can replace change-over switches. Several have been fitted up in the laboratory and, in particular, one pair is used as follows. (Details are given as the idea may appeal to many home constructors.) A pair of sockets is screwed on a board, side by side, and a pair of leads from the loud-speaker terminals of the main set (which is permanently tuned to the local station) are made to terminate in a pair of Clix pin tags, which exactly fit these Brownie sockets. Two or three different loud speakers have these leads similarly finished off with the Clix tags, while a length of twin lead has attached at one end a pair of spade terminals for connection to any set; at the other end it is finished with a pair of pin tags. When it is desired to compare loud speakers on a set or sets on a loud speaker, it is a very simple matter to insert or withdraw the pair of tags from the spring clips, the time taken being scarcely longer than required to throw over a D.P.D.T. switch. The tag sockets cost only 1s. 3d. each, so that one can fit several without feeling very extravagant about it!



The triple-screened coil unit made by the Lewcos people is specially designed for use in Solodyne receivers.

A New R.C. Unit

The Mullard Wireless Service Co., Ltd., have sent us a specimen of the new Mullard P.M. Resistance Capacity Unit. It is a well-made and neatly

An efficient R.C. unit made by the Mullard Wireless Service Co., Ltd.

finished device, designed for use with the modern high-impedance R.C. valve. The appearance of the unit can be gathered from the accompanying photograph, and detailed measurement in the laboratory showed that the values of the anode resistance, grid leak and coupling condenser have been carefully chosen to give good amplification and reproduction. A useful feature is the incorporation of means to prevent high-frequency getting through to the low-frequency side. The method used is certainly a sound and effective one and consists in placing a high resistance in series with the grid lead, as frequently recommended in this journal. Sound soldering lugs and terminals of generous size are provided for easy connection to the set. After the usual laboratory tests, etc., the unit was incorporated in a set and submitted to a practical test of working on signals. The amplification and purity of reproduction were up to a very high standard, and the unit can be thoroughly recommended to all readers.

A Handy Fixed Resistor

Messrs. Dubilier's have submitted for test and report a sample of their new fixed resistor, which is very ingeniously made and of the same size as their standard grid-leak, so that the standard grid-leak holder can be used as a fixed-resistor holder. The fixed resistors are obtainable in all the usual values, and are particularly

The Dubilier fixed resistor is the same size as the grid-leak, so the holder of the latter can be used as a fixed-resistor holder.

neat and compact. They are, of course, distinctively labelled, which prevents the user falling into the error of using a fixed resistor instead of a grid leak and vice versa!

A Triple-Coil Arrangement

The accompanying photograph shows the Triple Screened Coil Unit now obtainable from The London Electric Wire Co. (makers of the Lewcos components) for use in sets of the Solodyne type. The particular feature of this arrangement is that both the 250 to 550 and the 1,000 to 2,000-metre coils are incorporated in each screen, a simple switch operated from the front of the set changing over all three at once from the short to the long waves. In addition, the three coils have been very carefully matched so that no difficulty will be experienced when using this unit with triple-ganged condensers.

While the unit submitted to us was of the split-primary type, we understand that sets of three of any of the standard windings are obtainable. The size of the unit is such that it is readily interchangeable with the existing screens in the Solodyne. Thus readers who may wish to add to the convenience of this set can easily make the change.

WHAT'S NEW

—*continued from page 241*

A Good Choke

We have received for test a sample of the Magnum radio-frequency choke manufactured by Messrs. Burne-Jones & Co., Ltd. The general make-up of this choke is of the popular "pyramid" type, with a number of sections. A radio-frequency choke to be useful must work satisfactorily on both the ordinary band up to 600 metres and on the longer wave-band from 1,000 to 2,000 metres. Most chokes are quite satisfactory on the short wave-band, but a number tested in this laboratory have failed on the Daventry band. Many have just scraped through the test by choking satisfactorily up to Radio-Paris and refusing to function above. The Magnum choke proved to be quite satisfactory up to well above the 2,500-metre mark and is perfectly satisfactory for the ordinary broadcast band and for the Daventry range.

A Useful Former and Base

Many home constructors like to wind their own coils; indeed, there is an appreciable saving by so doing. Catering for this public, the makers of the Ebonart panels are supplying the Ebonart six-pin coil former and base. The former is cut from a good grade of ebonite and is provided with ribs and six pins which fit into the base provided. The six pins are not of the standard "southern cross" spacing, but of a wider spacing than this—no disadvantage from the electrical point of view although not complying with the standard. The appearance of the former and base can be gathered from the photograph, and the component can be thoroughly recommended to all our readers.

A Sound Filter Choke

Iron-core chokes are becoming more and more popular among experimenters, particularly for use in output filters. It is not generally realised that there are two distinct advantages in using an output filter. First, and generally known, is the fact that the anode current of the last valve is kept out of the loud-speaker windings, thus enabling the loud speaker to handle stronger signals without overloading. The second advantage, which really is more important, is that it is possible to make the D.C. resistance of the filter much lower than that of the loud speaker. For example, with an output valve of 3,000 ohms resistance and a loud speaker of 3,000 ohms D.C. resistance, the actual voltage applied to the plate of the last valve is just half the battery figure. If the filter used has a D.C. resistance of only, say, 200 ohms, fifteen-sixteenths of the voltage will be applied to the valve. Messrs. R.I.-Varley, Ltd., are now marketing an excellent choke which has an iron core of adequate size to avoid the saturation which occurs in some of the smaller chokes and with a very low D.C. resistance. This choke can be obtained in several values, the most useful value being about 30 henries.

Ingenious Coils and Mountings

The Formo Company are now producing a new line of coils in which the insulating material is reduced to a minimum, the wire being wound on extremely thin celluloid, which, by a special process, is made to form a "binder." Thus, while the coil appears to be self-supporting a closer examination shows that transparent celluloid is giving the necessary rigidity. The coils made are in the usual conventional windings, but a special and very ingenious holder has been prepared corresponding with the contacts on the coil base.

OUR NEWS BULLETIN

Some of the More Interesting Happenings in the Radio World this Month

The Season's Greetings

WELL, here we are with a nice brand New Year facing us. Before we put old 1927 to bed, let us give it due credit for the real radio progress made then. In the fight for man's mastery over the ether the last twelve months have seen four big pushes planned and won. First there was the triumph of the transatlantic telephone; then the Empire bridge-building by "Beam"; then the beginning of the alternative programme push by 5 G B at Daventry; and, finally, the short-wave success to and from Sydney!

Progress All Round

Although the "Beam" and the transatlantic telephone do not directly affect programmes at present, both these developments are of first-class importance to listeners. For in both directions success tends to improve the broadcasting conditions. The Regional Scheme of alternative programmes inaugurated at Daventry is going to double the production of the ordinary broadcast receiver, and now that Sydney and 5 S W, the Chelmsford station, are getting pally, we shall have the whole wide world from which to select our programmes.

Five-Metre "Fishing"

One thing that 1928 is going to do for us, is to give us a fresh idea about what is a "short-wave." Those U.S.A. boys who bang the transmitting keys do not consider that 20 or 30 metres is short at all. They are doing some deep diving down into the *five*-metre wave-band, and already they have scored some startling successes. During November they had an international test on five metres, and when the results are published we may find that these frequencies are as far ahead of the 20-30 metres wave-band as the latter is of the ordinary broadcasting wave-lengths.

A Shocking Affair

Two startled readers have recently reported to me their surprise at receiving a sharp shock when touching the aerial terminal. Both of these readers were under the impression that it was not necessary to earth the aerial in the winter-time. This is wrong, for it is possible for an aerial to accumulate a small charge from sleet or snow, and sometimes quite a severe shock will result from this kind of thing. The trouble only occurs, of course, when there is a condenser in series with the aerial. So that if your installation is of this type you should use an earthing switch to avoid any hanky-panky tricks by stray electric charges.

Long-Waves a Little Longer

Fortnuately, the report that the conference at Washington had used an axe on the long-wave stations was premature. The technical sub-committee that tackled the job of regulating the long waves has decided that stations between 1,340 and 1,550 metres should not shut down, as

(*Continued on page* 246.)

OUR NEWS BULLETIN

—continued from page 244

rumoured, but can carry on as usual for at least a year.

Getting Busy with the Beam

The first figures issued in Australia regarding the rivalry in radio and cable services shows that the Beam has collared a good share of the traffic to the United Kingdom. During the three months under review the Beam system handled about 60 per cent of the United Kingdom business. But this does not mean that the cables are correspondingly idle. As a matter of fact, the cable traffic was actually higher than it was at the previous year.

Amateurs Recognised at Last!

One very pleasing result of the Radio Telegraphic Conference at Washington has been the complete recognition officially accorded to the transmitting radio amateur. For the first time he is to have a proper status and standing recognised officially by the Government. The conference agreed that amateur transmitters should have reserved for their use certain wave-bands which are to be evenly distributed throughout the whole range of wave-lengths. Undoubtedly this recognition is due to the American Delegation of Radio Amateurs, who were so clamorous in their claims that they have won a valuable concession for every radio amateur transmitter in the world.

The Chelmsford Experiments

Talking to Captain Eckersley the other day I found him full of enthusiasm about his recent visit to America. He took the opportunity of comparing notes with Dr. Goldsmith, the chief engineer of The Radio Corporation of America. Between them they are going to have a go at the fading problem, the British part of the bargain being the testing of the spaced-aerial system.

Pot-Pourri

Experiments are now being undertaken at Chelmsford, and it is hoped that by picking up the same programme on several different receiving aerials and mixing up the results (like Ronald Gourlay's pot-pourri on the piano), fading will be found to cancel out so that the total programme strength will not fluctuate at all. In this, as in some of the other radio troubles, 1928 should prove a year full of fruitful research.

Wireless for Hospitals

Hearty congratulations to "The Daily News" on the completion of their wireless for hospitals' scheme. The final hospital on the list to be equipped, The Woolwich War Memorial Hospital, was recently opened by H.R.H. The Duke of York. Since the good work was begun, no less than 15,766 hospital beds have been provided with broadcasting. The founder of "The Daily News" was Charles Dickens—how he would have rejoiced in this scheme for brightening the lot of helpless sufferers!

Waves and Wave-Lengths

Quite a queer excuse for wave-length wandering has been put forward by the Coney Island Station, W C G U, New York. The station aerial is situated only 75 ft. from the seashore, and it is stated that as the tide falls and rises so the wave-length varies between 210 and 211·6 metres. The Chief Engineer of the station certainly deserves a hearty slap on the back, for it is not everyone who could have caught old Father Neptune interfering with the frequency of transmission! SAVOYARD.

ONE OR TWO?

—*continued from page* 208

One point which must be watched carefully when wiring is to see that the wiring is so arranged that plenty of room is left for the coils, valves and grid-bias battery.

It is as well for this reason to have the components just mentioned handy while wiring, so that they can be inserted at various times to check the space allowed for them.

If it is intended to use ordinary coils with the set the latter can now be tested, but a description of the special home-wound aerial coils is given at this point for those who desire to make them.

The Coils

A description of the coil for the ordinary broadcast band will serve the purpose, since the Daventry coil is made in the same way and only differs in the number of turns used. A cardboard tube or tin, or even a tumbler of the same diameter as the inside of the reaction coil must first be obtained. This is to serve as a former for the coil.

Wind 50 turns of the 24-gauge wire on this former in hank fashion and then make a loop for tapping purposes. Now wind on another 20 turns and then remove the coil from the former by sliding it off, and twist a piece of wire round it to hold the turns together. The beginning of the coil is joined to the pin of the mount for the coil and the tap on the coil to the socket of this mount.

The end of the coil is cut about 6 in. long and is joined to the aerial terminal. Instead of an ordinary nut on the shank of the aerial terminal, an ordinary terminal nut and terminal should be used so as to facilitate the changing of the aerial coil.

For the Daventry coil, 200 turns of the 28-gauge wire should be used for the tuned coil and about 75 for the aerial. It is connected to the socket in the same manner as the low-wave coil. The coils are held in position by being bound with empire tape to the fibre strip which is used with the coil mount.

It is as well to try the coils in the set before the final fixing so as to be sure it is the correct way round to obtain reaction.

There is no need to say much about the operation of this set since it is similar to that of the majority of two-valve sets consisting of a detector and low-frequency valve. The only difference is that to increase reaction the value of the reaction condenser has to be decreased.

Results Obtained

Two-, four- or six-volt valves may be used, and it is as well to use a power valve in the second position. No resistors are incorporated in the set, as modern valves can be run safely direct from the accumulator. In any case, there is bound to be a certain amount of voltage drop in the battery leads, wiring, etc.

The results to be expected from this set are indicated at the beginning of the article. The author has not had an opportunity up to the moment of writing of carrying out a prolonged test to identify stations received. However, with the 'phones on two valves, apart from the local and Daventry stations, between ten and twenty stations have been heard at good strength on most nights.

Many of these could also be heard on one valve. 2 L O, 5 X X and 5 G B all came in at good loud-speaker strength, and occasionally stations like Langenberg, Toulouse and Frankfurt were heard on the loud speaker.

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4-volt: 410 H.F. or Det. (Red Band), for H.F. or Detector use, 10/6; 410 R.C. (Blue Band), for Resistance or Choke Coupling, 10/6; 410 L.F. (Black Band) First L.F. Stage, 10/6; 410 P (Stentor Four) Super Power Valve, 12/6.
6-volt: 610 H.F. or Det. (Red Band), for H.F. or Detector use, 10/6; 610 R.C. (Blue Band), for Resistance or Choke Coupling, 10/6; 610 L.F. (Black Band) First L.F. Stage, 10/6; 610 P. (Stentor Six) Super Power Valve, 20/-.

MULLARD P.M. VALVES

For 2-volt accumulator.		*For 6-volt accumulator or 4 dry cells.*	
P.M.1 H.F.	10/6		
P.M.1 L.F.	10/6	P.M.5X (General Purpose)	10/6
*P.M.1A (Resist. Capacity)	10/6	*P.M.5B (Resist. Capacity)	10/6
P.M.2 (Power) ..	12/6	P.M.6 (Power) ..	12/6
For 4-volt accumulator or 3 dry cells.			
P.M.3 (General Purpose)	10/6	*Super-power valves for last L.F. Stage.*	
*P.M.3A (Resist. Capacity)	10/6	P.M.254 (4 volts)..	20/-
P.M.4 (Power) ...	12/6	P.M.256 (6 volts)..	20/-

MARCONI, EDISWAN, OSRAM, B.T.H., COSMOS VALVES at USUAL PRICES.

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OUR NOTED 1-VALVE (L.F.) & CRYSTAL SET

In Solid Polished Cabinet.
COMPLETE WITH LION MICRO DETECTOR.
SET only 22/6 Carr. 1/6.
Or complete with valves, phones, H.T. and L.T. Units, Aerial Equipment. Extraordinary value. **45/11** Post 2/-

TESTIMONIAL. G. A. Ross, Esq., 21, Wharfdale Rd., N.1. March, 1927.

Messrs. Raymond,—I am sending this letter to tell you how pleased I am with the three sets purchased from you. They are working in Billericay, Chiswick, and Wandsworth, and I must say the results are simply wonderful, loud-speaker reception being impossible to beat.
You may rest assured that I shall heartily recommend them to anyone whom I know is in need of a set, as there is no better value obtainable anywhere.
(The above entirely unsolicited.)

PERSONAL SHOPPERS

NOTE CLOSED XMAS DAY
OPEN BOXING MORN 11-1

WEEK BEFORE XMAS OPEN LATE

USUAL HOURS
ALL DAY SATURDAY
ALL DAY THURSDAY
ALL DAY EVERY DAY
9 a.m. to 8 p.m.
Sat. 9 a.m. to 9 p.m.
Sunday morning 11-1

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Can be purchased with ordinary goods value 17/6.

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Hinged lid, baseboard, 12×8 5/- (List, 10/9) 14×8 7/11 (List, 15/11)
Can be purchased with ordinary goods value 25/- & 30/- respectively.

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Price 2/3 with 10/6 worth of ordinary goods.

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(List price, 7/6)
Long or Short Wave
Price 3/6 with reasonable purchase of ordinary goods.

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Solid Oak, glass finish, beautifully made.

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WATE'S UNIVERSAL TEST METER, L.T. & H.T. Also READS, from 1 to 36 milliamps. A really wonderful instrument. Post Free 8/6 U.K.

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2-VALVE SETS
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Grid Bias
100-volt H.T.

Tax Paid.

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SETS OF COMPONENT PARTS

RADIANO "THREE" (*March, '27, Wireless Constructor*). All parts as specified with Terminals. 2 Ormond S.L.F. Variables, with friction gear; 3 Coil Sockets; T.C.C. ·0003 and Clips and 2-meg. Leak; 3 Benjamin Valve Holders; 3 Fixed Resistors and Bases; On/and Off Switch; Gecophone 1st Stage L.F.; B.T.H. 2nd Stage L.F.; Engraved Strip, with Terminals and Nuts; 2 B.L. Terminals for Front Panel; ¼ Gross Pinch-on Spades; Rubber Flex. £4/10/0 lot, post free U.K.
EDISWAN R.C. THREESOME. Set of Parts: 2 Ediswan R.C. units; 1 Ediswan P.V.2 Valve; 2 Ediswan R.C.2 ditto; 3 Lotus V.H.; 3 Fil. Rheostats; 9-v. Grid Bias; Lotus 2-way L.H.; ·0005 Tuning Condenser. £3/5/0 the lot, post free U.K.
SIGNAL BOX (*P. Harris, May, '27, W. Cons.*) 1 Ormond S.L.F. ·0005 and 2 ·0003, with friction gear; 2 6-pin bases; 1 Neutrovernia; 1 Neutralising; 4 V.H.; 4 Resistors; ·0001 and stand; R.I. Choke; 100,000 Anode and Base, 3-c/o Switches; Carborundum Unit; R.I. Multi; Ferranti do.; 4 Strips and Terminals; ·015 Dubilier; Glazite; 6-pin H.F. Trans., S.S. type; Do. S.P. for Broadcast Range. Components as specified. The lot, post free nett, £7/10/0 U.K.
FAMILY FOUR PARTS (*Percy Harris, Aug., '27.*) 14 Belling-Lee Terminals; 4 Anti-Micro V.H.; 4 Burndept Res. & Bases; 1 30-ohm B.B. Rheostat; 2 six-pin Bases; 1 Formodenser; Dubilier ·0003, with clips; 4 meg. and ½-meg. Leaks; ·015 Fixed, 610 type with Series Clip; 100,000 ohm Wire Wound; 300,000 ohm ditto Resistances (Dubilier or R.I.-Varley); Neut. Condenser, B.B.; R.F. Choke; Gecophone L.F.; 2 "J.B." ·0005 and 2 S.M. Dials; Popular ·0003; Igranic o/o Switch; 3 Lotus D.C. Jacks and Plugs; Binocular Coils 250/550; S.P. H.F. Transformers, 250/550 and 1,000/2,000 metres; S. Secondary ditto for Daventry. THE COMPONENTS, ALL AS SPECIFIED, SENT POST FREE NETT FOR £8/8/0 U.K.
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COME TO
LEICESTER SQ. TUBE
(Important)
Ask for *back* of Daly's Theatre
This address is opposite.

THE VALVE VOLTMETER

—*continued from page* 193

end. Readings were taken with the coil connected, as in Fig. E, which shows that the voltage across the coil with the aerial condenser short-circuited was 0·6, while as the condenser was reduced in value the voltage developed fell considerably. Signals would undoubtedly have been stronger if the aerial tapping were made farther up the coil from the earth end.

Aerial Coil Tests

In diagram F we give the results of a test on a 200 MH coil of single-layer spaced winding type now on the market, with the aerial connected to the centre point through a fixed condenser. The voltages are rather higher than for any of the other coils so far tested, and the effect of the series condenser is not very marked as regards signal strength, although tuning is noticeably sharper when a ·0001-mfd. fixed condenser was used.

We finally tested an extremely efficient aerial-grid transformer having a secondary winding of Litzendraht wire with a fine wire primary. The primary has two tappings, and first of all we measured the voltage developed across the secondary with the aerial connected to terminal A_1 on the coil. The voltages were measured with various fixed-condenser values in series with the aerial, as shown, although the coil was so designed that a fixed condenser was not necessary. This is borne out by the figures obtained, a voltage of 0·9 being developed when the series condenser was short-circuited. When the aerial was connected to tapping A_2, the voltages were rather different, as shown in diagram G.

The tests show that it pays to use good coils in the aerial circuit. An ordinary basket coil, roughly equivalent to about No. 40, gave only 0·2 volt; other plug-in coils gave from 0·15 to 0·4 volt, while the results given above show that it is easily possible to have 0·5 to 0·9 volt. Attention to the aerial circuit is therefore worth while.

The magnitude of the voltages available may come as a surprise to some people, particularly as the tests were made at a place 12 miles from 2 L O. They show that given a good coil sufficient voltage is obtained *without* reaction to work an anode-bend rectifier effectively.

An anode-bend detector was therefore set up, as in Fig. 5. Its grid bias was −1·5 volt, the valve was a D.E.5b, and the other values were as indicated in the figure. The valve voltmeter was first of all connected at points AB, and the voltage received from 2 L O noted. Then the voltmeter was connected across the grid leak R_2 at points CD.

By doing this we measure the high-frequency voltages applied to the detector and the low-frequency voltages got out of the detector. Strangely enough, for an high-frequency input of 0·9 volt we got out a low-frequency voltage of 0·9 volt for speech and weak orchestral music. Passages of music of average strength gave a voltage of about 1·5, whilst the loud passages caused the volt-meter needle to remain steady at 3 volts.

Measuring L.F. Voltages

Whilst measuring low-frequency voltages the needle of the voltmeter is always varying, of course, but these values appear to be average ones. Occasionally the very loud passages would produce a low-frequency voltage of 4, but the average was between 1 and 2 volts—this for a high-frequency input of 0·9 volt. When an R.C. valve was used the low-frequency voltages were roughly 30 per cent more.

(*Continued on page* 252.)

THE VALVE VOLTMETER

—continued from page 250

We next connected a transformer-coupled stage to give the circuit of Fig. 6, with the object of measuring the voltages across EF. The transformer was a well-known and excellent make, ratio 3·5, and we used a D.E.5 valve at V_2. This valve has an amplification factor of 7; hence we should expect a step-up for the stage of 24·5. We therefore altered the anode circuit of the detector so as to cut down the voltage to a reasonable value; in fact, we reduced it to give about 0·5 across points CD. We say about 0·5 volt because the low-frequency voltages are varying all the time, and in order to obtain an accurate reading it was necessary to fit a switch, as shown, so as to be able to read voltage CD and EF quite quickly. In this way we found the stage amplified as expected, about 25 times.

Non-distorting Volume Control

Under normal conditions then, that is with a high-frequency input of 0·9 volt, our three-valve set will give low-frequency voltages varying from 22·5 to 75 across the grid and filament of the last valve. Thus our three-valve set *without reaction* amplifies too much—we have to cut it down considerably. A convenient way of doing this is shown in Fig. 6, where a tapped anode resistance is used. This form of volume control is non-distorting, and is really necessary with many sets.

"MY 'FLY-POWER' TRANSMITTER"

—continued from page 212

rating being about 4,200 miles per watt.

The aerial was afterwards changed, a 65-foot inverted "L" being used in conjunction with a counterpoise of similar dimensions. This system was tuned by the 4-turn coil and the ·0005 aerial condenser to 90 metres, and was thus worked at its second harmonic when the set was operating on 45 metres.

Crude Modulating System

Results did not seem any better than those obtained with the smaller system, although signals were apparently stronger at close range.

For telephony a very crude system of modulation was employed. The grid leak, instead of being connected across the grid condenser, as usual, was taken from the grid to the negative end of the filament, the microphone simply being connected in series with it, and, of course, at the filament end. The modulation obtained was surprisingly great, and the speech was quite intelligible in Brussels, Paris and Glasgow with the ·3-watt input. This system would, of course, be useless with higher powers.

At the conclusion of these tests the power was raised to 9 watts, obtained from an M–L anode converter. The keying system had to be altered somewhat, but all the components stood up perfectly to the increased voltage and the results all round were quite as good as those obtained with the usual 10-watt transmitter employed by the writer for tests on 45 metres.

Reports Received

Five reports have been received from the East Coast of America on the 9-watt tests, and signals have been reported at R.9 in Sweden. This latter is probably in the nature of a freak, and the aerial is also directional for Sweden, but it is a fact that on two occasions a station in Stockholm reported the signals as "R.9 like the high-power commercial stations." It is rather curious that although the ·3-watt transmissions were R.5 in Morocco, the same station reported the 9-watt tests as R.6 only.

The transmitter is now being built for 23-metre work, and although the ·3-watt input will not be used exclusively the power will always be limited to 5 watts.

EDITOR'S NOTE.—This article is published for the information and interest of readers, and *not* as a suggestion for home construction, as such an instrument must not on any account be used without a *transmitting* licence. The ordinary licence does not cover transmission, and the unauthorised use of a transmitter renders the user liable to a heavy fine.

LETTERS FROM LISTENERS

Reception in Scotland—The Radiano Three.

SIR,—It is just three years ago that I first became interested in wireless as a hobby.

At that time I knew nothing of the technical side of radio. But thanks to the WIRELESS CONSTRUCTOR I have gained sufficient knowledge to enable me to represent a well-known firm, and am still looking for fresh fields to conquer.

I find the WIRELESS CONSTRUCTOR suits my needs admirably, although at present I do not use more than three valves.

There is no local station here in the country, but I receive Aberdeen at approximately 130 miles on the L.S. with a two-valve straight Det. and L.F., which means that reception conditions are very good.

I have been trying the short waves with some success. (Keep up the S.W. articles, please.)

I can only wish the WIRELESS CONSTRUCTOR every success, and would like to express my sincere appreciation of the articles therein, which have afforded me the greatest pleasure and instruction.

I am,
Yours faithfully,
Berwickshire. M. A. BURNS.

SIR,—The article recently on the "Radiano Silencer" says that it would increase the selectivity of the "Radiano Three." But it would find it difficult with mine. The set is so selective that it is difficult to tune in even the local station (which is only 50 miles or less away) without being extraordinarily careful. Fortunately, I have a steady hand, or I don't believe I could. On the Daventry range it may not be so selective. I have not tried it with a tapped coil. As we are so near I just use the ordinary coils. The result is positively *deafening*. Fortunately, as I have adapted an old "All Britain" receiver to the "Radiano Three," I have variable rheostats, and can turn the detector valve nearly off, or else we could not possibly put up with the tremendous volume produced. The quality, too, is remarkable. People who come in invariably remark on the clarity of voices and the faithfulness of the reproduction. Personally, I am very pleased indeed with the way orchestral music is delivered.

Yours very truly,
Leicester. L. W. ORTON.

WITHIN THE VACUUM

—continued from page 210

is almost impossible to find out what has happened. The quickest way, of course, is to substitute another valve of the same type in its socket, but not everybody has another valve, and so I would advise everyone owning a three-valve or more elaborate receiver, and especially when making a first-class set, to have a milliammeter so that they can readily check the various portions of the circuit which are likely to give trouble.

Most Useful Instrument

A milliammeter can be tremendously useful in all sorts of circuits. It is one of the most useful instruments we have, for with suitable resistances it can be used as a voltmeter, while, of course, as a test for overloading it is certainly second to none. There are, of course, other causes of distortion, but I have indicated the main ones, and the majority of readers who are troubled with distortion will find the cause among one of those mentioned.

Indiscriminate use of Fluxite when soldering may give rise to crackling troubles, but this hardly comes under the heading of distortion. It should, however, be remembered that after soldering each joint of a receiver the place should be carefully wiped when warm and all traces of Fluxite removed.

As a rule, the loud speaker itself should be suspected last. These instruments do not often go wrong, and any distortion or peculiarity of reception is more likely to be caused as a result of something happening in the set than in the loud speaker or the broadcast transmitter. So that when your troubles arise do not forget to run over the batteries first, then try with a milliammeter and see if you are overloading anywhere.

Reliable Valves

Do not suspect your valves till last. When well chosen, they are not likely to let you down, for the modern valve is very reliable, and it is more likely to be due to something else in the set than to a technical fault in your valve. Overloading, as before stated, is easily accounted for, but with that fear removed you can be reasonably certain that your valves are not causing the trouble, and that your distortion is being generated in other portions of the receiver.

STORING SPARE VALVES

RACKS for spare valves are apt to be troublesome if the valves have to be fitted into holders or clips when they are put aside. One is tempted to put a valve down on the bench when it is not wanted for a few moments, rather than fit it into the rack. For some time I had a rack consisting of holes drilled in a board for the valve legs. The valves had to fit fairly tightly in order to be safe, and the business of putting them in and taking them out was finicky enough to make me avoid using the rack when trying a series of valves in a receiver, for example.

A Simple Box

The untimely demise of a treasured valve, through its rolling off the bench, led to the construction of the much simpler storing box which is illustrated in Fig. 1. It consists merely of a tray divided into compartments with wooden partitions. Thick pasteboard could be used equally well. The exact dimensions are not important, but the compartments should be larger than the diameter of the valve bulbs, so that there is ample room for the fingers

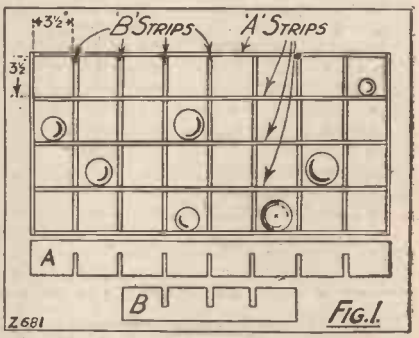


FIG. 1.

when picking out a valve. The depth of the box is such that a flat lid can be placed on the top of it without touching any of the valves.

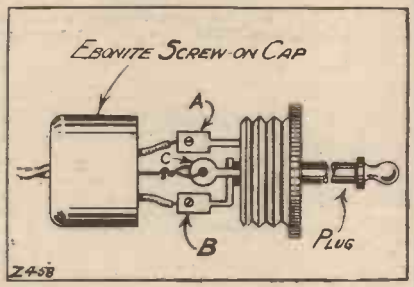
At the points of intersection the partitions are cut as shown in the diagram. There is a pad of cotton wool in each compartment. The valves can then be slipped in without damage. To make it easy to find any desired valve, the valves are always kept in the same places, a slip of paper with the identification letters and figures of the valve being gummed to the near edge of each compartment.

A. V. D. H.

ANOTHER PUZZLING FAULT

An account was given recently in the WIRELESS CONSTRUCTOR of a particularly baffling fault in a receiving set, which was eventually traced to a defect in the plug used for connecting the loud speaker to a jack. A breakdown of an even more puzzling nature has just occurred to the writer and was traced also to the plug, though this was not of the same make as the previous culprit, and was, in fact, of quite different design. His former experience led to fairly rapid tracking down of the second fault, though he must admit that had his eyes not been opened to the possibilities of plugs as sources of trouble it might have taken a long time to discover.

The symptoms were briefly these. A new receiving set had just been



completed, every component of which had been thoroughly tested out before use. The wiring had been gone over with great care, and it was known that there was no defect in it. The valves gave excellent results on another set, and the voltmeter showed that the batteries were right up. When the loud speaker was plugged in for testing purposes the set absolutely refused to function.

Milliammeter Test

There was, in fact, no answering "plock" as the plug was inserted or withdrawn. This seemed at first sight to show that the plug was not working the jack properly, but the milliammeter proved that such an idea was erroneous. With the plug not in position it registered a zero reading, but as soon as the plug was inserted the needle indicated that 10 milliamperes were passing. Each of the valves was switched off in turn, a corresponding drop in the plate current being indicated by the milliammeter.

When only the last valve was left in action the instrument read 5

(*Continued on page 256.*)

ANOTHER PUZZLING FAULT

—continued from page 255

milliamperes. Clearly, then, a satisfactory amount of current was passing in the plate circuit of the last valve when the plug was pushed home, but why was there no "plock" from the loud-speaker when this was done? The leads running to the loud-speaker terminals were disconnected and fixed to the terminals of the milliammeter. On inserting the plug it was now found that the instrument showed a reading of only a tiny fraction of a milliampere. Clearly, then, there was almost a complete short-circuit somewhere in the plug. Tests with a flashlamp battery and the milliammeter showed that this was actually the case—but where was the short?

An Anchoring Point

The drawing illustrates the internal anatomy of this particular kind of plug. The connection marked A is in direct electrical contact with the body and sleeve of the plug, whilst that marked B is connected to the point only, being insulated from the other parts. C is a small metal loop fixed to the body of the plug and intended as an anchorage for the securing cord which takes any pull applied to the leads and prevents the bared ends from being inadvertently wrenched out from connections A and B. Connection B was not quite in its proper position, with the result that it was just touching loop C.

A Simple Cure

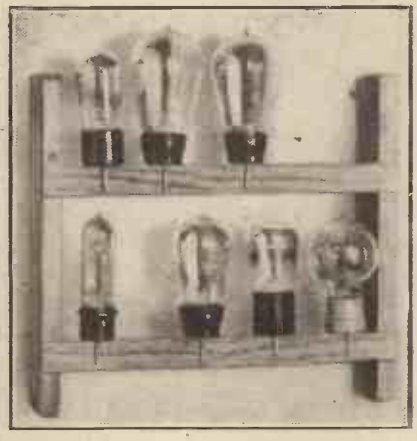
There was, therefore, a path for current from the point to the sleeve of the plug via the resulting short-circuit. The cure was, of course, simplicity itself, consisting as it did merely in moving connection B away from the loop and in tightening up the nut which secured the former to the stem of the plug. It will be realised, however, that its detection might have been a matter of some considerable difficulty, particularly as the plug was a brand-new one, and one does not, as a rule, suspect faults in small components of this kind. The way in which it was tracked down affords yet another proof of the supreme usefulness of the milliammeter as a trouble detector.

Order your copy of next month's "Wireless Constructor" now! It is a Special Gift Number.

ANOTHER GOOD VALVE RACK

EVEN if you cannot make a decent soldered joint, you will be able to make this rack. It consists of just four pieces of wood, two "brass plates" to hang it up by, and fourteen screws.

It is only when you have spent the necessary few minutes in constructing this little rack and in fixing it securely to your wall that you will begin to appreciate the many virtues which the innocent simplicity of its appearance do not proclaim. You will already have noticed, perhaps, that the plate leg of each valve is placed outermost, but, as a matter of fact, you cannot get them on in any other position.



The valves stand quite securely, and can be placed just as close together or as far apart as one desires. You can make the rack in any size you like, according to the extent of your stock, there being only one measurement you need bother about—the quarter-inch thickness of the bars.

TWO USEFUL HINTS

MANY of us when we were small boys at school probably wondered what earthly use we should ever be able to find for the curious problems concerning lines, circles and plane figures by a gentleman named Euclid, or contained in the geometry book which some years ago replaced his immortal works. Actually there are two propositions, one a problem and the other a

(*Continued on page 258.*)

TWO USEFUL HINTS

—continued from page 257

theorem, which can be ever-present helps in time of trouble to the wireless constructor.

The first of these concerns the finding the centre of a circle. You may desire to drill in an ivorine disc to be used as a scale of a wave-meter a central hole to admit the spindle of a variable condenser; the centre of the disc is not marked. Or, in making the layout of a panel you may have moved condenser dials about on a piece of paper until the most convenient positions have been found. You trace round them with a pencil; you wish to find the centre. Or again, you may have a scale comprising only a portion of the circumference of a circle, and you wish to locate the centre for the purpose of drilling a hole for a spindle. Here is the simplest way of doing so. Draw in two chords as shown in Fig. 1. Find the mid-point of each of these and from it draw a straight line at right-angles to the chord. The point at which these two straight lines cut one another is the centre of the circle.

The top two lines are the two "chords." The lengths of these do not vary the accuracy of the manoeuvre and they do not even have to be of similar dimensions so long as the ends just meet as shown.

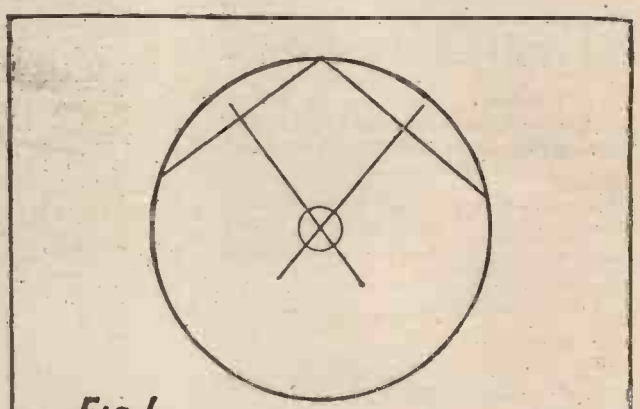


FIG. 1. FINDING THE CENTRE L.022.

Now for the second case. You are squaring up an ebonite panel, a sheet of metal or a piece of wood, and either you have no set-square or it has hidden itself, as set-squares will. Our friend Euclid made, more than two thousand years ago, the discovery that in a right-angled triangle the square on the side opposite to the right-angle is equal to the sum of the squares on the two other sides. If you want to see whether a corner is square or not you can do so with consummate ease with the aid of this proposition. On one of the straight edges make a scriber-mark exactly 4 in. from the corner; on the other make a mark exactly 3 in. from the corner. If the corner is a true right-angle, a line joining the two marks that you have made will be exactly 5 in. in length. There is no need to draw this line; you can measure the distance between the two points without doing so. Should the line AB be less than 5 in. in length the corner is less than a right-angle; if it is more than 5 in. it is greater.

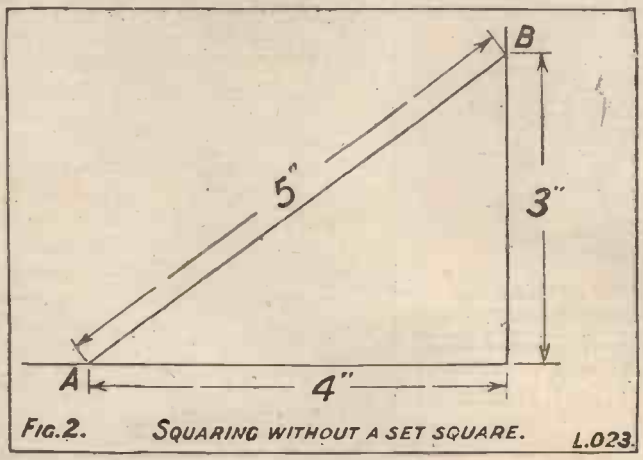


FIG. 2. SQUARING WITHOUT A SET SQUARE. L.023.

e reason why lengths of 3 in., 4 in. and 5 in. are used is simply that the square of five is equal to the square of three plus that of four.

A BLACK STAIN FOR WOODEN PANELS

QUITE a number of radio amateurs employ wooden panels, not necessarily for actual radio set use, but for supporting instruments and components which may be used for testing purposes. Such panels often serve their purposes very well, but generally they have not a good appearance, simply because they *are* wooden ones.

Naturally, the way to get over this objection which accompanies the use of all wooden panels and instrument boards is to stain the surface of the wood black, in order to imitate as closely as possible the appearance of ebonite. Most black stains, however, contain lampblack as their basic ingredient, and thus, lampblack being composed of finely-ground carbon, a wooden panel or board stained black with the aid of such a staining preparation would probably set up excessive current leakages across the surface of the woodwork.

Matt or Polished

A non-conducting stain, however, may be prepared as follows:

Mix the following ingredients (finely ground) in the proportions (by weight) given below.

Ground shellac, two parts; powdered borax, five parts; glycerine, two parts; water, twenty parts.

After these materials have been well mixed together, and the shellac almost completely dissolved (if necessary, after heating the liquid), add to the mixture ten parts of finely-ground aniline black (obtainable from any paint shop) and stir thoroughly.

For use, the resulting preparation should be painted over the surface of the woodwork rather sparingly with a soft brush. Apply three or four coats altogether, but allow ample time for each coat to dry before putting on the next.

The result will be a wooden panel or instrument board which will have a dead matt surface something like the inside of a good camera. If, however, a polished appearance is required, a single thin coating of clear varnish will bring about the desired result.

A semi-matt appearance can also be imparted to the dull black woodwork by rubbing it over with a soft rag which has previously been saturated with olive or sweet oil.

THE B.B.C.'S OWN BOOK

A review of a recent publication that reveals what the B.B.C. is doing, and the underlying motives.

THE British Broadcasting Corporation seems to be slowly spreading its activities beyond the limits of actual broadcasting, the latest indication of this extension being the "B.B.C. Handbook, 1928," a neatly bound and clearly printed volume, a copy of which lies before us. It can be said at once that this is a most interesting and useful production, the price being remarkably low for the quality and quantity given.

Comprehensive Book

The book apparently is an attempt by those who conduct the broadcasting service to explain to the general public just what they are doing, how they do it, and the motives which actuate them throughout. In some four hundred pages (or perhaps one should say three hundred after subtracting the advertisements) almost every aspect of broadcasting is covered, the volume opening with a foreword by the Earl of Clarendon, and a very comprehensive introduction by Sir J. C. W. Reith. Following the introduction we find a series of articles on Programmes, Engineering, Publicity, "Sidelights," and the Wireless Trade. There is also a lengthy article purporting to explain the Regional Scheme, but leaving the reader at the end of its perusal in a thoroughly befogged state! This particular article is commented upon elsewhere in the current issue.

Perhaps the most interesting section for readers of this journal is that which comes under the general title of "Engineering." Transmitters, studio construction and technique, microphone amplifiers, and so forth, are all clearly explained, and a number of articles under the heading of "Reception" cover such matters as the broadcast receiving set, methods of reception, telephones and loud speakers, and the like.

In the article entitled "The Broadcast Receiving Set," the author issues an obsolete warning against ebonite panels, and says they should be "preferably with a matt finish."

Surely anyone connected with the B.B.C. technical department should know by now that the majority of panels sold have a highly polished surface, the polish being non-conducting and completely free from the metallic compound which characterised the finish on the earlier sheets of ebonite. Indeed, it is grave injustice to panel manufacturers to suggest that their polished panels are inferior.

Polished Panels Superior

Actually, polished panels are in nearly all cases superior to matt, while it is much more difficult to put good polish on an inferior grade of ebonite than on a good one. The greatest protection the home constructor can have against inferior ebonite is to buy a ready-cut panel of one of the well-known brands.

There is other evidence in the article that the writer is not so fully acquainted with his subject as he might be. One paragraph is particularly misleading. It reads as follows: "The set may be fitted with a volume control. If, when the set is properly tuned, the volume given is too great this may be reduced by adjusting the volume control; *in no case* should the volume be reduced by detuning." (The italics are ours).

Although perhaps not intended, this certainly suggests to the reader that he does wrong by reducing his volume by detuning, whereas in a very large number of sets this is a very effective, safe, and convenient way. Some sets are fitted with a type of volume control which accompanies the reduction by distortion, and in such sets it is often preferable to control volume by detuning than by the special "volume control" provided.

A Valuable Section

These are minor criticisms, however, and there is a great deal of value, interest and help to every listener in the volume. We would particularly recommend it to readers of the WIRELESS CONSTRUCTOR who are fond of listening to distant stations, for there is a section entitled "Foreign Identification Panels," which provides most valuable information on the distant stations, giving not only wave-length, frequency and power, but the approximate distance from London, the call sign, interval signals, methods of announcing, typical phrases, and any other peculiarities which help to identify the station. This section alone fully warrants the price charged for the whole book.

We congratulate the British Broadcasting Corporation on producing such a well-printed, illustrated and edited volume.

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Printed and published on the 15th of each month by the Proprietors, The Amalgamated Press, Ltd., The Fleetway House, Farringdon Street, London, E.C.4. Advertisement Offices only: Messrs. J. H. Lile, Ltd., 4, Ludgate Circus, London, E.C.4. Registered for transmission by Canadian Magazine Post. Subscription Rates: Inland and Abroad, 8/6 per annum. Canada only, 7/6 per annum. Sole agents for South Africa: Central News Agency, Ltd. Sole agents for Australia and New Zealand: Messrs. Gordon & Gotch, Ltd., and for Canada: The Imperial News Company (Canada), Ltd. R/R