MODERN WIRELESS

August

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Vol. III. No. 3. Edited by JOHN SCOTT-TAGGART, F.Inst.P., A.M.I.E.E. August, 1924.

Vol. III.
No. 3.

MULTI-STAGE HIGH-FREQUENCY AMPLIFIERS
By John Scott-Taggart, F.Inst.P., A.M.I.E.E.

A ROMANCE OF FLEET STREET.

HOW I DESIGN MY WIRELESS SETS.
By Percy W. Harris.

A BEGINNER'S CR

HOW TO BUILD A

By Stanl

Frame A
Continenta

Reflex

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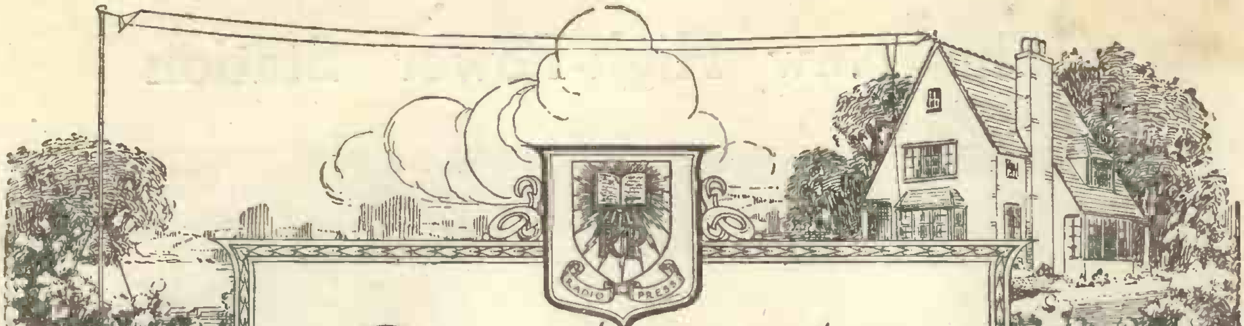

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MODERN WIRELESS

Radio Press Ltd
PUBLISHERS OF *WIRELESS WEEKLY*
DEVEREUX COURT.
STRAND.W.C.2
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The New High-Power Station

The Chelmsford works of the Marconi Company where 5XX, the Experimental High-Power Station of the British Broadcasting Company, is situated. The huge masts of the steel tube type are four hundred and fifty feet high.

A Single-Valve Reflex Receiver

By HERBERT K. SIMPSON

The single-valve reflex receiver is very useful when the maximum economy in filament current is desired. This article gives full constructional details for building a simple and easily - handled instrument. Although no direct reaction is provided, the results show that the set is very sensitive.

Fig. 1.—Compactness is a special feature of this instrument.

THE attention of most experimenters has been directed of late to dual amplification circuits, many examples of which have appeared in the technical papers. Of the many circuits of this nature which have appeared from time to time, that in which only one valve is used seems to have been overlooked to a marked extent.

The writer, realising that there is a large number of "one-valve" men who desire to obtain the best results from their set, has made up the present receiver with a view to assisting this class of experimenters in obtaining the desired results. As will be seen in the photograph, Fig. 1, the finished receiver is of neat design, while the controls are reduced to two variable condensers, the crystal detector and filament resistance.

The Circuit

Fig. 5 is a diagram showing the arrangement of the circuit. The Valve V_1 acts primarily as a high-frequency amplifier, the amplified oscillations being passed via the high-frequency transformer L_2, L_3 to the crystal detector D. The rectified currents are then fed back through the low-frequency intervalve transformer T_2 to the valve, which now acts as a low-frequency amplifier, the magnified signals being heard in the telephone receivers T.

Constant Aerial Tuning

This form of tuning may be applied, when on the shorter wavelengths, by joining the aerial to terminal A, earth to E, and connecting B and C together by a short piece of wire. The 0.0001 μF condenser C A T is then included in series with the aerial, and the variable condenser C_1 is in parallel with the aerial tuning coil L_1.

Parallel Tuning

To use the aerial condenser C_1 in parallel with the aerial tuning coil L_1, without using constant aerial tuning, the aerial lead is joined to terminal A_1, leaving A free, joining B and C together, and connecting the earth to E. The small series condenser is thus omitted from the circuit.

Series Tuning

The aerial tuning condenser C_1 may be used in series with the aerial tuning coil by joining the aerial lead to terminal B, leaving A, A_1 and C free, and joining the earth lead to E.

Components required

To make this receiver, the following parts will be required :—

- 1 box, 8 in. by 10 in. by 5 in. deep (Wright & Palmer).
- 1 panel, 8 in. by 10 in. by ¼ in. (Paragon. Peter Curtis, Ltd.).
- 1 variable condenser 0.0005 μF capacity (K. Raymond).
- 1 variable condenser 0.0003 μF capacity (K. Raymond).
- 1 low frequency transformer (Lissen, Ltd. T_3).

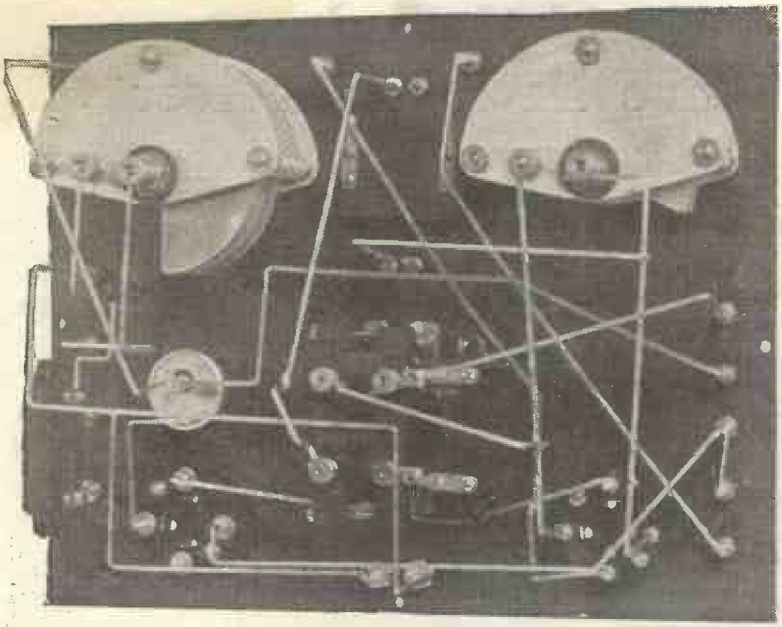


Fig. 2.—A plan-view photograph of the wiring.

1 filament resistance (Microstat, Wates Bros.).
1 crystal detector (Burndept, Ltd.).
1 coil plug for panel mounting (Sparks Radio Supplies).
Fixed condensers : one 0.0001 μF one 0.001 μF, and one 0.002 μF (Dubilier, Ltd.)
2 valve holders (H.T.C. Electrical Co. Type C.).
1 doz. 4 B.A. W.O. type terminals.
6 ft. square wire.

It is not essential that the parts used should be of the make specified, but the constructor is advised to use such parts as are used in Modern Wireless sets, these parts having been fully tested.

The ebonite used for the panel should be of the best quality, and free from surface leakage, but if unguaranteed ebonite is used, the surface skin should be removed by rubbing with emery cloth, as this skin is detrimental to the insulating quality of the ebonite.

Drilling the Panel

Fig. 7 is a scale drawing of the top of the panel, showing the positions of the necessary holes. Full dimensions are given, thus it is a simple matter to mark out the panel from the figure given. Do not use a pencil for marking out, as the lead will form a series of leaks across the panel, and will cause a lot of trouble. Use a scriber or some such instrument which has a sharp steel point. When it comes to the actual drilling, make a scratch against all holes of the same smallest size, and drill these first. All holes of the next size are then drilled, and so on, thus saving much time. The parts may next be mounted up, and secured firmly in position. Leave the glass of the crystal detector in a safe place until ready to test the set, to prevent accidental damage.

Fig. 6 is a drawing showing how the wiring is carried out, and no difficulty should be experienced in following the course of each wire. Square section wire has been used in this receiver, but should the constructor not have the ability to work this wire, he may use ordinary wire covered with systoflex tubing.

Connections to the H.F. Transformer

Special care must be taken over the connections to the high-frequency transformer, as the usual scheme of connections has been slightly modified in this receiver. Fig. 4 (left) shows how the connections should be made *for ordinary work* with the McMichael transformer, when looking at the pins of the instrument. It will readily be appreciated that these connections are the same when viewed from the underside of the panel with the transformer in position. Fig. 4 (right) shows the scheme of connections in this receiver. Briefly, the fact is that the primary is treated as the secondary, and is tuned, while the original secondary winding becomes the primary and is connected in the anode circuit of the valve. No alteration to the transformer itself is necessary, the change being effected by the connections to the socket.

Coils to Use

For the ordinary broadcasting wavelengths, when using constant aerial tuning, a No. 50 coil should be used up to 420 metres, above which a No. 75 may be tried. For the 1,600 metre station a No. 150 coil may be plugged in to the socket L_1, the correct high-frequency transformer for this wavelength being substituted for the one previously employed.

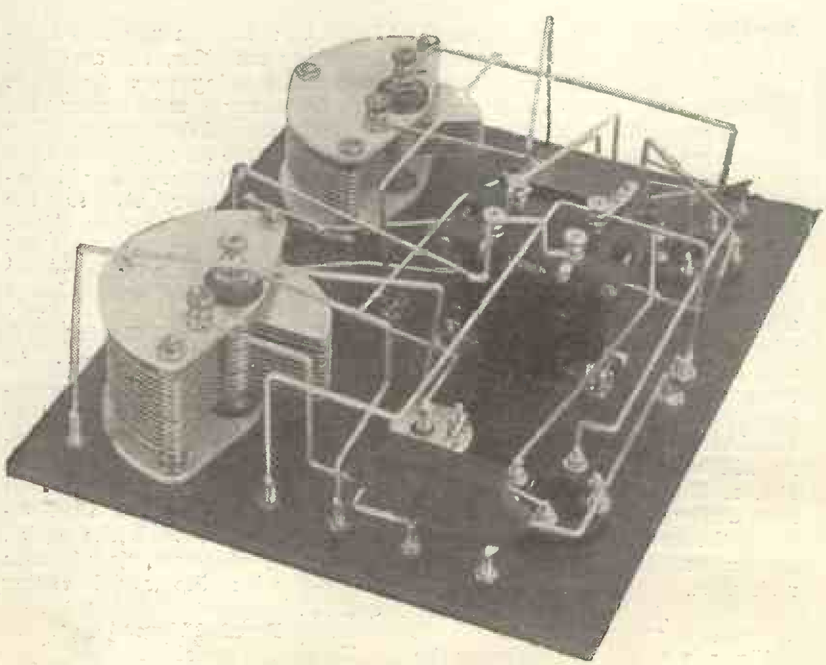


Fig. 3.—The wiring viewed in perspective.

Almost any good make of valve will be found satisfactory in this receiver, provided correct potentials are used.

Testing the Set

Commence testing by using constant aerial tuning on the local

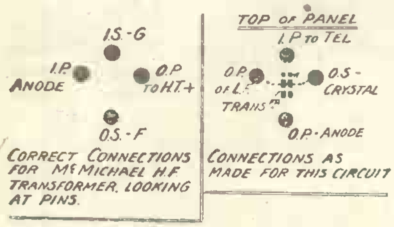


Fig. 4.—Transformer details.

station. Connect the aerial to A, earth to E, join B and C together and insert a No. 50 or No. 75 coil in the position L_1, according to the wavelength. The batteries are joined to the terminals indicated in Fig. 7, while if no grid

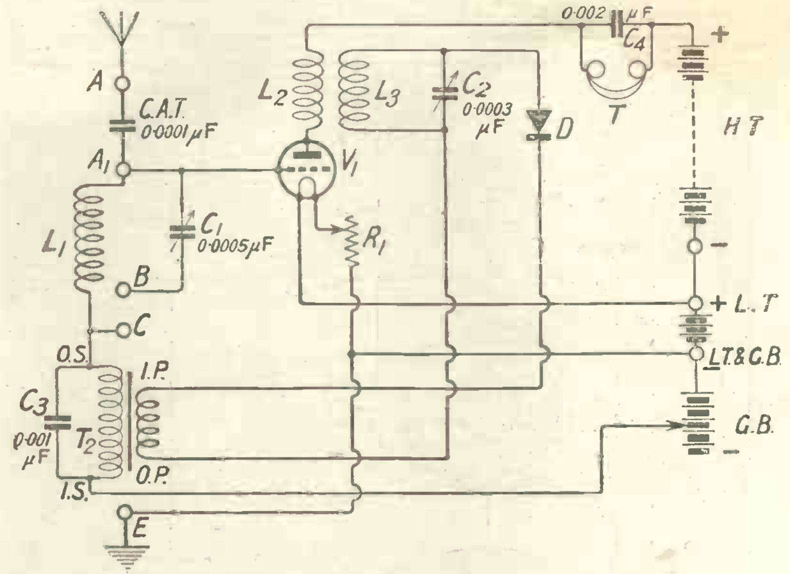


Fig. 5,—Theoretical circuit diagram.

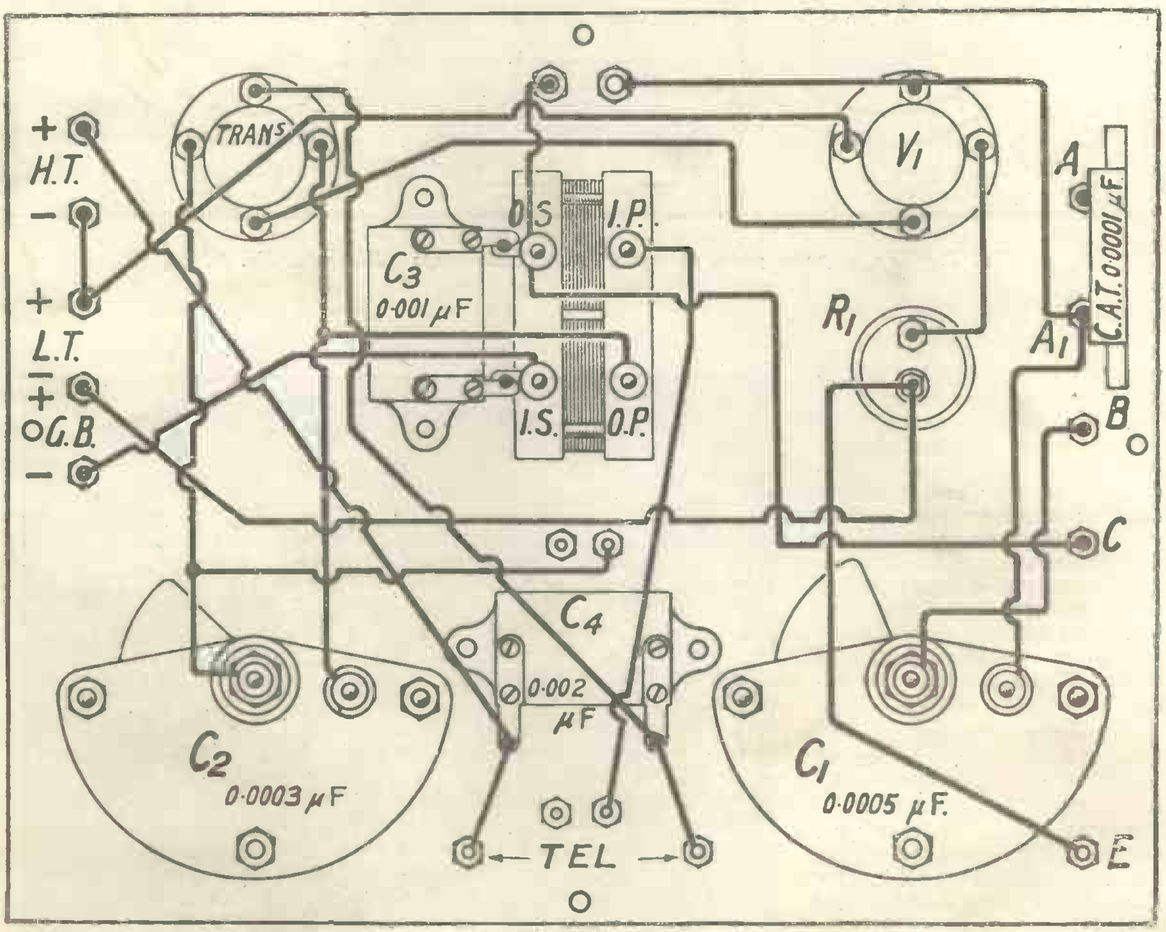


Fig. 6.—Practical wiring diagram. Blueprint No. 56B.

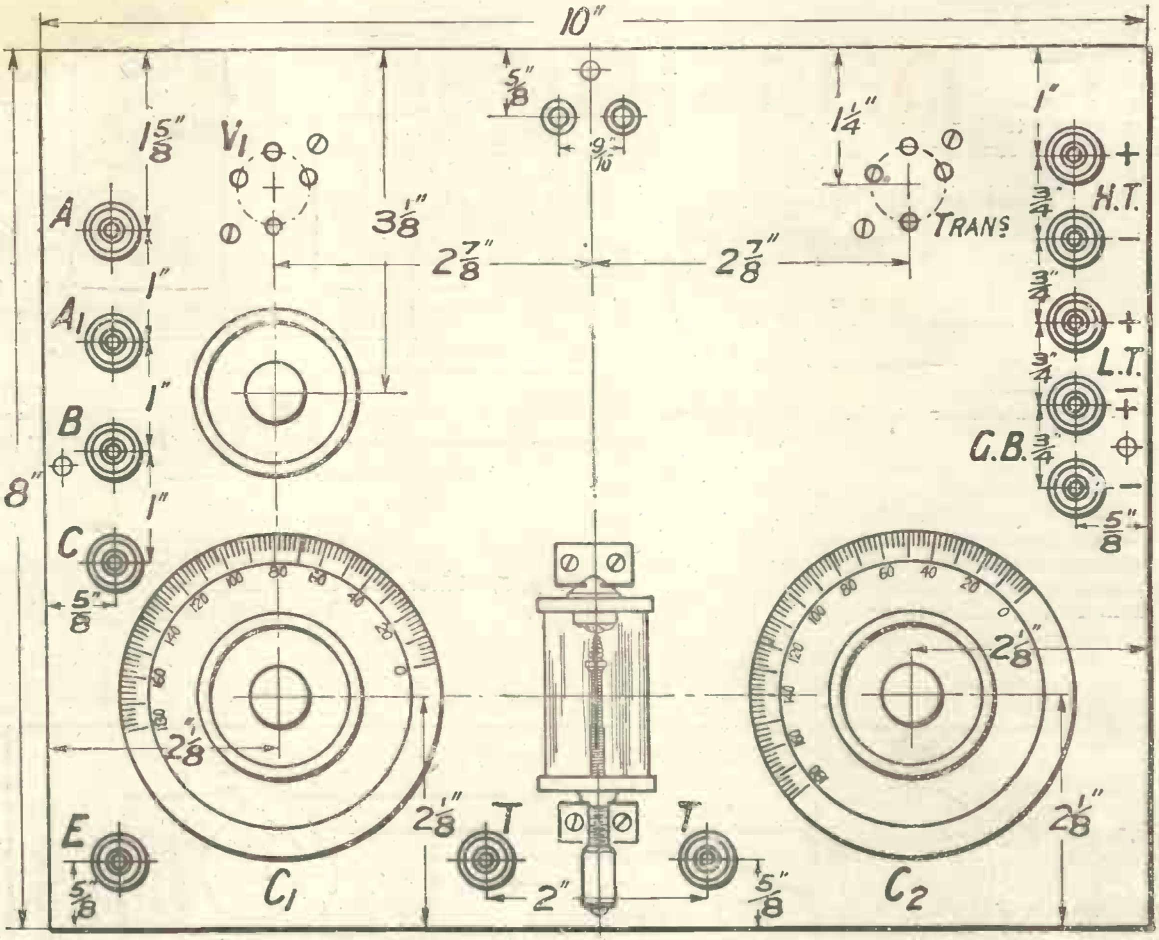


Fig. 7.—Top of panel plan, showing terminal markings Blueprint No. 56A.

bias battery is employed, the terminal G B – must be shorted to L T –. Having inserted the valve and transformer, connect up the telephones to the terminals in the front of the receiver, and, with the cat-whisker touching the crystal, turn on the filament supply to the valve. Tune on C_1 and C_2, when the local station should be heard at good strength. A final adjustment of the crystal detector to a sensitive spot will be necessary, and the condenser C_2 should then be re-adjusted.

Results Obtained

Using this receiver, London at 10 miles was strong enough to operate a small loud-speaker, while Birmingham and Bournemouth were received at good telephone strength. Newcastle and Glasgow were also heard in the telephones.

Full sized blueprints of the receiver (Nos. 56A and B) are obtainable from Radio Press, Ltd., price 1s. 6d. each, post free.

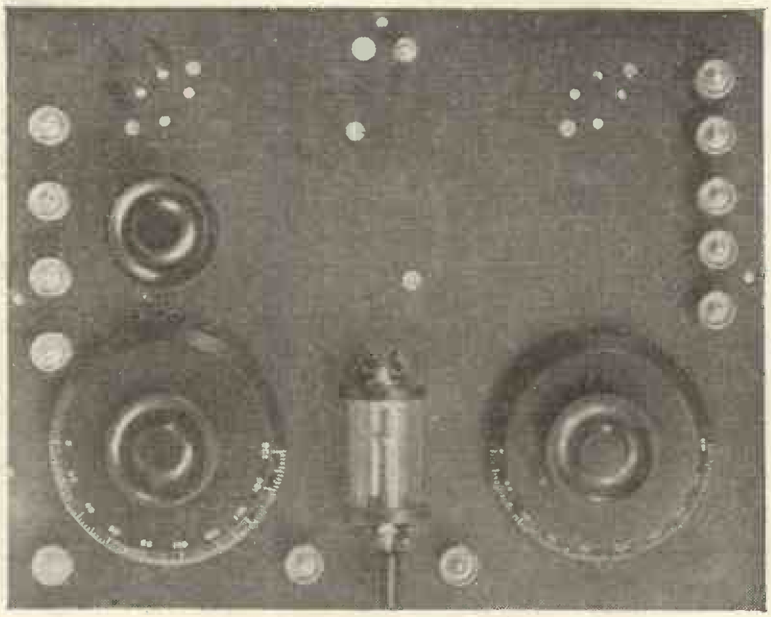


Fig. 8.—A photographic representation of the panel top.

A Nasty Spirit

"AND now," I said to Poddleby, as I straightened the crick out of my back after making the last beautifully soldered joint in my newest five-valve receiver, "and now I want you to lend me your wavemeter." Poddleby, I should explain, had strolled round to my workshop to help me to finish off the job. I cannot say that his assistance was of extreme value, for he has a way of breathing rather hard when he gets excited, and the small soldering iron which I use for fine work cools very rapidly under such treatment. It was only by sending Poddleby for a stroll round the garden that I ever got that last joint made at all.

I regret to say that Poddleby received my request for the loan of his wavemeter without the enthusiasm that I would have liked to see. In fact he leapt back as if he had been stung and began to talk rapidly and rather vehemently about the condensers, valves, telephones, batteries, grid-leaks, coils, detectors, rheostats, transformers and other things which he alleged he had lent me at various times and had never seen again. I pointed out to him at once that this was not showing the right spirit. Among all real wireless men there is perfect community of goods, everyone being only too willing to lend anything to any of his friends who is in need of it. Poddleby was nasty enough to say that he had never managed to borrow anything from me, but I soon put a stop to this kind of talk by reminding him that only the previous week I had lent him Gubbsworthy's loud-speaker. I am sorry that Poddleby behaved in this way, for if there is one thing that I hate it is any kind of meanness.

A Far, Far Better Thing

I think I must have let myself go a bit, for Poddleby wilted visibly under the flow of invective which I poured upon him. At length he held up his hands as a sign of surrender and said rather sulkily that I could have the blessed thing if I wanted it. It was now my turn to be haughty, and I told him that after his lamentable display I would not take his wavemeter as a gift. He said, rudely, that if he lent it to me it would be as good as a gift, but I took no notice of this remark. I merely told him that he had a nasty and miserly character, that he knew nothing about wireless, that he was known to be by far the worst howler in the place, that his set was a disgrace and that his presence in my workshop was superfluous. I then went round to see Snaggsby, and being lucky enough to find him out borrowed his wavemeter without trouble of any kind. I cheered myself with the thought that it was a much simpler affair to use than Poddleby's. Poddleby's wavemeter is one of the what-you-may-call-it kind, I mean one of those things which squeals when you turn the knob. I have never really liked these, for it is so very hard to tell whether you have found the wave you want or whether it is only the man next door trying to find it. Snaggsby's wavemeter, on the other hand, is the what's-its-name, which is, of course, a very much handier arrangement. You merely turn a little knob to the position marked "buzzer" and the thing begins to whine like a hungry mosquito. You place it near your set and twiddle the other knob until you hear the whine very plainly in your receivers. You then read off the wavelength on the neatly marked dial. What could be more delightful, more handy, more completely satisfactory than such an arrangement as this?

A False Start

I carried Snaggsby's what's-its-name home and prepared to get to work on the calibration of the new set. Of course the set refused to work when I first turned it on, and appeared to have developed a most mysterious fault. I went to the workshop and resoldered the majority of the joints, doing the job in peace this time, since Poddleby was no longer there. Then I took it back, and was still getting no results when it occurred to me that things would have a better chance if I were to turn over the aerial earthing switch. Failure to do this is one of the commonest causes of poor reception in amateur sets, as I have frequently pointed out in lectures to the wireless club, and in learned articles upon such subjects as "How to make certain of good reception" and "Method in wireless." Things now went well, and after tuning in one or two transmissions I decided to get on with the calibration.

So Simple

I placed the wavemeter upon the bench at a convenient distance from the set, and with a mind unclouded by any foreboding of coming trouble, turned the little knob to the position marked "buzzer." There was a loud silence. However, I know something about these buzzer wavemeters, and of course all that the thing wanted was a gentle tap. I tapped. Some more silence. I tapped harder. The silence was more pronounced than ever. I took the thing and shook it until it rattled. Still silence. I smote it gently but firmly with a hammer. It remained dumb. "Ah, well," I thought, "I suppose the buzzer is slightly out of adjustment. We will soon remedy that." I provided myself with a small screwdriver and settled down with a light heart. Even if he were rather annoyed at my having taken his wavemeter in his absence, Snaggsby would certainly be delighted when I returned it with its buzzer properly adjusted. I opened the little door in the case and settled to my task. It is a perfectly simple thing really, for there are only two screws that you have to twiddle. One makes the thing buzz and the other tunes the note until it reaches a high-pitched squeal. Could anything be more straightforward? As a preliminary I slackened off both the buzz screw and the squeal screw. The next thing to do, as everybody knows, is to turn the buzz screw gently down until its point just touches the thing-a-me-bob—I have forgotten its name, but it is shaped like one of those things that you pat butter with. When you do so the buzzer will begin to buzz. I did so. The buzzer did not buzz. I kept on doing it for quite a long time and the buzzer kept on not buzzing. The battery must be run down. I tried it with a voltmeter and was disgusted to find that it was slightly over the normal voltage. Very well, let's start again. Probably I had been turning the screw down rather too fast. In these matters it's gently as does it. This time I got a buzz, not a very tuneful one I admit, for it sounded rather like the tearing of rotten calico. Still, it was a buzz. The only thing left was to get the proper setting of the other screw. I gave it about a millionth of a turn and the buzz promptly stopped. I turned it back to where it started from. Nothing happened. Then I tried the other screw again, with an equal lack of success.

Perseverance Rewarded

It is experiences such as this that are a real test of the wireless man. A hasty fellow who is no genuine devotee of the art would probably have tried tapping the wavemeter with a coke hammer or with the toe of his stoutest boot. Or he might have tested the effect of throwing it downstairs or dropping it out of the window. A cowardly soul would have hurried round to Snaggsby to return the wavemeter ere he came home and discovered its absence. But I am not built on any of those lines. Once I have taken a job in hand I see it through. At the end of a couple of hours I had made the thing buzz three times, and on each occasion the raucous noise emitted promptly ceased directly I touched the tuning screw. Then quite suddenly and unexpectedly I got it. On my putting the first screw into a position in which it had been at least three hundred times before the buzzer burst into song. No weakly ragged note this, but a strong healthy roar such as made my heart leap for sheer joy. I left it buzzing for a bit so that it might have a little practice and get thoroughly into its stride. Then with a prayer to the gods of wireless, with knees knocking together and with quivering hands I ventured to touch the tuning screw. Would the first tiny turn stifle that lusty note into silence? I made it. It did not. The pitch rose a little. Filled with a new hope I turned on and on what time the note went higher and higher up the scale, till at last I had the perfect buzz, a note so shrill that in comparison with it the most soprano mosquito would have seemed a bass. Success at last. One can do anything by sticking to it.

A Poser

I switched off so as not to run the battery down and turned on the set once more. Then I switched on the buzzer. Where, oh where was my beautiful note? I waggled the switch violently from side to side. The little lamp glowed quite prettily when I got to its part of the switch, but the buzzer refused to rise to the occasion. However, by firm but gentle tapping I roused it into life once more and proceeded to calibrate. On giving my A.T.C. a gentle touch I heard strange music. I tuned him in. A strong signal—must be Bournemouth or Newcastle. The wavemeter would set all doubts at rest. Placing it, with its buzzer working, fairly close to the A.T.I. I tried 385 metres; it was not that. It was not 400 metres either. In fact the wavemeter said that it was not anything that lay between 300 and 4,000 metres. This was a little puzzling, since the coils in use were right, I knew, for the broadcast band. I tried other sets of coils and was horrified to find that my set was apparently tunable to no wavelength whatever though I was able to pick up all kinds of signals of known wave.

Breadsnapp to the Rescue

Just then Breadsnapp, who is always helpful, dropped in to show me some new gadget, and I dragged him to the wireless table to share my sorrows. "Oh, yes," he said, when he heard my tale, "it often happens at certain adjustments of the buzzer that these meters won't radiate. I cannot tell you why, but they won't. All you have got to do is to readjust the buzzer." I looked at him coldly and asked if he had ever tried to adjust one of these buzzers. He told me that anyone but a perfect fool could do the job in a tick. I said that I had had my tick for that day and that he could try if he liked. I then begged him to excuse me for a moment as I had an urgent letter to write. When I came back in an hour's time Breadsnapp was looking a little worried. When I asked him how many sets of coils he had calibrated in my absence he explained that his task had been an unexpectedly difficult one. If you got the thing to buzz properly it would not radiate, and if you got it to radiate it would not buzz for more than about one second at a time. The only way, we found, was for me to work the set while Breadsnapp armed with a gong stick stood by the wavemeter and gave it one for itself whenever it showed signs of getting tired. It was rather a laborious process, especially as Breadsnapp's exasperated smacks were occasionally so violent as to throw the buzzer out of its stride and to necessitate a halt for fresh adjustments. Still we did get one lot of coils done in some sort of way.

Is it Cricket?

I felt that a wavemeter of this kind was really not worth borrowing for any length of time, so I carried it back to Snaggsby after dinner. I took the opportunity of telling him rather plainly what I thought of a man who could own such a dud piece of apparatus "Why, what's the matter?" he asked. I recounted my own adventures and the things which had happened to Breadsnapp. "Oh," he said, "of course you did not see the third screw." "The *third* screw!" I gasped. "Why there isn't one." It appeared that there was, though, for Snaggsby, who is of an ingenious turn of mind, had made a slight alteration in this buzzer and had fitted a beastly little screw tucked away where you would never think of looking for it. All you had to do was to twiddle it and the wavemeter would eat out of your hand. He showed me how to adjust it in about two seconds. Now this, I think, is not the way to go to work. The man who has a wavemeter must know that his friends will borrow it, and to go and fit a wretched little gadget like that without letting other people know is about the rottenest thing that I ever heard of. There must be something evil about wavemeters if one may judge from the effects which their ownership produces upon the characters of such otherwise good fellows as Poddleby and Snaggsby.

THE LISTENER-IN.

The author experimenting with a ten-valve receiver with seven stages of high-frequency amplification.

Multi-Stage High-Frequency Amplification

By JOHN SCOTT-TAGGART, F.Inst.P., A.M.I.E.E.

This article is the most comprehensive one ever published in connection with a problem which interests all who desire to receive signals over long ranges.

Introductory

THE achievement of long distance reception is closely bound up with efficient high-frequency amplification. Rarely, however, is any trouble experienced when only using a single stage of this method of strengthening signals. On the other hand, whenever two or more stages are employed, the apparently straightforward process of simply adding extra valves brings in its train complications which interfere with the whole action of radio frequency amplification.

In some quarters we frequently see several tuned anode circuits connected in cascade with delightful abandon, but everyone who has tried to arrange such circuits has found that they are completely unworkable. Oscillation will inevitably be set up, and once an amplifying arrangement is oscillating it is practically useless for reception of telephony.

The effective amplification of radio-frequency currents of high frequency, such as those employed for broadcast transmission, is inevitably bound up with the use of tuned circuits in the intervalve couplings. These tuned circuits are responsible for the tendency which all high-frequency amplifiers have to oscillate, but, on the other hand, the use of a tuned circuit results in all the beneficial building up of oscillations given by resonant phenomena. We can, of course, dispense with tuned intervalve couplings, using aperiodic transformers, but although great stability may be obtained with such arrangements, the sensitiveness is small and a very large number of valves are required to give a result which may be more easily obtained with one or two stages of efficient tuned high-frequency amplification arrangements. An aperiodic high-frequency amplifying system gives such inferior results on short wavelengths that it is not proposed to deal with such arrangements in this article.

The Simple Circuit

The simplest form of amplifying circuit using a valve for the magnification of radio frequency currents, is that illustrated in Fig. 1. We have an oscillatory circuit L_1 C_1 in the grid circuit of a valve. It will be seen that one side of the circuit L_1 C_1 is connected to the grid G, and the other side to the negative terminal of the filament battery B_1; a rheostat

Y Z without the valve V commencing to oscillate.

If such a circuit is arranged, it will be found that unless there is a heavy load on the circuit L_1 C_1, or the circuit L_2 C_2, that when the two circuits are tuned to the same wavelength, the valve will generate continuous oscillations of its own

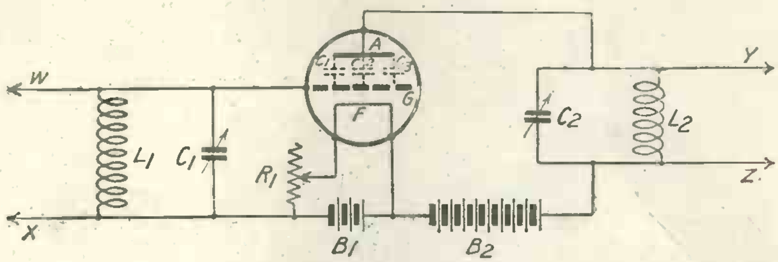


Fig. 1.—The simplest form of radio-frequency amplifier.

R_1 is included in the negative lead to the filament, this resulting in the grid being given, via L_1, a negative potential corresponding to the potential drop across the used portion of the rheostat R. This negative potential will usually be in the neighbourhood of 1 or 2 volts, and serves to prevent the establishment of any appreciable grid current in the grid circuit of the valve. Such a grid current would introduce damping into the grid circuit, and so lessen the potentials established across the grid and filament of the valve. The anode circuit of the valve contains the anode A, the tuned circuit L_2 C_2, and the high-tension battery, or anode battery, B_2. A condenser of, say, 0.002 μF capacity may be connected across B_2 to act as a by-pass for the high-frequency currents in the anode circuit, but in practice, this is unnecessary, and from the high-frequency point of view, the battery B_2 may be regarded as merely a continuation of the wiring to the filament, from the circuit L_2 C_2.

In this simple amplifying arrangement it is supposed that energy is fed into the circuit L_1 C_1 from some source to the left of the circuit. In ordinary cases this source of input energy will be an aerial, or equivalent system, or the anode current of a preceding high-frequency amplifying valve. Likewise, the amplified oscillations established across the circuit L_2 C_2 will be communicated, either to a detector, or to another stage of high-frequency amplification. We are therefore principally concerned with the ratio of the E.M.F.'s across W X, and those across Y Z. It is our object to obtain the highest possible E.M.F.'s across

accord, and the merit of the arrangement as an amplifier of externally applied high-frequency currents is gone.

This self-oscillation effect is due to a reaction effect which is carried beyond the stable condition, and is due to a transference of the amplified energy in the output circuit of the valve (L_2 C_2) to the

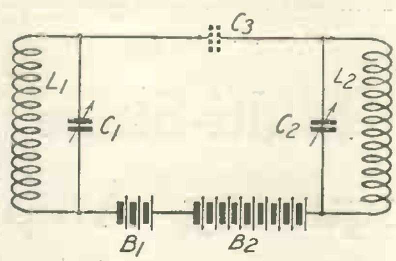


Fig. 2.—The Fig. 1 circuit simplified.

input circuit (L_1 C_1). To prevent self-oscillation of a valve we have to prevent a transference of energy from the output circuit to the input circuit.

This transference of energy is accomplished by two forms of coupling :—

1. Capacity coupling between one circuit and the other.
2. Inductive or magnetic coupling between the inductance in the anode circuit and the inductance in the grid circuit.

Capacity Coupling in a Valve

Capacity coupling between the anode circuit of a valve and the grid circuit is responsible for probably at least 80 per cent. of the undesirable self-oscillation of high-frequency amplifiers.

This capacity coupling is effected in two different ways which, however, both act in the same direction to produce self-oscillation.

These forms of capacity coupling are due :—

1. To the inter-electrode capacity of the valve, *i.e.*, the capacity formed by the grid and anode of the valve, and the capacity between the grid and anode valve pins and sockets, and wires going to these points.
2. The capacity coupling between the inductance coils themselves.

There is a tendency to blame the capacity between the grid and anode of a valve to almost too great an extent, and insufficient attention is paid to the other capacities which act in parallel with the condenser action of the valve itself.

In Fig. 1 I have shown three small phantom condensers C_1, C_2 and C_3 (shown in dotted lines), which are intended to indicate the distributed capacity between the grid and the anode. The grid, of course, is usually in the form of a spiral wire concentric with a cylindrical anode. The result is that the grid acts as one plate of a very small condenser and the anode as the other plate. The grid and anode inside the valve therefore acts like a condenser, and this condenser couples the circuit L_1 C_1 to the circuit L_2 C_2 by ordinary capacity coupling.

The grid has also a capacity with respect to the filament, the grid forming one side of a still smaller condenser, and the filament the other side. This capacity, although playing a part in the process of high-frequency amplification, may conveniently be left out of consideration, at the present stage, for the sake of simplicity. Likewise, the capacity between the anode and the filament may, at this stage, be left out of consideration.

If we simplify the circuit shown in Fig. 1, regarding the valve merely as a means of coupling one circuit to the other by a capacity coupling, we arrive at Fig. 2. Here, the batteries B_1 and B_2 serve to give a direct connection from the foot of L_1 C_1 to the foot of L_2 C_2, while the condenser C3, in dotted line, represents the capacity between the grid of the valve and the anode. The batteries B_1 and B_2, having negligible resistance and impedance, do not in any way

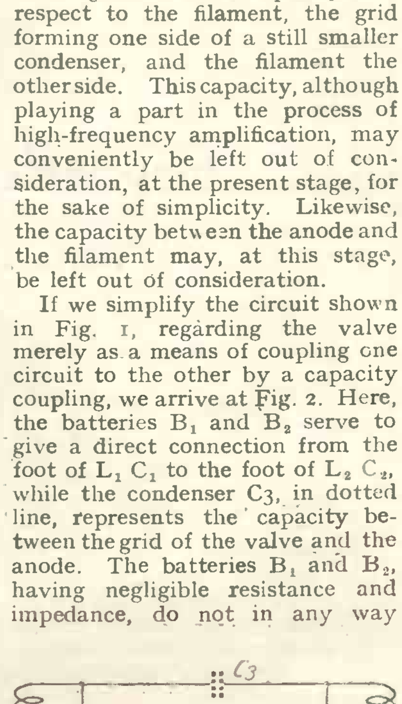


Fig. 3.—Further Simplification

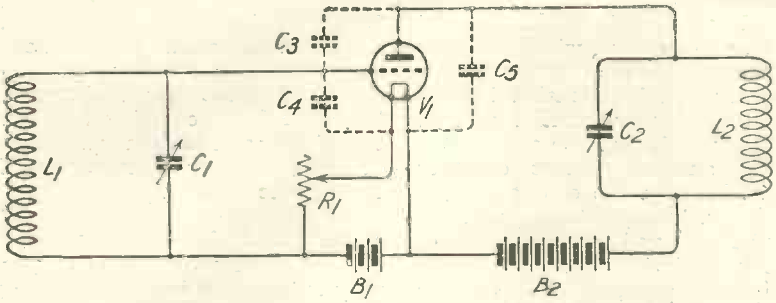


Fig. 4.—Inter-electrode capacities involved in a high-frequency amplifier.

affect the high-frequency aspects of the circuit, and we can consequently simplify the Fig. 2 arrangement as shown in Fig. 3.

This figure will be recognised as one of the standard methods of coupling two tuned oscillation circuits together. Such circuits may always be coupled together by means of inductive, capacitative or resistance coupling, and Fig. 3 is a typical method of coupling two tuned circuits together by means of a condenser. Sometimes the condenser is inserted between one end of one circuit and one end of the other, and another condenser between the other end of the first circuit and the other end of the second circuit; two condensers, however, are not required, provided two ends of the respective circuits are directly connected.

In the Fig. 1 arrangement, the oscillations in L_2 C_2 are, due to the amplification of the valve V, very much stronger than the oscillations in the circuit L_1 C_1; we are therefore concerned with the feeding-back of high-frequency energy from the circuit L_2 C_2 to the circuit L_1 C_1. This energy is fed back to the capacity between the grid and anode of the valve, *i.e.*, through the condenser C_3 in Fig. 3. Provided the phase relationship between the oscillations in L_2 C_2 and L_1 C_1 is correct, the valve will generate continuous oscillations.

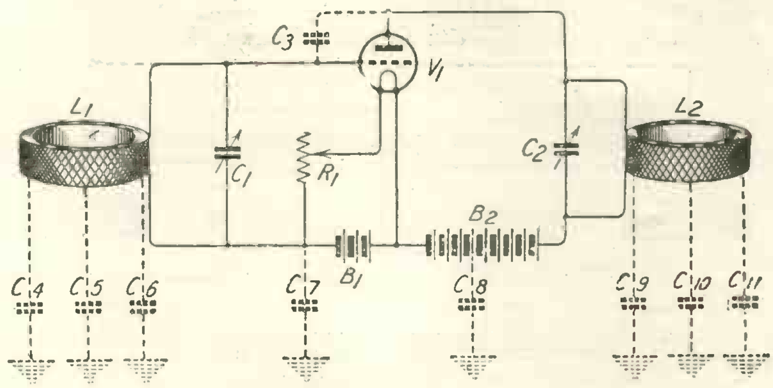


Fig. 5.—Stray capacities to earth.

Both Circuits must be Tuned

It is, however, important to appreciate that energy will not be transferred from the circuit L_2 C_2 to the circuit L_1 C_1 unless both circuits are approximately tuned to the same wavelength. If, for example, we detune L_2 C_2 so that the wavelength of this circuit is less, or greater, than that of the circuit L_1 C_1, the valve will remain stable, and not only will it not oscillate, but it will not amplify. Slight variations in the tuning will cause variations in the tendency of the valve to oscillate, and if the tendency is too great, a detuning of one of the condensers C_1 or C_2 will render the apparatus stable. The ideal state of affairs is to have both circuits exactly tuned to the wavelength of the signals to be amplified. If it is necessary to detune one of the circuits to prevent self-oscillation of the valve, the degree of amplification will be reduced, and if the variation is made too great, the amplification effect will be nil. Moreover, the detuning of one of the circuits may result, in the case of a wireless receiver, in some other station being picked up, and, in any case, the adjustments at the self-oscillation point may cause a great deal of interference with neighbouring wireless sets owing to the radiation of the continuous oscillations set up by the valve.

Fig. 4 shows the various capacities involved in a high-frequency valve amplifier. It will be seen that there is a capacity C_3 which acts between the grid and anode of a valve, while there is also a capacity effect directly between the anode A of the valve and the filament F; this capacity is represented by C_5 in Fig. 4. The capacity C_5 acts in parallel with the capacity C_2, the battery B_2 not interfering with the action of the oscillatory current, as has already been explained. Apart from the capacity C_5, we may also consider the anode to filament path of the valve acting as two capacities in series. These would be the only capacities if the grid were solid, and the two capacities C_3 and C_4, therefore, while acting in series

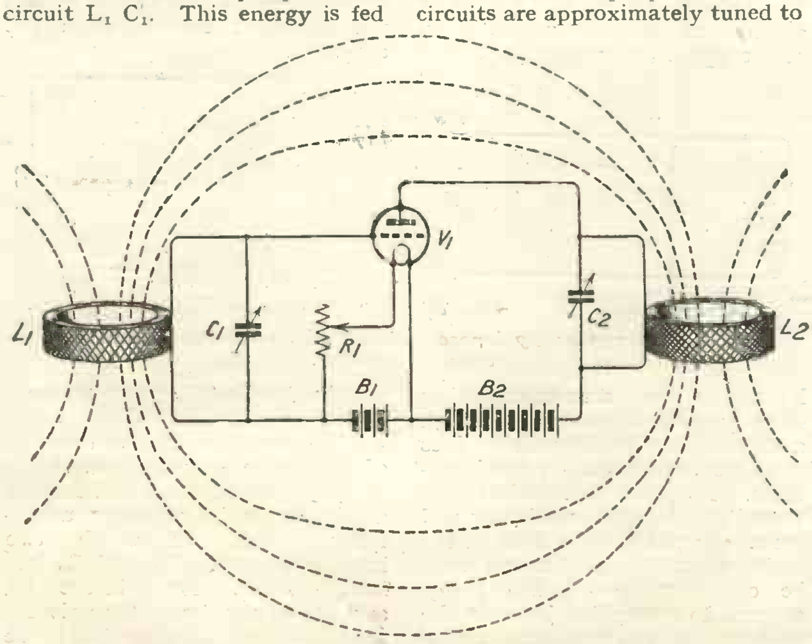


Fig. 6.—Inherent inductive coupling between coils in a high-frequency amplifier.

with each other, are jointly in parallel with C_2, and therefore any oscillations in L_2 C_2 will set up varying potential differences across both C_4 and C_3. The potentials across C_4 will be communicated to the circuit L_1 C_1, so that, in effect, the grid to filament capacity also contributes to the passing on of energy from the anode circuit to the grid circuit. This aspect seems to have been neglected in previous discussions, but the fact remains that the essential coupling medium between the anode and grid circuits of the valve is the grid to anode capacity inside the valve, the capacity between the leads going to these electrodes and the capacity inside the valve holder and valve cap.

The separation of valve sockets in a valve holder considerably lessens this capacity effect, and consequently there is less tendency to self-oscillation.

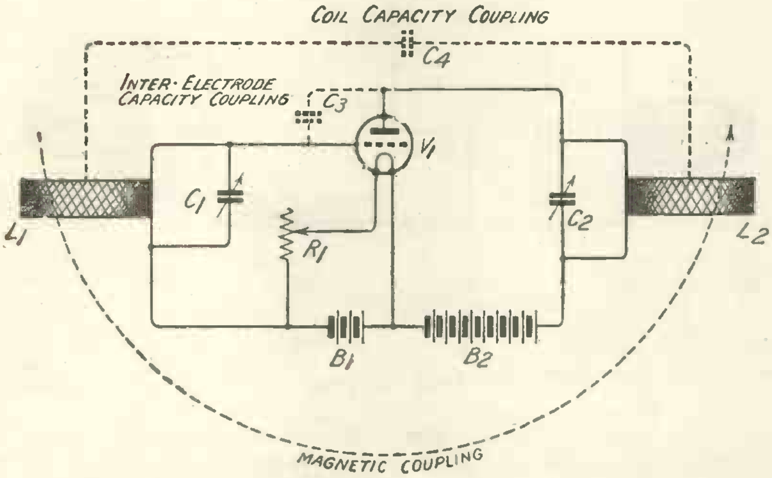


Fig. 7.—Showing the three principal causes of self-oscillation.

Capacity between Coils

There appears to be an almost total neglect of an important cause of self-oscillation in high-frequency amplifiers. Although attention is regularly given to the capacity inside the valve, yet a capacity effect which is often very many times greater is that between inductance coils in the circuit. This trouble, of course, is worse when the inductance coils are of large size, but the effect is also very noticeable even on broadcast wave-lengths. Sometimes the capacity is directly between one coil and another, but if coils are placed well apart direct capacity coupling is small.

What usually happens is that each coil has a substantial capacity to some common conductor; for example, each coil possesses a certain capacity to earth, the word earth also implying wiring which is connected to the filament accumulator and high-tension battery which, being substantial masses, have a relatively large capacity to earth, and the direct capacity effect between the coils and such batteries, transformers, variable condensers and other pieces of apparatus inside a set which have substantial capacity to earth and to each other. All these capacities add together to couple the two oscillatory circuits and their join effect is frequently very much greater than the actual capacity between the grid and the anode.

Effect in Transformers

Where there is transformer coupling in a high-frequency amplifier the inductances in the grid and anode circuit of a valve, respectively, are coupled to windings which have one end connected either directly to the filament, or through a high-tension battery which does not affect high-frequency considerations. The result is that the capacity between the primary and secondary windings of each of the high-frequency transformers may be considerable, and will really amount to a coupling between the grid inductance and the anode inductance. This aspect of high-frequency transformers is, again, a point which seems to have been overlooked by writers on the subject, and the moral, of course, is to use loose coupling between the primary and secondary windings of high-frequency transformers, if these are to be used.

Effect of Condensers

Variable condensers are also very troublesome in supplementing the capacity coupling between grid and anode circuits of a valve. If, in Fig. 5, the variable condenser C_1 is placed close to the variable condenser C_2, it will be obvious that there will be a substantial capacity coupling between the upper plate of C_1 and the upper plate of C_2, *i.e.*, the plates which vary at high-frequency potential with respect to the filament. Since the upper plate of C_1 is connected to the grid and the upper plate of C_2 is connected to the anode of a valve, we have this capacity coupling adding itself to the capacity C_3 between grid and anode of the valve itself. The moral here, of course, is to separate our variable condensers as far as conveniently possible, because they are a great source of self-oscillation in high-frequency amplifiers, although many experimenters imagine that if they separate the coils and take other precautions, such as the keeping of all wiring separate, no serious trouble will be experienced. On the other hand, the position is that however careful one may be, in certain directions, the placing of variable condensers fairly close to each other will nullify all the other precautions and cause serious self-oscillation tendencies in the amplifier.

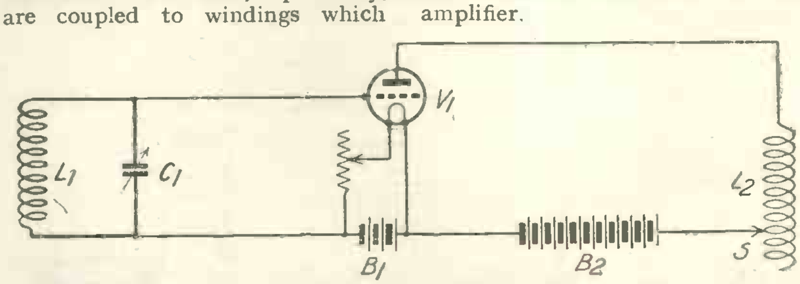


Fig. 8.—An apparently innocent circuit which oscillates on certain adjustments of S.

Inductive Coupling as a source of Self-Oscillation

We now come to the question of inductive coupling in high-frequency amplifiers. Fig. 6 shows a simple radio-frequency amplifying system in which two honeycomb coils L_1 and L_2 are included, respectively, in the grid and anode circuits of the valve.

The dotted lines indicate the magnetic linkage, or inductive

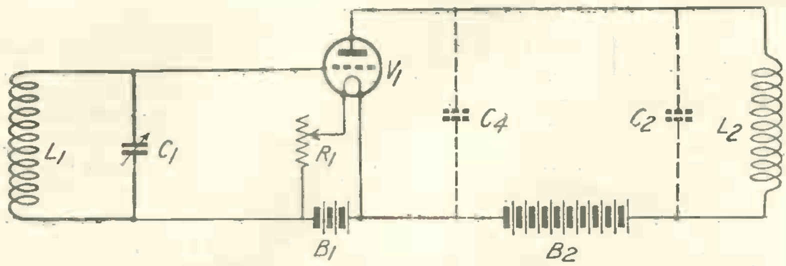


Fig. 9.—The circuit of Fig. 8, showing self-capacity of coil and internal valve capacity in parallel with L_2.

coupling, between coils L_1 and L_2, and this coupling may be in such a direction as to produce a reaction effect which, either by itself or in combination with the capacity reaction effect, may set up oscillations. On the other hand, of course, the coupling between the coils may be such as to tend to decrease a tendency to self-oscillation, and in some receivers the coils are arranged to produce this effect. Usually, however, the proximity of inductance coils leads to an inductive reaction which will help to set up self-oscillation. Various methods of overcoming this effect have been suggested and will be described later in this article.

Combined Effects

Fig. 7 shows again the typical high-frequency amplifying circuit in which we now find illustrated the three principal causes of self-oscillation in the valve.

These causes comprise the inter-electrode capacity coupling inside the valve, the coil capacity coupling represented by the condenser C_4, and the inductive coupling, which is shown by the dotted arrow-head passing through L_1 and L_2.

Before passing on to the methods of preventing self-oscillation in a high-frequency amplifier, it would be as well to examine another aspect of the conditions under which self-oscillation may occur.

The Tuned or Aperiodic Anode Circuit

We have so far considered the simple circuit where the grid and anode circuits have been tuned to the same wavelength. Under these conditions it has been explained that a valve will tend to oscillate, provided the valve is a sufficiently good amplifier.

We meet, however, with a large number of circuits in which the grid or anode circuits are not tuned. Frequently one of the circuits is tuned and the other is not.

This type of circuit generally has less tendency to produce self-oscillation than a circuit in which

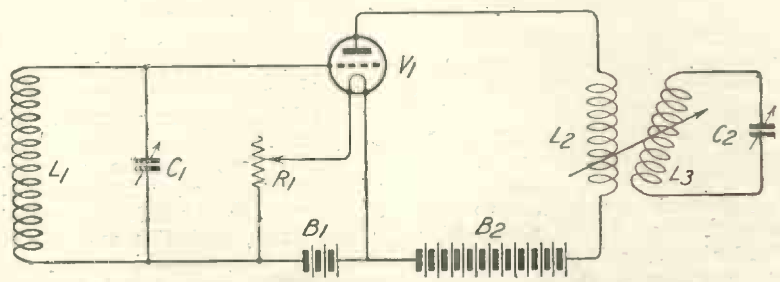


Fig. 10.—Showing variably coupled H.F. transformer, the degree of coupling affecting the tendency of the valve to oscillate.

there is a tuned grid and tuned anode circuit.

We, however, sometimes have a circuit of the kind shown in Fig. 8, which, while not possessing an obviously tuned anode circuit, may, in reality, comprise an equivalent arrangement. In Fig. 8 it will be seen that the anode circuit includes the inductance L_2, which is variable. It will be found that by sliding the contact S from the top to the bottom and measuring the output E.M.F.'s across the used portion of L_2, that, at first, there is, to all intents and purposes, no amplification at all. A point, however, is reached when sufficient inductance is included in the anode circuit of the valve when a very decided amplification is obtained. As the inductance is increased still further, a point of maximum amplification is reached, and after that the amplification falls off a little, although a large amount of inductance may be included in the anode circuit of a valve.

The absence of a condenser across the used portion of L_2 might suggest, to the beginner, that there is no tuning in the anode circuit, of a valve and that the coil was, therefore, aperiodic. This, however, is not strictly true; the used portion of the coil L_2 will really have in parallel with it the self-capacity of the inductance itself, the capacity between anode and filament of the valve, and the capacity of the coil to earth.

Fig. 9 shows the self-capacity of the coil C_2 and the anode to filament capacity C_4. These two capacities assist in producing a tuned anode circuit in which, however, the parallel capacity is very small. If the particular value of the inductance in the anode circuit of a valve is so chosen that what is sometimes known as the natural wavelength of the coil is equal to the wavelength to which the grid circuit is tuned, the valve will tend to oscillate and will probably do so.

If, however, the inductance is increased so that the natural wavelength is higher than the wavelength to which the grid circuit is tuned, the valve will continue to act as a high-frequency amplifier, although there will not be a tendency towards self-oscillation. The so-called aperiodic output coil, in which the only capacities are those just mentioned, does not produce selective amplification, as in the case of the tuned anode circuits. In the latter case, of course, if we increase the wavelength of the tuned anode circuit above that of the grid circuit to any appreciable extent, the valve will cease to function as a high-frequency amplifier, whereas in the case of the Fig. 8 or Fig. 9 circuits, large increases in the anode inductance

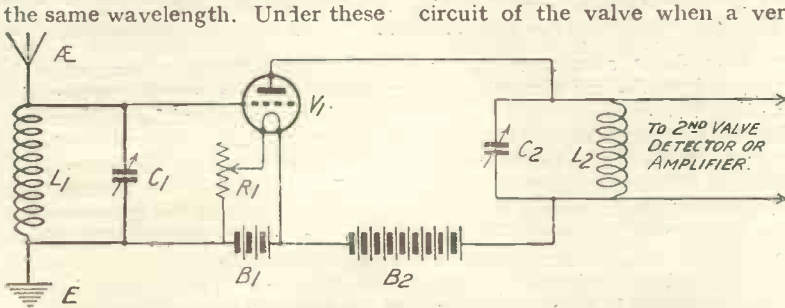


Fig. 11.—A direct coupled aerial circuit, the load of which stabilises the valve.

do not prevent the valve acting as a high-frequency amplifier, and the so-called aperiodic inductance may be used to couple two valves together, although it is true the degree of amplification is not large.

The main point I desire to bring out here is that the fact that there is no variable condenser in the anode circuit of the valve does not mean that there is no tendency for the valve to oscillate—a very commonly experienced phenomenon in connection with the ordinary reaction circuit where an aperiodic reaction coil is coupled to a tuned grid circuit for increasing signal strength. If a certain size of reaction coil is used (round about 100 to 150 turns in the case of the British Broadcasting stations) the coil and the capacities mentioned form an oscillatory circuit which may be tuned to the same wavelength as the grid circuit. Under these conditions the receiver will be difficult to operate and may oscillate without there being any direct magnetic coupling between the reaction coil and the grid coil.

In the case of the high-frequency amplifier where there is a tendency to self-oscillation, it is equally important to avoid self-oscillation due to a so-called aperiodic coil in the anode circuit being actually tuned to the same wavelength as the grid circuit.

When using the Fig. 9 type of circuit and using the inductance L_2 as a means of coupling the valve V_1 to a succeeding valve, it is undesirable to have the coil L_2 smaller than the coil necessary to produce a natural wavelength in the anode circuit equal to the wavelength to which the grid circuit is tuned. It is better to have the coil larger so that the natural wavelength of the anode circuit is greater than the wavelength of the grid circuit. These considerations, however, do not apply in the case where a radio - frequency transformer is used to couple one valve to the next.

The Case of High-Frequency Transformers

High - frequency transformers generally have either the primary or secondary windings tuned, and sometimes both.

If the primary winding, *i.e.*, the one in the anode circuit, is tuned, the valve will have all the same tendency towards self-oscillation as the fundamental tuned anode circuit illustrated in Fig. 1. The same applies in the case where both the primary and secondary windings of the high-frequency transformer are tuned.

While, however, the primary winding is untuned and the secondary is tuned, quite a different state of affairs exist, and this method of coupling is one which can be consequently recommended.

A typical amplifying circuit in which these conditions obtain is illustrated in Fig. 10. We here have in the anode circuit of the valve the primary L_2 of the radio-frequency transformer L_2, L_3. In this circuit the coupling between L_2 and L_3 is variable, and a variable condenser C_2 is connected across the secondary L_3 for the purpose of tuning it.

Let us first consider the state of affairs when L_3 is right away from L_2 and there is no effective coupling between the anode circuit of the valve and the tuned circuit L_3, C_2. The circuit, which now ignores L_3, C_2, resolves itself into the arrangement of Fig. 9, and the same conditions apply. If the coil L_2 is small there will be no tendency whatever for the valve to oscillate; if, however, the coil L_2 is of such particular size that when its own self-capacity and the self-capacity of the valve are acting across it, the wavelength to which it is tuned is equal to the wavelength to which the grid circuit is tuned, then the valve will probably oscillate. If, however, the coil L_2 is made larger than this critical value of inductance, then once again there will be no trouble from self-oscillation of the valve. This point has to be noted in the design of suitable high-frequency transformers.

These transformers may either consist of, say, two honeycomb coils variably coupled, or the commercial article in which the coupling between the two coils is fixed. As the design work in high-frequency transformers has already been performed, the experimenter is not likely to be concerned with the present discussion, except from the technical interest standpoint. If, however, it is proposed to use two honeycomb coils as the transformer, these theoretical considerations have a very practical importance because, if the experimenter uses, say, a No. 100 or 150 plug-in coil as the primary of his high-frequency transformer when receiving stations on the 300 to 500 metre waveband, he may wonder why it is that the valve is so unstable; he will probably find that by using a No. 75 plug-in coil as the primary, his troubles will disappear and the reasons are those here stated.

Assuming, then, that the coil L_2 is not of the critical size, we will proceed to the consideration of what happens when L_3 is brought up close to L_2. No matter how close the coupling between L_3 and L_2, provided the circuit L_3 C_2 is not tuned to the same wavelength as the grid circuit, the valve will not oscillate.

If, however, the circuit L_3 C_2 is kept tuned to the same wavelength as the grid circuit, then, as

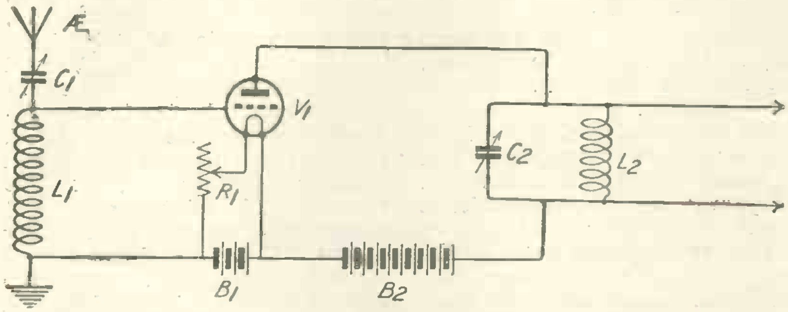


Fig. 12.—Similar direct circuit; less stable than Fig. 11, due to series condenser

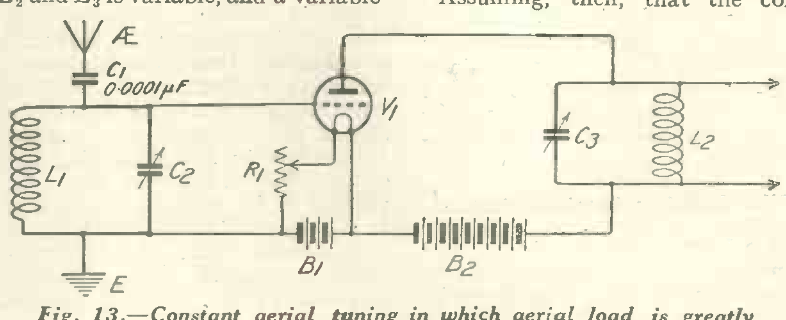


Fig. 13.—Constant aerial tuning in which aerial load is greatly reduced.

L_3 is brought closer to L_2 the tendency to oscillate will increase with the tightness of the coupling. Here again is an effect which many experimenters do not fully appreciate. It is not possible to regard the two windings L_2 and L_3 as entirely separate; it is not possible to say that because the coil L_2 has been so chosen that the valve will not oscillate that the presence of the circuit L_3 C_2 will not alter the condition of affairs.

As a matter of fact, the looser the coupling between L_2 and L_3 the more separate do the two sets of circuits become and the mutual effect is less. On the other hand, the tighter the coupling between L_2 and L_3 the greater will be the effect of the circuit L_3 C_2 on the anode circuit of the valve.

As the coil is brought closer to L_2 the anode circuit of the valve and the circuit L_3 C_2 merge together and the extreme case would be where the coil L_3 was wound directly over the inductance L_2. From an electrical point of view, the two windings might readily be replaced by a single winding which, of course, would result in arriving at a simple tuned anode circuit containing a single inductance and a single variable condenser. As a matter of fact, in actual practice, when L_3 is very tightly coupled to L_2, the whole circuit behaves in a manner very similar to that of Fig. 1, and the tendency to oscillate is almost as great. As, however, we move the coil L_3 gradually away from L_2 the tendency to oscillate becomes less, and this, therefore, affords us an excellent means of controlling the tendency of the valve to oscillate. If there is any tendency for instability, the remedy is to loosen the coupling between L_3 and L_2, and this will effect a cure.

At the same time, unfortunately, the E.M.F.'s established across the circuit L_3 C_2 will decrease. In other words, the amplification effected by the valve diminishes and becomes zero when the coupling between L_2 and L_3 is zero. We are therefore faced with the alternative of a tendency to oscillate and good signal strength or greater stability and weaker signals. It is, however, to be noticed that very frequently if the coupling between L_2 and L_3 is too tight, signals are rather weaker than if the coupling between L_2 and L_3 is a little looser. It will usually be found that there is a certain coupling between L_2 and L_3 which gives the best results; loosening the coupling still further will result in still greater stability but weaker signals.

Overcoming the Tendency to Self-Oscillation in High-Frequency Amplifiers

Self-oscillation in high-frequency amplifying apparatus lends itself to two forms of treatment:—

1. Cure.
2. Prevention.

It is very much easier to cure self-oscillation than to prevent it. The word "cure" in this sense is meant to indicate that self-oscillation troubles are in existence when the circuit is designed, and that some kind of a brake must be put on the circuit to prevent it. By "prevention" I mean the designing of a circuit so that no self-oscillation tendency will arise.

Cure implies that the circuit has to be "tied down" by various expedients, all of which involve energy loss and consequent loss of amplification. Prevention, on the other hand, implies no energy loss but a full development of amplification.

The easiest and most undesirable method of obtaining high-frequency amplification is to take no precautions to avoid self-oscillation and, when the effect is experienced, to introduce energy consuming devices to keep down the oscillations.

Damping Methods and a Common Fallacy

The earliest, and even at the present day, the most popular method of reducing the tendency of a valve amplifier to oscillate, involves the introduction of damping into one or more of the oscillatory circuits.

This, however, is merely a palliative for the trouble, and there is a common fallacy which many believe in connection with this method of obtaining stability. It must first be understood that a valve will oscillate even though the degree of amplification is small, and that, however inefficient the amplification may be, it is nearly always possible, by having suitable coupling between the anode and grid circuits of the valve, to obtain self-oscillation. It is possible, for example, to get self-oscillation when the valve is only giving an amplification of twice, whereas for proper amplification the multiplication should be of from four to seven times, although this is rarely achieved. If, however, the circuits are designed without any regard to the prevention of self-oscillation, the valve will readily oscillate, even though the amplification may be very low. If, now, we introduce damping devices and energy consumers, the degree of amplification will be still lower.

The fallacy is to imagine that because the valve is adjusted to the pre-oscillation point, that a high degree of amplification is being obtained. Nothing is further from the truth, and with a properly designed circuit it is possible to get a higher amplification without the circuit being anywhere near oscillation point than in the case of a poorly designed circuit with the reaction adjusted to the critical value.

Energy consumers in valve amplifying circuits may be compared to the effect of a brake on a high speed motor car. If we desire to obtain a speed of, say, 30 miles per hour with a car, we can either adjust the engine controls, etc., so that normally a speed of 60 miles per hour would be obtained, and then apply brakes to ensure that the speed does not exceed 30 miles per hour, or we can use a lower-powered car without attempting to apply brakes.

An examination of the kind of brakes applied to valve amplifiers will now be made.

Adding Damping to a High-Frequency Amplifier

The application of damping devices to a valve amplifier may involve the introduction of resistances or other energy consumers, or the damping may be introduced in a very natural manner.

This latter method is commonly employed and may consist in suitably adjusting and arranging the aerial circuit of the receiver.

Fig. 11 shows a high-frequency amplifying valve V_1 with its grid circuit included in the aerial circuit. This is commonly known as direct coupling, and by this means the heaviest load is placed on the grid circuit, and if the valve wishes to oscillate, it will not only have to oscillate the grid circuit, but also the whole of the aerial circuit. The valve would find it much harder work to oscillate the whole of the aerial circuit than merely a loose and free tuned grid circuit. A motor generator will tend to run at a much higher speed when there is no load than when a heavy current is being drawn from it. Likewise a valve will tend to oscillate much more readily when there is a minimum of load on the grid and anode circuits.

In Fig. 11 the aerial is tightly coupled to the grid circuit, and therefore the damping of this circuit is greatest.

The tendency to oscillate will be greater the smaller the aerial. Moreover, the smaller the value of C_1 the greater the tendency of the valve to oscillate, and conversely. These facts are vitally important in the design of wireless receivers, and an alteration in the method of aerial tuning will affect the whole stability of a receiver. The best method of tuning to obtain stability is therefore that given in Fig. 11.

Fig. 12 shows the aerial tuned by means of a series variable condenser C_1. This method of tuning involves a smaller load on the grid circuit, which circuit, however, now includes the aerial as an essential part. This circuit will tend to oscillate more readily than that of Fig. 11, and in circuits where it is difficult to obtain sufficient reaction, series tuning will be found beneficial.

Fig. 13 shows my constant aerial tuning method, which consists in connecting a 0.0001 μF fixed condenser in the aerial lead for the purpose of making the receiver substantially independent of the aerial constant. This constant aerial tuning method makes it possible to specify what coil to use to cover a given wavelength range on any aerial, it improves selectivity and makes it easier to obtain reaction.

This last quality is, in the case of a multi-stage high-frequency amplifying system, rather a disadvantage, because it tends to make the first valve unstable. The load on the grid circuit in Fig. 13 is now less than in either Fig. 11 or Fig. 12, and consequently amplification work where there are two or more stages (unless, of course, the circuital arrangements employed are in themselves sufficient to prevent a tendency to self-oscillation).

Fig. 14 shows a loose-coupled arrangement in which the aerial circuit is loosely coupled to a tuned grid circuit. In this circuit the damping of the grid circuit, and therefore the tendency of the valve to oscillate, depends essentially upon the coupling between L_1 and L_2, and the tuning of the aerial and grid circuits. If the coupling between L_1 and L_2 is tight, the load on the grid circuit will be heaviest and the valve will not have the least tendency towards self-oscillation. If, however, L_1 and L_2 are very loosely coupled the grid circuit will be almost free and the valve will readily oscillate. Even though L_1 and L_2 are tightly coupled, a detuning of the aerial circuit L_1 C_1 will be equivalent to moving the aerial coil away from the grid coil because when the aerial circuit is out of tune with the grid circuit the aerial circuit will not absorb energy from the grid circuit and will therefore not have any appreciable damping effect on it.

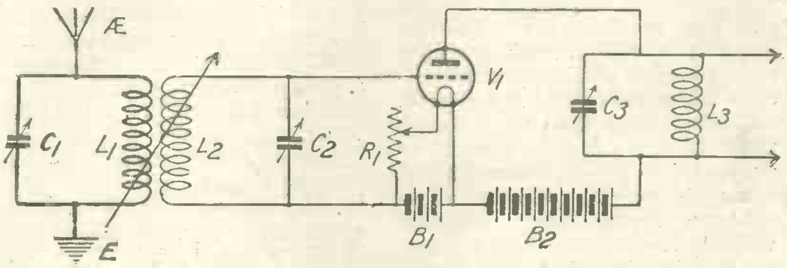


Fig. 14. A loose coupled circuit which will oscillate readily.

The loose coupled arrangement of Fig. 14 is not to be recommended where a number of stages of high-frequency amplification are employed, unless the methods of stopping self-oscillation are perfected.

The conclusions to be drawn from these remarks are to the effect that the Fig. 11 type of aerial tuning is the best for ordinary purposes where there are a plurality of stages of high-frequency amplification.

(*To be continued*).

Amateur Preparation of Galena

By E. J. Williams, B.Sc., F.C.S.

THE preparation of lead sulphide for detector crystals by heating lead with sulphur is not to be recommended since, owing to the volatility of sulphur (boiling point, 444 C), the resulting product is almost certain to contain free lead; if the cat's whisker makes contact with this a short circuit, of course, results.

Experiments recently made by the writer with crystals obtained by re-crystallisation of precipitated lead sulphide have given results at least equal to those obtainable with the best commercial crystals. As the preparation may easily be carried out by anyone having access to a chemical laboratory a brief description of it may prove of interest.

(*a*) Preparation of lead sulphide. (If desired this may be purchased very cheaply from any manufacturing chemist.) The starting point may be either metallic lead, lead carbonite (white lead), litharge, or lead nitrate. A solution of lead nitrate in water is required. This may be prepared from the first three by dissolving them in dilute nitric acid. The acid should be warmed and a large excess of it should be avoided. The liquid is filtered from any solid matter. If, at this stage, a little silver nitrate solution be added, the re-crystallisation of the lead sulphide will be facilitated, since the melting point will be lowered, and also the detecting properties of the crystals will be improved.

Sulphuretted hydrogen gas is now passed slowly through the solution for at least an hour. The length of time depends upon the quantity of lead nitrate used. The sulphuretted hydrogen causes a heavy black precipitate of lead sulphide to fall, together with a little silver sulphide. The precipitate is filtered off and washed with water on the filter paper. It is then dried by exposure to the air, or more rapidly, between folds of filter paper. For the benefit of any desirous of carrying out the preparation at home, it may be stated that sulphuretted hydrogen is prepared by the action of dilute hydrochloric on ferrous sulphide, but he who prepares the gas at home is likely to be unpopular.

(*b*) Re-crystallisation. For this a small porcelain crucible and lid, a "Davies" crucible furnace and a good Bunsen burner are required. The lead sulphide is placed in the crucible and covered with the lid, which must fit well or oxidation will occur yielding other products. The crucible is heated in the furnace as strongly as possible for one and a half to two hours, thus melting the sulphide. It is then gradually allowed to cool by reducing the flame of the burner a little at a time. When the flame is turned out the crucible is left in the furnace until cold. The cooling should occupy at least one hour, preferably longer. The residue will drop out if the crucible is inverted, and the mass may be broken into pieces of a suitable size for mounting.

A Low-Loss Coil Former

By G. P. KENDALL, B.Sc., Staff Editor

Showing how losses previously neglected have an important bearing on short-wave work.

ONE of the most valuable properties of short waves of the order of 100 metres to the experimenter is to be found in their great utility for testing purposes, both in transmission and reception. Losses which are of only small proportions upon the broadcasting wavelengths, and consequently which are difficult to discover and eliminate, may become so pronounced as to be recognised quite easily when the wavelength drops below 200 metres. All sorts of high-frequency losses are usually accentuated by an increase in the frequency of the received oscillations, notably those due to stray capacities. For example, the resistance-capacity method of high-frequency amplification is reasonably efficient on the longer wavelengths, yet, as the frequency increases with reduction of wavelength, the effect of various stray capacities by-passing the H.F. currents which should pass through the coupling resistances becomes so great that when we come down to the broadcast waves little or no amplification is obtained with a resistance amplifier as ordinarily arranged.

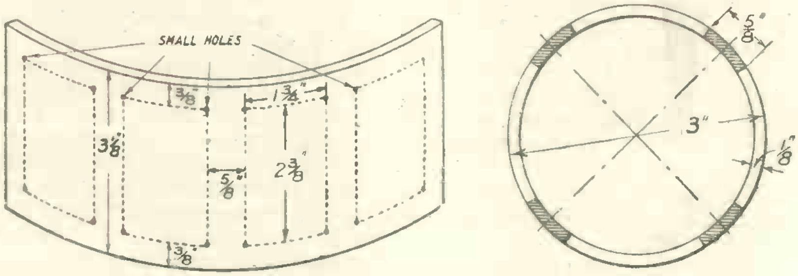


Fig. 1.—Showing ebonite tube drawn as if "opened out" to give dimensions. On the right, an end view.

Resistance Losses

Resistance losses also become more serious, but it is probably in the case of dielectric losses that the effect is most noticeable, and hence the shorter waves are exceedingly useful for carrying out tests upon coil formers, variable condensers and other constituents of the tuned circuits of a receiver.

Such work as I have done in hundred-metre reception has convinced me that the great importance of dielectric losses in the materials used in the construction and mounting of tuning coils has been largely overlooked. An example of the kind of observation leading to such a conclusion will perhaps serve to drive the point home. I used for some time a specially-constructed short-wave receiver (described in *Wireless Weekly*, Vol. iii., No. 9) in which the coils were permanently mounted in the set, so that it was not possible to interchange them. Later, when I desired to try further types of windings I inserted a form of plug-in mounting for the aerial and secondary coils (a form of "aperiodic aerial" circuit was used), and the first experiment was to mount the original coil upon the appropriate plug and replace it in circuit. The effect of the alteration was most marked. The transmission of a certain amateur in the Midlands which I had found of great use for testing on account of its constancy was perceptibly diminished in strength and required a critical adjustment of reaction to produce even readable signals. It did not appear that the loss was due to the shunting across the ends of the coil of the capacity of the plug mounting, since the elements of the plug were well spaced and only a minute alteration in the tuning was observed.

A Strange Case

The plug had been made from an odd piece of $\frac{3}{16}$-in. sheet ebonite of unknown pedigree, and I naturally suspected leakage, but could find no sign of it. (This plug has since been tested upon a megger, and found to be of very fair quality so far as insulation was concerned.) Dielectric loss was therefore suspected, and a new plug was made of ebonite of known quality, with the result that signal strength was *almost* restored to its original value.

If losses at only one point can produce such marked effects as this, it is obvious that where the whole field of a coil is more or less filled with dielectric material the possibilities are serious. Most experimenters who have had much experience of short-wave work are realising the importance of eliminating dielectric material from coil fields as far as possible, and a variety of ingenious methods of supporting and mounting windings have been described in the technical press. Some of these seem to be effective, and some appear to defeat their own end by including such dielectric material as must be used for supporting purposes actually *between* the turns of the winding.

Former Details

The former illustrated in the accompanying photograph represents rather a step in the right

Fig. 2.—The tube after cutting out.

direction than anything for which I should like to claim perfection. It is certainly a highly efficient former, but I do not wish to imply that it could not be improved upon.

The basis is a piece of ebonite tube of the desired dimensions from which four rectangular pieces have been cut with a fret-saw, leaving the skeleton, shown in Fig. 2. The wire is wound round the former in the ordinary manner, taking care to begin and end the winding a little distance from the ends of the former.

Dimensions for a specimen former are given in Fig. 1, the sizes being approximately given (*i.e.* in convenient vulgar fractions). The narrower the four supporting strips of the former the better of course, the only limitation being that if they are reduced too much they lack the necessary stiffness. The tube from which the specimen illustrated was cut was rather unusually thin-walled, and therefore the strips were made fairly wide. If tube with a wall thickness of perhaps ⅛ in. is used the strips can be reduced to about ¼ in. in width with advantage: the width must obviously be adjusted to the thickness of the wall, bearing in mind the necessity of reducing to the absolute minimum the quantity of ebonite remaining in close proximity to the winding.

The diagrams give the necessary data for the marking out of a specimen former suitable for carrying the windings for a primary and secondary for waves of, say, 200 metres, using what is usually called the "aperiodic aerial" circuit. The secondary winding consists of 40 turns of No. 22 d.c.c., left without impregnation of any sort, and upon the top of this the aerial turns, of No. 20 d.c.c., are to be wound. The best number for these varies with local conditions (size of aerial chiefly), and will usually be between five and ten, experiment being necessary in each case.

For use on 100 metres a variable condenser in series in the aerial may be desirable, and the secondary turns should be reduced to 20. The same gauges of wire will serve. In both cases the variable condenser across the secondary should be of the type possessing a really low minimum value, such as the "square-law" pattern.

Formers of this type have proved particularly useful for wave-trap coils, where it is of course essential to cut down all losses to the absolute minimum.

NOTE.—With regard to the author's mention of the great importance of dielectric losses in wave-trap circuits, we would add that a correspondent has just reported that with celluloid and cardboard formers he can only obtain fair elimination of the local station, while signals from distant stations were perceptibly weakened. With a self-supporting coil he obtained complete elimination and an *increase* in strength of the other stations!—ED.

THE JUNE ONE-VALVE RECEIVER

To the Editor of MODERN WIRELESS.

SIR,—Having constructed the single valve receiver, described by Mr. Herbert K. Simpson in the June issue of MODERN WIRELESS, I thought you would care to hear of my results with it. On Monday night or rather Tuesday morning (12-15 a.m.) after the stations had closed down I tuned in 2LO and heard him calling all the B.C.C. stations, heard 6LV answer, 5IT, 5WA, (not so good), 6BM (almost as loud as 2LO); 5NO (very weak). 2LO asked 5NO to "come up a bit, you're very weak" (5SC not readable), and of course 2ZY, who nearly knocked my head off when he replied "Hello London!" This afternoon (Thursday) from 4.30 to 5 p.m., I tuned in 6LV and heard with remarkable clearness an orchestral item, "Fair Spring is Returning," from "Samson and Delilah," followed by a pianoforte solo, and then succeeded by orchestral item, "Softly Awakes My Heart," and the remainder of the programme until 5 p.m., when 6LV closed down. This morning (Thursday) I again got 2LO, but not very strong. It is certainly a wonderful circuit and does more than the author claims for it. I made an alteration by omitting the 'phone condenser, adding a variable grid leak and condenser and a .0003 variable anode condenser. Thanking Mr. Simpson and wishing your journal every success.—Yours truly,

J. E. NEEDHAM.

Blackley, Manchester.

THE CRYSTAL MENACE

To the Editor of MODERN WIRELESS.

SIR,—With reference to your article on "The Crystal Menace," in the July number, for some time I have been experiencing some curious effects. I understand my neighbours, two doors away, have a crystal set. During the programme from 2 LO, I can hear them discussing the various items, and during the "two minutes, please," if I switch on another valve (I normally use two) I can follow their conversation easily. I have been inclined to inform the people concerned, but have been rather dubious as to how they would take it. Another curious point: my next door neighbour has a valve and crystal, and I frequently, through this method of re-radiation, share the joys (?) of searching for a sensitive spot, the grating and "ping" of the catswhisker being distinctly audible. Also, when he lifts the catswhisker my reception improves about 20 per cent. Also when he oscillates the noise is diabolical! I may mention that both these aerials are parallel to and higher than mine. The only remedy, it appears, is to approach them, unless this letter happens to catch their eye, in which case, to spare their blushes, I will ask you to be good enough not to publish my address.

Yours truly,

W. T. BARTHOLOMEW.

Making a Crystal Oscillate

AN INTERESTING NEW LINE OF RESEARCH

CONSIDERABLE interest has been aroused by the announcement in *Wireless Weekly* of successful continuous wave reception by Mr. John Scott-Taggart, with an oscillating crystal, and a brief outline of the circuit and methods employed will doubtless be acceptable.

With the circuit shown in Fig. 1, low-frequency oscillation is fairly easily obtained, but on attempting

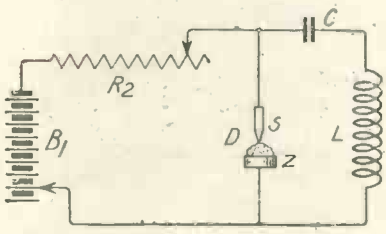


Fig. 1.—The circuit used for producing oscillations.

to produce radio frequency oscillations by the substitution of correct values of inductance and capacity, the crystal shows more reluctance to oscillate. The Fig. 1 circuit may be used for testing crystals, and should be experimented with before attempting actual C.W. reception. D is the crystal oscillator, R_2 is a resistance varying between 600 and 2,000 ohms (a post office resistance box which has a still larger variation of resistance is quite suitable here), while the battery B_1, the *negative* terminal of which is connected to the steel contact of the oscillator, is an ordinary high-tension battery, having as many tappings as possible. The value of the condenser C may lie between 0.2 and 0.5 μF, and the inductance L is a No. 1,250 plug in coil, although results have been obtained with a much smaller coil. To test for low frequency oscillation, telephones are connected across L.

Adjusting the Crystal Contact

A number of zincite crystals should be tried, using a steel or carbon contact, as this combination has proved to be the most efficient, galena crystals being practically useless. Different specimens of zincite will be found to give quite different results, and probably one of three or four tried will be found suitable for the purpose required. A gramophone needle will serve as the steel contact. Adjusting the contact on the crystal is a very difficult operation, entailing care and patience. While the adjustment is being carried out, the other components are best left alone, about 20 volts being taken from the high-tension battery. Having obtained an audible note in the telephones, an attempt may be made to strengthen it by variation of R_2 and B_1, but as the note is usually rather uncertain, it may be lost altogether. It is possible, however, to obtain a quite steady note, and at good strength.

Continuous Wave Reception

Fig. 2 shows the circuit used for continuous wave reception. It will be seen that the right-hand portion of the circuit is an ordinary crystal receiving circuit, the capacity of the variable condenser C_3 being 0.001 μF. D_2 is an ordinary galena type crystal detector. The values of L_1 and L_2, which are variably coupled, will naturally depend upon the wavelength to be received, but L_1 will always be a fairly large coil. Z_1 and Z_2 are radio-chokes, and may conveniently be No. 1,250 plug in coils. Smaller coils may often be substituted, however, and they may sometimes be entirely dispensed with. R_1 is a 300 or 400 ohm potentiometer connected across 3 or 4 volts of the battery B_1 for fine control, and R_2 is a resistance of 800 ohms. C_2 is a 0.001 variable condenser, and for C_1, in parallel with C_2, capacities between 0.001 and 0.005 should be tried.

Operating the Circuit

Telephones should be connected across L_1 to test the circuit first for low-frequency oscillation, C_1 having in this case a capacity of about 0.25 μF. Having obtained a steady note, the telephones should be connected where shown in the diagram, and one of the indicated capacities inserted for C_1. Now by tuning on the condensers C_2 and C_3, and trying different capacities for C_1, it should be possible to pick up a continuous wave Morse signal, the note being varied by adjustment of C_2, this of course providing correct sizes of coils are being used. Failure to receive the desired signals may be due to the oscillator crystal setting having become useless. This latter is the chief difficulty experienced in operating the circuit, for after spending a long time adjusting the crystal, it may immediately cease to oscillate on changing a value in the circuit.

As an experiment the reception of continuous wave telegraphy by means of an oscillating crystal is decidedly interesting, but the fact that it is a very unstable device appears to rule out the possibility of its competing with the three electrode valve.

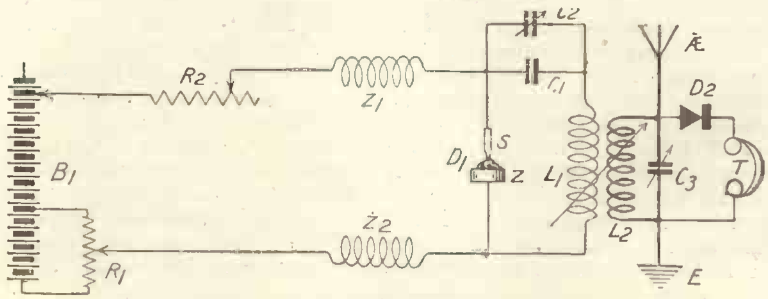
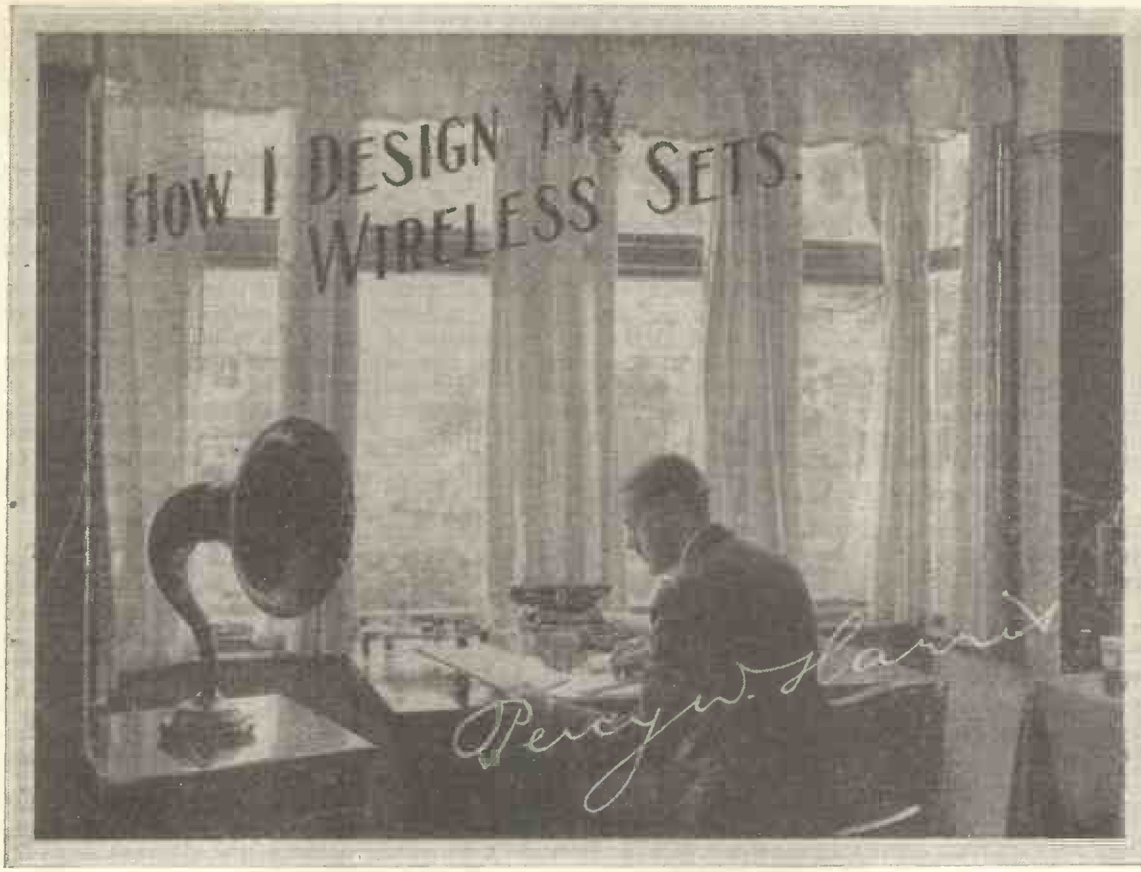


Fig 2.—The actual circuit employed in the experiments.



EVERY month, without an exception, for over a year I have designed and described a new wireless set in these pages, quite apart from a dozen or more similar sets in our companion journal, *Wireless Weekly*. This month, for the purpose of introducing a little variety, I am giving, with some diffidence, a description of the processes involved in the design of a wireless set, in the hope that here and there the reader may find some little hint or tip which may prove useful. Seeing, too, that writers can describe best those things with which they are most intimately acquainted, I hope I shall be pardoned for dealing exclusively with my own work.

The Origin of a Design

How does a design come into being? It is very difficult to say just where it will start. Quite possibly the idea may germinate in a discussion with Mr. Scott-Taggart and the Editorial Staff, or in conversations as to the relative merits of different arrangements. Again, new theories may be put forward and each of us may work them out in his own way. Some new line of research, or the publication of the description of some theoretical work, may suggest a new practical application. Thus in the beginning the scheme exists as a nebulous idea.

For my own part the idea generally begins to take practical shape in those odd moments when the mind is not particularly occupied, such as while shaving or in the train. In such cases a loose-leaf note-book in my hip pocket is useful, and a rough sketch of the circuit may be jotted down for more convenient consideration. As soon as possible after this I choose a quiet evening and sit down at the study desk intent on turning the rough idea into a practical design.

The desk itself is the first of several labour-saving devices used in the production of an article. It is really a business desk with a plain polished top and drawers on each side. The two right-hand drawers contain, respectively, card indexes with tabulated data and a vertical file with a quantity of useful material duly classified in folders. On the left-hand side of the desk are drawers containing squared and plain paper, note-books, etc., while the centre drawer is given up to drawing and measuring instruments.

Gradually the design takes shape on successive sheets of foolscap paper, until a stage is reached when one begins to consider the actual dimensions and practical lay-out. For this large sheets of squared paper are used, so that a full-sized rough drawing may be prepared. The next step is to collect together sundry component parts, which are tried in various relative positions so as to fulfil the threefold purpose of efficiency, compactness and symmetry. In practically all cases I endeavour so to design a set that all of the components shall be supported upon a single panel, and frequently substitutions of parts have to be made in order to arrive at the best arrangements.

New Circuits

If the circuit itself has particular novel features, the component parts are now temporarily wired up on the test table to get some idea of how the arrangement will work out in practice. In circuits utilising high-frequency amplification, and particularly in reflex circuits, actual connections to transformers (which wire shall go to I.P., O.P., etc.) and other considerations are very important. A trial on the test table establishes the best general connections here, although it is not wise to place too much reliance upon results obtained with loosely distributed parts. When, for general purposes, the best connections are established in this way, the components are reassembled on the squared paper and their sizes roughly indicated, together with the positions of terminals.

Design of Wiring

The component parts can now be laid aside until the wiring has been worked out. This is probably more intricate work than the average beginner realises, as the actual disposition of wires is very important. First of all the components are joined up on paper without regard to the disposition of the various wires.

Trimming panel edges.

Marking out.

When preliminary rough drawings have been made the wiring can be greatly simplified by further study. Readers who find wiring diagrams easy to follow and the actual wiring simple are liable to overlook the fact that simplicity is often gained only after much experiment. Dozens of sketches may be prepared at this stage before a satisfactory design is obtained. Even now we cannot say that finality of wiring is reached, for subsequent workshop practice will perhaps indicate modifications.

In the Workshop

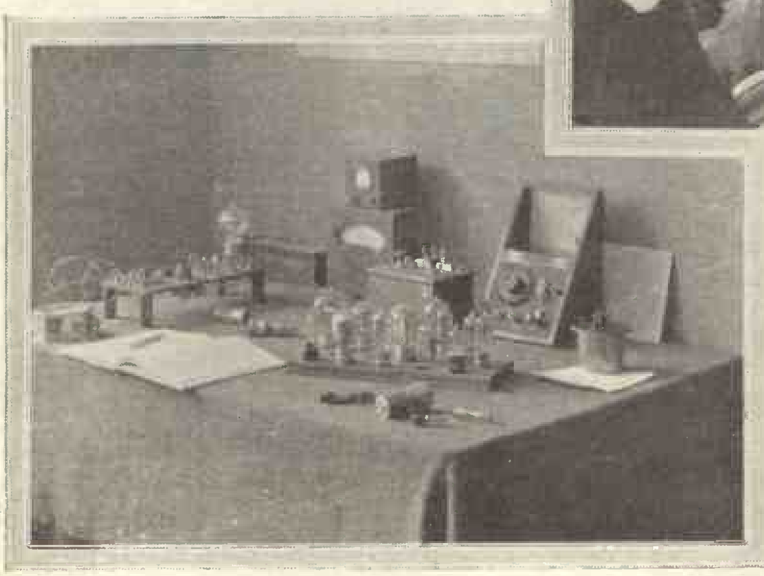
We have now reached a stage when the set really begins to take practical form, and the design must now be continued in the workshop. Here is available a large bench carrying at one end the tool rack and at the other a vice, while along the back are disposed a number of boxes. The first box, nearest to hand, contains centre punches, scribers, screw-drivers and other small tools, while the next holds a small steel rule or two, a micrometer gauge, dividers and other measuring instruments. The third box is given up to special large drills, countersink bits, expanding bits and so forth, while near at hand is a nest of drills of all Morse numbers from 0 to 60. Other boxes contain taps and dies for all B.A. sizes (these are for my own experimental work, as regular readers know that none of my designs contain tapped holes), copper foil, graded mica of two mils thickness (for fixed condensers), and other sundries. The remaining

Using a centre punch for marking the drilling positions.

Final soldering of "Transatlantic V."

requisite tools for wireless work, such as hacksaws, fretsaws, small and large hammers and so forth, are conveniently disposed to hand, while a space at the back of the bench is taken up by a special box containing small compartments for metal screws, nuts, washers, etc., sorted into various B.A. sizes.

Component parts are kept in cupboards and drawers in the study, but raw material, such as sheet ebonite, brass rods, etc., is stored in the workshop. There is also to hand a Drummond 4 in. screw-cutting lathe, a drilling machine, carborundum wheel, etc., for special work. These are not used in the manufacture of Modern Wireless sets, as it is considered that they are not generally available to the average experimenter. Only those tools are used which the average reader is likely to find at hand.



Valve and other testing equipment.

The first step in the workshop is to select from the ebonite stock a piece of a suitable size from which can be cut the panel required (unless, of course, the set is to be made up on a wooden panel, when ¼-in. mahogany is used). On the rough sheet the actual dimensions of the panel are scratched out with a scriber and the panel cut by means of a hacksaw kept for the purpose. Occasionally panels are purchased cut to size, and now that manufacturers are introducing ready-cut and finished panels, I shall probably be doing less panel cutting myself.

At work on the lathe.

The actual cutting up and finishing of a panel takes a considerable proportion of the time needed in making a set, and I am glad to welcome ready-cut panels on the British market.

The next step is to trim the edges of the ebonite in a vice with protecting pieces to prevent injuring the surface, filing the edges first with a rough and then with a smooth file, and finally finishing off with emery cloth slipped over a wooden block. Following this, the positions of the various holes are marked out and the panel drilled. It should be noted that the surface skin is not yet removed from the panel. I recommend that the panel should be marked out with a scriber and steel rule and all drilling done before the surface skin is removed. If this procedure is followed, there is far less likelihood of marking the finished surface of the panel. Lately I have been making increased use of ebonite which is guaranteed free from surface leakage. Unless the ebonite is so guaranteed, it is essential to remove the surface skin.

The only satisfactory way to drill a panel is to mark with intersecting lines the position where the drill-hole is to be made and then to take a centre punch and give it a slight tap with a hammer, making a small depression in the ebonite. The drill point will now rest in this depression and will enable you to drill exactly where you want. If you attempt to drill a hole without such a depression, there are ten chances to one that the drill will enter the panel in a point not exactly where you designed it to go, and the general symmetrical lay-out may be spoiled. If, in addition, the holes have to be made to take parts of a definite size, you may possibly find that the components will not fit.

Dictating the article to the Dictaphone.

The holes are now countersunk to take the countersunk screw-heads, and the various component parts mounted in position. Sometimes, if the set is of a new design, the parts may be quite roughly wired up to see whether there is much interaction between them. Some readers may wonder why I go to the extent of completely drilling the panel and mounting the parts before testing out in this way. The answer is that it is quite impossible to judge what the results will be until you have actually mounted the components on the panel you are to use. In any case, before wiring is commenced, whether for rough or finished wiring, the various parts to be soldered are rubbed with a smooth file so as to expose a bright surface. The soldering equipment consists of an electric soldering iron, the flexible lead from which is plugged into a power point in a convenient spot, a tin of fluxite, and a tin lid containing a mixture of solder and flux. The electric soldering iron takes only a minute or two to heat up, and is, of course, kept clean and ready tinned. A tiny touch of fluxite on every point precedes the tinning of the point, and then with the aid of pliers square section wire is bent to the best shape. The rest of the wiring follows up the method I have so frequently described in previous constructional articles.

Final tests on "Transatlantic V."

Re-Wiring

Almost invariably the wiring will be drastically altered once it has been done, for only in finished wiring can you judge the relative position of leads. As soon as the set appears to be satisfactorily wired, it is taken back to the study.

Preliminary Tests

One large table here is specially devoted to work such as this. It has immediately available leads from high-tension batteries of various voltages, accumulators, and grid-biasing batteries, together with leads from aerial and earth. The set, it must be remembered, at this stage has no box or cabinet and must be suitably supported and connected up. Practical experience with many sets is sufficient to indicate whether it is generally working satisfactorily, although in a number of cases it has to be taken back for some alteration to be made or some component changed. As soon as the set appears to be functioning properly in these preliminary tests, it is carefully tried out on the various B.B.C. and other stations, and notes made of its behaviour. Sometimes, as a result of these preliminary tests, the set is entirely re-designed and built up in a different manner.

Component Tests

So far, you will notice, I have omitted any reference to tests of separate components. Such tests cannot be said to come within the general design of a set, but nevertheless much has to be done in testing and experimenting with various parts. Accurately calibrated apparatus is available for testing such things as the maxima and minima of condensers (some manufacturers of variable condensers have very elastic consciences when stating the capacity claimed).

If the new receiver survives the first tests it is necessary to procure a cabinet. Personally I rather enjoy cabinet work and make a number of my own boxes, but generally readers prefer to buy a ready-made cabinet, finding carpentry too uninteresting. A certain number of sets, therefore, are made up in bought cabinets, which are generally ordered when the panel size has been decided. At times these can be purchased ready made. With the introduction of standard panel sizes, of course, there will be a corresponding increase in standardisation of cabinets.

Final tests are carried out with practically all of the existing makes of valves (both dull and bright emitters) and with different makes of plug-in coils, if this form of tuning inductance is used. Actual tests on the aerial occupy several evenings, for it is always dangerous to draw conclusions from one evening's results only. During the final tests accurate measurements of total filament current, plate current, best grid voltage for amplifying valves, potentiometer adjustments, and so forth, are carried out under full practical working conditions, and finally the set is considered ready for description in MODERN WIRELESS. The preparation of the article takes place at the desk where the design originated. In actual practice it is entirely dictated to the Dictaphone with the actual set at hand, together with the test figures which have been prepared during the preliminary and final tests. In this way one has to draw on the memory for nothing. The actual set is there, test figures are immediately available, and as the set is, so to speak, "hot from the workshop," all salient points and matters of possible difficulty are quite obvious at the time. A final dusting of the panel with a dusting brush, a rub over the cabinet with a polishing cloth, and the set is ready to take to Devereux Court, where the chief draughtsman and his staff are awaiting its arrival. With the set in front of them, the working drawings are prepared, while the typist is transcribing from the reproducing Dictaphone. Corrected manuscript is sent to the printer, drawings are handed to the process engravers, and in due course the proof sheets are ready. These, together with the diagrams, are triple-checked by members of the Editorial Staff, while the full-sized wiring diagram is despatched to the makers of blue prints. Within a week or so MODERN WIRELESS appears on the bookstalls and you will find a new "how to make" article.

Meanwhile a lone passenger may be seen in the corner of a carriage on the "Wimbledon non-stop" District train describing hieroglyphics with a pencil on a sheet of his loose-leaf pocket-book. Next month's design is well on the way!

PHOTOGRAPHIC RECORDING

The recording of wireless signals at high speeds is one of the problems of long-distance commercial wireless work. This photograph shows the photographic recording apparatus in use at a great French wireless station.

A Three-Slide-Tuner Crystal Set

Although the slider type of tuner is very little used to-day, it is still a most interesting device for the beginner.

An idea of the size of the finished set may be gathered from this photograph.

FOR crystal reception a simple form of inductance to use is that which takes the form of a solenoid, tuning being effected by means of a slider or sliders. By this means greater selectivity is obtainable than with a single coil, or variometer, as, when two sliders, one for aerial and one for earth, are used, the effect is obtained of having two tuned circuits coupled closely together. An additional refinement is added by having another slider connected to the crystal detector, instead of the latter being connected directly to the aerial end of the coil. This will be better understood by reference to the circuit, diagram Fig. 1. The aerial lead Æ is joined directly to the slider S_1, while the earth is connected to the slider S_3. One tag of the telephone receivers TEL is joined to the lower end of the inductance coil L_1, the other being connected to the cat-whisker of the crystal detector D, while the crystal cup is joined to the slider S_2. The tuned circuits are then (*a*) aerial, slider S_1, coil, slider S_3, earth; and (*b*) slider S_2, coil, this circuit being completed through the receivers and crystal detector. These two circuits are tightly coupled together, and thus the best signal strength is obtained, while the effect of having coupled circuits is valuable where interference is experienced.

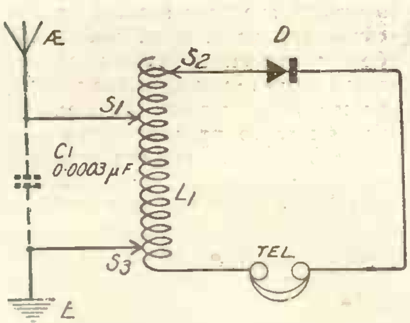


Fig. 1.—Showing the circuit of the receiver.

The Longer Wave

Provision is made in this set, a photograph of which is seen in Fig. 4, for reception of programmes transmitted by the long-wave broadcasting station. The inductance coil incorporated in the set is quite large enough, with the small condenser provided, to tune to the wavelength of this station. By a movement of the sliders, therefore, the constructor of this crystal receiver will be able to change from the programme of his local station to that of the high-power one, always provided, of course, that he is within crystal range of the latter station.

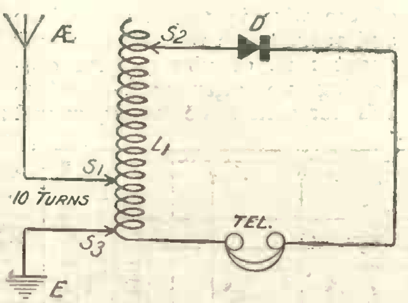


Fig. 2.—Showing how a form of aperiodic aerial coupling may be used.

Other very interesting circuits may be obtained on this set by making one or two very slight alterations to the wiring.

Aperiodic Aerial Circuit

The slider S_1 is brought near to S_3, with the earth slider S_3 near the lower end of the coil, so as to include about 10 turns or so of the coil. This may be left constant, and tuning effected by variation of the position of the slider S_2. This circuit, which is shown in the diagram Fig. 2, will give a fair degree of selectivity with great ease of tuning, as it is practically equivalent to a coupled circuit.

A Simple Circuit

An even simpler circuit may be obtained by joining the sliders S_1 and S_2 together, S_2 being left at the extreme left-hand end of the coil. The slider S_3 is left in position at the extreme right-hand end of the coil, and tuning is carried out by varying the position of S_1. This gives an exceedingly simple set, but will not be found very selective. The turns of the coil not in use are short-circuited, thereby eliminating a certain amount of dead-end loss. The connection between the sliders S_1 and S_2 is most easily accomplished by joining

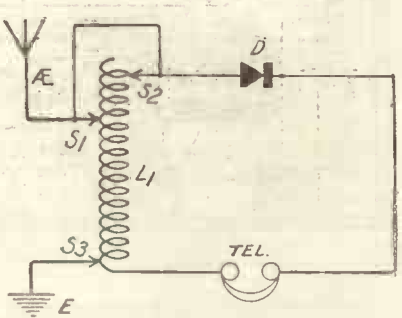


Fig. 3.—A simple circuit which may be tried by joining the sliders S_1 and S_3 together.

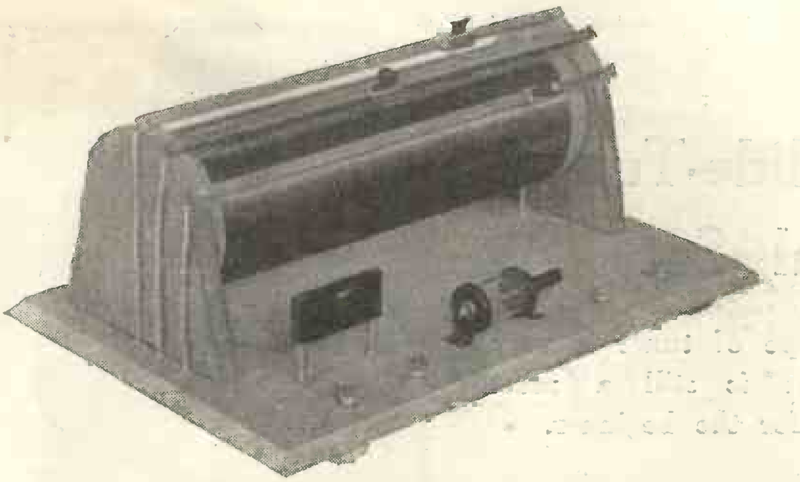


Fig. 4.—The completed crystal receiver.

terminal A to the crystal cup. A diagram of this circuit is seen in Fig. 3.

Parts Required

The parts required are listed below, and will be found inexpensive to buy, but do not buy shoddy material because it is cheaper. The best always pays in the end.

Wooden base, 10 in. by 15 in. by ⅜ in.

2 pieces of wood, ½ in. thick, shaped as shown in Fig. 6, to support the coil.

Cardboard tube, 12 in. long, 3½ in. diameter.

Quantity of No. 22 S.W.G. enamelled wire (about 1 lb. will be required).

3 brass rods, 13 in. long, ¼ in. square, with sliders.

1 crystal detector (Burndept, Ltd.).

1 0.0003 μF condenser, plug-in type (Peto-Scott Co.).

2 valve legs, into which the condenser plugs.

4 terminals.

About 1 yard of Systoflex sleeving.

Winding the Coil

The cardboard tube should fir t of all be thoroughly baked to drive out any moisture it may contain. About ½ in. from each end make two holes with a small drill or a large needle. Commence winding by threading the beginning of the wire in through one hole and out through the other, leaving about 1 ft. of wire free for connecting up afterwards. The coil may now be easily wound by rotating the cardboard tube in the hand and feeding the wire into position, keeping an even tension on the feed wire in order that an even winding may result. A little patience is all that is necessary, and a good, workmanlike coil will be produced. The end of the winding is secured in the same manner as the commencement, by threading through the two holes, leaving, in this case, no free length of wire.

The coil may now be laid aside while the supports and base are prepared. The diagram, Fig. 6, shows the shape and size of the supports, which are cut from wood ½ in. in thickness. A small piece of ½ in. wood, 1 in. wide, is secured, as shown, to each support, to which the cardboard tube is fixed. The base may be prepared from ⅜ in. thick wood, and has the holes drilled in it as shown in Fig. 5, which is a plan view looking down on to the top of the baseboard; the wiring is seen dotted; thus the diagram acts as a combined drilling and wiring figure. The chamfered edge of the baseboard may present some difficulty to the constructor, and may, of course, be omitted, the edges of the board being merely rounded off slightly. The coil cheeks or supports are then secured to the cardboard tube, upon which the coil is wound, by means of two wood screws in each end, a washer being placed under the head of the screw to prevent damage to the cardboard. Having mounted up the coil in this way, place it in position upon the base with the free end of the winding to the right of the base, and mark round the edges of the supporting pieces with a pencil. Now remove the coil, and note that the screw holes in the base are not too close to the edge of the supporting pieces.

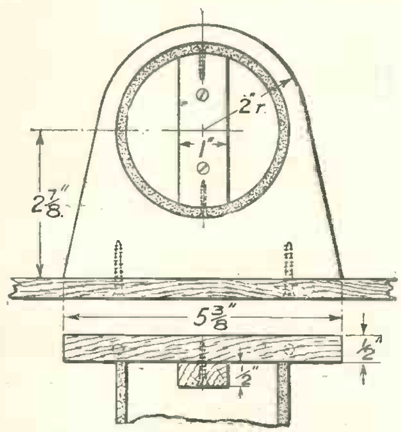


Fig. 6.—Showing the shape and size of the coil supports.

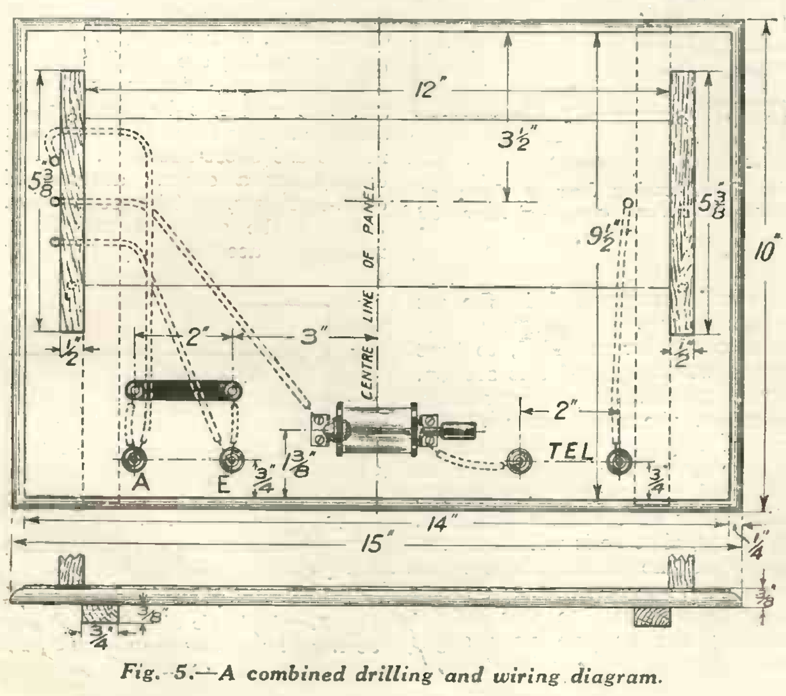


Fig. 5.—A combined drilling and wiring diagram.

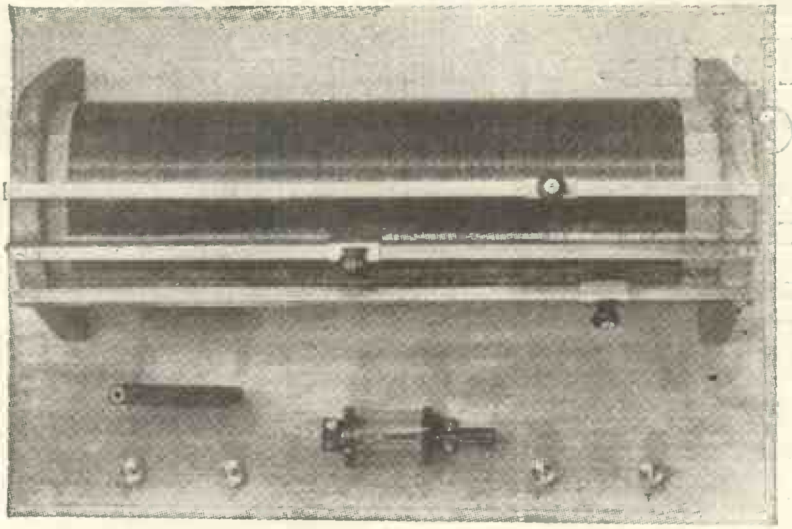


Fig. 7.—Another view of the set, showing the positions of the sliders.

This being confirmed, the supports are fixed to the base by two wood screws, about 1 in. long, in each end, the screws being passed through the base from underneath. Two strips of wood about ½ in. thick by about 1 in. wide are tacked underneath the base board, in order to give a clearance to the wiring, terminals, etc., which are under the board.

The crystal detector, terminals and the two sockets for the condenser are then mounted up, and the various points joined. The free end of the coil winding, which was left over, is covered with a length of Systoflex tubing, and is passed through the panel and joined to the right-hand telephone terminal, the left-hand terminal of the telephones being joined to the cat-whisker of the crystal detector.

The three sliders may now be placed in position, as seen in the photograph, and secured by wood screws about ½ in. long. The slider on the top of the coil, marked A, is joined by a piece of wire covered with Systoflex to the terminal marked A on the extreme left of the set, and also to the left-hand socket of the condenser. The middle slider, marked DET, is connected in the same manner to the crystal cup, while the third slider, marked E, is joined to the remaining terminal and socket. The wires from the sliders pass through holes in the base close to the left-hand coil support, this being the end remote from that of the coil which is joined to the telephones.

Testing the Set

When completed, the receiver may be tried out. Join up the aerial to the left-hand terminal, and the earth to that immediately to its right. The telephone receivers are connected to the two right-hand terminals.

For the shorter broadcast wavelengths the fixed condenser may be removed from its socket. Move each slider up and down the coil several times in order to free the wire of enamel along their tracks, finishing off, if necessary, with a penknife or a small piece of emery cloth.

To commence testing, set the "earth" slider E at the right-hand end of the coil, and, keeping the DET slider above the aerial slider, tune on the latter until signals are heard. Slight adjustment of each may result in increased signal strength, and a final touch should be given to the crystal detector.

Results Obtained

Using this receiver at about twelve miles from 2LO, signals were so strong in the telephones that slight detuning was necessary in order that discomfort should be avoided. The test transmissions from 5XX were received at very good strength, the distance being about 36 miles.

The September Double Number of "Modern Wireless" will be the Finest Constructional Issue yet published

The Puriflex. "Amazing Purity."

To the Editor of MODERN WIRELESS.

SIR,—Congratulations on having evolved the ideal loud-speaker set. Before we read of this excellent circuit we were always dissatisfied with the quality of our loud-speaker reception. Now we seem to be actually present in the theatre or opera house, so faithfully is every word and note reproduced.

With such a set there can be no possible chance of distortion, such as is often present when L.F. transformers are used. There will be many wireless enthusiasts who will take their "Puriflex" away with them this summer to astonish their friends with its amazing purity. There will be no more complaints of So-and-So's wireless gramophone! As you say, it is just the set for out-of-door use on a motor or caravan.

It is even better than the well-known "All Concert" receiver, about which I wrote to you a short time ago.

Yours truly,
G. J. MARCUS.

Sutton, Surrey.

"Cowper" Sets and Sharp Tuning.

To the Editor MODERN WIRELESS.

SIR,—I have constructed the Auto-transformer crystal receiver which you described in No. 6 of MODERN WIRELESS, and also the Neutrodyne Dual Set in No. 7. I feel that thanks and a report are due to you.

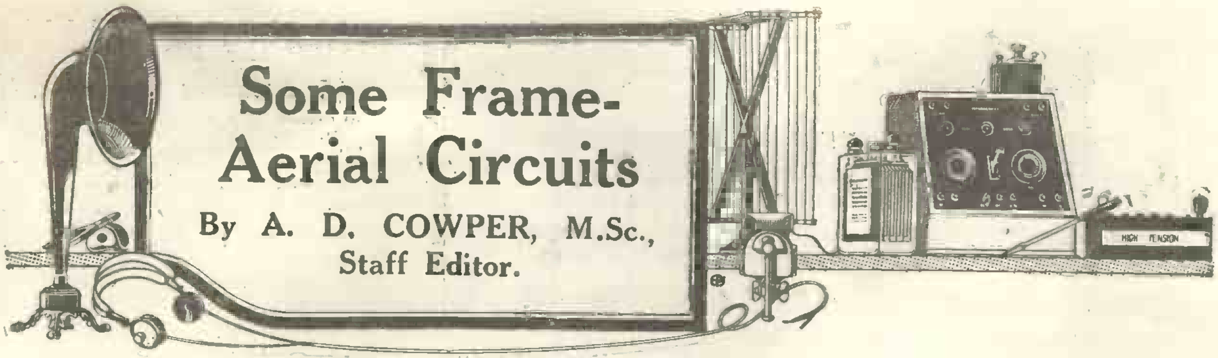
The crystal set is by far the best of many I have tried. It received Manchester (40 miles away) on an indoor aerial.

For the dual circuit I used a Wecovalve and zincite-bornite detector, otherwise it is according to your specification. I get Manchester on the indoor aerial quite strongly enough for three pairs of telephones and the reception is distortionless. On certain nights I get Bournemouth and London direct, and am able to tune Manchester out, which latter is a difficult thing to do here.

I am exceedingly pleased with both receivers and thank you heartily.

Yours truly,
G. R. HILL.

Liverpool.



Some Frame-Aerial Circuits

By A. D. COWPER, M.Sc., Staff Editor.

WHILST it is always advisable to use the best possible aerial that can be erected under the particular circumstances, there are occasions when a frame-aerial is actually the best available, as in the case of really portable sets, and for those whose accommodation is greatly limited.

The limited power available with a small in-door frame-aerial, even for local broadcast reception, involves the use of a sensitive circuit, with extremely finely controlled reaction; and if possible the dual amplification principle, so that a stage of H.F. amplification is possible before detection. The time has passed when we were glibly told that six valves were necessary for successful frame-aerial reception, it has been shown in innumerable cases that, given a fairly favourable environment and efficient apparatus, at least two of the broadcast stations should be readable on a two-foot frame with one valve.

The circuits described here were inspired by an exceedingly interesting account in a contemporary by Messrs. Medlam and Schwald of the effect of using a tapping-point for "earth" connection in a frame-aerial circuit—with quantitative measurements, a paper which was a model of how such pieces of investigation should be done, to have any scientific value. These authors found, by means of actual measurement of signal-voltage, a very decided increase in efficiency by using a middle tapping in the frame-aerial for connection to the valve filament; and that then the tuning could be done by a single condenser right across the whole inductance, after the style of certain transmitter circuits. After the experimental work, the results of which are given here, was finished, an article appeared in the same contemporary by Mr. Reyner, showing the use of the Reinartz type of reaction with a frame-aerial, in straight and dual circuits, but with a separate reaction-coil coupled magnetically with a small coil in series with the actual frame. The writer's aim was to use the principle of the tapped aerial, after Messrs. Medlam and Schwald's circuit, but applying Reinartz reaction to the circuit by using the free half of the frame as a Reinartz reaction coil: getting back, in fact, to a transmitting circuit of well-known type, but using the whole inductance for the frame-aerial itself.

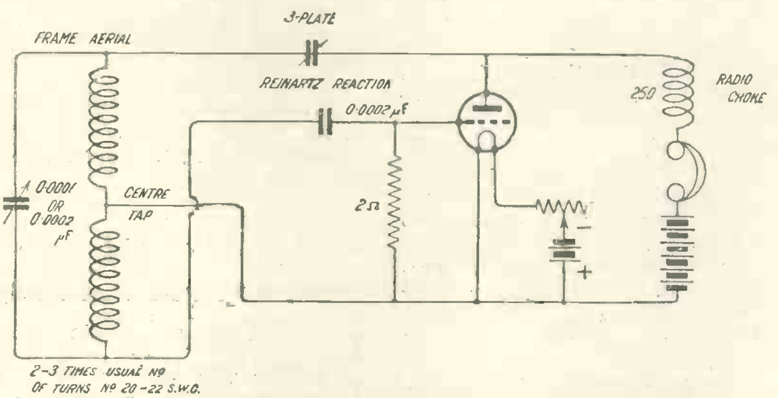


Fig. 1.—A straight frame aerial circuit: Transmitter type.

Fig. 1 indicates the circuit resulting, which is undoubtedly the most powerful and easiest-controlled single-valve straight circuit with which the writer has experimented. Transmitters will recognise the close resemblance to a simple C.W. transmitting circuit. As this mode of connection has the effect of minimising casual capacities, an exceedingly small tuning condenser across the frame will cover a large range of wave-length. A low-minimum .0001 μF (such as the Jackson Bros. old type with ebonite end-pieces) will cover the whole broadcast belt with a frame aerial 2 ft. square with about 25 turns of No. 20 or 22 spaced at 1/4 in., and with a centre tapping for the filament connection. The tapping-point need not be exactly at the centre; there is no particular advantage in placing it much to one side or the other of the centre. On account of the powerful reaction-effect given by this type of circuit the controlling Reinartz reaction-condenser *must*

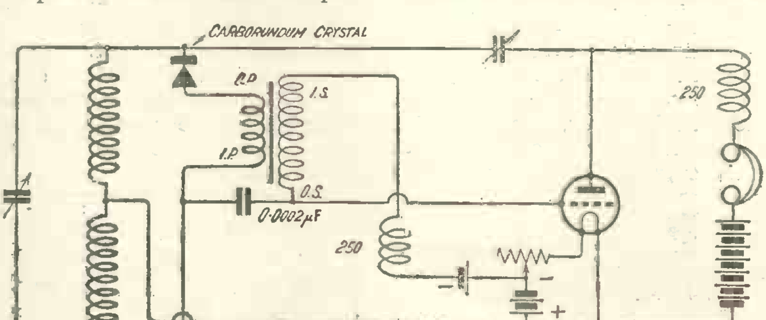


Fig. 2.—A dual circuit with two radio-chokes.

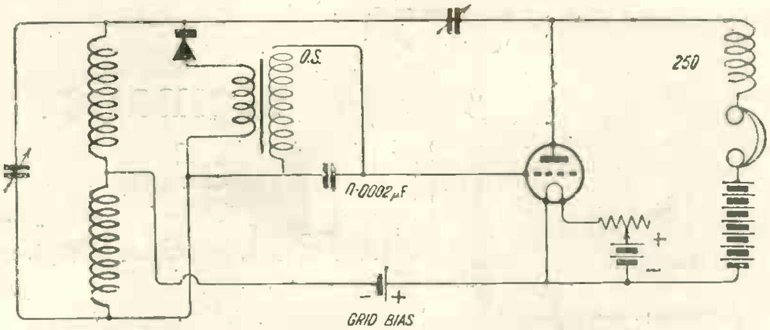


Fig. 3.—An alternative to Fig. 2, eliminating one of the radio-chokes.

be very small and of extremely low minimum capacity. Even some three-plate "vernier" condensers, especially some with metal end-plates and small insulating bushes, have so high a minimum capacity that the circuit will oscillate hopelessly with them. With a liberal valve, a two-plate condenser made up with the usual plates and spindle, with ample clearance, will often suffice.

With this circuit, an R valve and moderate H.T. supply, the local station is read at a dozen miles at comfortable phone strength. Hand capacity effects are marked, of course, so that long tuning handles are called for; and the frame aerial should be mounted well away from the experimenter, as otherwise his movements in its proximity will interfere with the tuning. The reaction-control is wonderfully smooth. Stations at 100 miles, as well as local 10-watters, can be read in a favourable location. The radio-choke is the customary coil of about 200-300 turns of any convenient size and build, but of fairly low distributed capacity.

Developing this into a dual circuit, of the general type already described by the writer for an Ultraudion circuit, we get Fig. 2. As there is plenty of power available now, and stability is all important, the writer prefers to use the reliable and trouble-proof carborundum crystal, without potentiometer. With a Pye No. 1 L.F. transformer, which operates exceedingly well in such circuits and gives an unusually high step-up effect, the connections should be made as shown, the crystal being next to the O.P. and the contact spring (the writer uses a plain piece of tinned iron: "tin") next to the reaction condenser end of the frame. As the transformer has an H.F. potential relative to earth, it should be well insulated; the connection via a grid-bias cell being taken to the lowest point of the L.T. through a radio-choke of the same type as that used in the plate-circuit. This can be avoided by making the slight modification indicated in Fig. 3—which suggests dimly certain American dual circuit arrangements. Both of these give most excellent reception of local broadcasting in an outer suburb, with careful tuning, and are easily controlled. Distant stations can be read at comfortable strength, searching in the dual arrangement being unusually easy.

Loud-speaker reception in the vicinity of the local station is given by No. 4, where a stage of power amplification is provided, with extra H.T. and proper grid-bias on each valve. The connections are indicated for the Pye No. 1 first stage transformer, and the second-stage for the R.I. or those similarly marked. It would be well to try the effect of "ringing the changes" on these connections with other makes of transformers. As different grid-bias will be needed on the two valves, the No. 2 circuit is used for the first valve. As indicated, excellent loud-speaking is reached with this circuit up to a dozen miles, using a good R valve and an L.S. or small power valve, and 100-300 volts H.T. on the plate of the second valve.

The same general principle has been applied by the writer to an Armstrong single-valve super or "flivver" circuit with admirable results. Tuning for wave-length was fine, but the range for a particular frame-aerial without variable tappings was unusually great, while signal-strength was satisfactory on a very small frame, several of the distant B.B.C. stations being easily readable under favourable circumstances; and longer wave telephony was picked up clearly on the third harmonic.

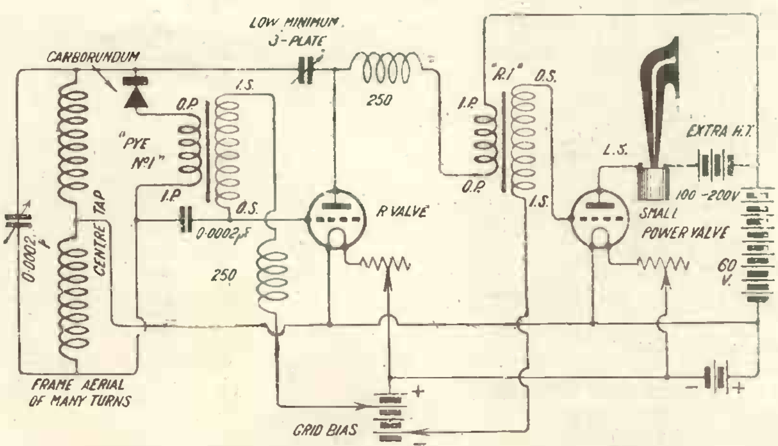


Fig. 4.—A two-valve circuit, dual amplification and power amplification, for loud speaker.

The Three-Valve Dual

To the Editor of MODERN WIRELESS.

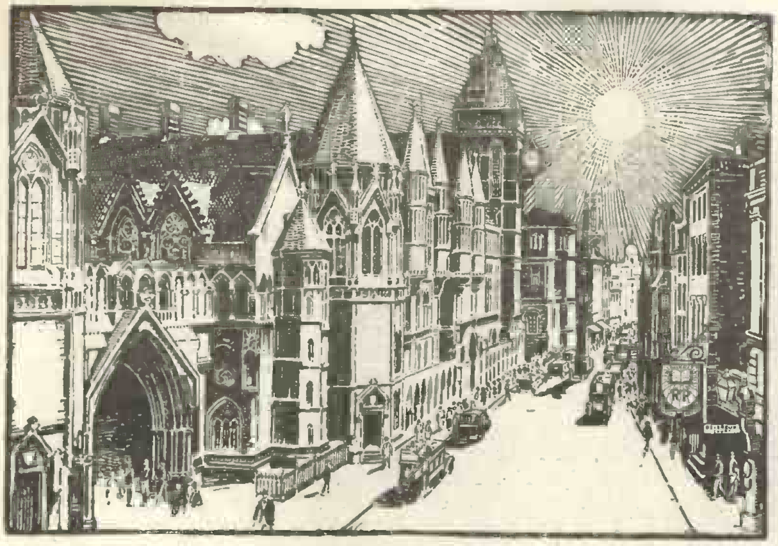
SIR,—Just four weeks ago a friend of mine accidently left a copy of MODERN WIRELESS on my room table; it was the April issue. Being an ex-operator I picked the book up not a little critically, and I became interested in the 3-valve Dual Set. After a little consideration I decided to try it.

Well, I wish you to accept my congratulations. The performance is excellent. All stations come in first-class, except Cardiff, and this is subject to fading.

Paris and Brussels give strength nearly equal to Manchester.

I have placed an order with my newsagent for a copy of your very interesting magazine. — Yours sincerely,

Leeds. J. E. GOODWIN.



A Romance of Fleet Street

By

ERNEST R. GILBERT

Some intimate details of the work and development of Radio Press, Limited, in which all supporters of R.P. publications will be interested.

FLEET STREET has earned the traditional title of "The Street of Adventure." One of the shortest streets in London, stretching only from Ludgate Circus to the Royal Courts of Justice, this thoroughfare has witnessed the rise and fall of many great newspaper houses and publishers. Unimpressive as are nearly all the buildings, nevertheless fortunes have been made—and lost—in these precincts.

At the extreme end of Fleet Street stand the chambers of the leading counsel of the day. Directly opposite the Law Courts a passage, bearing the name of Devereux Court, leads into the heart of the legal world.

The buildings in this quarter are hundreds of years old, and there are an old-world charm and an air of romance which relieve the severity of the architecture.

In these parts the Knights-Templars of old had their headquarters, and many a Crusade to the Holy Land was launched from this quarter. Students of the law, however, soon began to congregate around what is now known as the Temple, and to-day practically the whole area is occupied by the dingy chambers of barristers and judges of the High Court.

In this atmosphere of law, exactitude and responsibility, we find the House of Radio Press. From a publishing point of view. Devereux Court was a happy choice The building occupied by Radio Press, Limited, is ideally situated with regard to the great wholesale and distributing houses which supply bookstalls, newsagents and booksellers throughout the Kingdom. Where time is so essential, a convenient location is vital, and here the various printing works which produce the various publications, as well as the wholesale distributing centres, are all within a very short radius.

The Radio Press have declared that they are the largest wireless publishers in the world, and no denial of this has been, or will be, forthcoming. I remember when their first activities commenced

El Circuito Reinartz modificado

Pergi W. Harris A. E. of «Modern Wireless»

...CCION DE A. MEDINA Y GOMEZ

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... partes del circuito
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En Hilsen fra S. T.

Englands mest populære Radioexpert John Scott Taggart, som gennem sine mesterligt ledede Radiomagasiner »Modern Wireless« og »Wireless Weekly« har gjort sit Navn kendt i alle Lande hvor der findes Radioamatører, sender idag — gennem »Radio« Maaneds-Magasin — de danske Radioamatører.

...est doubt, the
larise this most in
success it do...

RADIO MAANEDS-MAGASIN

Hvorledes jeg opfandt Audionen.

Af Dr. Lee de Forest

„Wireless Weekly"

Denne overordentlig interessante Artikel om Opfindelsen og den første Udførelse af den moderne Audion-Lampe er skrevet af den store Opfinder selv og vil blive fulgt med Interesse af vore Læsere.

tin-Elektroder, der blev holdt ganske i den i Flammen, forbundet med et udvendig løb bestaaende af et Batteri paa 18 Volt mindelig Høretelefon.

Fra Begyndelsen var jeg opfyldt af T... opdage et Detektor-Relais i hvilket En...

El circuito S. T. 100

LUIS M. DE PALACIO

Ninguno de los circuitos modernos de recepción, ha tenido una acogida tan entusiasta y una tan rápida aceptación entre los aficionados ingleses como el S. T. 100 de John Scott-Taggart.

Cuando una novedad se ime...

con todos sus sim...
o super. P...
se di...

北京前門內西
城根十號
郭孝志先生

A few indications of the foreign influence of "Wireless Weekly" and "Modern Wireless."

only two and a half years ago, and I have watched with interest, not unmingled with wonder, the ever widening influence of this concern. Radio Press are the proprietors and publishers of this magazine, MODERN WIRELESS, and of the equally successful paper, WIRELESS WEEKLY, and of a large number of non-periodical publications, including books, Envelopes, etc.

I have had the privilege of an examination into the extraordinarily large amount of business carried on by Radio Press, not only in this country but in all parts of the world, and familiar as I was with the outward influence of their publications, I had not hitherto appreciated the magnitude of the operations carried out by this company.

Sooner or later every single listener and experimenter in the country comes under the influence of the Radio Press. When he first becomes interested the wireless enthusiast in embryo probably picks up the first of the Radio Press series of handbooks. A quarter of a million are known by the publishers through their sales-figures to have started the wireless ladder by mounting the first step of the Radio Press series. Of this number a large proportion continue to improve their knowledge by passing from book to book and then on to the periodicals. I could not help realising, perhaps for the first time, the great influence which this publishing house exercises through its book business. The advice on design, the advice on apparatus, the advice on the home constructing of sets, and the advice on all allied matters carries weight in every section of the country. The words WIRELESS WEEKLY and MODERN WIRELESS, and the recurrent appearance of these popular journals, produce an infinitely greater impression on the mind of the outsider than that produced by books, Envelopes and other non-periodical publications.

Nevertheless, the sales of these latter publications are so great, and so many thousands of sets are constructed and circuits made up from these publications, that wireless men, generally, whether professional or amateur, cannot ignore the unquestionable fact that the Radio Press influence through their b k sales is directly exercised over a number of enthusiasts which exceeds at least four times that of the combined circulations of WIRELESS WEEKLY and MODERN WIRELESS, large as they are.

This places the House of Radio Press in a position of power and influence which cannot be approached by any other publishing establishment. There are many wireless constructors in the country who take no technical paper at all, but who buy books at intervals, and this mass of the public is reached by the Radio Press where it is not reached at all, or only reached to a much smaller extent, by any other organisation concerned with the technically interested section of the wireless public.

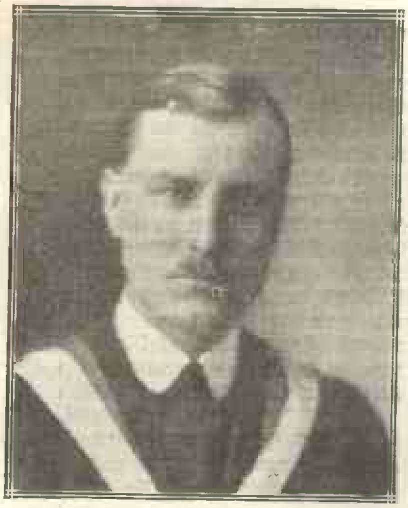
That this power and influence have been used for the benefit of the wireless public and the wireless industry, in a fair and impartial manner, can be denied by none. The House has, in an unostentatious manner, been a leading influence in the placing of the wireless industry on an unassailable basis. By the closest co-operation between publishers and responsible members of the industry, the manufacturer of shoddy apparatus is being rapidly thrust out of business. By a rigid exclusion of doubtful advertisements from the pages of its publications the House of Radio Press has helped, first, its readers, and, secondly, the industry as a whole.

John Scott-Taggart, F.Inst.P., A.M.I.E.E., Managing Director, Radio Press Limited.

I have expressed astonishment at certain of the extremely candid criticisms of apparatus submitted for test. The reports published are sometimes startling in their frankness, and the publishers make no secret of the fact that much advertisement business is lost in doing what would completely counteract the effect of any advertisement. They believe, and, if I may say so, rightly, that their prestige depends upon serving their readers, who place great faith in their judgment in these matters, and who know that they have never yet been let down. Frequently new products of valued advertisers come in for severe criticism, and the fearlessness and impartiality of the reports, published quite regardless of consequences, have become widely known and respected.

On inquiry as to the financial interests in the business, I was informed that not a penny piece of the capital is in the hands of anyone connected in any manner whatsoever with the wireless industry. This fact, coupled with the further fact that the Radio Press confines itself exclusively to the publication of wireless literature, may be one of the reasons for the success of this concern.

Of the members of the staff I need say little because they are all well-known to readers. The



A. D. Cowper, B.Sc. (London), M.Sc.

whole business and editorial control of Radio Press is in the hands of Mr. John Scott-Taggart, F.Inst.P., A.M.I.E.E. When I asked him the other day when he first took an interest in wireless, he said that he attended his first lecture at the age of five, and I was also interested to learn that the first wireless article he wrote was published when he was fourteen years of age. He also edited a "paper" at the age of nine, but the circulation was only 1/10,000th of that of MODERN WIRELESS; there was, however, a profit of 2½d. per week!

The Radio Press has a unique advantage in having at its head a professional radio engineer, instead of a purely business organiser. His enthusiasm for his work is equalled by that of his staff, and his choice of colleagues has been a most happy one. Each is more or

R. W. Hallows, M.A.

G. P. Kendall, B.Sc.

E. H. Chapman, M.A., D.Sc.

E. Redpath.

Percy W. Harris.

less an expert in certain branches of the work. Each member of the staff, however, has a very intimate knowledge, not only of general experimenting and constructional work, but of the difficulties and problems encountered by the average "radioist."

If I were asked what are the pervading ideals in the organisation, I would suggest that they were a desire always to act so as to gain the confidence of readers, to criticise fearlessly but in a sane and fair manner and to develop new ideas and inventions for the benefit of experimenters.

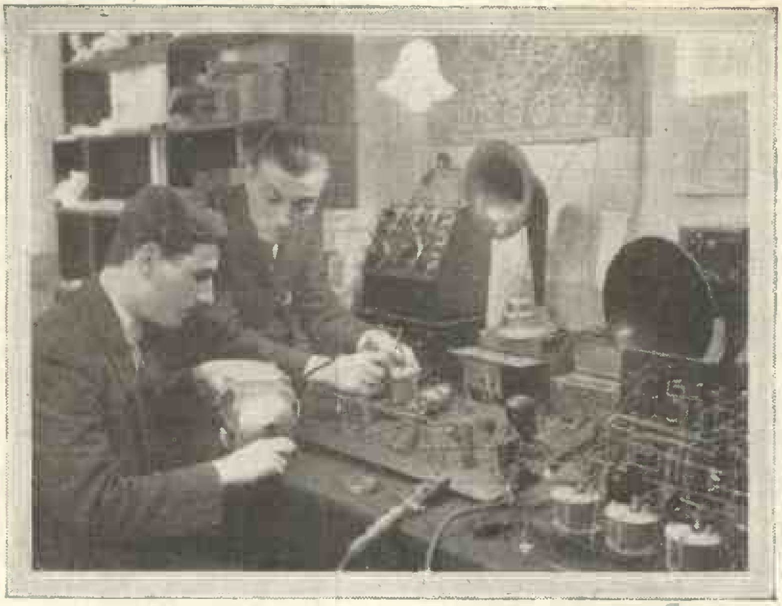
Every human endeavour is made to ensure the accuracy of the technical contents of the publications and the absolute efficiency of the apparatus described.

Every single set described in any publication, I understand, is brought to the head office and is

Stanley G. Rattee, Member I.R.E.

examined and tested by one or more members of the Radio Press staff. Where the set is made by an actual member of the staff, it is usual for several other members to try the set out at home in order that a perfectly sound judgment may be made of the capabilities of the set under various conditions. Where some new interesting set has been produced I have frequently, before publication, had the privilege of testing it out at my own home.

Recent developments have taken place which make it, more than ever, easy for readers to have the most perfect confidence in the workability of receivers. Every single set now described in WIRELESS WEEKLY, MODERN WIRELESS, or any of the books or other publications of Radio Press, is on view at No. 9, Devereux Court, and may be inspected by any reader, who is free to make a close examination of the set. Special arrangements, I understand, can be made for arranging demonstrations. Sets described in Envelopes are permanently on view, but sets described in either of the periodicals are returned to the authors after three weeks.

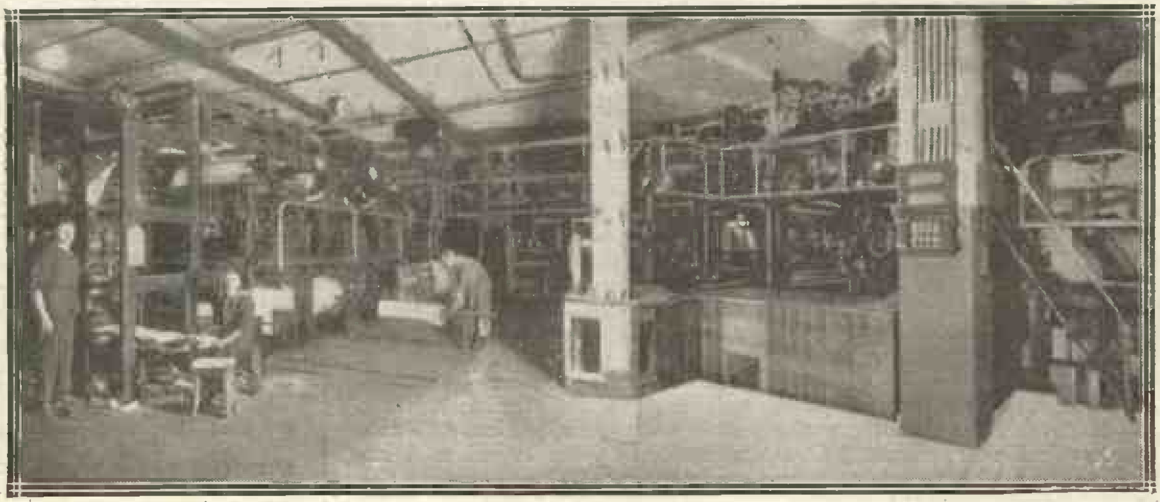


At work in Radio Press Test Department.

At this address, which is only a few yards from the Head Office of Radio Press, Limited, is installed the recently formed organisation called Radio Press Service Department, Limited, a subsidiary company of Radio Press, Limited, which is engaged purely in dealing with problems and difficulties of readers. No service of any kind whatsoever is given to anyone who is not a supporter of the Radio Press. The Service Department will examine and report on any set which does not give the expected results. In other words, the Radio Press, through its Service Department, guarantees the efficient operation of every set for which constructional details are given in any of its publications. The charges made are extremely moderate, usually averaging about 2s. 6d. per valve. These charges are only intended to cover the expenses involved, and no charge whatsoever is made where the constructor shows that the fault is due to the publication from which he has constructed the set. The service, it is hoped, will be made to pay its way, or to suffer only a small loss, and consequently the charges are very much lower than those which would be charged by a commercial or professional organisation in the ordinary way.

During the occasions when I have inspected work in progress in the Testing Department I have inquired in what way faults have arisen. I have found that in all cases either some departure from the design had been made, or the trouble was found to be due to some faulty component (frequently of unknown make).

I was naturally rather interested to hear whether any complaints were ever received regarding apparatus supplied as a result of replying to an advertisement of an advertiser in Radio Press publications. I was informed that in no single case had any reader ever



One of the giant rotary presses on which "Modern Wireless" is printed.

ordered goods from the pages of WIRELESS WEEKLY or MODERN WIRELESS without receiving the fullest satisfaction either from the advertisers or from Radio Press, Limited.

It is, therefore, not very surprising that readers of Radio Press publications enjoy a feeling of perfect security. Readers know that the whole of the publications are planned to avoid any duplication, the whole of the editorial direction being centred in one person; discrepancies between different books, or different periodicals never rise, and the reader knows that he need never go outside the publications of the Radio Press for any information he desires. He has confidence in the technical accuracy of the articles; he has confidence in the absolute efficiency of every set of which details are given, and he has every confidence that in every case he will obtain a thoroughly square deal when he orders goods from advertisers in their publications.

Nothing sensational is allowed to stampede the judgment of the Radio Press. No circulation-raising stunt or sensational announcement unfounded on solid facts is allowed to interfere with the consolidating and building up of prestige and a reputation for soundness.

That this reputation is not confined to this country is evidenced by the fact that WIRELESS WEEKLY and MODERN WIRELESS are translated, in part, into seven or eight foreign languages, and Japanese editions are in preparation!

Radio Press agencies exist in all the principal countries of the world, and I was informed, as a matter of interest, that Iceland, particularly, has a partiality for Radio Press products. The following are a few of the areas in which Radio Press carries out regular business: China, France, Iceland, Italy, Spain, Greece, Austria, Switzerland, Holland, Sweden, Norway, British Solomon Islands, Egypt, Australia, New Zealand, India, Finland, Denmark, South Africa, Ghent, United States of America, Singapore, British Guiana, Tasmania, Baghdad, Hungary, Portugal, Bilbao, Faroe Islands, Dutch East Indies, Morocco, Ceylon, Esthonia, Azores, Java, Czechoslovakia, Mexico, Roumania, Burma, Siam, Malta, Japan.

It will, no doubt, be of interest to readers to hear that the Czechoslovakia Broadcasting Company, after a visit to this country to study conditions, are proposing to instruct their public in the construction of wireless sets by means of the Radio Press Envelope Series, which they consider ideal for this purpose, in view of the completeness and simplicity of the instructions, which could be followed even without understanding the text.

Some of Radio Press publications, showing the wide range of subjects covered.

A feature of the Radio Press Service is that there never exists in any of their publications a hint of superiority or technical snobbishness; in spite of the fact that the whole of the senior staff consists of highly qualified men, there is always only a feeling of close friendship with all classes of reader. The absolute novice, often unnecessarily apologetic, receives the same welcome attention and consideration as the experienced experimenter.

This genuine friendship is, no doubt, fostered by the personal popularity of members of the staff with readers, and although these gentlemen are frequently only seen by a small fraction of those who read their articles and books, yet this does not interfere with the mutual bond of friendship. For the benefit of those who are interested to know more about the authors whose articles they so frequently read, I have obtained some photographs which are reproduced in this article.

Readers who intend submitting their technical queries to this Journal are referred to the article on page 294 for details.

Fig. 1.—The neat arrangement of the layout may be gathered from this photograph.

A Distinctive Two-Valve Receiver

By
STANLEY G. RATTEE,
Member I.R.E., Staff Editor

A receiver for all telephony wavelengths in which either tuned anode or resistance H.F. coupling may be used. The safe method of applying reaction to the tuned anode is also incorporated for the lower wavelengths, with aerial reaction for the longer waves.

THE outstanding feature of this receiver is that whereas the tuned anode method of high-frequency coupling is employed for the lower wavelengths, the operator has for the higher waves of 1,000 to 3,000 metres, the option of choosing between tuned anode and resistance capacity coupling; further, in the case of the tuned anode, reaction is applied to the anode coil, whereas with the resistance coupling, reaction is obtained by coupling the reaction and aerial coils. For wavelengths above 3,000 metres resistance capacity coupling is used.

The method of obtaining tuned anode coupling is unique, in that it has not been previously suggested in this journal, and familiar, in that it resembles somewhat the well-known plug-in coil method with parallel condenser.

Actually the Sterling Anode Reaction Unit and Adaptor are employed, which permit the interchanging of three different units, each fitted with its own reaction coil, to cover wavelengths from 280 to 3,000 metres, the tuning of these units being made by means of a 0.00025μF square law condenser.

For the British Broadcasting wavelengths, only one of the units is required, thereby permitting, if financial ability prevents further expenditure, wavelengths above 1,000 metres to be received upon resistance capacity coupling.

Switching.

A glance at the photographs will show a small double-pole-double throw switch, and the purpose served by this is to change from tuned-anode to resistance capacity coupling and at the same time to bring into circuit the effective reaction coil.

Beyond this switching there is little complication likely to develop in the constructor's progress, and since the connections are given in both the circuit and wiring diagrams, there should be little difficulty, if any.

The receiver is intended to be a permanent two-valve instrument and no switching other than that mentioned above is provided. The reason for this omission is to preserve as far as possible the simplicity of design and construction with the precaution that no undue

Fig. 2.—A view of the receiver with valves and coils removed. Note that with this type of coil-holder the pins are removable, an advantage when using a certain make of coil.

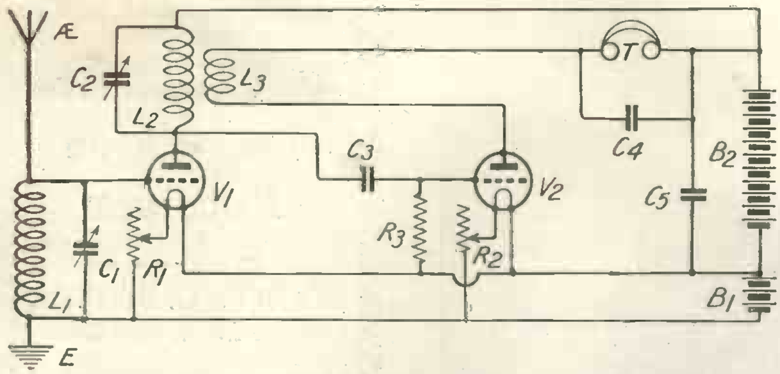


Fig. 3.—A simple two-valve circuit using tuned anode coupling with reaction applied to the anode circuit.

lengthening of the most critical leads may result.

Should the reader desire a receiver with the ability of cutting out the first valve, then he must, of necessity, turn to a more complicated design with more intricate wiring.

Components and Materials

For the assistance of those readers who propose to construct this receiver the names of the manufacturers of the various components are given, together with the components themselves, and though there is virtually no obligation in the choice of makes, for results similar to those obtainable upon the receiver illustrated, the values mentioned must be adhered to :—

1 Ebonite panel measuring 12½ in. by 9 in. by ¼ in.
1 Variable condenser of 0.0005μF capacity (Radio Instruments, Ltd.)
1 Two coil-holder (Burne-Jones.)
2 Lissenstat Minor (Lissen, Ltd.)
3 Anode reaction units covering wavelengths between 280 and 3,000 metres (Sterling Telephone Co., Ltd.)
1 Anode reaction unit adaptor by the same Company.

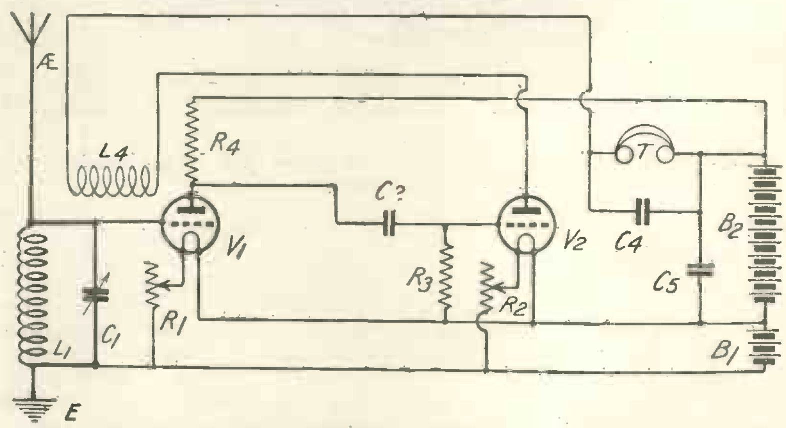


Fig. 4.—A two-valve resistance capacity coupled circuit using aerial reaction. The coil L4 is shown at minimum reaction position.

1 Watmel variable grid-leak.
1 Watmel variable anode resistance.
1 Variable (square law) condenser of 0.00025 μF capacity (Bowyer-Lowe Co., Ltd.)
8 Terminals.
1 Double - pole - double - throw switch for panel mounting (McMichael, Ltd.)
8 Valve legs or alternatively two valve holders.
1 Grid condenser of 0.0003μF (Dubilier).
1 Fixed condenser of 0.002μF (Dubilier).
1 Mansbridge condenser of 0.05μF capacity.

In addition to the above the following accessories will be required :—

2 General purpose receiving valves.
1 6 volt 40 ampere hour (actual) accumulator for bright emitter valves or, 4 volt 10 or 20 ampere hour for dull emitter valves.
1 75 to 100 volt H.T. battery with wander plugs.
1 Pair of 2,000 ohm resistance telephones.
Set of plug-in coils for the wavelengths required as given in a later paragraph.
Quantity of No. 16 tinned copper wire or "square-rod" for connecting purposes.

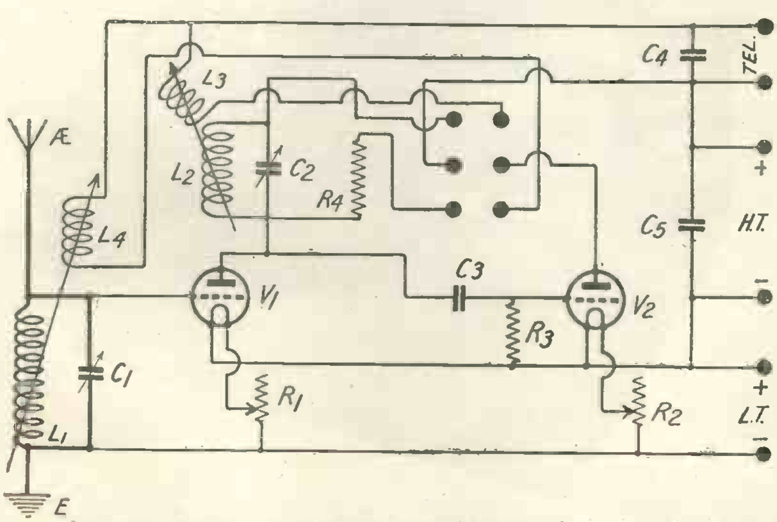


Fig. 5.—The theoretical circuit employed in the receiver. Note the connections to the double-pole change-over switch.

Valves

Since the receiver is fitted with filament resistances suitable for use with either bright or dull emitter valves, the reader may choose any receiving valve of repute with the assurance that results will be equally effective with either the bright or dull emitting variety, though it must be borne in mind that the H.T. voltage will need to be experimented with in both cases, as a suitable voltage for bright emitting valves is not always desirable in the case of dull-emitter types.

The Circuit

A simple tuned anode coupled two-valve circuit is given in Fig. 3 whilst an equally simple resistance

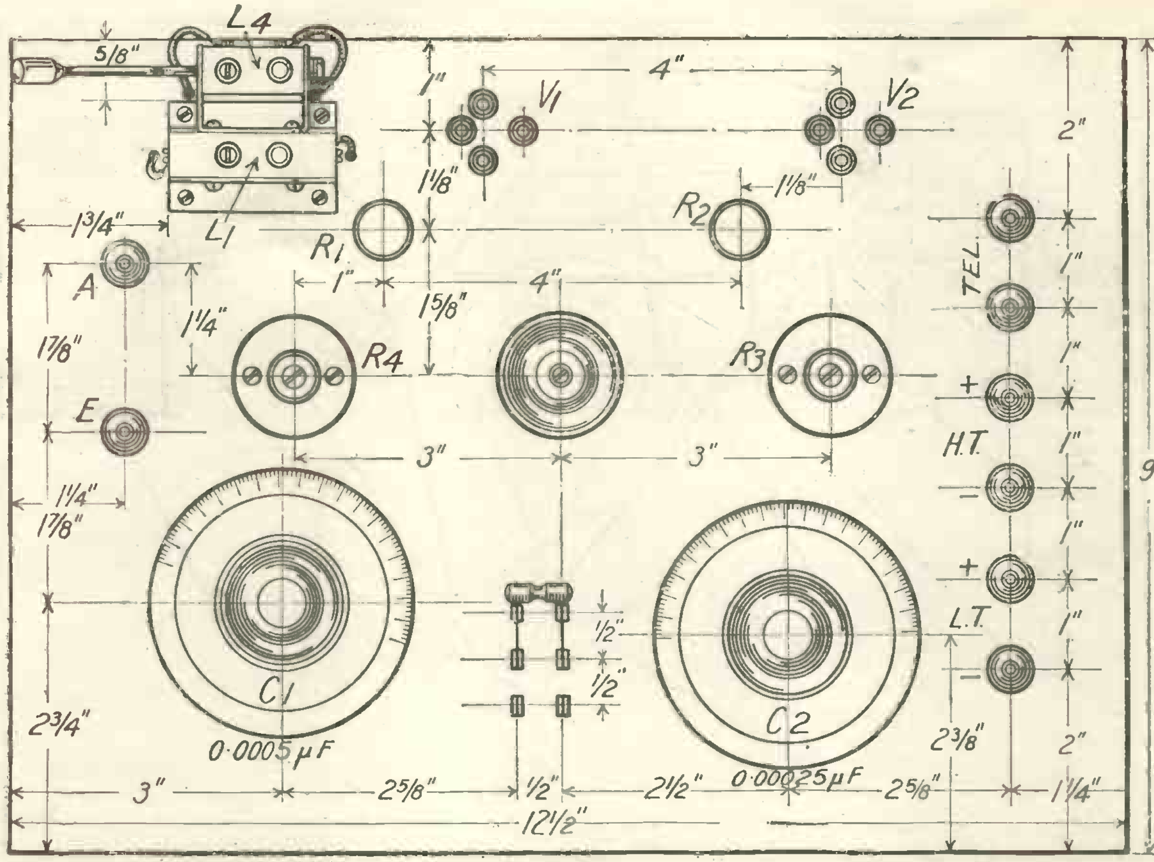


Fig. 6.—The layout of the panel giving dimensions and purposes served by the various terminals.

coupled two valve circuit is given in the next figure.

Before making a study of the actual circuit used in the receiver under description readers are advised to acquaint themselves with these two arrangements.

The tuned anode circuit, it will, be seen, consists of a tuning coil and condenser connected in the plate circuit of the first valve, tuned to the same frequency as the received wavelength, and coupled to the grid of the next valve by means of a grid condenser and leak.

The resistance capacity coupled circuit consists of a resistance of 50,000—100,000 ohms connected between the plate of the first valve and the H.T. positive and coupled to the next valve in precisely the same manner as in the case of the tuned anode.

The circuit of the receiver illustrated is a combination of both these circuits, made possible by the introduction of the double-pole-change-over switch and shown in Fig. 5. L_1 is the aerial tuning inductance consisting of a plug-in coil tuned by the condenser C_1. V_1 is the high-frequency valve with L_2 and C_2 its tuned anode, whilst R_4 is the anode resistance. L_3 is the reaction coil for use when tuned anode coupling is employed, whilst L_4 constitutes the reaction coil for use with resistance capacity coupling.

The connections to the change-over switch are clearly shown and call for no remarks other than that the constructor follows the instructions implicitly.

R_1 and R_2 are the filament resistances; C_3 and R_3 the grid condenser and leak respectively, whilst C_4 and C_5 are the two fixed condensers across the telephone terminals in the one case and across the H.T. terminals in the other.

The Panel

This is drilled in accordance with the layout illustrated in Fig. 6, after which the panel should undergo on both sides a treatment of careful rubbing with fine emery cloth in order to remove the glossy finish.

Certain manufacturers are, however, marketing a specially prepared ebonite which has a highly polished finish, guaranteed to be free from any possible surface leakage, and in those cases where readers are assured that the material purchased is of the type referred to, the removing of the surface skin is not in any way necessary. In order that there may be easy access to the interior of the set for changing the anode unit when desired the panel is fixed to the box by means of hinges instead of the usual screws.

Wiring the Receiver

The general arrangement of the wiring may be gathered from the photographs showing the underneath of the panel; whilst the actual wiring of the components may be followed from the practical wiring diagram.

For the best results all connections should be soldered, and leads must be kept as short as possible, especially is this so in the case of the high-frequency valve and grid connections.

Operating the Receiver

Attach to the anode reaction unit adaptor the first of the units, taking care in so doing that it is placed in position with the two arrows marked upon the adaptor and the unit, facing each other.

Throw the switch in position so that the two centre contacts are each connected to the two upper

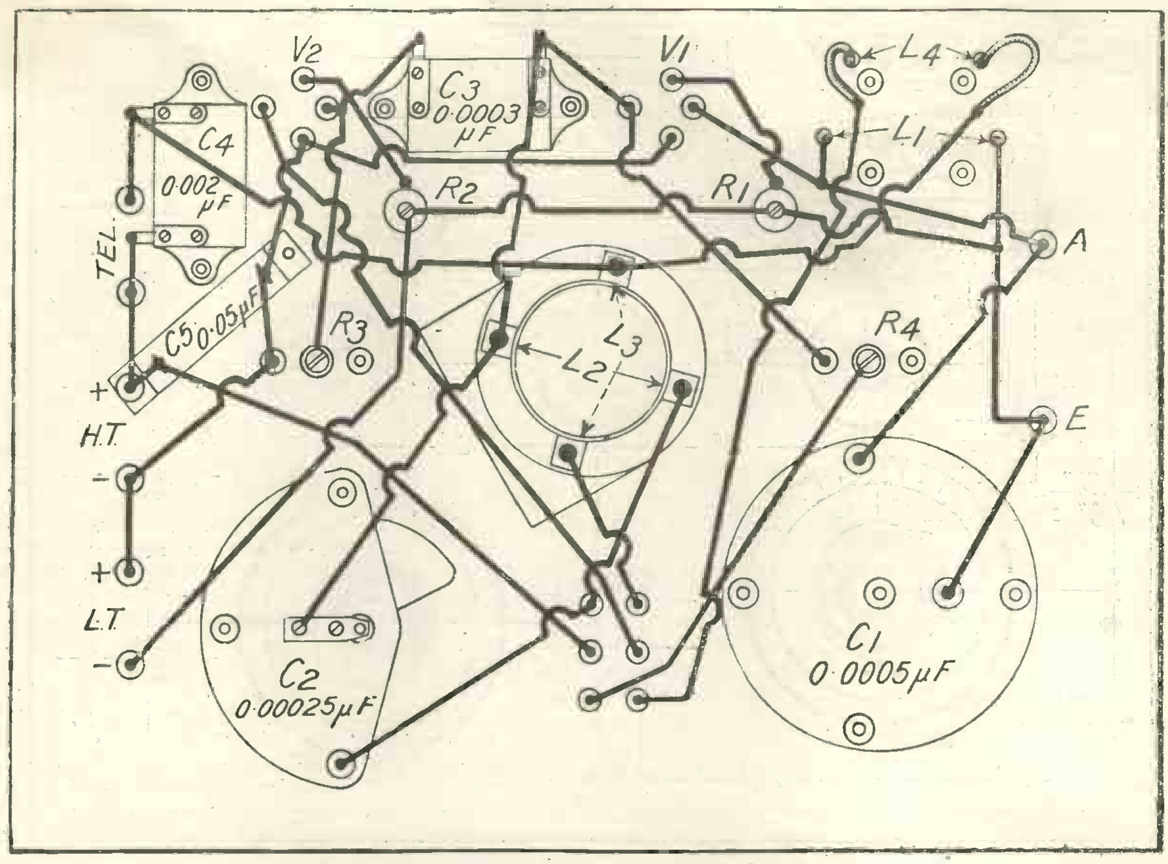


Fig. 7.—A practical wiring diagram of the receiver.

contacts, when the set is ready for work, using tuned anode coupling with tuned anode reaction.

For the reception of the B.B.C. stations with wavelengths up to 400 metres a No. 35 or 50 plug-in coil should be inserted in the aerial socket (fixed) with the reaction coil socket left free. The filament resistances should be turned to the "off" position and the H.T. and L.T. connections made to the terminals intended for them as shown in the panel layout. Light the valves to a suitable degree of brilliance and proceed to tune with the aerial tuning condenser C_1 and the anode condenser C_2; if the set shows any tendency to oscillate the tuned anode reaction handle should be turned to either the left or right until the oscillation ceases. With the signal tuned to its loudest volume, turn the reaction knob to either the left or right (found by experiment) until the signal is increased to its maximum volume. It will be found that if too much reaction is applied the signal will become distorted and the set inclined to squeal, in which case reaction must be reduced until the clearest and best results are obtained. When this condition has been arrived at, final adjustment should be made upon the anode condenser C_2.

For the reception of B.B.C. wavelengths above 400 metres the same instructions hold good, with the exception that a No. 50 or 75 coil is used in the aerial socket.

Wavelengths Other Than B.B.C.

Those readers who desire to receive wavelengths above those

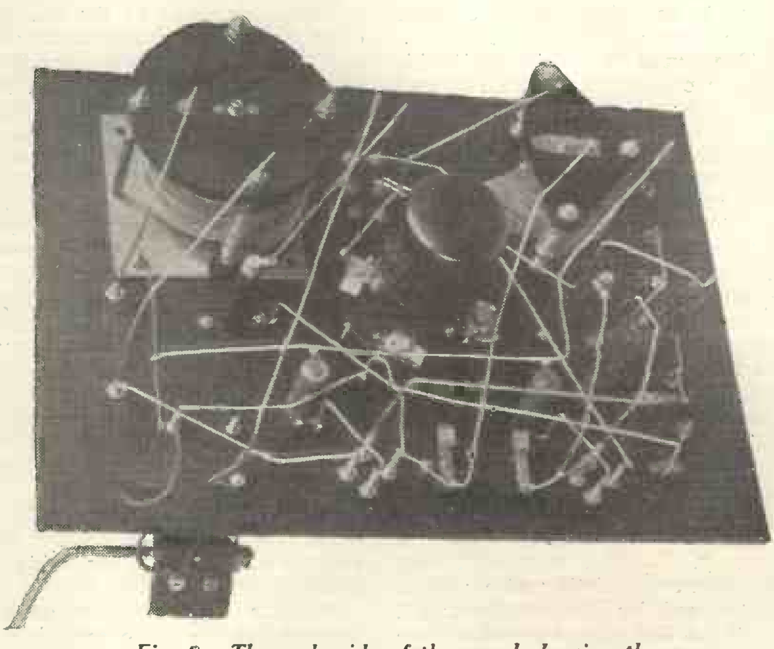


Fig. 8.—The underside of the panel showing the anode reaction unit in position.

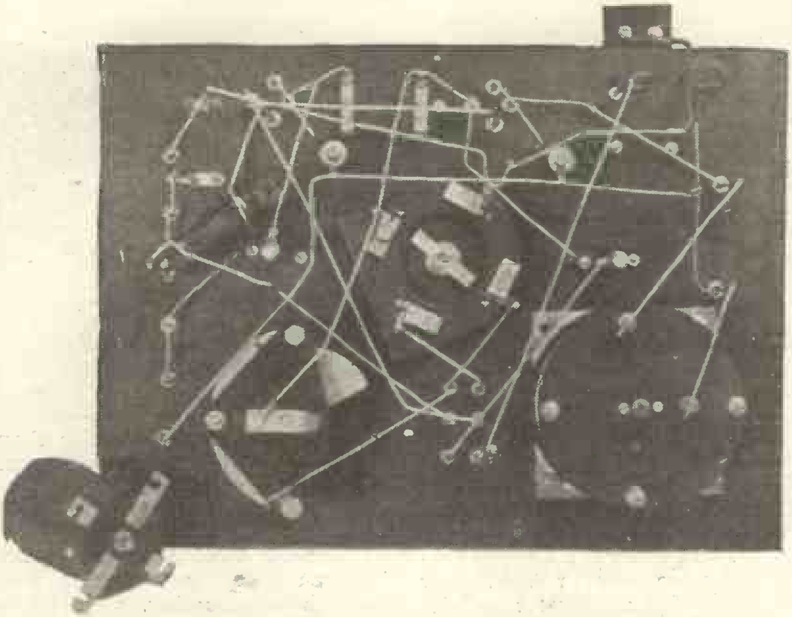


Fig. 9.—This photograph shows clearly both the anode reaction adaptor itself and the method of mounting the unit by means of the prongs. Note the unit in the bottom left-hand corner.

commonly used for broadcasting, such as those upon which aircraft telephony or the long-wave B.B.C. station may be heard should, in the case of tuned anode coupling, change to the second anode reaction unit, using for aircraft telephony a No. 75 or 100 coil in the aerial, and for the long-wave B.B.C. station a No. 100 or 150 coil.

For the reception of these two stations upon resistance capacity coupling the change-over switch should be thrown over the other way, and with the same aerial coils, use a No. 150 or 200 for reaction in the case of aircraft telephony and No. 200 or 250 in the case of the long-wave B.B.C. station.

The operation of tuning when using resistance coupling is precisely the same as before, with the exception that there is only one condeinser (C_1) to tune, and the reacton coil is now coupled to the aerial coil.

The best method of handling this class of circuit is to turn the two coils at right angles to each other and move the condenser very slowly, at the same time bringing the reaction coil nearer the aerial coil, taking every care that the set is not made to oscillate, as with this type of reaction any oscillation produced by bad operation will cause considerable interference to neighbours.

When the desired signal has been picked up leave the reaction coil in position and vary the condenser slightly until the best result is obtained. With this adjustment at its best again adjust the reaction coil, making final slight alterations on the condenser.

For the reception of Radiola, with tuned anode coupling, the third anode reaction unit should be used in conjunction with a No. 150 coil in the aerial socket; in the case of resistance coupling, coil No. 150 should be used in the aerial with a No. 250 or 300 for reaction.

For the reception of the Eiffel Tower on tuned anode coupling the third anode reaction unit should be used with a No. 250 coil in the aerial socket; for the reception of the same station with resistance coupling coil No. 250 should be used in the aerial with No. 400 or 500 for reaction.

Resistance Coupling

When using resistance capacity coupling the values of both the anode resistance and the grid-leak should be varied until the best results are obtained; it will also be found advisable when using this coupling to increase the high-tension voltage in order to compensate for the drop in E.M.F. across the anode resistance. The values of these three are best found upon experiment, and since all are of the adjustable type little trouble is likely to be experienced in arriving at a satisfactory conclusion.

The Containing Box

It is not thought necessary to give a detailed description of this, other than that the box should be of sufficient area to take the panel and of at least six inches depth in order to take the components and their wiring.

What the Receiver Will Do

With the instrument shown in the photographs the tuning in of Bournemouth, Birmingham and Cardiff upon an indoor aerial in S.E. London offers no very great difficulty, whilst the reception of Continental telephony upon the higher wavelengths is equally as easily accomplished. The receiver is selective, sensitive and easy in its control of reaction when coupled to an average P.M.G. aerial.

The receiver when tested by two persons, excluding the author, upon two separate aerials gave results equally good as those obtained in writer's case, the same stations in addition to others being received. The reception of Radiola upon 1780 metres is both good and easy to obtain, the control of reaction being easy and smooth.

On local broadcasting loud-speaking of a volume consistent with the exclusion of low-frequency amplification is obtainable and of sufficient strength to be easily heard in the average room above the local noise of rustling newspapers which usually accompanies the evening's listening-in.

Blue Prints

For the benefit of those readers who prefer to work from full-sized drawings, blueprints of Figs. 6 and 7 may be obtained from the offices of this journal, price 1s. 6d. each, post free. When applying for these drawings Blueprint No. 54A (panel lay out), Blueprint No. 54B (wiring diagram) should be quoted.

GOOD RESULTS FROM THE ALL-WAVE CRYSTAL SET

To the Editor of MODERN WIRELESS.

SIR,—Having constructed "A Simple All Wave Crystal Set" by E. Redpath, as described in your July issue, I find that by using basket coils and a 0.0003 μF condenser across the A.T.I., 2 LO comes in with approximately a third greater strength than with one of the best known sets on the market. I also find that by disconnecting the aerial and placing a finger on the inductance side of the phone terminal 2 LO is readable.

Wishing your journal the success it deserves.

Yours truly,
R. MILLER.

Kilburn, N.W.6.

Above & below the Broadcast Wavelengths

(*Continued from page 175, July issue.*)

For the Beginner

For the beginner one would recommend either the circuit shown in Fig. 8 or that of Fig. 9. In the former a tapped anode reactance is used, and in the latter a semi-aperiodic transformer. Selectivity is obtained in either circuit by the use of a loose coupled tuner, the closed circuit being earthed as shown. Either of these circuits will be found extremely easy to handle, and an additional H.F. stage can be fitted without many complications. If reaction is required the inductance may be coupled either to the secondary coil or to the aerial tuning inductance. It will be found in actual practice that the amplification obtained by two stages of semi-aperiodic coupling is rather better than one stage sharply tuned.

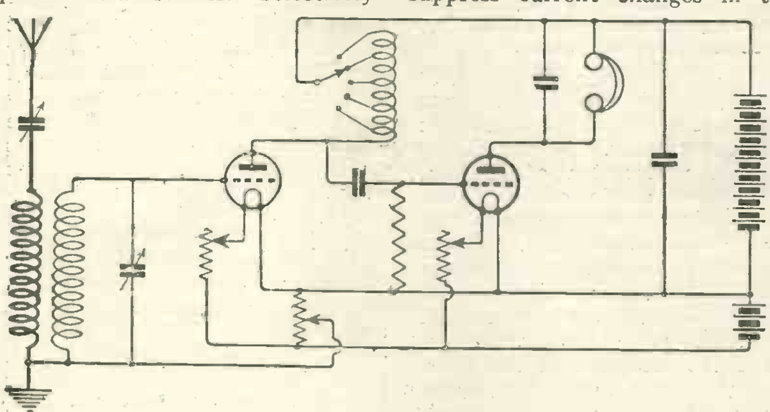


Fig. 8. Semi-aperiodic anode reactance.

The Oscillation Problem

It should be noted that aperiodic or semi-aperiodic couplings are less prone to fall into self-oscillation than those which are sharply tuned. Such self-oscillation results from the capacity coupling which exists between the grid and anode of the valve. It is not always realised that whilst the plate is connected to the positive end of the high tension battery the grid is joined to its negative end with usually a portion of the low tension battery in series. Hence plate and grid form the positive and negative plates of a condenser, and there is a large potential difference between them. Now when we entirely, or almost entirely, suppress current changes in the anode circuit, obtaining in their stead large variations of voltage on the anode we are very apt to set up oscillation owing to the fact that these voltage changes are impressed back on to the grid. A sharply tuned high frequency coupling is more difficult to handle than one which is aperiodic, for it will obviously be less stable.

For the Old Hand

The old hand has the choice between tuned transformer and tuned anode coupling. Of the two I personally prefer the tuned anode, though there is little to choose really between these and the loose coupled tuned transformer. For either, plug-in coils should be used; and the tuned anode method has the advantage that only one need be changed at a time if it is desired to tune in a higher wavelength. The tuned anode coupling, like most things in wireless, is something of a compromise. The voltage variations across the inductance are applied directly to the rectifier, for which reason the shunt capacity should be as small as possible in order to obtain sensitiveness, for any large capacity in shunt with an inductance will lead to a certain reduction of potential. On the other hand, we desire to obtain selectivity as well as sensitiveness, and the ideal condition for this is sometimes held to be a large capacity in parallel. We make a compromise by using a condenser of .0002 or .0003 μF. and arranging to work always with a

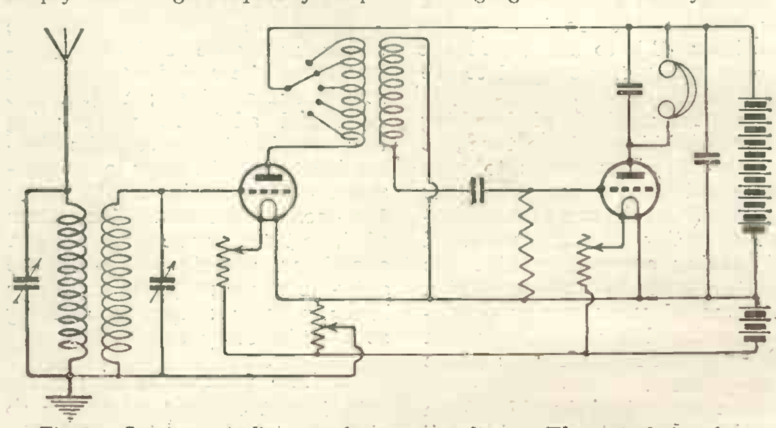


Fig 9. Semi-aperiodic transformer coupling. The switch is often arranged to short-circuit the dead turns in this and the preceding circuit.

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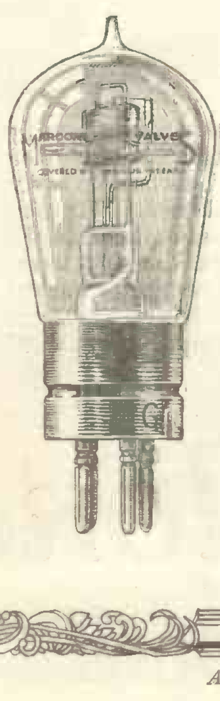

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certain proportion of this capacity in parallel. With the ordinary type of condenser we shall be compelled willy-nilly to do this, since on the early part of the scale the tiniest alteration makes an enormous difference to the frequency to which the circuit is tuned. With square

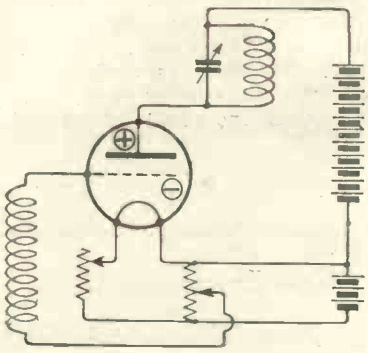

Fig. 10. Plate-grid capacity.

law condensers a much more even distribution is obtained, and we may find it a temptation to work right down to the bottom of the scale in order to avoid changing coils. It is not advisable to do this, for if the shunt capacity is very small the set will show a greater tendency to oscillate.

The Range of the Circuit

The tuned anode circuit is usually held to be efficient for the shortest wavelengths up to about 1,000 metres. Beyond that point two disadvantages arise: firstly, the inductances become rather large, and secondly, very fine tuning of the anode circuits is not essential. Above 1,000 metres the resistance capacity method of coupling is perfectly satisfactory. As a matter of fact I find it a distinct advantage despite the size of the inductances to use the tuned anode rather than resistance capacity coupling up to little more than 2,000 metres. If the reader wishes to test this statement out for himself he can do so very easily by tuning in Radiola on 1,780 metres first with tuned anode coupling and afterwards with resistance capacity. In nearly every case he will find that the former gives very much better results. When, however, FL or Konigswusterhausen are coming in there will be little or nothing to choose in point of signal strength between the two systems, and the resistance capacity method will be found very much more handy. Now all this points to the fact that a set designed primarily for the tuned anode coupling is by far the handiest form of receiving equipment that the experienced amateur can possess. The anode tuning condenser should be wired permanently to a plug and socket on the panel of the set. For the shorter wavelengths a suitable coil is plugged in and tuning is done with the variable condenser. When it is desired to receive signals upon a wavelength above 2,000 metres a plug-in anode resistance replaces the coil and the variable condenser is turned to zero. It should be noted by the way that any capacity in shunt with the resistance will effect a decrease in signal strength when the resistance capacity coupling is in use. It is therefore important that the anode tuning condenser should be one which has a very low minimum capacity. No reaction coil is shown in the circuit in Fig. 11, but if it is desired to make the set oscillate for the reception of continuous waves the coil may be coupled to the anode inductance when the tuned anode method is in use or direct to the aerial with resistance capacity.

Several H.F. Stages

To work a single stage of high frequency amplification where the coupling is to be tuned transformer, tuned anode or resistance capacity is quite easy, but complications ensue to a certain extent when a second stage is added. As a matter of fact these have been rather exaggerated by many writers, for as was described in these notes last month, even two tuned anodes become tame if a little thought is exercised in the design of the set. Two stages of resistance capacity coupled H.F. amplification are comparatively simple to handle, and if transformers are used the principle laid down for tuned anodes holds good—there will be little tendency to oscillation if transformers are so placed that interaction does not take place between them. With all methods potentiometer control is of course essential, but it must not be misused. The purpose of the potentiometer is not to kill oscillation by introducing an undue amount of damping, but rather to enable valves to be worked upon the correct point in their characteristic curves. For short wavelengths it is certainly desirable to use valves of the anti-capacity type such as the V_{24}, Q, QX, DEV, DEQ, S_3, S_7 or Ora B, but above 300 metres ordinary 4-pin valves will answer perfectly well and give no trouble at all, so long as the wiring of the set is arranged so that there is minimum capacity between plate and grid leads.

The Long and the Short of it.

It is curious to notice how opinion has changed with regard to the wavelengths most suitable for long-distance commercial purposes. The earliest experiments in wireless were made with very short waves indeed on ranges which to-day seem almost absurdly small when we think of the distances at which even a five-watt transmitter can establish communication with a sensitive receiving station. Then increased ranges were obtained by using higher power which was adopted in conjunction with greater and greater wavelengths. Most of the big stations built for trans-Atlantic and other long-distance work were designed for such big wavelengths that their frequencies came within measurable distance of the audible and it was mooted at one time whether we should see stations in the future transmitting upon 100,000 metres or more. As it is, Bordeaux's 23,450 metres mean a frequency of 12,793, which may be classed as just within the upper limit of audio-frequency, but there are probably few human ears which could hear a note so high pitched. Some of the stations with huge wavelengths are Lyons with 15,000, Annapolis 17,000, Eilvese 14,400, Carnarvon 14,000, Tuckerton 16,100, New Brunswick 13,600, Nauen 12,600, Stavanger

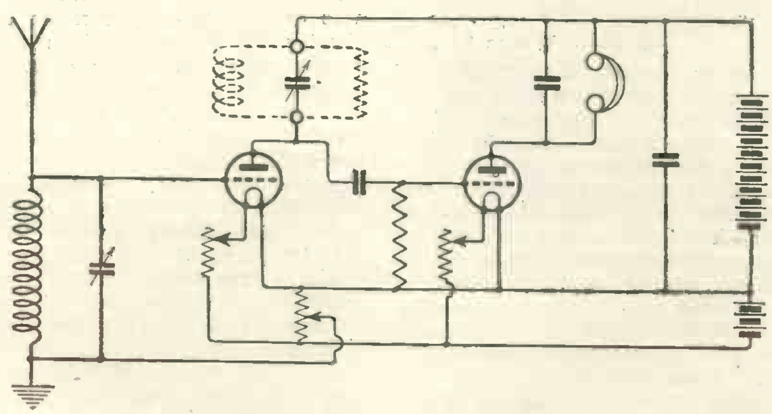

Fig. 11. Tuned anode or resistance capacity circuit.

12,000, Long Island 19,200, and St. Assise 15,000. There are vast numbers of long-range commercial stations with wavelengths between 5,000 and 12,000 metres, as any experimenter may see for himself by fitting a set of large coils to his receiving apparatus.

A Crowded Band

The wave band in the neighbourhood of 12,000 metres is one of the most crowded of all. If we sum up the opinions held two or three years ago they were roughly to the effect that wavelengths below 150 metres were of very little use for any purpose, that those between 150 and 450 metres would serve for quite short-range work, that the band between 450 and 2,000 was suitable for medium ranges, and that for anything like long-range work a high-powered station was required with a wavelength of at least 5,000 metres. The chief reason why the very long waves were preferred for work over great distances was that they were found to be less affected by varying conditions of day and night time working. It is essential for commercial purposes that a station should be able to establish and maintain communication during as large a part as possible of the twenty-four hours, and a high-powered station capable of generating long waves of enormous amplitude was found to be most reliable in this respect.

The Short Waves

Quite recently the attention of experimenters began to be directed once more to the short waves. This was, I think, brought about by a variety of causes. A great deal of amateur work in this country was done upon wavelengths of 180 metres or less, and it was found that with even the very limited power permitted enormous ranges were occasionally obtained. Then a very great impetus to short wave investigation was given by the reception of trans-Atlantic broadcasting. When this was first accomplished it was regarded as a remarkable feat, but as soon as attempts to receive WJZ, WGY, KDKA and the others on wavelengths between 300 and 500 metres began to be widely made, it was discovered that any well-made set provided with one or two stages of high frequency amplification, if attached to a good aerial and earth, could pick up these transmissions with fair regularity. Since then the reception of trans-Atlantic broadcasting has become commonplace, and many stations have been heard upon a single valve. Meanwhile Senatore Marconi and Mr. Franklin had gone right down to the bottom of the scale and were engaged upon experimenting with directional wireless, using in their tests between Hendon and Birmingham, wavelengths as low as $1\frac{1}{2}$ metres. It was, of course, impossible to receive these with any kind of "straight" set owing to the enormous frequencies involved, and the Supersonic heterodyne method of reception was developed to meet the case. The principle has already been described in these notes. Briefly, it consists in establishing by means of a local oscillator a beat at a much lower frequency, which is subsequently amplified and rectified by a standard receiver designed for short or medium wavelengths.

100-Metre Waves

Wonderful results were obtained with wavelengths between $1\frac{1}{2}$ metres and 5 metres, and attention was next turned to those in the neighbourhood of 100 metres. The American broadcasting station, KDKA, began some months ago to transmit simultaneously upon two wavelengths, the higher of these, 326 metres, was intended for direct reception by broadcast listeners; the lower, 102.5 metres, was employed chiefly for relay work. As soon as this double transmission started it was found that the power used, 15 kilowatts, was quite sufficient to make the shorter wave transmissions easy to pick up in this country on sets designed to deal with frequencies of the order of 3,000,000 per second. It was quite possible to use straight sets for the purpose provided that all stray capacities were avoided by good design, and these transmissions came in with amazing strength and with extraordinary regularity. This was indeed a revelation, for though 15 kilowatts is a high power for a broadcasting station, it is very small when compared with that used by long-range commercial stations.

Marconi's Latest.

In his latest experiments Senatore Marconi has been investigating the behaviour of waves in the neighbourhood of 100 metres in varying conditions as well as the possibilities of focussing them into a beam of comparatively small arc. The results obtained have been astonishing. It was found that when the yacht *Electra* was in the neighbourhood of the Azores, si n ls transmitted from Poldhu with an input of only one kilowatt were received loudly and clearly without either aerial or earth, and Mr. Franklin calculated that an input of 100 watts would have sufficed to produce good intelligible signals. The directional system, in which parabolic reflectors are used, can be applied with extraordinary success to wavelengths of 100 metres. Telephony between Poldhu and Sydney in Australia was actually carried out with complete success, and tests conducted between the former station and Buenos Ayres showed not only that regular and reliable transmissions could be conducted, but also that, to a limited extent, secrecy could be obtained in wireless.

The Transatlantic Set

To the Editor of MODERN WIRELESS.

SIR,—In this month's issue of MODERN WIRELESS you give a splendid constructional article on the Transatlantic Five, and invite constructors experiences of this set. I thought mine might interest you.

About three months ago I completed the building of your Transatlantic set, with two stage power amplification, into a cabinet, and the results are very gratifying.

I get a large volume of undistorted music, etc., from London. You will see I have slightly shortened the wiring on the H.F. side by inverting the H.F. transformers. I can also listen with the 2 H.F. and detector, also with one or both note magnifiers.

Bournemouth, Cardiff, Birmingham, Radiola and Petit Parisien, and all other B.B.C stations, except relays have been received with ample strength on L.S., but not recently.

After buying No. 1 of MODERN WIRELESS the wiring diagrams so frightened me that I left the subject alone, till happening to see the November issue the Trans-Atlantic set appealed to me so much that this is the outcome.

I am using Mullard Ora B for 2 H.F. and Det. and B.T.H. B4's for note magnifiers, with $1\frac{1}{2}$ v. permanent grid bias on first valve and variable 0-6 v. on last valve. About 40 v. H.T. on first 4 valves and 100 v. on last give satisfatory results. I am using clix throughout. From the strong stations the set is plainly audible at $\frac{1}{4}$ mile, and has been heard over $\frac{1}{2}$ mile away.

Wishing you and your splendid paper every success,

Yours truly,

Northleach, Glos. W. RICH.

LISSENIUM.

How your body forms one side of a condenser——

WE all know that critical tuning in a receiver is desirable, particularly where selectivity or distant reception is desired, but the adjustments by which such tuning is made should always be a definite thing and should never rest on haphazard movement of the hand or body.

WHEN your body is at earth potential, if any part of yourself, such as your hand, comes into contact or is in close proximity with any portion of your receiver which is not at earth potential, a stray capacity must be formed between your body and the nearest point of high potential in your receiver. The effect of this is not noticeable, nor is it of any importance, when one is adjusting a switch or is extracting a coil from its socket, for instance, but in practice is manifest when the final touches to tuning are being attempted on the condenser—particularly if in conjunction with perhaps a critical reaction setting for the reception of distant telephony.

IF one has to add the final touches to tuning by keeping the hand near the condenser, it IS NO RECOMMENDATION TO THE TUNING QUALITIES OF THE RECEIVER, but is rather a reflection on the inherent defects of the type of condenser used.

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Lissen one-hole fixing, of course.

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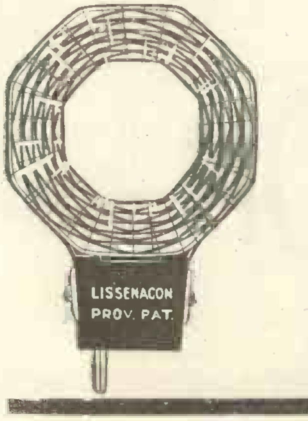

LISSENAGON TUNING CHART. Note the Intermediate Coils, 30, 40 and 60.

	TABLE 1. Wavelength range when used as Primary Coils with Standard P.M.G. Aerial and .001 mfd. condenser in parallel.		TABLE 2. Wavelength range when used as Secondary Coils with .001 mfd. condenser in parallel.		
No. of coil	Minimum Wavelength	Maximum Wavelength	Minimum Wavelength	Maximum Wavelength	PRICE
25	185	350	100	325	4/10
30	**235**	**440**	**130**	**425**	**4/10**
35	285	530	160	490	4/10
40	**360**	**675**	**200**	**635**	**4/10**
50	480	850	250	800	5/-
60	**500**	**950**	**295**	**900**	**5/4**
75	600	1,300	360	1,100	5/4
100	820	1,700	500	1,550	6/9
150	965	2,300	700	2,150	7/7
200	1,885	3,200	925	3,000	8/5
250	2,300	3,800	1,100	3,600	8/9
300	2,500	4,600	1,400	4,300	9/2

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What Valve Curves Mean

An Article of Interest and Value to Every Valve User

By R. W. HALLOWS, M.A., Staff Editor

HOW many amateurs, I wonder, can "read" a set of valve curves? These things must obviously mean something, but comparatively few people are able to say just what they do tell about the particular valve to which they refer. Most makers issue certain curves for their valves and others are to be found in the accounts of tests which are published in the technical press. These do actually give us a very great deal of useful information about the performances of a valve, and, if we can read them properly, they help us to use it in the receiving set in such a way as to get the very best out of it. If you place in the hands of an expert the particulars of several motor cars, including the cylinder capacity, the wheel size, the gear ratio and so on, he will have very little difficulty in sorting them out into classes; he will, I mean, be able to tell you which of them are most likely to be speedy on the racing track, which useful as touring cars and which most suitable for taking heavy loads at slow speeds. Now with valves we are concerned with problems of very similar nature, for we too must be able to classify. The valves on our sets have three entirely different functions to perform, in high frequency amplification, rectification and low frequency amplification. Curves give us just the information that we want in order to be able to assign any particular valve to its class without actually trying it upon the set. We shall not always find that our predictions are exactly borne out in practice; still they will give us, on the whole, a pretty exact indication of what is to be expected from any particular valve.

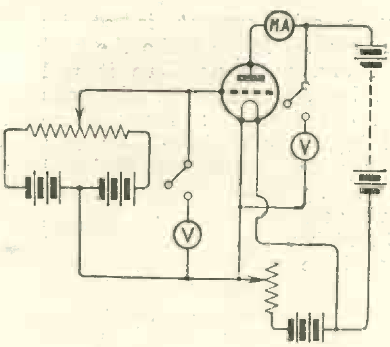

Fig. 1.—Circuit for taking grid volts—anode current curve. V = Voltmeter MA = Milliammeter.

The Grid Volts—Anode Current Curve

Fig. 1 shows the circuit which is used for taking the grid volts anode current curve. In the plate circuit is a milliammeter which enables the current flowing to be read, whilst a voltmeter shunted across the high tension battery, and provided with a switch, makes it possible to measure, exactly, the plate voltage. In the grid circuit is a potentiometer in shunt with a battery of small cells, to the middle point of which is connected a lead from the negative leg of the filament. A second voltmeter placed in this circuit enables the tester to ascertain the grid voltage with respect to the negative leg of the filament. This voltage can be made of any positive or negative value within the capacity of the battery by moving the slider of the potentiometer. In practice the plate voltage is first adjusted to a value of, say, 20 volts. The potentiometer is then moved over to the negative side until the milliammeter in the plate circuit shows a zero reading. The grid voltmeter now shows the grid potential required to dam back entirely the electron emission from the filament. The potentiometer slider is now moved slightly towards the positive side and milliammeter readings are taken at each volt as the grid becomes more and more positive. A dot representing each reading is made on a piece of graph paper. When further increases in the positive potential upon the grid make little or no difference to the current flowing in the plate circuit the tester knows that he has reached the saturation point: that is to say, the plate is now receiving every possible electron from the filament. He then starts upon a second test, increasing the plate potential to perhaps 30 volts and proceeds as before. Having once more come to the saturation point he makes another curve with a still higher plate voltage. He then draws in free-hand curves, following as nearly as possible the sets of dots that he has made upon the paper. The result is a "family" of curves such as that shown in Fig. 2. Now what can we learn from the particular family illustrated in this diagram? In the first place with the filament voltage used (we will see presently how this is determined) this valve shows a saturation current of about 1.5 milliampere. It will not therefore be suitable for working a large loudspeaker if used as a low frequency amplifier. Secondly, we see that progressive increases in the anode potential move the curve considerably greater distances to the left. Hence with something rather higher than 50 volts we shall have a curve well to the left

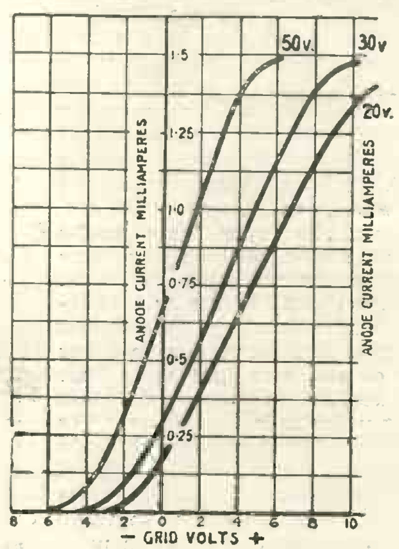

Fig. 2.—A family of grid volts—anode current curves.

of the zero line, which should give good and undistorted low frequency amplification. The valve is therefore very suitable as a first stage note magnifier. How will it do as a rectifier? Some would prophesy excellent results on

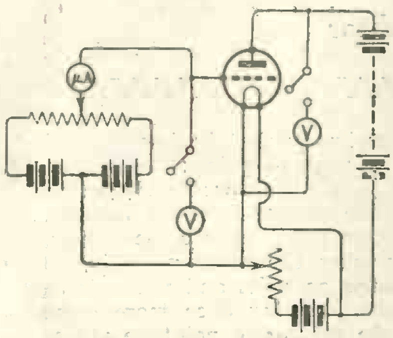

Fig. 3.—Circuit for grid current curve. μA=microammeter.

account of its "well marked lower bends." These bends, however, are entirely useless from any point of view, for probably not one set in ten thousand makes use of plate rectification. Rectification depends mainly upon the grid volts-grid current curve to which we shall come presently. As the Editor has pointed out, the rectifying valve has two functions to perform. It acts in the first place as a diode or Fleming valve for rectification purposes, and in the second as a low frequency amplifier. Its working grid potential will usually be in the neighbourhood of zero grid volts and the voltage changes upon its grid will not be very large unless several stages of high frequency amplification are used before it. What we want in the grid volts-plate current curve of the rectifier is a good straight portion on either side of the zero grid volts line. This we have in the 50 volt curve of the valve under discussion. For high frequency amplification again we require a well defined straight portion of the curve, but it is difficult to say whether the valve will do well in that position until we know something about its grid current curve. Of the family of curves that we have been discussing we may say that they appear to be those of a good general purpose valve likely to give very satisfactory results in any part of the set. They are as a matter of fact the curves of the Mullard Ora valve.

The Grid Current Curve

Fig. 3 shows the way in which the grid current curve is taken. The plate and filament voltages are fixed at suitable values; then the grid potentials are varied and current readings are taken by means of the microammeter, dots being made and curves afterwards drawn as before. Fig. 4 shows a typical curve of a hard valve. With the grid at zero volts the amount of current may be in the neighbourhood of .6 microampere. As the voltage on the grid is made more and more negative the current falls very rapidly indeed until at .6 volts negative a zero reading is obtained. From this point onwards a rather curious effect takes place. Reverse current is found to flow, which in the case of the valve whose curve is given in Fig. 4 reaches a maximum of .14 microampere at 1.8 volt negative. The gradual increasing of the negative grid potential now has the effect of reducing the backlash current until at 4 volts we again have a zero reading on the microammeter. The reverse current or "backlash kink" is caused in a rather interesting way. No valve contains a really perfect vacuum; there must always be present within the bulb gas molecules. As electrons pass from filament to plate they collide with gas atoms and owing to their speed actually drive electrons out of them. This process is known as ionisation by collision. It results in the formation of positive ions which normally return to the filament. When, however, the grid has reached a certain negative value it begins to attract

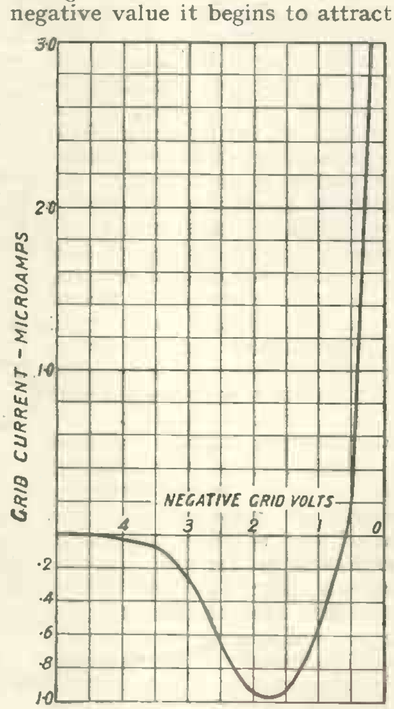

Fig. 5.—Grid current curve of soft (Dutch) valve.

these positive ions, with the result that a reverse current flows. The process goes on until the negative potential of the grid reaches a point at which its electron-stopping and ion-collecting qualities are balanced. When this happens

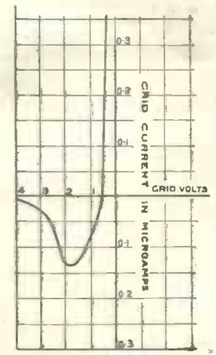

Fig. 4.—Grid current curve of hard valve.

reverse grid current is at its maximum. If we make the grid more and more negative it will dam back the flow of electrons from the filament; hence there will be fewer positive ions and the reverse grid current will fall off. Fig. 5 shows the grid current curve actually obtained from a *soft* Dutch valve. Here the flow of positive grid current at zero grid volts is very much higher than in the last case, reaching a value of over 5 microamperes. This is due to the fact that the larger quantities of residual gas within the bulb make for a much greater amount of ionisation by collision. The electron stream from the filament is denser, and a greater number of electrons is caught in the meshes of the grid. The positive ions submit the filament to a heavy bombardment. For the same reason the backlash kink is again very much larger, reaching in this case a maximum value of .98 microampere. We now see one thing that the grid volts grid current curve will tell us: it gives us to a great extent the measure of the valve's hardness. Secondly it gives us a very fair indication of how the valve will function as a rectifier. Fig. 6 shows how grid current is used for rectification purposes. For rectifying therefore we require a valve with a well marked backlash kink in the grid current curve. Fig. 6 is further interesting from another point of view, for it shows us how we sometimes obtain a curious kind of distortion by the use of several stages of high frequency amplification: the voltage changes applied to the grid of the rectifier may be so

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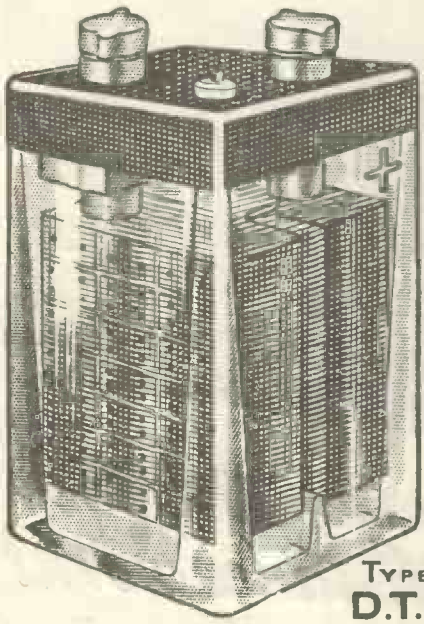

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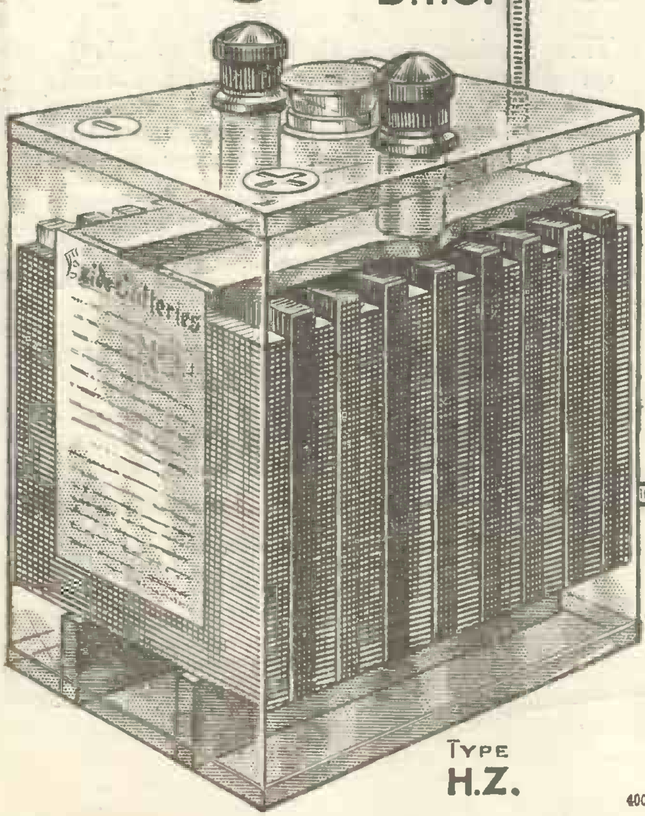

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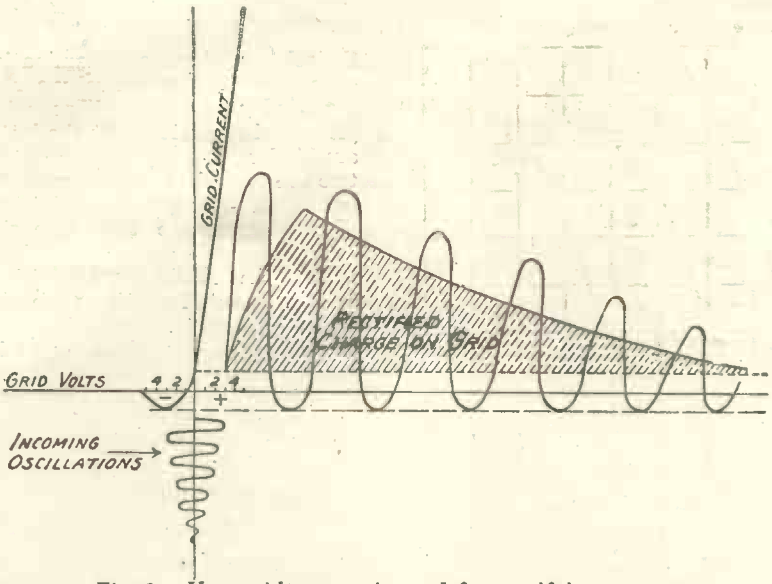


Fig. 6.—How grid current is used for rectifying purposes.

great that it is overloaded by them, the negative half cycles going far beyond the point of maximum reverse grid current and possibly even reducing the flow to zero once more. It shows us, too, that we must adjust the anode and grid voltages of high frequency amplifiers so that no rectification is taking

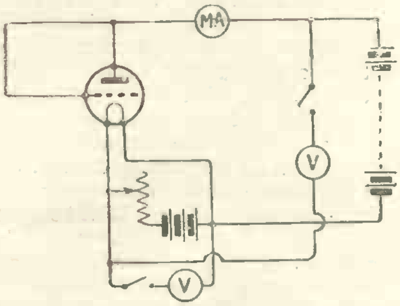


Fig. 7.—Taking the emission curve.

place in them, otherwise we may expect distortion from that cause. From the curve of the soft valve we can see why it is that these valves are so efficient as rectifiers, especially when they are used on single valve sets where the voltage changes upon the grid are very small indeed. For a rectifier, then, we require a respectable flow of positive grid current at zero grid volts, whilst for the high frequency amplifier grid current must not be too high at zero grid volts, otherwise pronounced damping and distortion of the wave forms will occur. The curves given in Figs. 4 and 5 may be read as follows. The valve from which the first was made should be an efficient rectifier and should also do well as a high frequency valve, for the grid current is quite small at zero grid volts. The second will rectify very well, provided that it is used by itself or with no more than one stage of high frequency amplification in front of it. It will not function as a high frequency amplifier with anything like success owing to the large current at zero grid volts.

Grid current provides us with one of the most interesting instances of the importance of the minute in wireless. The curve shown in Fig. 4 appears quite large, but that is merely because it is drawn to a much bigger scale than those in Fig. 2 for instance. To draw the latter on the same scale as the grid curve we should have to increase the height of the vertical line ten thousand times. Suppose you draw both the anode and grid current curves upon a full sized billiard table, taking the baulk line for the grid volts and making the volt divisions no larger than those shown in any of the drawings in this article. If we draw a line straight through the row of spots

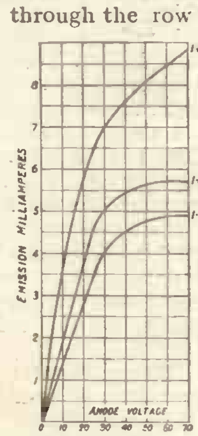


Fig. 8.—Emission curves.

down the centre of the table we can mark off on this ten compartments each 10 in. long to represent 1 milliampere apiece. Our grid current curve would cross the centre line *one hundredth of an inch* above the baulk line and its backlash kink would be represented by a curve *dropping one-thousandth of an inch below the line!* To get anything like results we shall have to draw the curves upon a large football field 120 yards in length. Here we can make a centre line between the goal posts, dividing it into ten compartments 432 in. long, each representing 1 milliampere. The anode current curve would then be a beautiful sweep of enormous size. If the grid current is one microampere at zero volts the grid curve would cross the centre line .432 in. or rather less than ½ in. from its base. The backlash kink would be represented by a curve coming .0432 in. below

Fig. 9.—Compare these curves with those in Fig. 10 and decide which are the steeper.

the line, or about half the thickness of the standard spacing washer used in variable condensers! If we wish to carry the experiment rather further by drawing on the same scale a current-consumption curve for the filament of the valve we shall have to make our centre line 12,000 yards or nearly seven miles in length.

The Emission Curve

The last curve of importance is the emission curve, which helps us to determine the correct filament potential at the normal plate voltage of the valve. To take this curve we proceed as

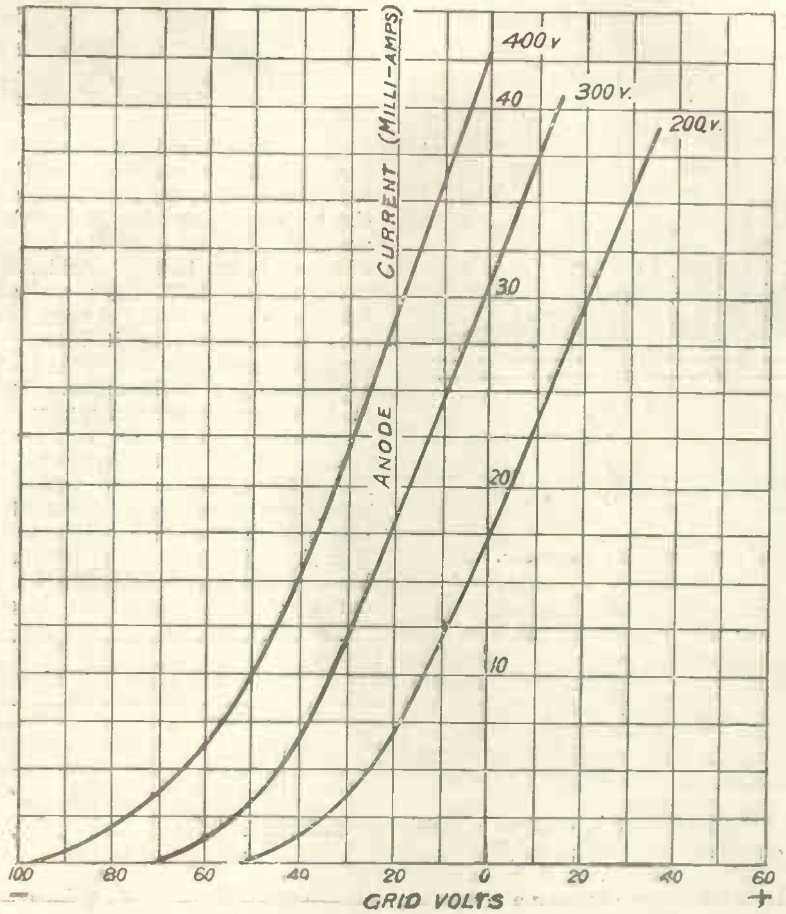


Fig. 10.—Further curves, to be compared with Fig. 9.

shown in Fig. 7, connecting the grid and plate together, and placing a milliammeter in the high tension circuit. The arrangement shown, of course, produces a condition such as will never occur when the valve is used on the receiving set, for it is unlikely that the grid will, at any time, be more than two or three volts positive at the outside. Our object is, however, to collect and pass through the milliammeter the largest possible proportion of the whole number of electrons emitted by the filament. Some makers work to an entirely arbitrary figure of five milliamperes, taking this as the desirable emission under these conditions. When they have found a filament potential which gives a total emission of five milliamperes for a general purpose valve at a reasonable plate voltage, they take it that this is the correct filament reading for the valve, and that it will function well on the receiving set with the rheostat so adjusted that the voltage across its filament is at this figure. In taking the curve they adjust the filament voltage first of all to a rather low value, and then take a set of readings, raising the anode voltage progressively by ten volt steps. The curves in Fig. 8 are those obtained from a dull emitter valve whose filament was adjusted successively to potentials of 1.5, 1.6 and 1.8 volts. It will be seen that at 1.5 volts the desired figure of 5 milliamperes is not reached at all. The raising of the anode voltage from 40 to 70 volts produces only a slight rise in the emission; in fact, with 30 volts on the anode the curve begins to bend round, showing that we are approaching the maximum point. With 1.6 volts on the filament things are better. We do reach 5 milliamperes, but the curve begins to bend rather sharply with the anode about 25 volts positive. By raising the filament potential to 1.8 volts we obtain a very much better curve which shows us that we can obtain a steadily increasing "emission" as the plate voltage is raised to 70. 1.8 volts was, therefore, taken as the correct filament voltage for the valve under test.

Some Pitfalls

Makers naturally wish to do the best for their own products, and for this reason you will generally find that the curves which they give do not err in the direction of gentleness in their slopes. A cursory examination of the two sets of power valve curves given in Figs. 9 and 10 will probably give the impression that the latter are by far the steeper. But if the two are looked at with care it will be seen that the grid volts divisions of the former are the same size as the milliampere divisions, whilst the milliampere divisions in Fig. 10 are four times the size of the grid volts. For this reason the curves in Fig. 9 appear to be much flatter than those in Fig. 10. If, however, the two are drawn out to the same scale, it will be found that the truth is precisely the reverse of this. Both are curves of power amplifiers of great efficiency. It will be seen that good low frequency amplification may be expected even with 100 volts upon the plate with the valve whose curve is shown in Fig. 9. The grid bias required in this case will be five volts negative, and there will be no distortion since the curve is quite straight between zero and —10 volts. We shall do better still with 300 or 400 volts upon the plate, for here we have absolutely straight lines and we can apply a grid biasing potential of 15 volts or more which will entirely eliminate the flow of grid current even if the tops and bottoms of the waves to be dealt with represent a rise and fall of 8 volts above or below zero. The second valve, whose curves are shown in Fig. 10, will function well with 200 volts on the plate and a negative grid bias of 10 volts. With an anode voltage of 400 we can apply 30 volts negative bias to the grid, thus cutting down grid current and effecting great economy in the high tension current without undue loss of signal strength.

Though it is impossible to go fully into the question of valve curves, it is hoped that enough has been said to give readers a good indication of the information about any valves which they can obtain from a careful inspection of its various curves. The curves usually published by makers are those showing the effects upon anode current of varying grid potentials at different plate voltages. Most manufacturers, however, will supply other curves if asked to do so. In conclusion, I would recommend every user of valves to make himself familiar with curves, for he then knows exactly what he is doing when he varies grid or anode potentials, moves the slider of the potentiometer or adjusts his grid biasing battery.

Readers' Experiences

THE S.T.100.

To the Editor of MODERN WIRELESS.

SIR,—I have been using your S.T.100 circuit for some time, but have only just completed the set in accordance with the instructions in your envelope.

The results have been remarkable, all B.B.C. stations coming in at sufficient strength for four pairs of 'phones, and Newcastle, Bournemouth, and Glasgow at fair loud-speaker strength. Ecole Supérieure also is quite good on the Amplion Junior, but Morse interference is terrible.

After finishing the set I made up two basket-coils, one of 18 turns 24-gauge and one of 23 turns 26-gauge, and with condenser in series with former and vernier only on reaction coil, I tuned in KDKA from 12 (midnight) till 1.30 a.m., when I lost his carrier wave completely. Another night, however, when conditions were more favourable, KDKA came in at great strength. In fact, it was quite audible, though not decipherable, on the loud-speaker. Hand capacity effects were most disconcerting, and anti-capacity handles are my next purchase. Also a vernier condenser seems to be needed on the A.T.C. for long-range work on short waves.

I am using D.E.R. valves, which seem to suit the circuit.

I have once received WGY, but the music was terribly distorted and the call signal alone intelligible, and this only after repetition.

I am now going to have a try at the Omni Circuit receiver, but will construct it from new parts, as I would not disturb the S.T.100 in its present form in any circumstances.

Yours faithfully,
L. W. EDWARDS.

P.S.—My aerial is fair, being 75 ft. long single wire, 35 ft. at free end, but badly screened by trees to the west and also by the neighbours' bundles of wire, called by them " antennæ " (they have crystal sets with sliders and 12 by 4 coils). Since writing the above I have picked up WGY, Gen. Elec., Schenectady, on about 100 metres. The strength was equal to that of 2LO on a crystal set. Fading was not noticeable, but the wavelength jumped all over the place and fine tuning had to be carried out with the hand owing to the variation. The generator hum was most pronounced.

THE TRANSATLANTIC RECEIVER.

To the Editor of MODERN WIRELESS.

SIR,—You might be interested to hear that I wired up a " Transatlantic Receiver " as described in your late issues of MODERN WIRELESS, with a few slight alterations I thought could not be beaten for design.

We have received *all* the British broadcasting stations. Cardiff seems always weak here.

The first night my son and I were in a hurry to see what we could get at the distance, and at 11.55 to 12.25 we picked up dance music and clapping, one tune being repeated as encore, but we could get no call sign and there was occasional fading. We retired early. A few nights after I tried again and got more music. No call sign. I called my wife down to listen in, and it, the music, was undoubtedly of American origin. But the fading was bad to inaudibility and rose steadily to loud-speaker strength, and so periodically it was repeated.

I have decided to try after 3 a.m., as I did with my previous set, and will let you know the result.

Yesterday I tuned in FL. She came in strong, but was washed out every few minutes by C.W. and spark combined. By altering grid potential and filament heat got her back again, to be immediately washed out by spark and mush. This has not occurred at my previous attempts, when I have held FL and Radiola with perfect distinctness with very slight interference.

We got PP—. Could not get last two letters. Apparently Holland, lecture on dancing with illustrations, speech " Dutch." But they ended up with " Good night, Gentlemen," in quite the approved style, and gave their national anthem and " closing down " in broken English, 11.55 to 12.55. We thought it might be a Brussels station, but the wavelength was just over 1,000 metres to 1,100. Have not calibrated this yet.

It is a very interesting set with possibilities, and I have to thank you as a constant subscriber to your papers, and remain

Yours truly,
H. E. H.

London, W.

THE DOUBLE DUAL CIRCUIT ON THE OMNI RECEIVER.

To the Editor of MODERN WIRELESS.

SIR,—Just a few lines to inform you that I wired my " Omni Circuit " receiver in accordance with wiring plan " Double Dual Receiving Circuit " published in March MODERN WIRELESS. I am delighted with the circuit, have had all the B.B.C. stations, in my opinion, better even than with S.T.100, and, most important of all, I was able to totally cut out 5WA while listening to Radiola station on Sunday last. As my house is only about ½ mile from 5WA transmitting station, I think you will agree that it speaks wonders for the circuit. (I must add that this was without using wave-trap or any other device.)

Yours truly,
P. F. BOOTH.

Victoria Park,
Cardiff.

A TRANSATLANTIC WITH NOTE-MAGNIFIER

To the Editor of MODERN WIRELESS.

SIR,—You may possibly like to know the results of my Transatlantic receiver and companion note magnifier which I recently completed to your design.

The only departures from the design, as published in MODERN WIRELESS, were as follows:

1. In order to have the choice of a greater variety of valves 4-pin valves were used, taking every possible precaution to reduce capacity in the holders to a minimum.

2. A 2-pin socket with a shorting plug was fitted (for reaction when using the 2-coil holder for long waves) on the panel, instead of a permanent connection to the 2-coil holder, which latter is not at present attached to the box. I did not use a sloping front cabinet, as I have not yet decided on the most convenient position for it.

3. A vernier filament resistance is used for the H.F. valves.

4. I have put H.T. terminals on both sides of the note magnifier panel, so that, if necessary, the same H.T. supply can be used for both panels by employing connecting strips between the two.

Although the combination only differs in detail of lay-out of the components from an experimental 5-valve set which I made to my own design nearly two years ago, it is incomparably more efficient and altogether delightful to work with. Reaction down to the lowest wavelength which I have tried—200 metres—is delightfully smooth, and, with correct H.T. voltage, without a vestige of overlap. Adjustment of the filament rheostat of the H.F. valves is, as you said *extremely* critical; when on the border line of oscillation less than one-eighth of a turn of the vernier of the Igranic rheostat suffices to put it into or out of oscillation. It can be set on the very verge of oscillation and remains there with perfect stability, which is extraordinary, seeing that very little grid bias is used on the potentiometer—an Igranic. I should advise anyone constructing one of these receivers to use a vernier rheostat for the H.F. valves, as the control by its use is perfect.

Altogether I am more than delighted with the results, and I cannot conceive a better set as a standard for general use.

The only point requiring attention when one has to get the last ounce out of the set is that the accumulators are in good condition, as, owing to the extreme sensitiveness to H.F. filament brightness, any fall of accumulator potential is accompanied by a more serious loss of signal strength than in most sets. This, however, is only a disadvantage when the receiver is in one room and the loud-speaker in another, as a minute movement of the vernier of the rheostat immediately restores strength, or a correspondingly minute movement on the potentiometer towards –. For this reason I doubt whether dull emitters, *run off dry batteries*, would be very satisfactory with the instrument and loud-speaker in different rooms, but they would, of course, be all right if run off accumulators.

I have for some time past been carrying out trials of all the latest dual circuits in "board" form, and I must confess that, in my hands, I was unable to obtain satisfactory stability unless stabilisation was carried to the point of serious loss of signal strength. For distant work, such as obtains here, they have to have reaction pushed a bit, and, under these conditions, they are all, in my experience, liable to burst into oscillation on the very slightest provocation, or, indeed, without any provocation at all! For shorter distances they may be quite satisfactory, but I have no experience of really short range work. But except as a matter of experimental interest I should never dream of using a dual as standard receiver for anything like distant work. The best is S.T.100 with an extra H.F. stage, although the varying damping by the crystal is a great source of instability, unless two crystals and *firm* contact are employed.

I did not find that the addition of an H.F. stage increased the instability of this circuit appreciably, if at all.

Yours faithfully,
MEADE J. C. DENNIS, Col.
(Late 2HY).

County Wicklow.

The Transatlantic receiver made up by our correspondent at Kilburn.

THE TRANSATLANTIC RECEIVER.

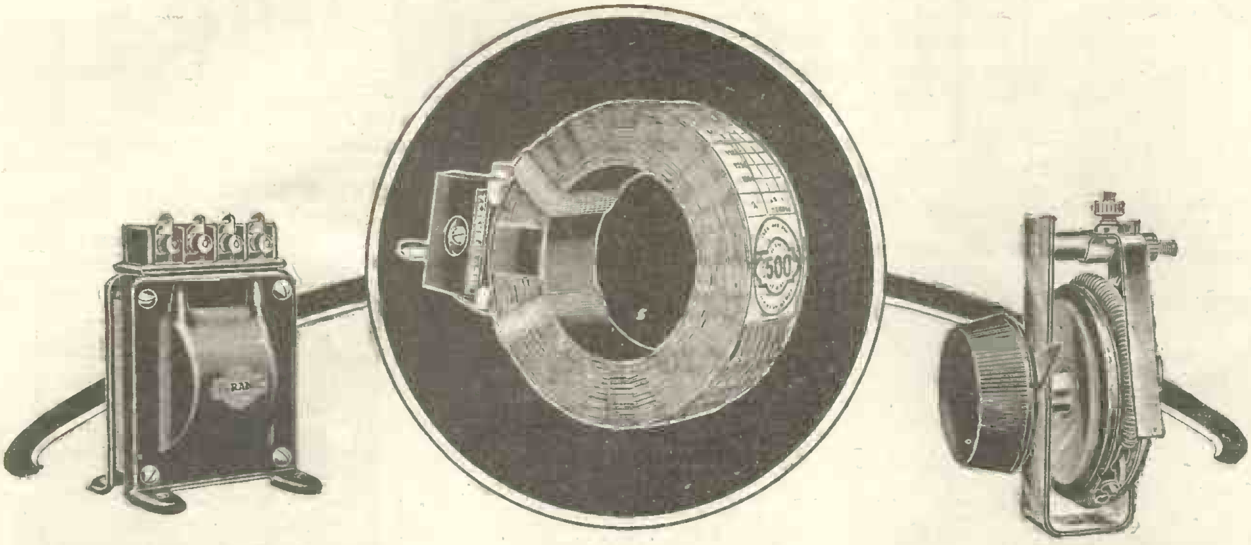
To the Editor of MODERN WIRELESS.

SIR,—I have recently constructed your Transatlantic receiver with two-valve amplifier, and thought you may be interested to know of results and to have photograph of the set. I find that a Bretwood variable grid-leak connected in series to L.T. + increases strength quite 10 per cent., also separate high tension batteries for L.F. valves greatly improve loud-speaker results. I should also like to add that the Ora B valves which I am using in this set work excellently; also that a 50-100,000 ohm variable resistance connected across the secondary (I.S.-O.S.) of second L.F. transformer cuts out any mush, although it slightly decreases strength. The set is very selective. Living only 4½ miles from 2LO, I can cut it out completely when using the H.F. valves and without any wave-trap. Using a 2 ft. 6 in. frame aerial, I picked up Bournemouth and Glasgow on 2 H.F., D. and 'phones. With a twin 30 ft. aerial, approximately 70 ft. high, all B.B.C. stations are audible on loud-speaker under favourable conditions, using 2 H.F. and D., also Radiola and L'Ecole, and using the two amplifiers, all the above can be heard quite 150 ft. away from the speaker. I have not seriously tried for American broadcasting, but received WJAX on December 27th, using four valves, but atmospherics being very bad, I gave up after 20 minutes. In conclusion, I should like to congratulate you on the compact lay-out of this excellent set.

Yours faithfully,
G. W. N.

Kilburn, N.W.

ORDER YOUR SEPTEMBER DOUBLE NUMBER EARLY



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Low-frequency Transformer.

IGRANIC
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Filament Rheostat.

ELECTRON WIRE
THE PERFECT AERIAL

THIS WONDERFUL WIRE IS THE ONLY AERIAL WHICH CAN STAND THE RIGOURS OF THE ARCTIC.

READ THIS AND BE CONVINCED.

Extract from the "Wireless Weekly." *June 25th, 1924.*

THE ALGARSSON ARCTIC EXPEDITION. ELECTRON WIRE IN THE ARCTIC.

A good deal of public interest has been aroused by the Algarsson Expedition from the Thames for the Arctic Circle. After the work is finished in the Arctic, the vessel will return direct across the Atlantic to New York. Their destination is a point some 200 miles from the Pole. She is a small vessel of 23 tons, and there was some difficulty in erecting the aerial. She possesses two masts between which it was quite impossible to string the aerial in the usual position, because her sails would have fouled it. A downlead between the two mast heads was entirely ruled out by the arrangement of the rigging. The only possible position for the span of the aerial was between the masthead and a point in the bow, the aerial being of the twin type with 6 foot spreaders. The only possible point from which the downlead could be taken proved to be the upper end of the aerial, and a most difficult problem arose as to how this was to be brought down to the level of the deck. It could not be brought in the obvious manner straight down the mast, because it would have interfered with certain of the running rigging, and the only possible route or t proved to be down the steel ratlines, no doubt a very undesirable method, but the only possible compromise in the circumstances. Even after its arrival upon the deck, the lead had to follow a somewhat devious route for some distance along under the bulwarks, and then across the deck, and through a skylight. Since a great part of the route of the downlead was liable to be wetted by spray at any time, and also to be submerged at intervals by seas breaking inboard, the question of the type of wire to use for this and for the aerial itself, whose lower extremity was liable to similar treatment, was naturally a serious problem. Remembering the corrosive action of sea water, it was obvious that an extremely durable form of insulated wire was necessary, led to the choice of ELECTRON, the Cable now being sold by The New London Electron Works, Ltd. ELECTRON wire has great mechanical strength and resistance to corrosive influences, and was used for the whole of the aerial and the downlead.

THE SECRET OF "ELECTRON" WIRE.

Wireless experts agree that the ether waves flow only on the surface or skin of the conductor which carries them. Therefore, aerials which consist of several small wires stranded together are more efficient than a single wire of thicker gauge.

It is also an established fact that SILVER is the finest conductor, closely followed by TIN. Silver is not only too expensive to use generally as an aerial, but for many technical reasons it is impracticable.

On the other hand, Tin, an expensive conductor, four times the value of copper, lends itself admirably, inasmuch as it can so easily be coated on other wires of the necessary strength and durability, so that it fulfils the purpose of a perfect conducting "Skin."

That each separate strand of wire is scientifically coated with a skin of pure tin.

Enthusiasts who are using "Electron" Wire in all parts of England and America report wonderfully clear results with either crystal or valve sets. The ether waves penetrate the protective coverings, all incoming signals being held. Suspend "Electron" Wire where you will, lead direct to the set (no separate lead-in required), use "Electron" Wire for earth, and a greatly improved reception will be the result.

EXTEND YOUR 'PHONES or loud-speaker to any part of the house or garden with "Electron" Wire, which being insulated with vulcanised rubber, no further insulation is necessary. You may allow it to touch anything anywhere, indoors or out-of-doors, in perfect confidence. "Electron" Wire has no equal at ten times the price.

"Electron" Wire is ideal for all kinds of Indoor Aerials, Frame Aerials, etc. There is plenty of scope for experimenting. Try every possible way of erecting, and quite likely some new arrangement will be found which will be of great help to others. The set should be as near as possible to the aerial. Lead in at right angles in one continuous length.

The CHEAPEST AERIAL and the Best in the World. 100 ft. **1/8** Postage 6d.

Also for extending 'Phones, Loud Speaker, etc.

Two 150 feet lengths twisted	Two 250 feet lengths twisted	Two 500 feet lengths twisted
300 ft.	500 ft.	1,000 ft.
5/-	8/-	15/-

Carriage Paid.

"Electron" Wire is ideal for all kinds of Indoor Aerials, Frame Aerials, etc. There is plenty of scope for experimenting. Try every possible way of erecting, and quite likely some new arrangement will be found which will be of great help to others. The Set should be as near as possible to the Aerial. Lead in at right angles in one continuous length.

INDOOR AERIALS

"Electron" Wire has been used with great success

Round the Picture Rail,
Parallel across the Room,
Round a Fire Screen,
Round a Cupboard Door,
Along the Corridor,
and almost everywhere.

PUBLIC WARNING

Buy Electron Wire in BOXES ONLY. Take no substitute.
Some dealers try to deceive you. They make coils to look like Electron. They know the way to sell you another wire is to make it seem like Electron.
Buy Electron Wire in BOXES ONLY.
AVOID DECEPTION. Don't buy another wire made to look or to sound like Electron.
LOOK AT THE NAME AND THE BOX.

ON SALE EVERYWHERE

NEW LONDON ELECTRON WORKS, Ltd.

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Telephone: East 1821. East 6043. **99, REGENT'S DOCK, LONDON, E.14.** Tel.: "Stannum, London."

'BUSES Nos. 15, 23, 40, from Aldgate or Bank. (Near East Stepney Station, L.N.E.R.)

Tested by Ourselves

A L.F. Intervalve Transformer

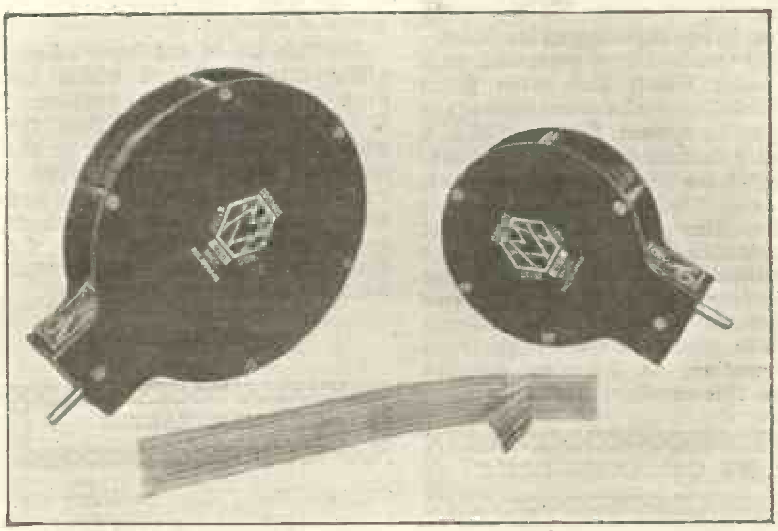
Messrs. Brown Bros., Ltd., have submitted a small low-frequency intervalve transformer. This is of the usual type, having a closed circuit core of iron stampings and brass frame provided with holding-down brackets ready drilled and very small terminals in an ebonite strip at the top. The iron core was noticed to be of extremely small dimensions, and from the relatively low D.C. resistance of the windings it could be deduced that the amount of wire in the coils was not very great. The insulation-resistance was found on test to be satisfactory.

Tested in actual reception, the results in general were disappointing, the tone being thin and tinny, and the amplification not remarkable, being of the order of 4 as compared with 7 for the standard transformer under similar conditions. Evidently both primary impedance and area of core were insufficient to give the best results.

Short-Wave Cosmos Strip Coil

Messrs. Metropolitan - Vickers Electrical Co., Ltd., have submitted for trial several coils of their series of plug-in inductances, wound with the special Cosmos strip. It will be remembered that in this strip several parallel wires are embedded and insulated from one another, in a paper strip. This lends itself admirably to the construction of low-resistance coils for the shorter wave-lengths, as by putting these wires in parallel there is obtained a very favourable type of conductor of really low H.F. resistance, and the strip can be wound in a flat spiral to as many turns as required. So far we have tested the No. 25 coil.

The completed coil is mounted in a neat case, $3\frac{3}{8}$ in. diam by $\frac{7}{8}$in. thick, carrying the usual plug-and-socket fitting. The inductance value is given as 25 microhenries—it is an excellent idea to print the actual inductance on the coil, and much more scientific than giving merely the turns—and on test in a secondary circuit covered from below 75 metres to just under 200 metres wavelength with a parallel .0005 μF tuning condenser and ordinary R valve and panel. With even the low minimum of a small series condenser it was not possible to go quite down to 100 metres on a P.M.G. aerial, either double 40 ft. or single 70 ft. With the customary two-circuit arrangement, a six-turn coil of No. 18 wire on a three-inch former in series with a small variable condenser (.0002 max.) as primary, and this coil as secondary in a three-coil tuner with a parallel .0001 tuning-condenser, with a No. 25 coil of standard make as reaction, it became possible to get down readily below 100 metres on the large aerial. Various short-wave morse transmissions of amateur origin were received at good strength; and a test transmission in the early hours of Sunday morning (apparently of commercial character) on just below 100 metres came in in London at good loud-speaker strength on a O-V-I circuit. While atmospherics were very prevalent at the time of the test, they troubled one but little with this tuning device. Selectivity was excellent, and tuning extremely sharp. The high-frequency resistance was evidently reduced to a minimum. One rather expected to find some unfavourable result from the use of so much paper dielectric;



Two Cosmos short-wave coils, and a strip of the special ribbon with which they are wound.

but apparently the dry paper does not introduce serious dielectric losses

We can confidently recommend this type of short-wave coil to our readers. For the reception of K.D.K.A. and other short-wave transmissions this No. 25 coil is admirably adapted, when used in the manner suggested here. Tests on the other coil will follow shortly.

"Aerio" Insulated Detector Whisker

The elimination of several possible faults in the connection to the catswhisker in ordinary crystal-detectors with adjustable whisker-holder is aimed at in the "Aerio" insulated detector whisker, a sample of which has been sent us by Ernest Bastock.

In this the connection is made direct from the aerial terminal to the whisker by a 9-in. piece of insulated flexible wire, which is actually soldered to the "Spear-point" whisker. This eliminates some half-dozen connections through joints which may become loose or otherwise defective, and in many cases may result in much improved reception. The whisker-holder fits readily in the place of the usual types, a small ebonite tube with set-screw being placed on the sliding rod of the detector in place of the usual metal piece. There is, of course, no particular point in having this part insulated.

On test in actual reception, on a detector which had often given trouble through loose contacts in the adjusting system, the value of this device became apparent. The setting of the crystal was facilitated, as the "fading" effects due to intermittent bad contacts whilst manipulating the mechanism were dispelled. It is a thoroughly sound principle to separate the two functions of mechanical adjustability and continuous electrical connection, as becomes possible with this excellent device.

RE GAMBRELL COILS

To the Editor of MODERN WIRELESS.

SIR,—With reference to your test of the Gambrell Efficiency Coil "a/2," reported on page 761 of the May issue of MODERN WIRELESS, we as manufacturers of this coil would like to make the following observations.

While admitting that principles are fairly well established for comparatively long waves, we cannot agree that this is so for short waves, especially in view of the remarkable results recently obtained in short-wave working.

In order to obtain unbiased figures on the question of gauge of wire, we have requested the National Physical Laboratory to measure the effective resistance at a wave-length of 100 metres of three "a/2" coils identical in all respects except gauge of wire, the results of which we give below:

Wire.	D.C. Resistance Ohms.	H.F. Res. at 100 metres Ohms.
24	.22	2.1
18	.054	1.9
9/36 stranded	.21	2.4

As inductances of this class have to work on a fairly wide band of wave-length, in choosing the gauge of wire for their construction the effective resistance at one frequency is not the only factor to be taken into consideration. The change of resistance with frequency must also be considered and we have chosen 24 gauge for coil "a 2" because the H.F. resistance is more uniform over the range of wave-length on which the coil is designed to work. At 100 metres, 24 gauge gives a result only .2 ohm higher than 18 gauge (see table). At a wave-length of 50 metres, further experiments, at present incomplete, indicate, as we originally found, that 24 gauge is superior.

Further, we do not know of any other detachable coil which has such a low effective resistance. We are not surprised that the selectivity was poor, owing to the admitted tight coupling between the circuits. If loose coupling had been employed, the complaint would not have been that the tuning was flat, but that vernier condensers were necessary.

Yours truly,

GAMBRELL BROS., LTD.

POWER VALVES

To the Editor of MODERN WIRELESS.

SIR,—A great deal has been written lately both in this magazine and in others on the subject of low-frequency amplification. In almost every case the writer has advocated the use of special valves of the "power" type, in conjunction with a high-tension battery of about 120 volts, if maximum results are to be obtained. This type of valve is constructed to handle heavy potentials and certainly gives a large volume of sound and very good quality of reproduction; it is significant to note how many firms are fitting their receivers with a stage of power amplification. There are several power valves on the market at present, and some of the more recent type consume only .25 amp. of filament current, but in my opinion they all suffer from one fault—they are too expensive. The average price is thirty-five shillings, almost treble that of the ordinary bright emitter valve of the "R" type. The special filaments used may account for a certain increase in price, but surely even a couple of inches of special filament, a few extra centimetres of wire, metal and glass, with, perhaps, some little extra time in the exhausting chamber, does not warrant such a large increase over the price of the ordinary valve. There are, of course, the smaller power valves, such as the L.S. 3 and the P.V. 3, which costs only twenty-two and sixpence. I have tested the L.S. 3 on my own set with different values of H.T. and grid bias, but, frankly, I cannot see any difference either in construction or in results between this type and the ordinary "R" valve. What is really required is a valve with a reasonably large plate and grid and a filament that takes the usual .65 amp. It should be capable of handling effectively an H.T. potential of anything up to 300 volts, and should be sold at a price of about twenty shillings. Such a valve would, I am sure, command a ready sale. Most loud-speakers require a strong output from the amplifier in order to do full justice both in volume and in quality to the reproduction. In many cases distortion is due, not to faulty transformer construction or to lack of suitable grid bias, but to thinness or "attenuation" of volume.

Yours truly,

BASIL HAW.

Sidcup, Kent.

THE NEUTRODYNE

To the Editor of MODERN WIRELESS.

SIR,—I have completed your Dual Receiver with Neutrodyne Control, April, by Mr. A. D. Cowper. The set is wonderfully selective and very sensitive.

Also I have just completed March Cabinet Receiver by Mr. Herbert K. Simpson, for my friend.

Please accept my thanks and congratulations on the very excellent design.

Yours truly,

T. K. HOSAI.

Manchester Square, London, W1.

PARAGON-CURTIS ONE PIECE MICA CONDENSER

Marks a FUNDAMENTAL DEVELOPMENT in FIXED CONDENSERS.

Guaranteed CONSTANT capacity at all Temperatures, under all conditions.

Made in ONE piece. NO WAX.

The old-fashioned Fixed Condenser, with its plates and mica di-electric held together in a tin sheath and set in a mould of doubtful insulating properties filled with wax, was at best a temporary expedient which answered the abnormal demand inherent in a new and rapidly increasing industry.

In the Paragon-Curtis one-piece Fixed Condenser the metal plates, mica di-electric and connecting terminals are set in Paralite composition and moulded simultaneously under considerable pressure. So firmly welded are the various parts as to make the **Paragon-Curtis Condenser practically indestructible: it may be immersed in boiling water for an indefinite period; will stand flame heat without damage or loss of efficiency.**

.0001 to .0009 mfd., 1/9 each. .001 to .006 mfd., 2/- each.
For other capacities and particulars SEE LISTS.

The RADIONETTE CRYSTAL RECEIVERS

Established during the earliest days of Wireless Broadcasting, the present many thousands of satisfied Radionette users are a striking testimony, and must be a solid guarantee of uniform Radionette efficiency.

The RADIONETTE "JUNIOR," all-Ebonite Variometer tuning, **15/-**

The RADIONETTE "POPULAR," 200 to 1,850 metres, **20/-**

For other Models, SEE LISTS

The "Popular" Model is designed to operate on ALL British Stations, INCLUDING the High-Powered Station. NO EXTRA COILS REQUIRED.

UNDER "ALLEGED" IMPOSSIBLE CONDITIONS

FIFTY yards from the Generating Station, surrounded by a mass of working machinery, and myriads of Neon Tubes, in the Palace of Engineering, Avenue 14, Bay 12.

WEMBLEY

THE RADIO-STRUCTA

gives a daily solo loud-speaking demonstration, throughout Broadcasting hours, of extra-ordinary power and volume

The "Blind" spot must be "Blind" indeed in which the Radio-Structa will not operate

For prices and particulars of the NEW 2, 3 and 4 Valve Radio-Structa models with Silver-plated fittings, see lists.

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RADIO QUALITY

EBONITE

is manufactured from the purest materials only in accordance with the OFFICIAL POST OFFICE SPECIFICATION "B" and

GUARANTEED TO CONTAIN NO "FILLINGS" or "LOADINGS"

to increase the weight.

Therefore PARAGON RADIO QUALITY EBONITE is

1. The lightest in weight.

Size of sheet.	Average weight Paragon.	Average weight other makes.
24×24×¼	6 lb.	7½ lb.
24×24×3/16	4½ lb.	6 lb.

i.e. 30% more superficial area for the same weight.

2. **Of Guaranteed Quality** as it is manufactured to **Government Specification.** You *do* know what you get when it is PARAGON.
3. ASSURES, because of its purity, 25% increased machining speed without chipping and double life for cutting tools.
4. The uniform fine grain, dead matt surface of **Paragon Radio Quality Ebonite** is obtained by a secret process and is unequalled for its distinctive appearance.

SHEETS, RODS, TUBES, MOULDINGS.

TESTED AND RECOMMENDED BY MODERN WIRELESS

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Radio Quality
Post Office "B"

"The Best Made." **EBONITE PANELS**

Fine grain, dry matt finish, ground edges.

EACH PANEL in SEALED CARTON
Stamped "PARAGON."

STANDARD SIZES.

6½ × 5½ × 3/16	1/9d	*24 × 10 × ¼	15/-
6½ × 5½ × ¼	2/3d	*10½ × 7 × ¼	4/7d
8 × 6 × 3/16	2/6d	*12 × 6 × ¼	4/6d
8 × 6 × ¼	3/3d	*22 × 11 × ¼	15/3d
10½ × 8½ × ¼	5/6d	*16 × 9 × ¼	9/-
12 × 10 × ¼	7/6d	*12 × 11 × ¼	8/3d
14 × 12 × ¼	10/6	*18 × 6 × ¼	6/9d
16 × 12 × ¼	12/-	*12 × 8 × ¼	6/-
		*10 × 8 × ¼	6/9

* Extra price for.

Modern Wireless Panels Drilled & Engraved from stock

High Frequency S.T. 100, 5/9.
Efficient Single Valve Receivers, 3/6.
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Portable Receiver, 8/-
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Single Valve All-Wave [Set, 3/6
PRICE FOR PANELS ONLY see "Standard Sizes."

Special Panels, similar quality and finish, **Cut, Edges Squared** and despatched same day. ¾d. per square inch—postage 6d. extra

Stocked by all reputable Stores. But it must be in Paragon sealed carton.

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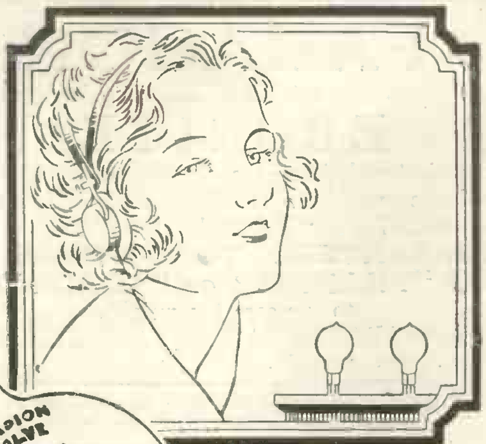

Your "REFLEX" RECEIVER

can be doubly economical if you fit Radion Valves. D.4 for single valve circuits. A.2 for second stage in S.T.100, etc. These valves use only a third of usual filament current.
Use only .25 amps. at 3.5 to 4 volts. Anode Volts 30 to 90.
On all normal plate voltages no grid bias is needed.

Two Types : A2 for amplifying.
D4 for detecting.

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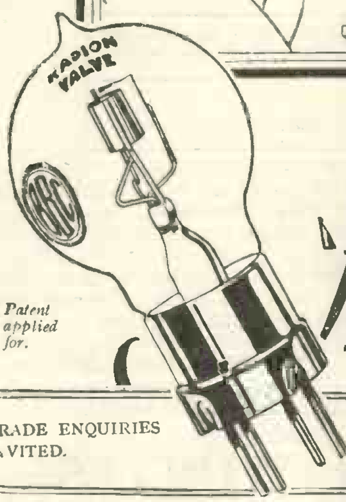

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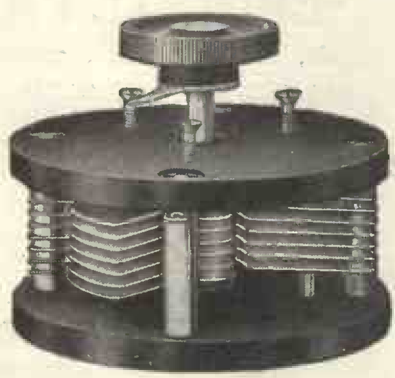

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Basket Coils

A New Type of Mounting and 3-Coil Holder.

Basket Coils are coming into favour in many quarters, and would be still more popular if the mounting methods were improved. This article describes a very practical holder.

THIS 3-coil holder and type of mounting here described has been found very satisfactory by the writer, and will no doubt appeal to those who construct their own apparatus on account of the small cost involved (approximately 3s. for the holder), and when completed makes a very neat and compact piece of apparatus.

The holder may be used either as a separate unit or mounted on a cabinet.

Coils wound on a permanent cardboard or fibre former are the type for which this form of mounting and holder is designed. These are mechanically stronger than those wound on a removable former, but with little extra work this method may be adopted to other types of coils.

With a view to facilitating the purchase of parts and materials, the following table is given :—

Item and Material.	Fig.	Size.	Quantity.
Required for Mounting 1 Coil.			
Ebonite..	1	2½ in. ×1 in. ×⅛ in.	1
Spacer, Wood	1	⅞ in. ×1 in. ×½ in.	1
Contacts, No. 22 S.W.G., phosphor bronze strip	1	1⅜ in. ×⅜ in.	2
Screws, brass, cheese head (or bolts)	1	No. 8B.A. ×5/16 in.	4
Nuts, brass	1	No. 8B.A.	4
Screws, brass, wood, countersunk head	1	No. 2 ×5/16 in.	2
Screws, brass, wood, round head	1	No. 2 ×3/16 in.	2
Required for Holder.			
Base, wood	2 & 3	4⅞ in. ×2 in. ×½ in.	1
Spindle Supports, wood ..	2, 3 & 4	4⅞ in. ×2 in. ×½ in.	2
Rotating Holders, ebonite ..	3 & 5	1¼ in. ×1½ in. ×5/16 in.	2
Fixed Holders, ebonite ..	3 & 6	1½ in. ×2 in. ×5/16 in.	1
Terminal Blocks, ebonite ..	2, 3 & 8	2 in. ×⅝ in. ×⅛ in.	3
Knobs, ebonite	2 & 3	—	2
Springs, contact, No. 22 S.W.G., phosphor bronze	5 & 7	2 1/16 in. ×⅜ in.	6
Spindles, brass rod	3	No. 2B.A. ×5⅜ in.	2
Bushes, brass	3	To clear No. 2B.A.	4
Nuts, brass, round or hexagon, ⅛ in. thick	3	No. 2B.A.	4
Nuts, brass, hexagon, ordinary	3	,,	2
Nuts, brass, lock	3	,,	2
Washers, spring	3	,,	2
Screws, brass, cheese head ..	5	No. 8B.A. ×¼ in.	12
Screws, brass, countersunk head	2 & 3	No. 6B.A. ×⅜ in.	4
Screws, wood, brass countersunk head	2 & 3	No. 3 ×⅜ in.	12
Do. do. do. ..	2	No. 1 ×5/16 in.	8
Do. do. do. ..	2	No. 4 ×1 in.	4

NOTE.—Three feet of phosphor bronze strip, No. 22 S.W.G. ×⅜ in., can be purchased for about 4d., and this will be sufficient to make springs for 8 coils and also for the holder.

Coil Mounting

Fig. 1. Having cut the phosphor bronze contacts, ebonite and wood spacer to dimensions given, and drilled all necessary holes, the coil can now be mounted. Commence by screwing the coil to the spacer by means of two No. 2 ×3/16 in. round head brass wood-screws. It may be as well to mention that the wood spacer is used in order that the holders may be spaced a reasonable distance apart and yet a tight coupling may be obtained.

The contacts should now be fixed to the ebonite strip by means of the screws (or bolts) and nuts as shown. This done, the strip may now be screwed to the wood spacer, the contacts being on the side nearest the coil. All that remains to be done is to pass the two leads from the coil through the holes drilled for that purpose in the ebonite strip and solder each to the screws securing the contacts, or, as an alternative, tags can be soldered to the leads and fastened under the nuts.

When inserted in the holder the coil is held quite rigidly by the contact springs.

The Holder

The minimum amount of ebonite is used in the construction of the holder. Any odd pieces of ebonite left over from other jobs may be of use ; if not, such pieces may be purchased at many wireless dealers for a few pence.

The wood used was well-seasoned mahogany, French polished, but, of course, choice of wood and finish is best left to individual taste.

Construction

Having decided on the wood, the first operation will be to prepare the Base (Figs. 2 and 3), ½ in. wood.

Cut to size (4⅞ in. ×2 in.) and drill four holes for No. 4 wood screws (for fixing spindle supports), two on each side, ⅛ in. from the edge and 1 in. from each end (Fig. 2). Countersink these holes on the underside of the base. Polish or varnish as desired.

Spindle Supports (Figs. 2, 3 and 4).

Two of these are needed, but only *one* should have the two holes drilled for the terminals as shown. The diameter of these two holes cannot be given as it depends on the size of terminal fitted, but each hole should be of such a size that the nut and washer securing the terminal to the ebonite block is clear of the wood. Each support is slotted at the ends to take the terminal blocks.

Rotating Holders (Fig. 5).

Two of these are required complete with contact springs. Thicker ebonite may be used, but the thickness given will allow a clearance hole for No. 2B.A. quite well, provided care is taken in drilling. It was found that the surest way with a hand drill was to place the ebonite in a vice so that the drill was used horizontally. A piece of wood of the same thickness as the ebonite, placed in the vice so that the drill itself will lay along its edge acting as a guide horizontally whilst the eye above has only one direction to correct.

The four fixing holes for contact springs should now be drilled and tapped No. 8B.A.

Fixed Holder (Fig. 6).

Four fixing holes (2 in each side as indicated) tapped No. 6B.A. and four holes tapped No. 8B.A. (as in the case of the rotating holders) complete this item.

Contact Springs (Fig. 7).

These are made from No. 22 S.W.G. phosphor bronze strip ⅜ in. wide (mentioned previously) and are, perhaps, the most difficult parts to make. A length of phosphor bronze 2 5/16 in. long (this being the length before bending as shown) should be cut. Next drill the two holes clear for No. 8B.A. Now we come to the operation of bending to shape. This may be done with round-nosed pliers or a template may be made in wood to the shape at "A." As there are six springs to be made it will be advisable to spend a little extra time in making the template which will ensure the springs being identical in shape and therefore pressure, which is important for holding the coils rigidly and making good contact. The outer surface may be polished and lacquered as indicated.

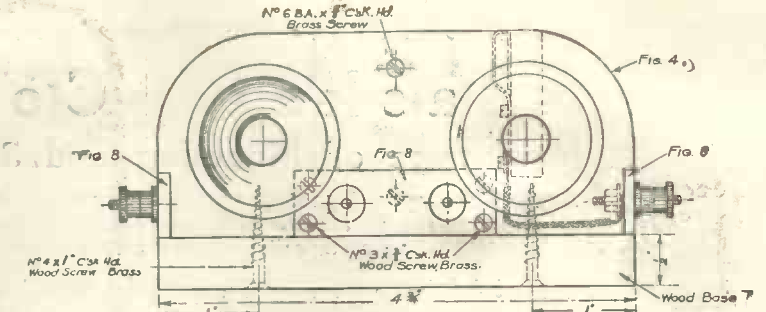


FIG. 2. FRONT ELEVATION

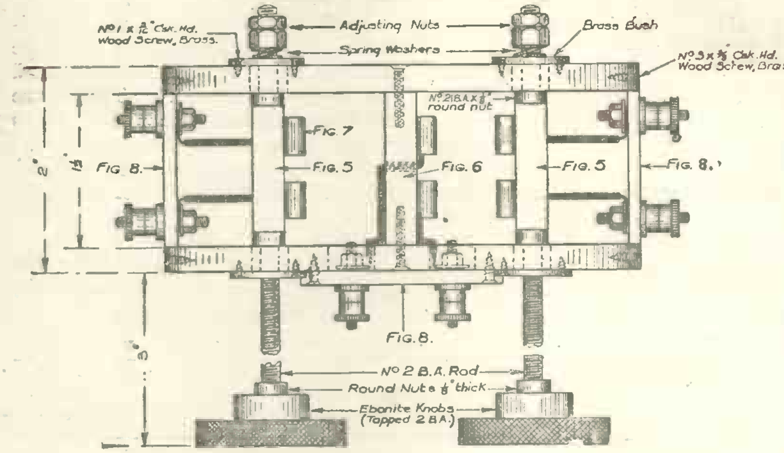


FIG. 3. PLAN

Figs. 2 and 3 Constructional details of the spindle supports.

Terminal Blocks (Fig. 8).

These are simple and need no explanation. Brass bushes, terminals, nuts, washers, ebonite knobs and 2B.A. rod can all be purchased for about 2s. 6d.

Assembly

Commence by fixing the bushes into the spindle supports with No. 1 wood-screws, as shown in Fig. 3. Now screw the spindle support having two terminal holes to the base by two No. 4 × 1 in. countersunk head brass wood-screws. Leave this for the time being and proceed to fix the contact springs on each holder by the top screw first, then, before screwing in the lower screw,

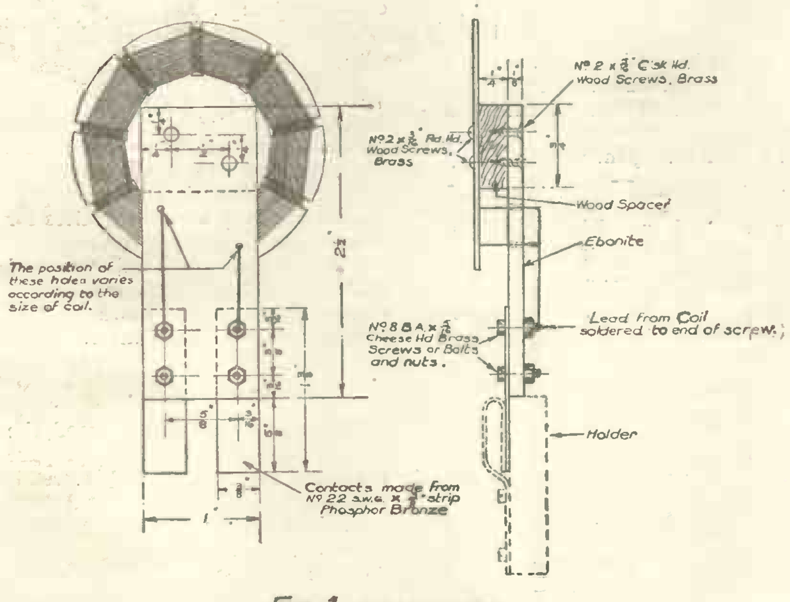


FIG. 1 COIL MOUNTING

Fig. 1.—Details of the coil mount and illustration of how the coil is mounted.

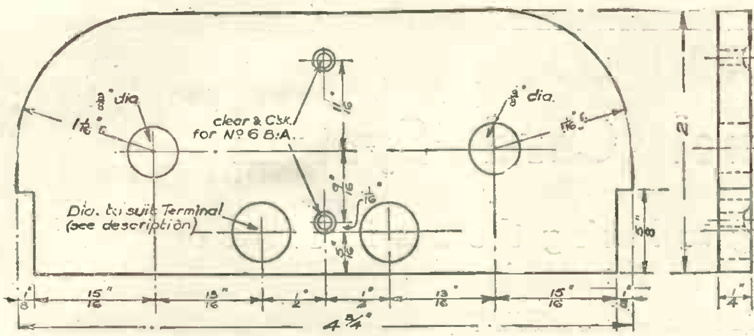


FIG. 4. SPINDLE SUPPORTS. WOOD
2 off, 1 without holes for Terminals

Drilling Dimensions of the spindle supports.

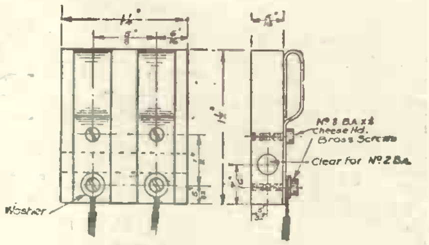


FIG. 5 2 off.
ROTATING EBONITE HOLDER
Showing Springs Fixed

Details of the holder for the moving coils.

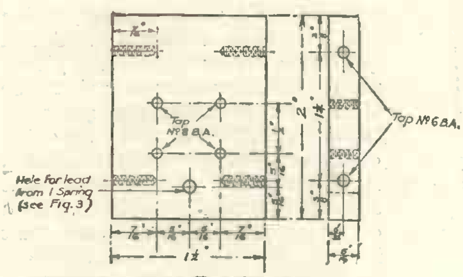


FIG. 6 1 off
FIXED EBONITE HOLDER

Dimensions for the fixed coil holder.

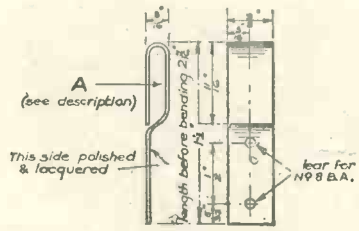


FIG. 7 6 off
CONTACT SPRINGS
Phosphor-Bronze Strip, No 22 S.W.G. x ⅜"

Constructional data of the contact springs for holding the coil mount.

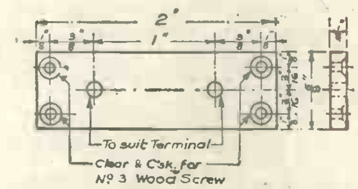


FIG. 8 3 off
TERMINAL BLOCK EBONITE

Two terminal blocks will be required to the dimensions given above.

take a length of flex (in the case of the rotating holders sufficient length should be allowed for the movement of the holder) and strip off the insulation from one end for $\frac{3}{8}$ in., make a loop and line with thread. Place under the washer and screw down as indicated in Fig. 5. Each spring contact on all three holders having a lead attached in this manner.

The centre holder should now be fixed to the spindle support already mentioned, by two No. 6B.A. × $\frac{3}{8}$ in. screws (Fig. 2).

The next parts to receive attention are the rotating holders. These are fixed on the spindles about $\frac{7}{8}$ in. from one end by two round or hexagonal nuts $\frac{1}{8}$ in. thick (one on each side). Now pass the longer end of the spindle through the bushes and fix the ebonite knobs as shown in Fig. 3.

The other spindle support may now be fixed (as in the case of the first) by screwing it to the centre holder and base by similar screws.

Movement may be adjusted by means of the nuts and spring washers as indicated in Fig. 3.

In carrying out the final operations of fixing terminals, blocks and wiring it will be found easiest to assemble the terminals on the blocks, attach the various leads and then screw the blocks into positions shown in Fig. 3.

A Reader's Experiences

To the Editor of MODERN WIRELESS.

SIR,—Certain letters in the June issue prompt me to express to you my thanks for a delightful hobby derived almost entirely from *Wireless Weekly* and MODERN WIRELESS, which I have taken in—and still treasure—from No. 1 of each.

I have made Mr. Cowper's really loud crystal set in December *M.W.*; it is well-named, for it works my large Claritone quite nicely.

Then Mr. Percy Harris' ST100 for the beginner: excellent results. And so on to the portable ST100; and there is one after my own ideas totally enclosed, but easily accessible: the latter was in nightly use until I succumbed to Mr. Percy Harris' family receiver: excellent. It will pick up Aberdeen and Paris on one valve by having the H.F. valve switched on, but not lighting the filament. Eiffel Tower is pleasant on L.S. on three valves, and emphatically loud on four. America several times, twice on the L.S. was audible two or three yards away. As 5IT is only $1\frac{1}{2}$ miles away I use one valve for the L.S. when alone, and two is ample in my corner 30 ft. away. I cannot tune in Glasgow or Aberdeen with local station at work: the waves from 5IT fairly shake the wire!

So, then, I built another for a friend!

But, best of all, your papers have enabled me to reproduce music—not mere noise.

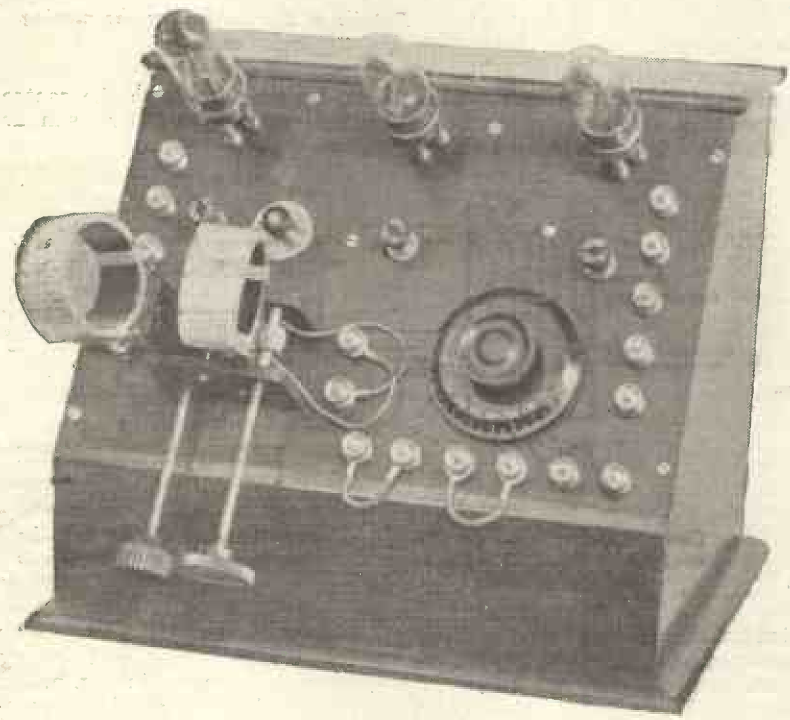
Wishing every success to M.W. and *W.W.*—Yours truly,

W. F. JESSON.

Edgbaston,
Birmingham.

The Panel Card System

"The Next Best Thing to having the Set in Front of You"



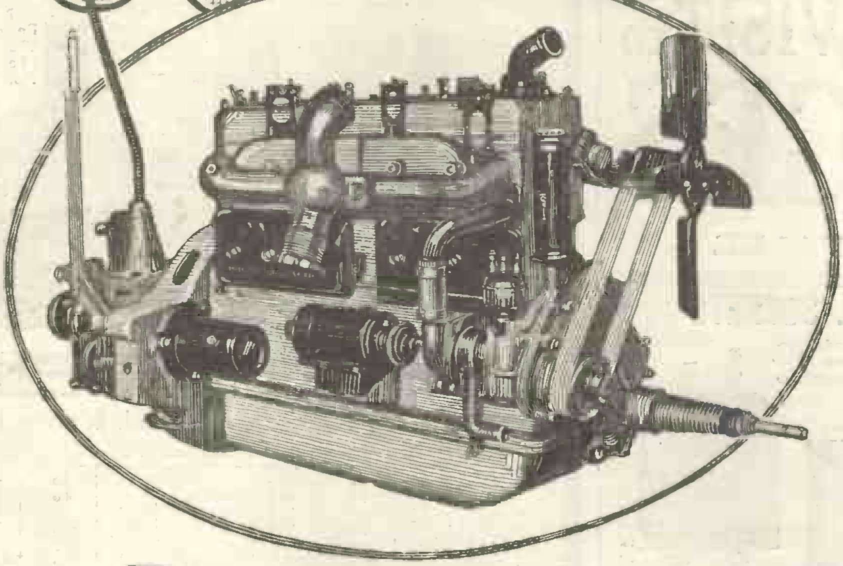
The W.1 Receiver. Note the simplicity of its controls.

PROBABLY the most ingenious aid to the constructor yet produced by Radio Press is what is known as the Panel Card System. Only the first card has yet appeared, but its great success indicates clearly that its producers were right in their belief that the system would prove of great benefit to the wireless constructor. The panel card undoubtedly gives just that feeling of something concrete to work to which can never be obtained from the ordinary magazine article, however detailed and comprehensive it may be. The panel card itself consists of a full size flat cardboard model of the panel, which is printed upon one side with a reproduction from a photograph of the actual original set, and upon the other side with a drawing of the exact wiring. This wiring diagram also shows the arrangement of the various parts upon the other side of the panel, and therefore with this model in his hands, the constructor can obtain a perfectly clear idea of the whole disposition and lay-out of the set by simply turning from one side of the model to the other. In the matter of the smallest detail he can make up his mind exactly how things will be arranged, by taking a pin and pricking through the panel card so that he can trace exactly the correspondence between back and front. The two sides have been made to register as exactly as possible, when due allowance is made for optical imperfections of any camera used for photographing the panel itself. In fact, it is practically as good as having a fully finished set in front of you to copy, and the constructor will find the panel card system makes an irresistible appeal.

The card is enclosed in an attractive envelope carrying a view of the finished receiver, and it is accompanied by a sheet which bears upon one side clear and concise instructions for making the set and putting it into operation, and upon the other a full size diagram for the drilling of the panel, which can be used as a template. A full list of the necessary parts is given, with the approximate prices, so that the constructor can ascertain before he commits himself almost the exact amount of his expenditure. A numbered key to the wiring is also given, so that either system of wiring up can be adopted, that is to say, the points can be numbered and wired up from the key, or the wiring diagram can be copied, employing the usual method of crossing out each line as the corresponding wire is soldered into position. A circuit diagram of the receiver is also given for the benefit of the more advanced reader who likes to know exactly what kind of receiver he is building, so that he may compare its performance with others, which he may have used, employing a similar arrangement.

Radio Press Panel Card No. 1 (price 1s. net), by Herbert K. Simpson, is now available to the constructor, and this card deals with the well-known W.1 Three-Valve Receiver. This set is one which can be very easily made, and is particularly easy to operate, since it has only one tuned circuit, and, therefore, all that is needed in searching for distant stations is to adjust suitably the reaction coupling, and vary the capacity of the tuning condenser. The circuit consists of a rectifying valve with adjustable reaction, and two stages of low-frequency amplification, which can be brought into circuit as required by means of appropriate terminals. The set has given excellent results and many of our readers have reported great success with it.

Cossor



The Power Unit of your Receiver.

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And so it is with Radio. The Valve is the power Unit of your Set — the mysterious "something" that makes it work. If your Valves work efficiently then you can be sure of getting the best possible results.

Just as there are plenty of car owners who will never experience the finer delights of motoring until they ride in a luxurious limousine, so there are still many wireless enthusiasts who will never know how well their Receiving Sets can work until they use Cossor Valves.

There is no substitute for a Cossor Valve. The secret of its success lies entirely in its unique design and superior construction. The hood-shaped Anode and Grid encloses, and makes use of, practically the whole of the electron stream—thus creating superior rectifying properties.

The filament, arched like a bridge for strength, ensures a very long life under all conditions. The Grid, built up on a solid nickel band, is actually anchored in three distinct positions to each turn of wire—thus eliminating all microphonic noises.

These are but three advantages not found in any other Valve—it is no wonder that the Cossor holds such a dominating position in the minds of those who want to extract the last "ounce of efficiency" out of their Receiving Sets.

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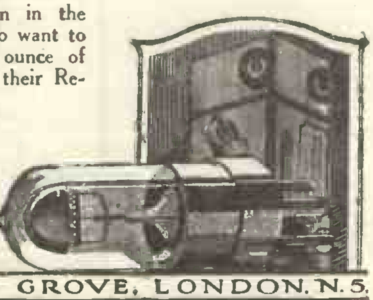

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Home Built Wireless Components

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This book is a collection of constructional articles, which describe every component necessary in the building of wireless sets. It is complete with diagrams and illustrations, and as the fullest details are given, the home construction of any particular component is rendered a very simple matter. Before buying components for your next wireless set, get a copy of this book, it may save you money. **2/6**

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This new Book by G. P. Kendall, B.Sc. (staff editor), contains concise details for making every type of Coil used in Wireless to-day. All necessary data, such as diameter of tubes, gauge of wire, number of turns, etc., are given—the results of the author's own experiments. **1/6**

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REFLEX WIRELESS RECEIVERS IN THEORY AND PRACTICE.—CHAPTER VI.

By *JOHN SCOTT-TAGGART, F.Inst.P., A.M.I.E.E.*

(*Continued from page* 191, *July Issue.*)

A FORM of back-coupling which overcomes a good many troubles in a reflex receiver consists merely of a condenser which is charged up by the rectified currents from a crystal detector. No transformer is used, and consequently it is a simple matter to obviate the setting up of a low-frequency oscillation circuit which would be liable to assist in producing low-frequency oscillations.

The elimination of a transformer certainly stabilises a reflex circuit, but, on the other hand, the same step-up effect is not obtained. The effect is very similar to a receiver consisting of a crystal set followed by a valve without any intermediary transformer. The usual procedure, in this case, is to connect one of the telephone terminals of the set to the grid of the valve, and the other side (the one nearest the earth) to the negative side of the filament accumulator. Such a circuit, while giving quite good results, is inferior to one employing a step-up transformer between the output circuit of the crystal set and the grid circuit of the valve. The absence of a transformer, however, possesses certain advantages outlined above in the case of a reflex circuit, and, consequently many experimenters who are anxious to produce absolute stability will prefer to use a circuit of the kind illustrated in Fig. 23, in suitable circumstances.

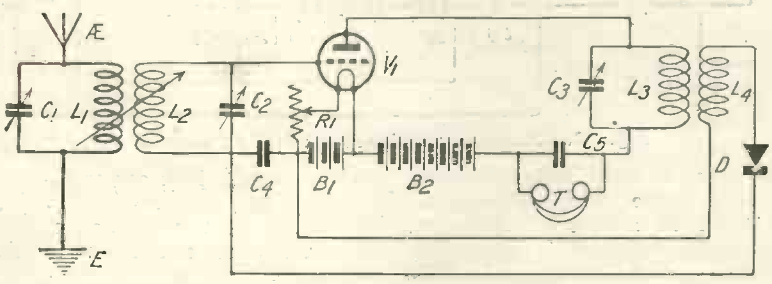


Fig. 23.—A circuit in which the feed-back transformer is eliminated.

In this circuit separate aerial tuning is illustrated, although here again this is merely for the purpose of explaining the action of the circuit without introducing the complications which may arise when direct coupling is employed. The high-frequency potentials are communicated to the grid of the valve and produce amplified currents in the circuit L_3, C_3, which is tuned to the incoming wavelength. The amplified oscillations are now passed on to the inductance L_4, which will usually be coupled in a fixed manner to L_3 (in the standard commercial high-frequency transformer), and thence to the crystal detector D which rectifies the currents. The rectified currents are now fed into the condenser C_4 which may have a value of 0.0003 μF. The result is that the left-hand side of C_4, when signals are being received, varies at a low-frequency potential with respect to the filament of the valve, and these potentials across the condenser C_4 will be communicated through the inductance L_2, which, of course, will not affect them in any way, to the grid of the valve. The valve now proceeds to amplify these low-frequency potential variations and

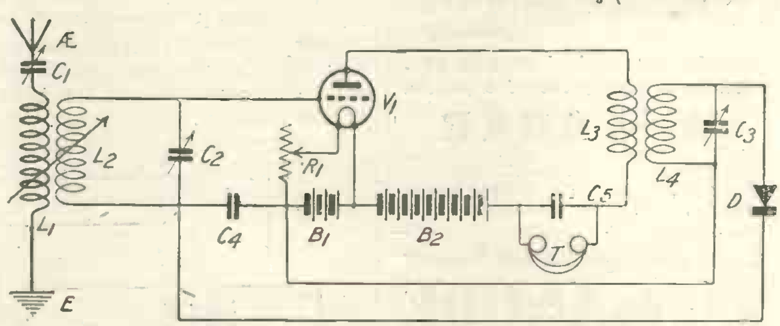


Fig. 24.—A modification of the previous circuit in which the crystal detector circuit is tuned.

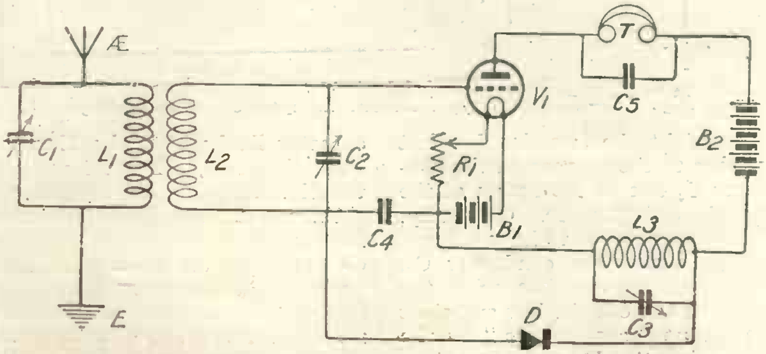
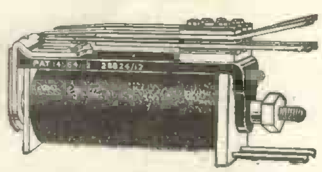


Fig. 25.—An interesting circuit not previously published.



the amplified currents pass through the telephones T in the ordinary way, the usual by-pass condenser C_5, of, say, 0.002 μF capacity, being provided to allow for the passage of the high-frequency currents in the anode circuit.

A modified form of the Fig. 23 circuit is shown in Fig. 24, and here it will be seen that the only variation is to tune the crystal detector circuit instead of the anode circuit. This has the advantage that the valve does not have the same alter the operating point on the characteristic curve of the crystal detector. This aspect does not seem to have been considered previously, but the reason for this is probably because there is always a certain amount of leakage across C_4 in any case. Nevertheless, the effect is there, and may be compared to the use of a grid condenser without any leak across it. In this case, of course, if there is any question of choking up, it is a very simple matter to connect a

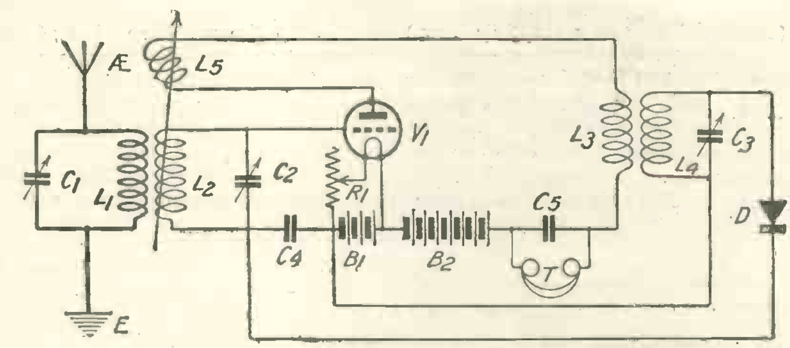


Fig. 26.—Reaction applied to the Fig. 24 circuit.

tendency towards self-oscillation. This, of course, may in a sense be a defect in a circuit where no deliberate reaction is provided, because a slight tendency to self-oscillation, of course, means that there is an inherent reaction effect in the circuit which will help to strengthen signals. If, however, a reaction effect is to be obtained, the author believes in trying to cut out any inherent reaction and to put in a deliberate means for introducing reaction.

high resistance leak across C_4—an ordinary grid-leak may be used. As a matter of fact, in practice this, however, does not seem to be necessary.

Another point that may occur to the beginner will be the question of the grid circuit of the valve choking up because of the condenser C_4. An examination of the circuit, however, will show that any accumulation of electrons on the grid can leak away through the inductance L_2, through the crystal

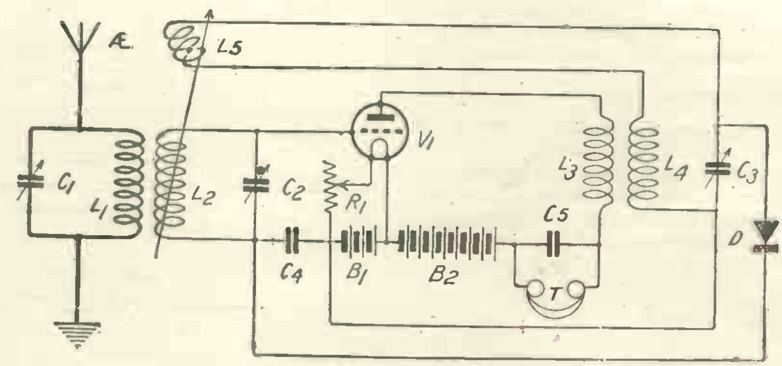


Fig. 27.—Reaction applied from the transformer secondary.

It might be wondered what happens to the charges on the condenser C_4 due to the action of the crystal detector D. Obviously, what is required is to have a small leakage across the condenser C_4, insufficient to interfere with the action of the circuit, but sufficient to prevent "choking up" of the crystal detector D., *i.e.*, the establishment of a steady potential across the condenser C_4 which would

detector D, back to the filament This, therefore, will not cause any trouble.

The use of a high-frequency transformer in these circuits is fairly obvious. If an ordinary tuned anode circuit were employed, the high-tension battery would communicate its voltage through the crystal detector to the grid of the valve, which would consequently be given a high positive potential

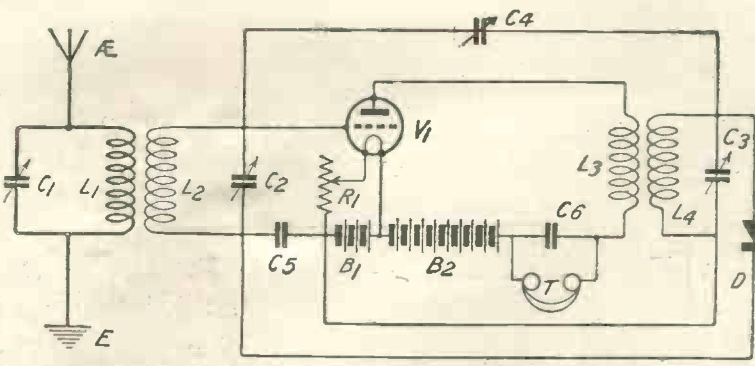


Fig. 28.—Capacity coupling from transformer secondary to grid.

which would prevent the operation of the valve. A transformer separates out the direct anode circuits, and therefore obviates a good many of the troubles experienced in reflex circuits.

An Important Point

A rather important point is to note which end of L_4 should be connected to the crystal detector D. Earlier in this series it has been explained that, in the case of a high-frequency transformer such as L_3, L_4, there is a high potential end of the inductance L_4 when signals are being received, and it is this end which should be connected to one side of the crystal detector. When using a circuit of the kind illustrated in Fig. 23 or Fig. 24, the experimenter should try reversing the connections to L_4. He will generally find that one way round gives better results than the other. A reversal to the connections of the crystal detector may also be tried, but this, generally, is found to make no difference. The effect it has is to cause the low-frequency potentials given to the grid to be either positive or negative, according to the direction of the crystal detector.

A Tuned Anode Transformerless Reflex Circuit

It must not be imagined that the use of a transformer is imperative when the method of feeding back illustrated in Fig. 23 is employed. Although not previously published, the circuit of Fig. 25 will work and give quite good results. This however, is essentially a one-valve circuit, and it will be seen that the high-tension battery, instead of having its negative terminal connected to the positive terminal of the accumulator, is connected on the anode side of the circuit L_3 C_3. This means that the high-tension battery and telephones (both of which should be carefully insulated) are at high-frequency potential to earth, and one of the fundamental rules given in an earlier chapter has been broken. Although the full desirable signal strength is not obtained, and although touching the phones or high-tension battery will affect the signal strength, yet quite good results are obtainable with an arrangement of the Fig. 25 type, and it is given here more as a matter of interest than anything else.

No attempt, of course, should be made to add a low-frequency amplifying valve to this circuit if both filament battery and high-tension battery are to remain the same.

Adding Reaction to the Transformerless Circuit

To increase the signal strength obtained with the type of circuit illustrated in Fig. 23 and Fig. 24, reaction may be applied, and it is proposed to describe some of the methods whereby a reaction effect is obtainable in this class of circuit.

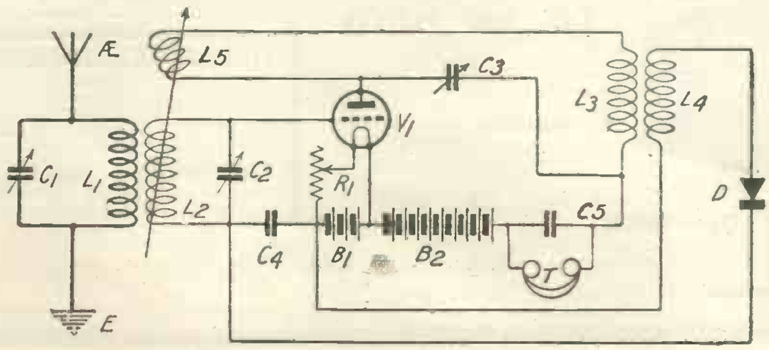


Fig. 29.—Another method of introducing reaction.

One method is illustrated in Fig. 26. It will be seen that this corresponds to Fig. 24, and that a reaction coil L_5 has been included in series with the primary L_3 of the high-frequency transformer L_3 L_4. This reaction coil L_5 should be as small as possible while still obtaining the necessary reaction effect. A trouble which may arise occurs when the reaction coil L_5, together with the primary L_3, forms an oscillation circuit, shunted by the self-capacity of the coils and the filament to anode capacity of the valve so as to form a circuit resonant to the same frequency as the grid circuit. Self-oscillation is very likely to occur under these circumstances, and the remedy is to use as small a reaction coil as possible.

Fig. 27 shows how the reaction may be applied from the secondary of the transformer, and this will usually be found a convenient method, although it is to be noticed that the introduction of the reaction coil will increase the minimum wavelength of the secondary of the transformer, and, therefore, the reaction coil should be kept as small as possible, and it should be remembered that if the transformer is designed so as to cover a wavelength of, say, 300 to 600 metres, the introduction of a reaction coil will raise the minimum wavelength to, say, 350 metres or 400 metres, according to the size of the reaction coil.

Fig. 28 shows how capacity coupling between the tuned secondary of the transformer and the grid circuit of the valve may be used to produce a reaction effect. This capacity is provided by the small vernier condenser C_4, the size of which, however, will depend upon the wavelength to be received. The writer is not greatly in favour of the use of capacity reaction in a circuit of this kind, because it varies with the wavelength to be received so largely, and different sizes of condensers are really necessary if the set is to be capable of covering all wavelengths, whereas when magnetic reaction, using a reaction coil, is employed, different coils may be plugged into the coil holder, whereas variable condensers cannot readily be changed to suit particular conditions.

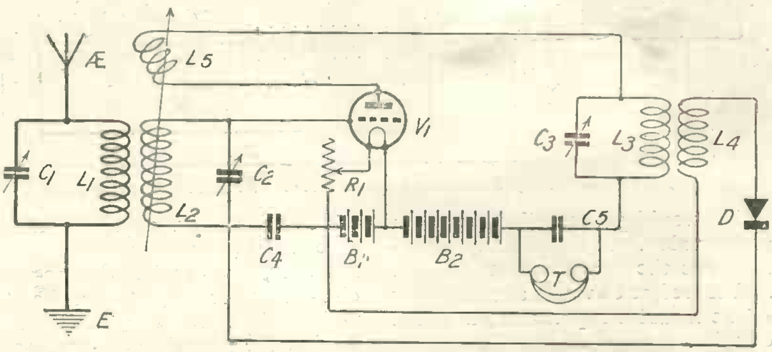


Fig. 30.—In this case the reaction coil does not make a material difference to the tuning of the circuit.

Fig. 29 illustrates a method of introducing reaction into a transformerless reflex circuit of the kind discussed. (*Continued on p.* 293.)

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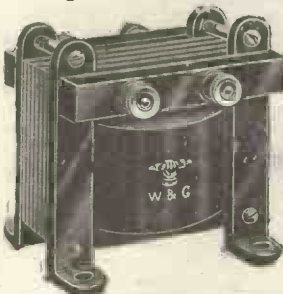

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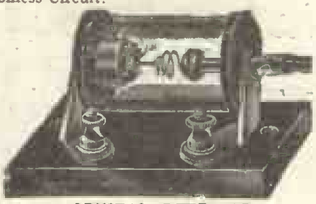

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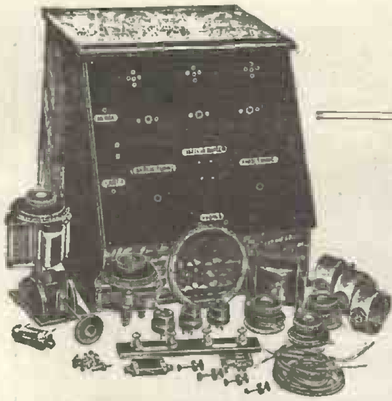

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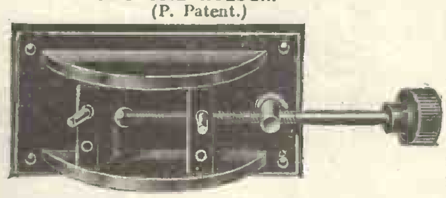

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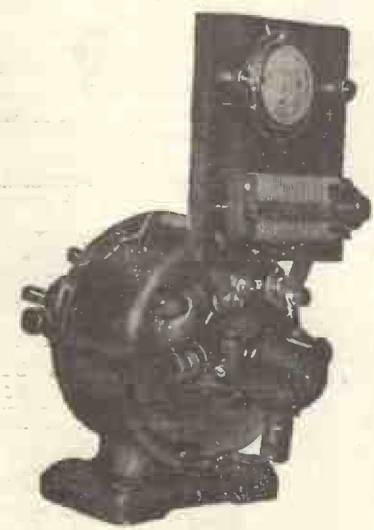

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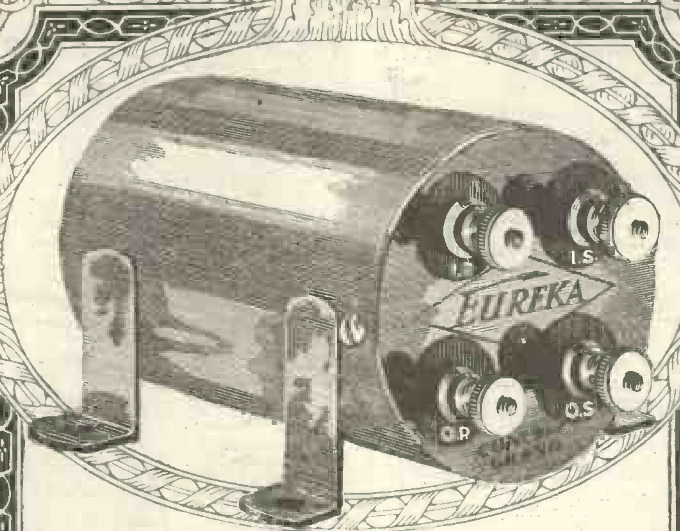

The economy of good Quality

AT last—probably as the result of much editorial space being devoted to the subject—the L.F. Transformer is being selected on quality and performance. Not as so much iron and copper wire, but as a definite part of a Receiving Set which can make or mar reputation for clear and truthful reception.

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In this case it will be seen that the reaction coil L_5 is actually included in the anode circuit of the valve, the oscillatory circuit now consisting of the inductance L_5 and the inductance L_3 in series, both shunted by the variable condenser C_3. Here again, it is to be noticed that the addition of a reaction coil to the anode circuit of the valve will increase the minimum wavelength to which the high-frequency transformer will tune. This point has already been discussed previously.

An arrangement in which the reaction coil does not make any material difference to the tuning of a transformer, is that illustrated in Fig. 30, where it will be seen that the reaction coil is in the anode circuit of the valve, but is actually outside the tuned circuit $L_3 C_3$, and therefore does not appreciably affect the tuning of this circuit. Some trouble may occasionally be experienced with this class of circuit due to two oscillation circuits being formed, the valve tending to oscillate on one or other of two wavelengths. The reaction adjustment is also liable to be rather erratic and disconcerting.

(*To be continued.*)

An Appreciation from Australia

To the Editor of MODERN WIRELESS.

SIR,—I am taking the liberty of addressing this short note to you in order to express appreciation, from this side of the globe, for your wonderful S.T.100 circuit and also for that fine publication known as MODERN WIRELESS.

I have just received the Spring Double Number, and it easily ranks, in my opinion, as the best and most accurate wireless periodical published.

I have had the S.T. 100 circuit going for some time now, in experimental form, and find it easily the best of all the various circuits I have tried, using up to four valves. In fact, the results have induced a number of my friends to convert their four valve sets.

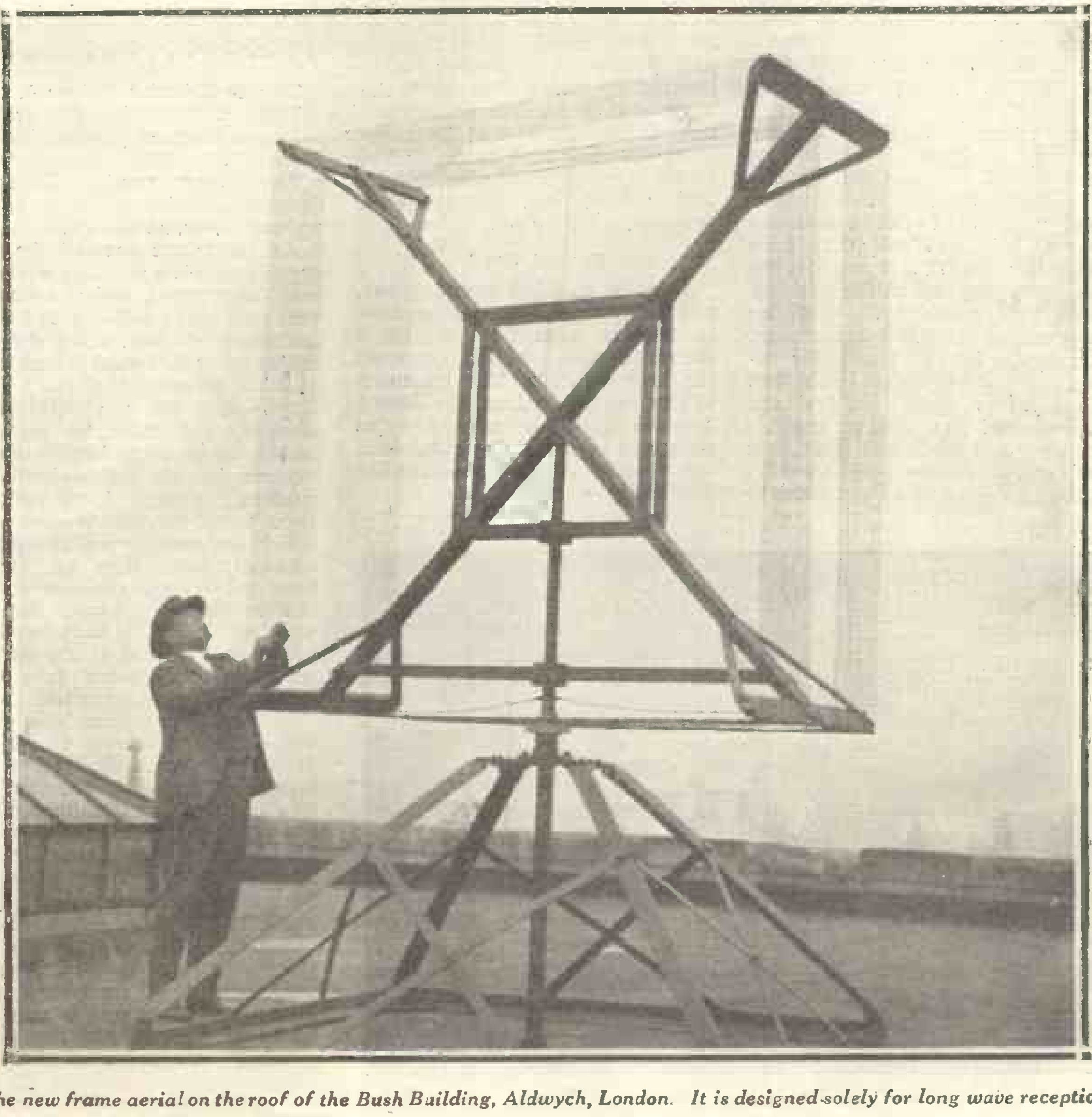
I have been experimenting with an extra H.F. valve in front of the first dual valve in this circuit; up to date, I have not been too successful in this direction, but hope to get it going before long.

Yours truly,

FRANK L. CARBINES.

South Melbourne,
Victoria, Australia.

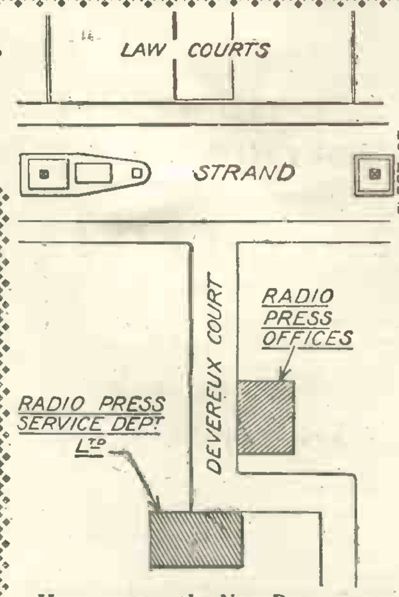
Why not try the special circuit given in our issue of June, 1924.—ED.



The new frame aerial on the roof of the Bush Building, Aldwych, London. It is designed solely for long wave reception.

More Aid for the Constructor

THE RADIO PRESS SERVICE DEPT., LTD., AND ITS WORK



How to get to the New Department.

IT is with great pleasure that we are able to announce that a new organisation has been formed to carry forward the work of the various branches of the Radio Press, starting from the point where the various written descriptions and instructions supplied to the constructor leave off. The new organisation is a separate company, to be known as "Radio Press Service Dept., Ltd.," with Mr. John Scott-Taggart, F.Inst.P., A.M.I.E.E., as managing director, and will concern itself largely with the period between the completion of any given set and the moment when the constructor feels that the set is giving satisfactory service.

An announcement has already appeared in *Wireless Weekly*, and the work of the new organisation is steadily increasing, since it seems that readers of the companion journal, *Wireless Weekly*, have been quick to realise that it provides the one remaining link in the chain of Radio Press reliability. With the co-operation of the new department, our service for the set-builder becomes complete, in that in the first place he is given articles and diagrams of the greatest possible accuracy and clearness; next, that for a period of three weeks after the date of publication he can come to the offices of the Service Dept. and inspect the original set for himself; and, finally, if he will follow out the design faithfully we can positively guarantee that his results will be equal to those of the original, and that if he has any trouble in getting the set to work properly as a result of the presence of a faulty component, a trifling error in wiring, or some other cause, all that he has to do is to take the set to the Service Dept. and they will see to the rest. Thus at one stroke is abolished for all readers of Radio Press publications that feeling of uncertainty which has been the bugbear of the amateur constructor since the earliest days of the movement—the fear that at the end of all his expenditure of time, trouble and cash the set may not work properly.

Special Staff

A special staff has been engaged, and new offices have been opened in Grecian Chambers, Devereux Court, Strand, W.C.2 (opposite the Law Courts). The approach to the new offices from the Strand is given upon the accompanying plan, and it should be added that the nearest Tube stations are the following :—

Temple (District Railway).
Holborn (Piccadilly Railway).
British Museum (Central London Railway).

The 'buses passing Devereux Court are Services No. 6, 9, 11, 13, 15, 96, 60, 67, 48 and 94.

An important part of the new organisation is a properly equipped test department, where constructors may bring faulty sets for examination and test, a full detailed report being furnished in each case. It is not intended that the Service Dept. shall be a profit-yielding concern, but may be regarded rather, as its name implies, as an organisation for the *service* of our readers. Charges have therefore been fixed for the various tests, which our readers will find purely nominal, since they are merely intended to cover expenses.

The scale of charges for the ordinary set testing work has been provisionally fixed at 2s. 6d. per valve in multi-valve sets, dual valves being counted as two.

In view of the great amount of trouble which is given to the test staff by sets which have been made up with heavy alterations from the original design, an additional charge of 25 per cent. is imposed where any serious modification has been made. In these cases also it is not possible to guarantee that results fully equal to the original set will be obtained, since, of course, the placing of parts in a set is often very crucial to its proper performance. (This rule is only enforced in cases of real necessity.)

These fees cover a thorough examination and test of the set and all its components, and the furnishing of a detailed report

A view in the Radio Press Service Department.

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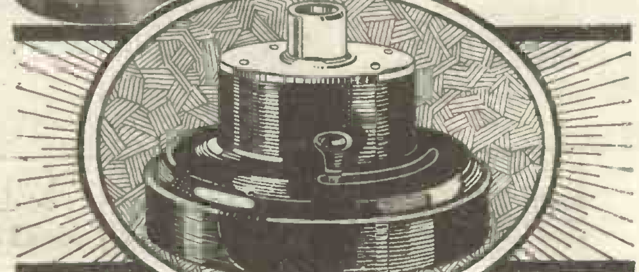
Demonstrations of the "Sparta" Loud-Speaker are given during broadcasting hours at Gamages, Harrods, Selfridges, The Service Trading Co., 289-292, High Holborn, City Accumulator Co., Ltd., 79, Mark Lane, E.C., G. Salmon, 33, Grafton Street, Tottenham Court Road, Peto-Scott, Ltd., 64 & 99, High Holborn, Messrs. Piggott Bros., Bishopsgate, E.C., and at our own depots, etc.



upon its condition, any faults being, of course, pointed out.

Alterations to Sets

It is expected that the usual form of procedure will be to leave the owner of the set to make the necessary alterations to the receiver, and if in any case it is found that making the alterations which we suggest does not remove the fault, a further test will, of course, be carried out free of charge. In special cases where readers desire us to make the necessary alterations we shall be able to do so, an estimate being given in such cases.

Carriage Arrangements

It is best for readers to bring their own sets, but when this is impossible they can be sent by post or rail. They should always be most securely packed in a stout wooden crate, cardboard boxes having proved to be quite useless, and the set should always be either insured or registered. A similar precaution is taken by the Service Dept. in returning them. The set is, of course, at the owner's risk during the whole period that it is out of his hands, but every possible care is taken by the Test Dept.

Hours

The Service Dept. offices are open from 9.30 a.m. to 6 p.m. on week-days and 1 p.m. on Saturdays. Appointments can be made for times up to 8 p.m., for the benefit of those readers who find it impossible to bring their sets during these hours.

Special Cases

The Service Dept. can undertake a great variety of other services besides the mere testing of defective receivers, dealing with all sorts of components, visiting localities to investigate cases of special difficulty, giving advice by post and so on.

In special cases a qualified member of the Test Dept. staff can be sent to the reader's address, so long as this is within the London area, and tests or any other investigation carried out upon the spot. A special fee will, of course, be necessary in such cases, in addition to travelling expenses.

Postal Queries

The old Postal Queries Dept. of Radio Press, known as the Information Dept., is being merged in the new organisation and will carry on its work as before. The old regulations concerning postal queries are therefore still in force, and readers will remember that a fee of 2s. 6d. is charged for a reply to a query, a stamped addressed envelope being required from the reader in each case.

Exhibition of Sets

Finally, it will be noted that part of the premises of the Service Dept. are allotted to the exhibition for a limited period of the various MODERN WIRELESS and *Wireless Weekly* sets for a period of 3 weeks after publication. The *Radio Press* Envelope Receivers will be on view for an indefinite period.

Visitors are asked to remember, however, that the testing staff are not authorised to give advice or answer readers' queries themselves, and these matters must either be submitted by post in the ordinary way as postal queries, or an appointment for a consultation must be made, for which a fee of 2s. 6d. for a ten minutes' interview has been fixed.

A LOOSELY COUPLED S.T. 100 SET

To the Editor of MODERN WIRELESS.

SIR,—I enclose two photographs of my portable S.T. 100 receiver, showing the outside (above panel) disposition of parts, and the internal wiring arrangements. Considering that it is only the second set that I have made, and that I had only been doing wireless for nine months when I made up this set, I am extremely pleased with the results that I am getting with it.

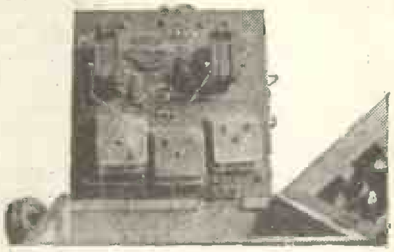
As you will see from the photograph, I have fitted loose-coupled aerial tuning, but apart from this, the circuit was taken from MODERN WIRELESS, Vol. 1, No. 6, the disposition of parts being arranged to suit the panel which is twelve inches square.

Mr. Green's Set.

I think the loose-coupled tuning is easily worth the extra bother in tuning as it gives the following advantages: (1) Increased selectivity; (2) greater ease of oscillation, especially on the very short waves; and (3) enables one to use a larger coil in the grid circuit, which is a great advantage on the very short waves.

So far, at ten miles from 2 LO, I have had the following stations quite comfortably audible on the loud speaker, Bournemouth, Newcastle, Glasgow, Birmingham, Aberdeen, Brussels and Ecole Superieure. With 2 LO off I have also had Cardiff and Manchester on the loud speaker. Radiola, is, of course, quite easy to get on the L.S., in fact, with the set in an upstairs room with 16 ft. of wire in the loft for aerial, I have had it on the L.S. distinctly audible in the next room, and that within the last fortnight.

As you will see in the photo, all my parts are of well-known



Internal Wiring.

make, as I have always worked to the motto that a set that is worth making is worth good parts.

The method of mounting the valves was devised in order to obviate the necessity of removing them each time the cabinet was closed.

Yours truly,
ARTHUR F. GREEN.
Eltham, S.E.9.

AN APPRECIATION FROM SWEDEN

To the Editor of MODERN WIRELESS.

SIR,—I am writing this with the object of offering my congratulations to Mr. P. Harris, on his very fine "Four-valve Family Receiver," and are hoping that you will find room for this in your excellent magazine, of which I am an ardent reader.

I can recommend all who wish to build a powerful and sensitive receiver to send for MODERN WIRELESS Envelope No. 2.

All the B.B.C. stations come in with good strength. Aberdeen and Newcastle quite good on loud speaker, so also do Paris, Brussels and all the German stations.

Instead of a 0.005 mfd. condenser, the aerial circuit I use is a 0.001 mfd.

Wishing you every success with your publication, and assuring you that I will not fail to recommend the circuit to my friends.

Yours truly,
ANDREAS KRISTENSEN.
Holstebro.

Supersonic Heterodyne Reception

A READER'S EXPERIENCES

To the Editor of MODERN WIRELESS.

SIR,—May I be allowed to congratulate your correspondent, Mr. Alford, on his having brought the above to the notice of your readers?

May I also suggest that your staff might well try the circuit for themselves and give your readers the benefit of their trials?

In my view it is the most astonishing receiver I have ever met from the point of view of the ordinary man who wishes to be able to get our broadcasting really well, and who lives 50 miles from the nearest station.

It is extremely simple to work. One can use N + 1 valves with the controls for 3 only. Its selectivity is *absolute*. Here I was able to separate the Petit Parisien station on 363 metres from 2LO on 365 metres and telegraph the name of the jammer to the B.B.C.

Its range seems to be unbounded. Canadian broadcasting has been got at loud-speaker strength, ditto most of the German stations, ditto most of our relay stations, while conversations from aeroplanes crossing the Channel can be got here on the telephones even when such conversation has to be passed from one aeroplane to the other through Croydon.

The power is greater than one would expect, and seems to be due to the heterodyne valve. On June 21st at a garden fete held here the party danced on the lawn to 2ZY dance band from 8 p.m. to 9.30 p.m., while the orchestras from 2LO, 5IT Cardiff, and 2ZY kept the show going from 3.30 p.m. onwards, being audible above the noise of an attendance of 400 to 500 people. The receiving set was 1 H.F., 1 Het., 1 Det. for the fundamental wave; 2 H.F., 1 Det., Grebe C.R. 13 M.W. modification for the long wave side; followed by a power amplifier of 2 LS 5 valves. Three Amplion 120 w. loud-speakers were used.

The system deserves more attention than it has received. This is probably due to the fact that people are frightened of it. The facts are that a child could work it, and it is undoubtedly simpler to handle than the far-famed S.T. 100. In my humble opinion it is the only method of reception for 50 miles or over.

It is not necessary to use expensive low-capacity valves on either side of the circuit.

I am using Cossor valves for all except the heterodyne valve, and here I find an Ediswan A.R. or M.O. R. do best. Any coils of basket type do for the heterodyne. I find I get best results from two basket coils of 60 turns each. These cover the broadcasting wave band from 300 m. up to 1,100 m. at least.

Reaction is unnecessary in any form. Potentiometer control for all valves and a micro-condenser for the heterodyne are essential.—Yours faithfully,

C. R. BATES.

Market Harboro'.

Regular Programmes from Continental Broadcasting Stations

Times in British Summer Time

Edited by CAPTAIN L. F. PLUGGE, B.Sc., F.R.Ae.S., F.R.Met.S.

WEEK DAYS.

British Summer Time.	Name of Station.	Call Sign and Wave Length.	Locality where situated.	Nature of Transmission.	Closing-down time or approx. duration of Transmission.
a.m.					
7.40	Eiffel Tower	F.L. 2600 m.	Paris	Weather Forecast	5 minutes.
10.23	Eiffel Tower	F.L. 2600 m.	Paris	Time Signal in G.M.T. (Spark)	3 minutes.
10.30	Lyons	Y.N. 470 m.	Lyons	Concert	until 11.15 a.m.
10.40	Eiffel Tower	F.L. 2600 m.	Paris	Cotton and Coffee quotations	5 minutes.
11.00	Eiffel Tower	F.L. 2600 m.	Paris	Time Signal in Greenwich Sidereal Time (Spark).	5 minutes.
11.14	Eiffel Tower	F.L. 2600 m.	Paris	Time Signal in French Summer Time (Spoken), followed by Weather Forecast.	5 minutes.
11.44	Eiffel Tower	F.L. 2600 m.	Paris	Time Signal in G.M.T. (Spark)	3 minutes.
11.55	Eiffel Tower	F.L. 2600 m.	Paris	Fish Market quotations (Mondays excepted).	5 minutes.
p.m.					
12.14	Eiffel Tower	F.L. 2600 m	Paris	Time Signal in French Summer Time (Spoken), followed by Weather Forecast.	5 minutes.
12.30	Radio-Paris	S.F.R. 1780 m.	Clichy	Items of News	15 minutes.
12.45	Radio-Paris	S.F.R. 1780 m.	Clichy	Concert (Light Orchestra), followed by Exchange Opening Prices.	1.45 p.m.
12.57	Nauen	P.O.Z. 2800 m.	Berlin	Time Signal in G.M.T. (Spark)	3 minutes.
1.00	Haeren	B.A.V. 1100 m.	Brussels	Weather Forecast	3 minutes.
1.15	Geneva	H.B.1 1100 m.	Switzerland	Weather Forecast, followed by Lecture.	One half-hour.
2.00	Haeren	B.A.V. 1100 m.	Brussels	Weather Forecast	5 minutes.
3.40	Eiffel Tower	F.L. 2600 m.	Paris	Stock Exchange Intelligence (Saturdays excepted).	8 minutes.
4.30	Radio-Paris	S.F.R. 1780 m.	Clichy	News, followed by Concert and late News	Until 5.45 p.m.
4.50	Haeren	B.A.V. 1100 m.	Brussels	Weather Forecast	3 minutes
5.00	Radio-Belgique	S.B.R. 262 m.	Brussels	Concert	6 p.m.
5.00	Geneva	H.B.1 1100 m.	Switzerland	Lecture	One hour.
5.30	Eiffel Tower	F.L. 2600 m.	Paris	Stock Exchange, closing prices (Saturdays excepted)	8 minutes.
5.50	Haeren	B.A.V. 1100 m.	Brussels	Weather Forecast	5 minutes.
6.15	Eiffel Tower	F.L. 2600 m.	Paris	Concert, followed by News Bulletin	One hour.
8.00	Eiffel Tower	F.L. 2600 m.	Paris	General Weather Forecast	8 minutes.
8.00	Radio-Belgique	S.B.R. 262 m.	Brussels	Concert, followed by News Bulletin	Till 10.10 p.m.
8.15	Ecole. Sup. des Postes et Telegraphes.	P.T.T. 385 m.	Paris	Lecture, followed by Concert. (Usually Outside Broadcast, sometimes begins at 8 or 8.30.)	Two to three hours.
8.15	Lausanne	H.B.2 800 m.	Switzerland	Concert (Thursdays excepted)	Until 9.30 p.m.
8.30	Ecole Sup. des Postes et Telegraphes	P.T.T. 385 m.	Paris	Lecture, followed by Concert (Usually Outside Broadcast, sometimes begins at 8.15 or 8.45 p.m.)	Two to three hours.
8.30	Radio-Paris	S.F.R. 1780 m.	Clichy	General News Bulletin	One half hour.
9.00	Radio-Paris	S.F.R. 1780 m.	Clichy	Time Signal in French Summer Time, followed by Concert.	9.50 p.m.
10.30	Madrid	—— 408 m.	Spain	Concert	Until midnight.
11.00	Eiffel Tower	F.L. 2600 m.	Paris	Time Signal in Greenwich Sidereal Time (Spark).	5 minutes.
11.44	Eiffel Tower	F.L. 2600 m.	Paris	Time Signal in G.M.T. (Spark)	3 minutes.
a.m.					
12.57	Nauen	P.O.Z. 2800 m.	Berlin	Time Signal in G.M.T. (Spark)	3 minutes.

(Continued on page 305.)

HULLO, EVERYBODY!!

Goods are sent *post free* except where marked. NO POST ORDERS from Callers' Columns. Please write distinctly and be sure to put NAME and ADDRESS. FOREIGN ORDERS must have *extra postage* and packing enclosed. All previous lists cancelled. Kindly mention paper.

OPEN EVERY DAY 9 a.m. to 7.45 p.m. SUNDAYS 10 a.m. to 1 p.m.

POST FREE COLUMN.

W.O. Pillar, large .. doz. 1/3
'Phone 4 B.A. .. doz. 1/1
'Phone 2 B.A. .. 6 for 1/-
Med. Pillar 4 B.A. .. doz. 1/1
Valve Sockets, plain .. 10d.
Ditto with Shoulder .. 1/1
(Above with Nut and Washer)
Single Coil Plug on stand 1/3
Ditto Swivel movement .. 1/6
Plug and Socket .. 6 pairs 10d.
Screw Spade Terminals doz. 1/-
Pin Screw Terminals doz. 10d.
Spade Tags .. .. doz. 5d.
Empire Tape, ½ in. .. 12 yds. 9d.
Insulating Sleeving .. 6 yds. 2/-
Ebonite Coil Plugs .. 2 for 1/6
Best quality ditto .. 2 for 1/10
Ebonite Knobs, 1½ in. 2 B.A. 6d.
Moulded Knobs, 1½ in. 2 for 8d.
Knobs, ¾ in. 4 B.A. .. 2 for 8d.
Ditto, 1 in. 2 B.A. .. 2 for 8d.
H.F. Transformers Plug-in type 250/700 .. .. 3/11
Ebonite ex handles, 6 in. .. 9d.
Ebonite Bushes 2 or 4 B.A. doz. 1/-
D.C.C., I.R.C. Bell Wire 10 yds. 1/-
Gauze Valve Windows .. 7d.
Double 'Phone Cords, 72 in. 1/11
Porcelain S.P.D.T. Switch .. 1/11
Ditto D.P.D.T. Switch .. 2/6
Battery Clips .. .. doz. 10d.
Ebonite Valve Holders .. 1/-
Variometer 250/650 .. 2/6
Lead-in Wire .. 10 yds. 1/6
Twin Flex .. 12 yds. 1/11
100 ft. 7/22 Aerial Wire .. 3/9
with four insulators
Nugraving Titles .. .. 8d.
"R.I." Choke Coil .. 10/-
Watmel Var. Grid Leak .. 2/6
Watmel Anode Resistance .. 3/6
Nickel Panel Switches, D.P.D.T. 1/5
Ditto, S.P.D.T. 1/2
Insulating Sleeving 3 yds. 1/4
Tinned Copper, square 16 gauge, 18 ft. 1/-
Spearpoint Whisker .. 4d.
Gold whisker .. .. 4d.
Set of 5, one gold .. .. 6d.
100,000 ohm Fixed .. 1/6
Real Ebonite dials 1/3
1 in. Knobs 2BA .. ... 6d.
¾ in. Knobs 4BA .. ... 6d.

RHOESTATS.

Ormond 2/-
Raymond 1/6
Do. with dial 2/-
Extra value do. 2/6
T.C.B. 6 ohms 4/-
Ditto, 15, 30 ohms .. 4/-
Potentiometer, T.C.B. .. 5/-
Microstat, for D.E. & R.. .. 2/9
Edison Bell Coil Plugs .. 1/3

When Visiting Wembley, Call Here, we

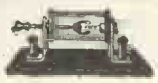
PAY YOUR FARE

up to 2/6 in £. on Ordinary Prices (N.A.R.M. and fixed excluded)

Ebonite Valve Holder, cut from solid rod, hand-turned, 8 nuts and washers .. 1/3

This first-class Switch Arm, with 12 Studs, 12 Nuts, 12 Washers, Callers 10½d. Post 1/6 set

"RAYMOND" Crystal Detectors



Enclosed Glass.
As Sketch, on Ebonite Base.

Brass 1/4, 1/6, 2/-
Nickel 1/6, 2/-
Ebonite 1/6
Perikon 1/8, 2/2
(With Zincite and Bornite)

OUR WONDERFUL MICROMETER ADJUSTMENT GLASS-ENCLOSED DETECTOR. WHY PAY MORE? 1/11 POST 6d. each.

HERTZITE
SHAW'S
GENUINE,
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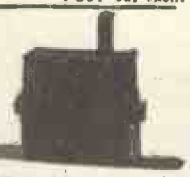
BEATS ALL
OTHER "ITES."



COIL PLUG & CLIPS 10d, Post 4d.

WEST END DEPOT FOR

POLAR; JACKSON BROS.; BOWYER LOWE; R. I.; BURNDEPT; GOSWELL ENG. CO.; GRAFTON ELECTRIC; SILVERTOWN; IGRANIC; LISSEN; RADIO PRESS ENVELOPES; DUBILIER; EDISON BELL; WOODHALL GOODS, ETC.

J. B. CONDENSERS

	Standard	Super
·001	8/6	9/6
·00075	8/-	9/-
·0005	7/-	8/-
·0003	5/9	6/9
·00025	5/9	6/9
·0002	5/-	5/6
·0001	4/9	5/3
Vernier	4/-	4/6

Post 4d. set

ENAMELLED WIRE

S.W.G.	¼ lb.
18	9d.
20	10d.
22	10d.
24	1/-
26	1/1
28	1/3
30	1/4

Other sizes stocked. Post 6d. reel.

H.F. PLUG-IN TRANSFORMERS.

No. 1 150-450 .. 3/6
No. 2. 250-700 .. 3/11
No. 3. 450-1200 .. 4/3
No. 4. 900-2000 .. 4/6
No. 5. 1600-3000 4/9
No. 6. 2200-5000 4/11

D.C.C. WIRE.

S.W.G.	¼ lb.
18	9d.
20	10d.
22	10d.
24	1/-
26	1/1
28	1/3
30	1/6
34	–
36	–

Post 6d. reel.

VARIOMETERS

Ebonite 200/650 .. 4/6
Ebonite Ball Rotor 7/6
Impregnated Board 3/6
Raymond "Inside" Winding .. 10/11

EBONITE COIL STANDS

2-way, ex handles .. 4/6
3-way, ex handles .. 5/6
2-way, good value .. 3/9
3-way, good value .. 4/11
Also at 4/3, 4/6, 5/11
2-way for Basket Coils 5/11
Universal 5/11
3-way, 1/6 each extra.
Franco:
2-way 12/6
3-way 17/5
Cam Vernier:
2-way .. 8/6 & 9/6

L.F. TRANSFORMERS

Radio Instruments 25/-
Igranic, Shrouded .. 21/-
Powquip, Shrouded 18/-
Formo, Shrouded .. 18/-
General Radio .. 14/11
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Powquip, 2-1 or 4-1 14/6
Raymond 10/-
Eureka Concert Grand 30/-
Ditto, 2nd Stage .. 22/6
Silvertown .. 21/-
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EBONITE

3/16th in. Stock sizes.

6 x 6 .. .. 1/6
7 x 5 .. .. 1/6
8 x 6 .. .. 2/-
9 x 10 .. .. 2/3
10 x 8 .. .. 3/4
11 x 7 .. .. 3/4
12 x 9 .. .. 4/6
12 x 12 .. .. 6/-
18 x 8 .. .. 6/-
20 x 9 .. .. 7/6

Foreign Post extra.

H.T. BATTERIES

Post 1/- each.

Ever-Ready 66 v. 13/6
Ever-Ready 108 v. 22/-
B.B.C. 60 v. .. 10/6

N. & K. HEADPHONES

GENUINE STAMPED
4,000 ohms .. 12/9
6,000 ohms .. 13/3
Genuine N. & K. Post 6d. pair.

LARGE STOCKS of the FOLLOWING

LISSEN

Variable Grid Leak 2/6
Anode Resistance .. 2/6
Lissen Minor .. 3/6
Lissenstat 7/6
Do. Universal .. 10/6
2-way Switch .. 2/9
Series Parallel .. 3/9
T1 Transformers .. 30/-
T2, 25/-; T3, 16/6
Lissen Coils and all parts stocked

IGRANIC

Coils: 25, 5/-; 35, 5/-; 50, 5/2; 75, 5/6; 100, 7/-; 150, 7/10; 200, 8/8; 250, 9/-; 300, 9/5; 400, 10/3; 500, 10/6
Fil. Rheostat .. 4/6
Potentiometer .. 7/-
Vernier Rheostat 7/6
30 ohm Rheostat .. 7/-

DUBILIER CONDENSERS

.001, .002, .003, .004, .005, .006 .. 3/-
.0001, .0002, .0003, .0004, .0005 .. 2/6
Type 577, .01 .. 7/6
Grid Leaks each 2/6
Anode Resistance, 50,000, 80,000 or 100,000, on stand complete .. 5/6
Minicap Switch .. 8/-

GOSWELL ENGINEERING CO.

Patent Valve Holder 1/6
Cam operated Vernier, Two-way Coil Stand .. 9/-
Ditto, with Switch 12/6

ACCUMULATORS

BEST MAKES. UNDER MY OWN LABEL.

4 v. 40 .. .. 17/6
4 v. 60 .. .. 21/-
6 v. 60 .. .. 28/6
6 v. 80 .. .. 34/-
6 v. 100 .. .. 42/-
Post 1/- extra

MC MICHAEL H.F. SPECIAL PLUG-IN TRANSFORMERS

50-150 .. .. 8/-
150-300 .. .. 7/-
300-600 .. .. 7/-
500-1200 .. .. 7/-
1100-3000 .. .. 7/-
275 meters upwards .. 25/-
Post 6d.

POLAR CONDENSERS

.001, .0003, .0005 each 10/6
2 way coil stand Cam Vernier 11/-
Post 6d. each.

BURNDEPT Parts

Transformers
226 L.F. 25/-
333 L.F. 27/6
Telephone 21/-
Crystal Detector .. 5/6
Coils from 4/3
Dual Rheostat .. 7/6

STERLING Square Law Variable Condensers

with Vernier.

.001 .. .. .. 30/
0005 .. .. .. 25/6
.0003 .. .. .. 23/6
Or Orders in Rotation, Limited Number.

EDISON BELL FIXED CONDENSERS

.0001 to .0005 .. 1/3
.002 to .006 .. .. 2/-
.001 .. .. .. 1/3
.0003 Leak 2/6
Variometer 10/6
Twin Detector .. 5/9

LOUD SPEAKERS.

27/6 - JUNIOR AMPLION Newest Model.
42/- - JUNIOR DE LUXE Oak Trumpet.
55/- - BABY STERLING Splendid Value.

ALL AMPLIONS STOCKED. BROWN BABY 48/-

RIGHT OPPOSITE DALY'S GALLERY DOOR

K. RAYMOND

27, LISLE STREET, W.C.2

'PHONE: GERRARD 4637.

No responsibility accepted on post orders unless cheques and postal orders are crossed and made payable to the firm. Moneys sent must be registered.

HOURS OF BUSINESS:
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HULLO, EVERYBODY!!

RAYMOND'S VARIABLE CONDENSERS

NEW MODEL.

INCLUDING KNOB.

Nat. Phys. Lab. Certificate for Guaranteed Capacity.

Cap.	Price.	Height without Connections
·001	6/11	3⅛ in.
·00075	5/11	2⅝ in.
·0005	4/11	2 in.
·0003	4/6	1⅜ in.
·0002	4/-	1½ in.
·0001	3/6	1 in.
·00005 (vernier)	2/6	

EBONITE DIAL 8d. extra

POST 6d. SET.

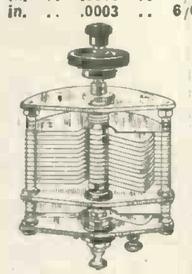
ALL PARTS NICKELLED. One hole fixing. Narrowest spacing. Aluminium end plates. Accurate Constant Capacity Rigid Construction. Low Loss. Electrically and Mechanically Perfect.

Many Unsolicited Testimonials

NEW MODEL with 3 Plate Vernier at bottom. Specification as ordinary, but the Vernier allows absolutely the finest tuning possible. Very sharp and defined. They do not need varied long and technical words to recommend them. Satisfied users are the best recommendation. Assembled for panel mounting, and for a limited period I will include FREE an EBONITE DIAL to retail customers only.

POST 6d. PER SET PLEASE.

Height	Cap.	Price
4 in.	.001	8/11
2¾ in.	.0005	6/11
2¼ in.	.0003	6/6



Complete with 2 Knobs & Dial.

VALVES.

B.T.H.
- R4 .. .. 12/6
- B5 .06 .. .. 30/-
- Power Valve .. 35/-

COSSOR.
- P1. P2 .. .. 12/6

MULLARD.
- ORA 12/6
- D.F. ORA .. 30/-
- 1 Volt 30/-

EDISWAN.
- A.R. 12/6
- A.R.D.E. .. 21/-
- A.R. .06 .. .. 30/-

LISSEN COILS.

No. of Coil.	PRICE
25	4/10
30	4/10
35	4/10
40	4/10
50	5/-
60	5/4
75	5/4
100	6/9
150	7/7
200	8/5
250	8/9
300	9/2

MANSBRIDGE (T.C.C.) NEW FIXED CONDENSERS.

- .25 .. .. 3/6
- .05 .. .. 3/6
- .1 .. .. 3/6
- 1 MFD. 4/-
- 2 MFD. 4/6

A. W. CRYSTAL LOUD-SPEAKER SET.

- Stand for 'Phones 1/6
- Aluminium Button 5/-
- Brass Button .. 4/6
- Hedgehog Transformer 14/-
- Single 120 ohm 'phone 5/6
- Single 4,000 ohm 'phone 7/-

HEADPHONES.

- Sterling, 4,000 ohms 25/-
- Brown "F" type .. 25/-
- Brown's "A" type 62/-
- B.T.H. 25/-
- Siemens 25/-
- Gecophone .. 25/-
- Western Electric .. 25/-
- Brunet, 4,000 .. 17/6
- Single Brunet, 4,000 8/6
- 8,000 Brunet .. 19/11 (for Crystal sets only).
- Brunet De Luxe .. 18/11
- Lightweight "K" 10/9
- Dr. Nesper, adjustable .. 13/6
- Ericsson (EV) .. 12/6

H.T.C.

- Special valve holder above panel .. 1/9
- Ditto for under panel 1/6

Post 2d. each.

Parts for P.W. Unidyne Circuit.

- Variable Condenser .0005 .. .. 5/3
- Ditto, with vernier 7/5
- Two-way Coil Holder 3/6
- 2 Basket Adapters 2/6
- 2 Basket Coils .. 1/6
- Four-Electrode Valve 12/6
- Variable Grid Leak 1/9, 2/6
- Filament Rheostat 2/6

Testimonial

that speaks for itself

July 20/24.
From C. Walton, Esq.
Radio Engineer,
Andover.

I have tested your new variable condensers on Megger and get "INFINITY."

Yours sincerely,
C. WALTON.

BASKET ADAPTER.

10d. Post 4d.
2 for 2/-

EXTRA QUALITY with plug
1/3. Post 4d.
2 for 2/8.

For CHELMSFORD

LOADING COIL FITTINGS. An efficient, easily fitted loading device, which will adapt your set for ALL WAVELENGTHS 1/- per set. Postage 2d.

HEAVY BRASS COIL FORMERS.

To wind your own coils. 23 spokes each side. Our own make. Very fine value.
- Callers 3/7
- Post orders 4/6

I will always oblige Trade customers as far as I can. And I stock what is advertised. Discount allowed to Radio Clubs.

BASKET COILS.

- Chelmsford (T'andco) 2/-
- T'andco 1300/1750 metres 1/8 (All T'andco in stock)
- Waxless, set of 5, 200/2,000... .. 1/11
- Waxed, set of 6, 200/3,600 ... 1/11
- Special Duplex coil fitted on adapter for Chelmsford .. .. 2/11 (for variometer 650 metres).

Post 4d. each.

CALLER'S COLUMN. NO POST ORDERS

- Wound Coils (1600) 1/6
- Tapped Coils (1600) 1/6
- Filament Dials 2½d.
- Ebonite 4½d. with knob .. .. 5½d.
- Copper Foil foot .. 2½d.
- Washers, 2 & 4 B.A... doz. 1d.
- Nuts, 2B.A. 2 doz. 3½d.
- Nuts, 4, 5, 6, B.A. 2 doz. 3d.
- Filostat (D.E. or R. Valves) .. 1/9
- Microstat (D.E. or R. Valve) .. 2/6
- Allen Var. grid leak 1/6
- Ditto Anode Res. 1/6
- Good Fixed Condensers .. .. 8d.
- Dutch Valves Tubular .. 4/9
- Dutch Valves "R" type 5/-
- Phillips "R" .. 7/6
- French Metal .. 6/6
- Porcelain Switches, S.P.D.T. .. 1/3
- Ditto Switches, D.P.D.T. .. 1/11
- Insulated Pliers pair 1/-
- Screwed Rod, 2 B.A. foot .. 2½d.
- Ditto. 4B.A. foot .. 2d.
- Boxes, 8 x 6 x 5 deep 2/6
- Knobs, 1¼in. 2B.A. 1½d.
- Best quality ditto 3d.
- 1 in. 2 B.A. .. 2d.
- ¾ in. 4 B.A. .. 2d.
- Real Ebonite Dials 1/-
- Set of Spanners, etc. 1/3
- Best Grid Leak and Condenser 2/2
- Grid Leaks, 2 meg. 1/1
- Ebonite Ex. Handle, 6 in. .. .. 7d.
- 2, 4, 6, B.A. machine screws
- Easi-Fix crystal cups 1d.
- Vario. Couplers .. 3/-
- Vario. Crystal Sets 7/11
- Ebonite Variometer 3/11

TERMINALS.

- 'Phone nut and washer .. 1d.
- W.O. nut and washer .. 1d.
- Pillar, nut and washer 1d.
- Small Pillar, nut and washer 1d. 4 for 3½d.
- 'Phone, large, 2 B.A. 2 for 2½d.
- Valve Pins and nut 2 for 1d.
- Do. Sockets, nut and washer 2 for 1½d.
- Do. with shoulder, nut and washer 2 for 2d.
- Stop Pins and nut .. 2 for 1d.
- Spade Screw terminals each 1d.
- Ditto per doz. 10d.
- Pinscrew terminals 2 for 1½d.
- Spade Tags 4 for 1d.
- Brass Plug and Socket pair 1d.
- Wander Plugs, pair 2½d.
- Valve Holders, Ebonite .. 8d.
- Basket Coil Adapters .. 8½d.
- Ditto, extra quality 1/3
- Plug and Clips .. 6½d.
- Shaped Coil Plugs 8½d.
- Edison Bell .. 1/-
- Ebonite Coil Plugs 4d.
- Ditto, extra quality 6d., 7d., 8d.
- 72 in. 'Phone Cords 1/5
- Panel Switches nickel, S.P.D.T. 10½d.
- Ditto, D.P.D.T. 1/4
- Phillips' .04 .. 18/6
- Metal, .06 .. 18/11
- Studs, complete doz. 4½d.
- Pointers .. .. 2 a 1d.
- 100,000 ohm res. and clips .. 1/3
- Unit Coil Plug .. 1/1
- Nugraving Titles .. 7½d.
- Similar Titles .. 4½d.
- Scales, 0-180 .. 1½d.
- Transformer for Unidyne Set .. 15/-
- Myers' Valves .. 12/6
- Adhesive Tape roll 3d.
- 30 v. H.T. Batt... 4/6
- 60 v. H.T. Batt... 7/6
- H.F. Transformers 250/700 3/3
- Single 'Phones, 120 ohms 5/-
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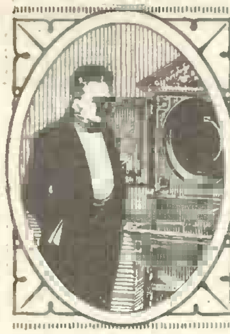
SUNDAYS.

Continued from page 299

British Summer Time.	Name of Station.	Call Sign and Wave Length.	Locality where situated.	Nature of Transmission.	Closing-down time or approx. duration of Transmission
a.m. 10.23	Eiffel Tower	F.L. 2600 m. ..	Paris ..	Time Signal in G.M.T. (Spark) ..	3 minutes.
11.00	Eiffel Tower	F.L. 2600 m. ..	Paris ..	Time Signal in Greenwich Sidereal Time (Spark).	[illegible] minutes.
11.44	Eiffel Tower	F.L. 2600 m. ..	Paris ..	Time Signal in G.M.T. (Spark) ..	3 minutes.
11.50	Kouigswusterhauzen	L.P. 2800 m. ..	Berlin ..	Concert	Until 12.45 p.m.
11.55	Eiffel Tower	F.L. 2600 m. ..	Paris ..	Fish Market quotations	5 minutes.
p.m. 12.45	Radio-Paris	S.F.R. 1780 m. ..	Clichy ..	Concert	1.45 p.m.
12.57	Nauen	P.O.Z. 2800 m. ..	Berlin ..	Time Signal in G.M.T. (Spark) ..	3 minutes.
2.40	Ned. Radio Industrie	P.C.G.G. 1050 m.	The Hague	Concert	Until 5.40 p.m.
4.45	Radio-Paris	S.F.R. 1780 m. ..	Clichy ..	Concert, followed by News ..	5.45 p.m.
5.00	Radio-Belgique ..	S.B.R. 262 m. ..	Brussels ..	Concert	6 p.m.
6.15	Eiffel Tower	F.L. 2600 m. ..	Paris ..	Concert, followed by News Bulletin	One hour.
8.00	Eiffel Tower	F.L. 2600 m. ..	Paris ..	General Weather Forecast	8 minutes.
8.00	Radio-Belgique ..	S.B.R. 262 m. ..	Brussels ..	Concert, followed by News Bulletin	Until 10p.m.
8.10	Ned. Seintoestellen Fabr.	N.S.F. 1050 m. ..	Hilversum	Concert	Until 10.10 p.m.
8.30	Radio-Paris	S.F.R. 1780 m. ..	Clichy ..	General News Bulletin	Until 9p.m.
8.30	Ecole Sup. des Postes et Telegraphes.	P.T.T. 385 m. ..	Paris ..	Concert or Lecture. (May begin a quarter-hour earlier or later).	Ends between 10.30 and midnight.
9.00	Radio-Paris	S.F.R. 1780 m. ..	Clichy ..	Concert, followed from 10 p.m. until 10.45 p.m. by a dance lesson. ..	Until 10.45 p.m.
9.00	Eiffel Tower	F.L. 2600 m. ..	Paris ..	Concert	Two hours.
9.30	Petit Parisien ..	—— 340 m. ..	Paris ..	Concert (Items announced in English as well as French).	Until midnight.
10.30	Madrid	—— 408 m. ..	Spain ..	Concert	Until 12.30 a.m.

SPECIAL DAYS.

British Summer Time.	Name of Station.	Call Sign and Wave Length.	Locality where Situated.	Day of Week.	Nature of Transmission.	Closing-down time or approx. duration of Transmission
p.m. 3.00	Ecole Sup. des Postes et Telegraphes	P.T.T. 385 m. ..	Paris ..	Fridays ..	Concert or Lecture	Two hours.
5.00	Lausanne	H.B2 800 m. ..	Switzerland	Thursdays ..	Children's Stories ..	One hour
7.40	Heussen Laboratory	P.C.U.U. 1050 m.	The Hague	Tuesdays ..	Concert	Until 9.40 p.m.
7.40	Smith and Hooghoudt	P.A.5 1050 m. ..	Amsterdam	Wednesdays	Concert	Until 9.40 p.m.
8.10	Ned. Radio Industrie	P.C.G.G. 1050 m.	The Hague	Mondays ..	Concert	Until 10.10 p.m.
8.10	Ned. Vereenigen van Radio Telegraphie	P.C.G.G. 1050 m.	The Hague	Thursdays ..	Concert	Until 10.10 p.m.
8.10	Middleraad	P.C.M.M. 1050 m.	Ymuiden ..	Saturdays ..	Concert	Until 9.40 p.m.
8.40	Ned. Seinteestellen Fabriek	N.S.F. 1050 m. ..	Hilversum	Fridays ..	Concert	Until 9.40 p.m.
9.00	Eiffel Tower	F.L. 2600 m. ..	Paris ..	Wednesdays	Concert	Until 10.55 p.m.
9.30	Petit Parisien ..	—— 340 m. ..	Paris ..	Thursdays ..	Concert (Items announced in English as well as French).	Midnight.
10.00	Radio-Paris	S.F.R. 1780 m. ..	Clichy ..	Mondays Thursdays & Fridays	Dancing Music ..	Until 10.45 p.m.
10.15	Le Matin	S.F.R. 1780 m. ..	Paris ..	Every 2nd & 4th Saturday of the month	Special Gala Concert with leading Parisian artists.	Till 11.30 p.m.



Remote Control of the Receiving Set

By G. P. KENDALL, B.Sc., Staff Editor.

A helpful article for those who wish to use their loud speaker at a distance from the actual set.

SOONER or later everyone wants to use either the loud speaker or telephones at a distance from the receiving set, either in a different room, in the garden, or in another building. This separation of receiving set and listener is a matter presenting a certain amount of practical difficulty, and it presents three main problems. The first concerns the behaviour of a loud speaker at a distance when connected to the receiving set through a pair of long leads, which may be quite different from its performance when its tags are connected directly to the output terminals of the set, while the second is a matter of the difficulty of tuning in effectively with the set when the operator is unable to hear the results being given by the loud speaker itself.

Effects of Distance.

Thirdly, there is the inconvenience produced by the fact that the listener may be at some considerable distance from a receiving set, and may desire to switch it off for an interval or at the end of the programme. At first sight, it would not appear that this particular difficulty was at all a serious one, but practical experience teaches the contrary. If one has to get up and go some considerable distance, possibly upstairs, to turn off the set some three or four times in an evening, what should be an entertainment is apt to become a nuisance, at least to the person responsible for operating the set. Practically the only effective solution of this problem is an additional pair of extension leads to permit of distant control of the filament circuits, and there are one or two points which must be observed here if success is to be achieved. In the first place, the wire used for the extension must be exceedingly heavy, since only a very slight resistance drop is permissible here. If the ordinary bright emitter valves are used with a 6 volt accumulator. it will be possible to use quite a lengthy extension lead if the heavy electric lighting flex is employed. The best flex for the purpose is really that used for wiring power circuits, but the heaviest used for lighting will suffice. When dull emitter valves of the .06 type are employed, the resistance of the extension lead becomes a matter of very much less importance, and quite thin wire can be used successfully.

Bell Wire.

The ordinary twin bell wire will serve perfectly well. If any trouble is experienced from the high resistance of the extension it is a simple and cheap matter to add another dry cell in series with the filament battery. Valves of the type which work from a 2 volt accumulator are difficult to use successfully when any kind of extension lead is used, so long as only the original battery is employed. If a 4 volt accumulator can be used with a good sized filament resistance, the matter is easy. An extension lead of quite moderate current carrying capacity will then serve, such as a double bell wire composed of two No. 18 conductors.

Ingenious Devices.

Ingenious devices have been arranged by the more advanced type of experimenter for controlling the filament by means of a relay switch upon the set itself, which is operated by a dry battery through the remote control line. Such arrangements, of course, are bound to be somewhat delicate in operation, and are considerably more trouble than the average user is likely to appreciate. The use of a good low resistance extension lead seems to be the best solution, and this can be laid along the skirting boards, etc., along with the two leads for the loud speaker or telephones. I have never found any ill effects result from their proximity.

Problems of Tuning.

The problem of tuning in with the set when the loud speaker is in some other room and consequently inaudible to the operator is a very real one, and really requires the co-operation of some person listening to the loud speaker and keeping in communication in some way with the operator for its entire solution. It is quite impossible to simply tune in upon the telephones and then, when the signals have been adjusted to a suitable volume, replace the 'phones with the long leads to the loud speaker, since if the signals are strong enough to work the loud speaker properly they must have been overloading the 'phones so heavily that it was quite impossible to say whether there was reasonable freedom from distortion. A method which I have found effective is to connect the telephones in series in the anode circuit of the rectifying valve, the loud speaker being connected permanently to the output terminals of the low frequency amplifying circuits.

A Useful Method.

In this way the signals can be tuned in upon the telephones at quite moderate strength, carefully adjusted as regards volume and freedom from distortion resulting from the use of too much reaction, and so forth, and the 'phones can be kept permanently in circuit for checking purposes. Unfortunately, this method gives no indication of the amount of distortion taking place in the low frequency circuits as to whether a suitable grid bias has been applied and so on. Since the adjustments of the variable factors in the low frequency circuits can usually be adjusted once and for all with any given set of valves and batteries, the easiest expedient to adopt here is simply to bring the loud speaker into the operating room, connect it directly to the

(Continued on page 313.)

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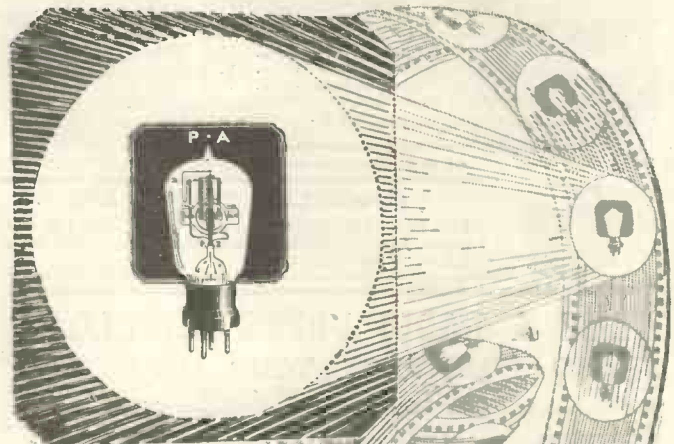
THE P.A.



THE MULLARD P.A. VALVES are designed to give loud speaker volume without distortion. The P.A.1 is used chiefly for power amplification at wireless concerts and requires 200-400 anode volts. For general loud speaker purposes, however, the P.A.2, with a working anode voltage of 150, gives sufficient volume for large rooms. The P.A.3 is similar to the P.A.2, but only requires a normal H.T. battery of 70–120 volts.

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Trouble Corner

Conducted by "ADSUM"

Faulty Insulation

A SET was brought round to me the other day by a despondent friend who, after spending a month's spare time in making it, was unable to get anything more from it than an incessant crackling roar punctuated occasionally by loud bangs. The noise was such as completely to drown even the strongest signal. Such an uproar seemed to be too much for even the vilest high-tension battery to produce entirely, but as a precautionary measure his high-tension battery was tried on my set and found to be in good order. Tests were then made with a view to seeing whether there was any disconnection at some point. The grid circuits were tried out first of all and then those of the plates. There was no sign of a disconnection or of a faulty joint anywhere. A milli-ammeter was then applied to the plate circuit of each valve in turn. Every one was passing its normal amount of current and there appeared to be nothing wrong here. It was certainly not the grid-leak or the grid condenser, for when others were tried as substitutes the noise persisted. The substitution process exonerated the low - frequency transformers. The high-tension battery condenser was then removed altogether, and conditions remained as before; obviously, then, this condenser had not broken down.

One appeared to be faced by a completely baffling mystery. Fig. 1 shows the circuit on the set in question, which is a perfectly straightforward one, such as one would never suspect of playing tricks of this kind. The solution was arrived at in quite an accidental way. I was running over the plate circuits once more with a pair of telephones to make assurance doubly sure, working through the set valve by valve. The rheostat of V4 was in the off position, and I unintentionally put the telephones into this plate circuit instead of into that of V3. The result was a fairly loud "plock," which of course should not have been there, for as the filament was cold there could be no emission from the valve. The fact that the plock was heard made it plain that there must be a short circuit in the high-tension wiring, and the only point where this could occur was between the filament and plate legs of the valve holder. On substituting the milli-ammeter for the telephones I obtained a distinct "kick," showing that a fraction of a milliampere of current was flowing, whenever the circuit was made. Each valve was then tried in the same way with the filament cold, and with one exception—the high-frequency valve—it was found that a short was present at each. A careful examination of the underside of the panel disclosed two facts of importance. In the first place, though the surface had been carefully removed from the *top* of the panel the underside had not been so dealt with. This is a thing which I have found more than once in sets made by beginners. Secondly, a very liberal allowance of greasy flux had been used when the leads were soldered to the valve legs; it had melted under the heat of the iron, and now formed quite a thick coating on the ebonite between the legs. Whether the fault lay in the presence of the layer of flux or in failure to remove the polished surface of the ebonite one could not tell, though either

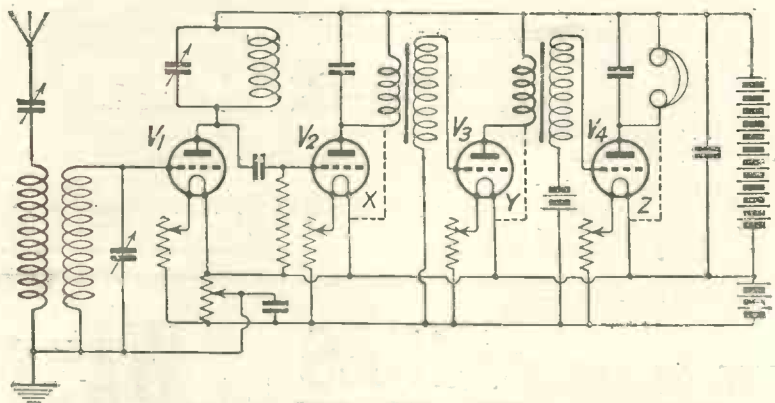

Fig. 1.—Shorts were found as indicated by the dotted lines at X, Y and Z.

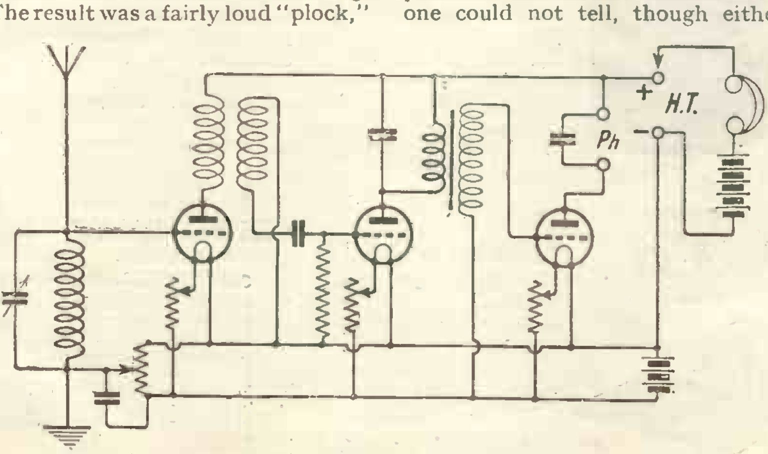

Fig. 2.—Testing for H.T. short. The filaments are "off."

might have been sufficient to account for the short. The set has since been rebuilt with attention to these points, and now works as it should.

A Second Case

Another very curious case of short-circuit occurred some time ago in a home-made set put together by a different constructor. He had used a wooden panel, relying upon ebonite bushes for his insulation. The symptoms here were much the same as those in the last case, except that the noises were not quite bad enough to drown signals. As the panel bushes were of a well-known make which I have often used myself with quite satisfactory results, I felt that it was unlikely that they were to blame; still, to make quite sure, tests for a high-tension short-circuit were made in the way shown in Fig. 2, first with a pair of telephones and afterwards with a milli-ammeter. Between the high-tension minus and the high-tension plus terminals a distinct short was found, the milli-ammeter showing that with 60 volts about .5 milliampere of current was passing. In order to see whether the short was confined to these two terminals or whether a large part of the panel was faulty, the connection between the high-tension minus terminal and low-tension plus was cut with a pair of wire nippers, and the negative lead from the high-tension battery was connected to the low-tension plus terminal. The short was still there, though slightly less current was indicated. Tests made at various parts of the panel indicated that there were short-circuits between a great many points.

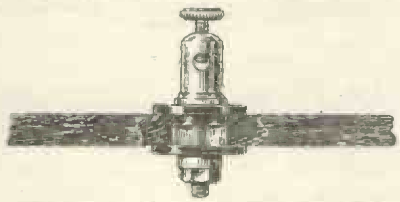

Fig. 3.—A good way of using panel bushes in thin wood.

On examining the underside of the panel it was found that as three-ply wood had been used it was not possible to use a pair of bushes in the ordinary way, inserting one from above and the other from below into a half-inch hole. A single bush had therefore been used in each case, put in from above and fixed in place by means of some kind of glue. Far too much of this had been used, with the result that it covered the whole of the under surface of the bushes, forming a bridge between the shanks of the terminals and the wood. There was also a deposit of flux upon the glue, and pencil lines ran in various directions from terminal to terminal over the wood. Two of the bushed terminals between which a bad short had been found were removed and replaced by others in which no glue or flux was used. It was found that no short now existed. It is quite possible to use single bushes in the way described so long as one is careful to use only a little glue round the flange and to see that it does not go on to the lower surface. Care must be taken to ensure that there is no deposit of flux on the ebonite. A more secure way of fixing bushes into thin wood is that shown in Fig. 3. Seasoned hard wood usually makes a pretty good insulator, but it must be remembered that the layers of ply wood are glued together, so that a little more care is required to see that the insulation is perfect when this material is used.

What a Bad Joint can Do

The soldered joint may occasionally be a sad deceiver. Sometimes if one is in a hurry one makes them rather badly, usually because the surfaces to be joined are not properly cleaned first of all. Such a joint may appear to have taken quite well, though in reality there is only the most "chancy" kind of contact between the two parts. I had an experience quite lately of the trouble that may be caused in this way in a set which I must admit was a recently-made one of my own. It was rather noisy from the very first, though the battery was known to be in good condition. On some days the noises would be almost absent, whilst on others they were very unpleasant. All efforts to trace the cause failed, for no examination disclosed anything loose or adrift and none of the usual tests proved helpful. The set is a five-valver, whose circuit is shown in Fig. 4. Two or three days after it had been brought into use it was desired to make a slight alteration in the set, which was accordingly taken to the workshop, where it was subjected to the jolts, jars and shaking necessitated by punch-marking the panel and drilling holes. On being replaced on the wireless bench it refused absolutely to bring in any signals whatever, but it *did* produce about the finest fusilade of noise that I have ever heard. This took the form of continuous crackles with intermittent ear-splitting bangs. When one of these bangs occurred the pointer of the milliammeter which is permanently wired into the high-tension circuit showed

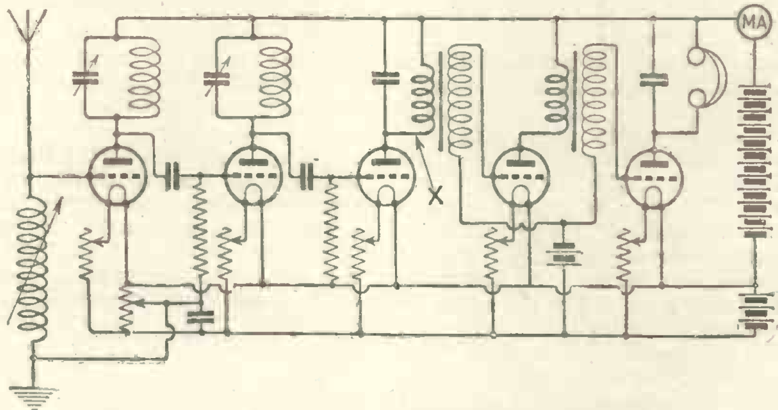

Fig. 4.—Where a badly soldered joint caused trouble.

a kick of from 3 to 5 milliamperes. Obviously there was a very bad contact somewhere. No sound could be heard as the anode tuning coils were pulled out, which indicated that nothing was going through the rectifier. The faulty connection was therefore probably in either the grid or plate circuit of this valve. The panel was removed and these points were examined. To all appearances there was nothing wrong with the leads or with the soldering, but when the wire running from I.P. of the first transformer to the plate leg of the rectifier was pulled with a pair of pliers it was found that though it looked all right it was not really connected to the plate leg at all. The end of this leg had not been properly cleaned, and the blob of solder used for making the connection had never made a good contact for the wire. The jarring received in the workshop had now caused the solder to give way altogether, though owing to the springiness of the wire it was held against the tip of the plate leg and the disconnection was not visible until the lead was pulled away. A touch up with a file and proper soldering with a hot iron put matters right at once. This kind of fault is not at all uncommon in amateur-made sets. The moral is that one should always be careful to clean the tips of valve legs and of terminal shanks thoroughly before soldering, and that after each joint is made the wire should be pulled hard with a pair of pliers to see that it really has taken. A well-made soldered joint will stand quite an amount of hard usage, but one that is faulty will crack away in time, and since the disconnection is hard to see it may give a very great deal of trouble when attempts are made to trace out the fault.

Do not miss the Constructional Articles in "Wireless Weekly,"

THE ORIGIN OF "SOS"

SO many explanations have been given of the origin of the wireless distress signal, used by ships at sea, that recently the International Telegraph Bureau was requested to give the correct version as to why these three letters were chosen. The Director of the Bureau states that the first suggestion for a distress signal for ships' use was made by the Italian delegates at the preliminary conference on wireless telegraphy held at Berlin in 1903, when the adoption of a universal signal "SSSDDD" was urged. "S" presumably being to indicate that it was a ship calling, and "D" being the international designation for an urgent message. All stations and ships should be compelled to receive such calls, suspending all other communications for the time being. The other delegates agreed to the need for such a signal, but the final decision was left for the special conference later. Shortly after this suggestion was made the Marconi Co. recognised that a distress call signal was necessary, and on February 1, 1904, the famous signal "CQD" was instituted on all ships fitted with their apparatus. "CQ" being the International Telegraph sign for "all Stations," while the letter "D," as already pointed out, is the designation used for an "Urgent" message.

Several countries, including the United States, adopted "CQD," and used it until the Radio Telegraph Conference in Berlin in 1906, when the German Government suggested that the standard distress signal for ships at sea should be "SOS"; previously German ships had used the signal "SOE," but the last letter "E" was easily dropped, as it consists of a single "dot," and was often lost in atmospheric disturbances. Finally the famous signal "SOS" was adopted officially by the International Radio Telegraph Convention in July, 1908. The "SOS" should be signalled without spaces "- - - — — — - - -" and not as it is often done "- - - — — — - - -" the Berne Bureau explains.—*Journal of Commerce.*

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(*Continued from page* 304.)

output terminals, and proceed to carry out the necessary adjustments, and then transfer it to the "auditorium."

An alternative method of adjustment is to have someone listening to the loud speaker at its distant position and communicating with the operator by some convenient means. For example, if an extension lead is used for filament control, the distant critic can convey his opinion of the loud speaker results by momentarily switching off the filaments of the valve to convey some predetermined code. As a rule, the only comment which he needs to convey is that the reproduction is either too loud or not loud enough and a two-meaning code is very easily devised. Where the use of the loud speaker in the distant room is intended to be a permanency, it would probably be worth while to lay a separate twin bell wire lead from one room to the other, and use a pair of the cheap telephones sold for inter-communication purposes.

The behaviour of the loud speaker at the end of a long extension line is a somewhat uncertain factor, and the most that one can say is that any trouble which may result will almost certainly be removed by the adoption of one or other of various devices which we will proceed to consider in a moment. Which of these devices will prove most efficacious in any given case it is again impossible to predict with any confidence, but it is a very simple matter to find out by experiment. It is not to be assumed that some sort of trouble will be experienced on *every* occasion of the use of long leads for the loud speaker, and I think that in the majority of cases no difficulty whatever is met with, the only difference resulting from the use of the extension being a slight alteration of the tone of the reproduction. This alteration can easily be compensated for by a readjustment of the capacity of the shunting condenser across the loud speaker itself. Trouble may be experienced, however, and it is usually a question of the setting up of continuous howling and whistling in the receiver, which is the most common trouble in the case of reflex receivers. The stability of some receivers appears to be seriously upset by the large capacity of the long leads, which of course are at a considerable low frequency difference of potential to earth.

Such howling is not often met with in the case of the improved ST 100 circuit, in which the reflex transformer is connected in the aerial circuit, and where it occurs with the older type, the effect of making this conversion should always be tried. Simply connect the earth wire to the low tension negative terminal.

The simplest remedy for such howling in almost any type of set, whether reflex or "straight," lies in the use of a telephone transformer, thereby taking the long leads out of the plate circuit of the last valve. With a high resistance loud speaker it may be preferable to use as a telephone transformer an ordinary intervalve transformer, using the secondary winding in the plate circuit and connecting the I.P. and O.P. terminals to the extension lead.

A little experimenting with fixed condensers across various points may be needed to get this arrangement working properly. Without any addition it is practically certain to remove the howling trouble, but the tone of the loud speaker may be altered, and it will sound as though a condenser of incorrect capacity is being used across the telephone terminals of the set

The remedy will usually be found in the condenser of moderate capacity, in the neighbourhood of .003 μF, across the telephone terminals of the receiving set.

If the effect of the transformer and extension lead is to make the loud speaker sound muffled, as though too large a shunting condenser is being used, the problem is a rather more difficult one, and the only palliative which I have found is the use of a non-inductive resistance such as an anode resistance of a rather low value, say 40,000 ohms, across the terminals of the loud speaker itself. A slight loss of volume will result, but I have not found this serious.

Another Remedy.

When these expedients fail, as sometimes happens, the usual remedies for howling in the receiver itself should be tried. Reverse the connections from the secondaries of the low frequency transformers, one at a time, try a resistance of 100,000 ohms across the secondary of the last transformer, and also, possibly, a fixed condenser of .0001 μF in the same position.

A filter circuit will also serve in many cases in place of a telephone transformer and may be found somewhat cheaper to install. Such a filter may consist of a non-inductive resistance of 100,000 ohms, the loud speaker leads and the condenser of .1 μF capacity being connected in series with each other and joined in parallel with the resistance to the output terminals of the set. In this way only the fluctuations of the anode current cause impulses to pass through the loud speaker. In obstinate cases one simply has to fall back upon trial and error methods, upsetting the natural frequency of parts of the circuit, such as connecting a 40,000 ohm resistance in series at some point or other, putting condensers of capacities between .002 and .008 in parallel across the ends of the extension line, and so on.

A final word about low frequency oscillation troubles; this fault may sometimes make its appearance in the form of severe distortion and weak signals, although no audible howl or whistle may be observed. In some cases this means that self-oscillation is taking place in the low frequency circuit at an inaudible periodicity, and the same remedies should be tried.

The other trouble which may occur with long leads with either telephones or a loud speaker at the further end is the picking up of currents by induction from power and lighting mains, giving a buzz or hum in the loud speaker. It is very difficult to remove this trouble when present, and as prevention is certainly very much better than cure, a certain amount of time should be spent in experimenting with the routes by which the extension lead is carried. It will often be found that the trouble is local in some particular part of the house.

If the effects are found to be widely distributed and it is impossible to find a route to the required destination which is free from them, similar remedies should be tried to those already detailed for howling troubles. In such a case it is usually more effective to use a filter than a telephone transformer, and when one of these is in use, it is often beneficial to connect in series with the loud speaker at the further end, that is to say, the end remote from the receiving set, a condenser of a capacity of about ½ μF.

Lead-Sheathed Wire.

In particularly severe cases probably the only real cure is to use lead-sheathed twin wire for the extension, and a telephone transformer. It is usually best in these cases to connect the metal sheathing of the lead to earth. Wire of this nature is used a good deal in telephone installations, and consists of twin separately insulated conductors enclosed in a thin walled lead tube.

The question of the kind of wire to use for extension leads should perhaps receive mention here. The nature of the extension, its route and its permanence or otherwise, will naturally affect the description of wire, and for a permanent lead running out of doors to another building or some definite point in the garden, by far the neatest and most satisfactory way of carrying out the work is to use two separate bare wires spaced about a foot apart, carried on small porcelain insulators like a telephone line. The wires should be carried at any convenient height above the ground, provided that it is not more than perhaps about 6 ft. (if you make it too high it will act as an aerial, and curious things may happen).

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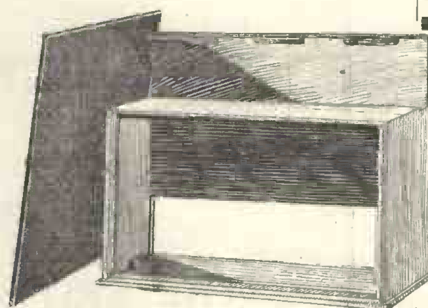

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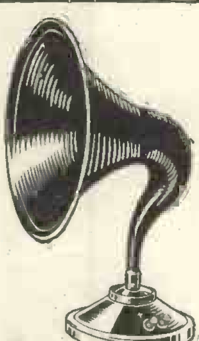

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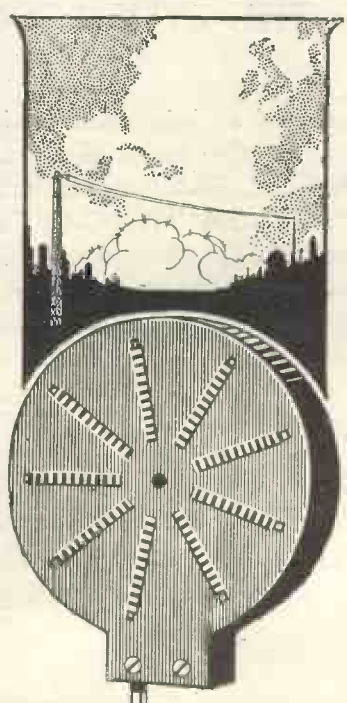

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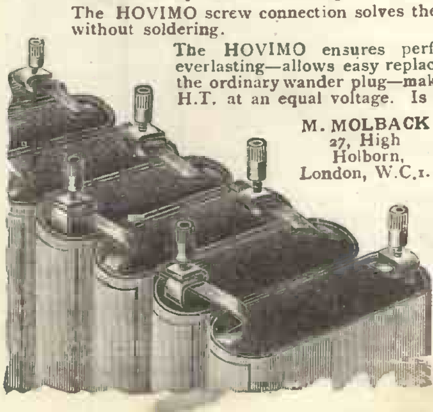

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