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Vol. III.
No. 2

THE PURIFLEX—A New Receiver. *By Percy W. Harris.*

THE CRYSTAL MENACE. *By John Scott-Taggart, F.Inst.P., A.M.I.E.E.*

SYSTEMATIC FAULT FINDING. *By G. P. Kendall, B.Sc.*

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MODERN WIRELESS

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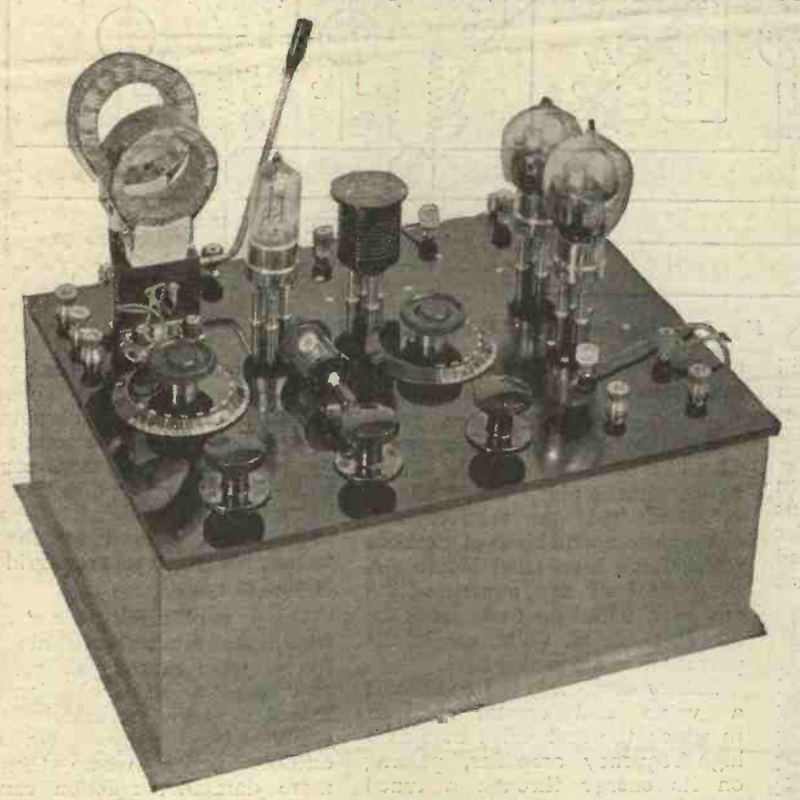
A New Three-Valve Portable Set

The compactness of this three-valve portable receiver, full particulars of which are given on another page, will appeal to all who love the open air.

The "Puriflex" Receiver
(MODEL I.)
A New Transformerless Reflex.



By
PERCY W. HARRIS,
Asst. Editor

For many months Mr. Harris has been studying the design of reflex receivers with the idea of producing an instrument which would give the greatest possible purity and volume, combined with simplicity and stability of operation. The instrument described below, which is destined to rival the "All-Concert" in popularity, is certainly the most interesting he has described in our pages.

IN the last few months, as many readers know, I have been experimenting a good deal with resistance coupling, and it occurred to me that if we could only combine the efficiency of reflexing with resistance coupling in such a way as completely to eliminate any low-frequency inter-valve transformers, we might get a receiver which would give very pure and pleasing reproduction with great volume. Further, by removing any low-frequency resonant circuits, we could perhaps eliminate nine-tenths of the troubles which heretofore have been inseparable from reflex receivers—those troubles which give rise to squeaks, howls and the whole chain of unpleasant noises which at times occur with even the best possible transformers in the simplest of designs. Furthermore, by the elimination of the transformers, we should save a good deal of cost, a consideration not to be ignored if efficiency can be retained.

I am pleased to say that, after many trials, I have produced a receiver which I hope can be looked upon as a "reflex with the trouble taken out of it." So far, neither I, nor any other members of the editorial staff who have tried it (and we have tried it in many places and under all kinds of conditions), have succeeded in getting a single buzz or howl out of it—save, of course, when it has been deliberately made to oscillate and heterodyne the carrier wave of a broadcasting station. Any straightforward circuit will do this if misused.

To give you some idea of its capabilities I may say that the preliminary tests were carried out in my new house at Wimbledon, at a time when I had not erected an outside aerial. Wimbledon, as you will see if you examine a map, is about seven miles south-west of 2LO, and here, using an inside aerial consisting of about 40 feet of wire round the rafters, led into a room immediately below the roof, and with a very inefficient earth connection on to a water pipe some way off, the set had to be detuned some degrees before the volume from 2LO was really comfortable, while in the telephones Birmingham could be read at really good telephone strength. Good loud-speaker results were easily obtained with about 10 feet of wire for an aerial in the room and about the same length of wire lying on the floor as earth connection, and thoroughly satisfying loud-speaker signals with a two-foot frame aerial. On a good average outdoor aerial the volume obtainable will satisfy the most ardent lover of volume, at the same time, even at fullest strength, retaining a crystal purity unexcelled by any other receiver I have yet heard. Upon any normal outdoor aerial in reasonable conditions all of the British broadcasting stations come in quite comfortably in telephones with a purity which, I think, will be a revelation to most readers of this journal, although the distant ones will not be quite so loud as with the "All-

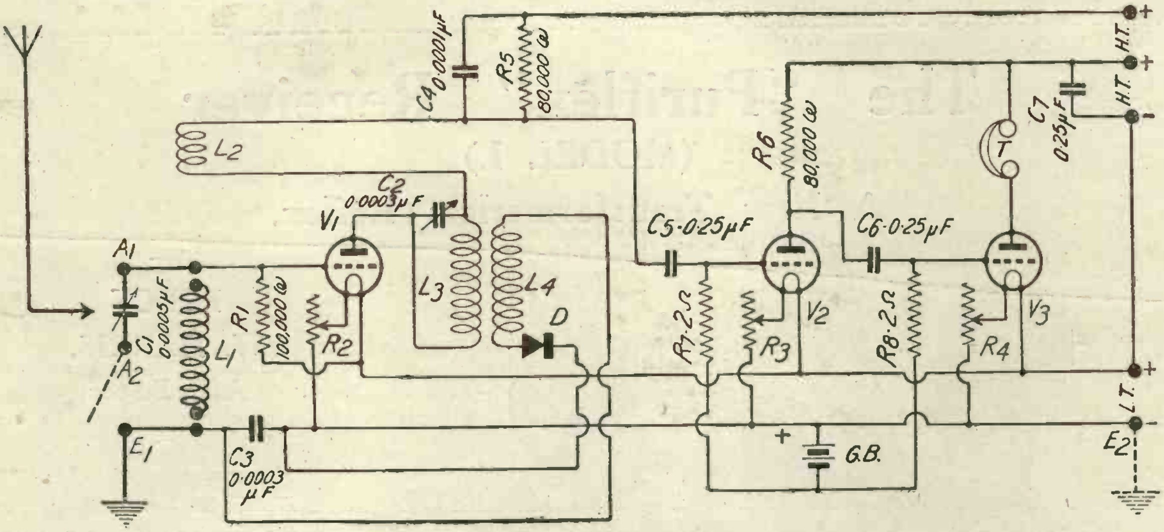


Fig. 1.—The circuit of "Puriflex Model 1."

Concert." Near-by stations will come in many times louder than on the latter instrument.

Why Model 1 ?

The name "Puriflex" has been given to the instrument for obvious reasons. Some readers may wonder why this particular type is called "Model 1." The reason is that

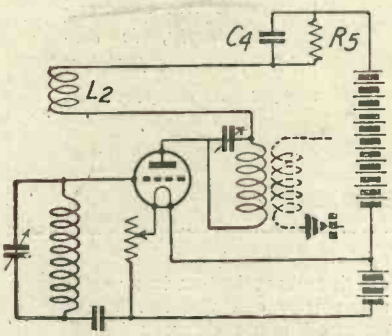


Fig. 2a.—The H.F. Circuit.

it is made up in rather a special form, which may appeal to certain readers. The reason for the form is that the panel is destined to fit in a special cabinet of the gramophone type, containing a built-in loud-speaker, and the panel has to be of the size given. In order that the panel can be lifted out very readily with a minimum of trouble in disconnecting, it will be seen that the battery leads are taken to Clix sockets, the same type of socket being used for connecting the loud-speaker attachment. There are, however, two additional terminals in parallel with these last, so that a pair of telephones can be connected in a moment for distant reception.

At later dates I shall be describing other models of Puriflex with the same circuit, but made up in slightly different forms to suit other needs.

General Description

For the benefit of those people who like to look over new things to see what is old, I would like to point out that the receiver is a combination of all kinds of methods which have been tried before. A good deal of my experimenting has been based on early work by Mr. P. G. A. H. Voigt, one of the pioneer workers in this field.

Briefly described, the Puriflex is a valve and crystal receiver, in which the first valve acts as a high-frequency amplifier, passing on its energy through a tuned transformer to a crystal, which feeds back the rectified energy into the grid circuit of the first valve direct, and without the interposition of the customary intervalve transformer. The signals are now re-amplified by the first valve, acting as a low-frequency amplifier, and passed on to the next valve, which is resistance coupled. Additional amplification is obtained by reaction, as will be seen, and a second stage of resistance-coupled audio-frequency amplification may be added at the end. Separate high-tension is used for the last valves, for which separate grid bias is also provided.

On a very small indoor aerial where the set will oscillate very freely, reaction may be reversed and control of oscillation obtained very accurately and easily this way. On large outdoor aerials where there is more damping, reaction can be used to bring the set up to oscillation point when required. The simple and accurate control of oscillation, together with the great simplicity of the crystal adjustment, is one of the greatest charms of this receiver when you begin to work with it.

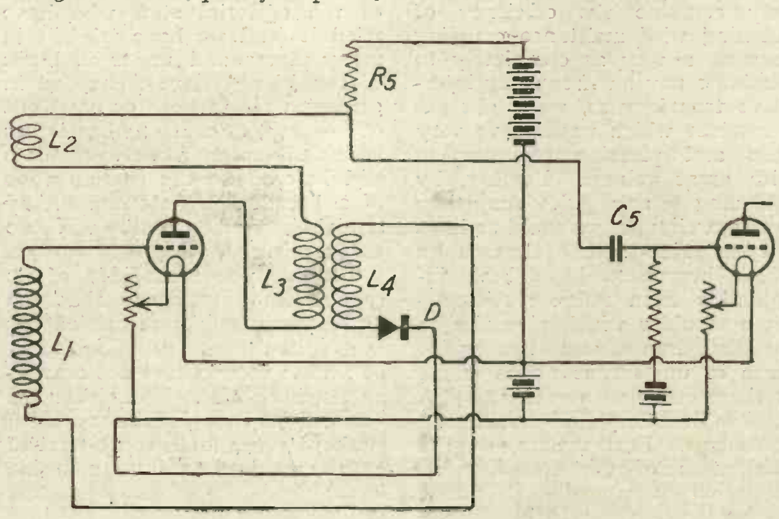


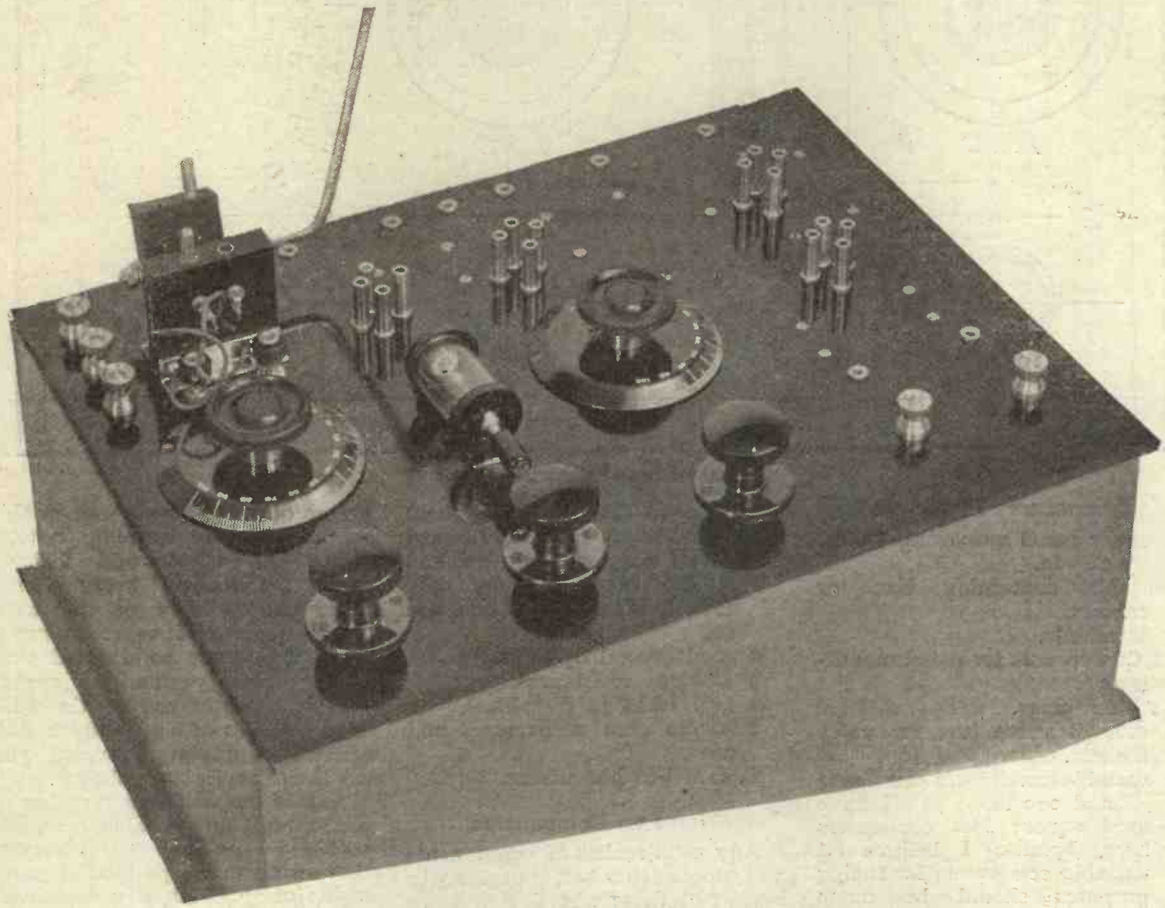
Fig. 2b.—The L.F. Circuit.

The Circuit

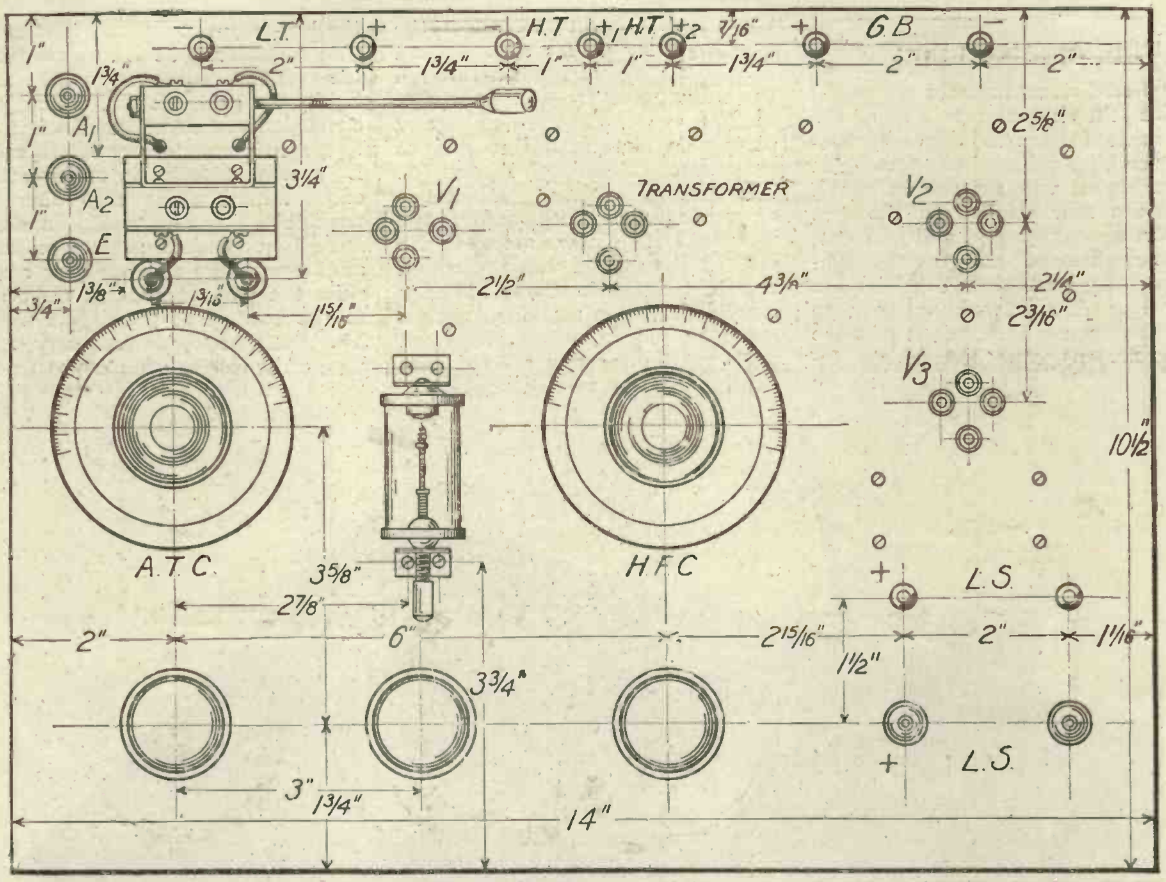
Fig. 1 shows the circuit used. The aerial tuning condenser C_1 can be placed either in series or parallel with the inductance L_1 in the manner I have so frequently described, by using three terminals. The signal voltages set up across L_1 are now applied to the first valve across the grid and filament, the condenser C_3 allowing the high-frequency oscillations to pass quite freely. The signal voltages so applied cause fluctuations of plate current to pass through the inductance L_3 (which is tuned by the condenser C_2), through L_2, which is untuned, the 80,000 ω resistance, to the high-tension battery, and thus round to the filament. The condenser C_4 acts as a high-frequency by-path to the resistance R_5.

L_3 is the primary of a high-frequency transformer, the secondary of which is formed by the inductance L_4. We thus have signal voltages set up across the terminals of L_4, and these are rectified by the crystal D and passed back, as will be seen, to the terminals of the condenser C_3. Now C_3 will not allow the low-frequency pulses to pass, and therefore they are applied through the inductance L_1 to the grid of the first valve. The low-frequency plate pulsations pass through the inductance L_3, through L_2 and R_5. The audio-frequency difference of potential set up across the resistance R_5 is now applied to the grid of the second valve, through the fixed condenser C_5, and is duly amplified. The amplified signals are now passed on to the third valve, again through a fixed condenser C_6, and in due course we get greatly amplified signal current in the plate circuit of the last valve. It will thus be seen that the first valve acts both as a high-frequency and a low-frequency amplifier. To help to make this clearer the paths of the two currents are shown separately in Fig. 2. The 100,000 ohms resistance R_1, shunted across the grid and the positive filament leg of the first valve, has since been removed, as the set is quite stable without it.

In Fig. 2A the high-frequency circuit is separated out. In Fig. 2B the low-frequency circuit is clearly shown. Starting at L_4, we see that the rectified pulses now pass from L_4 to the grid, *via* L_1, which, of course, offers a negligible impedance to low-frequency currents. L_3 and L_2 are inductances in series with one another, which also offer a negligible impedance to audio-frequency currents, so that on the audio-frequency side we may consider the plate connected directly to the bottom of R_5. We then have, of course, an ordinary resistance amplifier connected to the next valve through C_5. In passing, it may be stated that it is of the utmost importance to get the connections of L_3 and L_4 exactly as shown in the wiring diagram. By this I mean that the crystal detector must be at the correct end of the transformer secondary or the set will fail to work. A symptom that you have the crystal connected to the wrong end is that you will get signals whether the crystal point is on or not, and the set will not respond to reaction, whichever way round you connect the reaction coil.



Puriflex I. with valves, transformer and coil removed.



Top of panel arrangements.

Components Required

Ebonite panel measuring 14 in. by 10½ in.
Suitable containing box or cabinet.
5 terminals.
11 Clix sockets for panel mounting.
11 Clix plugs.
4 sets of valve legs for valve sockets.
2 variable condensers one .0003 μF and one .0005 μF (I have used square law condensers here, because I believe all variable condensers for tuning purposes should be made this way). You will not suffer any loss of signal strength by using the ordinary type of variable condenser, providing it is of good quality. The advantages of the square law condensers are ease of handling and calibration. Some people, however, may not consider that they are worth the additional cost.
1 two-coil holder.
1 fixed condenser, 0.0003 μF.
1 fixed condenser, 0.0001 μF.
3 fixed condensers, 0.25 μF (Mansbridge).
1 or more plug-in high-frequency transformers (cylindrical type or good disc type). These transformers can be obtained for all wavelength ranges, and if the reader desires only British broadcasting, one will do.
1 good crystal detector.
3 filament resistances.
2 grid leaks (2 megohms).
2 80,000 ohm resistances and clips.
Square bus bar wiring.

Notes on Components

Any good makes of components will do in this set, but for the benefit of those who like to know the actual parts used in this receiver the following are those I have used :—

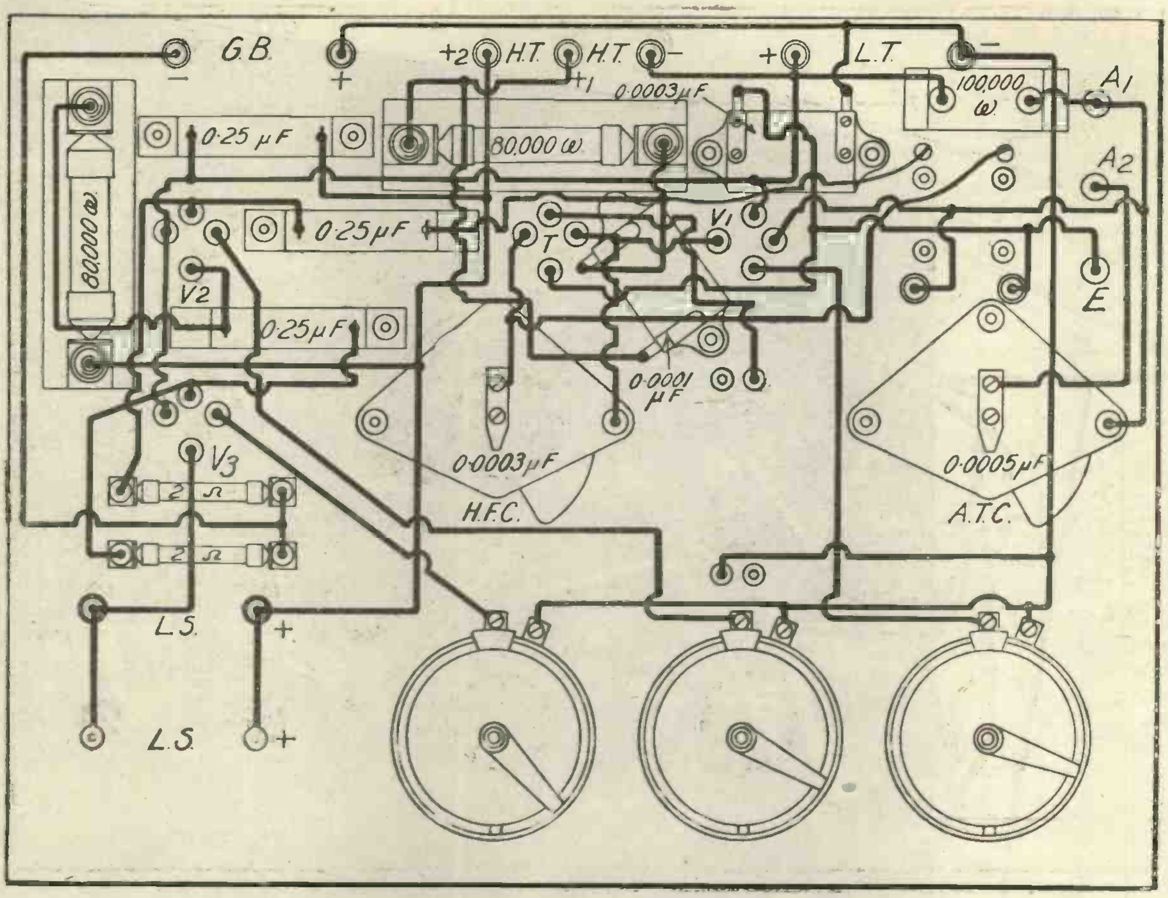
Variable condensers (Bowyer-Lowe).
Fixed condensers (Dubilier and Mansbridge).
Plug-in transformer (McMichael).
Filament resistances (Burndept dual for bright or dull emitters).
Coil-holder (Magnum).
Grid leaks (Dubilier).
80,000 ohm resistances (Dubilier, large pattern).
Crystal Detector (Burndept).

Coils and Valves

Practically all the well-known makes of valves work well in this set. There is nothing critical about the valves and I have used practically every kind successfully. Any of the well-known makes of R valve are good, while if you are so situated that dull emitters particularly appeal to you, three of any of the well-known makes of 0.06 ampere dull emitters will suit, provided you use the correct plate voltages.

Any of the well-known makes of plug-in coil are suitable here. It should be pointed out, however, that owing to the peculiar requirements of space already explained, the parts of the receiver are quite close together, and it will not be found possible to use some of the biggest makes of concert coil with some of the biggest valves for the first socket. Thus, if, for example, you use a Burndept or Igranic concert coil, there will not be sufficient space for a large round type of valve such as the conventional R valve. You will find, however, that even with a concert coil there is room for the cylindrical type of valve, such as the Cossor, Ora, Xtraudion, Ediswan A.R. and the dull emitters.

If it is desired to have space for the largest valves and the largest



Complete wiring diagram. Blueprint No. 48.

coils, then the panel should be made slightly longer to allow for this. I have worked this set with practically all of the leading makes of plug-in coils quite successfully. Those shown in the photograph of the instrument are the new pattern "Atlas" coil fitted with white porcelain sockets and special split pins to make sound contact.

Constructional Work

Be very careful in this receiver to see that your ebonite panel is of the first quality ebonite, and if it is not guaranteed free from surface leakage (the great majority of ebonite cannot be so guaranteed), remove the surface skin with fine emery so as to avoid all possibility of trouble in this direction.

Now mark out the positions for the Clix sockets and the terminals and drill holes for these with carefully marked centres to preserve the neatness of appearance. It is just as well to buy your components first of all and then lay them out on a piece of paper to see that you can arrange them all successfully in the space given. It may be that some components will be slightly larger than those I have used, making it necessary to have a somewhat larger panel. If, however, you find that you can get everything in the space, then you can use the wiring diagram as your guide. A blueprint, of course, is available at the usual price of 1s. 6d., post free. You should ask for blueprint No. 48.

Notice particularly the way the valve legs are arranged for the first valve and for the plug-in transformer. The Dubilier 80,000 ohm resistances should be mounted complete with the ebonite strip on the back of the panel as shown. I do not recommend you to try to remove the clips for direct mounting on the panel, as you will not get satisfactory results if you do so.

The mounting of the other parts calls for no special comment. The Mansbridge condensers and the Dubilier fixed condensers can be used, if necessary, as their own drilling templates. Flexible leads are used from the moving coil-holder.

Wiring Up

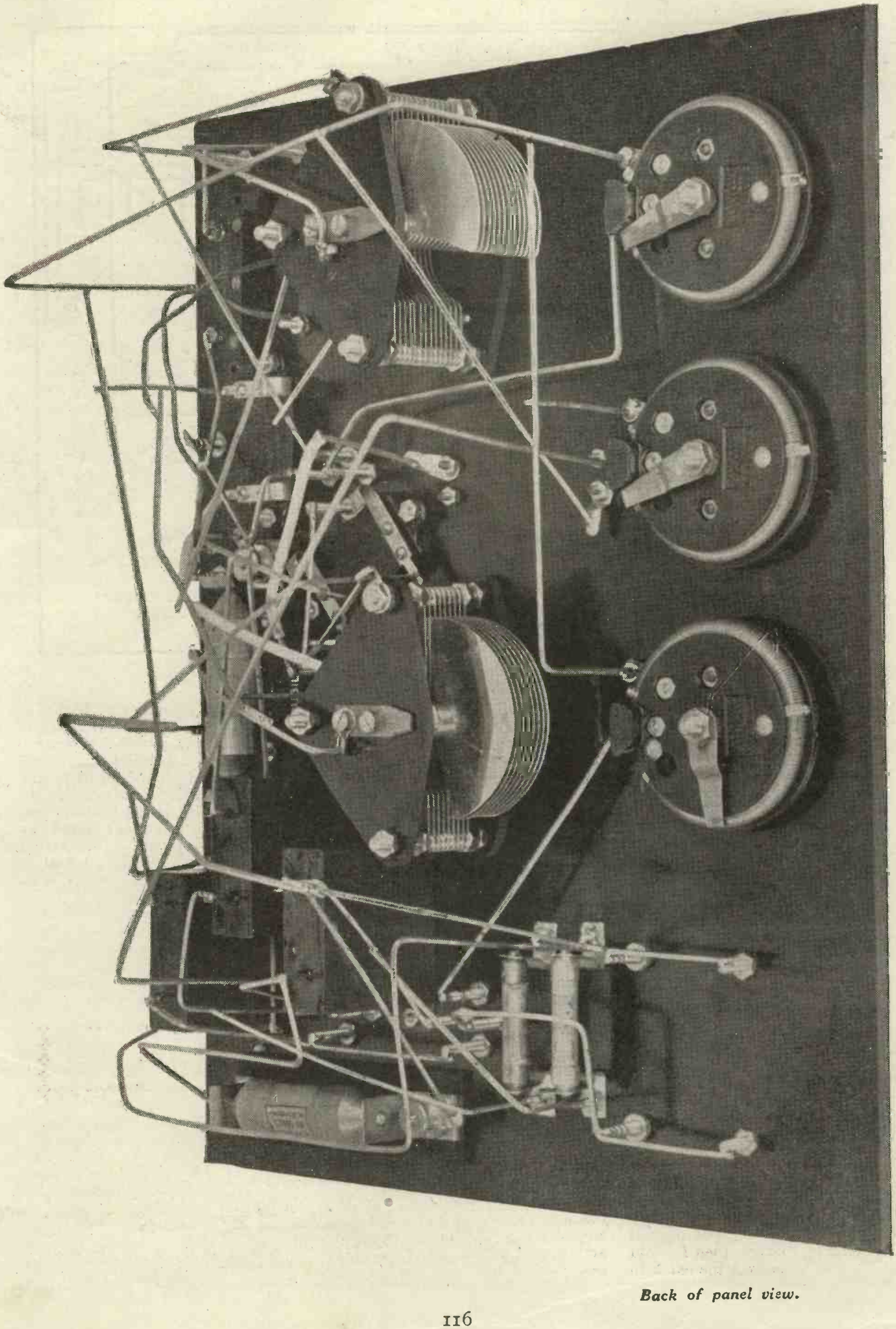
If you do not feel sure of your skill in wiring with the stiff wire, I would recommend you to use the flexible wire and insulating tubing. It is well to have one or two pieces of tubing on hand to slip over even the stiff wires where they may possibly touch others.

In any case, I would recommend you to wire up the high-frequency portion of the circuit with stiff wiring, and I strongly advise you to follow the lay-out given as closely as possible, as the actual lay-out of a set has a good deal to do with efficiency—far more than many people realise.

To save possible inquiries, I may state that I do not consider that variable grid leaks and variable anode resistances would be any improvement in this receiver, as the values do not seem at all critical.

Connections

When you have finished the instrument and are ready to connect it up, join up the batteries to the terminals shown, using suitable grid bias for the valves and voltages used. You will see that there are two H.T. positive sockets, one supplying the H.T. of the first valve, the second the high-tension of the last two valves. If you are using, for example, the Cossor P_2 in the first socket, you will probably find that a plate voltage of about 80 or 90 will suit here; and if you



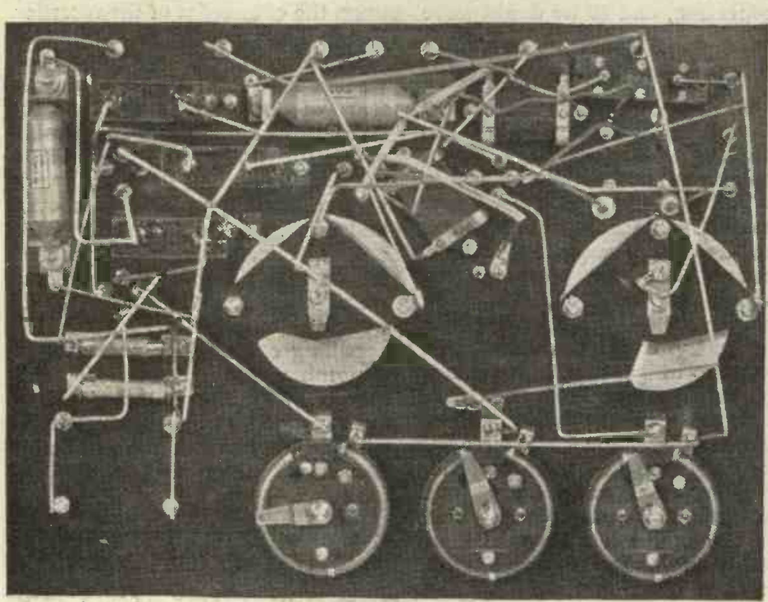
Back of panel view.

are using the R type or B4 valves, about 120 to 150 will give the best results, using a grid bias of about 4½ volts (an Ever Ready No. 126 type is very useful here). For dull emitters use the plate voltage specified by the makers; they will also tell you the correct grid bias for the voltages used.

The set will work quite well with three general purpose valves, using, say, 80 or 90 volts on all of the plates, although a higher voltage will give better signal strength. It should be remembered that in a resistance-coupled receiver there is a certain drop in voltage through the resistances, which must be compensated for by additional H.T. voltage. Thus, where you would normally use about 60, some 80 or 90 volts are required.

There are two Clix sockets for the loud-speaker in parallel with two ordinary terminals, so that if your loud-speaker is fitted with Clix you can plug-in, or if it is fitted with the ordinary terminal wire, then you can use the ordinary terminals provided. On the average outdoor aerial you will need a No. 25 or a No. 35 plug-in coil, with the condenser in parallel, for shorter waves, and a No. 35 or a No. 50 for the longest wavelengths used on British broadcasting. If your loud-speaker or telephones are to be used quite close to the set, then the earth connection may be taken to E_1 (Fig. 1). If, however, you want to use very long leads, from, say, one part of the house to another, then I would advise you to connect the earth to E_2, that is to say, the earth wire should go to the negative terminal of the accumulator. In so doing you alter the tuning somewhat, and you will require a one size larger coil to compensate for the alteration, otherwise you will find that you get very similar results, except that the set may oscillate more freely this way.

A short piece of wire should be used to join A_2 and E. To use the aerial tuning condenser in series, open the link joining A_2 and E, join aerial to A_2 and earth to E. For parallel close the link and join aerial to A_1, leaving earth on E. In the circuit diagram there are shown E_1 and E_2. E_1 is E of the receiver, E_2 is the negative terminal of the accumulator.



This vertical view will also help constructors.

You will notice that two flexible wires come from the aerial coil socket to a pair of Clix terminals, which can plug in either way so as to reverse the direction of current flow through this coil. This gives exactly the same effect as reversing the windings of the reaction coil, and the reversal is used on to the aerial coil merely because it enables the terminals to be changed more easily.

Adjust your crystal to what appears to be a good position, turn on your valve filaments to the correct temperature, open out the reaction coil to the full extent, and tune on C_1 and C_2 until you pick up your local station. The reaction coil, by the way, should be one or two sizes larger than the aerial coil. Now bring up the reaction coil and see whether the set will oscillate. If not, reverse the windings by reversing the Clix connections and try again. You will now probably find that the set will oscillate easily. If you still have difficulty in making the set oscillate on your aerial, place the aerial tuning condenser in series. Constant aerial tuning can be used very effectively in the Puriflex, and helps to make the set oscillate more freely on some aerials. Be careful, however, not to make these oscillation tests when the broadcasting station is actually transmitting. A slight readjustment of the crystal (adjustment of this crystal detector is far less critical than on the average reflex set) will bring in the signals at wonderful strength, and after a few minutes' adjustment you will find that you can handle it as easily as any other receiver.

If you find that you can get equally loud signals with the crystal point on or off, and if you find that the set will not oscillate whichever way round the reaction is connected and in whatever position you place the two coils, then it is probable that the crystal is connected to the wrong end of the intervalve transformer secondary.

On very small indoor aerials you will find that the set will oscillate when you come to the tuned point, even with the coils wide open. In this case reverse the Clix terminals in front of the aerial coil socket and use the reverse reaction winding to check self-oscillation. You will find this a very excellent method of using very small aerials indoors. If you have a very heavily damped aerial which in previous sets has shown that it will not oscillate very readily, you will probably get much better results by the E_2 connection of the earth wire in place of the E_1. This simply means that you take the earth lead off the E terminal and connect it to the negative L.T. terminal.

A NOTE ON "TRANSATLANTIC V."

When using "Transatlantic V." with 4 volts on the first three valves and 6 volts on the last two valves, it will be found on turning off the filament switch that some of the valves will remain feebly illuminated. They will all be extinguished by turning the switch to the three-valve position.

In passing

Those Little Slips

IT was Mr. Punch, I think, who first had the idea of collecting, as examples of commercial candour, advertisements in which misprints made the would-be vendor say something quite different from what he intended in his attempts to lure the public into purchasing his wares. The *Little Puddleton Gazette* has just printed one of the best I ever saw. Our local wireless store sent in the announcement of a clearance sale at enormous sacrifices. "Everything," the proprietor wrote, "that you require at most reasonable prices." His intentions were excellent, but the compositor was one too many for him. Either he could not read the writing or he had a strong sense of humour, but anyhow he turned the "t" of "at" into an "l," and then inserted the full-stop which seemed necessary. The splash heading "Everything that you require. Almost reasonable prices," created even more levity than the mistake made a few weeks earlier by the *Gazette* when it ran together two paragraphs unintentionally and announced: "We congratulate Professor and Mrs. Goop upon the arrival of a son and heir. Complaints have been received recently of a great increase in howling. The B.B.C. are investigating the matter, and we trust that the offenders' licences will be cancelled." But it is not always the country cousins of a place like Little Puddleton who thus add to the gaiety of the world by little touches of unconscious humour. I was walking the other day down one of London's proudest thoroughfares when I paused to flatten my nose in company with many others at the windows of a large wireless shop. All kinds of goods were displayed there, but what took me most was a tray of selector switch arms attached to which was a card bearing the words "Lamentation switch arms sixpence each." This is an absolute fact. If you do not believe me go and look for yourself at a window in Holborn not a thousand miles from Staple Inn. I certainly have had, though not from this shop, laminated arms provocative of lamentation, and so no doubt have you.

A Triumph for the Village

The name of Little Puddleton will ring through history as the birthplace of Professor Goop. People now make pilgrimages to Stratford-on-Avon, where a fellow named Shakespeare lived some time ago, who was the author, I believe, of a few plays written specially for the "Old Vic." In years to come excursionists will pour in by train, charabanc and aeroplane to gaze with reverence upon the abode of Professor Goop, the inventor of the latest unit of measurement. You know already, or at any rate you ought to, the names of Ohm and Henry (not John of that ilk) and Volta. But that of Goop will soon put them quite in the shade. I always think that it is most fortunate, by the way, that the people who invent these things have such nice short names. Now fancy if the man who first thought of the unit of current had been named Cholmondeley-Marjoribanks. It would have been a sad mouthful, would it not, to speak of a 50 cholmondeley-marjoribanks hour accumulator, or of a millicholmondeley-marjoribanksmeter. Professor Goop is equally fortunate in his cognomen, and we shall have no difficulty over the goop, kilogoop, milligoop and microgoop. It fits equally well with the suppression of its final p to metres of various kinds. Such a word as milligoommeter, for example, rolls lightly off the tongue and is unlikely to dislocate even the most delicate jaw. And now I suppose you will want to know precisely what a goop is. It is the unit of signal strength, and its introduction will deal a shrewd blow at the activities of the radioliar. To-day, you know, he tells us: "I got WGY last night at extraordinary strength. R9 on one valve." We smile politely and can say no more, for R9 is what may be termed an elastic unit whose value depends largely upon the conscience of the recorder. But in a few months' time, when the milligoommeter is on the market, we shall be able to say without fear of contradiction that the strength of Budapest was 19 milligoops, for, thanks to the Professor, we shall be able to back our words by readings from this wonderful instrument. His task was a colossal one, as you may imagine, for he had to embody in a small metal case something capable of working out all by itself the appalling calculations necessary to determine the answer. I have ordered a milligoommeter, for I am not good at figures, but those who choose to work things out for themselves may do so by the formula :—

$$S = \sqrt{\frac{\lambda \times \sqrt{\beta} + (h \times 2L)}{\frac{F}{2} \times \cos \delta}}$$

in which S is the signal strength in milligoops ; λ, the wavelength of the transmitting station ; β, the barometer reading in millibars as given in the second news bulletin ; h, the height of the aerial above sea-level ; L, the inductance of the telephones in microhenries ; F, the distance between you and the transmitting station ; and δ the angle between your aerial and true north. As the milligoommeter contains a compass and a barometer, the only adjustments necessary can be made in a moment with the help of a hacksaw and coal chisel, a screwdriver and a hairpin. Once set, the instrument is quite self-acting and no further alterations of any kind need be made. Naturally we are all delighted at the Professor's distinctive rise to fame, the only dissentient voice being that of Mrs. Goop, whose godfathers and godmothers named her Mildred. She objects to being known as the milligoop; nor does she like references to her infant son as the microgoop.

Up-to-Date

Whatever we do at the wireless club we always endeavour to keep up with the march of things. Last week we had the first wireless picnic of the season. If your own wireless club has not yet arranged one let me urge you to prevail upon the secretary to do so forthwith, for there are few more entertaining functions. The average picnic is, of course, a comparatively dull and uneventful affair. You drive, walk, ride or cycle some distance into the country, taking supplies of food with you. You choose a suitable spot, where you strew rugs, overcoats, cushions and other aids to comfort. The men, if they are wise, then sit down whilst the ladies prepare tea. It is usually found that one of the cushions has been placed over the entrance of a wasps' nest, and this lends one of the few notes of gaiety to an otherwise dull function. The only other adventures which can befall are (*a*) that the tea has been left behind; (*b*) that water is unobtainable, or (*c*) that no wood can be found with which to light a fire. Now the wireless picnic is a different business altogether, for it goes with a bang from start to finish with never a dull moment. Here is what happened to us. At the preliminary meeting Poddleby, our secretary, told us the rendezvous and expressed the hope that some of us would bring our portable wireless sets. We were to proceed to the place appointed for the orgy by whatever conveyance we chose. The first to arrive on the scene was Professor Goop upon his tricycle, with no fewer than four sets in a trailer behind. General Blood Thunderby came bestriding a stout cob with a set strapped to his shoulders boy-scout fashion. Others turned up on motor-scooters, in cars and on push-bikes, whilst Gubbsworthy had chartered a charabanc to convey a large party of his closest pals.

Plenty of Material

Finding us assembled, he cheerily expressed the hope that somebody had brought a wireless set. As a matter of fact no one had failed to do so. Several people had brought their entire stock, and when we took count we found that no fewer than forty-six instruments were available and that every owner was loudly insistent that his should have the honour of entertaining the party. It looked for a moment as though a free fight were inevitable, but luckily our attention was distracted by the General, who appeared to be holding a kind of rodeo all on his own at a little distance. Amidst the cheers of the throng he was bucked now on to his steed's neck, now on to its quarters. Incommoded by the receiving set affixed to his shoulders, he was not perhaps at his best as a horseman; but all agreed that the display was thrilling, and when the warrior after a flight through the air came to rest on an ant-hill we clustered round to shake him by the hand and thank him warmly for his little entertainment. When he recovered his powers of speech we gathered that his mount had been stung by a horsefly, and he said that Poddleby was just the kind of fat-headed, bottle-nosed, bandy-legged, lop-eared, cross-eyed idiot who would choose for the picnic just the one wood in the neighbourhood that was known to all sensible men to be infested by these pests. Later in the evening, when we had returned to the club house, a special vote of thanks was accorded to Poddleby.

Setting to Work

The only way of deciding whose set should be brought into use seemed to be to draw lots for precedence and to allow each bright owner three minutes in which to do his worst. The first problem was to erect an aerial, and after a little discussion we elected Bumpleby-Brown and Breadsnapp as our official wire slingers. Two handy trees were pointed out to them as the scene of their endeavours. The rest of us then lay down to rest until such time as the aerial should be ready. Bumpleby-Brown took charge of the operation, directing Breadsnapp to shin up the taller and spikier of the two trees. Breadsnapp appeared desirous of declining the offer, and we heard him declare that his doctor had expressly forbidden tree-climbing as a recreation. However, his better feelings at length prevailed, and after mounting on to Bumpleby-Brown's shoulders he reached for the lowest branch. He would have been an inch short of it if he had not had the inspiration of planting his right foot upon Bumpleby-Brown's upturned face, on which he secured quite a good take-off. Having reached a height of twenty feet or so from the ground, it occurred to him that he had forgotten to take up the cord which was to secure the wire. Bumpleby-Brown called to him to stay where he was and said that he would soon have it up to him. He suggested that if the General would stand on the back of his horse he might be able to pass the rope up to him without further casualties, but Blood Thunderby was not of the same opinion. At length Breadsnapp made an improvised rope by knotting together his necktie and his braces and lowering these down to Bumpleby-Brown, who, mounting upon the stalwart back of Poddleby, pressed into service as a temporary help, was able to fasten the end of the rope to it. This end of the wire was slung without other adventures, and Bumpleby-Brown gave quite a good display of middle-aged acrobatics in the other tree.

Reception at Last

After about an hour all was ready for the reception of broadcasting to begin. "What's on at 2LO?" everybody asked expectantly. Poddleby glanced at his watch, then unfolded the programme and murmured that we had just struck the beginning of a half-hour interval. Unfortunately all other stations were also taking a rest, but Professor Goop during his three minutes obtained quite an admirable spark solo from GNF. By the time that Gubbsworthy had rigged up his apparatus his three minutes were nearly up, but we distinctly caught the words "changing over" from Croydon. Other would-be entertainers followed one another with varying success, one of the best items being a glorious outburst of crescendo howls emitted by Broggsworthy's loud-speaker. Broggsworthy, by the way, is the fellow who writes letters to the papers condemning ether hogs and signing himself "Anti-oscillator." Presently Poddleby suggested that we might wait ten minutes before the next man had a shot, for by that time broadcasting would be in full swing again. This seemed an excellent suggestion, and Rear-Admiral Whiskerton-Cuttle, who was the next on the list, was heartily in favour of it. The Admiral unstrapped the trunk containing his apparatus, fixed it up, and all was ready. We were all waiting on the tiptoe of expectancy to catch the first strains of sweet music when down came the rain. Yes, if you have not yet had a wireless picnic do not delay, for there are few better ways of spending a summer afternoon.

THE LISTENER-IN.

The Crystal Menace!

By THE EDITOR.

An article of particular interest to all crystal users.

I AM afraid the title of this article is more sensational than the article itself is going to be. Nevertheless, the innocent look which always appears on the face of the crystal user when the oscillation nuisance is mentioned is, in some cases, merely a mask.

The persistent manipulator of a cat's-whisker can cause quite a lot of interference with his neighbours, whether these neighbours use valves or crystals. The reason for these troubles is very interesting, and a full investigation does not seem to have been published. There are several allied matters which also are of no small interest to both crystal and valve users alike.

There is, for example, the phenomenon of listening-in to a neighbour's private conversation. Fortunately, this is only a very rare occurrence, but those who desire their neighbours to hear what they are saying, either about them or any other matter, can readily do so, although the offence is more heinous than oscillating.

Re-radiation

The first thing I would like to point out is that radiation from an aerial due to a valve oscillating at a receiving station is quite a different matter from re-radiation, although this latter term is very commonly employed to mean oscillation. When the reaction of a valve set is increased to too great an extent, the valve begins to generate oscillating currents, and the set becomes a miniature transmitting station. If the adjustments of the set are now altered, *e.g.*, by swinging the condenser, the wavelength of the radiated waves from the receiver will be varied, and when it is approximately the same as at the broadcasting station which is being received by a neighbour, for example, a howl will be heard by that neighbour, this note varying in pitch according to the proximity of the radiated wavelength to the wavelength of the incoming signals. The great oscillation trouble is due to the waves sent out by an oscillating valve receiving station combining, or "beating," as it is called, with the carrier wave of the broadcasting station. This carrier wave consists of continuous waves of constant amplitude, or strength, and its strength varies up and down according to the speech or music being transmitted from a broadcasting station. When your neighbour oscillates, his waves, mixed with the incoming waves from the broadcasting station, produce a musical note in your receiver, which is frequently termed a "howl." The trouble is most prevalent when the broadcasting station is standing-by for a few minutes in between intervals. The carrier wave only is now being sent out from a broadcasting station, but it is usually of very substantial strength, and whenever the stations have closed down there is invariably a large number of listeners who immediately start varying their reaction and adjusting their sets in the vague hope of picking up the station again. The number includes many who have only just started listening and are unaware that there is an interval.

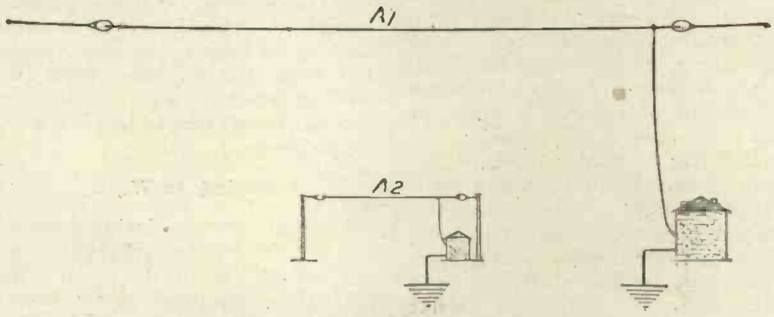


Fig. 1.—Re-radiation from a high aerial to a lower one.

The oscillation of a valve set is purely and simply radiation ; the receiving aerial is actually radiating itself, as well as absorbing energy ; the portion radiated is the portion which causes the trouble. When an oscillating valve set is adjusted to oscillate on exactly the same wavelength as the carrier wave of the incoming broadcasting, the howl disappears, but will come back if the receiving condenser is moved to either side. In the middle position there is usually a considerable amount of distortion, in spite of the absence of the howl. A neighbour who has adjusted his set to this position and leaves it there is frequently far more of a

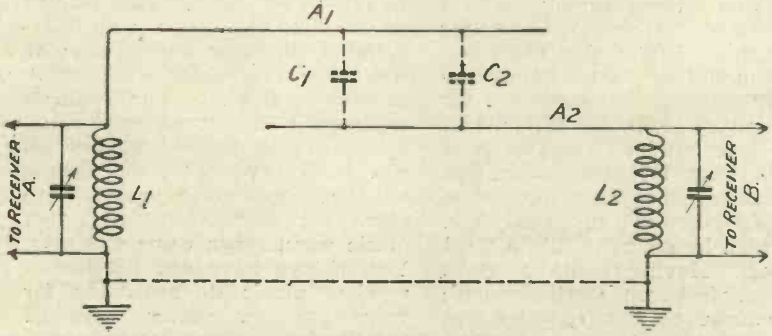


Fig. 2.—Capacity coupling between two near-by aerials.

nuisance than the one who occasionally oscillates and produces a howl in your receiver.

The worst type of neighbour to have, however, is he who has his valve oscillating so that he continues to receive the broadcasting with a high-pitched whistle continually there. The neighbour, apparently, is not very critical of the results he is obtaining, and apparently does not mind the high-pitched whistle. He can understand what is being said, even if he is not getting the proper purity of reproduction. The result is that he may sit tight for a whole evening with his valve oscillating so as to produce a beat with the carrier wave of the incoming broadcasting, the beat note, however, being high.

My first experience of this high-pitched whistle worried me considerably, because the set I was using consisted of several valves, and I thought that some peculiar high-pitched oscillation of audible frequency was taking place in the receiver. Loosening all couplings made no difference, and I began to wonder whether there was some low-frequency reaction going on which produced the high-pitched whistle, which, incidentally, completely spoiled the effect for the whole evening of the broadcast programme; although everything was perfectly intelligible, yet the distortion was appreciable. Someone in the vicinity must have, however, been content with his own reproduction, because it would be suffering from exactly the same disadvantages as mine. Changing over to an extremely simple circuit which could not possibly result in oscillation, I still found the trouble remained, and it was traceable to the fact that a neighbour was oscillating, with the result that his radiated wave combined with the carrier wave of the broadcasting station to produce the high-pitched whistle.

An Unpleasant Neighbour

Incidentally, another unpleasant neighbour to have is one who uses a switch fitted with studs for varying an inductance. When this type of person oscillates, he frequently moves the switch over the studs, varying his wavelength so as to produce sounds similar to playing up and down the scale on a piano.

This radiation, however, is very different from re-radiation. Re-radiation is beneficial to neighbours rather than the reverse. If you have an aerial and a crystal receiver, the incoming waves will produce high-frequency currents in that aerial, and even though these high-frequency currents are very weak, they will send out feeble waves of their own which may be picked up by a near-by aerial; this latter aerial will, of course, tend to pick up the original waves direct, but in some cases the signals to be picked up from the re-radiating aerial are stronger than those which would be obtained direct.

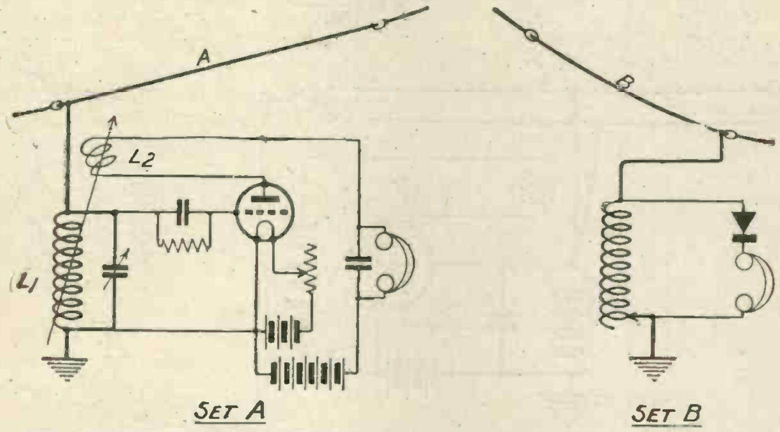


Fig. 3.—How a reacting valve set may influence a near-by crystal set.

Re-Radiation

Look at Fig. 1, for example. We have here A_1, a large high aerial, and A_2, a very small aerial in close proximity to A_1. The A_1 aerial circuit is tuned to the incoming wavelength, and the A_2 aerial circuit is likewise tuned to the same wavelength. The big aerial will pick up the signals readily, whereas the small aerial might be totally incapable of picking up sufficiently strong signals to be heard in the A_2 receiver. Since, however, the aerial A_1 not only picks up the incoming waves, but also re-radiates, the aerial A_2 may pick up the re-radiated waves, with the result that the aerial A_2 will pick up good strong signals, whereas if the aerial A_1 were missing, the aerial A_2 would pick up nothing.

When the aerials are close together they may form the two plates of a condenser, and the transfer of the energy from one aerial to the other may be a form of ordinary capacity coupling, which is rather a different matter from the re-radiation of electric waves. Fig. 2 shows how the effect may be obtained; the upper aerial A_1 is sufficiently close to the aerial A_2 to form a kind of condenser, the capacity between the two aerials being indicated in dotted lines by the condensers C_1 and C_2. Under these conditions the receiver B may enjoy the strong signals in the aerial A_1.

Whether the Fig. 1 or Fig. 2 phenomenon is involved, the fact remains that a poor aerial may enjoy the work done by a near-by aerial of greater height or better efficiency. The better aerial, in some cases, may be the loser.

Valve and Crystal Sets

When one set is a valve receiver using reaction (particularly if the reaction is applied to the aerial circuit), and the other is a crystal receiver, the phenomenon of re-radiation becomes distinctly marked.

When reaction is applied to the aerial circuit which is tuned to the incoming wavelength, the oscillations in the aerial circuit are built up to a much greater strength than would be the case if no reaction were employed. The additional strength of the oscillations in the aerial circuit will result in a corresponding increase in the re-radiation effect, and receiving stations placed around a set using reaction on the aerial circuit will benefit to quite a considerable extent in some cases. A common example is that illustrated in Fig. 3, where a single valve set A is connected up to an aerial which is next to another aerial connected to a neighbour's crystal receiver. If both sets are tuned to the incoming wavelength and reaction is introduced into the aerial A by coupling the inductance L_2 to L_1, there will be a considerable amount of re-radiation from the aerial A, and this will affect the aerial B, which will consequently appear to be giving better results. If the set A shuts down, the signals given by the aerial B will be normal, but when the set A is being used it is quite likely that the signal strength given by the set B will be 50 per cent. better. Here, again, as in the case illustrated in Fig. 2, there may be a distinct capacity coupling between the two aerials, with the result that reaction is introduced into the crystal set B by actual capacity coupling; this will result in a certain absorption of energy from the set A, but this may be compensated for by introducing a little more reaction into the set A.

Under these particular conditions the signal strength given by the set B may vary so as to produce an effect similar to fading. This will occur when the operator working the set A is, for example, adjusting his reaction or altering his tuning. Under these conditions the reaction effect which is communicated to the set B will vary, producing a corresponding variation of signal strength in the 'phones of the set B. Fluctuations in signal strength in a crystal receiver may be due to a neighbour, having a valve set with reaction, altering his adjustments.

The effect of one aerial on another so as to produce an effect similar to fading is, of course, well known where two aerials are very close together; in the latter case when one aerial circuit is tuned and detuned a varying effect will be produced in the other. This is particularly marked in reaction sets which are placed next to crystal sets. It must not, however, be imagined that interaction between one aerial and the other is confined to cases where a reaction valve set is employed next to a crystal set. Instead of a crystal set, any other kind of receiver might be in use, and even where there are two reaction receivers next to each other, alteration of the tuning of one may seriously affect the tuning of the other; it is even possible for one set to cause a neighbour's valve to start oscillating. For example, if one set is absorbing energy from a neighbour's reaction set and then the former set is detuned so as not to absorb any energy from the neighbour's set, the latter receiver may start oscillating if it has been critically adjusted beforehand.

A Communal Relay Station

An interesting speculation is to consider the possibility of having a sort of communal "boosting-up" station in an area where signal strength is below normal. This boosting-up station could simply consist of a large aerial which would have reaction applied to it by means of a valve to a point preceding oscillation. This station would cast its beneficent influence over all surrounding receivers.

The idea is illustrated in Fig. 4, and it is not nearly so fantastic as it at first appears. In this figure C represents a central station with a very large re-radiating aerial. Reaction is introduced into the aerial circuit by means of the valve V. This valve need not, of course, be used as a receiver in any way, since it merely serves to introduce reaction into the aerial circuit. Around this central station C there are a large number of small power sets A, B, D, E, F, G, which may be crystal receivers. All these sets, when tuned in to the desired wavelength, will derive the benefit from the re-radiations from the large re-radiating station C.

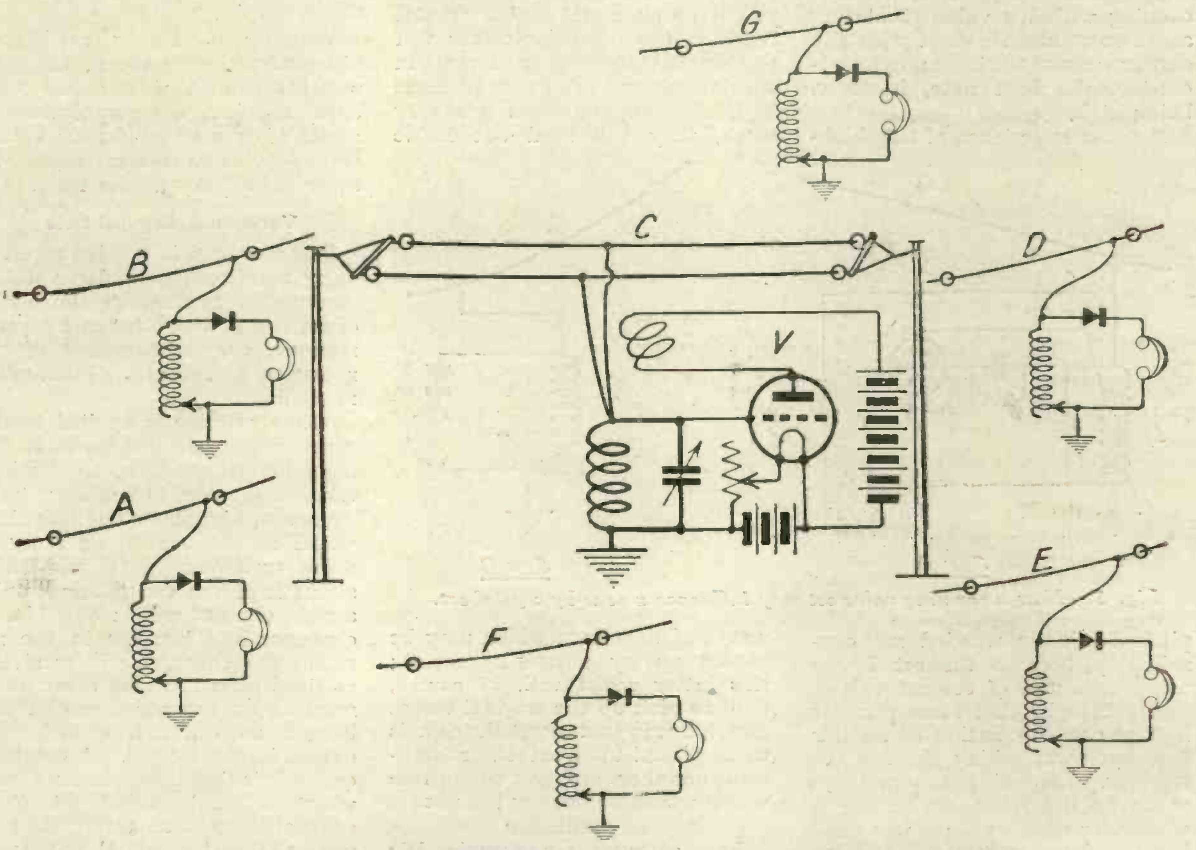


Fig. 4.—An idea for a communal relay station which has been suggested.

The extent to which such a station would assist local reception is a matter of speculation. The effect could be greatly increased by using the Armstrong super-regenerative type of circuit, and this has, in fact, been put forward as a suggestion for increasing signal strength in areas where some such device is desired. By introducing super-regeneration into the aerial circuit, a stronger effect would be obtained than by merely using the full amount of reaction. Perhaps some troubles due to distortion, etc., might arise in such a case.

The idea, however, is of chief interest as showing the possibilities of re-radiation effects. An interesting example of unintentional re-radiation is that of the big American station of Annapolis. Frequently experimenters situated around this station were able to receive signals from Nauen in Germany with the simplest of

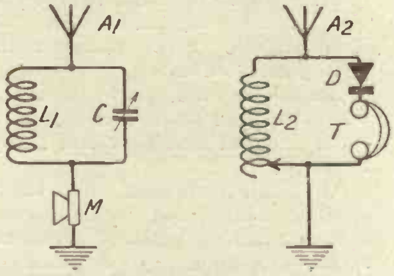


Fig. 5.—Using the carrier wave for telephony.

apparatus, and the reason was found to be due to the re-radiation from the large Annapolis aerial to which reaction had been applied.

Wireless Telephony Effects

It is not generally known that wireless telephony communication can be carried out over short distances by borrowing the carrier wave from a broadcasting station.

The usual telephony transmitter consists of a source of high-frequency current which produces oscillations in the aerial, the magnitude of these oscillations being then controlled by means of a microphone in some way or another. In the case of an ordinary receiver there is no source of continuous oscillations, except when a valve is used and it is caused to oscillate. The existence of a source of oscillations at the speaking station is not essential. The actual source of power may be situated many miles away. My own home is about 10 miles from 2LO and the aerial currents set up by 2LO's carrier wave are quite appreciable, and there is an appreciable amount of re-radiation. Assuming, then, that there is a steady high-frequency current in the aerial circuit, the effect is the same as if I had provided an actual oscillating valve at my station, the only difference being that, when relying on 2LO's carrier wave, much weaker oscillations are received.

If we control the current in the receiving aerial in some way, we will vary the re-radiated energy, and so be able to influence neighbouring receivers. The effect is also obtainable by means of the capacity effect between two aerials very close together; this has already been explained.

An interesting experiment to show the effect of using the carrier wave for transmission is shown in Fig. 5. The inductance L_1, shunted by the condenser C, represents the aerial tuning portion of a receiver; a microphone M is included in the position shown. A second aerial, A_2, is close to the first, and may be arranged in another room in the house. When the circuits L_1C and L_2 are both tuned to the same wavelength as the carrier wave, it is possible to speak from one set to the other by talking into the microphone M. Various other methods of modulation, of course, might be employed.

Fig. 6 shows another method whereby it is possible to speak from a crystal station to another crystal station or to a valve station. In this case the crystal detector D_1 absorbs a certain amount of the energy in the A_1 aerial circuit. If we vary the absorption of energy by the crystal D_1, we will vary the oscillations in A_1, and, therefore, we will be able to vary the currents in A_2 to a certain extent, with the result that the receiving station A_2 will be

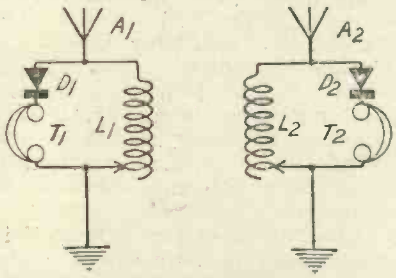


Fig. 6.—Another method by which speech can be sent between crystal sets

able to hear speech produced in the station A_1. There are two methods of varying the resistance of the crystal detector; one is to try moving the cat's-whisker about on the surface, and the other is to vary the voltage across the crystal.

Here, then, we have the explanation why crystal scratching can often be heard by a neighbouring set. What is really being done is to vary the absorption of energy in the aerial A_1 by altering the position of the cat's-whisker in the detector D_1 and thereby causing a variation of signal strength of the carrier wave in A_2. This effect, of course, would be principally obtained when telephony is not coming through, but only the steady carrier wave.

Scratchy Noises.

The peculiar scratchy noises sometimes heard in a receiver are not infrequently due to a neighbouring crystal user actively manipulating the cat's-whisker. This is particularly the case when the other station is a valve receiver using reaction. Such a state of affairs, for example, is illustrated in Fig. 7. The receiving set A_2 employs reaction on to the aerial circuit, and although the valve is not made to oscillate, yet the oscillations in the aerial circuit cause a re-radiation effect which envelopes the receiving aerial A_1. Any adjustment of the cat's-whisker of the receiver A_1 will vary the signal strength in the receiver A_2, if the two receivers are close together.

In most cases, fortunately, the effect is not very noticeable, but in every centre there are innumerable aerials which run parallel to each other and are in very close proximity. In these circumstances the interaction is quite noticeable.

Catwhisker Sounds.

Returning to the question of speaking between two receiving stations, we indicated that variation of the cat's-whisker will cause noises in a neighbouring receiver. If, however, the crystal detector is adjusted in the ordinary way, and the telephone receivers T_1 in Fig. 6 are held up to the mouth and spoken into, varying E.M.F.s will be produced across T_1 on account of the magnetophone effect, which is very similar to that employed in some of the microphones used by the B.B.C. (*e.g.*, at 2LO). The E.M.F.s across T_1 are communicated through L_1 to the detector D_1, and consequently the point on the characteristic curve of the crystal detector D_1 is varied. This will result in a varying absorption of energy from the aerial circuit, and consequently the fluctuations in current in the

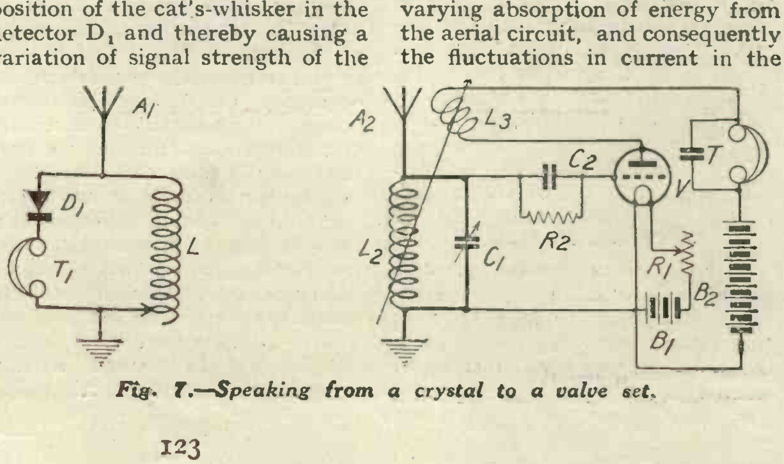


Fig. 7.—Speaking from a crystal to a valve set.

aerial circuit will be communicated to a near-by aerial A_2, and the listener on the set A_2 will hear what the person speaking into T_1 is saying. This is an experiment which anyone can try in his own home by fitting up two aerials close to each other, one set being in one room and the other in another. All that has to be done is to talk into the telephones of the crystal receiver and for someone else to listen on the other set. It is important that both circuits should be tuned in to the carrier wave and that

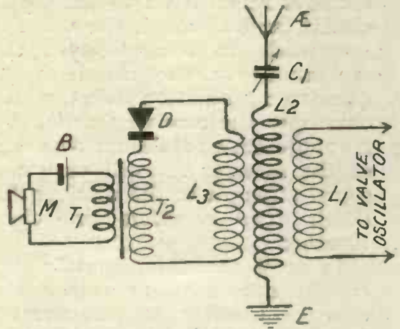


Fig. 8. The use of a crystal detector as modulator.

both crystals should be properly adjusted. If the set A_2 is a valve set the effect, of course, will be very much more noticeable, because the set will be much more sensitive, particularly if reaction is used. We then have the circumstances shown in Fig. 7, speech being communicated from the set A_1 to the set A_2 by speaking into the telephones T_1.

It is quite possible, therefore, for a crystal user to have his remarks communicated to a neighbour in this way, although fortunately this is very rare. The effect is only noticeable over very short distances, and if this were otherwise, a very serious nuisance would be created. If the telephones are placed on the table, however, and loud conversation is proceeding in the room, it is quite possible for a neighbour to hear what is going on during intervals of broadcasting, provided both sets are tuned in to the carrier wave.

To avoid any possibility of radiating conversations, the aerial may be disconnected, or the tuning of the receiver altered, or the cat's-whisker moved off the crystal.

A Crystal Modulator

The use of a crystal detector as a modulator in a telephony transmitter may be mentioned at this point, and Fig. 8 shows a circuit which will give short range results. It will be seen that the inductance L_1 feeds high-frequency currents from a valve oscillator into the aerial circuit, the potentials across the detector D being varied by means of a microphone M, which feeds low-frequency currents into the crystal circuit *via* the microphone transformer T_1 T_2.

I indicated the possibility of a large number of stations deriving the benefit from a big reaction station. Another interesting thought, not really connected with broadcast reception, is the use of a central station simply radiating continuous waves and producing an atmosphere in which any number of stations may talk to each other without having separate transmitting plants of their own.

A perfectly practical arrangement is possible on this basis, although, of course, there are distinct limitations of range. In a large building, for example, it would be possible for a number of crystal receivers with small aerials to be installed. Communication could be carried out between all the stations by using the central supply power, which would be a powerfully oscillating valve. It would be as if the whole building were flooded with a conducting ether medium through which communication could be carried out. The idea is perfectly practicable, but is only mentioned here to illustrate a principle.

The moral of this article, if it has one, is to use a valve set and avoid some of the troubles attendant on the use of crystal sets. In any case, whose soul is so dead that he never wishes to get beyond the crystal stage ?

THE JUNE ONE VALVE RECEIVER

To the Editor of MODERN WIRELESS.

SIR,—Having built the efficient "One-Valve Receiver" described in your June issue of MODERN WIRELESS by Herbert K. Simpson, we thought it may be of interest to you to know the results we have obtained. On a thirty-foot aerial (twin) and an earth which consists of a buried zinc bucket, we have received Sheffield and Manchester sufficiently powerful to operate an "Amplion" Junior loud-speaker so as to be heard all round the room. Another feature of this set is the purity of tone. Wishing MODERN WIRELESS every success.

Yours truly,

P. AND A. SMITH,

Huddersfield, Yorkshire.

FIRST READERS' RESULTS WITH "TRANSATLANTIC FIVE"

To the Editor of MODERN WIRELESS.

SIR,—Just a few lines to give you the results obtained with the Transatlantic Five Receiver in your June number.

Aerial—10 metres 8/10 d.c.c. wire stretched on the ceiling of a room situated first floor and badly screened.

All English stations on a loud-speaker heard 100 yards away. French stations without aerial or earth—loud-speaker 50 yards away. Belgian stations (Brussels) loud-speaker. I have heard two German stations, but unable to give call signal.

Results on frame aerial 50 cms. x 50 cms. with 14 turns of 8/10

A recent portrait of Mr. Percy W. Harris.

d.c.c. wire. All English stations loud-speaker heard 15 yards away, but the tuning is very delicate.

In my opinion it is 50 per cent. better than the original Transatlantic receiver, both in range and purity of reception.

Should this letter be of interest to your readers you can publish it, should you so desire.

Again wishing your journal every success in the future.—Yours truly,

R. A. STUART-FRY.

Paris (XVII.).

A Simple 'All Wave' Crystal Set

By E. REDPATH, Assistant Editor

Constructional details of a simple but efficient crystal receiver with untuned or aperiodic secondary circuit.

Fig. 1.—The complete receiver ready for operation.

WIRELESS experimenters and constructors who are interested in their hobby to the extent of considering the underlying theoretical principles which govern the functioning of the various pieces of apparatus which they employ, will no doubt be acquainted with the fact that present day detectors, crystal or valve, are voltage operated.

For the benefit of those who are not so familiar with the theory, this particular point may be made clearer by considering a simple hydraulic analogy. With a given quality of water, pressure or potential would be obtained by confining the water in a vertical tube or pipe of considerable height and small bore. Owing to the "head" or pressure, the water would be capable of doing useful work upon a suitable device placed at the lower end of the tube or pipe. The same quantity of water in a barrel or shallow trough at ground level would have scarcely any "head" and its useful pressure or potential would therefore be practically nil.

The application of energy for the most efficient working of a crystal detector requires to be such that the greatest possible changes of electrical pressure or potential are set up across it.

The Theory Applied to a Wireless Circuit

However large and efficient a receiving aerial, and whatever its distance from a transmitting station, the amount of energy induced in it is strictly limited. This limited amount of energy may be dissipated or consumed in two ways. Firstly, in an avoidably wasteful manner due to leakage from and the resistance of the aerial circuit and re-radiation; and, secondly, in a useful manner in actuating the detector and telephone receivers.

Losses due to leakage in the aerial circuit may be prevented by paying careful attention to the insulation, whilst those due to its resistance may be minimised by employing aerial wires of high conductivity and ample size, a good earth connection and tuning inductances constructed of fairly large gauge wire.

In the present article, however, the writer desires to deal more particularly with the method of applying the energy in the most useful manner to the crystal detector. If a tuning inductance consisting of a considerable number of turns of wire (one hundred or more) is connected in the aerial circuit, the crystal detector and telephone receivers, in series with one another, may be connected right across that inductance; one terminal of the crystal detector being connected to the aerial end of the coil and one lead of the telephones to the earth end.

As the number of turns in the

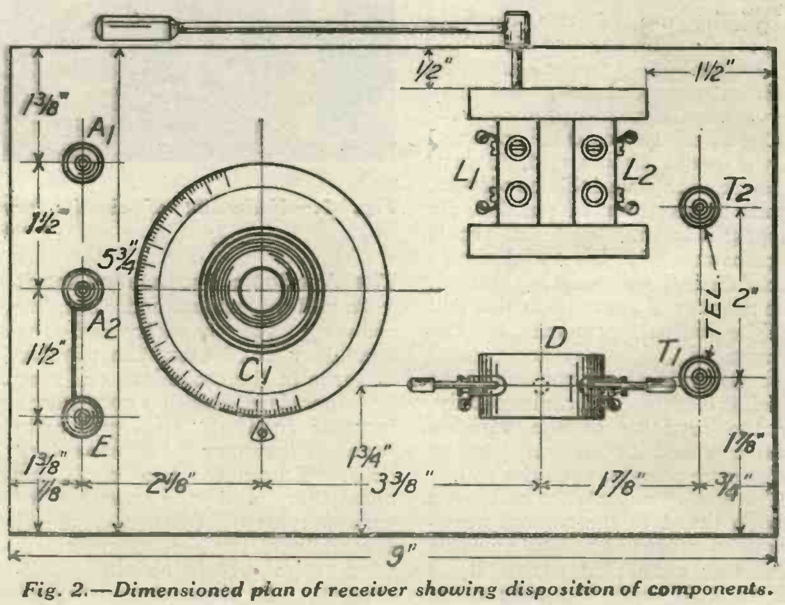


Fig. 2.—Dimensioned plan of receiver showing disposition of components.

coil is fairly large, considerable differences in potential are set up between its two ends when oscillatory currents are flowing in the aerial circuit, and such an arrangement will yield quite good results, although the high rate at which energy is absorbed from the aerial circuit by the detector and telephones tends to prevent the building up and persistence of oscilla-

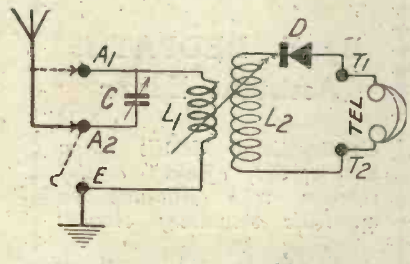


Fig. 3.—The simple circuit arrangement adopted.

tions, an effect known as "damping." In other words, the aerial circuit is working under a heavy load.

For short wave reception the arrangement is still less successful, as only a comparatively small number of turns may be included in the aerial circuit before the required wavelength is reached (even though a series aerial tuning condenser is employed), and consequently the differences in potential between the ends of the tuning inductance are smaller, whilst the direct load upon the aerial is still great. The arrangement just described is known as single circuit direct coupling.

Inductively-Coupled Circuits

By the use of two separate inductance coils, the two difficulties of excessive damping and insufficient potential differences may be very satisfactorily overcome.

One of the two coils is connected in the aerial circuit and, in conjunction with a variable condenser, either in series or in parallel, its purpose is to tune the aerial circuit to resonance with the aerial circuit of the desired transmitting station. The number of turns upon this coil will be limited, primarily by the dimensions (inductance and capacity values) of the aerial to which it is connected, and secondly, by the capacity of the variable condenser and its position either in series or in parallel with the coil.

The second inductance coil, even though tuned to the correct wavelength by means of a *small* variable condenser connected across it, is not saddled with the inductance and capacity values of the aerial, and may therefore consist of a much greater number of turns than the aerial or primary inductance coil. By placing the two coils close together (coupling them is the technical term), oscillatory currents in the aerial or primary coil will induce currents into the secondary coil, but owing to the difference in the number of turns of the respective coils, a "step-up" in voltage is obtained and is available for operating the detector, which may be connected across the secondary coil or across the small variable condenser which tunes it.

If the two coils are mounted so that the electro-magnetic coupling between them may be varied, the rate at which energy is transferred from the primary to the secondary circuit will be controllable, and, in practice, it is possible to arrive at an optinum coupling which, whilst permitting the transfer of sufficient energy to give satisfactory reception in the telephones, is not unduly damping the aerial circuit.

the secondary circuit is no longer a tuned circuit. It will respond to oscillations of any frequency over an extremely wide range and is termed an aperiodic secondary circuit.

The arrangement is not by any means new. The writer employed it with excellent results as long ago as 1913. Resuscitated and put into a more convenient and practical form than was possible at that date, the arrangement has been tried with satisfactory results as regards reception from the local broadcasting station, some 15 miles distant, and constructional details are here given for the guidance of those readers who care to try this old principle under modern conditions.

Constructional Details

The photograph, Fig. 1, shows the receiving set complete with primary and secondary inductances of the low-capacity plug-in type, and telephone receivers. Further details of the components and the

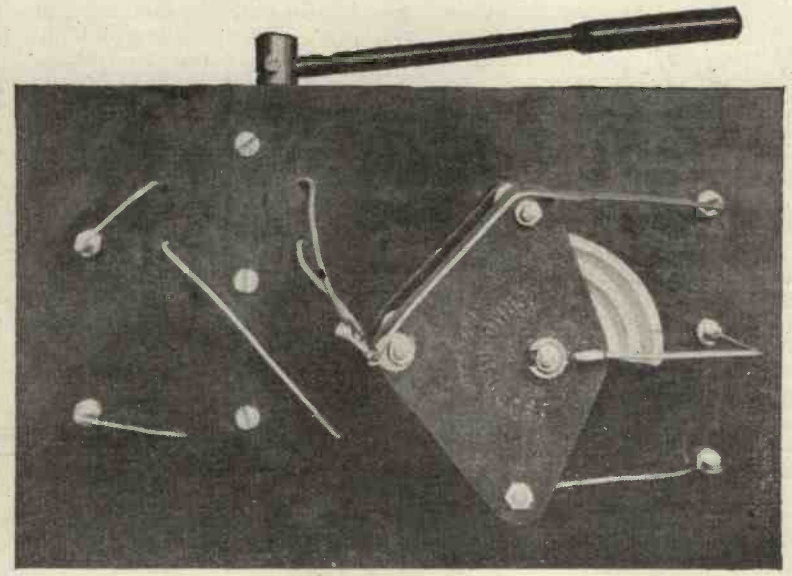


Fig. 4.—Underside of ebonite panel, showing variable condenser and connections.

The Aperiodic Secondary Circuit

It will be understood that, by reducing the capacity of the secondary condenser, the number of turns in the secondary coil may be increased, with consequent increase in the "step-up" ratio between primary and secondary coils. Eliminate the condenser altogether, and the number of turns may be still further increased, especially if the secondary coil is of a type which has low self-capacity. In these circumstances,

disposition of them upon the ebonite panel will be gathered from Fig. 2. The actual components fitted permanently to the ebonite panel are not numerous, and comprise the following :—

1 Variable condenser, capacity 0.001 μF (or 0.0005 μF).
1 Standard two-coil holder.
1 Crystal detector.
5 Terminals.

If a 0.0005 μF variable condenser is on hand, it may be used instead

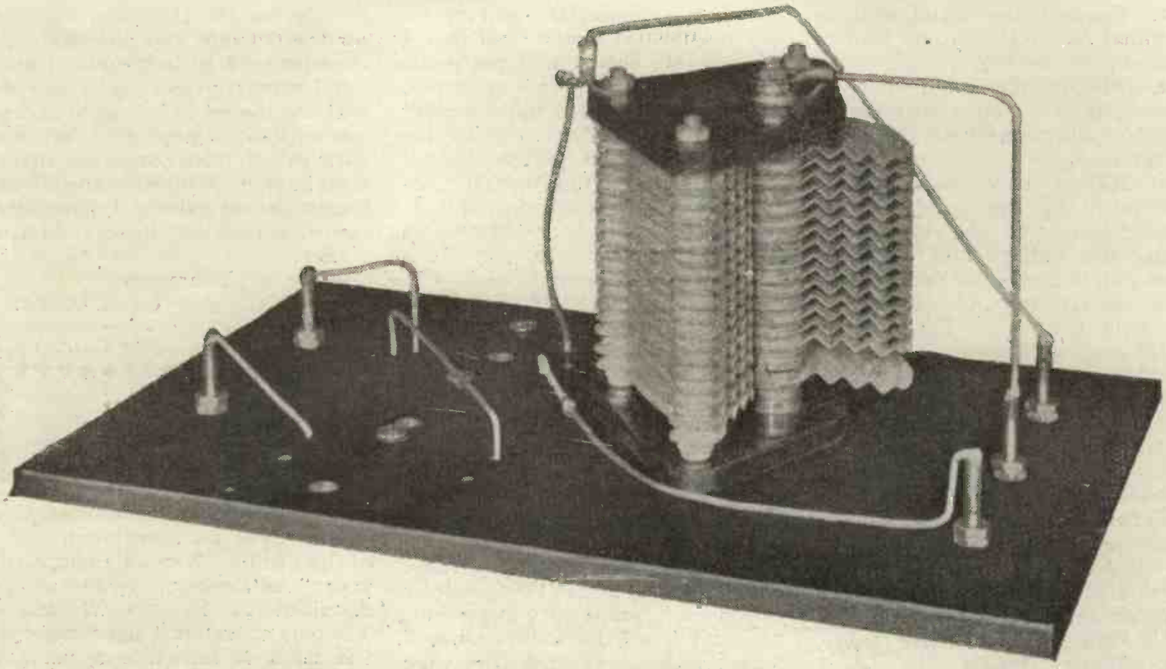


Fig. 5.—Another back-of-panel view. Note the compact 0.0001 μF condenser and the extreme simplicity of the wiring, which is carried out with No. 16 S.W.G. tinned copper wire, except the two leads to the moving coil.

of the 0.001 μF condenser as specified, but, in this case, additional coils will be required in order to avoid any gaps in the range of wavelengths. The variable condenser actually fitted to the set

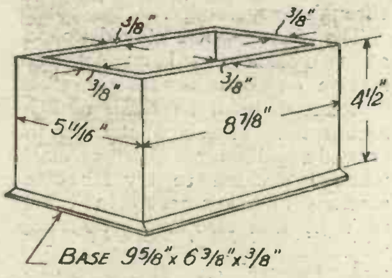


Fig. 6.—Details of the containing box.

illustrated is a "Formo-denser," and owing to the method of construction adopted, it is extremely compact. In this particular set the vernier condenser is scarcely necessary as, on account of the aperiodic secondary, the tuning is not critical.

The crystal detector is of a design known as the "Herslea"; both cat's-whisker and crystal are mounted upon universal joints and are glass enclosed. The two inductance coils shown in Fig. 1 are a No. 35 (primary) and a No. 100 (secondary) "O'Keefe" coils, designed to have very low self-capacity values.

Various coils up to No. 250 have been tried as secondary coils, but for broadcast reception coils having 100 to 150 turns proved quite satisfactory.

Fig. 3 is a theoretical circuit diagram, in which A_1 and A_2 are the aerial terminals; connecting the aerial to A_2 places the variable condenser C in series and connecting the aerial to terminal A_1 and joining A_2 to E, the earth terminal, places the condenser in parallel across the primary coil L_1. L_1 may be a No. 35 or No. 50, and L_2 a No. 100, 150, 200, or 250 coil, of the plug-in type, whilst D represents the crystal detector, T_1 and T_2 the telephone terminals with telephone receivers indicated at TEL.

The simplicity of the back-of-panel arrangement and connections will be gathered from the photograph, Fig. 4, whilst Fig. 5 gives a perspective view.

As this simple crystal set presents very little difficulty in construction, and none whatever in operation, it can be recommended as being particularly suitable for beginners, for whose convenience a diagram of the actual wiring at the back of the ebonite panel is given in Fig. 7.

Operating the Receiver

The actual operation of the set is extremely simple, and the procedure to be adopted is as follows:

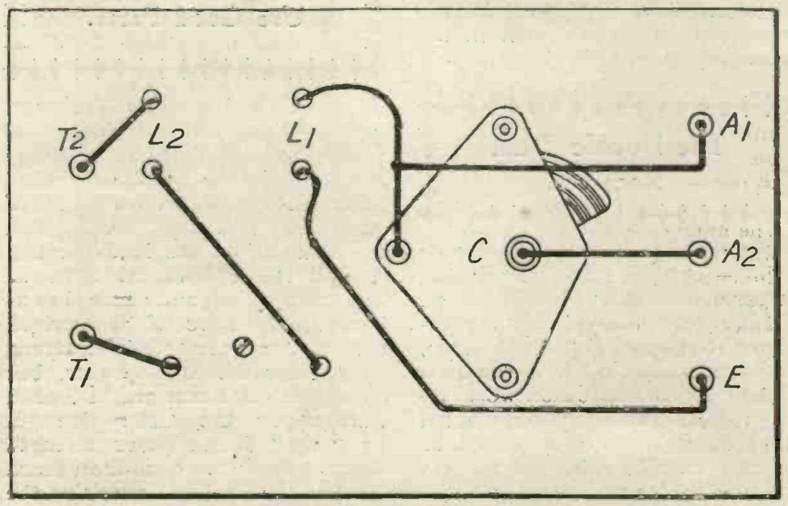


Fig. 7.—The back-of-panel wiring diagram.

1. Connect the aerial lead to terminal A_2, and the earth lead to terminal E (see Fig. 3).

2. Plug-in the required coils, placing them as close together as possible, and connect the telephone receivers.

3. Adjust the crystal detector, preferably by means of a small testing buzzer or old electric bell with the gong and hammer removed, placed a foot or two away from the receiver and operated by a single dry cell. The pressure of the cat's-whisker and its position upon the surface of the crystal should be varied until the loudest signals are heard in the telephones, when the buzzer is operated.

4. Slowly turn the knob of the variable condenser C over the entire scale. If no signals are heard, connect the aerial lead to terminal A_1, short circuit terminals A_2 and E by means of a piece of wire or short-circuiting link, and again rotate the condenser slowly.

5. When signals are heard loosen the coupling between coils L_1 and L_2 (by moving them apart), at the same time readjusting condenser C until best reception is obtained.

The small indicating arrow against the variable condenser scale is merely a small piece of ivorine (from an old label) cut to shape and secured to the panel by a small countersunk-headed screw.

Readers who may have ebonite panels on hand of different dimensions to those indicated may certainly use them and arrange their components to the best possible advantage, in which case, of course, the containing box (illustrated in Fig. 6) will also require to be modified to suit.

For the 1,600-metre wave of the Chelmsford station, a No. 150 or 200 coil should be used in the aerial circuit and any coil having from 400 to 1,000 turns in the secondary circuit.

The Double Dual Receiver.

To the Editor of MODERN WIRELESS.

SIR,—In Vol. 2, No. 6, you describe a Double Dual Receiver. I have been using lately my receiver connected up as S.T.100, and found same all that could be wished for loud-speaker work up to 50 miles, and very consistent in its behaviour. I reconnected as for new circuit, using for the 1st valve a reactance capacity tuner and a choke 12,000 - 400 *closed iron circuit*, the rest as for S.T.100, except for R^4, so that I have 3 L.F. stages, and the result is, on local work I get a terrific volume of very good tonal quality (I always use a filter circuit for the loud-speaker) and get very good L.S. strength on Continental Telephony. With last stage of L.F. cut out the result is not so good as S.T.100, but, of course, very much better for Continental.

I find that if I use an open cored choke 14,000 - 37 - ¾-in. core the set is difficult to handle, and is inclined to whistle badly at times. Care must be taken in adjusting R^3, R^4, in fact R^3 is not necessary with closed iron choke. If R^4 is set too high in valve when changing position of H.T. wander plug the signals cease utterly, and then gradually come back. Also correct value of C^4 and C^3 must be found by experiment, and is very important, as I have found this to be a cause of failure with others when they were trying S.T.100.

I find Permanite to be the best crystal for these circuits, with a silver point and with light contact for long distance, and not quite so light for local work, in fact so good is this crystal that I have left it adjusted for weeks on end.

I am very pleased with result as I get much more power on all distances than I could hitherto get with 1 H.T., 1 D., 2 L.F. straight circuit.

I may add that the choke Z is just inserted in the H.T. wander plug lead, so can be added to any H.F. panel quite easily.

Yours faithfully,
R. WESTBROOK.

Tottenham Park, S.W.20.

Use Good Parts.

To the Editor of MODERN WIRELESS.

SIR,—You will no doubt be pleased to know that I am receiving splendid results with "Transatlantic Receiver." With the use of one-valve "note-mag" I can get all the stations on the loud-speaker, also all the Continental Stations. The clear speech and music is wonderful. I have also received several American stations strong enough for the loud-speaker, but as others at home are in bed I cannot put the latter through, as "my" loud-speaker strength means that it can be heard all over the house. I am using the ordinary "four-leg" valve (Cossor, red-top for the H.F. and Ediswan for the detector and note-mag). I experienced a little trouble at first, but I strongly recommend anyone building the set to buy good instruments, *as by changing my original parts* (which were not a type advertised in your journals) to the instruments as advertised, I have succeeded in receiving these wonderful results.

Yours truly,
CYRIL AGER.

Brixton.

America on the All-Concert.

To the Editor of MODERN WIRELESS.

SIR,—It may interest you to know of the results I am obtaining with your "All Concert" 3-valve set as described in MODERN WIRELESS. The only alteration I have made in the set is to introduce a variable grid-leak.

I can get all B.B.C. stations with ease, and all but Aberdeen at loud-speaker strength. In addition to this I get three French stations, Ecole Superieure, one on about 330 metres which I presume is Le Petit Parisien, and one on about 410 metres whose identity I have not yet been able to discover, but it is perhaps Brussels. Frankfurt-am-Main comes through very loudly.

The other night I stayed up, and at 1 o'clock heard an American station on about 325 metres, which announced itself as WBD at Massachusetts. The signal strength improved steadily up to about 3 o'clock, when I decided to try for other stations and succeeded in tuning in WJZ and also another station, which I think was WGY, as it was exactly on Bournemouth's wavelength. My aerial is a good one as regards height, but runs parellel to about thirty telegraph wires and an electric tramway.

In conclusion I should like to congratulate you on producing two such wonderful papers as MODERN WIRELESS and *Wireless Weekly*, both of which I read regularly.

Yours faithfully,
S. TOWNSEND.

Gloucester.

Correction.

Will readers please note that the box given in the article "A Crystal Receiver with special coupling" (Fig. 6) last month, was dimensioned for the single valve receiver described in the same issue. For the crystal set the box must be dimensioned to carry a panel 12 in. by 6 in.

Systematic Fault Finding

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

NO doubt, if the person doing the testing is fairly experienced in the work, the easiest and usually the quickest way of finding out what is wrong with a set which doesn't work is to connect it up to batteries, aerial and earth, etc., and attempt to identify the fault by the indications which result in the 'phones, coupled with a superficial examination of the wiring and components. The method which I advocate, however, and which is employed whenever I do any set testing, depends upon the use of a logical and systematised procedure, of which I propose to give an abbreviated version in this contribution, in a form which I think will be found suitable for use by any experimenter who is so unfortunate as to find himself in possession of a set which either refuses to work or gives only weak signals.

Necessary Equipment

To carry out a proper systematic examination easily a certain amount of apparatus is necessary, most of which can be improvised from odd pieces of gear which the average experimenter is fairly certain to possess. *Desirable* accessories are a sensitive galvanometer and milliammeter, but since the majority of readers will not possess them and will probably not regard an occasional test as sufficient justification for their purchase, I shall not describe any tests which involve their use.

The chief tests are for continuity of current-paths and insulation of circuits, *i.e.*, freedom from short circuits, and these two can be done at a pinch with a pair of 'phones and a dry cell. The indications obtained in this way are not so certain as those given by a galvanometer, and precautions must be taken to guard against the misleading effects of the condensers in the circuits, as is explained at a later point in this article.

The other test is that which is applied to condensers to ascertain whether there is a proper connection from their terminals or tags to their plates, and for this we require a buzzer and a small induction coil, which can be obtained for about two shillings from a dealer in telephone accessories. The kind of coil required is that which would be better described as a step-up transformer, possessing no vibrator, but lacking such a one a small medical coil can be used, the vibrator being screwed up tightly.

With these simple appliances all the commoner faults can be located with the aid of a little ingenuity in devising tests, as we shall see.

one would be observed at the end because the corresponding line upon the diagram would remain unmarked.

Assuming that no fault has been found in the wiring, the next step is a careful examination of all the soldered connections, most critical attention being paid to the quality of the soldering, remembering that just one bad joint may completely upset some types of receiver. Probably the best test is to administer a sharp pull to each wire: if it comes off in your hand it obviously wants re-soldering! Use a hotter iron next time.

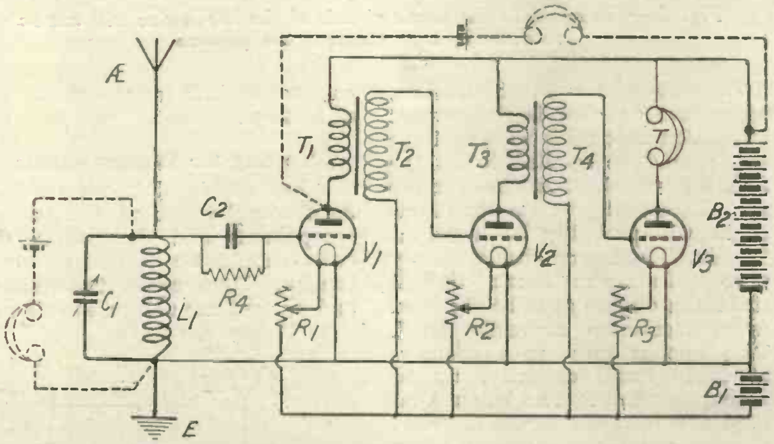


Fig. 1.—Illustrating the use of 'phones and a dry cell for testing complete circuits.

The First Step

When you first receive a set which is faulty, or come to the conclusion that one which you have made is defective in some way, the first thing to do is to check the wiring and make certain that no mistake has been made. To do this with certainty, proceed in this way: turn the panel upside down and lay beside it the wiring diagram. Now identify any given connection upon the set and see whether it agrees with the corresponding one upon the diagram or blue print. If it does, cross out the line upon the diagram, and continue in this way until the whole of the wiring has been checked. A wrong connection would be discovered in the course of this, and a missing

Examine the various components and note whether there is anything visibly amiss with any of them. Look particularly at the underside of the valve sockets, because many of those now on the market have such a small clearance between the nuts and washers on the shanks that a trace of brass dust resulting from the too energetic use of a pair of pliers in tightening the nuts is sufficient to cause a short circuit, or at least a serious leak.

Testing for Short Circuits and Defective Insulation

The first actual electrical test to be applied should be for short circuits in the various condensers, and this can be done with the 'phones and the dry cell. It will be observed that if the tags of the 'phones are placed across a dry cell loud clicks will be heard on making and breaking the circuit, and this is the indication which we shall use. Join one tag permanently to one of the terminals of the cell, and use the other tag and a wire from the other battery terminal for testing purposes. When these are touched upon points which ought to be in electrical connection, clicks will be obtained as before.

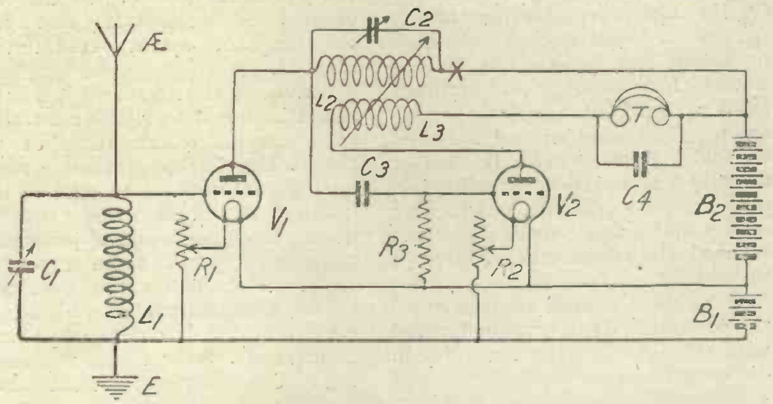


Fig. 2.—The break in the anode circuit of the H.F. valve will not be revealed by indications in the 'phones

In testing for short circuits, of course, *no click* is the desired indication that all is well, and the test should be applied to all the fixed and variable condensers in the set. In actual practice very faint clicks will probably be heard at "make" and perhaps a barely perceptible one at "break," though this latter ought not to be observed when insulation is really good. This applies only to condensers of fairly small capacity, up to perhaps 0.01 μF. The larger kind used as a reservoir across the H.T. battery and for one or two other purposes will usually give quite a good click at make and practically none at break. A click at break, of course, denotes an internal short circuit.

The insulation test is identical with that which we have just discussed, with slight modifications to suit the particular component being tested. The insulation between the windings of transformers and between the windings and the core should be tested exactly in the way described above. The next test is of the insulation of the panel, and here we require a battery of higher voltage to produce more definite indications. A 60 volt H.T. battery will serve, and the test should be applied to a pair of terminals fairly close together on the panel, but not, of course, ones that are connected together by the wiring, or by any component such as a valve socket whose insulation may be faulty. Probably the safest way in case of doubt is to test between two screws which hold two *different* components to the panel. No really distinct click should be heard.

Next, apply the same test to the valve sockets and coil holder, and make sure that their insulation is up to standard, since these are common points for the occurrence of leakage.

Testing for Disconnections

When the insulation tests have been completed, first the various components and then entire circuits should be tested for continuity. Here again the 'phones and dry cell are used, and it is well to commence with any components containing wound coils, such as transformers and variometers. The click obtained through such windings will depend upon their resistance for its loudness, and allowance must be made for this.

When all the components through which there should be a current path have been found to be free from broken connections, the testing of whole circuits can be undertaken. These tests will depend for their details upon the actual type of receiver undergoing examination, but I think that very little explanation is needed. The two testing leads from the 'phones and dry cell are applied to suitable points such as the aerial and earth terminals and note is taken of whether a proper click can be obtained between these points, indicating a complete circuit. In the case of the aerial circuit, of course, care must be taken that the tuning condenser is in parallel and not in series, that no constant aerial tuning condenser is included in the circuit, and that an aerial coil has been inserted in the coil holder; the coil, of course, should be tested before insertion, since a broken winding would give a fictitious result for the whole circuit.

After testing the aerial circuit, the connection from the tuning coil to the grid of the first valve can be tested by applying the testing leads to the aerial terminal or the aerial end of the tuning coil and to the grid socket of the valve holder. Similarly, the grid circuit of a low-frequency amplifying valve can be tested by applying the testing tags to the grid socket of the valve holder and to the low-tension negative terminal. A little thought will enable the experimenter to test in this way practically every circuit in his receiver. Fig. 1 gives the key as to how it may be done.

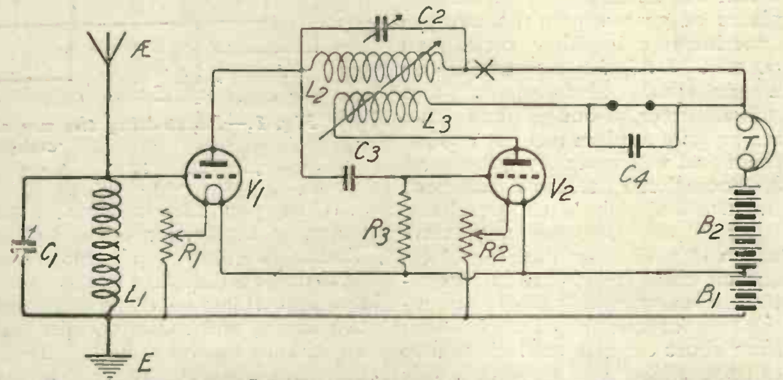


Fig. 3.—With the 'phones in this position the anode circuits of both valves can be tested for continuity.

The testing of the complete anode circuit of each valve can be done in the way just described or perhaps it can be more simply accomplished by the indication in a pair of 'phones of the flow of the anode current when the high-tension battery is connected and the valve filaments are alight. In

Fig. 2, for example, if the two valve filaments are turned out, and the high-tension plug pulled out of the H.T. battery and replaced, faint clicks should be heard, and when the filament of the last valve is alight, considerably louder clicks will be observed. In this circuit a break is indicated in the anode circuit of the first valve, which would not, of course, be revealed by this test, since the anode current for the rectifying valve would be flowing in a normal manner. Having ascertained that the anode circuit of the rectifying valve was

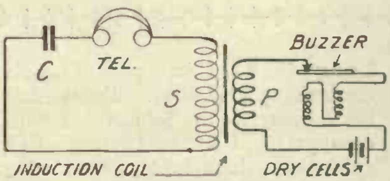


Fig. 4.—A simple piece of apparatus for the testing of condensers.

complete, the 'phones are taken out and their terminals short-circuited, and then re-inserted in circuit as shown in Fig. 3, that is to say, in series with the common high-tension lead to the set. Upon turning on and off the filament current of the first valve, or keeping the valve alight and pulling the high-tension plug in and out of its socket, strong clicks will be heard, provided that the anode circuit of each valve under test is complete. In this way the anode circuits of any number of valves can be tested in the receiver by simply turning on the filament of the one valve which it is desired to test, leaving the others turned off. This is a very quick and easy method of carrying out the anode circuit tests.

Testing Condensers

Although a condenser may show a satisfactory result on the tests for short circuits with 'phones and dry cell, there may, nevertheless, be a disconnection between the terminal or tag and the plates within. This applies more particularly to fixed condensers, especially those of cheap price and uncertain origin, which are now so commonly seen.

The only easy way to test them for continuity is to ascertain whether alternating currents can be passed through, and this may most easily be done by means of the simple apparatus shown in Fig. 4. This consists of a dry battery, buzzer and small induction coil, so connected that the intermittent current of the buzzer is passed through the primary of the induction coil, and reappears at the secondary as a moderately high voltage alternating current, which can be applied to the condenser in series with a pair of telephones. In condensers of anything except the very smallest capacities a quite noticeable buzz will be obtained through them, provided that they are in working order. The actual loudness of the buzz will, of course, depend upon the capacity, and one can judge capacities in this way with a little practice.

Gridleaks

Gridleaks and other high resistances are unfortunately exceedingly difficult for the amateur to test for himself, and I do not propose to attempt to give any account of a method suitable for the average experimenter with very limited apparatus. With practice, of course, one can gauge, more or less, the condition of a gridleak by the loudness of the clicks which are obtained through it with a pair of telephones and a high-tension battery, but this method is really not reliable. Probably the only really satisfactory method is to measure the resistance with a Megger. The only method of testing which is really suitable for the general experimenter is the substitution method, that is to say, the replacement of a suspected leak with one of known efficiency.

Other Possible Troubles

The tests which I have outlined will, in themselves, indicate practically any fault in the receiver itself, but it is quite possible that after carrying out all of them the source of the trouble will not have been discovered, for the simple reason that it is located in one of the accessories of the receiver. For example, valves, coils, and batteries are all open to suspicion. Coils are quite easy to test by the use of the telephones and dry cells, but the other components are very much better tested by the substitution method, which can also be applied to the aerial and earth connections.

A Fine Receiving List.

To the Editor Modern Wireless.

Sir,—Some time ago I wrote you a letter giving a record of my results with the "All Concert" set. I enclose herewith an amended list which may be of interest. Those starred have been heard by a friend of mine with a similar set using an indoor aerial and Weco valves. I have also heard altogether 176 amateurs, including telephony from 8 A.B. My method for 100λ reception is very crude as I do not use an A.T.I.; in spite of this, however, I can always hear KDKA after about 11.30 G.M.T., and have logged many amateurs on this wave. All these receptions were with 4 pairs of 'phones: *Great Britain* all B.B.C. stations,* and relay stations, Croydon*, Lympne, Cas., Bromwich,* Pulham, Manchester, Helston, Guernsey and Calshot. *France*, F.L.,*, Radiola,* Ecole Superieure,* Petit Parisien,* Le Bourget,* St. Inglevert, Abbéville and aeroplanes at Abbéville (Gravelines). *Holland*, PCGG,* PCUU,* PCFF, PCMM, PCKK, PAS NSF.* *Germany*, LP 4000λ,* 2700λ* and a special transmission on 1100λ, apparently S.B. Eberswalde, Vox Hauss, Norddeich 1800λ and 2500λ* and four others not identified. Brussels 410λ and 1100λ,* Madrid three wavelengths, Lyngly, Bornholm, Prague 4500λ, Kbel, Geneva, Lausanne, Rome 450λ and 3200λ, Svenska Radio Viglets. *America*, WGY (100λ and 380λ) many times,* KDKA 100λ and 330λ) many times, WJZ and WMAF, and two others not identified. As this allows us to check calls, etc., I think you will agree that this is a very fine list for a set with only one H.F. stage. I may say that, at my instigation, eleven of these sets have been made up by friends of mine.

Yours faithfully,

W. E. Pattman.

Birmingham.

INFORMATION DEPT.

Will readers who intend to avail themselves of the services of the Information Dept. please note that they will facilitate its work greatly if they will observe the regulation which requires that a stamped self-addressed envelope be sent with each enquiry?

The author with the set.

A Two-Valve Amplifier-de-Luxe.

BY HERBERT K. SIMPSON.

A description of a handsome-looking amplifier, which is very easy to construct, and which can be applied to either crystal or valve sets. In addition, its switching arrangements greatly facilitate experimental work.

MANY experimenters like to have at hand an amplifying unit which may be connected up quickly to any existing set, or experimental lay-out, but which, at the same time, may take its place by the side of a well-finished receiver without detracting from the appearance of the whole. To such, the present amplifying unit will appeal.

The amplifier is so arranged that it may be permanently wired up to a receiver, but if desired it can be cut right out of circuit by one movement of a switch, the telephone terminals being then connected directly to the "input" terminals of the amplifier. By means of another switch, one or two valves may be used as desired, the filaments being automatically switched on or off by the same movement of the switch.

The finished unit is seen in the photograph, Fig. 2. The switch on the left is that by means of which the 'phones are connected to the receiver or in the anode circuit of one of the amplifying valves, while the right-hand switch determines whether one or both of the valves are in use.

The input terminals are those on the extreme left of the amplifier, those on the right being for high and low tension batteries, while the telephones or loud-speaker are joined to the two terminals in the front of the panel.

Each valve has its own separate filament control, the middle knob being that of a potentiometer controlling grid bias. Three flash-lamp batteries are housed in a small compartment in the bottom of the cabinet, a door being provided as shown in the photograph. These batteries are connected to the selector switch seen between the valves.

Circuit Diagram

A diagram showing the circuit arrangement of the amplifier is given in Fig. 4, and the action of the switches is easily followed from this drawing. When the switch S_1 is over to the left, the telephones are connected directly to the two terminals marked "input" to which the telephone terminals of the existing receiver are joined. Thus in this position the 'phones are joined to the receiver, with no extra amplification. Turning the switch S_1 to

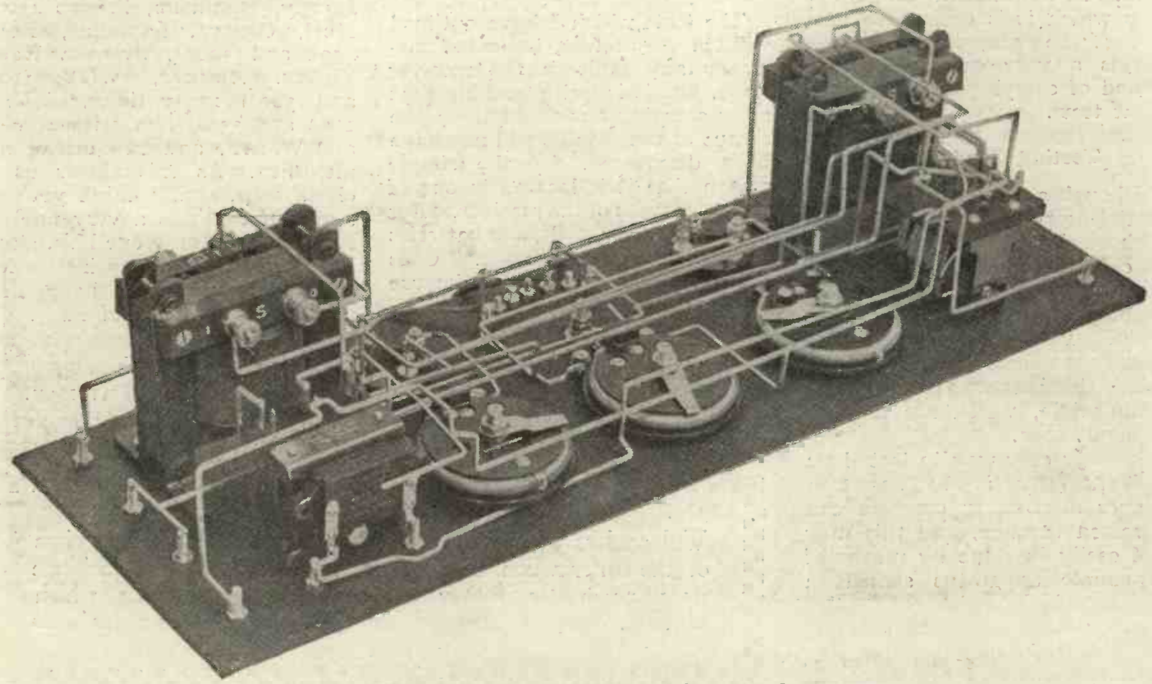


Fig. 1.—This photograph illustrates the simple layout.

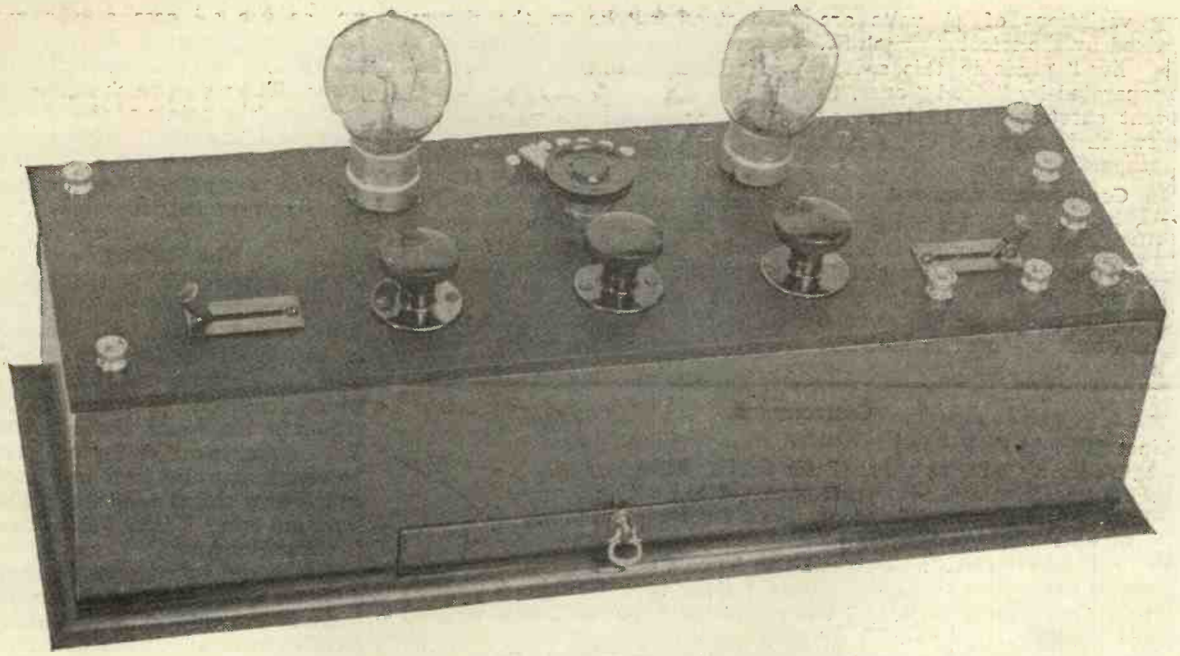


Fig. 2.—The completed instrument. The input terminals are on the left.

the right, and S_2 to the left, includes V_1 in the circuit, giving one stage of extra low-frequency amplification, while both valves are included by moving S_2 to the right-hand position.

A potentiometer is provided, by means of which the voltage applied to the grids may be varied, while

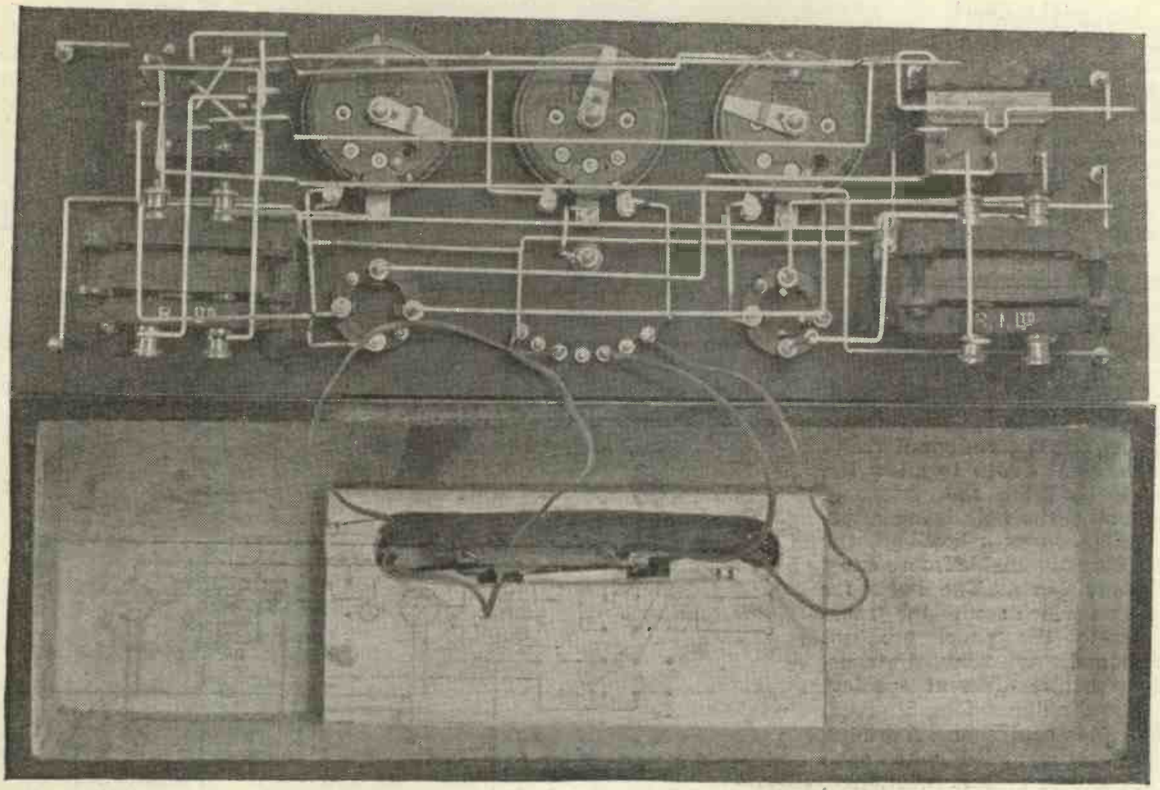


Fig. 3.—The method of making connection from the switch to the grid battery is clearly seen. The panel is turned over from front to back.

large variations of 4½ volts are obtained by the selector switch S_3. The "live" studs in this switch are separated by "dead" ones, to prevent shorting the batteries as the switch is moved.

Components required

The parts required for this set are listed below and, while it is not essential that all the parts should be of the make specified, it is advisable to use one or other of the makes which are used in MODERN WIRELESS sets, as these have been fully tried.

COMPONENTS.

Cabinet (Wright & Palmer)
Panel, 18 in. by 6 in. by ¼ in. (Peter Curtis, Ltd.)
2 L.F. Transformers (Radio Instruments, Ltd.)
2 Filament Resistances (Burndept, Ltd., Dual type)
1 Potentiometer (Burndept, Ltd.)
2 Valve Holders (H.T.C. Electrical Co., Type C)
1 4-Pole Change-over Switch, "Utility" lever type (Wilkins & Wright)
1 2-Pole Change-over Switch, "Utility" lever type (Wilkins & Wright)
1 0.004 Dubilier Condenser
1 1½ in. Radius Nickel-plated Switch-arm (Grafton Electric Co.)
7 ¼ in. by ¼ in. Switch Studs, Nickel-plated (Grafton Electric Co.)
8 4 B.A. Nickel-plated Terminals (Grafton Electric Co.)
20 ft. tinned square Wire
Screws, etc.

The Panel

The panel, which is of ebonite, measures 18 in. by 6 in. and should be ¼ in. thick. If ebonite the quality of which is not guaranteed be used, the surface skin should be thoroughly removed by rubbing with emery cloth, as this skin has low insulating properties, and will seriously affect the results obtained if allowed to remain on the ebonite.

Fig. 5 is a drawing showing the lay-out of the various parts upon the panel, and sufficient dimensions are given to enable all the necessary holes to be drilled.

In cases where screws fixing components come right through the panel, the latter is countersunk to a sufficient depth to allow the screw to lie below the surface of the ebonite, the hole being afterwards filled in with heel-ball, the latter being obtainable from almost any bootmaker's. The holes for the screws which secure the transformers to the panel are not dimensioned, as different transformers require different spacing, and thus the dimensions, if given, might lead to confusion. A drilling template is supplied with each valve-holder of the type mentioned, and the securing bolts should be countersunk and the holes filled in as explained above. Care should be taken when drilling the holes or the switch studs to ensure that the studs will lie on the circumference of a circle the radius of which is equal to that of the switch arm.

Mounting the Parts

Having drilled all the necessary holes, the constructor may proceed to mount up the parts. It will be found most convenient to mount up such parts as terminals, switch studs, and so on, first, leaving the heavier parts, such as transformers, until the last, as this keeps the weight down while working. When all parts are in position, it will be found advantageous if all points to which a wire has to be joined are thoroughly tinned, as this will greatly ease the task of wiring.

Wiring up

Wiring is carried out with square section tinned copper wire, about 20 feet being required. The lay-out of the wiring may be followed from the diagram, Fig. 6, which shows how the various points are joined. Two photographs of the underside of the panel are also given in Figs. 1 and 3, and will help to clear up any points of difficulty which may arise. Care must be taken to bend each wire exactly to shape before soldering up, as the stiffness of the wire makes it difficult to bend, when soldered up, without fracturing the joint. The wires which make contact with the points of the change-over switches must also receive considerable care in order that they may fit accurately and without touching one another.

The Cabinet

The construction of the cabinet should present no difficulty, and a dimensioned sketch will be seen in Fig. 7. If desired the cabinet may be obtained ready-made, in which case it is necessary to stipulate the exact size required. The arrangement of the grid bias batteries may be seen in Fig. 3, which also shows how the rubber leads are brought from the batteries to the switch-studs.

The batteries are inserted through a small slot-shaped hole in the front of the cabinet, into which a piece of wood fits, the latter having a small nickel handle, by means of which it may be removed.

The cabinet is made of ⅜ in. finished mahogany, and when complete, may be stained and polished, according to the ability of the constructor. The panel is secured to the cabinet by means of small screws.

Testing the Amplifier

When complete the amplifier may be connected up to an existing receiver and tested. It is quite suitable for use in conjunction with a crystal receiver, and if used with that described on page 48 of MODERN WIRELESS for June, 1924, the connections should be as follows:—

Aerial and earth to correct terminals on crystal receiver.

"Telephone" terminals of crystal set to "input" terminals of amplifier.

H.T. and L.T. batteries to terminals marked in Fig. 5.

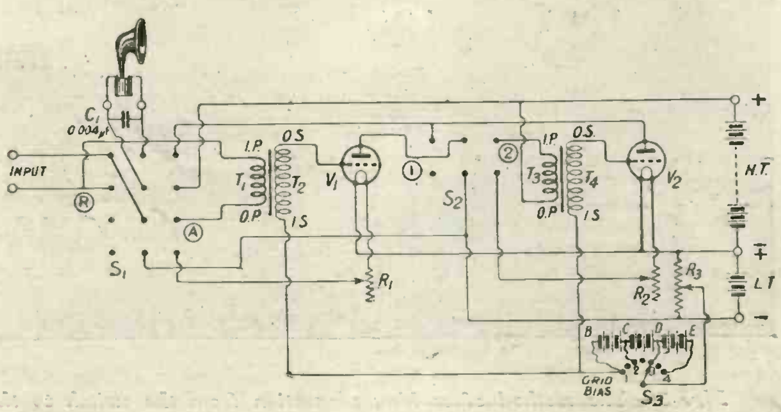


Fig. 4.—The circuit of the receiver. The action of the switches may be easily traced out.

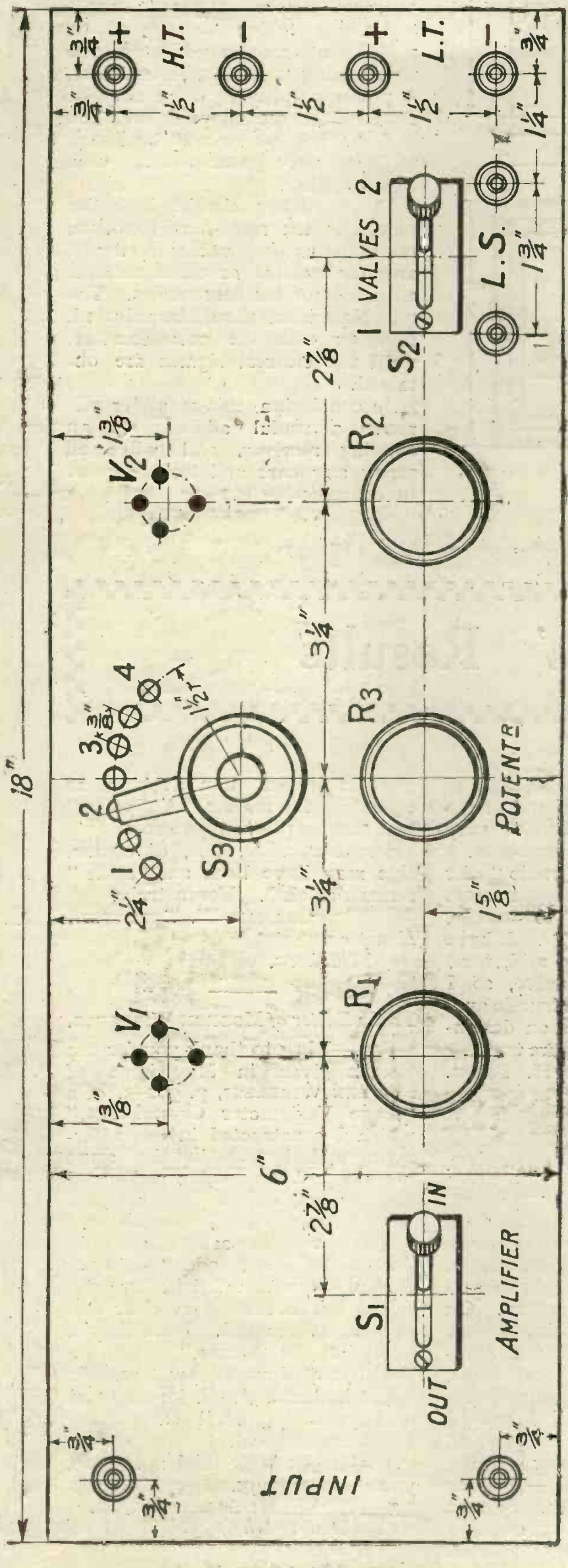


Fig. 5.—A scale drawing of the top of the panel showing the layout of the parts. (Blueprint No. 52 A.)

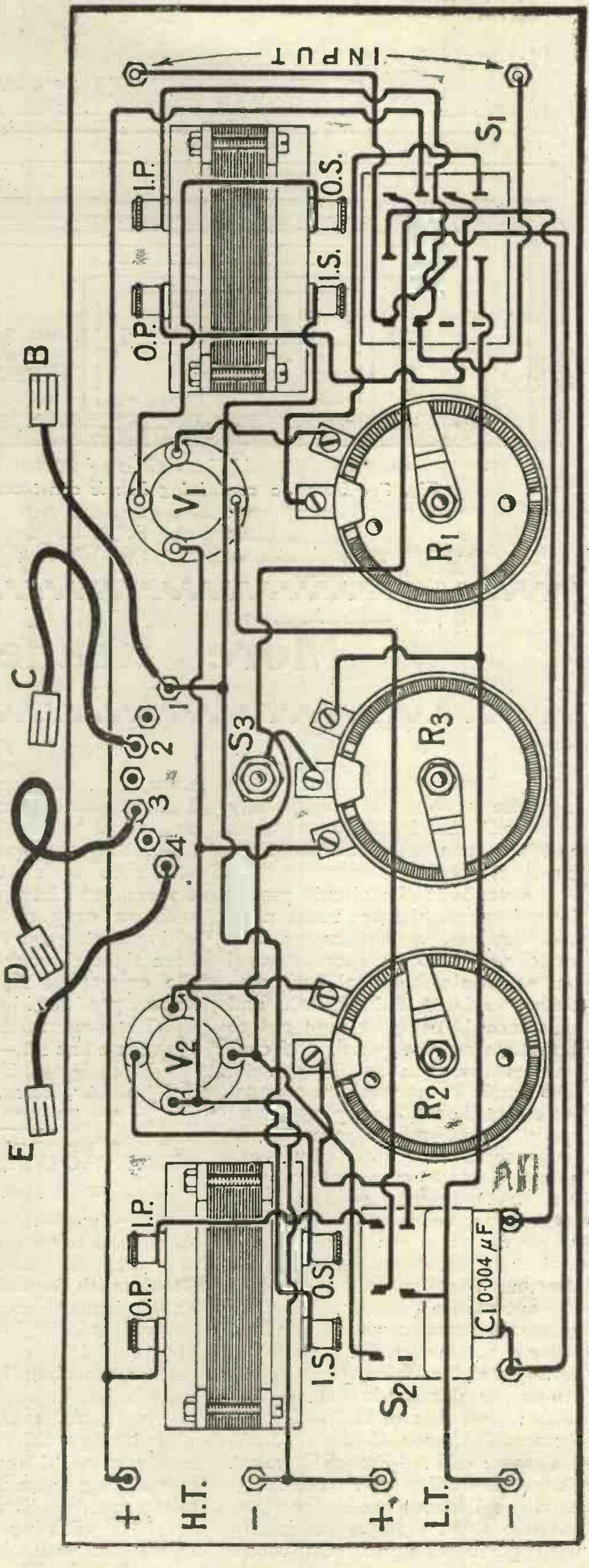


Fig. 6.—The wiring of the amplifier. The lettering on the flexible leads corresponds with Fig. 4. (Blueprint No. 52 B.)

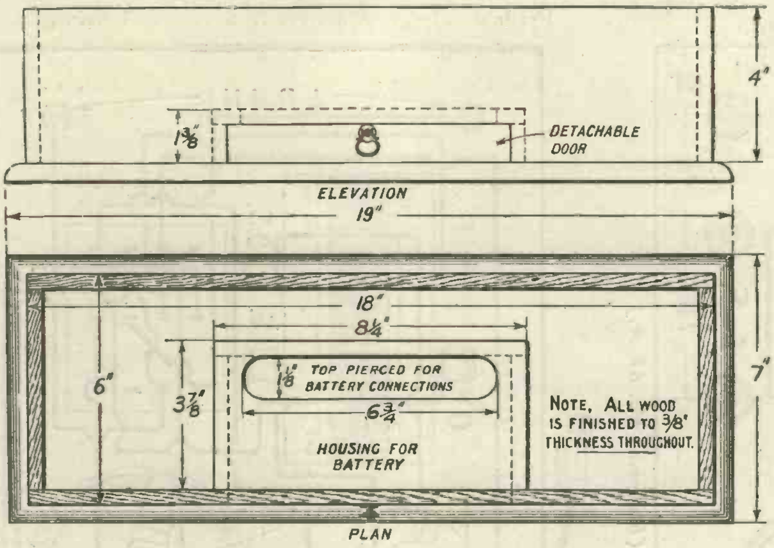


Fig. 7.—How the containing box is constructed.

Telephones or loud-speaker to terminals marked in Fig. 5.

A high-tension voltage of 60 volts or upwards may be used, 100 volts being a good all-round size. A power amplifying valve may be used in the second position. The B.T.H. B 4 valve will be found to give very good results with this amplifier.

The switches should both be placed in the right-hand position, thus putting both valves in circuit, and the crystal or other receiver adjusted for the best results. The grid biass witch should be adjusted, together with the potentiometer, until the clearest signals are obtained.

In conclusion, this amplifier will prove a useful addition to an existing receiver, and will well repay any care and trouble spent in constructing it.

More Readers' Results

SIR,—I recently completed building the "Four Valve Family Receiver," and I feel I must write and tell you what an excellent circuit it is.

I have built the circuit proper (transformers, filament resistances, valve-holders, potentiometer and switches) on to an ebonite panel on a satin-walnut cabinet, condenser leads (A.T.C., H.F.C., and reactance C.) being brought out to terminals on the panel, the condensers being in small cabinets. The whole is mounted on a panel affixed to the wall in my room, and has a very pleasing appearance.

As regards results: they are astonishing. Here, about 20 miles from 2LO, signals are quite loud enough for 'phones on 1 valve; 2 valves work the loud speaker easily; 3 valves are too much for the loud speaker, whilst 4 valves are out of the question. All Continental stations come in very loud indeed on 3 valves. Croydon, Lympne and all aircraft (over the whole route) come in fine.

The valves are H.F.—Cossor; Detector—Marconi-Osram; L.F.$_1$—Cossor; L.F.$_2$—French R. valve. 80 volts on all plates. The set is equally efficient on the higher wavelengths, C.W. stations coming in with great strength. On 600m. ships, etc., are very loud, and as I am a good reader of morse (30 words per min.) I find it very interesting reading the messages.

I have been at "radio" for 6 years, but I have not come across such an easy circuit to handle, giving such good results. I have been right through the mill, from the crystal to multi-valve, so I know a good set when I handle one.

With congratulations on designing such a fine set,—Yours truly,

ERIC H. PRICE.
Upminster, Essex.

COWPER CRYSTAL CIRCUIT.

To the Editor of MODERN WIRELESS.

SIR,—I made up this circuit with the 16 and 20 gauge wire as shown in diagram and photograph. Results with Brown's A 'phones and Shaw's hertzite are excellent. On Saturday evening immediately after 2LO closed down I heard Manchester conclude his local news, state he had two special announcements to make (which I missed while trying a different setting) and finally say "Manchester station now closing down until — o'clock to-morrow." Strength, about equal to 2LO upon an average crystal set with average 'phones. 2LO is louder than average, as stated by the author. A "voice" was also heard during a two-minute interval at 2LO, but, of course, this may have been an "aside" remark at 2LO. Yours truly,

GRAHAM W. THOMPSON.
Hampton,
Middlesex.

To the Editor of MODERN WIRELESS.

SIR,—I beg to thank you for the details given in May issue of MODERN WIRELESS, p. 702–3. of a "Cage Variometer Crystal Set," which I constructed in one afternoon and listened-in the same evening and the result was beyond my expectation. I, however, did not employ the "cat-whisker" referred to in the article, not even "three-ply," but odd pieces of thin wood which I had by me.

The instructions were clear and easy to understand. I am only a novice at the "game."

The cost of material was 7s. 6d., which included 3s. 9d. for a crystal detector and special cat-whisker to a tested crystal.

I thought this might interest you.—Yours truly,

W. M. ALLEN MAJOR.
Cranbrook Park,
Ilford.

Regular Programmes from British and Continental Broadcasting Stations

Times in British Summer Time.

GREAT BRITAIN.

Station.	*Call Sign.*	*Wave-length.*	*Times.*
Cardiff ...	5 WA	353	3.30 to 4.30 p.m and 5.0 to 10.30 p.m.
London ...	2 LO	365	
Manchester	2 ZY	375	
Bournemouth	6 BM	385	
Newcastle ...	5 NO	400	SUNDAYS. 3.0 to 5.0 p.m. and 8.30 to 10.30 p.m.
Glasgow ...	5 SC	420	
Birmingham	5 IT	475	
Aberdeen ...	2 BD	495	

FRANCE.

EIFFEL TOWER FL 2,600 metres.
(*Daily.*)

7.40 a.m. Forecast.
10.50 a.m. Fish prices in the Paris markets.
11.15 a.m. Regional forecast.
12.0 noon Livestock prices.
12.15 p.m. Announcement of the time. (*Tuesdays and Thursdays.*)
3.40 p.m. Financial news.
5.30 p.m Closing prices. (*Saturdays excepted.*)
6.15 p.m. Radio concerts.
8.0 p.m. General forecast.
11.0 p.m. General forecast. On Sundays the radio concerts and forecasts are given at 7 o'clock.

ECOLE SUPÉRIEURE DES POSTES ET TÉLÉGRAPHES (450 metres).

Concerts every night from 8.15 and generally Tuesday at 2.30 p.m.

RADIOLA (1,780 metres).

12.30 p.m.
4.30 p.m.
8.30 p.m. } Concerts.

These concerts are preceded by news items.

BELGIUM.

BRUSSELS (405 metres).

5.30 p.m.
6.0 p.m.
8.30 p.m. } Concerts and News.

HOLLAND.

THE HAGUE, PCGG (1,050 metres).
Concerts. Sundays, 3.0 to 6.0 p.m.

THE HAGUE, HEUSSEN PCUU (1,050 metres).
Thursdays, from 7.45 to 10.0 p.m., Irregular.
Sundays, from 9.40 to 10.40 a.m., Irregular.

THE HAGUE, VELTHYSEN, PCKK.
Fridays, from 8.40 to 9.40 p.m., Irregular.

THE HAGUE, IJMUIDEN, PCMM.
Saturdays, from 8.40 to 9.40 p.m., Irregular.

SPAIN.

MADRID (2,100 metres).
Trials from 11.0 to 1.0 p.m., Irregular.

SWITZERLAND.

LAUSANNE (1,100 metres).

9.5 a.m. Meteorological forecast for Lausanne.
11.50 a.m. Meteorological forecast for Geneva and Dubendal.
2.0 p.m. Meteorological report for Switzerland.
7.55 p.m. Meteorological report for Switzerland.
5.0 p.m. Tuesdays, Thursdays and Saturdays, Concerts.
8.0 p.m. Mondays, Wednesdays, Fridays and Saturdays, Concerts.

ITALY.

ROME (540 metres).
Weekdays from 6 p.m. to 7 p.m.

GERMANY.

BERLIN, VOX HAUS (Radio Stunde A.G., Potsdamer Str. 4).

Wavelength.—About 420 metres, varying between 415-435.

9 a.m.—Market prices.
9.15 a.m.—News report.
11.15 a.m.—Exchange quotations.
11.55 a.m.—Time signal.
1.15 p.m.—Exchange quotations.
3.5 p.m.—Concert.
6.30 p.m.—Lectures (not daily).
7.30 p.m.—Concert. (Sundays and holidays 6 p.m. / 7 p.m.).
8.45 p.m.—Last news report. Weather forecast.
9.50 p.m.—Dance music (not daily—usually Thursdays).

LEIPZIC—MITTELDEUTSCHE RUNDFUNK A.G.
Wavelength, about 400 metres.

9 a.m.—Market prices.
11.45 a.m.—Exchange quotations, etc.
11.55 a.m.—Time signal (from Nauen).
3.30 p.m. / 5 p.m.—Concert.
8.15—Concert and news (Sundays and holidays, 4 p.m. to 5 p.m.)
9 p.m—Dance music (not daily).

KONIGSWUSTERHAUSEN L.P., 4,000 metres.

6 a.m./7 a.m.—News.
11 a.m. to 12.30 p.m.—Exchange (on 2,700 metres).
3 p.m. to 4.30 p.m.—Exchange and news (on 4,000 metres).

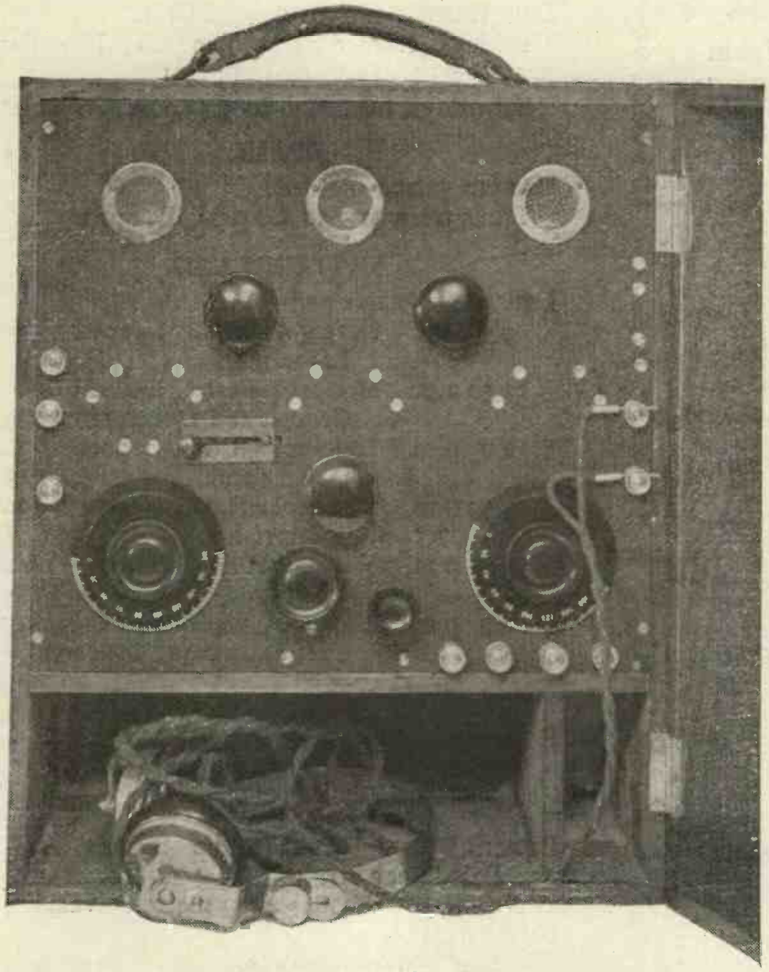


Fig. 1.—The completed portable receiver.

A New Three Valve Portable Set.

BY

Herbert K. SIMPSON

A portable set should never be tried by a beginner because of the necessary cramping of components, but in the hands of the more experienced reader this set will give excellent results.

So great is the desire among wireless enthusiasts for a set which may be taken about the country in the summer months, that it is felt that the description of a portable set, following lines different from those described in the May issue of this journal, will not be out of place. The receiver described below is of a very simple design, and its construction should present no difficulty to the wireless man of average constructional ability, while many pleasant hours may be enjoyed by its aid when the call of summer takes the radio enthusiast outside the precincts of his own station.

The present set may be used with a short length of wire attached to a convenient tree as an aerial, while the earth connection may consist of a short length, say one foot, of iron rod driven into the ground. At distances up to 15 miles from a broadcasting station a frame aerial may be used with good results.

The finished receiver may be seen on reference to the photograph, Fig. 1, this being a view taken with the front of the cabinet open, showing the controls. The valves are mounted behind the panel, windows being provided to allow the filament brightness to be seen. The filament resistances are situated below the valve windows, the resistance for the second valve being below and between the other two. The change-over switch, seen to the left of the second resistance, enables the aerial tuning condenser (the left hand dial) to be used in series or parallel with the aerial tuning coil. The anode tuning condenser is situated to the right of the A.T.C., while the two knobs between these two condensers are those which vary the coupling between the anode and reaction coils, the coil holder itself being situated behind the panel.

On the left are seen three terminals, these being respectively constant aerial tuning, parallel tuning with no C.A.T., and earth. It should be noted that when series tuning is required, the aerial lead is connected to the second terminal, the switch being put into the series position.

The bottom row of terminals, from left to right, are HT+, HT−, LT+, LT−, GB+, and GB−, while the telephones are joined to the two terminals on the right-hand side of the receiver. The high-tension battery is located in the larger compartment below the panel, while the low-tension battery, which may conveniently be an Ever-Ready battery of the type No. 126 when dull emitter valves of the .06 type are employed, is housed in the smaller compartment.

Circuit Diagram

The circuit arrangement of the receiver is given in the drawing Fig. 3, from which it will be seen that the aerial circuit comprises the coil L_1 and condenser C_1, the latter being of 0.0005 μF maximum capacity, and the small fixed condenser of 0.0001 μF capacity, by means of which the constant aerial tuning system may be introduced. The first valve V_1 acts as a high-frequency amplifier, having in its

This receiver makes use of a stage of high-frequency preceding the detector and therefore proves very efficient on frame or small aerials. Its compact form will make it very popular

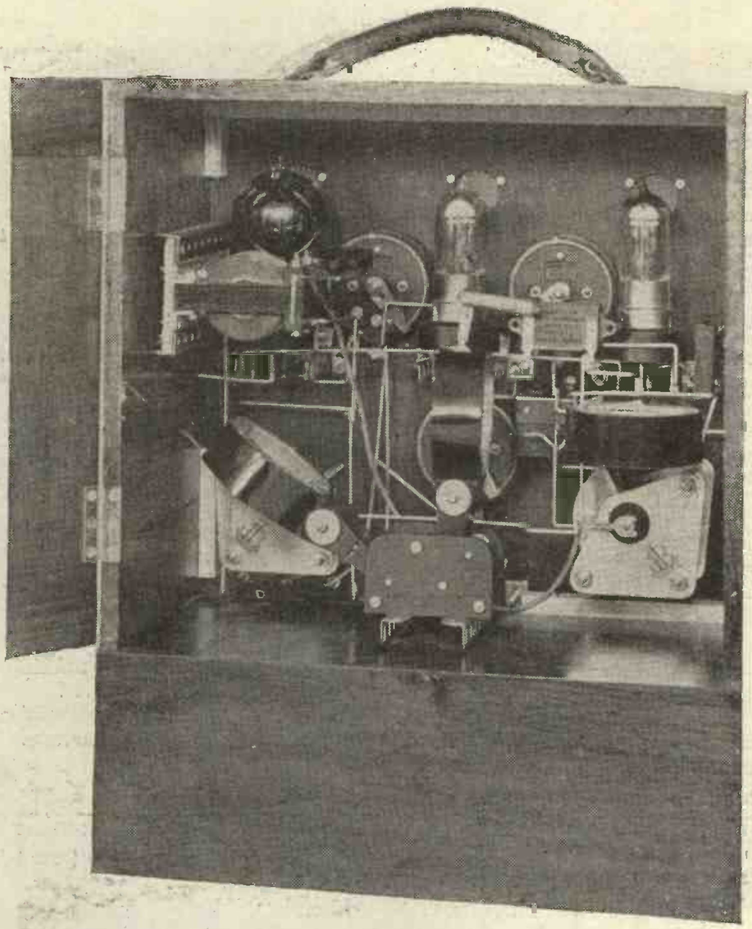


Fig. 2.—A view looking into the back of the cabinet.

anode circuit the coil L_2 and the variable condenser C_2 of 0.0003 μF maximum capacity. V_2 is the detector valve, reaction being introduced by means of the coil L_3 being coupled to L_2. V_3 is a low-frequency amplifier, and the telephones are situated in the anode circuit of this valve.

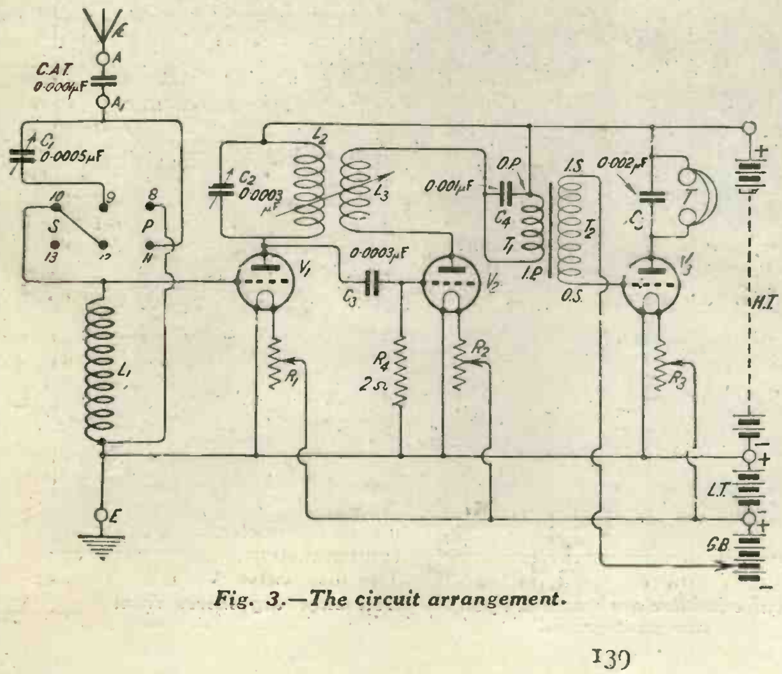


Fig. 3.—The circuit arrangement.

Constant Aerial Tuning

This form of aerial tuning may be employed by joining the aerial lead to terminal A, leaving A_1 free, and joining the earth to E. The switch must be in the "parallel" position. The simple form of parallel tuning, without constant aerial tuning, may be used by joining the aerial to terminal A_1, leaving A free, earth to E, and having the switch in the "parallel" position. Should it be desired to change over from this position to series tuning, all that is necessary is to turn the switch to the "series" position, leaving the aerial lead on A_1 and the earth on E.

Components required

The parts required for this receiver are listed below, and while it is not essential that the parts used should be of the make specified, and the constructor may use such components as he may have on hand, it is advisable to thoroughly test out these parts before building them up into the receiver, to ensure their being in perfect order.

Components.

Cabinet (Wright and Palmer)
Paragon Panel, 12 in. by 11 in. by ¼ in. (Peter Curtis, Ltd.)
1 0.0005 μF Variable Condenser (Jackson Bros.) Super Type
1 0.0003 μF Variable Condenser (Jackson Bros.) Super Type
1 Two-coil Holder (Goswell Engineering Co. Ltd.)
1 Coil plug, Type B (Goswell Engineering Co., Ltd.)
3 Valve holders, Type A (H.T.C. Electrical Co.)
3 Dual Filament Resistances (Burndept Ltd.)
1 "Tangent" L.F. Transformer (Gent and Co.)
1 Two-pole, Two-way Switch, Utility Lever Type, (Wilkins and Wright)
3 Nickel Valve-windows (K. Raymond)
Dubilier Condensers: one 0.0001 μF
one 0.0003 μF
one 0.001 μF
one 0.002 μF
One 2 megohm Dubilier Grid Leak with Clips
2 doz. 4 B.A. Screws with Nuts (K. Raymond)
9 4 B.A. W.O. Type Terminals (K. Raymond)
10 ft. Tinned Wire
Wood screws, rubber leads, etc.

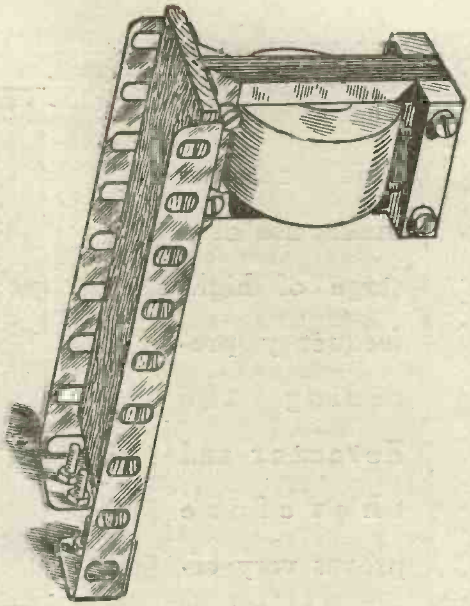


Fig. 4.—Showing how Meccano "angle girders" are used for supporting some of the parts.

Notes on Components

The two-coil holder is of the cam-operated vernier type, sold by the Goswell Engineering Co., Ltd., permitting fine adjustment of reaction to be obtained. The variable condensers are of a useful type for all general work, and are supplied by the makers, Jackson Bros., with a special tag for making contact to the moving vanes.

The resistances used are suitable for either bright or dull emitter valves.

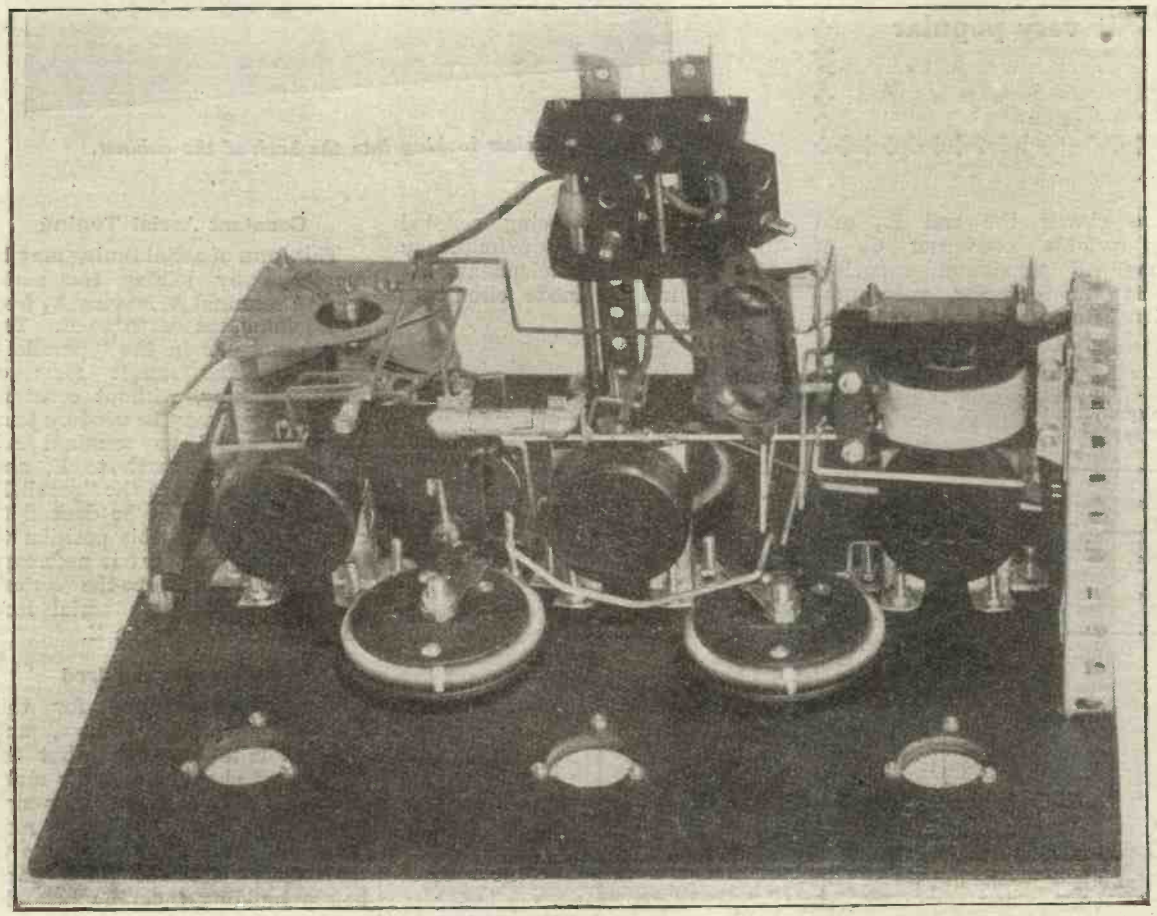


Fig. 5.—The manner in which the valve holders are mounted upon the panel may be gathered from this photograph.

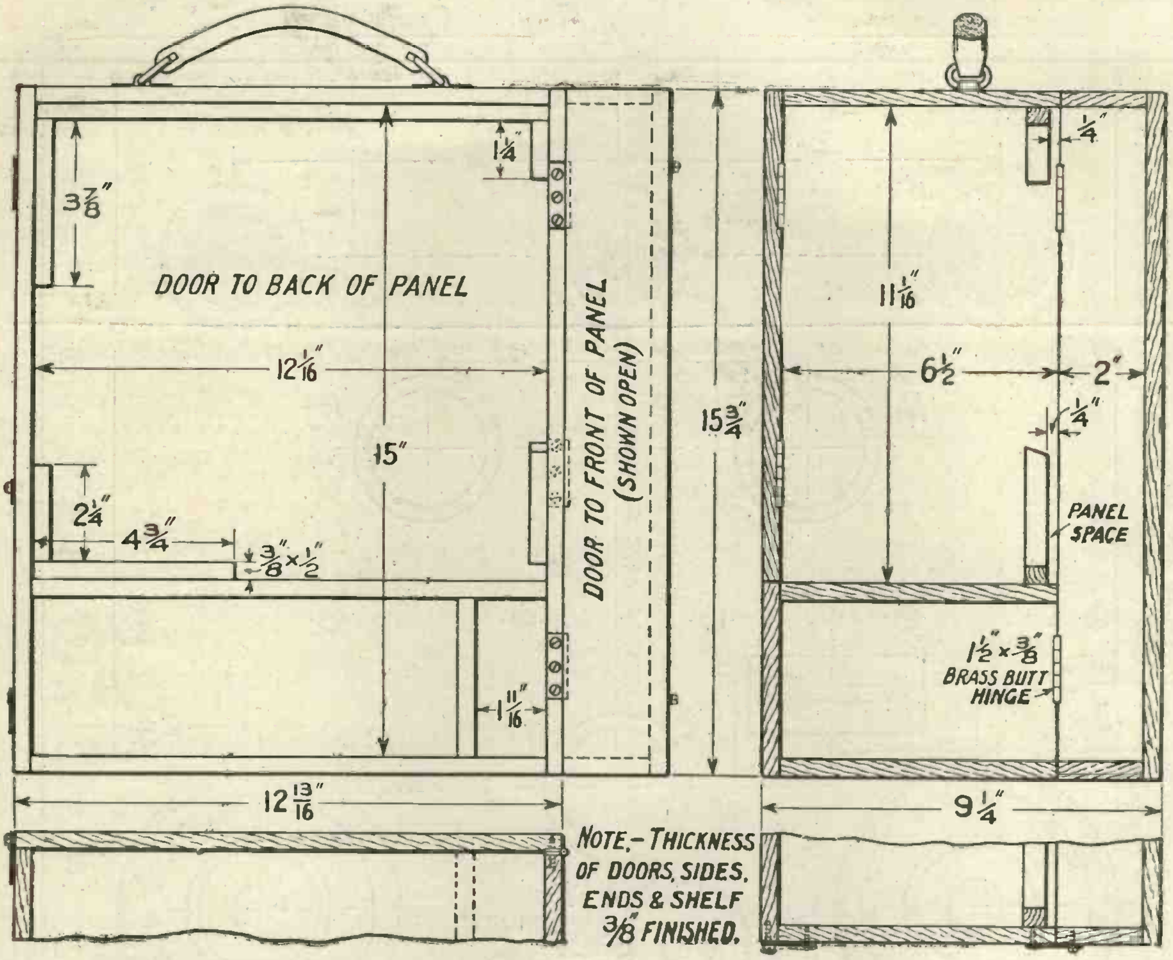


Fig. 6.—Sufficient dimensions are given in these two views to enable the case to be made quite easily.

The Panel

The panel, which is ebonite, measures 12 in. by 11 in. by ¼ in. thick, and should be of the best quality. If unguaranteed ebonite is used the surface skin must be removed by rubbing with emery cloth, as it forms a semi-conducting layer which detracts appreciably from the efficiency of the set. The material supplied by Messrs. Peter Curtis, Ltd., requires no rubbing down.

A scale drawing of the panel showing the layout of the parts is given in Fig. 8, and all the necessary dimensions will be found thereon. Mark out the positions of the holes with some sharp-pointed instrument, and make a small cross against all holes of the smallest size, drilling these first, and proceeding with those of the next size in turn. This method of drilling saves much time, and prevents the holes being wrongly drilled by accident. The holes for the valve windows may be made by one of two methods, failing a drill

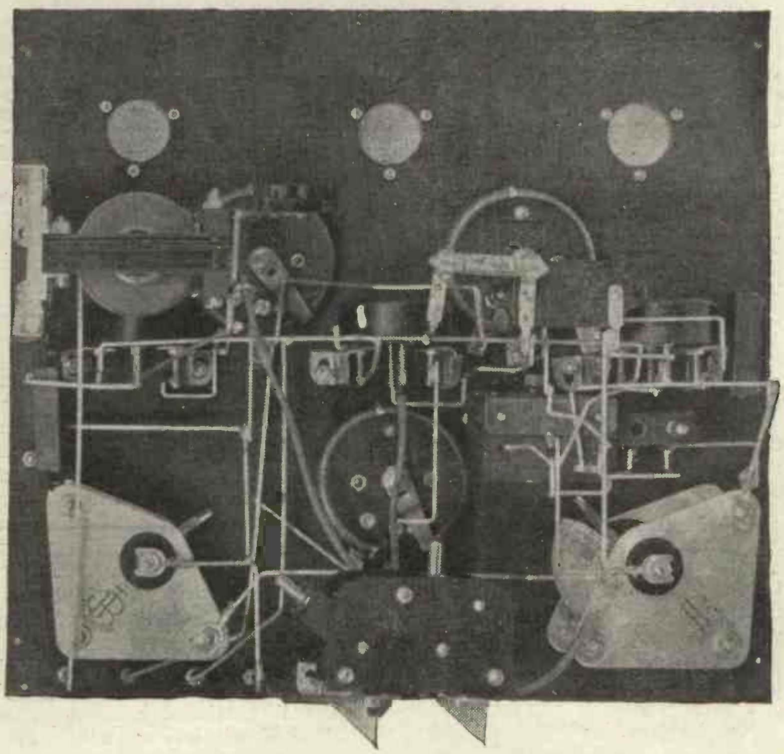


Fig. 7.—A further back-of-panel photograph.

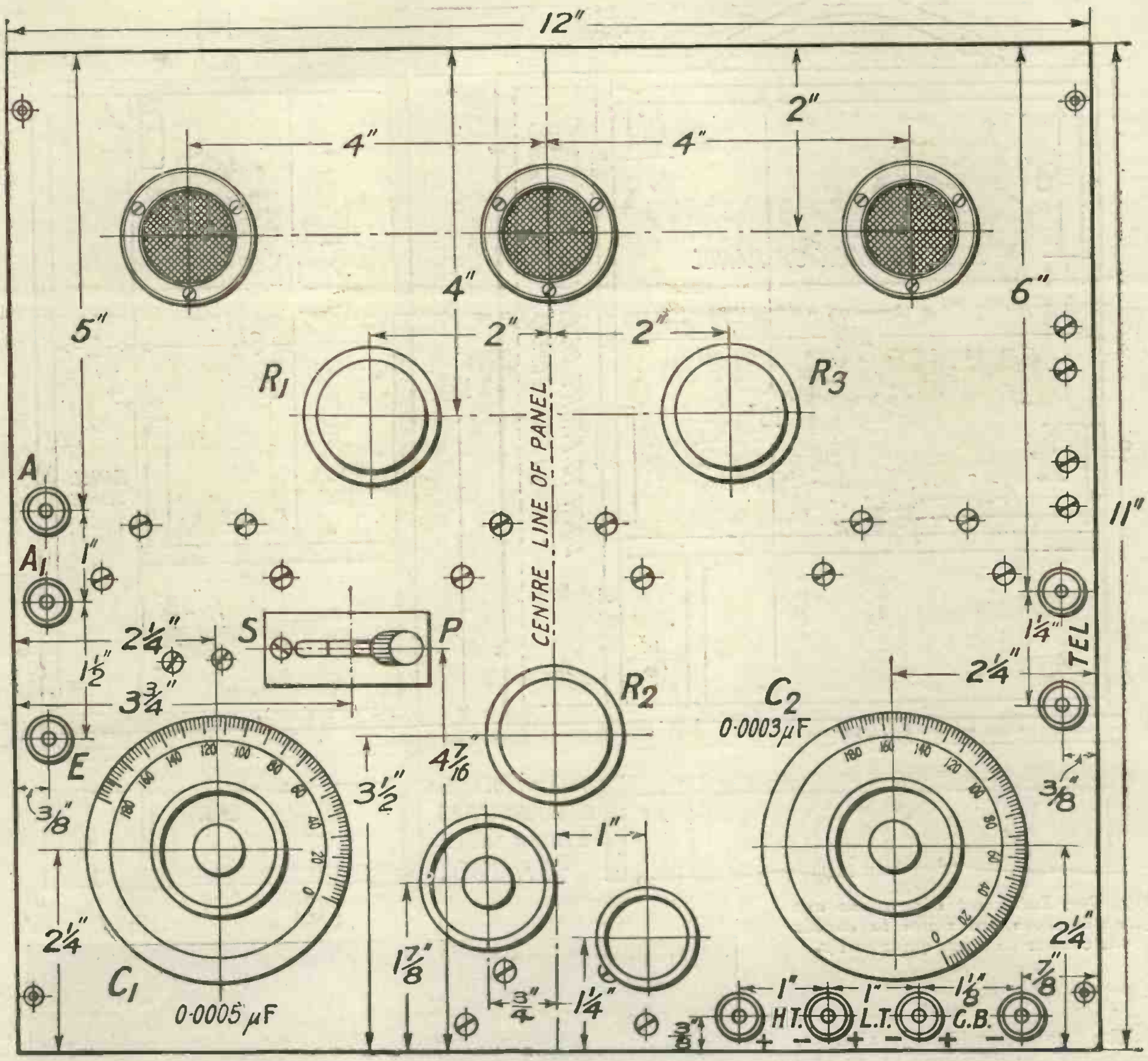


Fig. 8.—A half-size drawing showing the lay-out of parts upon the panel. Blue print No. 50a.

of the correct size. A fretsaw may be employed by those who possess one, or alternatively a series of holes may be drilled round the circumference of the circle to be cut out, the hole being afterwards trimmed up with a file. In connection with this section, it may be pointed out that in Fig. 8 all dimensions are taken from the centre line of the panel, as greater accuracy is thereby obtained.

Mounting the Parts

When the holes are all drilled the constructor may proceed to mount up the parts, commencing with the lighter parts, such as terminals, and then proceeding with the heavier parts in order.

The method of mounting the valve holders, transformer, and coil-holder may be gathered from the photographs of the back of the panel, and a detailed sketch is given in Fig. 4. Meccano "angle girders" are used, the ends being split and turned outward, in the case of the valve and coil holders, to fix upon the panel, being held in position by 4 B.A. screws and nuts. In the case of the valve-holders, each upright strut is secured to one filament leg of each valve-holder, thus holding the latter at right angles to the panel. The girders holding the low frequency transformer have a piece of wood secured to them, and the transformer is screwed to this. A change of transformer is thus possible without the necessity of redrilling the panel. The positions of the screws through the panel which hold the strips upon which the coil holder is carried are so adjusted that the coil holder will mount easily, using the holes in the girder strips to secure the holder to the strips by means of the screws supplied with the coil-holder.

Mounting the Fixed Condensers

The fixed condensers are not secured to the panel, but are held in position by the wiring, or by the terminals to which they are soldered. The grid leak is secured to the two clips, which are of the conventional type, one clip being soldered to one lug of the 0.0003 μF fixed condenser.

The Wiring

Fig. 9 is a drawing of the back of the panel, with the wiring left out, and, in its stead, all points to which a wire has to be joined are numbered, and a list of points to be joined will be found below.

It must be explained, to save confusion, that the contact numbered 13 on the "Utility" switch has been broken off, as it is not

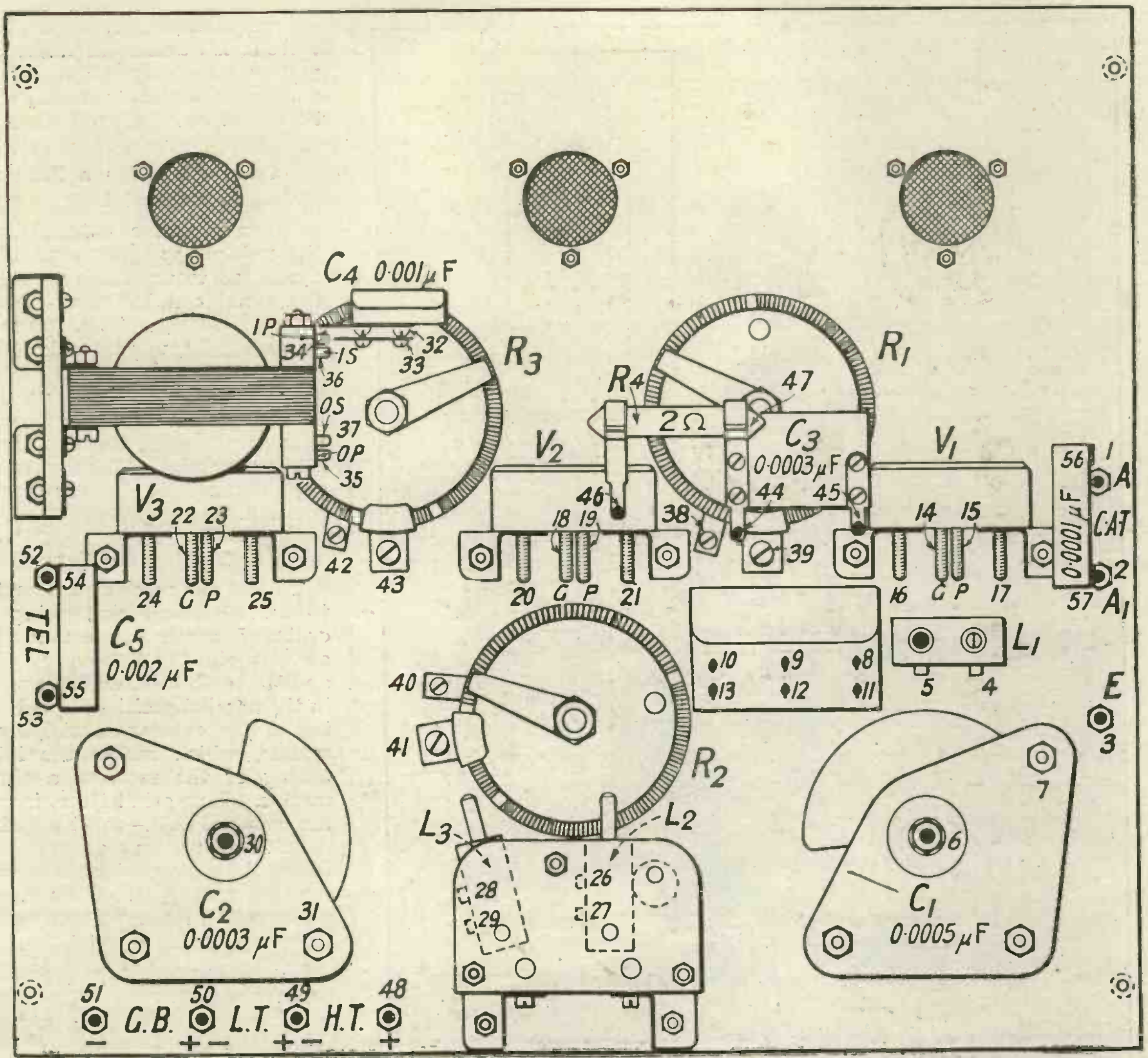


Fig. 9.—This diagram replaces the usual wiring diagram, a key being given below. Blue print No. 50b.

required in this case, but there is no need for the constructor to follow this example, as the contact 13 may simply be left with no wire joined to it.

List of Numbers.

Aerial circuit terminals; A, 1; A_1, 2; E, 3.

Aerial tuning coil L_1, 4, 5.

Aerial tuning condenser C_1 (0.0005 μF) 6, 7.

Contacts of change-over switch, 8 to 13.

H.F. valve V_1: G, 14; P, 15; Filaments, 16, 17.

Detector Valve V_2: G, 18; P, 19; Filaments, 20, 21.

L.F. valve V_3: G, 22; P, 23; Filaments, 24, 25.

Anode tuning coil L_2: 26, 27.

Reaction coil L_3: 28, 29.

Anode condenser C_2 (0.0003 μF) 30, 31.

Bypass condenser C_4 (0.001 μF) 32, 33.

L.F. transformer: IP, 34; OP, 35; IS, 36; OS, 37.

Filament resistances, R_1, 38, 39.

,, ,, R_2, 40, 41.

,, ,, R_3, 42, 43.

Grid condenser C_3 (0.0003 μF) 44, 45.

Grid leak R_4 (2 Ω) 46, 47.

H.T.+, 48; H.T.−L.T+, 49; L.T−G.B+, 50; G.B.−, 51.

Telephone terminals, 52, 53.

Telephone condenser C_5 (0.002μF) 54, 55.

C.A.T. condenser (0.0001 μF) 56, 57.

Points to be Joined

(1–56), (2–57), (2–7–11), (3–4–8–L.T.+Busbar), L.T.+Busbar joins 24–20–16–49, (5–12–10–14), (6–9), (15–45–31– flexible lead to 26), (17–39), (18–44–47 clips into clip provided), (19– flexible lead to 28), (21–41), (22–37), (23–52–54), (25–42), (27– flexible lead to 48), (48–30–53–35–32), (53–55), (29– flexible lead to 34), (33–34), (36–51)) (38–43–40–50), (46– L.T.+ Busbar.,

In some cases the lugs of the fixed condensers may be soldered directly to a terminal, the condenser thus being self-supporting. Such cases are: (2–57), (33–34), (52–54) and (53–55.) Large photographs of the wiring are given, and should prove useful in clearing up any points of difficulty which may arise.

The Case

For those who intend undertaking this part of the work, a sectional drawing of the case is given in Fig 6. and should prove sufficiently clear to enable the work to be carried out. The wood used is ⅜ in. finished mahogany, the whole of the front being on hinges, to open sideways. The portion of the back above the shelf only is hinged to permit of access to the back of the panel, when the latter is in position in the case. Fig 2 is a

Fig. 10.—The portability of the set will be appreciated.

view looking into the back of the receiver, with the rear door open.

Small pieces of wood are arranged at a distance of ¼ in. in from the front of the panel compartment, to which the panel is secured by means of wood screws.

Batteries

The high-tension battery is housed in the larger of the two lower compartments, and may either be of the conventional block type, or may be made up of several flash-lamp batteries connected in series. If the latter alternative is adopted the separate batteries should be interleaved with strips of waxed paper, of a width equal to the height of the batteries, thus effectively insulating each cell from the next. Connection is made from the battery to the correct terminals by means of rubber-covered flexible wire. Ever-Ready battery No. 126 may be used as low tension when dull emitter valves of the .06 type are used, and such valves should be considered an essential feature of a receiver like the present. The grid battery may be housed in the same compartment as the H.T. battery, and may consist of a flash-lamp battery.

Coils

The coil L_1 which plugs into the socket beside the Utility switch may be either a No. 50 or a No. 75, when using constant aerial tuning, according to whether the wavelength of the station to be received is below or above 420 metres. L_2 may be a No. 50, while the reaction coil L_3 should be a No. 75.

Connections for a Frame Aerial

When a frame aerial is used, the ends of the frame windings are connected to terminals A_1 and E, the aerial coil L_1 being removed from its socket. This leaves the frame windings as the only inductance in the grid circuit of the first valve, the circuit being tuned by the variable condenser C_1, which is in parallel with the windings of the frame aerial. The change-over switch must be in the parallel position.

Testing the Set

To test the receiver, connect up to an outside aerial, using the ordinary earth connection. The aerial is joined to A, leaving A_1 free, and the earth to E, with the switch in the parallel position, thus bringing in the constant aerial tuning system, which makes the initial tuning of the receiver a simple matter. If no grid battery is used, the terminal G.B.– must be joined to L.T.–G.B.+ by a piece of wire. Insert the valves, which may be of the Ediswan A.R. .06 type, and place coils in the sockets in the following order :—

L_1 : No. 50 or No. 75 (according to wavelength).
L_2 : No. 50.
L_3 : No. 75.

Connect the batteries and telephones to the terminals indicated in Fig 8. Keeping L_3 well away from L_2, tune on the variable condensers C_1 and C_2, and the local station should be heard at once, provided, of course, it is not one of the intervals. Bringing the coil L_3 closer up to L_2, and returning on C_2, should result in an increase in signal strength, and if this is not the case, the flexible leads to the socket L_3 should be changed over. Oscillation will take place if the coils L_2 and L_3 are placed too close together, and care must be taken to avoid this.

Results :

On a reasonably good aerial all the broadcasting stations should be received, and on actual test five have been heard at good strength, while excellent loud-speaker signals are obtainable from the nearest station. If desired, the panel may be used in an ordinary cabinet as a three-valve receiver for ordinary use.

Aerial Insulators

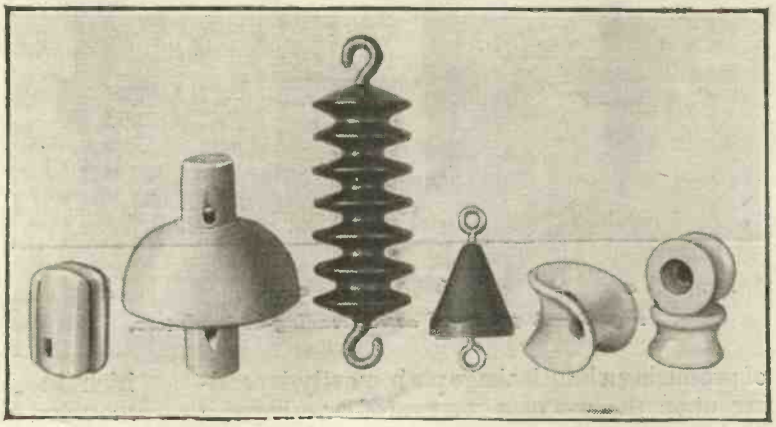
By G. P. KENDALL, B.Sc., Staff Editor.

An article containing some valuable advice upon a much-neglected detail of aerial construction.

It is probable that there is no other detail of aerial construction of equal importance which receives so little consideration from the average experimenter as the matter of aerial insulation and the choice of efficient insulators. Height of mast, position of aerial to secure freedom from screening, choice of good aerial wire and so on, all receive careful consideration, but when it comes to the insulators, all that is usually done is simply to go to the nearest shop and purchase a few porcelain ones of any type which they may happen to have in stock.

It should be realised at the outset of this article that the matter of aerial insulation is by no means a simple one, for there are many factors to be considered, and it is one which well repays a little care and thought. The importance of good aerial insulation is especially marked in the case of valve receivers which do not employ reaction, and crystal sets, since with these receivers it is not possible to compensate for the damping effect of aerial losses. It is, indeed, probable that it is the free use of reaction which has led many experimenters to become so slipshod in their methods of aerial insulation, since in this particular, as in so many others, reaction condones a multitude of sins.

To obtain a proper understanding of aerial insulation, it is essential to realise clearly what are the desirable features of an efficient insulator, and also to understand under what conditions these insulators will have to perform their work. A merely superficial examination of this latter question must inevitably reveal the fact that it would be difficult to secure a more severe and arduous test of an insulator than that provided by normal all-the-year-round use upon an aerial. Not merely is the insulator frequently wet but also it is almost always dirty, and frequently covered with a deposit of soot. In the air of industrial towns, moreover, insulators will frequently become coated with a thin film of various objectionable substances, all more or less conductive, such as dilute sulphuric acid from the fumes of blast furnaces.



a b c d e f

Fig. 1.—A group of insulators of different types.

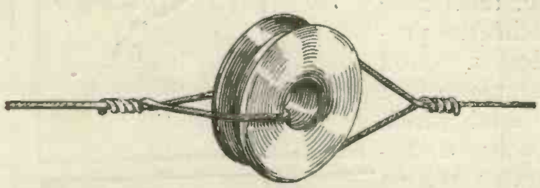
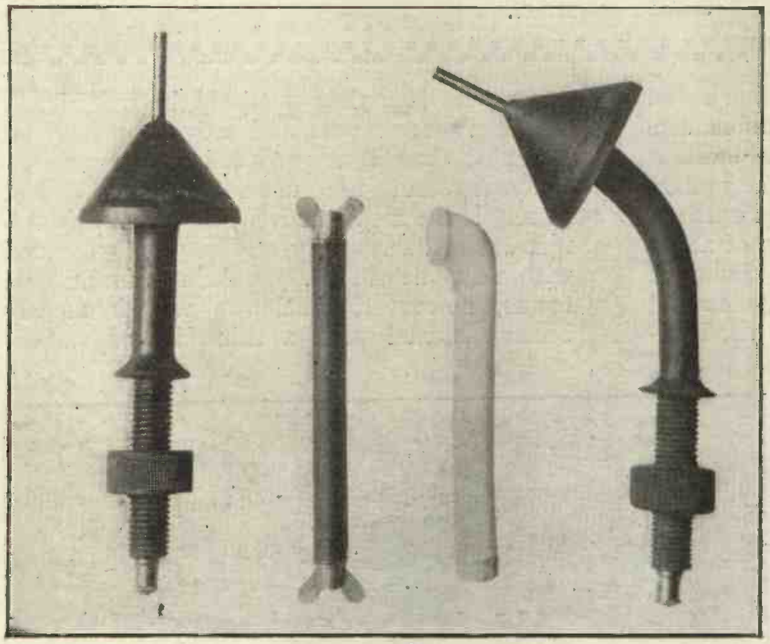


Fig. 2.—Method of putting wire on reel insulator.

We may now enumerate the necessary features of a good insulator. Firstly, it must have what is called a long leakage path, i.e., any current which leaks over its surface must have as long a distance as possible to travel between one end of the insulator and the other. Secondly, the material of which it is made must have high insulation resistance and must be such as to withstand the deteriorating influence of atmospheric conditions. Thirdly, it must be so designed as to maintain its insulating properties, even when wet. We are now in a position to consider the design of an insulator in rather more detail, which we will do under the following headings:—

1. Shape.
2. Material.
3. Size.

Shape.—The shape of a good insulator must be so designed as to give it, firstly, a long leakage path, and secondly, what is called all-weather insulation, that is, the power to maintain its insulating properties even during rain or snow. There are a great variety of methods of producing a long leakage path, mostly depending upon the use of a corrugated or otherwise broken up surface. A good example of the corrugated type is shown in Fig. 1 (*c*).



a b c d

Fig. 3.—A group of aerial leading-in insulators.

There is little to choose between the various methods of increasing the length of the leakage path, most of those adopted by manufacturers being satisfactory. The matter however, is very different when we come to consider the point of all-weather insulation, since in this particular the majority of otherwise satisfactory insulators fail lamentably. Take as an example the ordinary reel type insulator shown in Fig. 1 (*f*). This has quite a reasonably long leakage path, considering its size, and yet there is absolutely nothing to prevent its whole surface being wetted by rain. At first sight it would seem that a shower would cause such an insulator to become leaky. That such is not the case is due entirely to the choice of material employed in its construction, which is generally very highly glazed porcelain, upon whose surface rain does not easily form a continuous conducting film, but, on the contrary, separates into beads. Although not a particularly efficient type, very fair results can be obtained with such insulators by using a number of them joined together in series to form a chain and using these chains of insulators at each end of the aerial. One advantage of this type, from the mechanical point of view, is that should the insulator crack and break by the influence of frost or other agency, the aerial will not fall because the two wires (that is, the aerial wire and the wire round the insulator) are interlinked as shown in Fig. 2.

In producing an insulator having good all-weather efficiency, it is necessary to see that it possesses the non-hygroscopic surface referred to above, and that its shape is such as to maintain a considerable dry area at all times. This is generally done by providing it with some sort of shield or skirt to protect a part of it from rain. Some useful examples of insulators constructed on these lines are illustrated in Fig, 1 (*b*) and (*d*). Fig. 1 (*a*) is known as a barrel insulator and Fig. 1 (*e*) as a shell insulator.

Material. — The choice of material for the construction of aerial insulators depends upon a number of factors. It must, of course, be a substance having high insulating properties, it must be readily moulded or otherwise worked to the desired shape, and it must be capable of receiving a surface which shall be non-hygroscopic and impervious to deteriorating atmospheric influences. This last is most important, especially as regards resistance to atmospheric action. Insulators are sometimes made from ordinary ebonite, and these specimens provide a good example of a material which rapidly deteriorates when exposed to the weather. In the atmosphere of towns the surface of the ebonite rapidly

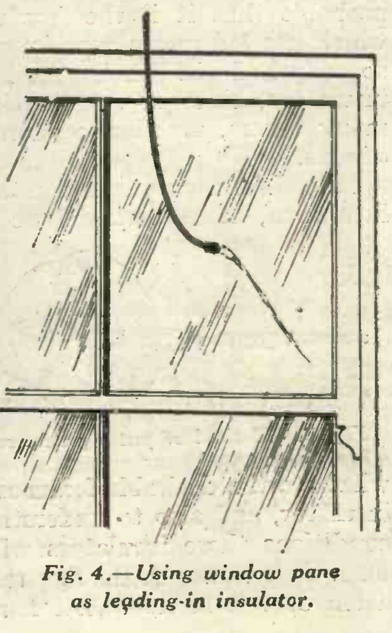


Fig. 4.—Using window pane as leading-in insulator.

corrodes and becomes covered with a thin film of sulphuric acid and other substances which, when rained upon, provide a continuous conductive film. Of the numerous materials which have been tried for the construction of aerial insulators, it is probable that porcelain is one of the best. It can be made into insulators of almost any shape, its insulating properties are good, and its surface is non-hygroscopic and impervious to atmospheric action.

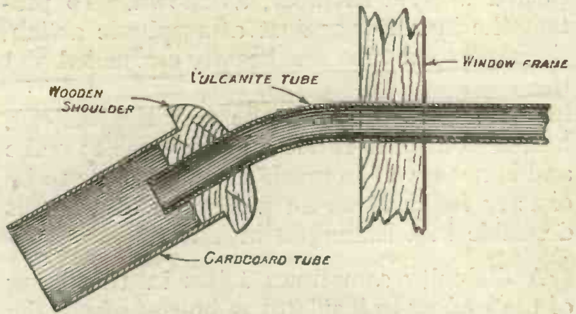


Fig. 5.—An efficient home-made lead-in tube.

Size.—The size of an insulator for aerial use is largely a matter of compromise between the opposing factors of high insulation and reasonable limits of weight. Naturally, the larger the insulator, the longer its leakage path, and hence the greater its effectiveness, but if it is made too large its weight will be such as to cause the aerial to sag, and in extreme cases to break. To obtain the maximum insulation with the minimum weight it is often advantageous to use a chain of insulators as explained above. A point worth noting in connection with such chains is this : their mechanical strength is, of course, only equal to that of their weakest link, but their electrical strength or resistance is always greater than that of their *strongest* link.

The Leading-in Insulator.—At no point upon the aerial is good insulation more important or more difficult to obtain than at the point at which the aerial enters the building. Of the great variety of leading-in insulators sold, very few indeed are really satisfactory from the point of view of all-weather insulation and resistance to atmospheric deterioration. Only a few of the insulators to be seen show any attempt to produce and maintain a permanently dry portion of the insulator during all weather conditions. One of the most effective types of leading-in insulators is one which is rarely seen nowadays, namely, the old-fashioned porcelain tube with a bend which turns the outer end downwards, so as to prevent rain from running in. The chief drawback of this type of insulator, of course, is the fact that it requires a rather large hole to be drilled in the window frame or wherever the wire is being brought into the building. A specimen of this type of insulator is illustrated in Fig. 3 (*c*), which shows an essential feature of all good leading-in tubes, namely, the bend in a downward direction which assists in preserving a dry zone during wet weather conditions. A more modern type of leading-in insulator possessing this desirable feature (and others) is shown in Fig. 3 (*d*). Fig, 3 (*a*) is another lead-in insulator of the type of *d*, and Fig. 3 (*b*) shows the most common form of lead-in tube.

Besides these professionally made leading-in insulators, there are, of course, a number of makeshift devices, some of which are quite good. For example, Fig. 4 shows a method which is used occasionally. In this the actual insulation is provided by one of the panes of the window, the aerial wire being taken through a small hole drilled in the centre. This method is not one to be generally recommended, simply because of the difficulty of drilling the necessary hole in the glass. This drilling can be accomplished with a certain amount of patience by means of a drill consisting of a short length of 3-16ths inch copper tubing which is kept supplied with turpentine and carborundum powder.

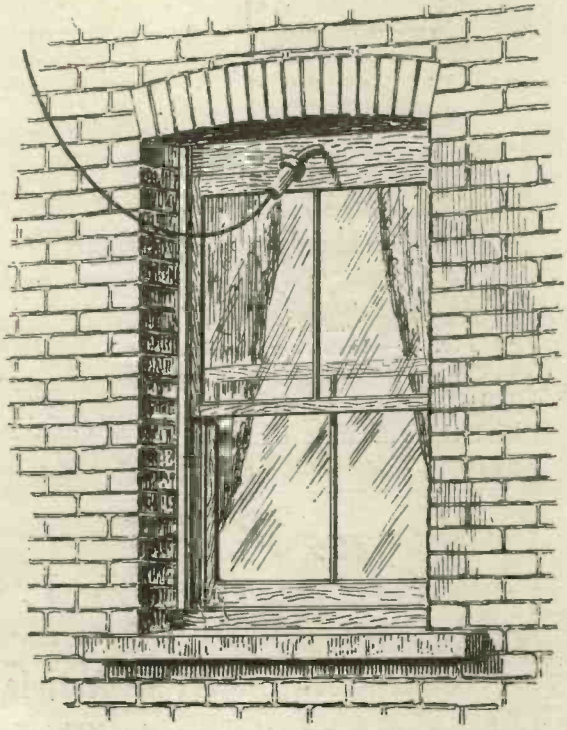


Fig. 6.—Useful method of fixing lead-in tube.

One of the best of home-made leading-in insulators is that employed upon his own aerial by the writer, who is somewhat fastidious in these matters. This insulator is shown in section in Fig. 5, and it consists essentially,

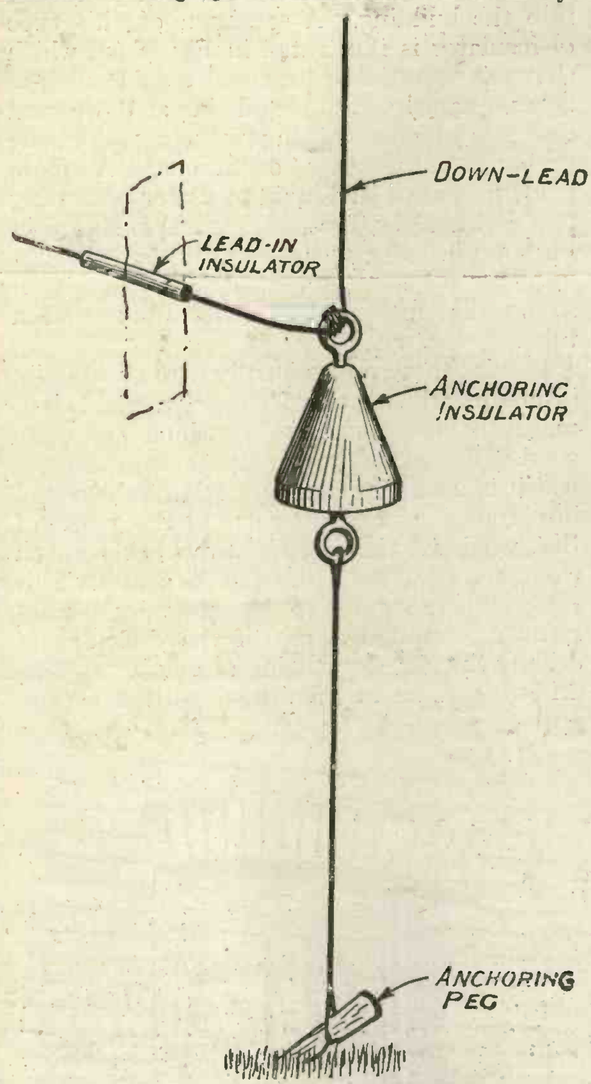


Fig. 7.—Anchoring the down-lead.

as will be seen, of a piece about 8 inches in length of the vulcanite barrel of an old bicycle pump. This piece of vulcanite tubing was softened by immersing in hot water and then given the necessary downward bend seen in the illustration. Upon the outer end of this tube a shielding skirt was fitted which consisted of a short section about 3 inches long of 2 inch diameter cardboard tube attached to the vulcanite insulating tube by means of a turned wooden shoulder, as shown. To protect the insulator against atmospheric action, the cardboard tube was heavily enamelled and the vulcanite was treated with bitumen. The insulator was found to be very satisfactory, but, of course, it is not an easy type to make and is not given so much as an example to be exactly followed as an indication of what is desirable in a leading-in insulator.

A difficulty sometimes arises in the fixing of the leading-in insulator in houses where the landlord objects to damage to his window-frames, etc., a good method of overcoming this difficulty is illustrated in Fig. 6, which shows how to take the leading-in insulator through the window without damage and yet without the necessity of leaving the window open. All that is necessary is to have a piece of board cut, say, 5 inches wide and of such a length as to fit exactly in the position shown in the window frame. A hole is bored in this piece of wood, into which the leading-in insulator is fitted, and it is then shut in the window frame above the sash in the position shown in the diagram.

A concluding point concerning the leading-in arrangements:—The scheme illustrated in Fig. 7 is often advantageous, in that it takes the strain of the down-lead off the leading-in insulator and puts it upon the special anchoring insulator. Other points to look after are that the anchoring insulators are not in a position where in strong winds they may blow against windows and break them.

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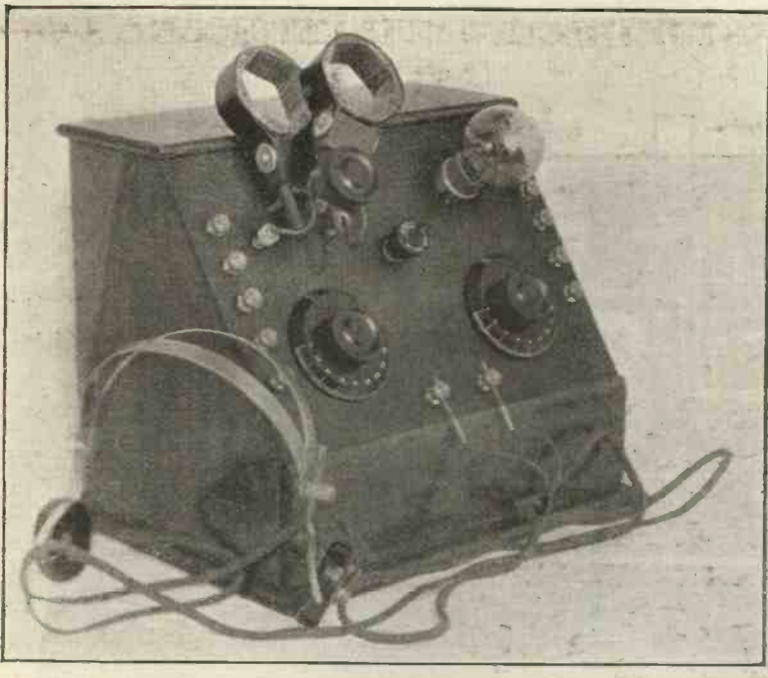

Fig. 1.—The completed receiver.

A Single Valve Receiver for all Wavelengths.

By

W. H. FULLER.

A single valve receiver which will tune to the wavelength of the proposed new broadcasting station.

MUCH interest has been aroused recently by the proposed erection of a high-power broadcasting station which will transmit upon a wavelength of 1,600 metres, and many readers have wondered what is the best way to alter their receivers in order that they may tune this station in. Those about to build a receiver will naturally desire to be able to hear this new station as well as the ones at present working, and in the present set provision for such tuning-range has been made. The receiver about to be described is of the single-valve type, the aerial circuit being tuned by a variometer, while provision is made for adding a loading-coil for the longer wavelengths and for reaction.

The finished receiver is seen in the photograph, Fig. 1, and is of a very simple design, presenting no difficulty from the constructional point of view to the veriest tyro. On the left of the set are the aerial circuit terminals, by means of which various arrangements are possible. The coil-holder is seen next these terminals, with the knob controlling the aerial variometer immediately below it. Provision is made for reversing the reaction coil, by means of Clix, joined to the coil-socket by rubber leads, which plug into Clix sockets upon the panel. The right-hand dial controls the variable condenser, which may be joined in circuit or omitted as desired. On the right of the panel are four terminals, which are, from top to bottom, H.T. +, H.T., L.T.+, and L.T. respectively, the telephones being joined to the two terminals in the front of the receiver.

Circuit Diagram

A diagram of the circuit arrangement is given in Fig. 2, a study of which will make the operation clear. C_1 is a fixed condenser of 0.0001 μF capacity, by means of which the minimum wavelength to which the circuit will tune may be lowered, when the aerial lead is joined to terminal A.

For the ordinary B.B.C. wavelengths, a small coil, say No. 25, is inserted in L_1 (the socket of the coil-holder which is nearest the panel), and reaction is obtained by coupling L_3 to this coil. The aerial is joined normally to A_1, but if it is found that the aerial circuit will not tune down to the wavelength of a particular station, the 0.01 μF condenser may be included in the circuit by moving the aerial lead to terminal A. For the longer wavelengths a larger coil is inserted in L_1, and the variable condenser C_2 may be connected across terminals A_1 and E, thus being in parallel with the coil L_1 and variometer L_2.

Series Tuning

The variable condenser C_2 may be used in series with the inductances, if desired, by joining the

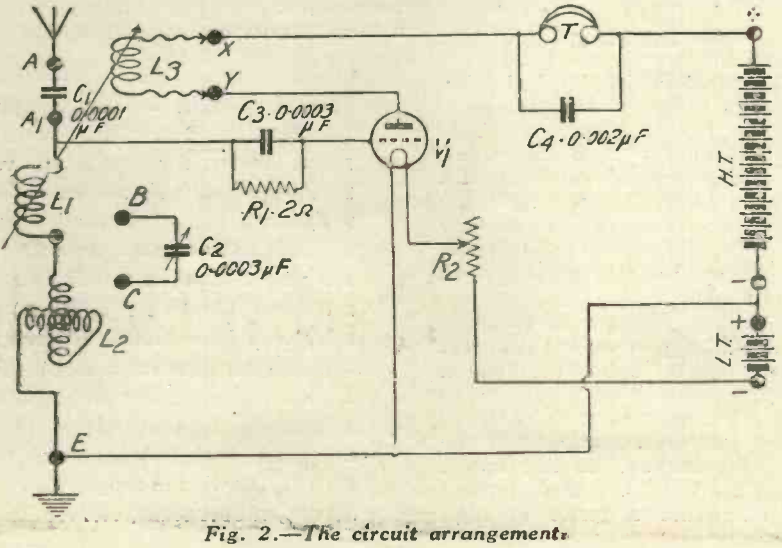

Fig. 2.—The circuit arrangement.

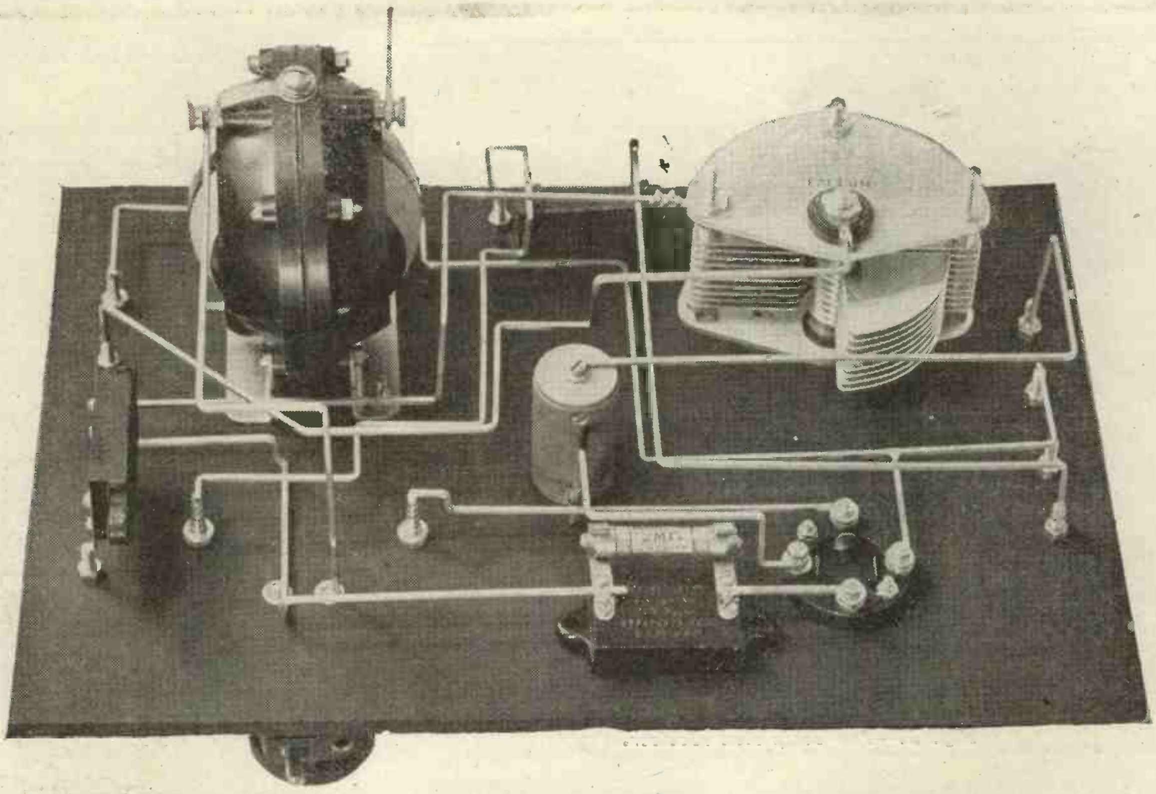

Fig. 3.—The wiring may be easily followed from this view of the back of the panel.

aerial lead to terminal C, earth to E, and joining B to A_1.

Reaction is obtained by coupling the coil L_3 to L_1.

Components

The components required for this receiver are listed below. It is not essential that the parts should be of the make specified, and the constructor may use such pieces of apparatus as he may already possess; but, if buying new parts, it is advisable to adhere as closely as possible to the specification given.

The Panel

The panel, which is of ebonite, measures 12 in. × 8 in. and may be either ¼ in. or 3/16 in. thick. Only the best quality should be used, but if unguaranteed ebonite with a glossy skin is used, this skin should be removed by rubbing with fine emery cloth, as otherwise the efficiency of the receiver will be impaired.

A drilling diagram is given in Fig. 4, which also shows the layout of the parts upon the panel. Sufficient dimensions are given to enable the necessary holes to be drilled, but when marking out the panel for drilling, do not use a pencil, as the lines thus formed will constitute a series of high resistance leaks all over the panel. Some sharp-pointed instrument should be used, and much time will be saved if a small cross is made against all the holes of the same size, these being drilled first, the next size holes being then drilled in turn. A drilling template is supplied with the valve-holders, of the type mentioned, and accurate drilling is thereby ensured.

Mounting the Parts

Having drilled all the necessary holes, the parts may be mounted up, taking care to tighten all nuts thoroughly. All points to which a wire has to be soldered should then be well tinned, as this will greatly facilitate wiring. Square wire is used for wiring up, and each piece should be bent to the correct shape to fit, before being soldered. A wiring diagram is given in Fig. 5, from which the layout of the wiring may be followed. Figs. 3 and 6 show the underside of the panel when completed, and will greatly assist the constructor in making the set.

The Cabinet

A dimensioned drawing of the cabinet is given in Fig. 7, and it will be seen that the sloping front type of box is employed. The work is carried out in ⅜in. finished

COMPONENTS.

Cabinet (Wright & Palmer, Type W_1)
Panel, 12 in. × 8 in. × ¼in. (Peter Curtis, Ltd.)
1 Variometer, for Broadcast wavelengths (Fallon Condenser Co).
1 0.0003μF variable condenser (Fallon Condenser Co.)
1 Two-coil holder (Goswell Eng. Co., Type V)
1 0.0001μF fixed condenser (Dubilier)
1 0.0003μF Condenser and 2 megohm leak (Dubilier)
1 0.002μF Condenser (Dubilier)
1 Valve-holder (H.T.C. Electrical Co., Type C)
1 Lissenstat filament resistance (Lissen Ltd.)
2 Clix, with insulator and locknut (Autoveyors)
2 Clix, with locknut only (Autoveyors)
11 4 B.A. Nickel-plated terminals (Grafton Electric Co.)
10ft. Square tinned copper wire
Screws, rubber leads, etc.

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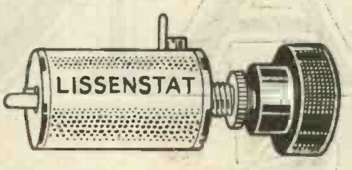

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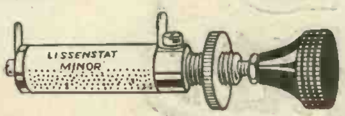

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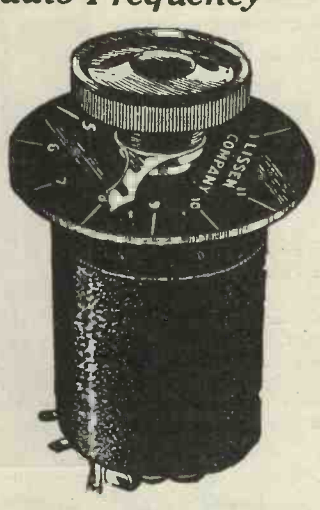

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Diagram with each shows the easy connections. **19/6**

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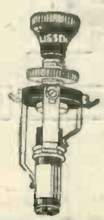

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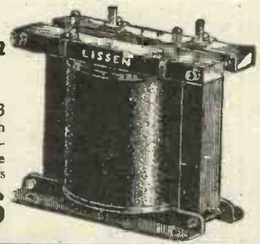

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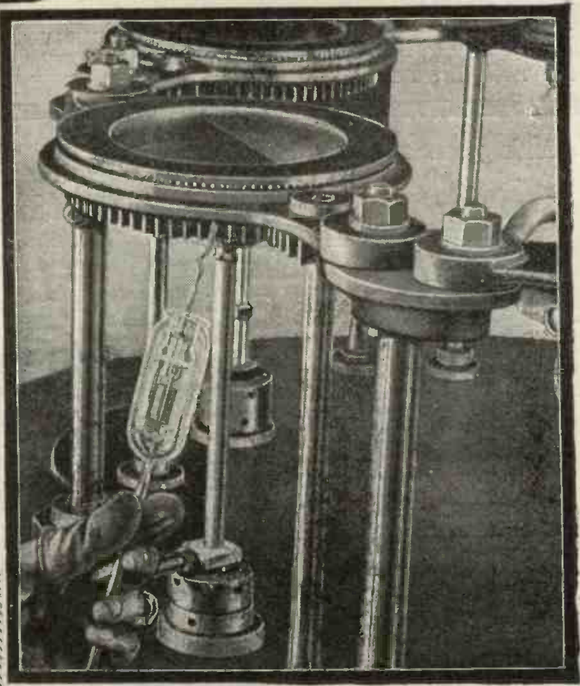

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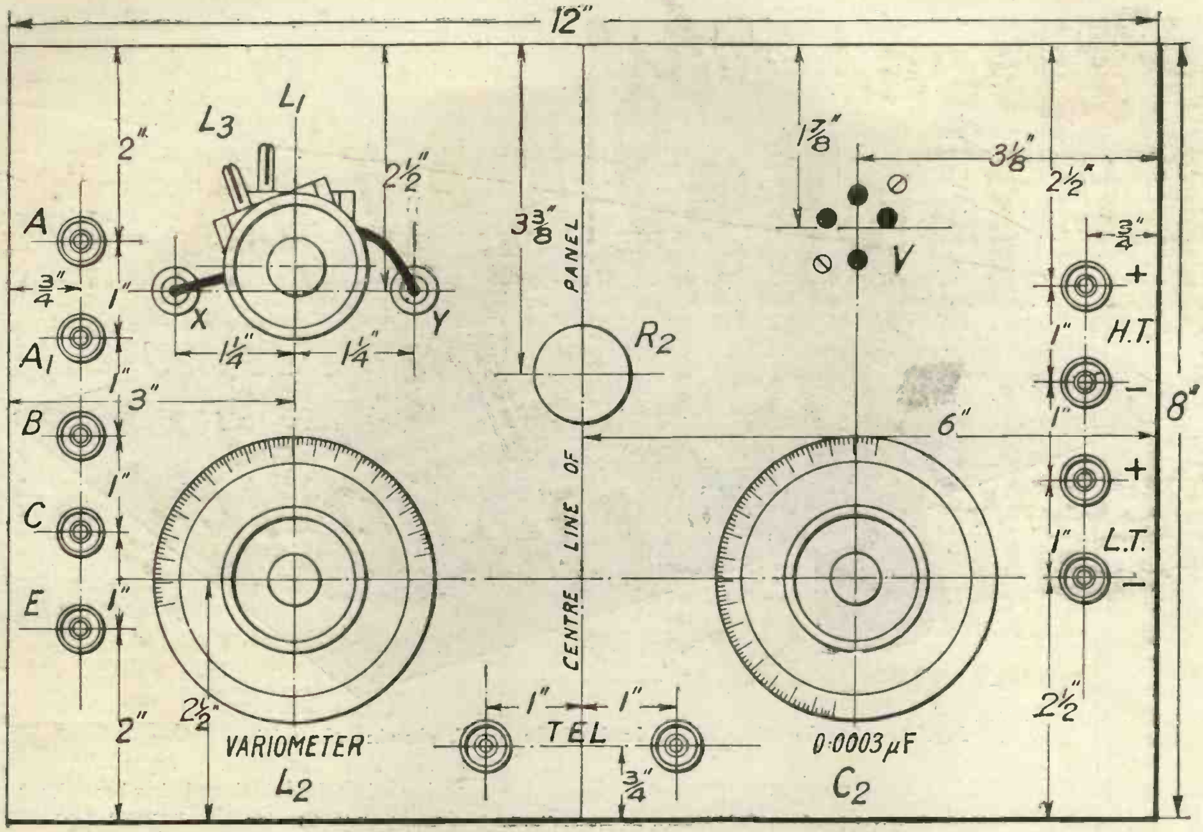

Fig. 4.—A half-size drawing of the top of the panel, showing the arrangement of the parts. Blueprint No. 53A.

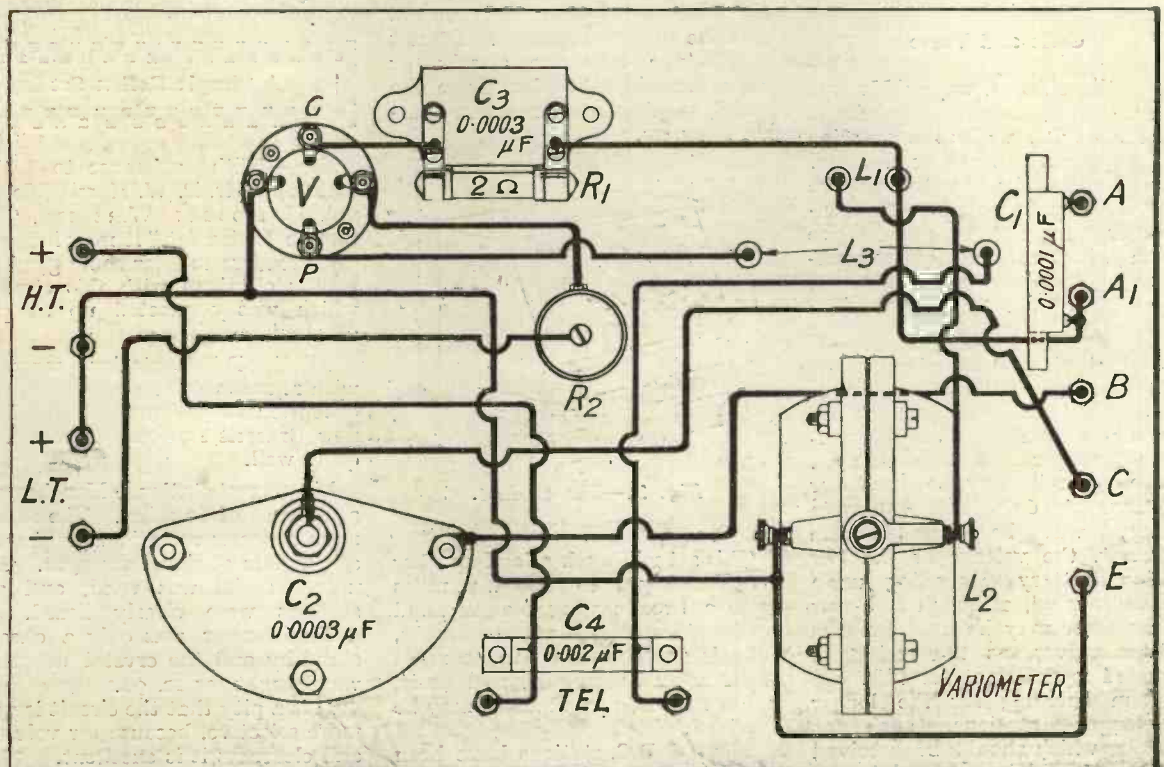

Fig. 5.—The wiring of the receiver. Blueprint No. 53B.

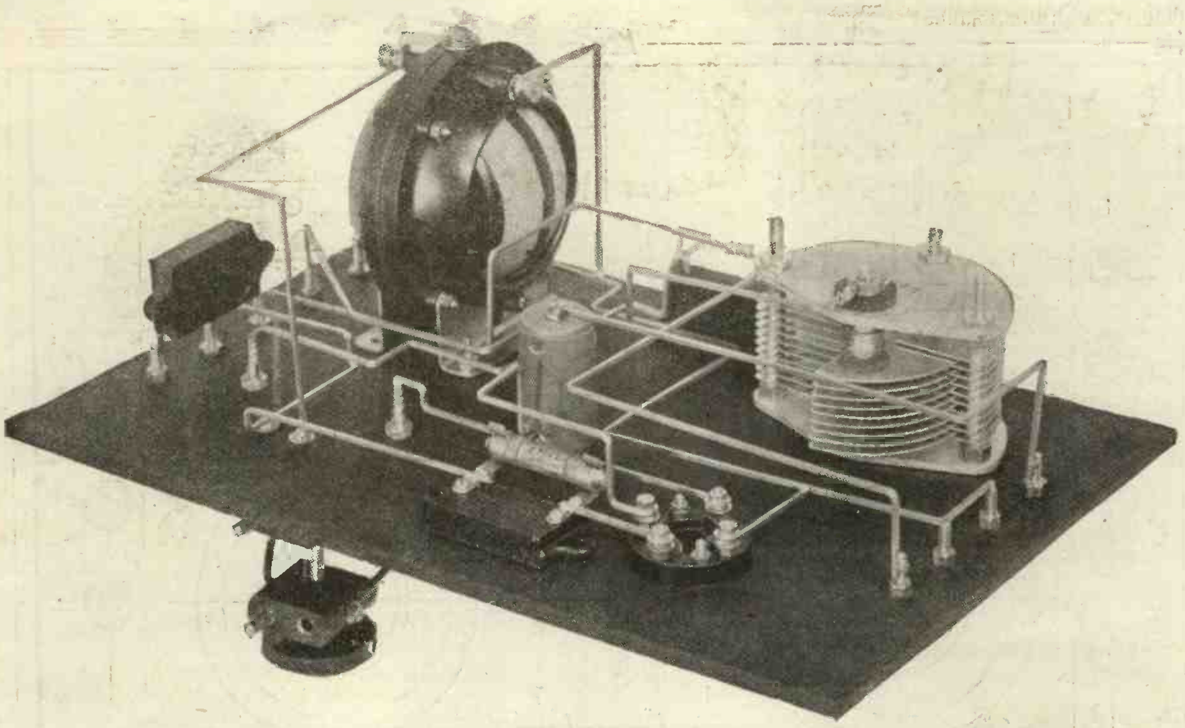

Fig. 6.—Another view of the back of the panel, showing the wiring.

mahogany, and should present no difficulty to the careful worker. If desired, the cabinet may be purchased ready made.

The panel is secured to the cabinet by four screws, two in each of the shorter sides.

Coils and Valve

For the 1,600m. wave a No. 150 coil will probably be required in the socket L_1, while the reaction coil may be a No. 200 or No. 250. Almost any make of valve may be used, and quite possibly the constructor may already possess one which will be found quite satisfactory.

Testing the Set

The set may be tested upon the transmission of the local broadcasting station by joining the aerial to A_1, earth to E, and inserting a No. 25 coil in the socket L_1. A No. 35 coil may be used for reaction. A 60-volt high-tension battery will be found quite sufficient, the voltage of the low tension battery depending upon the valve used, although a 6-volt accumulator may be used for dull emitter valves, as the resistance provided is sufficient for this.

When listening for the longer wavelength stations, such as Radiola, which should be received on a reasonably good aerial, the coils for the longer wavelengths must be used. Keep the reaction coil well away from L_1 until signals are heard, when the coupling may be slightly tightened, retuning on the variometer and condenser. If this does not result in an increase of signal strength, the leads to L_3 may be reversed and the process repeated. Do not couple the coils too closely, or radiation will take place from the aerial, causing interference to nearby listeners.

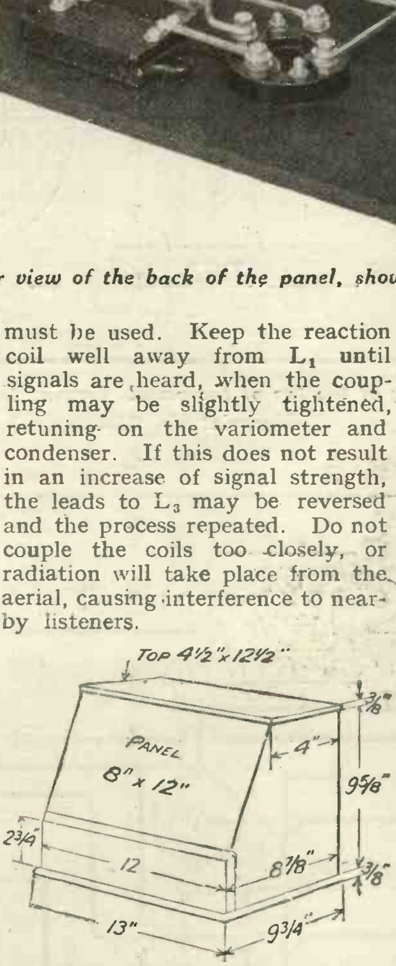

Fig. 7.—The cabinet.

Results

This set will work a loud-speaker quite well up to about 7 miles from a broadcasting station, and medinm results at 10 mlies. Signals on 'phones up to 50 miles are readily obtainable, and Paris, 2,600 metres, and Radiola may be received.

Three B.B.C. stations have been easily received in London, and probably further work would result in other stations being brought up. The set should receive the new 1,600 metre station very well throughout Great Britain.

In general, the results are above the average for a single valve straight circuit.

A Simple Reflex Set

Sir,—With reference to the article by Mr. P. W. Harris (No. 4, vol. II. Modern Wireless), "A Simple Reflex Set," it may interest your readers to hear some genuine results obtained with this circuit, which was connected up as per diagram.

All the B.B.C. stations come in with remarkable strength, with the exception of 5IT and 5WA. The new Brussels station also comes in quite well.

My nearest station is Manchester, a distance of 60 miles. The afternoon concerts come in with practically no loss of signal strength. An indoor aerial was tried, and all stations were clearly heard.

Transformer was only a cheap stand-by and the crystal detector was bought for 1s. 9d.

It is a pity that the circuit is not more selective, because for volume and clearness it is excellent.

I am, etc.,

"Experimenter."

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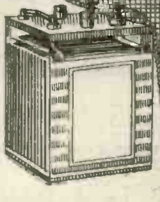

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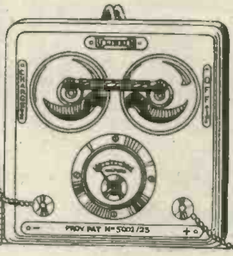

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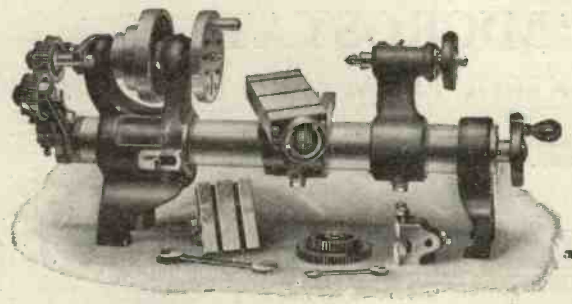

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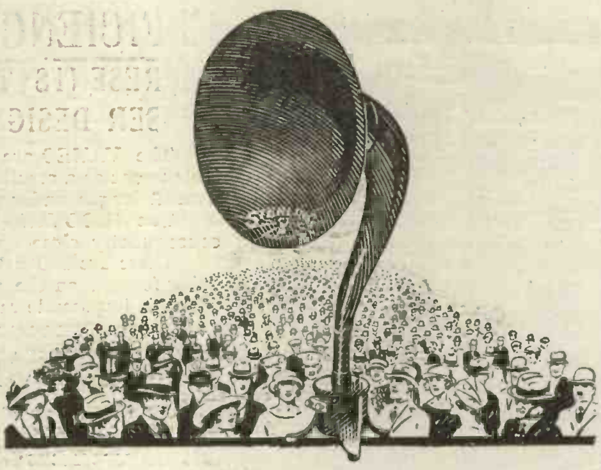

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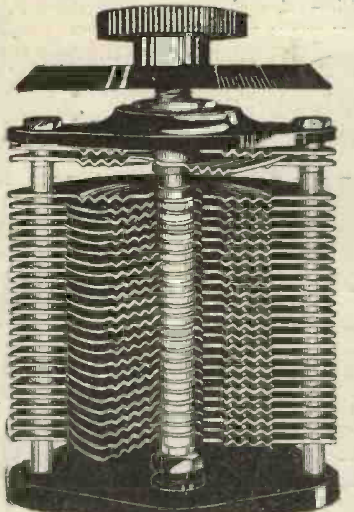

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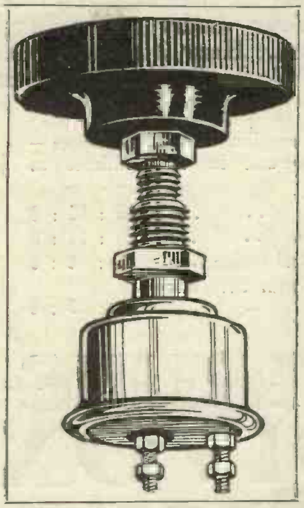

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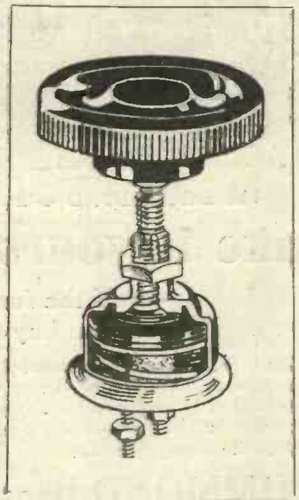

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SINGLE VALVE CIRCUITS

HOW TO GET THE BEST RESULTS WITH SIMPLE APPARATUS.

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

An article of great importance to every beginner.

THE single valve user is rather apt to be neglected, perhaps because few remain single valve users for more than three months. The desire to add another valve and open up perhaps four times as many circuits is so great that the new comer to the valve world soon deserts the ranks of the "one-valvers." The reason is probably that the only additional apparatus required is the valve itself, and, of course, a rheostat and holder. The same batteries, telephones, etc., all suffice, and although a low-frequency transformer is also usually added, yet there are a very large number of circuits in which two valves may be used without any intervalve transformer at all.

I propose to deal, at present, with single valve circuits, and these will be of interest, not only to the man with one valve, but also to those possessing two valves, because each and every circuit given in this article may be followed by a low-frequency amplifier valve to increase the signal strength. The method of doing this is explained later.

The Method

Probably the best way of dealing with the matter is to lay out the circuit, and to have a few notes under each one. A few general remarks, however, may be made which will guide the beginner as to which circuits he may use with confidence.

Fig. 1 is probably one of the best circuits for the absolute novice to try out. The valve now is used as a low-frequency amplifier or note amplifier, an intervalve transformer T_1 T_2 being used. The primary T_1 is connected in place of the telephones in the crystal receiver, and the secondary T_2 is connected in the grid circuit of the valve. The position of the rheostat and the telephones should be noted. Provided a good quality transformer is used, this circuit will give no trouble whatever. As regards the batteries to use, if bright emitters are to be employed, the best voltage to use is a 6-volt accumulator, and the capacity of the accumulator should not be less than 30 ampere hours (this is often the "lighting" capacity and is to be distinguished from what is called the "ignition" capacity, which is only one-half of the lighting capacity of an accumulator). A smaller capacity accumulator will, of course, work for a one-valve set, but as you are sure to be requiring more valves later, this size should do very well, although any reader who can afford it would do still better to buy an accumulator having a capacity of 50 or 60 ampere hours, or even higher. The telephone receivers should be of high resistance, *e.g.*, 2,000 ohms, or upwards. The valve may be any of the well-known makes now on the market; they are all very much alike. If a dull emitter valve is employed, a smaller accumulator may be used, and the size of the filament battery will depend upon the voltage of the valve. This varies from 1 volt to 5 volts, so that on the whole, for general purposes, it is probably best to stick to a 6-volt accumulator.

Another Good Circuit

The circuit given in Fig. 2 is probably the next best circuit to try out. The condenser C_1 is what I have termed the "constant aerial" tuning condenser. It has a capacity of 0.0001 μF (μF, of course, is the recognised symbol for microfarad, a unit of capacity). The object of this condenser in all the different circuits is to enable one to specify what coils to use for special purposes. For example, when such a condenser is used in the aerial circuit, and the inductance L is shunted by a variable condenser C_2 of 0.0005 μF capacity, it is possible to specify what particular coil will cover a given range of wavelengths independently of the particular aerial employed. This is a great convenience, and is not possible with ordinary tuning arrangements, because different aerials vary so much that, while one coil might be necessary on one aerial, a larger or smaller coil might be necessary on another to give a given station. The use of a constant aerial tuning condenser eliminates these differences, and it is possible to state that a No. 50 plug-in coil may be used to cover a wavelength range of about 300 to 500 metres on all aerials, although when the station to be received has a wavelength of over 420 metres it may be found that better signals are obtained by using a No. 75 plug-in coil, instead of a No. 50. These coils will give the ranges stated with a 0.0005 μF condenser in parallel on any aerial, and the data may be applied to any of the circuits, almost, given in this article. It may certainly be used in connection with any circuit using constant aerial tuning.

Use of Reaction

Fig. 3 shows the use of reaction, and this is a circuit which the beginner should feel quite at home with. He should try reversing the leads to the coil L_2, and avoid coupling the coil L_2 too closely to L_1, which would otherwise result in self-oscillation. Signal strength should, of course, increase as L_2 is brought closer to L_1, but the condenser C_2 should be varied. It is important for the beginner to remember that whenever he varies the reaction he should also retune. Merely increasing the reaction will very frequently result in no increase in signal strength, or even a decrease, unless retuning is carried out.

Capacity Coupling

Fig. 4 is also a reaction receiver, the reaction this time being obtained through what is known as "capacity coupling," the grid and anode forming a small condenser which serves to pass some of the amplified currents from the anode circuit back to the grid circuit. The variometer in the anode circuit should be of a large type suitable for this purpose. The circuit is in very common use in America, but I cannot recommend it very strongly for general use.

An H.F. Circuit

Fig. 5 is a very simple high-frequency amplifier circuit, which may be tried after, say, Fig. 3. In this case a tuned anode circuit L_2 C_3 is connected in the anode circuit of the valve, a crystal detector and telephones being connected across this circuit. The circuit L_2 C_3, of course, is tuned to the same

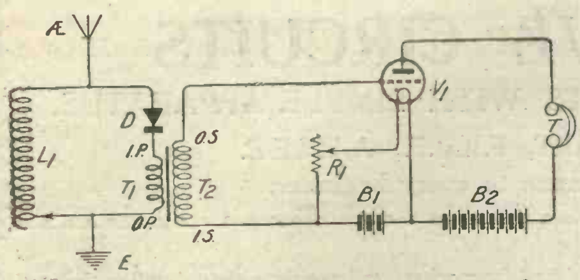

Fig. 1.—One of the best circuits for the absolute novice. The valve is used as a low-frequency amplifier.

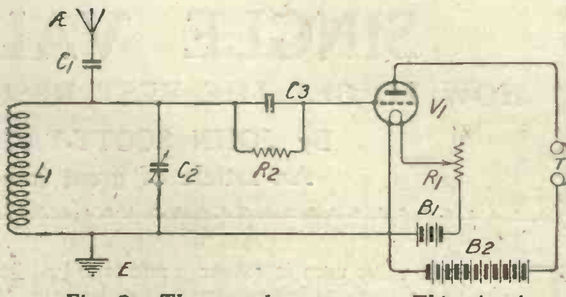

Fig. 2.—The next best to try. This circuit incorporates constant aerial tuning.

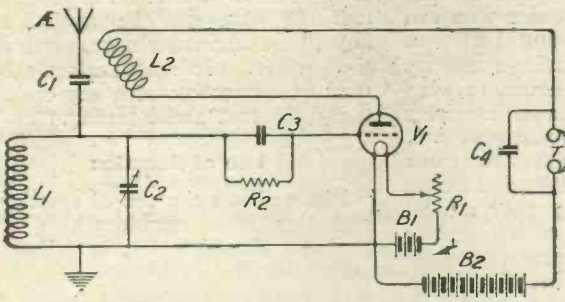

Fig. 3.—A circuit utilising reaction. It is very simple to use, but if not carefully handled will radiate badly.

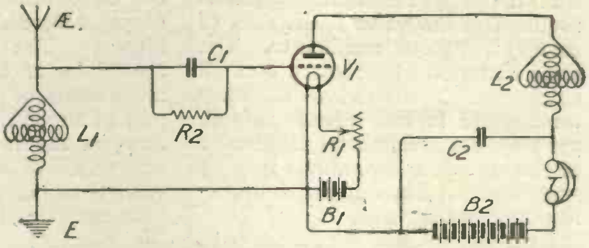

Fig. 4.—Another form of reaction receiver, this time using capacity coupling.

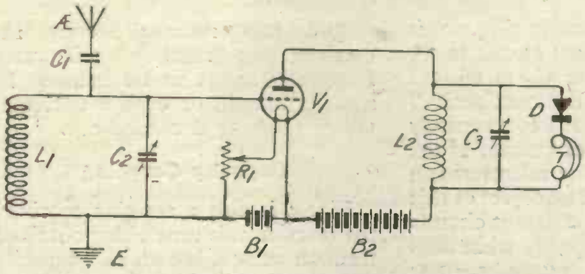

Fig. 5.—An extremely simple high-frequency amplifying circuit which will increase range of reception.

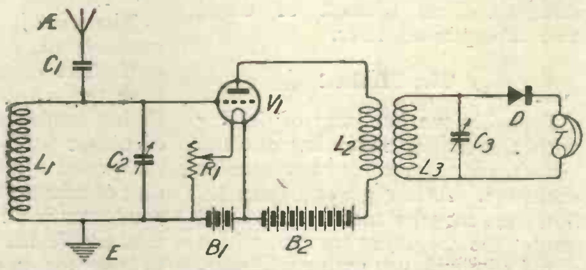

Fig. 6.—A modification of the Fig. 5 circuit, using a high-frequency transformer for the coupling.

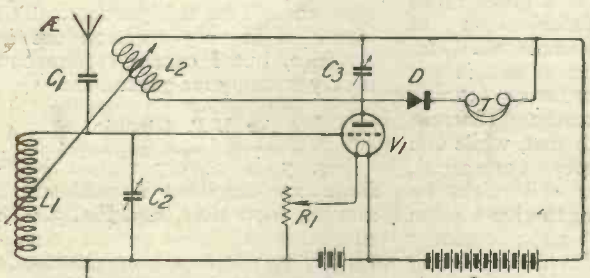

Fig. 7.—A high-frequency amplifying circuit, improved by the addition of reaction. This will increase the sensitiveness considerably.

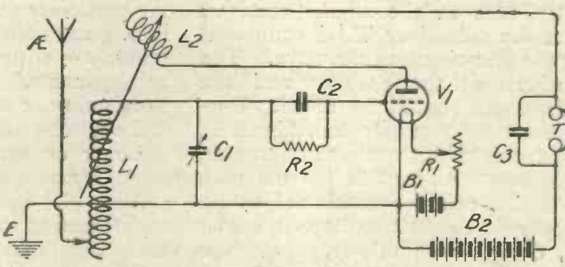

Fig. 8.—A reaction circuit which is very selective owing to the manner of coupling the aerial to the grid circuit.

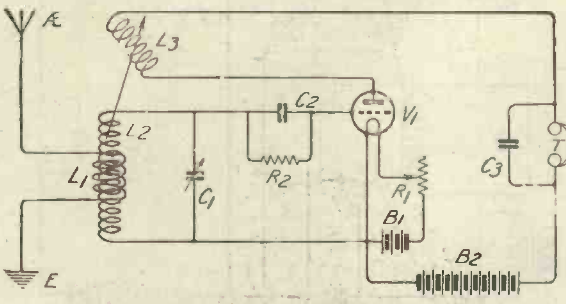

Fig. 9.—A modification of Fig. 8 circuit which is also very selective.

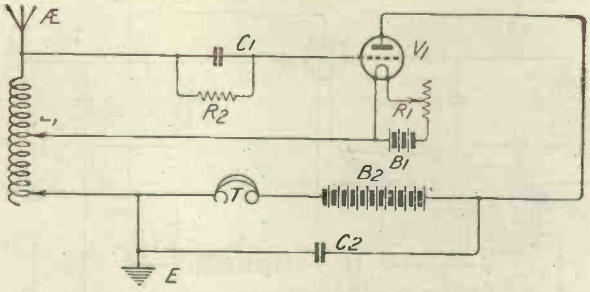

Fig. 10.—A peculiar but interesting reaction circuit which can be used with a slider coil.

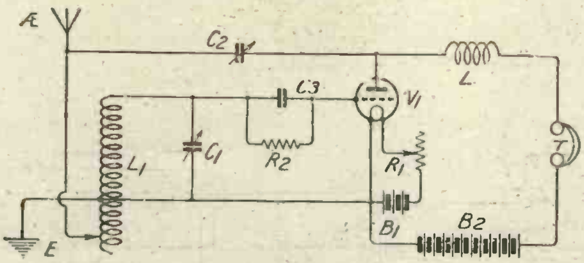

Fig. 11.—Capacity reaction with a circuit similar to that of Fig. 8.

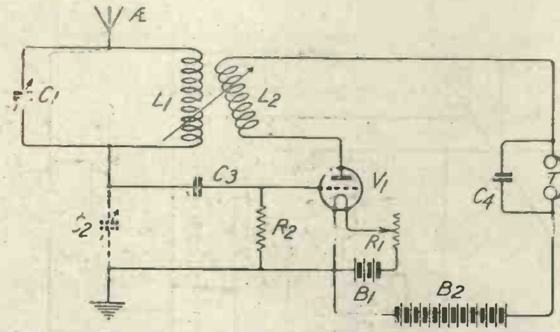

Fig. 12.—A very selective circuit of considerable experimental value.

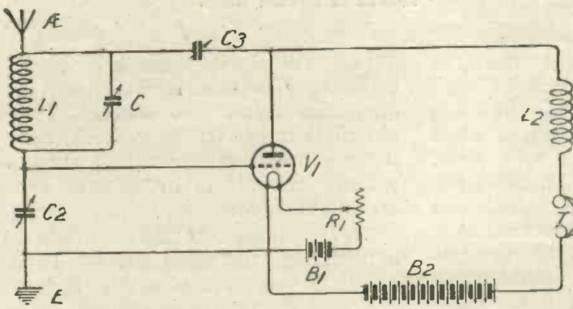

Fig. 13.—An interesting circuit similar to that of Fig. 12 but with capacity reaction.

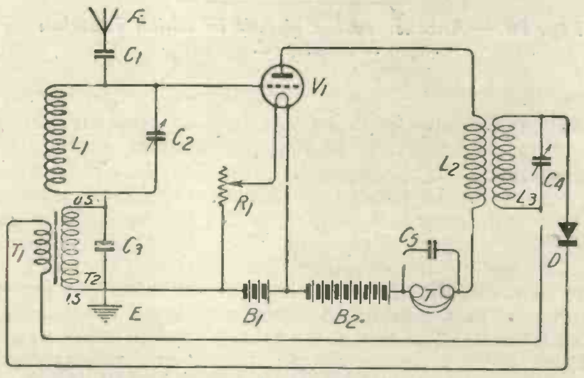

Fig. 14.—A very stable reflex circuit giving powerful signals.

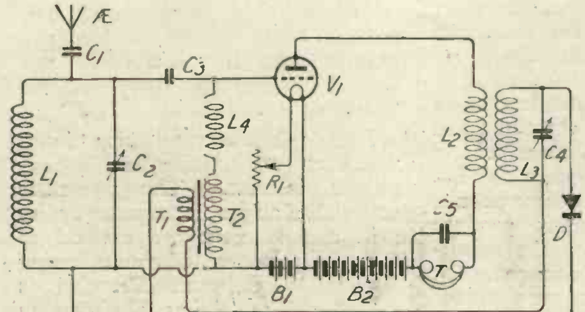

Fig. 15.—A modification of the Fig. 14 circuit, using a different method of feeding back the energy to the grid circuit.

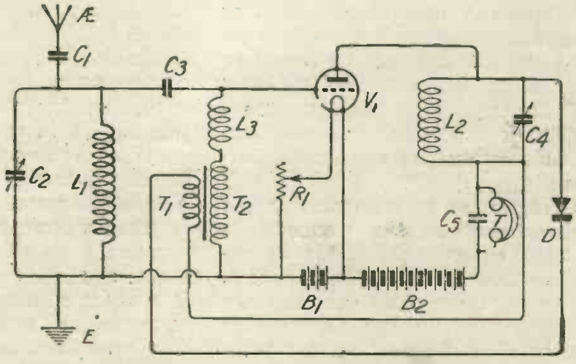

Fig. 16.—A similar circuit using a tuned anode coil in place of the high frequency transformer.

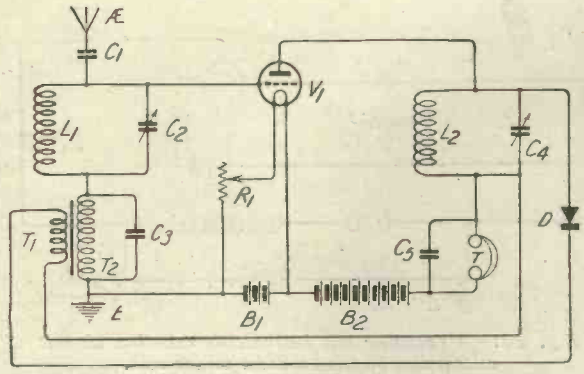

Fig. 17.—A reflex arrangement in which a transformer is included in the aerial circuit.

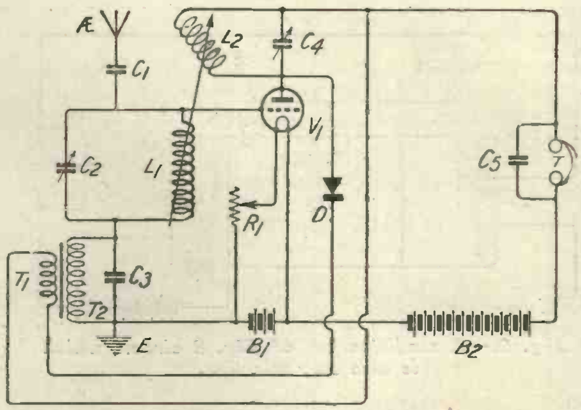

Fig. 18.— The previous circuit modified to give reaction effects.

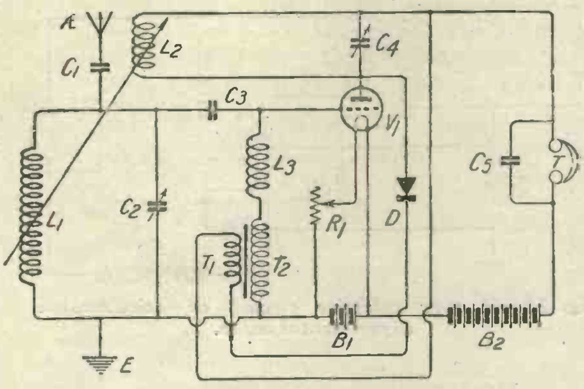

Fig. 19.—Another reflex circuit in which reaction is employed.

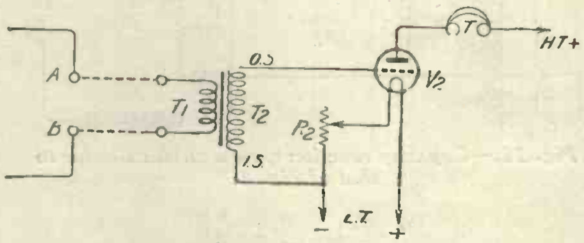

Fig. 20.— The method of adding low frequency valves is shown here.

wavelength as the incoming signals. Fig. 6 is a modification of Fig. 5, a transformer L_2 L_3 being used. The secondary L_3 is tuned by means of the condenser C_2, which will usually be of 0.0003 μF capacity. The high-frequency transformer L_2 L_3 may be made, but the most efficient types are best purchased from a reliable firm. The transformers are sold to cover a certain range; for example, the most useful for broadcasting would be one covering from 300 metres to about 650 or 600 metres, with a 0.0003 μF variable condenser.

While also using high-frequency amplification, the benefits of reaction may also be enjoyed by coupling the anode inductance to the grid coil, as shown in Fig. 7. Here again it is important to re-tune both variable condensers when an adjustment of reaction is made. It is also important to try reversing the reaction coil, because frequently a reaction effect is obtainable whichever way the anode coil is connected, the reason being due to the capacity coupling through the valve being greater than the inductive reverse reaction which may be taking place.

Fig. 8 is a very selective circuit, which, however, will not be found to give any better results than the circuit in Fig. 3. It will be seen that the inductance L_1 has the earth tapping taken where illustrated, while the aerial is connected to a point which may be variable on an extension of the coil L_1. The coil L_1 and its extension may all be wound on a single cardboard tube of, say, 3½ inches diameter, the number of turns overlapping beyond the earth connection being, say, 15. Tappings at 1, 5, 10 and 15 may be taken. The number of turns of inductance above the earth connection will vary according to the wavelength range, but about 70 turns will usually cover the B.B.C. stations, the condenser C_1 having a maximum capacity of 0.0005 μF.

Fig. 9 shows a modification of this circuit, in which the aerial coil consists of about 10 turns wound directly over the secondary coil L_2. The advantage of both these circuits is that different aerials produce practically no effect on the adjustments of the variable condenser C_1. The effect is, therefore, very similar to constant aerial tuning, except that plug-in coils cannot be used conveniently. I would not advise the absolute beginner to try these special circuits.

Fig. 10 shows another circuit which may be used with an inductance coil having two sliders. The circuit is rather tricky to work, but it is interesting because it shows another example of introducing reaction into a receiving circuit.

Fig. 11 shows still another method of obtaining the same effect. This circuit is very similar to Fig. 8, but this time reaction is introduced into the circuit L_1 C_1, not by magnetic coupling, but by capacity coupling provided by the variable condenser C_2. The size of this will vary with individual cases, but will usually be quite small, say, 0.0002 μF. The inductance L may be a No. 250 plug-in coil; this is a useful size for all choke coil purposes for broadcast reception.

Fig. 12 is a very selective circuit which is of considerable experimental interest. The potentials established across the capacity across grid and filament are applied to the grid, the valve, of course, acting also as a detector. Reaction is introduced into the aerial circuit by coupling L_2 to L_1. The condensers C_1 and C_2 may have a maximum value of 0.0005 μF. This is not a

(Continued on 167.)

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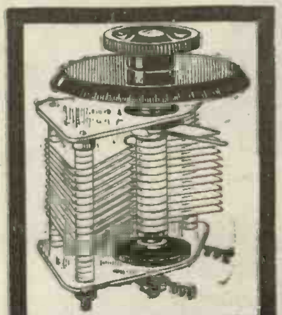

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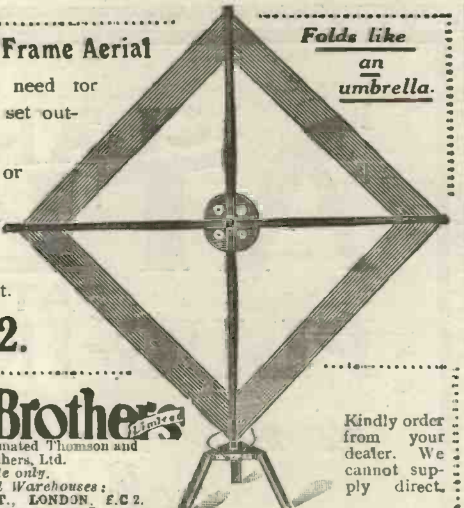

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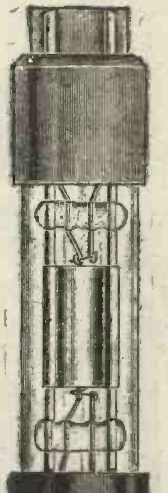

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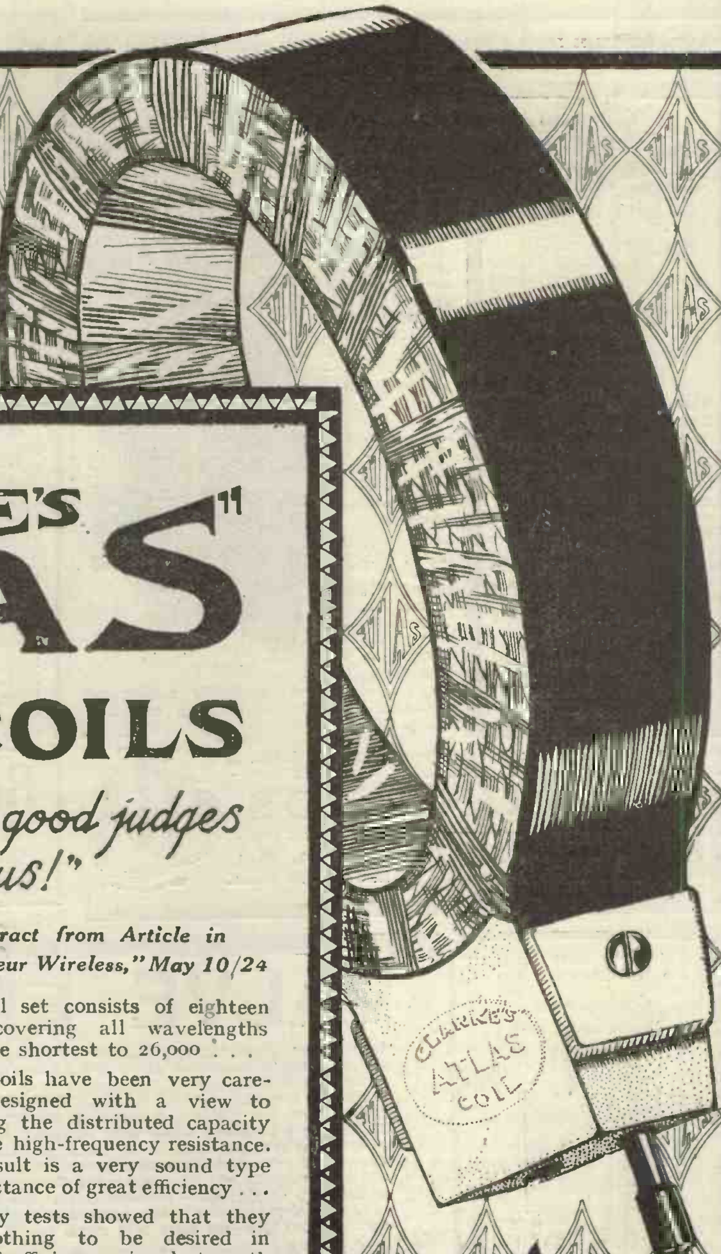

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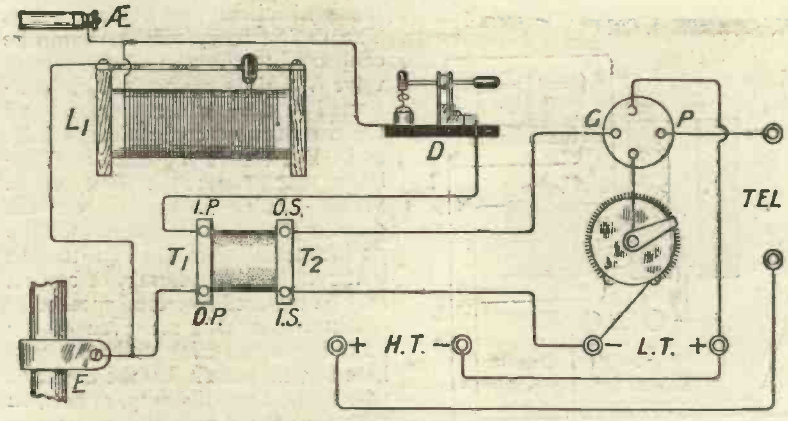


The Fig. 1 circuit in pictorial form.

(*Continued from* 164.)

standard circuit, but will be of interest to the experimentalist.

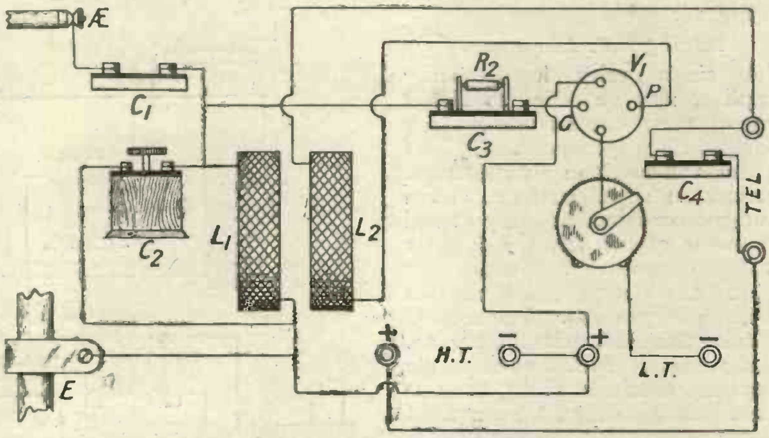
Fig. 13 is a somewhat similar sort of circuit, but this time reaction is introduced into the aerial circuit by means of a variable condenser C_3, a choke coil L_2 consisting of a No. 250 plug-in coil being employed.

Coming now to reflex circuits, the arrangement of Fig. 14 may be recommended for giving really stable results. This circuit is equivalent to one stage of high-frequency amplification, detection, and a stage of low-frequency amplification. The result is, therefore, equivalent to the use of a couple of valves and a crystal detector. No means of providing reaction in this circuit is given, and this is probably just as well in the case of beginners. In these reflex circuits it is usually desirable to connect the O.S. terminals of the step-up transformers so that the O.S. terminal is nearest the grid. The connections to the primary may be reversed to find out which way gives the best results. A fixed high-frequency transformer L_2 L_3 is used, and a condenser C_4 having a maximum capacity of 0.0003 μF is employed across L_3 for tuning purposes. It is important to see that the transformer L_2 L_3 is of suitable size to cover the wavelength range desired (see remarks above).

Fig. 15 shows a modification of the circuit in which a different method of feeding the low-frequency currents back into the grid circuit is shown. This time the secondary of the transformer T_2 is connected across grid and filament, a choke coil L_4 being connected in the position shown, this choke coil consisting of, say, a No. 250 coil. A fixed condenser C_3, having a capacity of 0.0003 μF, is connected where shown.

Fig. 16 is another arrangement using a single valve as a dual circuit, this time the anode circuit containing a tuned circuit L_2 C_4 tuned to the incoming wavelength. The magnified oscillations in this circuit are rectified by the crystal detector D, pass through the primary of T_1 and so introduced into the grid circuit of the valve *via* T_2. The choke coil L_3 is used as before.

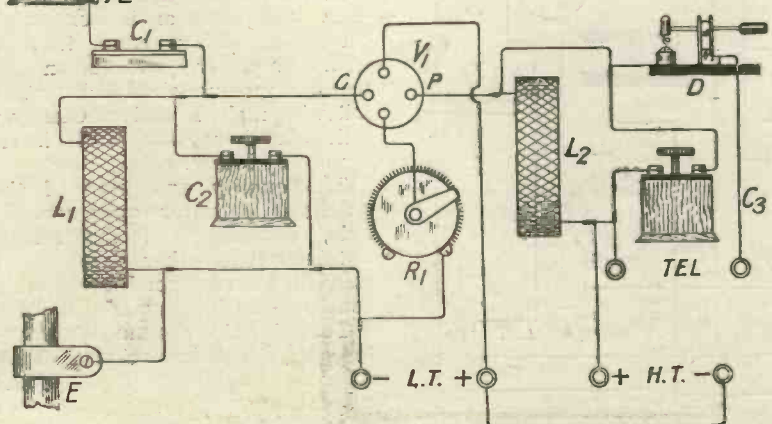
A simpler arrangement than this, using a tuned anode circuit, is illustrated in Fig. 17. The introduction of the iron core transformer into the aerial circuit was made by the writer and may be applied to all kinds of dual circuits. In all cases the telephones may be connected next to the anode of the valve, although this is not recommended. It may, however, be tried in certain cases, and has been known to improve results when a tendency to buzz was noticeable.



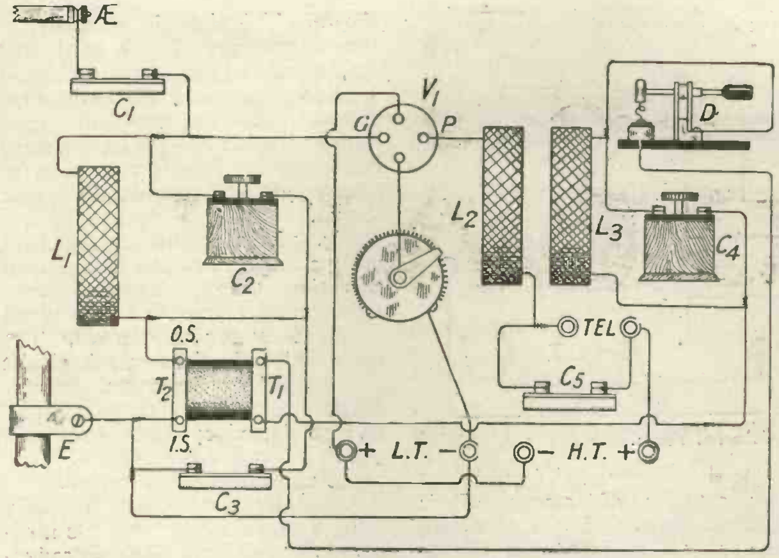
How to join up the Fig. 3 circuit.

Fig. 18 shows the Fig. 17 arrangement with the anode coil coupled back to the grid coil to produce a reaction effect. This circuit is a very good one, and resembles the first valve of the S.T.100 circuit. A 100,000 ohms resistance may be connected across the grid of the valve and the positive terminal of the accumulator if there is a tendency for a low-frequency buzz to be set up. There will always be a tendency for this whenever reaction is applied, so that care should be taken not to increase the reaction too much.

Fig. 19 shows another circuit in which a reflex reaction arrangement is employed. This time the method of feeding back the low-frequency



The Fig. 5 arrangement in graphic form



The Fig. 14 circuit works out quite simply.

the grid circuit of another valve. The O.S. terminal of T_2 should be connected to the grid of this second valve V_2. The rheostat R_2 is connected in the position shown, and the two filament connections,—L.T. and + L.T., go to the same accumulator that feeds the first valve. Where + H.T. is marked on the diagram, a lead is taken to the positive terminal of the high-tension battery. The telephones, of course, may be replaced by a loud speaker.

Pictorial circuits are given of the more important arrangements shown here for the benefit of the beginner who finds some difficulty, at first, in following the circuit diagrams.

The Four Valve Family Set.

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currents is similar to that illustrated in Fig. 16.

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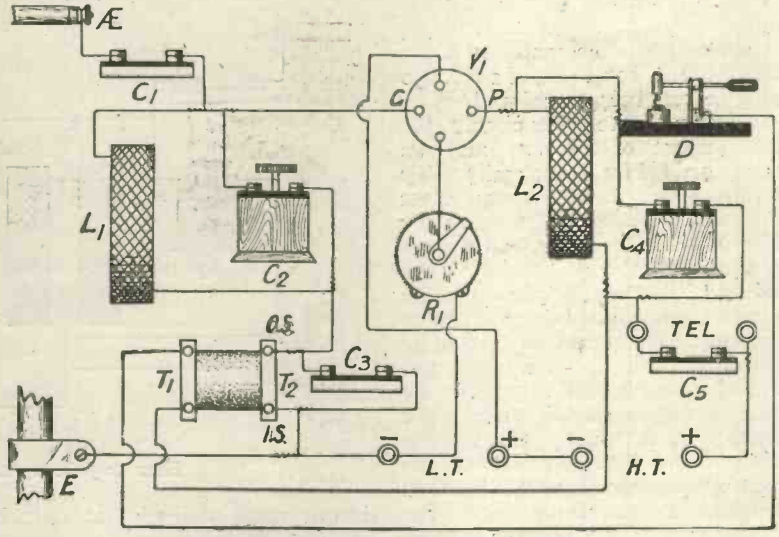
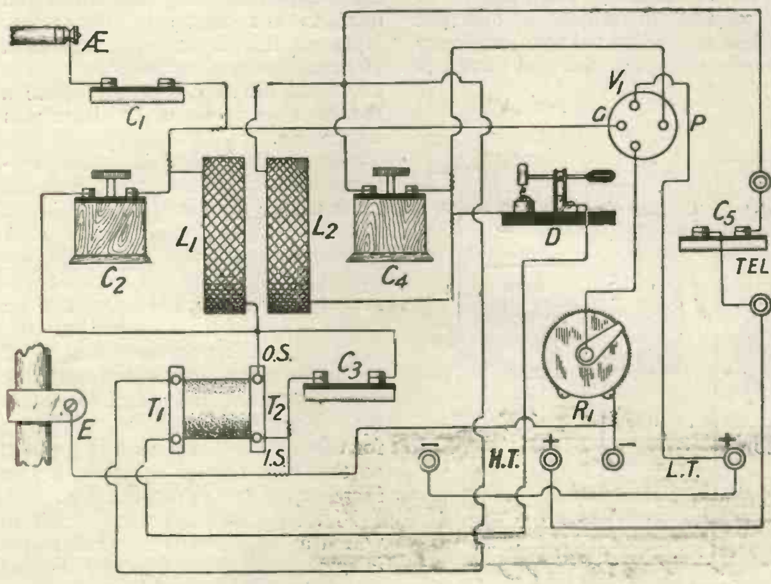


How to join up the Fig. 17 circuit.



The Fig. 18 circuit has proved a favourite with many.

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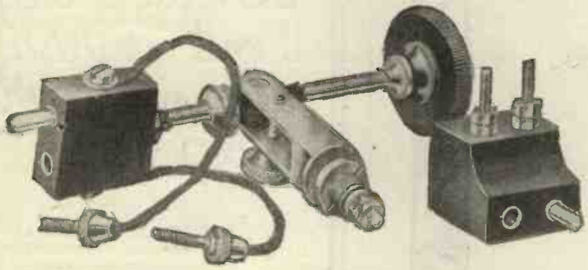

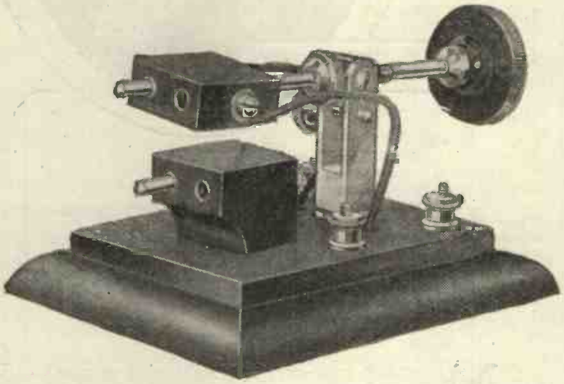

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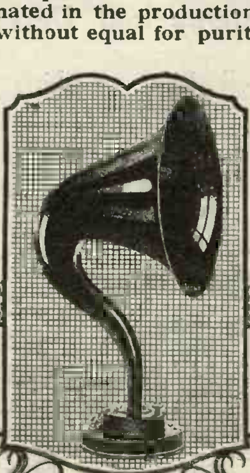

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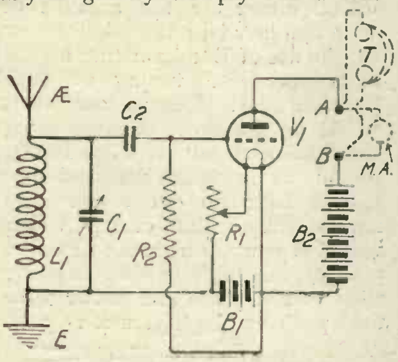


Fig. 1.—An interesting test.

therefore likely to be unstable unless most carefully handled to anyone who does not know a good deal about the little ways of valves, who is unable to recognise oscillation when it occurs or to check it when he does recognise it, and who is incapable of building a set in such a way as to minimise the effects of unwanted capacities. To such a person one would suggest some kind of aperiodic or semi-aperiodic coupling such as the resistance wound transformer or the anode coil made of very fine wire and therefore containing a resistance sufficient to flatten the tuning to some extent. Again, what is meant by the words "all round"? If they are used rather loosely and are intended to cover no more than the reception of broadcast telephony on wavelengths lying between 300 and 500 metres then the problem is fairly simple. But if by all round is meant a coupling which will give good results on all wavelengths from, say, 80 metres to 23,450 (these are about the shortest and the longest in general use), and if it is intended to cover the reception of spark and C.W. signals as well as telephony, then matters become a little more complicated.

The Purpose of the Coupling

It may be as well in the first place to see what purpose the coupling serves in the circuit whatever form it may take. If we make up a circuit like that shown in Fig. 1, connecting first of all the telephones to the terminals A and B and tuning in a very strong signal, and afterwards removing the telephones and substituting a milliammeter, we shall find, as might be expected, that the voltage changes upon the grid of the valve produce variations in the anode current which will be registered by the milliammeter. The valve in this case is rectifying, and if it is used by itself in a single valve receiver current changes are precisely what we need, since the telephones are current operated instruments. But suppose that we remove the grid-leak and condenser. The valve now becomes a high frequency amplifier whose output still takes the form of current fluctuations. If we are to add a further high frequency valve or rectifier we must find some means of converting current changes in the anode circuit of the first valve into voltage fluctuations, for unlike the telephones the valve is a potential operated device. A glance at the grid volts—anode current curve of any valve will show in a moment that the greater the voltage variations impressed upon its grid the greater will be the fluctuations in its output circuit. Hence the ideal coupling will be one capable of converting the current changes in the plate circuit of the first valve into the largest possible voltage changes for application to the grid of the second. The coupling between valves, of whatever kind it is, has also a second duty to carry out: it must insulate the grid of the second valve from the high tension currents which are flowing in the plate circuit of that which precedes it.

The Transformer

The most obvious form of coupling to fulfil both these purposes is what in wireless we call the transformer, though that name is probably in reality quite a misnomer. The transformer proper is used for hundreds of purposes in electrical engineering. Its principle is shown diagrammatically in Fig. 2. Here we have an alternator connected to a primary coil consisting of a given number of turns. If a step-up in voltage

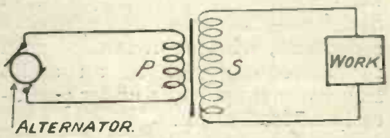


Fig. 2.—Principle of the transformer

is required there will be a larger number of turns in the secondary, the voltage step-up corresponding very nearly to the turn ratio between primary and secondary. A step down is obtained in a similar way by having more turns in the primary than in the secondary. We can apply the output of the secondary to work by connecting it to the terminals of a motor or other piece of apparatus. When this is done the transformer is under load. Now you cannot increase the voltage in the secondary without at the same time decreasing the amount of current. Let us take the case of a transformer with 10,000 turns in the primary and 40,000 in the secondary with a very high efficiency. The transformer as a matter of fact is perhaps one of the most efficient pieces of apparatus that man has produced, the losses in it being extremely small; the efficiency figure for a large apparatus may approach 98 per cent. If it were 100 per cent. in the transformer which we are considering then an input voltage of 100 would be stepped up to 400 in the secondary. But at the same time, if the apparatus worked by the secondary circuit were drawing 1 ampere of current, the primary load would be 4 amperes. To put it in another way, a 4 ampere current at 100 volts in the primary will give an output of 1 ampere at 400 volts. The action of the transformer depends upon the load of the secondary. Now the great difference between the commercial transformer and that used in the wireless set—a difference which has not been realised by the majority of designers—is that the latter's secondary, whether it is used as a radio frequency or as an audio frequency coupling, is under practically no load at all.

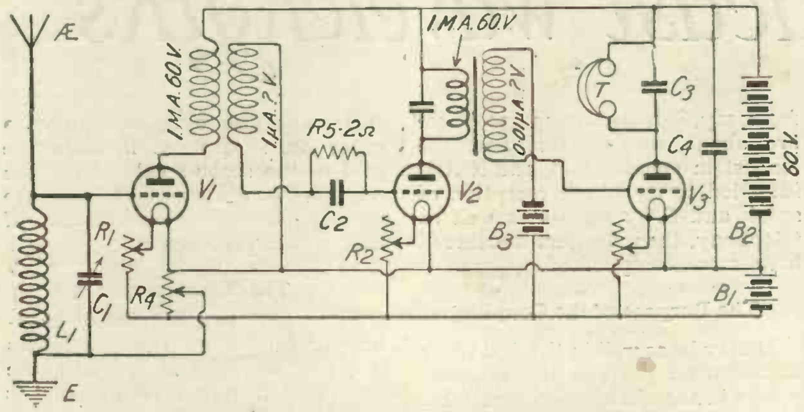


Fig. 3.—Currents in an average three-valve set.

Primary and Secondary Loads

Fig. 3 shows the steady voltages and currents in the primary and secondary circuits of an average three valve set consisting of one HF, a rectifier and a note magnifying stage, transformers being used for both high and low frequency couplings. In the primary of the high frequency transformers we have a normal current of about 1 milliampere at 60 volts given by the high tension battery. In the secondary of the same transformer the greatest possible flow of current will seldom exceed 1 microampere. At zero grid volts the grid current of the average hard valve under test conditions is seldom more than .75 microampere, and though V_2 has its gridleak connected to the positive side of the low tension battery, the extra resistance introduced is two megohms. One microampere may therefore be taken as about the average figure. The voltage of this circuit we do not yet know, but it is certainly not a big one. In the low frequency transformer the application of a very high plate voltage to V_3 in combination with a negative potential on the grid cuts down the flow of grid current to something very small indeed, in fact the figure of .01 microampere given in the diagram is excessively large for a well adjusted note magnifier, and in many circuits the current flowing is for all practical purposes nil. A practical proof of this may be obtained by connecting OS to the grid and leaving IS disconnected. The set will in many cases function almost as well as if the connection between IS and LT negative were there. Thus we see that the secondary of any type of wireless transformer is virtually under no load. From this it follows that the theories of voltage step-up have little or no application to the problem.

Do Transformers Transform ?

This is a controversial point. My own opinion is that they do not. I hold that the primary of the transformer serves to allow the plate circuit of the valve to which it is connected to be tuned—we shall see in a moment what follows from this—and that impulses are transferred from primary to secondary mainly by capacity. If this is so the ideal turn ratio in either a high or low frequency transformer would be 1 to 1, and actual tests show that little or nothing is gained as regards volume by having more turns in the secondary than in the primary, and that the 1 to 1 transformer gives purer reception with less likelihood of distortion. In wireless as in so many other branches of science we suffer greatly from "accepted facts," which are not facts at all. A statement is made by some early writer who is regarded as an authority, and those who deal subsequently with the subject do not bother to question the accuracy of his views. The thing becomes in time a superstition, and superstitions once formed die hard. Others which are of the same class as the turn ratio myth are the idea that the stranded aerial is more efficient than one of plain wire (actually the only marked advantage of the former lies in its greater strength), that high resistance telephones must be used with a crystal (try for yourself the effect of using low resistance receivers on a fairly powerful signal) and that a telephone condenser is essential.

What the Primary does

In the primary we have a circuit containing both inductance and capacity, for even if no shunted condenser fixed or variable is used the self capacity of the windings is always present. A circuit of this kind may be tuned either sharply or broadly. If its resistance is small the tuning will be sharp, but if a resistance is introduced either by the amount of wire employed in the windings or by the use of Eureka metal instead of copper the tuning at once becomes flat. Let us see what would be the effect of introducing the tunable circuit L_2 C_2 in Fig. 4. So long as no signals are coming in it will have no effect upon the normal steady plate current which will flow as usual from the negative pole of the high tension battery, then to the plate and so back to the positive high tension pole.

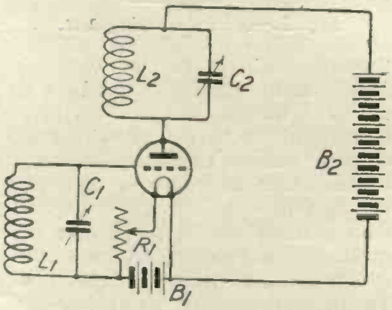


Fig. 4.—The effect of introducing a tuned circuit.

But when we tune both L_1 C_1 and L_2 C_2 to an incoming frequency then a very different state of affairs occurs. By tuning L_2 C_2 we mean that we have so adjusted both coil and condenser that the impedance of the circuit is now infinite to oscillations of a given frequency. In place of a steady plate current we have now variations in the anode circuit at radio frequency. And what is the effect upon them of a high or infinite impedance ? It prevents the

current passing through L2 from changing. If the circuit contains so little resistance that we can obtain really fine tuning then the current changes will be nil; but if there is resistance, and so broad tuning, then fluctuations will occur though they will be slight. The result then of employing a tuned circuit such as L_2 C_2 is to suppress the current changes which would otherwise take place owing to the voltage fluctuations upon the grid of the valve. A positive impulse reaches the grid; the anode current tries to rise but is prevented from doing so. We can see just what takes place by reference to the three curves shown in Fig. 5. These are actually the curves of a power valve, but they will serve very well for the purpose. With the grid at zero the current passing is 6 milliamperes at a plate voltage of about 80. A positive half cycle with a value of 3.8 volts tries to raise the plate current to something over 9 milliamperes, but is prevented from doing so by the choking effect of the tuned circuit L_2 C_2, across the inductance of which occurs a fall in voltage sufficient to keep the current down to 6 milliamperes. A glance at the curve will show that the plate voltage falls to about 60. The next half cycle on the grid has a negative value of the same amount and would normally lower the output to 3 milliamperes. Again, the current is kept steady, but this time by a rise in voltage to about 100. We may therefore say that the plate voltage of the valve works along the line XY when signals are coming in. The anode current remains unaltered, but voltage fluctuations take place across the inductance L_2. Actually voltages of such magnitude would not occur in high frequency amplification, but the principle remains the same. We can transfer the voltage fluctuations across L_2 to the grid of the following valve by either of the methods shown in Figs. 6 and 7. In the first the transfer takes place, I believe, by capacity from the primary to the secondary windings of the transformer. It does not in the least matter whether the primary or the secondary is tuned, for owing to the very close coupling between the two a variable condenser in shunt with the secondary will tune the primary. In the second the transfer takes place by means of the grid condenser, which is charged up by the varying voltages in the anode circuit. A gridleak is necessary whether V_2 is used as a rectifier or as a second amplifier, for otherwise the grid will be insulated and we shall be unable to adjust its potential to the correct working point.

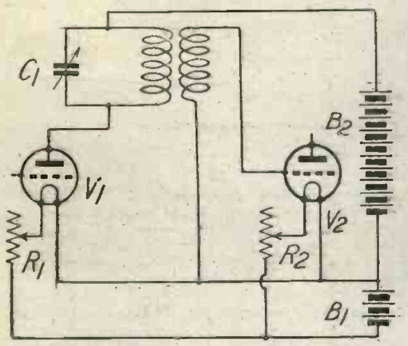


Fig. 6.—Transfer of voltage variations by transformer.

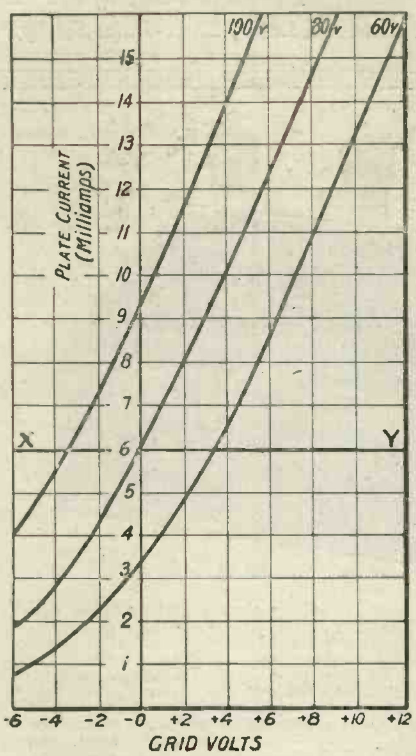


Fig. 5.—Three curves of a power valve.

Aperiodic Windings

It is possible to wind either the anode inductance or the primary of a transformer so that they become aperiodic and respond almost equally well to all frequencies covering a large wavelength band. When this is done the impedance offered by the tuned circuit formed by the coil itself and of the self capacity of its windings will not be infinite to any frequency, but it will be of a fairly high order to all frequencies for some distance on either side of the optimum wavelength for which the windings are made. It is obvious that since the impedance offered is much less than in the case of a sharply tuned circuit there will be less suppression of current variations and therefore smaller voltage changes across the windings. For this reason aperiodic forms of coupling do not give the same amplification per stage as those which are capable of being finely tuned. Either coils or transformers of this kind can be made by using resistance wire of No. 36 to No. 40 s.w.g. The finer the wire used the higher will be the resistance and the wider will be the band of frequencies to which the windings will respond well. Though there is no definite line of demarcation between aperiodic and semi-aperiodic coils we may take it that one which for broadcast purposes is almost equally efficient over the whole band is aperiodic, and that one which covers, say, 50 metres on either side of a given point is semi-aperiodic. The semi-aperiodic coil with tappings is becoming very popular just now for broadcast reception, and as the resistance is not very high it is possible to tune it to some extent by placing a very small condenser in shunt. Tapped coils of this kind are known as anode reactances. The main disadvantage of using any form of resistance wound coil is, as has been said, that there is a loss in the degree of amplification obtained per stage. The selectivity of the set also suffers, for as the anode coil or the primary of the transformer offers a large impedance to a large number of frequencies it is not possible with this kind of coupling to tune out signals which lie fairly close on one side or the other of the wavelength which it is desired to receive. At the same time such windings have one very great advantage indeed, and this is that they are much more stable than any form of sharply tuned high frequency coupling.

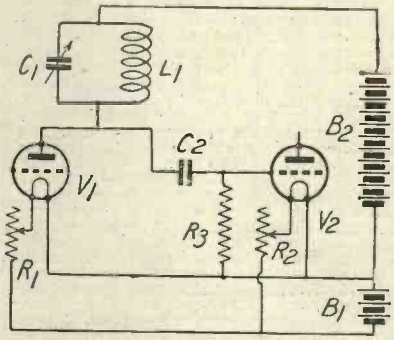


Fig. 7.—Transfer by grid condenser.

(*To be continued.*)

The Two New Envelope Sets

R. P. Envelope No. 3: The "Simplicity" Three-Valve Set, by G. P. Kendall, B.Sc., 2s. 9d. post free.
R. P. Envelope No. 4: The "All-Concert de Luxe" Three-Valve Set, by Percy W. Harris, 2s. 9d. post free.

The "Simplicity" Receiver.

NO doubt one of the greatest attractions of the Radio Press Envelope system to the constructor is the great elaboration of detail possible in the description and illustration of each set, permitted by the space available in these publications. There can be little doubt, for example, about the arrangement of the parts in a set of which the constructor is provided with as many as six or seven different photographs showing the instrument from all sorts of viewpoints, while a full-sized blue print of the wiring and another of the drilling of the panel leaves little to chance in the actual constructional work. Added to this is the fascination of a special set designed by a well-known expert to incorporate his latest ideas.

The two latest additions to the series are arousing much interest, and the two photographs upon this page will no doubt be welcomed by those who are still considering their construction. The set described in Radio Press Envelope No. 3, the "Simplicity Three-Valve Receiver," has been in constant use by the designer since the date of publication, and continues to give uniformly excellent results with the very minimum of trouble in operation. It has been tested for the reception of American broadcasting, and proved successful on two occasions in picking up at quite good telephone strength the station at WGY, Schenectady, upon an aerial of only quite moderate size, and upon this same aerial no difficulty whatever was experienced in picking up Madrid, Konigswusterhausen, the School of Posts and Telegraphs, the Petit Parisien station, and, of course, Eiffel Tower and Radiola, the latter being exceedingly loud in the 'phones, and with a little care in adjustment, providing quite good loud-speaker signals for a moderate-sized room.

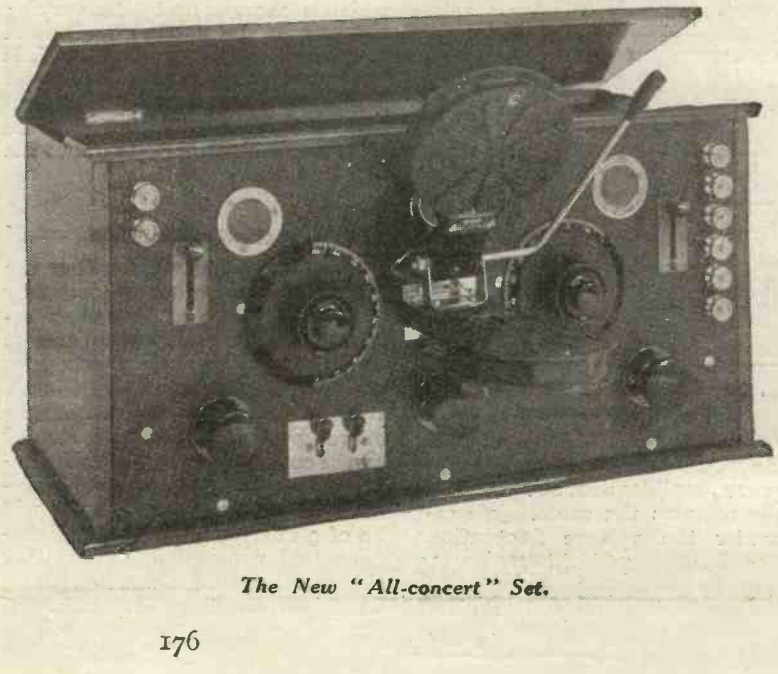
This set has also proved particularly useful in combination with a simple wave trap for reception of distant stations during the period of working of 2LO, notwithstanding the very simple nature of the tuning arrangements. With the type of wave trap described in the envelope (Radio Press Envelope No. 3), no difficulty whatever was experienced at a distance of about 8 miles from 2LO in tuning that station right out and receiving Bournemouth at very fair loud-speaker strength without the slightest interference whatever. This is to be considered as particularly meritorious in view of the fact that a very large and high aerial was used, with which the jamming from 2LO is exceedingly severe. Further tests have been carried out with this receiver upon different aerials and with deliberately very inefficient arrangements as regards the earth connection and so forth. Here, again, the merits of the set showed up particularly well, since its arrangement of reaction upon the aerial circuit enabled very inefficient arrangements to be used to quite good advantage, due care being taken, of course, not to cause interference by radiation. With a reasonable amount of care, however, this latter consideration need not worry the user, since once the risk is realised, the set is probably quite as safe as many which are believed, often erroneously, to be non-radiating.

The No. 4 Envelope Set, the De Luxe form of the famous "All-Concert Receiver," it need hardly be said, is also meeting with an enthusiastic reception. Many who built the original set are reconstructing their instruments upon the lines of the new and re-designed receiver, and are obtaining even better results than before. They are finding that the ease of control of the set has been very much enhanced by the provision of a series-parallel switch for the aerial tuning condenser, and the change-over device from telephones to loud-speaker. This latter, it has also been discovered, provides an exceedingly convenient method of comparing one loud-speaker with another.

The two filament switches are also being greatly appreciated in this set, the function of the left-hand switch visible upon the front of the instrument being to turn out the filament of the high-frequency valve, thereby converting the receiver into a two-valve set, which has certain very interesting properties as regards selectivity. The right-hand switch of the pair, of course, turns out the other two valves and enables the whole set to be switched off, leaving the filament resistances set to their correct adjustment, so that the set shall be ready for putting into operation at a moment's notice by the mere turning on of these two switches.

Of the handsome appearance of the set little need be said, since the photograph is eloquent testimony thereto. The reduction in the number of terminals on the panel produced by the enclosure of all the battery terminals inside the box, the leads being brought out through holes in the back, no doubt contributes largely to this fine appearance, as also does the symmetrical nature of the lay-out, and the provision of the neat valve windows.

Just as with the original "All-Concert Receiver," admirable results are obtained with this set, and upon any reasonably efficient aerial, it may be expected to give signals from all the B.B.C. stations, and also the great majority of the Continental ones, and no doubt, American stations under favourable conditions. The station at KDKA, working upon 100 metres, was, of course, received by the designer in his preliminary tests at very good strength.



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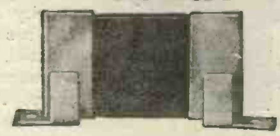

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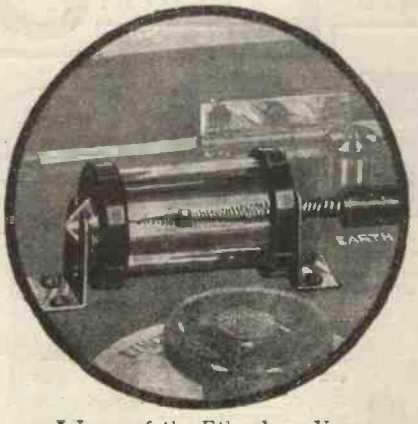

On the left the Burndept Crystal Detector is shown mounted on the panel of the Ethophone Junior Receiver. On the right, it is shown mounted on ebonite, on a walnut base, with lacquered terminals, ready for experimental use.

ALL who have used the Burndept Crystal Detector know that it gives the best possible results obtainable by crystal rectification. The Burndept synthetic crystal employed in this Detector is very sensitive. The specially shaped gold cat-whisker, controlled by a micrometer screw working through a ball-joint, is advanced *but not rotated* when the ebonite knob is turned. Great delicacy of contact can be made and the Detector will not require frequent adjustment, once a "sensitive spot" is found. The moving parts are enclosed in glass and ebonite, protected from dust.

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Trouble Corner

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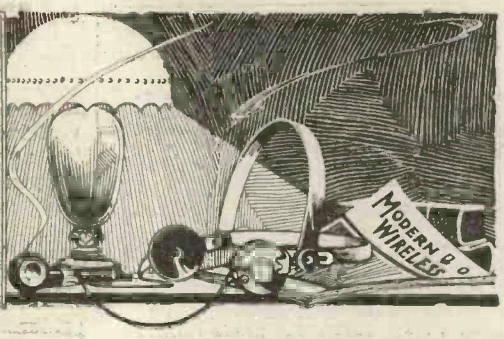
L.F. Transformers and their Troubles.



LOW frequency intervalve transformers may give rise to a good deal of trouble in the set at times. A mishap which will cause an entire breakdown in the receiving set, and may take quite a lot of tracing if one does not know what to look for, is the burning out of one of the windings, usually the primary. Why a transformer should burn out may at first sight seem rather a problem. The finest wire used is No. 42, which has a current carrying capacity of 130 milliamperes, and even if a large power valve is used nothing like this amount of current will ever flow through the primary. With an ordinary valve the anode current seldom exceeds two milliamperes even if a high voltage is used, whilst with a small power valve the flow will not normally exceed from 10 to 15 milliamperes, or one-tenth of the current carrying capacity of even those transformers which are wound with the finest wire. It is, however, more usual to use a stouter gauge wire than this, Nos. 36, 38 or 40 being commonly employed. These will carry without heating up to beyond 100 degrees Centigrade 280, 190 and 150 milliamperes respectively. One would imagine that this allowed the most ample factor of safety, especially as most good makers test their transformers with at least 500 volts before passing them for sale, and many types have to withstand 1,000. How then can a burn-out occur in the ordinary receiving set? We must remember in the first place that when it is in use upon the set the transformer has to deal not with direct but with pulsating currents, whose rapid changes set up greater strains. When the set is allowed to oscillate very high voltages indeed may occur across the primary of the transformer, but even these things are not in themselves sufficient to cause the destruction of the wire. Their presence, however, does give rise to powerful magnetic strains which may cause a break to take place. As soon as the wire is broken arcing takes place and a burn-out follows.

Locating the Trouble

Should the set suddenly go dumb when a fairly high plate voltage is in use, it is as well to test out the transformer at once should there be no obvious detect to account for the silence. As a preliminary, disconnect the leads from the terminals IP and OP in Fig. 1, remove the telephones from their ordinary position and place them in circuit instead of the primary of the transformer as shown by the dotted lines. Should signals now be heard then the fault is certainly on the low frequency side and the transformer should be carefully examined. A simple test can be made in the following way. Disconnect the telephones from IP and OP and join IP to the plate once more. Connect one of the phone leads to OP and with the other touch the high tension positive lead. If the primary of the transformer is undamaged strong clicks will be heard whenever contact is made, but should a break or a burn-out have occurred there will either be no clicks at all or they will be feeble and will probably not occur every time contact is made between the telephone lead and H.T. +. Supposing that the primary proves blameless the secondary may be tested out in the same way by disconnecting the lead from OS to LT— and putting the telephones in its place, making contact as before by touching the LT negative lead with one of the telephone wires. A faulty transformer may be affected in one of two ways: either there may be a complete burn-out, in which case repairs are out of the question, and the only remedy is to purchase a new transformer, or it may be that one of the leads from the windings to the terminals of the transformer is broken. If this has happened a repair can often be made by careful use of the soldering iron. To discover whether a lead is broken take the point of a pencil and press against each connection in turn. The broken lead will then become obvious.

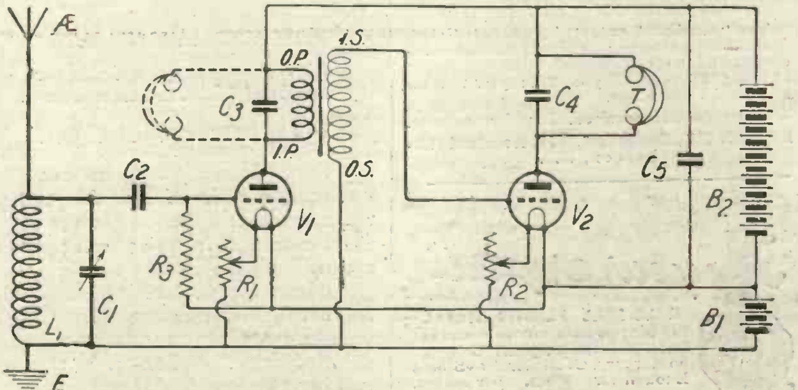


Fig. 1.—Testing a transformer winding.

Transformer Noisiness

Quite a different kind of transformer trouble is that which consists in noisiness of various kinds. We all desire that our sets should give us a background of complete silence when no signals are coming in, but few manage to obtain perfection in this respect. Careful listening will generally disclose the presence of cracklings and splutterings which are usually caused by the high tension battery. The transformers, however, may be to blame in this matter. Any transformer which is not thoroughly well insulated is almost certain to be noisy. The trouble can be counteracted to some extent by the use of a condenser across the primary and by earthing the core. The last is done by attaching a wire to one of the bolts which hold the laminations together and soldering the other end to the L.T. negative lead or to the earth terminal. Should the transformer be so designed that the bolts do not go through the laminations, a small hole should be drilled right through them and a 4 B.A. bolt inserted. These, however, are merely palliatives, and there is no real cure for a transformer whose bad design and poor construction make it noisy.

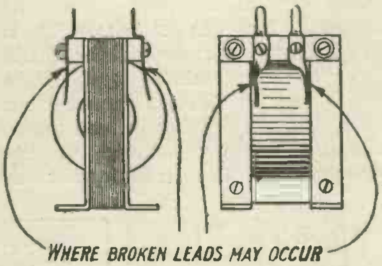


Fig. 2.—Likely points for trouble in L.F. transformers.

A much worse kind of noisiness is that caused by interaction between a pair of low frequency transformers. It is an easy matter to obtain quite undistorted reception with a single low frequency stage, but it is a much more difficult business than most people imagine to add a second satisfactorily. When a set containing two low frequency stages is under construction the components should always be laid out upon a board, the same size as the panel, and placed approximately in the positions relative to one another that they are intended to occupy when mounted upon the panel. The transformers should be moved about until the positions are found which give no interaction between them. Transformer interaction is recognisable by noisy and mushy reception with, in very bad cases, loud howling. It is quite easy to discover whether this howling is due to the high or low frequency side of the set by leaving the tuning unaltered and disconnecting the second low frequency transformer, putting the telephones in circuit in place of its primary. If the howling continues it is due to high frequency oscillations, whilst if it is no longer there it may safely be put down to low frequency transformer interaction. Howling due to this cause is luckily curable in most cases if care is taken. It will be found as a rule that if transformers are placed so that the windings of one are at right angles to those of the other the trouble will cease. The expression "right angles" here means that the windings should be placed like the upright and horizontal members of a "T" and not like those of an "L." If interaction persists when this has been done, join the two cores by a wire and earth them. Other cures which may be tried are to supply the second transformer as well as the first with a fixed condenser shunted across its primary, or to shunt the secondary of the second transformer with a resistance of about 80,000 ohms. But it will sometimes be found necessary to reverse the connections of one of the transformers in order to obtain really good results. In this case the first transformer may be connected in the usual way, plate to IP, OP to HT +, grid to OS and IS to LT −, whilst the second transformer is wired up plate to OP and IP to HT +, with the secondary connections as before. Should all of these suggestions fail, one last remedy remains, and that is to encase both transformers in iron boxes—tobacco boxes made of thick metal will answer quite well. The metal forms a shield which prevents interaction. The boxes should be earthed.

A Curious Effect

One sometimes comes across a very curious audio-frequency effect. When the low frequency valve is switched on a low humming noise is heard which grows rapidly louder and louder until a regular "boom" is issuing from the telephone receivers. I expect that most experimenters have experienced it at one time or another, and many have been rather at a loss to account for it. It is caused by low frequency oscillation, which begins quite gently and builds up to a point of extreme violence. It happens when the grid potential of the low frequency valve is made slightly negative. If you examine the grid volts—grid current curve of any valve drawn to a large scale (specimens of these curves appear on another page) you will find that it shows zero current at four or five volts negative and then dips sharply *down* below the line, indicating the presence of reverse or negative current. From the lowest point of the dip it rises steeply until at zero grid volts it is in the neighbourhood of one micro-ampere in the case of a hard valve. The size of the dip below the line depends upon the degree of the valve's vacuum. The softer the valve the more pronounced will it be. Now when the grid potential of the valve is so adjusted that its working point corresponds with the grid current backlash curve negative resistance occurs, a condition which will always give rise to oscillation. A new valve which is very hard very seldom produces the booming referred to, but when it has been in use for some time and has softened a little it may be responsible for it. The cure is to make the grid more negative until the working point is away from the backlash dip in the grid current curve. This may necessitate increasing the high tension voltage, for otherwise the extra negative grid potential may be sufficient to cut down the flow of anode current to such an extent that the valve will hardly function.

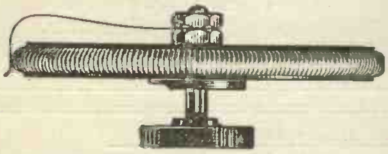


Fig. 3.—How to remedy a rheostat trouble.

A Valve Problem

A correspondent sends in a query which is rather interesting. He writes that some time ago he purchased a one-valve set made for the V 24 valve. As he lives in the country he wished to discard his accumulator and to use a dull emitter valve working off dry cells. He therefore purchased a DEQ, which will, of course, fit the V24 holder. He writes to say that the dull emitter gives very poor results; indeed, he can get little or nothing unless he uses an excessive amount of anode voltage. The reason is this. The V24 valve, when used as a rectifier, is designed to function in the usual way with gridleak and condenser. Its equivalent in the dull emitter type is DEV, which is designed to work in the same way. DEQ, like its bright emitter counterpart, is made to function either as an H.F. amplifier, or as a rectifier working, not on the grid current curve, but upon the bend in the grid volts-anode current curve. This valve, therefore, requires neither gridleak nor condenser on low voltages. I suggested to my correspondent that he should either substitute a DEV for the DEQ, or that he should try the result of removing the gridleak and condenser. I am rather doubtful whether in any case the DEV would be very successful in a single valve set owing to the very high plate-filament impedance.

Rheostat Troubles

I imagine there is no user of wireless receiving sets, whether he be "broadcatcher" or experimenter, who has not had bother with rheostats at one time or another. One of the commonest troubles arises from a bad system of fixing the contact arm to the spindle. Some rheostats are so poorly designed that it is a matter of extreme difficulty to get the arms securely fixed and at the same time to obtain a proper pressure between the point of the arm and the turns of the spiral. If you are plagued with filament resistances of this kind you will find that an excellent plan is to solder the arm to a 2 BA nut. This is a job which can be done by anyone. Here is the way in which to set about it. Clean and tin one surface of the nut and the underside surface of the arm round the hole through which the spindle passes. Then place the nut upon the arm so that the holes through them coincide and grasp them firmly in a pair of pliers. Hold the two in the flame of a gas ring or blow lamp until the tinning begins to run, then withdraw them and allow them to cool. It will be found that they are very firmly fixed together. The arm can now be secured properly to the spindle. Screw it on until the right pressure is obtained between the brushing contact and the resistance helix, and then put on a lock nut, tightening it down against the arm. Fixed in this way the arm will never shift no matter how much usage the rheostat has.

A second source of trouble arises from the turns of the resistance coil being made of wire of very thick gauge and possibly mounted upon a solid core. Rheostats made in this way have always rather an unpleasant action; not only is there a grating feeling as the knob is turned, but there is also as a rule a considerable amount of noise in the receivers during the process. It is exceedingly difficult to do anything with resistances of this kind, though occasionally they can be improved by fitting an arm of more springy metal. The arm may also be bent as shown in Fig. 3, in order to take full advantage of its springiness and to make the contact less harsh.

The third trouble is one of the most annoying of all. When it has been used for some time the rheostat develops bad contacts at various points as the arm is turned round. If you rotate the knob slowly from the off to the on position you find that instead of showing a gradual increase in brightness the filament grows bright at first, then becomes dim, then brightens again, next goes out. In fact, the whole process is one of jumps and jerks. An examination of a rheostat which has begun to behave like this will invariably show that the turns of the resistance coil have become crushed or displaced so that some are touching others and form short circuits, whilst in other places there are gaps over which the contact arm jumps, cutting off the current momentarily as it does so. If the damage is not very bad the displaced turns can sometimes be put back into position by carefully inserting the blade of a pocket knife between those that are touching and exerting a little pressure in the required direction. As a rule, however, such a case is quite hopeless, and the only thing for it is to fit a new spiral. Luckily these are obtainable ready-made for a few pence apiece, and as the wire is looped at both ends there is no difficulty in fitting them to the former. The very greatest care must be taken in handling rheostats whose coil is not supported by a solid core. Displacement of the resistance turns takes place usually whilst they are being fitted to the panels of the set. One grasps them rather too hard whilst inserting the screws, and the damage is done in a moment.

The Three-valve Dual Receiver.

It has been found in some cases that the reversal of the clips upon the condenser attached to the terminals T_8 and T_9 has led to a disconnection inside the condenser itself, the result being a rather obscure fault. With some types of fixed condenser this reversal is undesirable, and it is probably better to attach the condenser by soldering one tag to terminal T_8 and connecting the other to terminal T_9 by means of a short piece of wire.

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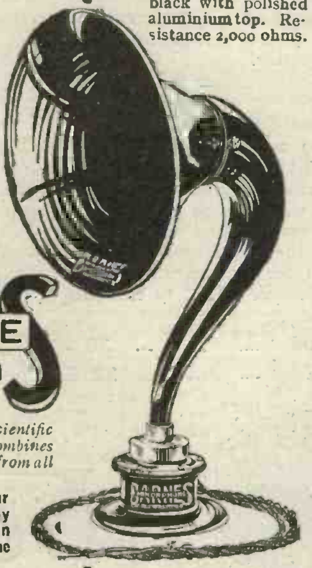

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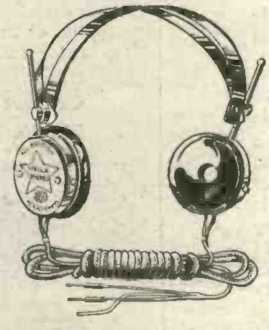

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REFLEX WIRELESS RECEIVERS IN THEORY AND PRACTICE.—CHAPTER V.

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

Tuned Anode Circuits

WE have so far considered, for the purposes of simple explanation, the use of a transformer in the anode circuit of a valve acting as a reflex amplifier. When such a transformer is used, either the primary (*i.e.*, the winding directly in the anode circuit of a valve) or the secondary may be tuned by a variable condenser, but there is less tendency towards self-oscillation when the variable condenser is across the secondary.

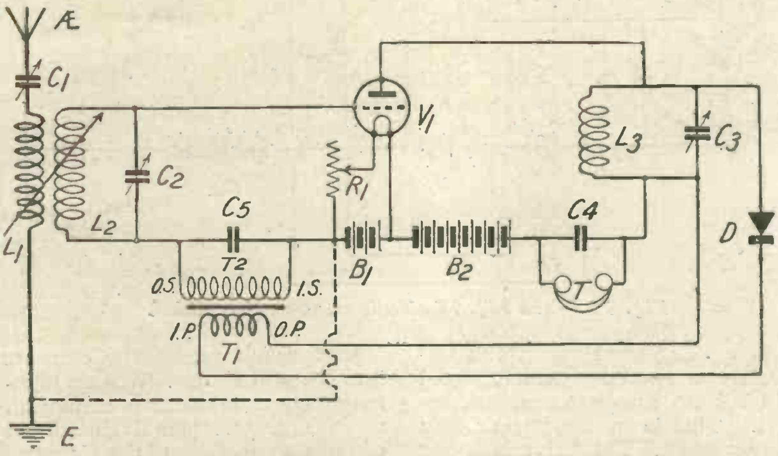

Fig. 17.—A simple reflex receiver using a tuned anode.

We now come to consider the use of a tuned anode circuit in place of the high-frequency transformer. The use of such a tuned anode circuit somewhat simplifies the apparatus; but on the other hand there is a certain increase in the tendency for instability.

Fig. 17 shows a simple reflex receiver using a tuned anode circuit. It will be seen that the aerial circuit is separate from the closed circuit L_2 C_2, the reason for this being to minimise the explanations necessary when dealing with this class of circuit. The use of direct coupled circuits involves special precautions, which will be explained in the next chapter. Meanwhile, we will continue to use loose-coupling, and the variable condenser C_1 may be connected either in series with the aerial coil L_1 or in parallel with it. The coupling between L_1 and L_2 should always be fairly tight when first using the circuit, because if the coupling is loose, the damping of the circuit L_2 C_2 will be reduced, with the result that the valve may tend to produce high-frequency oscillations which are not desired

The high-frequency currents are applied by means of the circuit. L_2 C_2 to the grid and filament of the valve in Fig. 17, and in the anode circuit of this valve we have the inductance coil L_3 shunted by the variable condenser C_3. Telephones T, and the usual high-tension battery, B_2, are included in the anode circuit of the valve, and to act as a by-pass for the high-frequency currents a condenser C_4 of, say, 0.002 μF capacity is connected across the telephones T. This condenser C_4 might alternatively be connected across the right-hand side of T and a terminal of the filament accumulator B_1. It is, however, quite customary, in valve receiving apparatus, to shunt the high-tension battery B_2 separately by a large condenser of, say, 1 microfarad capacity, the purpose of this condenser being to prevent small fluctuations of anode voltage. Such a reservoir condenser is particularly useful when using reflex circuits. The circuits L_1 C_1, L_2 C_2, L_3 C_3 are all tuned to the incoming wavelengths. The magnified oscillations which appear in the circuit L_3 C_3 are rectified by the crystal detector D, the low-frequency currents being passed through the transformer T_1 T_2 into the grid circuit of the valve which amplifies the low-frequency currents, these amplified currents then passing through the inductance L_3 and through the telephones T. The low-frequency currents, in passing through L_3, of course, do not interfere in any way with the high-frequency currents in that circuit, and do not affect the operation of the crystal detector, provided the resistance of L_3 is small. If the resistance, or impedance, of L_3 to the low-frequency currents were appreciable, varying low-frequency potentials would be set up across the detector D, and would modify its rectifying properties, with the result that distortion would occur. This effect, however, would not, in ordinary circumstances, be noticeable.

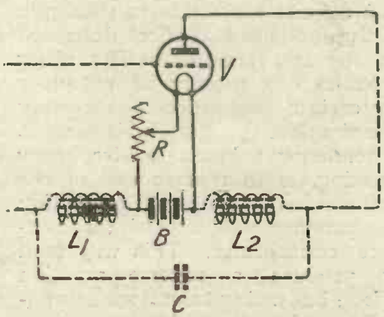

Fig. 18.—Explaining a low frequency reaction effect.

The connections of the transformer windings, T_1 T_2, may be as follows: The left-hand side of T_2, *i.e.*, the side which is nearest the grid, should always be the O.S. terminal of the transformer, while the right-hand side, of course, should be the I.S. terminal. The primary T_1 has two terminals, I.P. and O.P., and the connections to this winding should be tried both ways. It will usually be found that the right-hand side of T_1 should be the O.P. terminal, and the left-hand side the I.P., although very frequently it makes no difference whatever which way round the connections are made. Sometimes the connections to the secondary may also be reversed with advantage, although this is rare. It is nearly always best to connect the O.S. terminal of the transformer to the grid of the valve. It will be seen that a small fixed condenser, C_5, is connected across the secondary T_2; the reason for this is that, without some by-pass condenser, the high-frequency currents in the grid circuit might be choked back. The condenser C_5 has a value which depends upon the self-capacity of the winding T_2. Sometimes this capacity is sufficiently great to make a separate condenser unnecessary, but usually C_5 should have a value of from 0.0003 μF to 0.001 μF. The author would never advise the use of a higher value than 0.001 μF across the secondary of a reflex transformer, because when higher values are used a diminution of signal strength commences. A very good standard size of condenser to use across the secondary of a transformer which is included in a high-frequency circuit is 0.001 μF.

Possible Causes of Buzzing

This circuit, like every other reflex circuit, is sometimes liable to produce a steady buzzing noise in the telephones which is extremely unpleasant. There is one fundamental cause of buzzing which is inherent in every kind of reflex circuit. A full explanation of this phenomenon was given in the last chapter, when it was pointed out that, in many cases, the feeding back of the low-frequency currents into the grid circuit of the valve modulates the carrier wave, and the modulated currents, after amplification by the valve, are rectified by the crystal and produce low-frequency currents which are fed back into the grid circuit again. This produces what we propose to call a chain of low-frequency reaction. In this case the chain is very different from the usual kind, as it depends upon a high-frequency link. This, however, is by no means the only cause of buzzing in a reflex circuit.

A Common Fault

Probably a much more common fault results from simple low-frequency reaction. Low-frequency reaction is similar, in principle, to high-frequency reaction, and low-frequency self-oscillation may readily occur in a low-frequency amplifying apparatus. In the case of, say, a three-valve low-frequency amplifier using iron-core intervalve transformers, it often happens that a musical note is produced through the valves oscillating at low-frequency. A similar phenomenon is always likely to occur in a reflex circuit, the reason being that the amplified low-frequency currents in the anode circuit are liable to be fed back into the grid circuit, and when this happens low-frequency reaction is obtained which, if sufficiently strong, may set up actual low-frequency oscillations produce buzzing.

It is only necessary that sufficient low-frequency energy should be fed back from the anode circuit of the valve to the grid circuit to produce a decided reaction effect. This effect will frequently strengthen signals, although usually at the sacrifice of purity. A certain distortion will always occur, and frequently a specially strong signal will set up low-frequency oscillation. This is in the nature of a trigger effect. The valve is trying to oscillate at low-frequency, and only requires a kick, as it were, to start it. Of course, in some cases, the low-frequency reaction is so strong that the set, when joined up, will start buzzing.

The different causes of low-frequency oscillation in a reflex circuit are numerous, and the author has made a special study of the problem with the view of eliminating all the possible troubles. The only one which it is not definitely possible to eliminate is the fundamental effect described in the last chapter. The other troubles can usually be got over by certain precautions. Probably the simplest thing to do, if there is a tendency towards low-frequency buzzing, is to reverse one of the transformer windings, preferably the primary winding of an iron-core transformer. This will tend to produce a reverse reaction effect, but owing to various complications in the feeding back of the low-frequency energy, it is frequently possible that even a reversal of a transformer winding will not stop the oscillation. A somewhat similar effect is frequently obtained in high-frequency circuits where the reversal of the reaction coil of a tuned anode circuit will not prevent self-oscillation, owing to peculiar capacity coupling taking place.

In the circuit of Fig. 17, by the use of a tuned anode circuit, C_3 L_3, we are liable to get a low-frequency reaction effect, due to the fact that one side of the telephones T is connected to one side of the primary winding, T_1, of the transformer T_1 T_2. We have here, then, a direct connection between the low-frequency output circuit of the valve and the transformer which passes the currents into the grid circuit. When a high-frequency transformer is employed, as in Fig. 11, there is no direct connection between the low-frequency output circuit and the transformer which feeds the current back into the grid circuit of the valve. We therefore do not have the possibility of ordinary low-frequency reaction, but this ordinary effect is sometimes obtained in the Fig. 17 circuit.

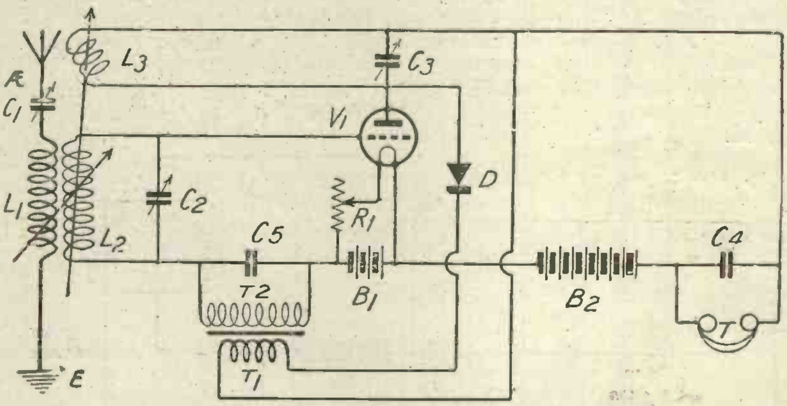

Fig. 19.—The Fig. 17 circuit with reaction added.

The low-frequency currents, which pass through the telephones T during the operation of the circuit, set up varying potential differences across T, because T is acting like an iron-core choke coil or other high impedance. If the voltages across T are suitably communicated back into the grid circuit of the valve, a direct low-frequency reaction effect is obtained.

Many will, no doubt, at some time or another, have tried connecting one terminal of the telephone receivers to the transformer carrying low-frequency currents. It will be found that by simply touching one terminal of the telephone

(Continued on page 189.)

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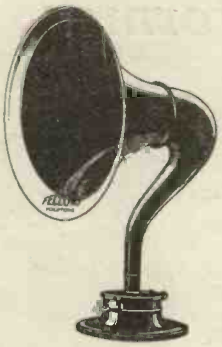

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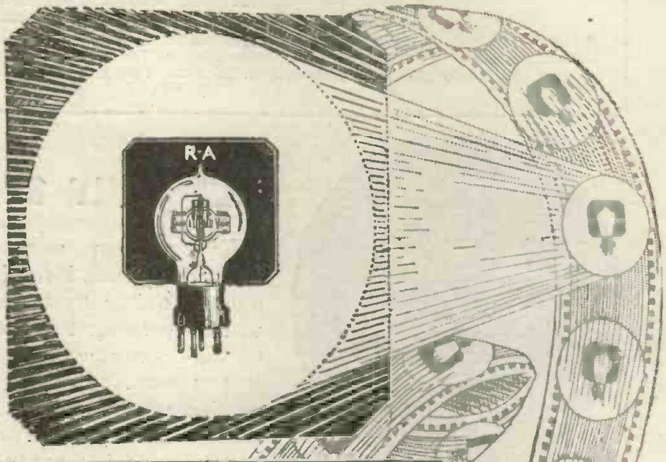

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(*Continued from page* 186.)

receivers to a circuit carrying low-frequency currents, it is possible to hear perfectly plainly in the 'phones, even although the other terminal of the 'phones is quite free. Of course, louder results are obtained when the low-frequency current is actually passed through the telephones, but the latter will certainly pick up low-frequency currents from simply one terminal. Similarly, one terminal of a transformer primary, if connected to a circuit carrying low-frequency currents, will set up alternating currents in the secondary of the transformer which will work telephones connected across this secondary. Various peculiar effects of this nature are possible, and the usual explanation is that the circuit is completed by some vague capacity somewhere.

In Fig. 17 the fact that one side of the telephones T is connected to the primary of a transformer T_1 T_2 is sufficient for the varying voltages across T partially to energise the transformer T_1 T_2 and to set up currents in the secondary which will be fed into the grid circuit of the valve and reamplified by it. This may readily result in a peculiar low-frequency reaction effect. It is perfectly well known that there is a very appreciable capacity effect between the primary and secondary windings of a transformer, and this capacity effect is in existence between every turn of the primary and every turn of the secondary. The position is, therefore, very complicated, and, apart from saying that there is a form of capacity coupling, and the possibility of the completion of low-frequency circuits by the incidental capacities in a transformer, it is impossible to state very definitely how the reaction effect gets back from the anode circuit to the grid circuit, but, nevertheless, it frequently does so.

One possible effect which may be obtained is that illustrated in Fig. 18. In this circuit it will be noticed that two iron-core inductances, L_1 and L_2, are connected in the grid and anode circuit of a valve, a capacity C being connected across the ends. Such a circuit will readily oscillate, producing low-frequency currents, provided the grid circuit is completed and that the anode circuit is completed with a high-tension battery. The circuits are not completed in Fig. 18 because inductances, condensers, etc., in different combinations, frequently appear in the grid and anode circuits, and it is only desired to give some general circuits showing low-frequency reaction.

In the arrangements of Fig. 17, it is quite possible that frequently the fundamental circuit of Fig. 18 is in existence and may lead to low-frequency oscillation. Actual inductive coupling, however, may also take place, the anode low-frequency circuit now consisting of the telephones T, the primary T_1, the completion of this circuit being formed by the capacity effect between T_1 and T_2. The low-frequency anode currents, for example, might flow through T, round through T_1, through the capacity between T_1 and T_2, back to the filament and so back to the left-hand side of T. We are not, of course, referring to any direct current, but only to the alternating potentials established across T.

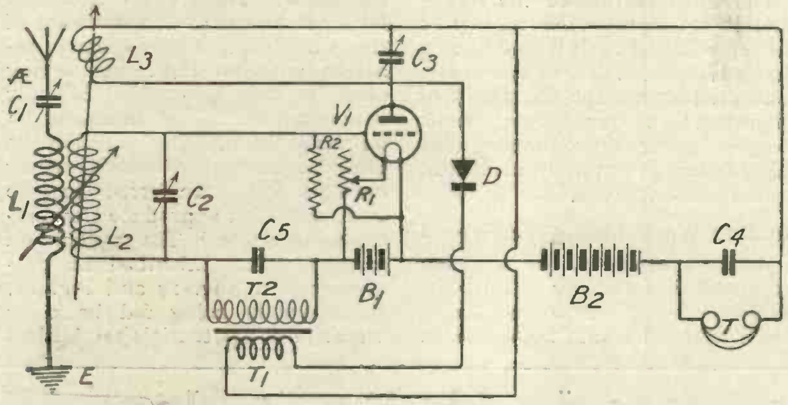

Fig. 20.—The addition of a 100,000 resistance R_1 to the previous circuit.

Adding Reaction

The circuit of Fig. 17 will usually be found perfectly stable, but when reaction is introduced, the possibility of low-frequency buzzing is greatly increased. Fig. 19 shows the arrangement of the circuit employing reaction. Separate aerial tuning is still employed, and is merely given here to prevent complications which arise when direct coupling is used. The object of these notes is to point out the various difficulties as they arise, and explain how they may be overcome.

It may be asked why the Fig. 19 circuit should tend to be more unstable than the arrangement of Fig. 17. There are several reasons: one of these is that as reaction is increased the valve tends to oscillate at high-frequency, and when this is done the low-frequency currents fed into the grid circuit tend to modulate these oscillations and produce a low-frequency reaction chain containing a high-frequency link, as explained in Chapter 4.

Another reason is that adding reaction tends to increase the signal strength, and the feed back will be greater. There is a tendency to increase any natural ordinary low-frequency reaction. When no high-frequency reaction is employed in a reflex circuit, there may always be present a slight low-frequency reaction effect which is only waiting to erupt. The addition of reaction and the increasing of the signals and the alteration of the general state of affairs in the valve frequently give an opportunity for the set to start oscillating, and very often this oscillation may be stopped simply by touching certain parts of the receiver, indicating that a trigger effect is present.

Stopping Buzzing

To stop any tendency of the Fig. 19 circuit to buzz, it is desirable to try reversing the leads to the primary of the iron-core transformer. If this does not improve matters, a very effective method of quietening a reflex circuit is to connect a resistance of the order of 100,000 ohms across the grid of the valve and a terminal of the filament accumulator. It has been usual to connect this resistance across the grid of the valve and the positive terminal of the accumulator.

Action of Stabilising Resistance

The action of this stabilising resistance, which may be a fixed resistance, of 100,000 ohms, or a variable resistance varying from, say, 50,000 to 100,000 ohms, is really threefold. In the first place, it introduces damping into the high-frequency oscillatory circuit, thereby lessening the tendency of the valve to produce high-frequency oscillations, which usually result in the establishment of a special form of low-frequency reaction which has been already discussed in Chapter 4.

Another important effect of the resistance is to introduce damping into the low-frequency circuit and so lessen the degree of low-frequency reaction, due particularly to the effect described in connection with Fig. 17 and Fig. 18.

This latter effect may be obtained by connecting the 100,000 ohm resistance across the secondary T_2 of the iron-core transformer T_1 T_2 of Fig. 19.

Fig. 20 shows the arrangement when the 100,000 ohm resistance is connected across the grid and filament of the valve. There is, of course, no point in using this resistance if it is not found necessary, but usually it will be found highly important to take advantage of the damping effect of the resistance. If a variable 100,000 ohm resistance is used, the damping may be varied, and this will be found very convenient, although a poor variable resistance is very much worse than a fixed one, and experimenters should be on their guard against the resistance which may have too low a value. Sometimes it has been found that a resistance of about 40,000 ohms has been used, although the value was supposed to be 100,000 ohms. The result, of course, is a very big diminution of signal strength, whereas a 100,000 ohm resistance should make practically no difference to the signal strength.

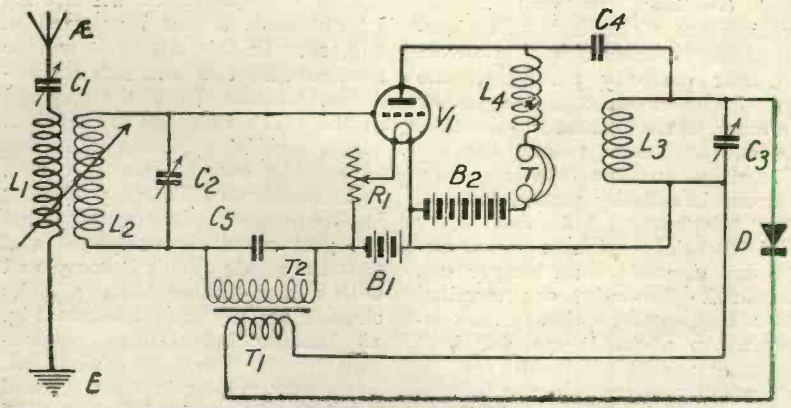

Fig. 21.—A method of avoiding one of the troubles in the previous circuit.

The third feature of the resistance is to improve the quality of the reproduction. It is well known that a high-resistance of this order, connected across the secondary of an intervalve transformer, tends to give purer reproduction, but this advantage is purely incidental in the present case.

Buzzing When Lifting the Crystal

When the crystal of a reflex circuit is isolated by lifting the cat's-whisker, it will frequently be found that a buzzing noise will be heard. This frequently happens in the S.T.100 circuit, which will be described later, and which is a two-valve reflex arrangement. Here, there can be no question of the Chapter 4 low-frequency reaction with an H.F. link taking place, because the crystal detector is now not in use and there can be no rectification. The question is: How do the output low-frequency currents get transferred to the grid circuit to produce low-frequency reaction? The explanation must be that described in connection with Fig. 17 and Fig. 18, the currents being fed back by virtue of the potentials established

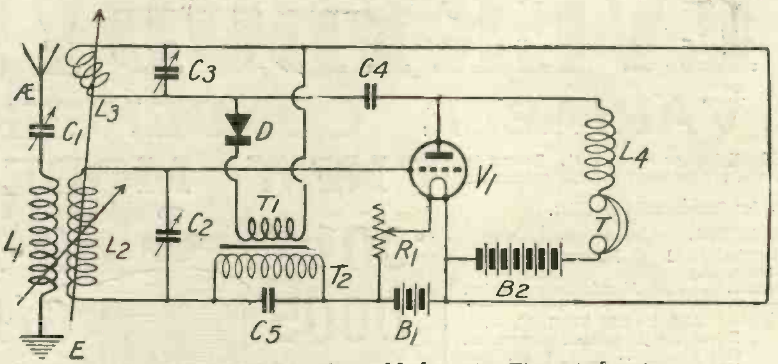

Fig. 22.—Reaction added to the Fig. 21 circuit.

across the telephones being communicated to the primary of the transformer T_1 T_2, and then back into the grid circuit, thus producing a low-frequency chain of reaction. When the crystal circuit is completed by lowering the cat's-whisker on to the crystal, the low-frequency chain may still be present, but the crystal has a very appreciable damping effect on the primary winding T_1, and will frequently be sufficient to stop excessive L.F. reaction.

Experimenters will have found, no doubt, that varying the pressure of the cat's-whisker on the crystal frequently varies the tendency towards low-frequency howling, and the reason is that the resistance of the crystal varies according to the pressure of the cat's-whisker on it, and this varying resistance alters the damping of the transformer winding, and so varies the reaction effect. A big pressure on the crystal, provided the crystal rectifies well, is, of course, best from the point of view of stability.

The trouble due to the potentials across the 'phones being communicated back to the grid circuit may be overcome in several ways, and the effect is not found when a transformer is used instead of a tuned anode circuit.

Another method of overcoming the trouble is illustrated in Fig. 21, this time the tuned anode circuit being kept separate from the direct anode circuit which contains the telephones. It will be seen that a radio-frequency choke L_4 is connected in the direct current anode circuit, together with the telephones T and the high-tension battery B_2. A coupling condenser C_4, which may have a value of 0.0003 μF to 0.002 μF (its value does not seem to matter), serves to feed the high-frequency impulses into the tuned circuit L_3 C_3, which is now separate instead of being connected directly in the anode circuit. This separation of the direct and low-frequency currents from the high-frequency currents was explained earlier in this series, and we have here a practical use of the arrangement, a use, moreover, which results in greater stability. The arrangement is therefore not merely an alternative, but an alternative with certain advantages, although the arrangement is a little more complicated, and which, in some cases, may not be quite as efficient, from the point of view of signal strength, as the plain tuned anode arrangement. For broadcast wavelengths the coil L_4 may be a No. 250 plug-in coil, which will be suitable for wavelengths up to 600 metres. Correspondingly larger choke coils are required for longer wavelengths.

Fig. 22 is simply the arrangement of Fig. 21, reaction being now obtained by coupling the inductance L_3 to L_2.

(To be continued.)

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A USEFUL TIP.

To the Editor of MODERN WIRELESS.

SIR,—Many of your readers may have found that, in efforts to eliminate the effects of body capacity, the fitting of extension handles to the condenser shafts was not an unqualified success, particularly when the condensers were panel-mounted. Not only are the handles unsightly, but on the average panel they are liable to foul the other controls, especially if one is experimenting. This difficulty can be overcome by drilling four tapering holes equal distances apart on the flat milled edge of the condenser knob. The condenser can then be moved by inserting the point of a pencil, or similar rod (which can be as long as desired), into the most convenient hole.
—Yours truly, B. W.

Edinburgh.

READERS' EXPERIENCES

SIR,—I notice in the May MODERN WIRELESS, on page 745, one of your readers, Mr. Rene Tolik, writes to say he received an American station — WBD ? — on March 30.

This station was heard by me on the same date, and though not using the same circuit as Mr. Rene Tolik, it may be of interest to him to have a copy of the programme which I heard and which has been confirmed by the station in question (WBZ).

Using six valves 3.V.2, I listened on a loud-speaker from 2 a.m. till 4 a.m.

2.0 a.m.	Orchestra.
2.40 ,,	Old Irish Airs. Male singer.
2.52 ,,	Valse Caprice.
2.57 ,,	Harp Solo, " Sound the Alarm." Soloist, Mme. Brandenburg.
3.0 ,,	Time signal for 10 o'clock
3.5 ,,	Mme. Brandenburg, harp.
3.10 ,,	Piano.
3.25 ,,	Duet, baritone and soprano.
3.27 ,,	Piano.
3.35 ,,	Nocturne in A minor (Chopin).
3.42 ,,	Voice Quartette.
3.50 ,,	Orchestra.
3.52 ,,	Announcements.
4.0 ,,	WBZ, Boston Studio, Brunswick Hotel, Springfield, Mass., signs off.

Hoping this letter will be of some use, I am, yours truly,

W. T. HOOLEY.

Stockport.

SIR,—I am still another reader to write and thank you, for the excellent 3-valve All-Concert receiver which was given some time ago in MODERN WIRELESS. I did not put it together in cabinet form, but on a table with the wires strewn everywhere. My brother and I have received every British broadcasting station so that it could be heard all over the room without the phones on; also Berlin on 400 metres.

Thanking you again for this excellent circuit.

Yours, etc.,

A. H. D.

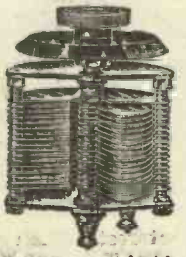
Meadowlands, Mere, Knutsfords.

HULLO EVERYBODY!!

RAYMOND'S VARIABLE CONDENSERS

Our Air Dielectric Condensers are the simplest and MOST efficient on the market. Lowest in price. Highest in quality. Made for panel mounting, and are the most suitable condensers for Broadcasting or Amateur work.

NEW MODEL. National Laboratory Certificate for Guaranteed Capacities.



NEW MODEL.

Accurate Constant Capacity.	Rigid Construction Throughout.	Electrically and Mechanically Perfect.	Narrowest possible spacing Aluminium end plates.

BEAUTIFULLY FINISHED. ALL PARTS NICKELLED.

Cap.	No. of Plates.	Price.	Height without connections.
·001	49	6/11	3½ in.
·00075	37	5/11	2¾ in.
·0005	25	4/11	2 in.
·0003	15	4/6	1¾ in.
·0002	11	4/-	1½ in.
·0001	5	3/6	1 in.

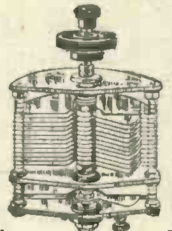
·00005 3-plate vernier, 2/6 (no dial)

A handsome dial with scale 0·180 given free.

EBONITE DIAL and scale 8d. extra. POST 3d. SET.

Special terms to Trade, Radio Clubs, etc.

NEW MODEL



·001	8/11
·0005	6/11
·0003	6/6

Ebonite Dial 8d. extra.

With vernier at bottom. Complete with dial, 2 knobs. Post 6d.

B. T. H. VALVES.

Type B5.
Fil. v. 3
Fil. c. .... 0·06 amp.
An. v. 20-80

30/-

Type R4. - 12/6

Power Valves 35/-

POST IN STOCK. FREE

ACCUMULATORS SUMMER TIME PRICES.

Callers Only, Nett.

Well-known Make, sold under my own label.

4 v. 40	16/6
4 v. 60	18/6
4 v. 80	22/6
6 v. 60	27/6
6 v. 80	33/-
6 v. 100	42/-

H.T. BATTERIES.

60 volt	7/6
30 volt	4/6

Guaranteed Quality.

VARIOMETERS.

POST FREE

New Model Inside Winding Ebonite Former .. 9/11

CALLERS' BARGAIN PRICES

ALL POST ORDERS FROM OTHER PAGE

BUY YOUR GOODS FROM A WIRELESS STORE, NOT FROM SIDE LINERS.

N and K GENUINE, ORIGINAL PATTERN HEADPHONES.

Most comfortable. If they were 25/- you would value them much more. Comfy Leather Headbands.

Lightweight, 4,000 ohms	10/9
Standard weight, 11/6,	12/9
Brunet, the old original, 4,000 ohms	14/6
Brunet, single, 4,000 ohms	7/11
Brunet De Luxe, 4,000 ohms	15/11
Brunet for Crystal Sets (8,000 ohms)	18/6
Premier B.B.C., 4,000 ohms	16/6
Lightweight B.B.C., 4,000 ohms	15/9
Brown's featherweight	25/-
Sterling B.B.C.	25/-
B.T.H., B.B.C.	25/-
French Thomson-Houston Wonderful Tone, 4,000 ohms	12/6
Ericsson E.V. type, 4,000 ohms	12/-

CRYSTAL DETECTORS.

Large upright	1/2
Large horizontal (Brass or Ebonite)	1/2
Ditto, Terminal fitting (Nickel or Brass)	1/6
Large Perikon	2/2
Small „ (Comp. with 2 Crystals)	1/8
Small horizontal	10d.

All above glass enclosed on Ebonite Base. SOME VALUE!

L.F. TRANSFORMERS.

Radio Instruments	25/-
Igranic Shrouded	21/-
Formo Shrouded	18/-
Brunet Shrouded	12/6
General Radio 83	14/11
Formo Open	12/6
Raymond Special	11/9
Lissen T.1.	30/-
Lissen T.2.	25/-
Lissen T.3.	16/6
Powquip 2-1, and 5-1	14/11
Tested on Aerial	14/11
Eureka Concert Grand	30/-
Eureka 2nd Stage	22/6

LISSEN PARTS.

Lissen T.1. Transformers	30/-
Lissen T.2. ditto	25/-
Lissen T.3. ditto	16/6
Variable Grid Leak	2/6
Variable Anode Resistance	2/6
Lissenstat Minor	3/6
Lissenstat	7/6
Lissenstat Universal	10/6
Lissen 2-way Switch	2/9
Lissen Series Parallel ditto	3/9

BASKET COILS.

6 waxed, 200/3,600 metres	1/8
7 „ 150/3,600 „	1/11
5 Waxless 200/2,000 „	1/11
6 „ 150/2,000 „	2/2
S.T. 100 (Set of 2) „	1/3
Radiola (equals 200)	1/6
2 for P.W. Unidyne Circuit	1/6

Electron (genuine) Wire 100 ft.	1/4
Quantity Lead-in .. 100 ft.	10d.
Telephone Terminals and Nut	1d.
Large Pillar, W.O. Army	1d.
Small Pillar .. 4 for	3d.
Detector Parts	3d.
Copper Foil .. per ft.	2½d.
Aerial Wire 7/25 .. 100 ft.	1/3
Valve Sockets, nut and washer .. 4 for	3d.
Ditto, shouldered each	1d.
5 Cats Whiskers (1 gold) lot	3d.
Bell Wire, I.R.C., D.C.C. 10 yds.	4d.
Twin Lighting Flex 4 yds.	6d.
Two Colour Flex .. yd.	2½d.
Contact Stops and Nut 2 a	1d.
Contact Studs, complete 6 for	2½d
Rheostat and Dial	2/6
Ditto, cheaper quality	1/8
Ormond Fil. Res.	1/9
Raymond .. 1/6 &	1/4
Battery Clips .. 3 for	2d
English 4·5 Batteries	4d.
B.B.C., with Connections	6d.
Raymond Var. Gd. Lk.	1/6
Raymond Anode Res.	1/9
Nuts, 5 and 6 B.A. doz.	1½d.
Nuts, 4 and 2 B.A. doz.	2d.
Brass Washers ., 3 doz.	2d.
French "R" Valves	6/6
Phillips "R" Valves	7/6
Dutch Tubular Valves	4/9
Dutch "R" Valves	5/3
French "Metal" ·06	17/6
Dutch Dull Emitters	11/-
Empire Tape, ½ in. 12 yds.	6d.
Ditto, ¾ in. 12 yds.	8d.
Transfers (Set)	6½d.
Lead-in Tubes, 6 in.	5d.
Wire Pliers	10½d.
Variometers, 200/650	1/6
Wound Coils, 200/650	1/8
Telephone Wood Screws	1d.
Tin Copper, 18 g. .. hank	5d.
Aerial Wire 7/22 .. 100 ft.	1/11
Extra Heavy 7/22 .. 100 ft.	2/3

Insulated Hooks	1d.
Ins. Staples .. 4 a	1d.
Spear Point Whisker	2d.
Real Gold or Silver	2d.
Adj. Earth Clips	4½d.
Roll Adhesive Tape	3d.
2 B.A. Rod .. foot	2d.
4 B.A. Rod .. foot	1½d.
Brass Spade Tags .. 4 a	1d.
Ebonite Fil. Dials	6d.
Slotted Adapters and Plug	1/3
Ditto, 2nd quality	10½d
Coil Plugs, Ebonite, 1,000 at	4d.
Coil Plugs „ 7d., 8d. &	9d.
Edison Bell shaped	1/-
Shaped, 2nd quality	10d.
Coil Stands, 2-way	2/6 & 2/11
Coil Stands, 2-way	3/3 & 4/6
Cam Vernier	7/6
Coil Stands, 3-way	4/3 & 4/6
Ditto, Special value	5/3
Nickel Valve Windows Gauze	5d.
Easi Fix Crystal Cups	1d.
Panel Mounting Switches, D.P.D.T.	1/3
Ditto, S.P.D.T.	10½d.
Lightning Switches, S.P.D.T.	1/3
Ditto, D.P.D.T.	2/-
Wander Plugs .. pair	2½d.
Sleeving, 1½ mm. .. yd.	4d.
Brass Plug and Socket pair	1d.
Screw Spade Terminals each	1d.
Pin Screw Terminals 2 for	1½d.
Ditto .. per doz.	8d.
Good Knobs, bushed 2 B.A.	2d.
Engraved Scales 0-180	3d.
Egg Insulators .. each	1d.

RIGHT OPPOSITE DALY'S GALLERY DOOR

K. RAYMOND
27, LISLE STREET, W.C.2
'PHONE: GERRARD 4637.

HOURS OF BUSINESS: Daily . 9 to 7.45 Sundays 10 to 1

BUY RAYMOND GOODS

BEST AND CHEAPEST. POST FREE.

EVERY ARTICLE ON THIS PAGE POST FREE EXCEPT WHERE MARKED.

POST ORDER PAGE. POST ORDER PAGE.

SUNDRIES!

Gauze Valve Windows, nickel .. .. 7d.
Empire Tape, ½in. doz. yds. 9d.
" ¾ in. doz. yds. 1/–
Phone Cords, Double 72 in. 1/11
Ebonite Bushes, 2 and 4 B.A. .. .. .. doz. 1/–
Ebonite Coil Plugs, best 2 for 2/–
Ditto, shaped, Edison Bell .. .. .. 2 for 2/6
Twin Flex .. .. 12 yds. 1/10
Bell Wire, D.C.C., I.R.C. 10 yds. 9d.
Pin Screw Terminals, 12 for 1/3
Spade Screw Terminals, 12 for 1/3
'Phone Wood Screw Terminals .. .. .. 4 for 6d.
Valve Sockets, Nut and Washer .. 12 for 1/2
Ditto, with Shoulder, 12 for 1/3
Brass Plug and Socket 6 pairs 9d.
Spear Point, Gold or Silver Whisker .. .. .. 4d.
Packet of 4, one gold .. 6d.
Terminals, with Nut, Pillar doz. 1/3
Ditto ditto 'Phone doz. 1/3
Ditto, 2 B.A., with Nut, 'Phone .. .. .. doz. 1/9
Ditto, 4 B.A., W.O. doz. 1/6
Large Pillar, complete doz. 1/6
Insulating Sleeving 3 yds. 1/3
Spade Tags .. .. doz. 5d.
2 B.A. Nuts .. 3 doz. 8d.
4, 5, or 6 B.A. Nuts 3 doz. 7d.
Tinned Copper, 14g. 3 yds. 1/–
Ditto, 16 g., 7d.; 18 g., 6d. for 3 yds.
Rubber Lead-in, good quality .. 10 yds. 1/6
Ditto, heavier .. 5 yds. 1/3
S.P.D.T. min. Panel switches 1/3
D.P.D.T. min. Panel switches 1/6
S.P.D.T. on Ebonite .. 1/9
D.P.D.T. ditto 2/11
Wander Plugs, Red and Black .. .. .. pair 6d.
Adhesive Tape .. roll 6d.
Copper Foil .. per ft. 6d.
Battery Clips .. doz. 1/–
Aerial Wire, heavy, 7/22 with 4 insulators 100 ft. 3/9
Midite or Talite Crystal .. 1/–
Tungstalite with Whisker 1/–
2-way Basket Coil Stand with Holders 5/11
Basket Coil Holders, with Plug 1/6
100,000 ohm Fixed Resistance 1/6
Burndept Crystal Detector 5/6
Variometer, 250/650 .. 2/6
Wound Coils, 250/650 .. 2/6

ANODE RES. VARIABLE.

Lissen	2/6
Watmel	3/6
Allen	1/11
Perfecta	1/11

Lissen Minor	3/6
Lissenstat	7/6
Lissen 2-way	2/9
Lissen Ser. Parallel ..	3/9

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

"FILOSTAT" FILAMENT RESISTANCE

Controls ONE IMPOSSIBLE D.E. as HOLE TO well as FIXING SHORT R. VALVES. CIRCUIT.
Screw Connections No Soldering. **2/-**

FILAMENT RHEOSTATS.

Ormond	2/–
Raymond	1/8
Ditto, with dial .. 2/–,	2/6
Igranic	4/6 each
T.C.B. 6, 13, 30 ohms ..	4/–
Ajax, 25.5 ohms	4/–
Ajax, 30.5 ohms	5/–

POTENTIOMETERS.

Ajax, 464 ohms	6/6
T.C.B. 300 ohms	5/–
Igranic	7/6
Peerless, 6 ohms	4/6
Peerless, 15 ohms	4/9
Peerless, 30 ohms	5/–

H.T. BATTERIES.

B.B.C. 60 v.	8/11
B.B.C. 30 v.	5/6

L.F. TRANSFORMERS.

"R.I."		25/–
Igranic	shrouded	21/–
Formo	"	18/–
Brunet	"	14/11
9. Radio 83 ..	"	14/11
Raymond ..	Open	10/11
Formo	"	12/6
Lissen T1		30/–
Lissen T2		25/–
Lissen T3		16/6
Powquip 2–1		14/11
Powquip 5–1		14/11
Tested		10/11
Eureka C9		30/–
Ditto, 2nd stage ..		22/6

VAR. GRID LEAKS.

Lissen 5 to 5M ea. ..	2/6
Watmel 5 to 5M " ..	2/6
Allen 5 to 5M " ..	1/9
Perfecta 5 to 5M " ..	1/9

P.W. UNIDYNE CIRCUIT.

BUY YOUR PARTS HERE. Why Pay High Prices?

.0005 var Condenser ..	5/3
Ditto, with Vernier ..	6/11
4 Electrode Valve	12/6
Valve Holder	1/6
2-way Cam Vernier Coil Holder	12/6
2-way Ordinary	3/11
Basket Coil Adapters, each	1/6
2 Basket Coils (Special) pr	1/8
Var. gd. Leak .. 1/9 or	2/6
Best Fil. Res.	2/–
Terminals (Set)	1/–

POST 3d.

N and K GENUINE ORIGINAL PATTERN

Post 6d. pair.

Famous for Comfort.—Every user of N. & K. 'Phones comments immediately on their comfort and the way they exclude outside sounds. This is due to two things—the extra size of the 'phones, covering the ear completely, and the leather covered head bands which have an additional sanitary value.

Light Weight	11/3
Standard	12/–

Both 4,000 ohms.

PLUG IN COILS.

Burndept, S1, S2, S3, S4 4/3
S2½, 4/3; 75, 4/6; 100, 5/6

IGRANIC COILS.

25 ..	5/–	100 ..	7/–
35 ..	5/–	150 ..	7/10
40 ..	—	200 ..	8/8
50 ..	5/2	250 ..	9/–
60 ..	—	300 ..	9/5
75 ..	5/6	400 ..	10/3

All Sizes Stocked.

LISSEN COILS.

25 ..	4/10	50 ..	5/–
30 ..	4/10	60 ..	5/4
30 ..	4/10	75 ..	5/4
40 ..	4/10	100 ..	6/9

WHEN VISITING WEMBLEY CALL HERE. WE PAY YOUR FARE up to 2/6 in £ on Ordinary Prices. (N.A.R.M. and fixed excluded)

LIGHTNING SWITCHES.

EXTRA QUALITY.

S.P.D.T. on Porcelain ..	2/–
D.P.D.T. on Porcelain ..	2/9

BOXES, Solid Mahogany.

8 × 6 High-class ..	5/11
6 × 6 Do.	4/11

LOUD SPEAKERS.

Amplion Jnr.	42/–
Sterling Baby	55/–
Ditto, Floral	60/–
Brown Baby	48/–

Shaw's Genuine HERTZITE, 1/–

ACCUMULATORS.

Summer Time Prices.
Well-known make sold under my own label.

4 v. 40 amp..	16/6
4 v. 60 amp..	18/6
4 v. 80 amp..	22/6
6 v. 60 amp..	27/6
6 v. 80 amp..	33/–
6 v. 100 amp..	42/–

Carriage 1/- each.

VALVES.

Phillips .04 valves ..	18/6
"Metal" .06 valves ..	18/6
Dutch Dull Emitters (D.E.R.)	12/6
Cossor P.1, P.2	12/6
Ediswan "R"	12/6
Marconi "R" 5	12/6
B.T.H. "R"	12/6

VALVES.

Mullard Ora	12/6
Marconi D.E.R. ..	21/–
Ediswan D.E.R. ..	21/–
Marconi D.E.3	30/–
Mullard, Ediswan, .06 ..	30/–

EBONITE 3/16 in.

Splendid Quality. Stock Sizes.

4½ × 4½	10d.	6 × 6	1/6
7 × 5	1/6	8 × 6	2/-
9 × 6	2/3	10 × 8	3/6
12 × 9	4/6	12 × 12	6/-

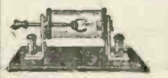
Post 3d. piece.
EBONITE cut to your size while you wait.

HEADPHONES.

4,000 ohms.

Sterling B.B.C. ..	25/–
B.T.H., B.B.C.	25/–
Brown's Featherweight ..	25/–
Brunet, Type D ..	14/6
Brunet—8,000 ohms. For Crystal Sets	19/11
Brunet—4,000 New Model "A" Type De Luxe	18/11
Brunet Single Earpiece 4,000 ohms	8/11
B.B.C. Fine 'Phones ..	15/6
Ericsson, E.V. (the old original)	12/–
French Thomson Houston, Finest Possible Tone, 4,000 ohms	13/6

CRYSTAL DETECTORS.



Enclosed Glass. Brass Nickel Fittings

Small	1/–,	1/3,	1/6,	2/–
Large	1/4,	1/6,	1/9,	2/6

Enclosed Perikon.
Small 1/8. Large, 2/2.
With Zincite and Bornite.
Post 6d. each.

DUBILIER PARTS. FIXED CONDENSERS.

.001 up to .006 ..	3/–
.0001 up to .0005 ..	2/6
Grid Leak	2/6
.01 for Loud Speaker ..	7/6
Anode Resistance ..	4/–
Minicap Switch ..	8/–

EDISON BELL PARTS. FIXED CONDENSERS.

.0001 up to .0005 ..	1/3
.002 up to .006 ..	2/–
Grid Leak	1/3
With .0003 Fixed ..	2/6
Twin Detector	5/6

MANSBRIDGE T.C.C. FXD. CONDENSERS, NEW

1 MFD.	3/6
1 MFD.	4/6
2 MFD.	5/6

VARIOMETERS.

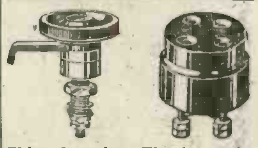
Ebonite 250/650 Ball Rotor	7/6
Ebonite 250/650 Compact	4/11
Fallon 200/700 Inside Winding	10/–
Raymond 200/700 Inside Winding	9/11
Impregnated Board with Clips 250/650 3⅞ × 2⅞	2/9

Post Extra on this Column.

D.C.C. WIRE.

S.W.G.	½ lb.
18 "	9d.
20 "	10d.
22 "	10d.
24 "	1/–
26 "	1/1
28 "	1/3
30 "	1/6

Post 6d. reel.



This first-class Ebonite Valve Switch Arm Holder, cut with 12 Studs, from solid rod, 12 Nuts, 12 hand turned, Washers. 8 nuts.
To Callers, 10½d. Each 1/3.
By Post, 1/6 Set Post Free.

BASKET COILS.

6 Waxed 200/3,000 metres	1/11
7 Waxed 150/3,600 metres	2/3
5 Waxless 200/2,000 metres	1/11
6 Waxless 150/2,000 metres	2/3
2 Waxless for ST 100 ..	1/6
1 for Radiola	1/6

Post 3d. Set.

RAYMOND FIXED CONDENSERS.

Ebonite Base. True Capacity. Pure Mica, etc.

.001, .0001 to .0005 ..	10d.
.002, .003, .004, .005 ..	1/–
.006, .000025	1/6
.01, .02	2/–

Post 3d. each.

A SNIP!

2-way Coil Stands, Ebonite. Some bargain .. 2/6
Post 1s. each.

SNIPS! No Post Orders.

Ebonite Coil Plugs ..	4d.
Good Knobs, Bushed 2 B.A.	1½d.
Shaped Coil Plugs ..	3½d.
Screwdrivers	4½d.
Bus Bar 1/16 T.C. 4 ft. ..	2½d.

West End Stockist for Lissen; Dubilier; Igranic; Edison Bell; etc.

NO CATCHPENNY AD. THIS

I HAVE THE GOODS

VALVE HOLDERS.

Complete with 8 nuts. Special Offer. No Post Orders. **6½d.**

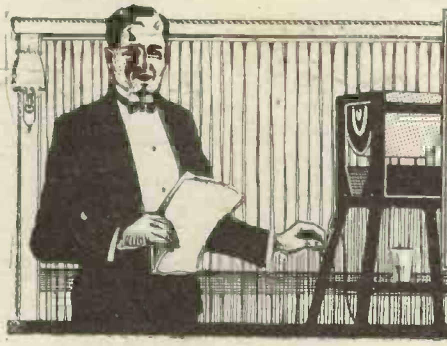
RIGHT OPPOSITE DALY'S GALLERY DOOR

K. RAYMOND

27, LISLE STREET, W.C.2

'PHONE: GERRARD 4637.

HOURS OF BUSINESS:
DAILY . 9 to 7.45
SUND. 10 to 1



Converting Your Receiver for 1,600 Metres

THE problem of converting a receiver in order to receive the transmission of the new high-power broadcasting station is one which has caused much thought on the part of many readers, and some hints on the subject will be helpful. This transmission is on a wavelength of 1,600 metres, and

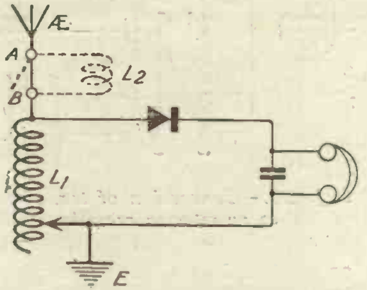


Fig. 1.—The wrong way to add a loading coil.

thus receivers which will tune to Radiola or Eiffel Tower will need no conversion. Ready-made sets using plug-in coils will require a No. 150 in the aerial socket, a No. 100 or larger for reaction, a No. 250 for the tuned anode, and if a tuned loose-coupled set is used, a coil of the same size as that in the tuned anode for the secondary circuit. Plug-in transformers, where used, will have to be changed for others tuning to the correct wavelength.

Conversion of Home-made Sets

A number of circuits are given which will provide the necessary data for the conversion of sets made

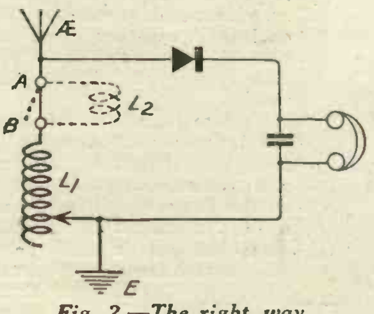


Fig. 2.—The right way.

by readers themselves. Crystal sets of the single-slider type may be converted by the addition of a loading coil in the aerial circuit, and care must be taken that the coil is added in the correct manner. In Fig. 1 are two terminals marked A and B, in series with the aerial and joined by a link. Taking out the link places the coil L_2 in series with L_1, thus increasing the wavelength to which the circuit will respond, but the crystal detector is across only a portion of the inductance, thus reducing the signal strength. Fig. 2 shows the correct way to add a loading coil, the latter being shorted by joining A to B, when lower wavelengths are to be received.

Fig. 3 shows how to convert a variometer tuned crystal set.

Size of Coil

In most cases a coil of size equivalent to a No. 150 plug-in

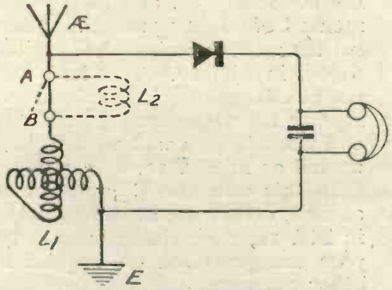


Fig. 3.—A loading coil for variometers.

coil will suit, as this, with the inductance already in the receiver, will bring up the wavelength to that which we require. A coil of 150 turns of No. 24 or No. 26 wire on a 3 in. former will suit, for those who wish to make their own coil. A basket coil may be used, and will be found excellent for the purpose if a coil equivalent to a No. 150 plug-in coil is made.

In Fig. 4 is shown a crystal set with the units and tens method of tuning, and a loading coil may be added as shown. In all the above cases a variable condenser may be shunted across the aerial and earth terminals of the set to enable fine tuning to be carried out.

Crystal Sets with Tuning Condenser

If the crystal receiver has a variable condenser shunted across its inductance, the loading coil must be inserted between the

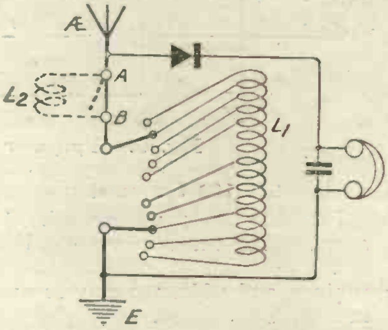


Fig. 4.—Adding a coil to a "units and tens" receiver.

inductance and the aerial in such a way that the condenser is now across both inductance and loading coil.

Conversion of Valve Sets

The vast majority of valve sets use plug-in coils; therefore we have only to use appropriate coils. Fig. 5 shows a simple single-valve set in which both L_1 and L_2 are plug-in coils. For the long waves L_2 may be a No. 100, 150, or 200, depending upon the ease with which the valve will oscillate. Constant aerial tuning is not recommended for the longer waves, and the C.A.T. condenser should be shorted.

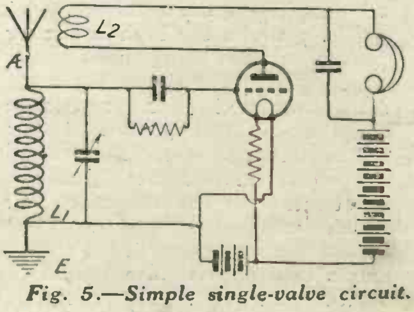


Fig. 5.—Simple single-valve circuit.

Where sets use tuned anode with reaction, the former coil may be a No. 250, while the reaction can be a No. 100 or 150 quite suitably. The aim should be to have the reaction coil just large enough to cause the set to oscillate when the coupling is rather tight. Fig. 6 shows a popular 3-valve circuit in which the coils may be: L_1, 150; L_2, 250; and L_3, 200, for the long wavelength.

and we can then pull out the coil L_2, set C_2 at zero, and insert the resistance, thus completing the conversion to long waves.

Fig. 9 shows the circuit of a transformer coupled high-frequency stage, the primary of the transformer being tuned by the condenser C_2, while the secondary is untuned. Practically all H.F. transformers are mounted on four pins which plug in to the standard

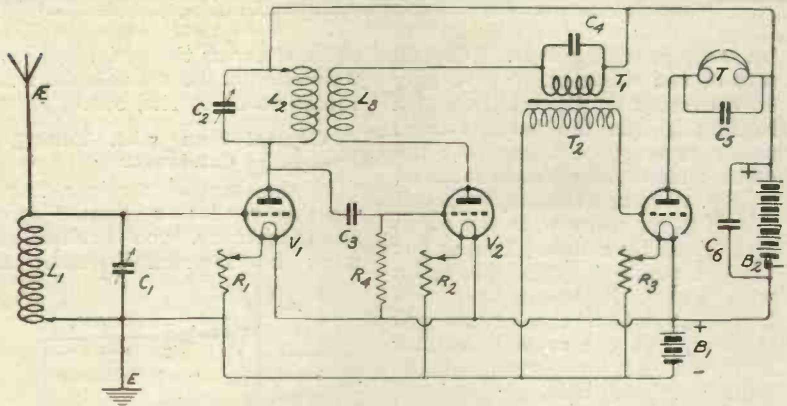


Fig. 6.—A popular three-valve arrangement.

S.T.100 Conversion

For the long wavelength the aerial coil in this receiver will be a No. 150 (without constant aerial tuning), and a No. 250 may be used in the anode socket.

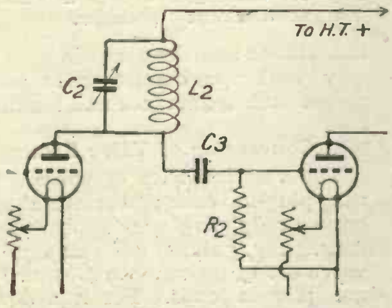


Fig. 7.—Tuned anode coupling.

Resistance Coupling

Very high efficiency is obtainable by resistance coupling on the longer wavelength, and as this form of coupling is untuned, we are simplifying our receivers.

Fig. 7 shows the high-frequency portion of a set using tuned anode coupling. Fig. 8 shows the same set converted for resistance coupling. It will be noticed that the sole change is the removal of the coil L_2 and condenser C_2 and the substitution of the resistance R_3, which may either be a fixed 80,000 ohm resistance or a variable anode resistance of the 50,000 to 100,000 ohm type. The resistance may be mounted upon a coil plug,

valve socket, giving the connections A, B, C and D. A new unit is made which plugs into the socket, having a resistance across A and B, B and C being joined by a wire, and D being left open. The receiver is now converted for resistance coupling, with one provision. In Fig. 9 the leak R_2 is shown across the condenser C_3, and for the new method of coupling must be placed so that it occupies the position shown in Fig. 10. This leak need not be changed back again when we replace the transformer, as the set will work just as well with R_2 connected as in Fig. 10.

In this case also C_2 must be set at zero, otherwise, as shown dotted in Fig. 10, the capacity would bypass energy which we require for other purposes.

Multi-stage H.F. Connections

If two stages of tuned anode coupling are used we can plug in

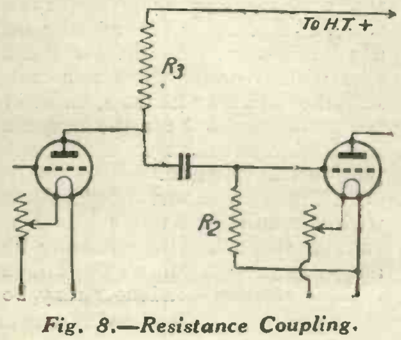


Fig. 8.—Resistance Coupling.

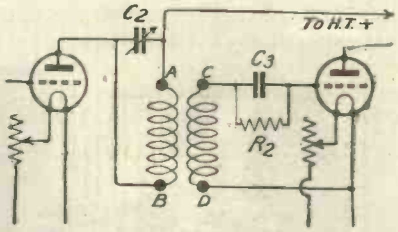


Fig. 9.—Transformer coupling.

two resistances, as explained. If, however, two stages of transformer coupling are used, then the first plug-in unit will have to contain the condenser and leak required for resistance coupling. Suitable units for this purpose were described in MODERN WIRELESS for March, 1924, these being designed for use with the Transatlantic receiver, which,

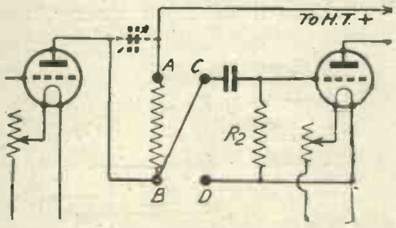


Fig. 10.—Conversion of transformer to resistance coupling.

as readers know, uses two plug-in transformers for the shorter wavelengths.

Radio Press Information Department

Owing to the tremendous increase in the number of queries, and the policy of the Radio Press to give expert advice and not merely "paper circuits," it has been found necessary to enlarge our staff dealing with such matters. In view of the expense incurred, we are reluctantly compelled to make a charge for replies of 2s. 6d., according to the rules below.

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(2) Not more than three questions will be answered at once.

(3) Complete designs for sets and complicated wiring diagrams are outside the scope of the department and cannot be supplied.

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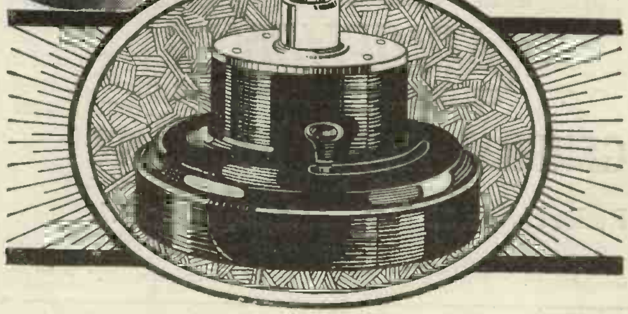

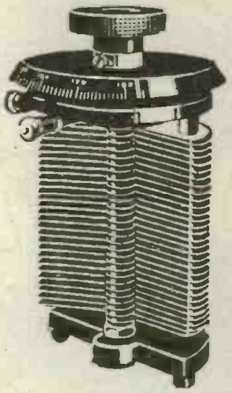

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The Vanicon.

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.0005 ,,	1 0 0	0 7 6
.0007 ,,	1 2 6	0 10 0
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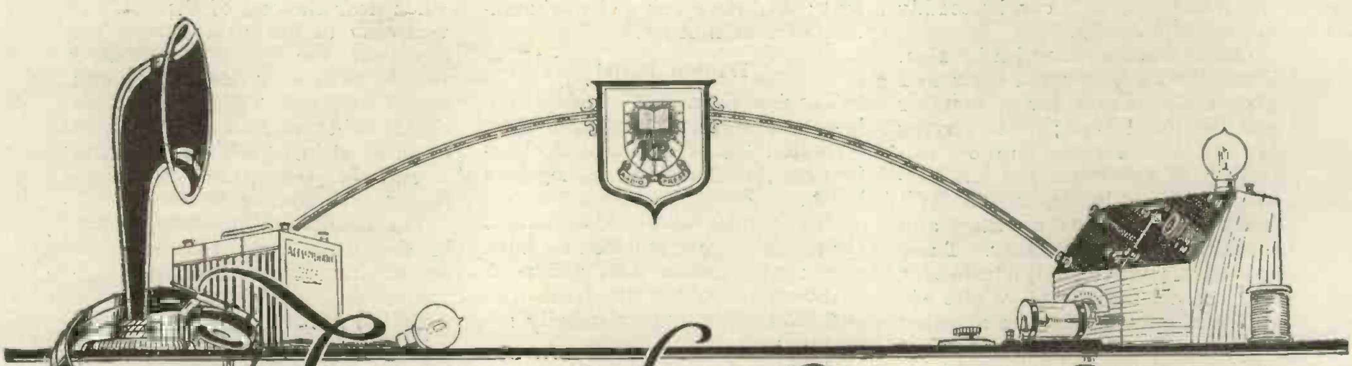


Tested by Ourselves

A Legless Valve-Holder

From the Goswell Engineering Co., Ltd., comes a sample of a new pattern legless valve-holder, in which the possibility of accidental short-circuits when inserting a valve (with the probable result of a burnt-out filament) is guarded against by insulating the plate socket at the top. Thus it is impossible to make electrical connection to the H.T. battery unless the legs are inserted some distance, which can only be done if they are placed in the right way.

The ebonite holder is drilled right through, thus forming its own drilling jig. A centre screw is provided for fixing. Small screws at the side enable connections to be made at the front of the panel, or act as binding-screws for under-panel connections if the latter method be used.

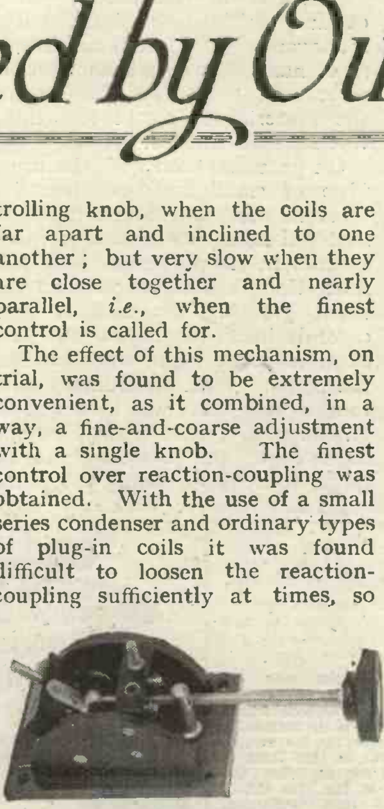
The holder is well made and finished; on test with the 500-volt "Meg" tester between sockets the insulation resistance was found excellent.

A Two-Coil Holder.

From Messrs. Ward and Goldstone comes a two-coil holder, mounted on an ebonite base, 4 ins. by $2\frac{5}{8}$ ins., for fixing on a cabinet or panel, with a fine-adjustment screw control of a novel type.

The one coil is fixed as usual; the holder for the second coil is pivoted, and moves away from the first against a stiff spring. A screw spindle with a spherical knob at the end works in a thread in a brass pillar, and pushes against a brass plate on the side of this moving holder, thus rotating it against the pressure of the spring. The geometrical design is such that the motion is rapid, for a given rate of turning of the spindle by its controlling knob, when the coils are far apart and inclined to one another; but very slow when they are close together and nearly parallel, *i.e.*, when the finest control is called for.

The effect of this mechanism, on trial, was found to be extremely convenient, as it combined, in a way, a fine-and-coarse adjustment with a single knob. The finest control over reaction-coupling was obtained. With the use of a small series condenser and ordinary types of plug-in coils it was found difficult to loosen the reaction-coupling sufficiently at times, so



A useful two-coil holder.

as to avoid oscillation with a liberal valve; a size smaller for the reaction-coil than is usually recommended had to be adopted. With direct coupling without series condenser, this trouble was absent.

The instrument is well made and finished; there was absence of back-lash in the movements. It was noticed that the spring fitted was not strong enough to control the position of coils heavier than, *e.g.*, No. 200, when the stand was horizontal on the table, but that in a vertical posture, as on the side of a cabinet, the apparatus worked smoothly with the largest coils. The small terminal screws were more accessible than is often the case, but might with advantage, for experimental work, be made larger.

Crystal Detectors

A series of crystal detectors of a substantial type, both already mounted on a moulded composition base, and in a form suitable for the home-constructor to mount on his own panel, have been sent for examination by Messrs. Quality Products, of Hyde. The finished "Kupee" crystal-detector has a stout whisker-holder moving in a ball joint at the top of a vertical column; opposite this is a rigid column carrying a crystal-cup, which is given a limited range of horizontal adjustment by means of a micrometer screw (controlled by a large ebonite knob) working against a spring. Terminals suitable for either wire or spade connections are provided on each column. The crystal-cup had an "Orgelite" crystal set in it; this on test showed excellent rectifying power and a multitude of sensitive spots.

The whole mechanism was found, on trial, to work smoothly and satisfactorily, fine adjustment of the crystal being facilitated by the double control. The workmanship and finish were of a high order.

The most elaborate outfit included a mounted crystal, 2 spare cups, 3 whisker-holders, and a tube of 5 different kinds of cat's-whiskers. The latter on quantitative comparative test showed each and every one the same good standard of rectifying efficiency.

Rex Double-Rectifier Crystal Detector

Messrs. Morch Bros. have sent for review an elaborate type of crystal detector, with which the changes can be rung on a large number of different arrangements of crystals, and in particular "double rectification" and "full-wave rectification" can be readily experimented with.

On an ebonite base 3¾in by 2½in. is mounted a large-sized horizontal glass-enclosed detector of more or less the usual type; but carrying at one end a screw-cup crystal-holder, at the other *two* whisker-holders in ball-joints, inclined at a small angle to one another, and insulated from one another. These have a micrometer adjustment for longitudinal movement, whilst the ball-joint pressure can be adjusted by a screw collar at the further end—an excellent point. Light springs also keep the points up to their work when stiff needle-points are used in place of springy whiskers. Small chucks on the ends of the holders enable exchange of whiskers, etc., to be made with ease, and these can be replaced at will by small cups (two of which are provided) for second crystals, e.g. for a perikon combination.

Thus very many combinations of crystals, steel points, double and triple crystal contacts, etc., can be tried with ease; and the instrument will appeal strongly to those interested in experiments in crystal rectification.

On trial, the instrument was found convenient to manipulate; the insulation resistance was excellent; and the finish and workmanship of a high order.

Radion Panel

The American Hard Rubber Co. have sent for test samples of their "Radion" panel-material of ebonite type; in black and mahoganite finish.

The samples submitted were $\frac{3}{16}$ in. thick, and highly polished on both sides; this polish does not need to be removed by the treatment with fine emery-paper usually recommended with ordinary ebonite, as there is no treacherous partly conducting surface layer. The mahoganite in particular has a most handsome appearance. Considerable care is needed in working the material to avoid scratching this finished surface.

On practical trial with the usual type of small radio-constructor's tools it became evident that the material closely resembled ordinary ebonite in its properties, but was if anything a little softer than the usual grades. The makers give careful instructions as to precautions to be taken when cutting the panel. With an ordinary fine-toothed saw there was a noticeable tendency to crumble away at the back edge, and care had to be taken to avoid breaking the panel when near the end of the cut. It was easy to file up and trim the edges of the panel; it drilled readily with no tendency to jam; whilst with care a No. 4 B.A. hole could be tapped in it. As with ordinary ebonite, after soldering to screws in the panel the nuts required tightening again.

The insulation-resistance, tested in the usual way between two screws inserted a short distance apart, was too high to measure with the 500-volt "Meg" tester.

While evidently a considerable amount of care is necessary in handling this high-class panel-material, for purposes where a fine finish and good appearance are a consideration, these "Radion" panels are very attractive.

"Soldo" Soldering Compound

A great many amateur constructors fight shy of soldered joints in their sets, on account of the difficulty often experienced in getting surfaces, not scrupulously cleaned in preparation for a soldered joint, to "take" the solder. They will welcome, accordingly, a new soldering compound, "Soldo," marketed by Messrs. Brown Bros., Ltd. (Motor Manufacturers, etc.), which combines the functions of cleaning, tinning, and soldering at one operation, without previous preparation.

A sample tin of this material has been submitted for practical trial. It consists of a mass of white crystals mingled with fine shreds of metal. The instructions are to heat the metal objects to be soldered, without troubling to clean them, and apply some of this substance when hot; the surface becomes properly tinned forthwith, and if two objects are clamped together and allowed to cool they will be found to be firmly united.

On trial, the compound was found to behave just as indicated; brass, copper or steel surfaces, oily or tarnished, became tinned as soon as the right heat was reached, and the tin spread over the surface in a manner which would appear magical to one who had experienced the usual amateur's troubles with the soldering iron. The makers suggest that an ordinary poker can be used as an iron; the writer found that he had inadvertently used a screwdriver as one; and a small spirit-lamp seemed adequate for any small job. A thick copper wire was heavily tinned in a minute or so, and a brass washer soldered on to a large piece of brass, without cleaning, use of other flux, or stick solder, so firmly that it could not be removed by considerable force.

While it should be supplemented by a supply of stick solder and a small iron, we can thoroughly recommend this compound for radio work. The makers claim that it is non-corrosive; it would be advisable, however, to wash (with water) any parts soldered with the assistance of the compound to remove traces of the flux.

A Filament Resistance

A neat and compact filament resistance for use in ordinary panel-mounting, one $\frac{5}{16}$in. hole and two small screw-holes being required for this purpose, is the "Fitton," submitted by Messrs. Shermays, Ltd.

In this the resistance spiral is quite small, being half embedded in a groove in the face of a disc of ebonite only $1\frac{3}{4}$in. diameter. On measurement it was found to have a maximum resistance of around 7 ohms, and would carry the current for a single R valve safely. A well-finished knob is provided, and the contact spring is mounted on the spindle by a set-screw, which might preferably be a little larger. Small terminal nuts are also provided for connections. Positive on and off stops are incorporated.

On trial the instrument gave smooth and silent control of a detector-valve.

Helenite Crystal and Cat's-Whisker

Messrs. Apex Electrical Supply Co. have sent samples of their "Helenite" galena-type of crystal, marketed in small glass tubes together with a suitable whisker.

This was found to be finely granular, and possessed a number of sensitive spots which gave, on quantitative measurement, a rectifying efficiency on a par with the usual standard for galenas; some of the specimens being appreciably better than others in regard to the proportion of the effective settings found. The sensitiveness was not confined to the surface.

The whisker appeared to be of suitable design and material, giving with standard crystals full rectifying efficiency.

"Vanicon" Double Variable Condenser

A double variable condenser of type suitable for tuning simultaneously two tuned anodes or H.F. transformers is the "Vanicon" double variable, submitted by

Messrs. Dubilier Condenser Co. (1921), Ltd.

This has two sets of plates, fixed and movable, the latter being mounted on the same spindle. Each part of the instrument had, on measurement, an exactly similar capacity of a trifle over .00025 μF maximum, the minimum being .000022 μF.

Thus, used as an ordinary tuning-condenser, either .0005 μF (with fixed plates connected together), .00025 (on either side), or .000125 (two parts in series) is available. For tuning simultaneously two stages of H.F. coupling, *e.g.*, the spindle can be connected to H.T. plus, and the two sets of fixed plates to the two anodes respectively.

The instrument is very compact, being only 3 in. diameter and 2½ in. deep, and is adapted apparently for mounting on a panel by cutting a circular hole of the size indicated—though in this case the terminals, which are arranged at the upper end and are of conveniently large size, might be somewhat awkward to accommodate. Considerable care has been taken to ensure good electrical connection to the moving plates, a substantial " pig-tail " winding up in a grooved guide being provided for this purpose. A high-class knob and bevel scale (with substantial fixing-screw) are supplied with the instrument, and positive stops which register accurately with the zero and maximum readings of the scale.

On test, the electrical insulation resistance was unexceptionable, and the instrument operated silently and effectively. It is obviously of the highest class; the finish and workmanship could hardly be excelled.

Amplitone Crystal and Detector

Charles Ledsham and Co. have sent for test samples of their " Amplitone " crystal and crystal detector in which the same crystal is incorporated.

The crystal is marketed already set (in a plastic material) in a cup, under guarantee. On close examination the fragment in the cup was found to be so small that further test of its rectifying properties was impracticable; the exposed surface in the original setting was found, on quantitative test, to give a rectifying efficiency equal to that of standard first-class galenas, and a large proportion of sensitive spots. Similarly, on testing the complete detector, excellent results were obtained, both in aural observation (of local broadcasting) and in measurements. The detector was of the horizontal enclosed type, on a small ebonite base with convenient terminals. The crystal-cup could be readily replaced, and the movement of the whisker-arm was smooth and without back-lash. A small chuck held the whisker. A thoughtful point was the provision of a white opaque lining on one side of the glass tube so as to facilitate the setting of the crystal, the fine whisker being far more visible against this background.

Magnum Tapped Plug-in Coils

To those who desire to cover a wide range of wave-lengths without necessarily providing themselves with a large number of different plug-in coils, the " Magnum " tapped plug-in coil will appeal. Samples submitted were found to cover effectively the range from 160 to 3,300 metres with two coils, each with four tapping-points.

These coils are enclosed in a well-finished case just under 4 in. diameter by 1⅜ in. thick, with the conventional plug - and - socket fitting on one side, the selecting switch being mounted on the flat face. The plug is reversible, so

(Continued on page 205.)

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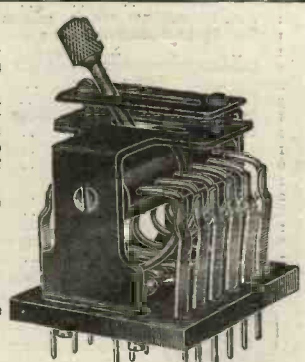
The "UTILITY" NO-CAPACITY SWITCH, as used in the constructional articles appearing in this journal.

Specially designed by electrical engineers to reduce the electrostatic capacity, this switch has proved to be exceptionally reliable in action and has self-cleaning contacts.



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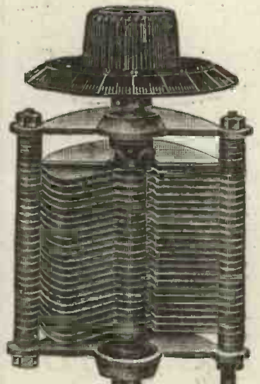
4 ,, ,, ,,	W147 /4	7 6
6 ,, ,, ,,	W147 /6	10/-



The "UTILITY" VARIABLE CONDENSER.

ONE Hole fixing for Panel Mounting. A.001 M.F. "Utility" Condenser tested by the National Physical Laboratory had an efficiency of 99.37%, practically perfect.

Cat. No.	Size	Ordinary	Vernier
W.122	.0015	16 -	18 /6
W.123	.001	12 /6	15 /-
W.144	.00075	11 /9	14 /3
W.124	.0005	10 /6	13 /-
W.125	.0003	8 /9	11 /3
W.145	.0002	7 /9	10 /3
W.146	.0001	7 /6	10 /-

Manufactured by

WILKINS and WRIGHT LIMITED,
UTILITY Works, Kenyon Street, Birmingham,

(*Continued from page* 202.)

that the coil can be used facing either way. The unit is strongly made, and very well finished.

On test, the first coil gave with its tapped cylindrical coil in conjunction with a valve-receiver and a low-minimum .0005 μF variable condenser, on the No. 25 point from 160-370 m., on the No. 35 from 200-500 m., on the No. 50, 240-590 m., and on the No. 75 stud 325-760 m., or to 1,070 m., with .001 μF variable condenser. The second gave: No. 100, 580-1,030; No. 150, 780-1,700; No. 200, 940-2,100; and No. 250, 1,060-2,400 metres; or to 3,300 m. with a .001 μF variable condenser.

On a P.M.G. double aerial, the No. 25 stud had to be used for 2LO with parallel tuning-condenser. With this, reception on the crystal (measuring the resulting signal-strength at a dozen miles) was sensibly better than with some standard types of plug-in coils. In valve reception with reaction, there was little difference to be observed, compared with untapped coils of standard make, except that on the higher wave-lengths the multiple basket-coils of the second tapped coil appeared to offer appreciably higher H.F. resistance, requiring a reaction-coil of twice the size required by the standard coils. It was also hard to get oscillation with the two coils used as A.T.I. and reaction-coil respectively, particularly when a parallel A.T.C. was used.

A Porcelain Valve-Holder

A very interesting type of valve-holder, made of porcelain, has been submitted for test by Messrs. The Athol Engineering Co. This is of about the dimensions customary with ebonite valve-holders, but the brass sockets for the valve-legs are suspended in four holes in the porcelain body by means of screws. As these are not in the centre, in one position the brass sockets project a short distance from the body. Arranged thus, the holder can be used behind a panel, with the sockets flush with the front. With the sockets the other way up the holder can be mounted on the front of the panel, as usual—the screws providing electrical connections—or on a base-board with exposed wiring; or alternatively behind the panel with clearing-holes for the valve-legs. Other alternative methods are also suggested by the makers.

A central fixing screw is provided, and is thoughtfully arranged with a hexagonal counter-sunk hole for the hexagonal nut, to prevent the latter from turning.

The insulation resistance was found too high to measure. The finish and appearance of the holder are good, even though the white porcelain looks a little strange to those accustomed to black ebonite holders. We welcome this departure as a step in the right direction of bringing radio components into line with the moderate-priced standard domestic appliances which are made on the large scale, and can strongly recommend this type of holder for general experimental work.

Special Notice.

The actual sets of which constructional details are given in this issue ("Pariflex," 3-valve portable, etc., etc.), are on view at Radio Press offices until 15th July. They can be seen by appointment (letter or telephone).

The Three Valve Dual Circuit

To the Editor of MODERN WIRELESS.

SIR,—As I am getting such excellent results with the three-valve dual circuit described on pp. 466-67 in the March issue of MODERN WIRELESS, by the Editor, I thought that maybe a description of my arrangement would be of interest to other experimenters, and to those who are rather prejudiced against dual circuits on the grounds that they are unstable and unselective. I, personally, have never handled a more sensitive or selective set, using two or three valves, or a more stable one either, and employ it in preference to any other when not experimenting and when I wish to hear broadcasting.

The only points about my set which differ from the arrangement shown on p. 466 of MODERN WIRELESS are as follows :—

Constant aerial tuning is employed using series .0001 mfd. condenser as recommended by Mr. Scott-Taggart. This makes the set much more selective and sensitive I find.

The coils used for aerial and H.F. transformer are home-made basket coils of 22 d.c.c. on a 2 in. former, the aerial coil having 56 turns, and the primary and secondary of transformer (which is in a two coil holder) 48 and 56 respectively.

Instead of a variable condenser in shunt with the A.T.I., a variometer can be placed in series with aerial coil and top end of L.F. transformer. This gives increased signal strength.

The variable condensers should be small, .0002, as tuning is very critical and requires extension handles 9 in. long or vernier.

The transformer coupling should be varied for best results, as if too close the set may " howl " at low frequency.

All B.B.C. stations can be received on 'phones on two valves, and the third valve allows a small loud-speaker to be used from most stations.

The set, while critical to tune, is very easy to control, and the stations can be tuned in without any oscillation or whistling.

The transformers are Eureka Concert Grand and Silvertown, valves are Cossor P2 for H.F., Dutch for detector, and Ediswan A.R. for L.F.

108 volts H.T. is used on H.F. and L.F. valves, and 26 on detector.

Glasgow and Manchester can be heard well on 'phones on two valves, using aerial of 20 ft. of wire stretched across a room on ground floor.

In the writer's opinion the set is easily as good as a four-valve straight circuit, and the two valves better than many three-valve sets, while the selectivity is much higher than most sets.

With many thanks for such an excellent circuit, and for many other good ones in your excellent papers MODERN WIRELESS and *Wireless Weekly*.—Yours truly,

J. MOORE-CALDER.

Stranmillis Road, Belfast.

To the Editor of MODERN WIRELESS.

SIR,—I feel I must write and congratulate you on the excellent three-valve dual receiver designed and described by you in the April number of MODERN WIRELESS. I made the set about two weeks after the April issue came out, so am sending you a few of the results obtained. The receiver is built as near to your plans as possible except the condensers, which in my set are a separate unit, owing to the fact that I had a cabinet (18 in. by 9 in.) and a ¼ in. ebonite panel to suit on hand. London (2LO) comes in at terrific volume on an Amplion Junior loud speaker, in fact, I dare not use reaction for fear of bringing the roof down. Birmingham (5IT), Bournemouth (6BM), and Cardiff (5WA) come in at good strength, while the French station, Ecole Supérieure des Postes et Télégraphes, comes in excellently, in fact, often drowning out 5IT, which on my other set spoils the French station. Amateurs in London and the outlying districts come in at great strength.

Wishing MODERN WIRELESS every success. — Yours truly,

F. CHILTON.

Stockwell Park Walk. Brixton, S.W.9.

"Two of a Kind."

Some Notes of Importance to New "Modern Wireless" Readers.

MANY newcomers to the art of wireless have viewed with amused tolerance the enthusiasm of older adherents as if they themselves were above such "madness." "I just want a set for the local programmes!" says Mr. Smith to the local dealer. "Something simple! None of your inductances and capacities and millibars and things!! I can't understand what some of these fellows get so potty about!"

So Smith senior takes home the wireless set, and, as the head of the family, is naturally expected to explain how it works. Now Smith has always been careful to uphold his dignity before the family, so he invests in a Radio Press explanatory book and "reads it up." Later he finds there is "something in this wireless," so he buys MODERN WIRELESS for the first time and regularly every month afterwards. (Perhaps *you* are Smith and perhaps this is *your* first copy.)

It does not take long to succumb to the fascination of radio. It is a wonderful art and has attracted some of the keenest intellects of the day. There is no need to extol the virtues of MODERN WIRELESS,—you know it as you are reading it now. But what about the "up-to-the-minute" wireless news,—the news of the almost daily progress in this great field of applied science, news that it is a shame to keep waiting for a whole month,—do you get it?

If you are an old reader of MODERN WIRELESS you will need no introduction to *Wireless Weekly*, the companion journal edited by the same famous technical staff that is responsible for the success of MODERN WIRELESS and the wonderful series of Radio Press books. As a new reader you will perhaps like to hear of some of the articles which have appeared during the last month.

Wireless Weekly was the first to give the real facts about the high-tension-less circuits for which such sensational claims were recently made. These circuits needed special four-electrode valves. *Wireless Weekly* was able to publish several remarkable circuits working without high-tension, using ordinary valves and ordinary apparatus.

Recent researches in Russia have shown that crystal receivers can be made to oscillate. *Wireless Weekly* has published not merely theoretical circuits but practical results obtained with oscillating crystals by its own technical staff. It is just this intimate and *practical* acquaintance with the art that makes MODERN WIRELESS and *Wireless Weekly* "two of a kind."

Sooner or later every crystal user wishes to try his hand at valve work. In the June 25 issue, Mr. E. Redpath began a series of articles explaining how every crystal user can become a valve expert. You can still obtain a copy of this issue if you order at once, and you will then be in a position to follow out this instructive series.

"Hints for Flat Dwellers"—a recent contribution by Mr. Percy W. Harris—aroused much interest, while the more advanced reader found Mr. G. P. Kendall's articles "Fault Finding in Reflex Circuits" of great help. Beginners and advanced readers alike are following Mr. Scott-Taggart's weekly "Valve Notes," and other special contributions.

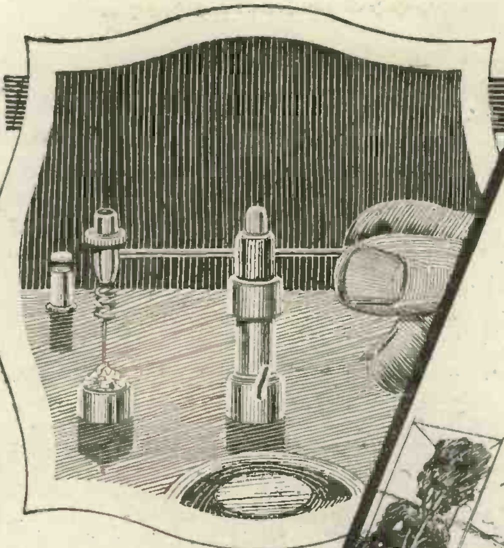
Wireless Weekly can be obtained from any newsagent or bookstall, price 6d. Tell your newsagent to deliver it each Wednesday for the next six issues as a trial. You will then be able to read a remarkable article by Captain H. J. Round, the famous expert on "Obtaining Loud Signals." This will appear in the issue for July 16.

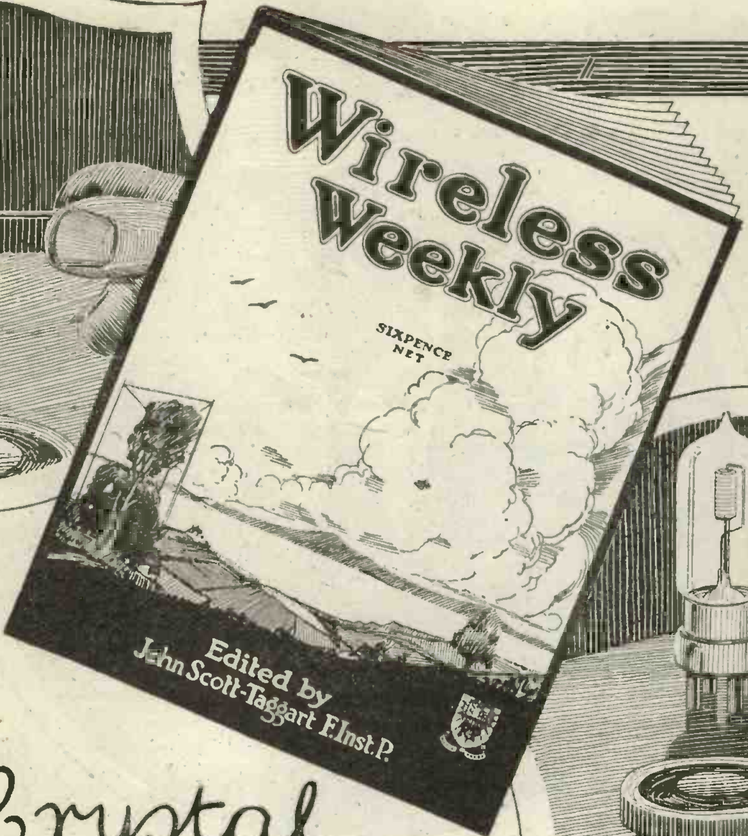
The W1 Receiver

That exceedingly popular set the W.1. three-valve receiver is proving even more attractive to the constructor in its new guise than when it first appeared in *Wireless Weekly*. The reason is not far to seek, since the novelty of the Radio Press Panel Card system makes an irresistible appeal to the builder of sets.

The flat cardboard model of the panel makes it absolutely clear to even the novice exactly how he is to fix the parts on the panel, and how to wire them up. The model is printed on one side with a reproduction of a photograph of the panel, and on the other with a drawing of the wiring. The model is accompanied by a sheet printed on one side with a drilling diagram and on the other instructions for making and using the set.

The price of the Panel Card, instructions, etc., is 1s. from any bookseller, or 1s. 3d. post free direct from the publishers.

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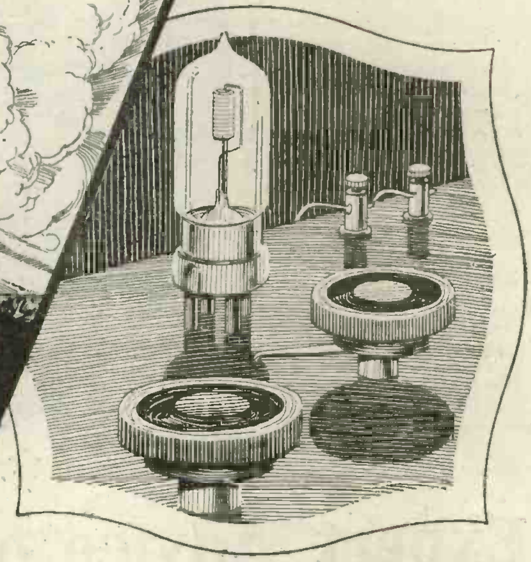

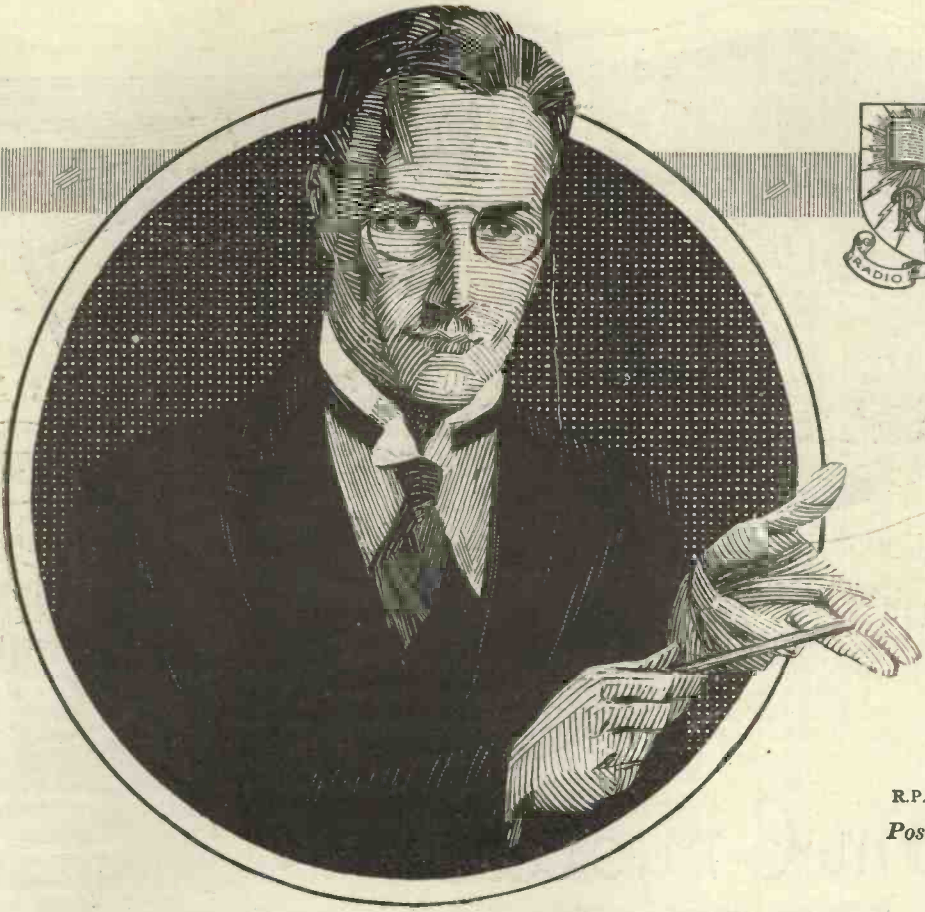

STEPPING STONES TO SUCCESS

RADIO PRESS

SUCCESS in Radio is certainly dependent upon gradual and logical progress. The man who sets out to build an intricate and elaborate Receiving Set without first taking the trouble to learn some of the more elementary principles of Wireless, is very much like the man who is in such a hurry to reach the other side of the stream, that he omits to take due advantage of the stepping stones provided.

Radio—like every other hobby—wants understanding, and the easiest and most economical way of acquiring knowledge is to make systematic use of the Radio Press "stepping-stones" given below.

		Price
1	Wireless for All ... By *John Scott-Taggart, F.Inst.P.*	9d.
2	Simplified Wireless ... By *John Scott-Taggart, F.Inst.P.*	1/-
3	How to Make your own Broadcast Receiver By *John Scott-Taggart, F.Inst.P.*	1/6
4	How to Erect Your Wireless Aerial ... By *B. Mittell, A.M.I.E.E.*	1/-
5	The Construction of Wireless Receiving Apparatus ... By *P. D. Tyers.*	1/6
6	The Construction of Crystal Receivers... By *Alan L. M. Douglas*	1/6
7	How to Make a "Unit" Wireless Receiver ... By *E. Redpath.*	2/6
8	Pictorial Wireless Circuits ... By *Oswald J. Rankin.*	1/6
9	Wireless Valves Simply Explained ... By *John Scott-Taggart, F.Inst.P.*	2/6
10	Practical Wireless Valve Circuits ... By *John Scott-Taggart, F.Inst.P.*	2/6
12	Radio Valves and How to Use Them... By *John Scott-Taggart, F.Inst.P.*	2/6
13	500 Wireless Questions Answered ... By *G. P. Kendall & E. Redpath.*	2/6
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No. 3.	How to Build the All-Concert de Luxe Receiver ... By *P. W. Harris.*	2/6
No. 4.	How to Build the "Simplicity" 3-Valve Set ... By *G. P. Kendall, B.Sc.*	2/6

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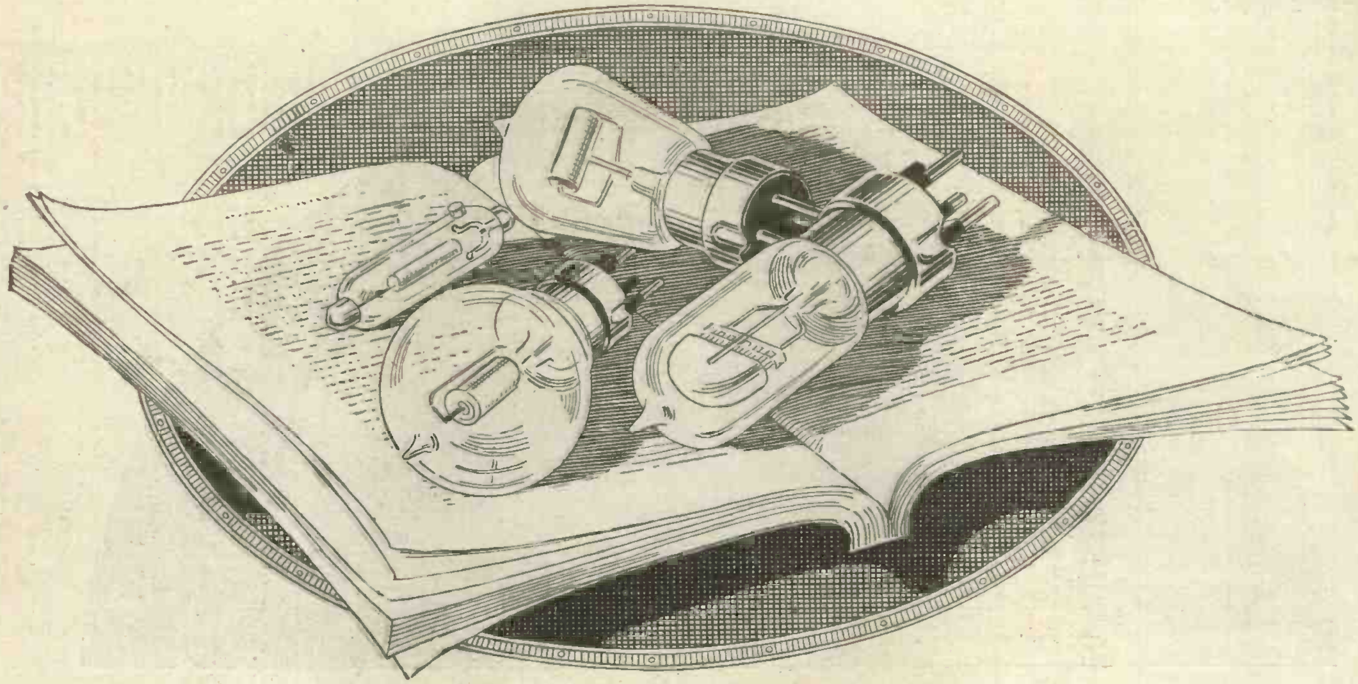

Give them a fair chance!

WOULD you buy a Car and expect to be able to keep it in perfect running order without the aid of the maker's book of instructions? Obviously not, yet thousands who will read this advertisement do something very similar with their Valves. They insert them into any socket of the Receiver without a thought as to the special duties they may be called upon to perform. They are quite indifferent as to the correct value of the H.T. or L.T. batteries. So long as the Valve glows and the Set works, they are more or less satisfied.

Such actions do not give Valves a fair chance.

The proper method to adopt is to consult some such book as "Radio Valves and How to Use Them," written by John Scott-Taggart, F.Inst.P. (Editor of this Magazine). Price 2/6, post free 2/8.

Some indea of the extraordinary scope of this Book may be gleaned from the following chapter headings:—

Two-electrode Valves and Their Uses.
Three-electrode Valves and How They Work.
The Use of the Valve as a High-frequency Amplifier and also as a Note-magnifier.
Using the Valve as a Detector.
Multi-valve Receivers in Theory and Practice.
Receivers Using Reaction and Their Operation.
Recent Circuits and Their Application.

Incidentally this Book is the largest half-crown Book published by Radio Press, Ltd., and represents extraordinary good value for money. Buy a copy to-day and spend an odd half-hour or two learning something about Valves. Once you have mastered this subject, your progress in Radio will be rapid and enjoyable.

Radio Valves and how to use them

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

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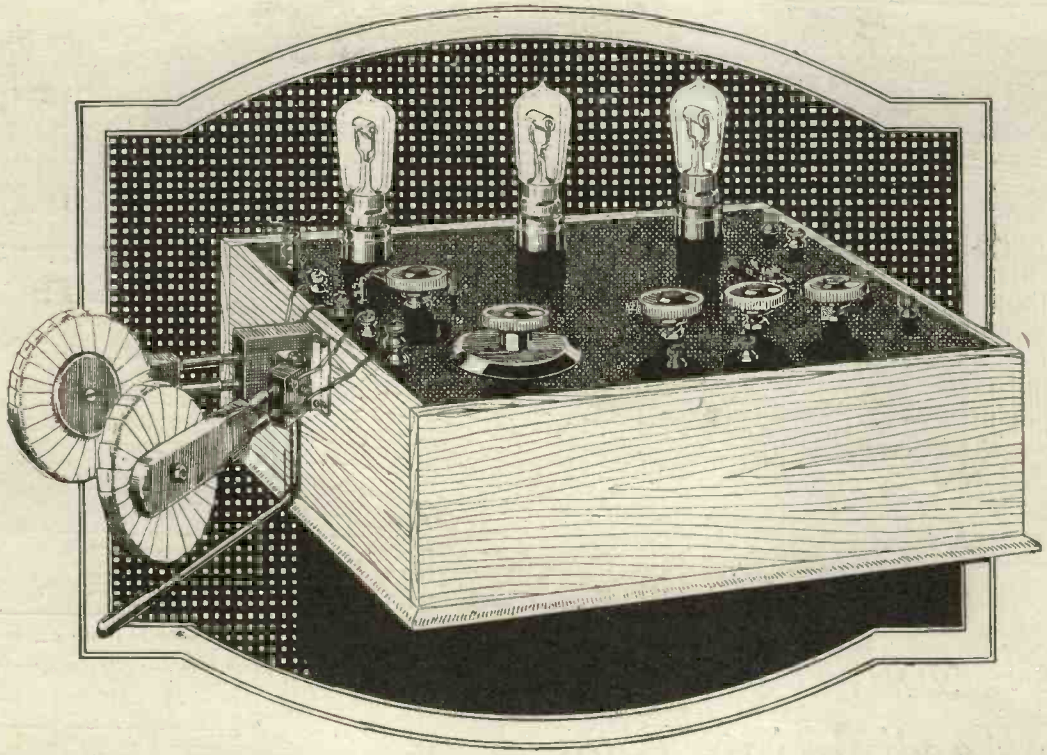

All the B.B.C. Stations on one knob—

THE usual three-valve Receiver presents rather a difficult problem in tuning (to obtain the best results) to the beginner. Almost invariably there are two condenser dials to be rotated simultaneously and coils to be adjusted. The 'old hand,' of course, makes light of such difficulties, but to the novice, undoubtedly they are certainly quite formidable.

The Set shown above, although using one stage of H.F., is tuned entirely by one variable condenser and one switch and has been designed throughout to give the best results with the greatest possible ease. At the same time, however, simplification in design has also resulted in marked economy in outlay. Any experimenter can now build this splendid 3-Valve set under the new Radio Press Envelope System at a total cost of but £4 to £5 (excluding Valves and accessories, of course) using the best components. If required the L.F. Valve can be cut out instantly by means of a switch. Why not make up this efficient Set, designed by G. P. Kendall, B.Sc., Staff Editor, and which has received all B.B.C. Stations in London—three of them on an indoor aerial. Upon a medium-sized outside aerial it picked up the Madrid, Konigswusterhausen, Petit Parisien, Eiffel Tower, and Radiola broadcasting stations, the last-named at very fair loud speaker strength. The American station W.G.Y. has also been received at good 'phone strength. If you have hitherto been afraid to build up a multi-valve Set here is just the Receiver you should build—order a copy from your Bookseller to-day.

Envelope No. 3 contains blue prints showing panel lay-out (front and back) and full wiring diagram, together with the most explicit instructions for assembly. It is practically impossible for even the most complete novice to go wrong in building up this Set. Photographs showing finished instrument in different positions also included, together with all necessary working drawings.

2/9, *post free.*

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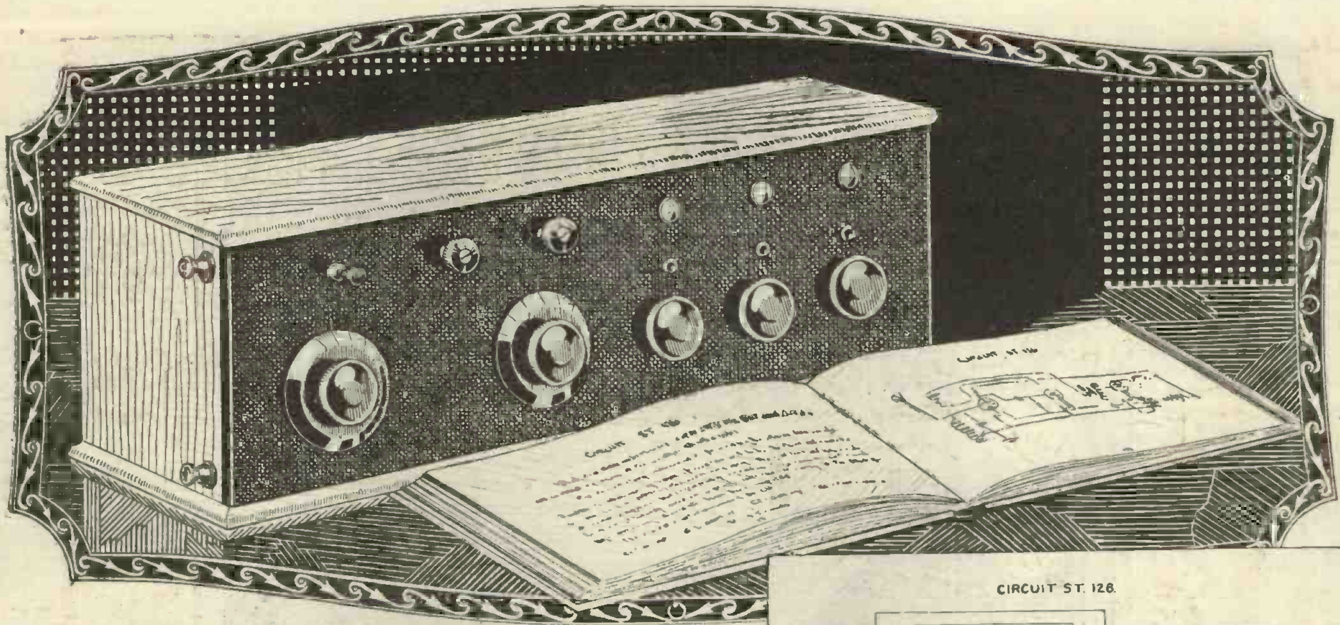
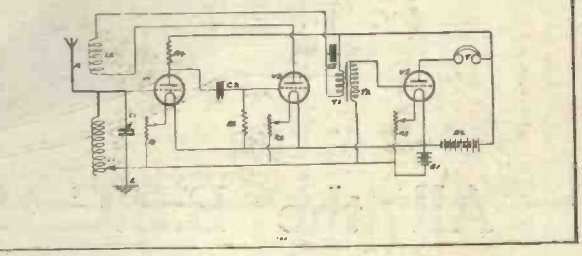
How to build the "Simplicity" 3 Valve Set

Radio Press Envelope No. 3.

G.A. 798.



CIRCUIT ST. 128.



Yes! you, too, need this fascinating Book of Circuits.

ALL the difference between success and failure in building a home-made Set lies in the correct values of the components and their arrangement.

Anyone who possesses a little wireless knowledge and who has built up a Set before will be able to pick up a copy of

MORE PRACTICAL VALVE CIRCUITS,

By John Scott-Taggart, F.Inst.P.

and build any type of Set according to his own ideas and incorporating any of the scores of circuits described in it without further assistance.

These clear diagrams are so accurate and the descriptions given are so complete, that to a man who already knows something about Wireless, the Book is almost as good as a huge constructional Book showing how to build dozens of different types of Instruments.

For instance, opposite every Circuit is a full description of it—its advantages and disadvantages, how it should be used, the values of the fixed condensers and resistances, and so on. All this information is given because every Circuit is a practical one, and not a paper one. You can be confident that it will do all that is claimed for it.

This Book contains a very large number of circuits, including all the recent reflex circuits, together with such "super" Circuits as the Armstrong and the Flewelling. It is beautifully printed on good quality paper and bound in full cloth—a real reference Book, in fact. Get a copy from your Bookseller to-day, or direct for 3/8 post free.

RADIO PRESS Ltd., Devereux Court, Strand, W.C.2.

More Practical Valve Circuits

By John Scott-Taggart, F.Inst.P., A.M.I.E.E.

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