Wireless Weekly, 6d. Net. Wednesday. June 4th, 1924.

Wireless Weekly

and the Wireless Constructor.

Vol. 4.
No. 5.

CONTENTS

The Cowper H.T.-less Set

HOW TO MAKE AND USE IT

By PERCY W. HARRIS

Wireless Weekly

Vol. 4, No. 5
June 4, 1924

CONTENTS

Editor: JOHN SCOTT-TAGGART, F.Inst.P., A.M.I.E.E.
Assistant Editors: P. W. HARRIS. E. REDPATH.

Radio Press, Ltd.
Publishers of Authoritative Wireless Literature.
DEVEREUX COURT, STRAND, W.C.2.
Tel.—Central 3763.
Advertisement Managers: SCHEFF PUBLICITY ORGANISATION, LTD., 125, Pall Mall, London, S.W.1
Tel.—Regent 2440.

RADIO PRESS

All correspondence relating to contributions is to be addressed to the Editor of "Wireless Weekly."

Nothing contained herein is to be regarded as permission or encouragement to infringe any patent rights.

Editorial

The Death Ray and the Moral

WIRELESS telegraphy and telephony have brought to the public notice so many seeming miracles that we are in danger of accepting any claim, no matter how astounding, just because almost equally marvellous claims have been justified before. Unfortunately, the daily Press, skilled as it is in presenting facts in an interesting fashion, is itself prone to accept claims at their face value without applying the cold and logical reasoning which is necessary in all such cases. Tremendous prominence has recently been given in the daily Press to what is referred to as the "Death Ray," and all kinds of reproaches have been levelled at the Government for not immediately "acquiring all rights" in the alleged marvellous invention. For our part we have seen so many claims made at various times for new "wireless" inventions that we must be forgiven a certain scepticism in this particular case. Certainly we hold no brief for those who would condemn the Government's attitude, for as their official statement shows, they have given every opportunity to the inventor to demonstrate his apparatus in such a way as to prove its alleged merits. Although the first invitation was given as early as February last, up to the time of writing the inventor has given but one demonstration, at which, it has been officially stated, nothing was done which could not be reproduced by the Government Departments concerned with their own staff.

Within the last few years we have seen flamboyant announcements indicating that wireless has been "revolutionised" in a dozen different ways. Two or three years ago the experiments of a certain Dr. Rogers were claimed to prove conclusively that high towers at wireless transmitting stations were absolutely unnecessary, yet the new Post Office station at Rugby, and, in fact, all the high power wireless transmitting stations under erection throughout the world, are using masts as tall as physical limitations will allow. The only safe way of judging the merits of a new invention is to see whether independent experts are satisfied with demonstrations given to them in conditions which are agreed by both sides to be fair.

The Radio Society and its Policy

In our issue for March 12 we strongly criticised the Radio Society policy regarding their programmes, and the choice of lectures and lecturers. We had high hopes that the reorganisation of the Society would bring with it a change of spirit and the realisation of its responsibility to its members and to the art. In particular it will be remembered we criticised the choice of subjects for lectures, pointing out, as an example, that the subject for May 28, "Wireless in British Military Aircraft up to August, 1914," is not among the many burning questions and pressing problems of vital interest, needing treatment in lectures before the leading Radio Society. The choice of such subjects shows an utter lack of realisation of what the experimenter really requires, and we can only point to the attendance on the evening in question as a justification for our criticism. The meetings, as our readers know, are held in the superb Lecture Theatre of the Institution of Electrical Engineers kindly lent to the Radio Society by that body. When the lecturer rose there were present, excluding Press representatives and officials, nineteen members, amongst whom we did not notice a single member of the Council. One could but contrast this with the packed meeting which welcomed Captain Eckersley when he gave his recent paper on "Pure Reception." Of the paper itself it would be kinder to say little, save that we do not consider it sufficiently interesting to report in our columns. Presumably the new Council are quite satisfied to leave to chance whether the members will attend or not. Such a small attendance out of a membership of nearly a thousand is a discourtesy to the great Institution which so kindly placed its unrivalled facilities at the disposal of the Society, and the fault lies solely at the door of those who decide the programmes.

A High-Tensionless Circuit using Ordinary Valves

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

A second part of the article giving details of a new high-tensionless circuit in which the ordinary valve may be used and employing audio-frequency reaction.

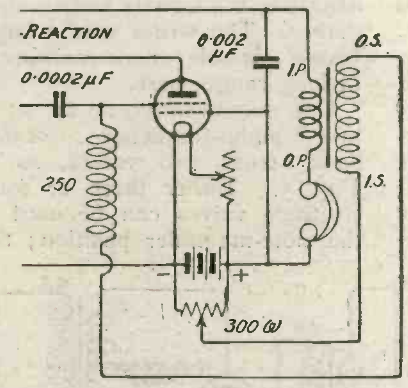


Fig. 1.—A four-electrode valve circuit with potentiometer control on the outer grid.

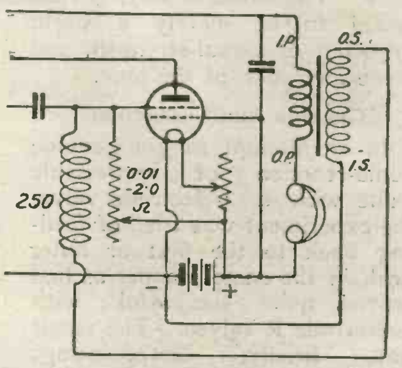


Fig. 3.—The use of a variable resistance across outer grid and L.T. plus.

THE possibilities of extending this same principle to 4-electrode valve circuits appeared attractive, as with the ordinary Phillips 4-electrode valve, with the second, inner grid simply connected to the L.T. plus so as to control the steady choking effect of the "space-charge," one obtains without further complication a performance very similar to that of a rather ungenerous R-valve used with moderate H.T.; whilst using actually only the potential drop in the filament-resistance when in conjunction with a six-volt L.T. battery.

Audio-Frequency Reaction

The writer showed in *Wireless Weekly*, Vol. 2, No. 2, p. 52, how an attempt can be made to get a measure of audio-reaction by means of the conventional feed-back device of L.F. transformer primary winding inserted in the plate circuit, the secondary being connected with the grid. In this case the second, inner grid was chosen. Unfortunately, the grid-to-filament impedance of the ordinary Phillips valve is fairly low—nearly half-a-milliampere current will be found to be flowing in the inner-grid circuit at times—so that only a slight or illusive effect can be obtained by feeding-back L.F. energy to this grid. The writer observed with one 4-electrode valve an audio-reaction effect of small magnitude, and extremely elusive, by using a plain audio-choke in this grid circuit; but this was not reproduceable with other specimens. The comparatively small signal-strength, and particularly the effect of small alterations in the circuit on the efficiency of the H.F. reaction one is endeavouring to apply to the aerial-circuit with this low power, require extreme caution in interpreting the immediate results observed.

A Recently Published Circuit

Thus in one circuit recently published, with a 4-electrode valve and about 2 volts effective H.T. from a 6-volt accumulator, in an

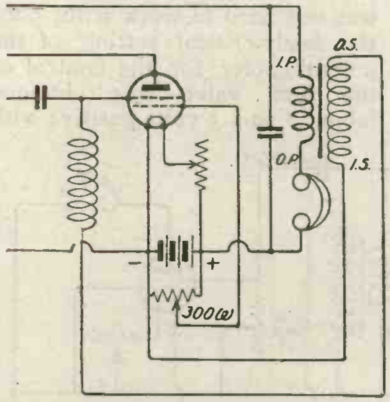


Fig. 2.—Direct potentiometer control of the inner grid.

otherwise ordinary Dutch circuit, an L.F. transformer is shown with the primary (or low-impedance) winding in series with the 'phones, and the secondary (or high impedance) winding simply short-circuited across the former two. The effect of this will be, of course, precisely zero, as far as useful build-up of signals is concerned—as five minutes' careful trial will show—provided that: A, the transformer has a fairly low-impedance primary (so as to choke back the audio signals as little as possible), and a large enough secondary so that that acts as an effective audio-choke and shunts away as little from the 'phones as possible, i.e., that the transformer is a high-ratio one; B, that the regular by-pass condenser of .001 or .002 μF across 'phones and transformer primary has not been omitted, so that there is a free path for the H.F. energy, and, therefore, effective reaction. In the absence of this by-pass condenser the effect of adding a transformer in the plate circuit across the 'phones may be actually to provide an easier H.F. path, via the distributed capacities in the windings (which are by no means negligible), and therefore improve the reaction-effect to an extent which may be very noticeable in the 'phones, in spite of the added audio-impedance in series with them. There is often considerable latitude for improvement in efficiency of reaction in these circuits, with the low H.T. and plate-current available; particularly in a heavily-damped, direct-coupled circuit of considerable H.F. resistance, and with a large parallel tuning condenser across the inductance.

Dispelling the Illusion

The writer has actually observed this delusive phenomenon, which might very easily be attributed incautiously to a genuine audio-reaction effect; the provision of the proper by-pass condenser dispels the delusion at once. The effect, if any, is then found to be merely a slight lowering of signal-strength, and some alteration of the tone.

Genuine Audio Reaction

In an attempt to get genuine audio-reaction of appreciable value with a 4-electrode valve, the experiment was tried of feeding back to the first or outer grid, in the same manner as had proved quite successful with 3-electrode R valves. The result was, briefly, disappointing. Whether control over howling was obtained as in Fig. 1, by potentiometer through the secondary winding of the feed-back L.F. transformer to the outer grid (as in the former circuits); or by direct potentiometer control of the inner grid, as in Fig. 2; or—as in the ST100 circuit—by a variable resistance across (outer) grid and L.T. plus (Fig. 3), the best results obtainable were always inferior to those with the Phillips 4-electrode valve used in the straight Dutch circuit, *i.e.*, with the inner grid to the L.T. plus and no audio feed-back. The extra power available (giving in some instances as much as .5 milliampere plate-current, and free oscillation on a large P.M.G. aerial when used with a small series condenser as indicated in the figures) gave signals almost precisely on a par with those obtained with a liberal French R valve *with* audio-reaction; and howling set in before any useful addition could be made by applying audio-reaction. If there was anything to choose between them, the R valve with audio-reaction gave perhaps slightly stronger signals; whilst the 4-electrode valve in a straight Dutch circuit oscillated the more readily, and was easier to work with.

Using an R valve with audio-reaction as the first valve in a two-valve circuit; and reactance-capacity coupling to a 4-electrode valve used as note-mag., the circuit in Fig. 4 was obtained; and on trial gave good results and quite fair amplification, though, of course, a long way short of what would be given with a little real H.T. to help. The amplification-ratio fell a good deal short of that otherwise obtainable with the transformer (Pye. No. 1) used. The circuit was not hard to work with, once the fairly-critical setting of the potentiometer for the control of the first valve was obtained (about 1 to 1.5 volts positive with the valve used by the writer, a Metal R). The variable grid-leak on the second valve requires careful setting: a *small* positive bias is all that is necessary, so that a variable grid-leak with high maximum should be tried. If the grid becomes appreciably negative, the signals vanish altogether. The writer used a large Lissen variable anode-resistance, of long range, here.

One may even go so far as to take audio-frequency reaction back across two valves, as in Fig. 5. Either three or four-electrode valves can be used in the note-magnifier position; the first must be a hard R valve, for the reason given above. If a four-electrode valve is used a negative grid-bias of say 1.4 volts can be applied, with great improvement in signal-strength: the valve comports itself here more as an ordinary valve with effective H.T. This is certainly a critical circuit, requiring very careful adjustment of potentiometer and H.F. reaction to avoid howling; but on trial it actually worked, and gave quite good amplification. The fixed grid-leak on the first valve imparts a little more stability.

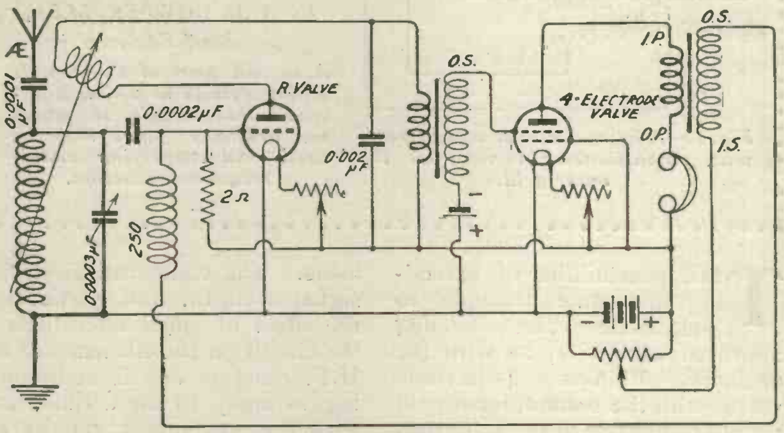


Fig. 5.—An interesting circuit with audio-frequency reaction across two valves.

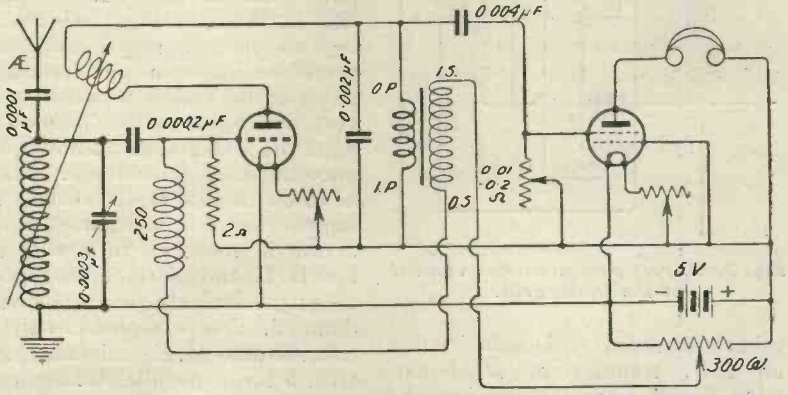


Fig. 4.—A circuit using audio-frequency reaction and a four-electrode valve as amplifier.

The Three-Valve Dual Receiver

("Modern Wireless," April issue).

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.

JOTTINGS BY THE WAY

In the Swim

IF there is one thing that I do like it is to keep both myself and my wireless set thoroughly up to date. It is a positive pain to me, for instance, if having wired my latest receiver with square tinned rod I find that Poddleby has got one ahead by using hexagonal rod for his.

The Only Way

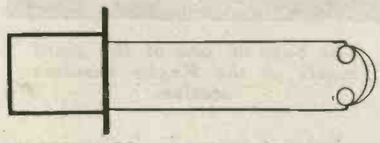
Naturally I tear the whole thing to pieces at once and substitute the proper stuff, and I am just in the throes of applying the last blob of solder when my soul is seared by the entrance of Gubblesby, who produces from his pocket a sample of the latest octagonal stuff which is to be on the market, so he tells me, the week after next. Before the days of wireless I, like many other mere males, had often speculated upon the trouble and pains which it must cost a lovely woman to keep abreast of the tide of fashion, or even one day ahead of it. But all her struggles, I make bold to say, are as nought compared with those of your real wireless enthusiast filled with the proper burning desire to be up to date. This wiring business is bad enough alone, and my soldering iron is worn to a shadow of its former self. It has given poor Professor Goop a pretty hectic time, for he is very short-sighted and finds soldering a very difficult business even at the best of times. You never quite know where he is going to place the blob that hangs upon the point of his iron. Not long ago, when his better half was sitting reading with her back turned to the table upon which he was working, he affixed her silver waistband unintentionally, but quite neatly, to one of his L.T. busbars, and as he then went out for his daily ten mile walk the poor lady was held prisoner several hours until he returned to release her. His latest adventure is one which will incite the sympathy of all wireless men. Requiring some more fluxite, but quite unable to remember the name, he went to the cupboard in which all kinds of household requirements are kept, and seized a small tin of the well-known size and shape. When I called upon him on the following day I found him in a terrible state of mind. The panels of his set looked more like a treacle pudding than anything else, a ghastly frying smell filled the room, which was full of blue smoke, and the Professor was tearing his hair on account of his inability to make any joint stick.

A Novel Flux

On investigation I found that he had spent half the night and all the next morning in endeavouring to make his joints with Zambuk as a flux. The directions on the tin inform the world that it is excellent stuff for joints, but it does not seem somehow fitted for those in the wireless set where stiffness *is* a desirable quality.

Elimination.

I thought I had settled down with a fairly respectable circuit arranged and wired in the most



My new circuit.

modern way when suddenly this terrible craze for elimination hit me. I have always regarded the high tension battery as a harmless and inoffensive thing not very expensive to buy and needing no great experience for its proper employment. True it crackles at you at times, but that is merely its little way of showing that you are asking too much of it. Does not the free and independent Briton go on strike at once from overwork? Then why in similar circumstances, or when it is nearing the old age pension limit, should not the high tension battery go on the crackle? However, experts have decreed that the poor H.T.B. must go. Therefore, as one who is ever in the swim, I promptly flung mine out of the window and decided to do without it. It expired grandly, for in its elimination it has eliminated also Poddleby's prize goldfish, whose bowl had been thoughtlessly placed close to the wall which separates our two demesnes. This done I went out and bought a four-electrode valve for £3 10s., thus saving minus £2 17s. 6d. on my new set.

Pride of Possession

However, it is something to possess a four-electrode valve. Have *you* got one? Ah, I thought not. There you are, you see. After rigging up a wondrous circuit I was amazed to find that I obtained signals, though I must confess they were rather on the feeble side. I rushed round to consult Professor Goop, who told me that I must use a six-volt accumulator. "But the filament of this valve is only supposed to take 3.5," I protested. "Quite," replied the Professor, "but you must have a six-volt accumulator for all that." Then he talked quite a lot about voltage drops and things of that kind, explaining that what you lost on the swings you gained on the roundabouts, or, in other words, that by straining out the odd 2½ volts in the rheostat you can push them on to the plate. Hence I visited the wireless shop again in search of another accumulator cell and so saved a further Rehsif; a Rehsif, I should explain, is the reciprocal of a Fisher. All being now ready, and feeling light in heart and pocket, I connected up and had the joy of hearing 2LO faintly but clearly. What, after all, does the sacrifice of a bit of signal strength or the shattering of a bank balance matter so long as you have the knowledge that your set is really up to date?

Going One Better

Then it occurred to me that elimination in various forms was likely to be the order of the next few months, and I could get well ahead of my friends by going thoroughly in this question and investigating its possibilities. With this end in view I have been conducting, in conjunction with Professor Goop, a series of experiments, the results of which I now give to readers of *Wireless Weekly*, so that they may be able at once to bring their sets at least three months ahead of the fashion

Expense no Object

As expense appears to be no object when one is eliminating I would say that the first step which the enthusiast should take is to sell his present house for what it will fetch and to purchase one within half a mile of 2LO. This is essential for the best results, and it is merely carrying out the ancient saw that if the mountain will not come to Mahomet then Mahomet must go to the mountain. Of course, it is quite optional which broadcasting station is chosen. You may, if you so desire, purchase your new house in Manchester or Newcastle, Glasgow or Aberdeen. If your work would require your presence in London you will find that the train services are excellent, and that season tickets can be obtained from these places to the Metropolis at quite reasonable rates. The true enthusiast will, of course, purchase a house at each broadcasting centre and instal a properly eliminated set therein. He will thus be able, by means of a short train journey, to enjoy programmes broadcast from any part of the country.

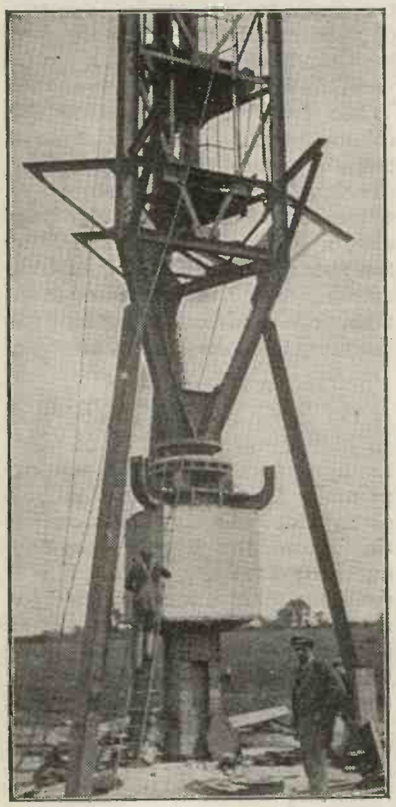
Another Way

Should the finances not run to the multiple home it is usually quite easy to arrange for a short sojourn at His Majesty's expense quite close to any broadcasting station. Most of these centres are provided with commodious and up to date jails into which the enthusiast can have himself flung by the simple expedient of breaking a shop window or bonneting a policeman. As the receiving apparatus is so very simple the said enthusiast will have no difficulty in concealing it, especially if he wears his hair rather on the long side.

An Experiment

The Professor and I took a simple *pied à terre* in the Adelphi and set about eliminating in good earnest. First we scrapped the valve, then the aerial was for it. The earth, of course, went too. The tuning inductance and its condenser seemed unnecessary excrescences, so we consigned them to the dustbin. The crystal detector also appeared an unsatisfactory kind of thing, so we got rid of that. This leaves us the circuit shown in the diagram, which beats any of them for sheer simplicity. This circuit I am proud to say, knocks each and everyone that has previously been produced absolutely off the mat. It contains also a brand new conventional sign. The thing which looks like a top hat turned sideways is simply a fireplace with an iron mantelpiece. Great care should be taken in choosing your receiving house to see that it contains one of these. If it does, and provided that it is within the prescribed radius of the broadcasting station, you will find that a pair of 'phones provides all the apparatus that is necessary for broadcast reception.

AT RUGBY



The base of one of the giant masts at the Rugby wireless station.

Hard Lines

Professor Goop and I having made this discovery saw wealth unbounded within our grasp. We hastened to the Patent Office to file our claim. But there, I am sorry to say, we met with no very encouraging reception. It appears that you cannot patent fireplaces with iron mantelpieces for several other johnnies have done that already. Nor can you patent telephones, for they, too, are amply covered. It was a disappointment, of course, but these little things will happen. We looked into each other's eyes and I said, " Goop, we are no profiteers. We will not seek to make filthy lucre out of our fellow wireless men. Nay, we will publish our discovery abroad so that they may all use it. The world will bless the combined names of Wayfarer and Goop, and even if Lockhart's rather than the Ritz is to be our dining place we shall have the satisfaction of knowing that ours are to be amongst the great names of wireless." It was nice to talk like this, and we both felt better after we had wept a little. The Professor is not quite satisfied with the circuit, for he is still hopeful of eliminating both the 'phones and the mantelpiece and training the drums of his ears to rectify. Time alone can show what his great brain will accomplish.

WIRELESS WAYFARER.

The 1,600 Metre Wave

HOW TO CONVERT EXISTING SETS

This article contains a host of practical hints for every owner of a wireless receiver.

BY the time this article appears many readers will be contemplating the changes necessary in their sets to receive the experimental transmissions of the new high-power broadcasting station. These, as has previously been pointed out,

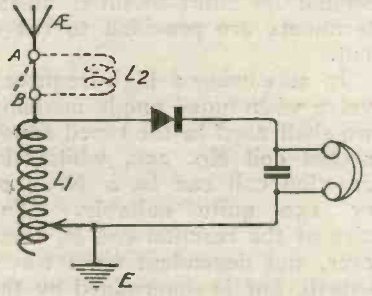


Fig. 1.—The wrong way to add a loading coil.

will take place on a wavelength of 1,600 metres, a wavelength which is some 1,100 metres longer than any so far used for British broadcasting. Practically all commercial sets are built in such a way that this wavelength can be received, for it is very close to that used by the Radiola transmissions from Paris (1,780 metres), and, of course, is shorter than the ever-popular Eiffel Tower transmissions on 2,600 metres. Commercial sets can be divided into two main classes, i.e., (1) those which

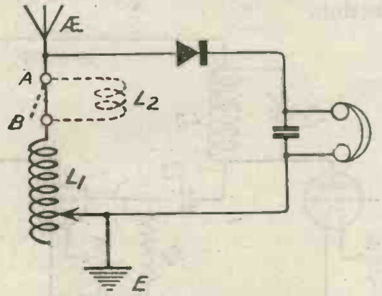


Fig. 2.—The right way.

have self-contained tuning units brought into operation by switches and condensers, and (2) those which tune with plug-in coils.

Plug-In Coils for Commercial Sets

Ready-made sets tuning with plug-in coils will need, if such are not already provided, a No. 150 coil for the aerial socket, a No. 100, or larger, for reaction, a No. 250 for the tuned anode, if one is used, and, in those rare cases where a tuned loose-coupled set is used, a coil of the same size as that in the tuned anode for the secondary winding. If plug-in transformers are used for high-frequency coupling then it will be necessary to change the transformer for the change in wavelength.

Conversion of Home-Made Sets

By far the larger proportion of our readers, however, will be

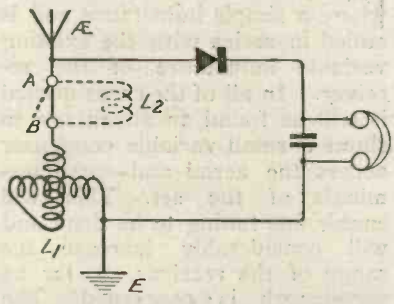


Fig. 3.—A loading coil for variometers.

those who have built their own sets, and are naturally anxious to see what is necessary in order that their particular receivers may be adapted to the new wavelength. In this article are published a number of circuits which we think will provide practically all the necessary data for changing most of the existing sets.

Crystal Set Conversions

The simplest of all crystal sets is that consisting of a coil on which runs a single slider. The theoretical circuit of such a set is shown in Fig. 1. It is customary to make such sets to tune up to 600 or 700 metres, and, naturally, with the maximum inductance in circuit we shall not be able to reach anything approaching the wavelength of the new station. It will, therefore, be necessary to add a "loading coil." As the sole purpose of this coil is to increase the inductance of the aerial and

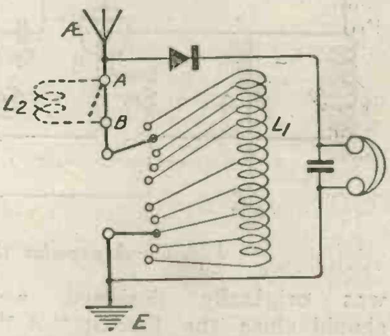


Fig. 4.—Adding a coil to a "units and tens" receiver.

thus make it respond to a lower frequency or longer wavelength, the additional coil must be inserted in series. Do not fall into the error of placing it in series with the aerial, but out of circuit with the detector. In Fig. 1 you will find two terminals marked "A" and "B," placed directly in series with the aerial and joined by a link. If we open the link, as shown by the dotted line, between "A" and "B" and insert the coil L2 it will fall in

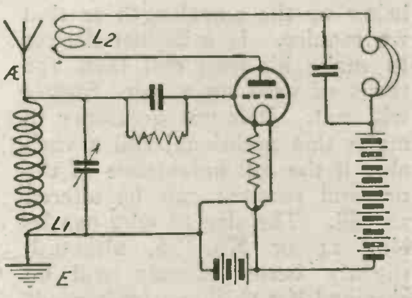


Fig. 5.—Simple single-valve circuit.

series with L1, and will increase the wavelength to which the aerial will respond. However, it will now be noticed that the crystal detector is shunted across only a portion of the total inductance in such a way that whilst signals would be received if close to the new station, the strength will be far less than it should be. We must, therefore, be careful when inserting a loading coil to place it as shown in Fig. 2, which indicates the correct arrangement of a crystal receiver with loading coil L2. When we desire to use the shorter wavelengths for which the receiver was originally designed, we should close the link at "A" and "B," thus short-circuiting the coil L2, which can, if necessary, be removed.

Fig. 3 shows a simple variometer set with the coil L2 inserted in series. Here again we must be careful to avoid the fault shown in Fig. 1. A point will now occur to us: What is the correct size for this coil? In practically all cases it will be found that a coil which is the electrical equivalent of a No. 150 of any of the recognised makes of plug-in-coil will suit here, as this, with the inductance already included in the receiver, will bring up the wavelength to that we require. If a builder desires to make his own coil then 150 turns of wire on a 3-in. former will suit. It is not necessary to make this additional coil a variable if the full inductance of the original receiver can be altered at will. The size of wire can be No. 24 or No. 26, although slightly better signals will be obtained if a thicker wire is used. The disadvantage of the thicker wire is that the coil will be unduly long; for example, 150 turns of No. 18 d.c.c. wire will occupy approximately 9 inches on a former, whilst No. 15 would occupy about 14 inches.

Perhaps the most satisfactory additional coil for a crystal receiver, particularly when a plug socket is provided to plug-in a loading coil, is the basket type, full particulars for the making of which will be found in Mr. G. P. Kendall's book, "Tuning Coils and How to Wind Them." The aim in winding this should be to make a coil equivalent to a No. 150 plug-in coil.

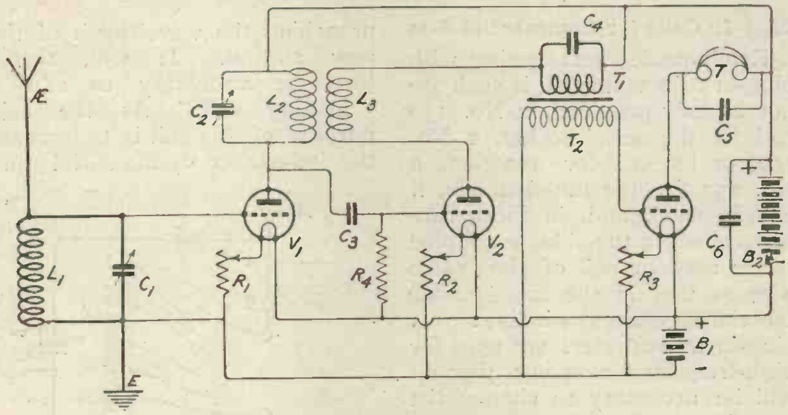


Fig. 6.—A popular three-valve arrangement.

Fig. 4 shows the arrangement of a crystal receiver made with the popular units and tens switch. So far, we have dealt with cases where a simple inductance coil is added in series with the existing variable inductance of the receiver. In all of the cases quoted it will be found an advantage to shunt a small variable condenser across the aerial and earth terminals of the set. This will enable fine tuning to be done and will considerably increase the range of the receiver, so far as wavelength is concerned. The addition of a condenser will not, however, increase the sensitiveness of the set, although the easier tuning may give the impression that the set is more sensitive than before.

Crystal Sets with Condenser Tuning

A number of crystal sets will have been made up in which a fixed inductance is tuned with a variable condenser shunted across it. In such cases we must introduce the loading coil between one end of the inductance and the aerial terminal in such a way that the condenser is shunted across the whole of the inductance, both original and additional.

Conversion of Valve Sets

It is probable that the great majority of valve sets are made to tune with plug-in coils, in which case, of course, we have only to change the particular plug-in coil used for aerial tuning from, say, the 25, 35 or 50 we are at present using, to a No. 150. Fig. 5 shows a simple single-valve reaction set in which both L1 and L2 are plug-in coils. L2 can be in the case of the longer wavelength a No. 100, 150 or 200, depending upon the ease with which the valve will oscillate, and whether or not we are using a high- or low-resistance aerial. Constant aerial tuning, which is very effective on the shorter broadcast wavelengths is not recommended for the longer waves, and the C.A.T. condenser should be short-circuited unless terminals are provided to cut it out.

In sets using a high-frequency valve with tuned anode coupling we shall need in the tuned anode socket coil No. 250, whilst the reaction coil can be a No. 100 or 150 quite suitably. The size of the reaction coil is, however, not dependent upon wavelength, but is determined by the facility with which oscillations can be set up. Some sets oscillate more freely than others, as do some kinds of valves, and the particular aerial we use will also have a bearing upon this subject. Perhaps the best way is to try which of the several coils we have available gives the best results. The aim should be to have the coil only just large enough to make the set oscillate when the reaction coupling is rather tight. Fig. 6 shows a popular 3-valve circuit with one stage of high-frequency, detector and one note magnifying valve. The coils here can be 150 in the aerial, 250 in the anode, and, say, 200 in reaction.

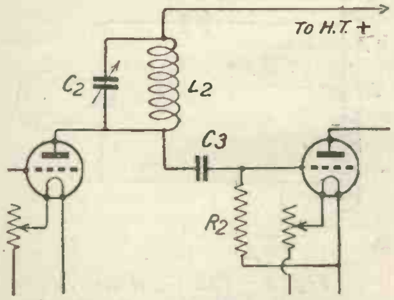


Fig. 7.—Tuned anode coupling.

Sets with High-frequency Transformers

A number of sets use plug-in transformers for high-frequency coupling. Here it will be necessary to change the transformers for sizes which are suitable to the new wavelength.

ST100 Conversion

Practically all the ST100 sets are worked with plug-in coils. For the new wavelength we shall require a No. 150 without constant aerial tuning in the aerial socket and a No. 250 or its equivalent in the anode socket.

Use of Resistance Coupling for Long Wavelengths

It is not generally known that very effective high-frequency amplification is obtainable in tuned anode and tuned transformer sets

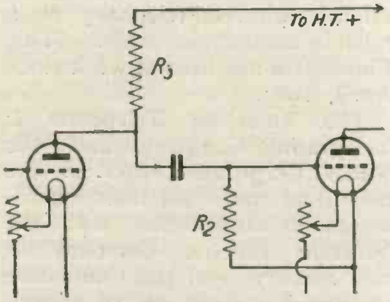


Fig. 8.—Resistance coupling.

with resistance coupling. The conversion from the tuned anode or tuned transformer to the other form of coupling is very simply made, and, being inexpensive, will probably appeal to a large number of readers. In addition, resistance coupling is untuned, and, therefore, we are able to eliminate one adjustment, this making for simplicity. Consider for a moment Fig. 7, which shows the high-frequency portion of a set using tuned anode coupling of a conventional type. Here C2 is the variable condenser tuning the anode inductance L2, whilst C3 and R2 are the coupling condenser and the leak respectively. Fig. 8 shows the same set converted for resistance coupling. It will be noticed that the sole change is the removal of the variable condenser C2, the coil L2, and the substitution of the resistance R3. This, in practically every case, can be a fixed resistance of 80,000 ohms, or we can utilise one of the variable anode resistances running from 50,000 to 100,000 ohms, and sold for use with ST100 and other similar circuits. If we take one of these resistances and mount it up in some suitable form upon a plug socket we can set our variable condenser C2 at zero, pull out the anode coil and plug-in the new unit R3, whereupon the set will be converted to resistance coupling which is very effective on a wavelength of 1,600 metres, although not quite so efficient as a well adjusted tuned anode.

In Fig. 9 we have the circuit arrangement of a transformer-coupled high-frequency stage. Here the condenser C2 tunes the primary AB, the secondary CD being untuned and connected to the grid and filament respectively. It will be noticed here that in the majority of cases the leak R2 is placed across the condenser C3. In practically all cases the plug-in transformer is mounted on the standard valve base, the four pins giving the connections A, B, C and D. Let us now pull out the transformer and substitute a new unit mounted on a valve base in such a way that legs corresponding to A, B, C and D in the plug-in transformer are connected as shown in Fig. 10, *i.e.*, the resistance between A and B, B and C being joined by a wire and D being left open. One other change, however, is necessary. The leak R2 in Fig. 9 must have its position changed to that in Fig. 10. Incidentally it may be remarked that even with plug-in

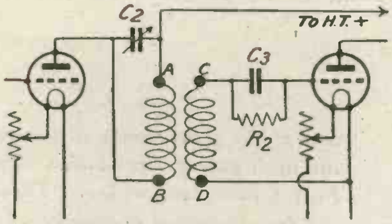


Fig. 9.—Transformer coupling.

transformers the set will work just as well with a resistance joined as shown in Fig. 10, so that once the alteration has been made this resistance need not be changed back again when we replace the transformer. In this case also it is essential to have the tuning condenser C2 in Fig. 9 placed at minimum, otherwise, as will be seen from examination of the dotted connection in Fig. 10, the capacity will be shunted across the resistance and will effectively by-pass energy which we require for other purposes.

Multi-Stage H.F. Connections

If two stages of tuned-anode high-frequency are used, we can plug-in two resistances as previously explained. If, however, two stages of transformer coupled high-frequency are used then the first plug-in unit will have to consist of something more than that shown in Fig. 10, and will have to include 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, as readers know, uses two plug-in transformers for the shorter waves.

P. W. H.

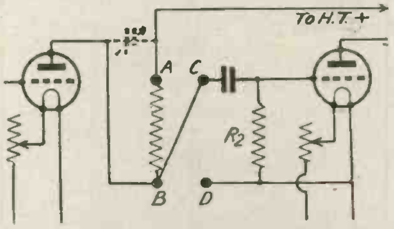


Fig. 10.—Conversion of transformer to resistance coupling.

WIRELESS NOTES AND NEWS

The date of opening of the Liverpool relay station has been postponed to June 11. The Lord Mayor will declare the station open, and his speech, together with that of Mr. J. C. W. Reith, managing director of the B.B.C., will be simultaneously broadcast from all stations.

□ □ □

The interference caused to the programmes of the British Broadcasting Company through naval wireless signalling is receiving the attention of the Admiralty, who are considering the question of reducing the destroyer wavelength to below 300 metres.

□ □ □

Pending an official decision on this matter, however, naval signalling between 7 and 10.30 p.m. each evening is to be avoided as far as possible.

□ □ □

The talks from the B.B.C. stations in future are to be more topical, for several half hours a week. The subjects and speakers will only be settled on the day before the talk.

Transatlantic Radiotelephony

POSSIBILITIES OF REGULAR SERVICE

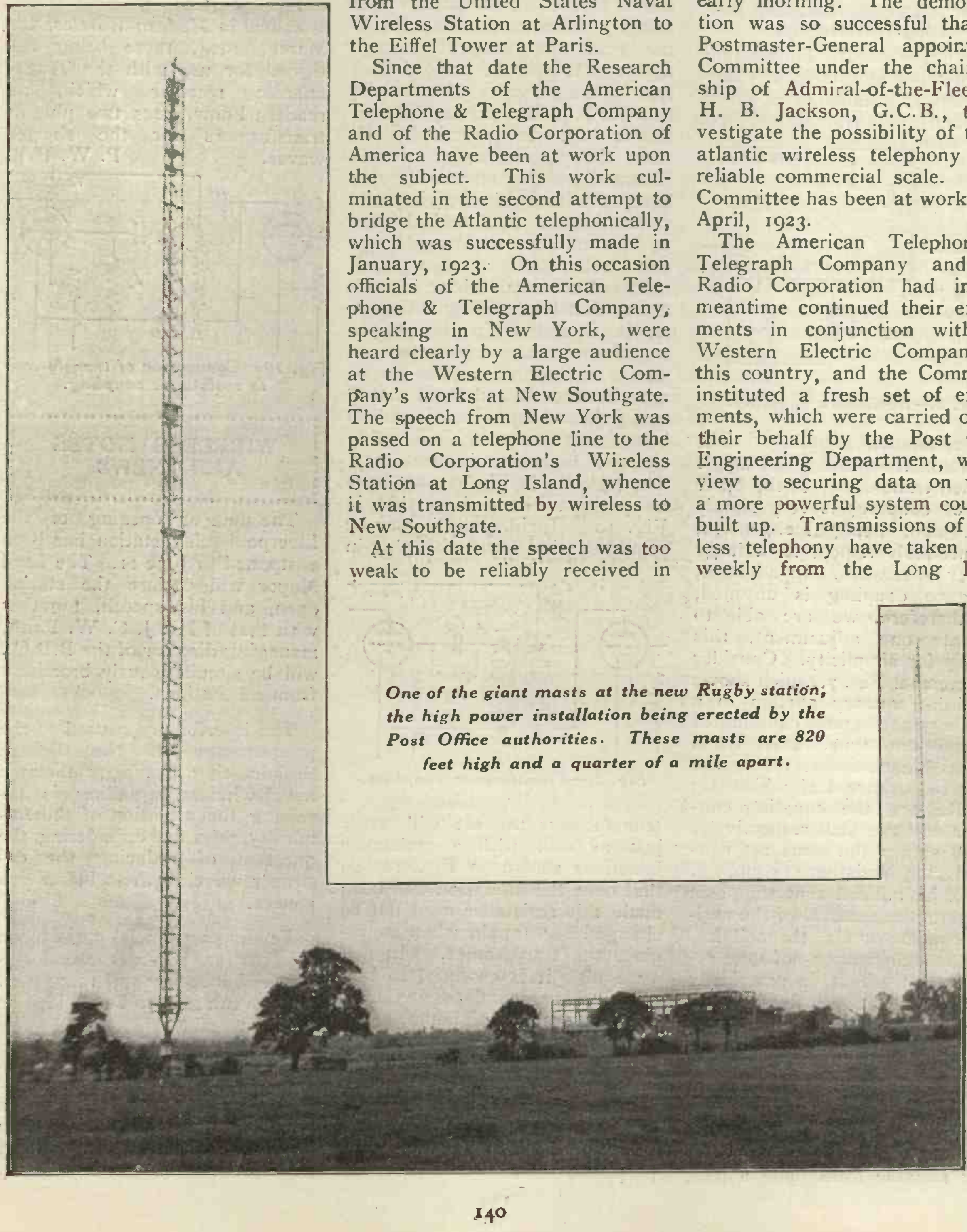
In this article a clear explanation is given of the present state of transatlantic telephony, and many interesting facts are revealed.

THE recent advances in the science of wireless telegraphy, including more particularly the invention of the Thermionic valve, have brought within the bounds of possibility the linking up of the American and European telephonic systems by wireless, which is impracticable with existing types of submarine cable. The first step in this direction was made during the war, in 1915, when speech was transmitted by the American Telephone & Telegraph Company from the United States Naval Wireless Station at Arlington to the Eiffel Tower at Paris.

Since that date the Research Departments of the American Telephone & Telegraph Company and of the Radio Corporation of America have been at work upon the subject. This work culminated in the second attempt to bridge the Atlantic telephonically, which was successfully made in January, 1923. On this occasion officials of the American Telephone & Telegraph Company, speaking in New York, were heard clearly by a large audience at the Western Electric Company's works at New Southgate. The speech from New York was passed on a telephone line to the Radio Corporation's Wireless Station at Long Island, whence it was transmitted by wireless to New Southgate.

At this date the speech was too weak to be reliably received in hours when there was daylight in both countries, but was quite clear and loud at night and in the early morning. The demonstration was so successful that the Postmaster-General appointed a Committee under the chairmanship of Admiral-of-the-Fleet Sir H. B. Jackson, G.C.B., to investigate the possibility of transatlantic wireless telephony on a reliable commercial scale. This Committee has been at work since April, 1923.

The American Telephone & Telegraph Company and the Radio Corporation had in the meantime continued their experiments in conjunction with the Western Electric Company in this country, and the Committee instituted a fresh set of experiments, which were carried out on their behalf by the Post Office Engineering Department, with a view to securing data on which a more powerful system could be built up. Transmissions of wireless telephony have taken place weekly from the Long Island

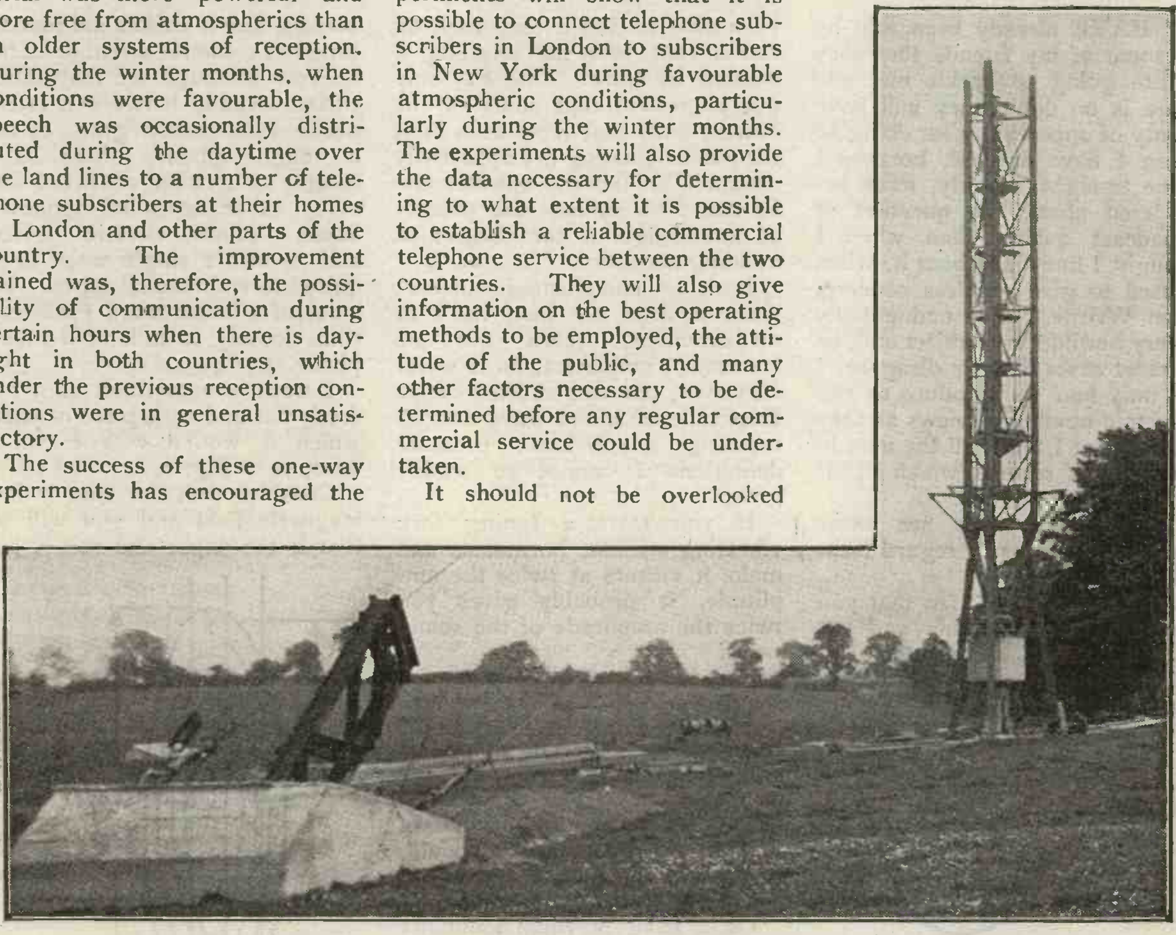


One of the giant masts at the new Rugby station, the high power installation being erected by the Post Office authorities. These masts are 820 feet high and a quarter of a mile apart.

Station, which have been received and measured in this country by the Post Office and by the Western Electric Company. In the January, 1923, demonstration a simple loop frame aerial was employed at the receiving end. A special receiving aerial was built by the Post Office, and tests showed that reception on this aerial was more powerful and more free from atmospherics than on older systems of reception. During the winter months, when conditions were favourable, the speech was occasionally distributed during the daytime over the land lines to a number of telephone subscribers at their homes in London and other parts of the country. The improvement gained was, therefore, the possibility of communication during certain hours when there is daylight in both countries, which under the previous reception conditions were in general unsatisfactory.

The success of these one-way experiments has encouraged the Committee to recommend to the Postmaster-General the installation of an experimental 200 K.W. telephony valve transmitting plant at the new Post Office station at Rugby, of a similar type to that in use for the experiments in America, so as to enable two-way conversations to be carried out. It is hoped that these experiments will show that it is possible to connect telephone subscribers in London to subscribers in New York during favourable atmospheric conditions, particularly during the winter months. The experiments will also provide the data necessary for determining to what extent it is possible to establish a reliable commercial telephone service between the two countries. They will also give information on the best operating methods to be employed, the attitude of the public, and many other factors necessary to be determined before any regular commercial service could be undertaken.

It should not be overlooked that there is a very wide gap between a system which is only capable of connecting the telephone services of the two countries under favourable conditions and a system which will give a reliable and continuous service.



A nearer view, showing one of the anchors and a mast in process of construction.

High *versus* Low-Resistance 'Phones

The novice is sometimes a little puzzled by the way in which some of his more experienced friends talk learnedly of the relative merits of high and low-resistance telephones. It seems to him that the higher their resistance the better, since their sensitiveness appears to increase with rise of resistance.

A brief explanation of the matter may perhaps be of use. It should be realised at the outset that when low-resistance 'phones are mentioned it is understood that they will be used with a step-down transformer, known as a telephone transformer, whose function is to reduce the pressure of the telephone current and increase its volume. The resulting larger current is thus able to actuate the low-resistance 'phones to the best advantage, and enables them to give signals which only fall short of those produced by the high-resistance type by an amount corresponding to the losses in the transformer, which should be very small.

Therefore, it may be concluded that where the greatest possible sensitiveness is required, as in crystal sets, high-resistance receivers should be used, while in multi-valve sets it is better practice to employ the more robust low-resistance pattern, which are protected from the harmful effects of the steady anode current of the valves by the telephone transformer.

G. P. K.

Readers will be interested to hear that Dr. E. H. Chapman, staff editor of "Wireless Weekly" and "Modern Wireless," will broadcast from 2LO, on July 3rd, a talk upon the weather.

Faithful Reproduction by Broadcast

By Capt. P. P. ECKERSLEY, M.I.E.E.

A paper recently read before the Radio Society of Great Britain by the Chief Engineer of the British Broadcasting Company.

I HAVE already been told by some of my friends that they are going to heckle me, and there is no doubt they will have plenty of opportunity for doing so when I have finished, because I come to-night, frankly, more bewildered about the question of broadcast quality than when I thought I knew all about it, when I used to give wireless concerts from Writtle. It is undoubtedly a very bewildering subject and, as in most cases doctors disagree, I am only here to introduce to you a certain number of views as they strike what I may call the man in the street of science, which I consider myself.

Technically, there are three paramount points as regard technical policy :—

(1) Strong signals (so that you can use indoor aerials and not have a licence). (Laughter.)

(2) Freedom from interference.

(3) Perfect quality.

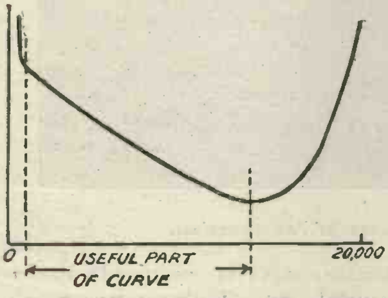


Fig. 1.—The relation of amplitude and audibility.

Now broadcast has two links : one, the transmitter and the other the receiver. It is the problem of quality considered as both from the point of view of the transmitter and the receiver that I am going to talk about to-night.

Before I start the technical part of the subject I want to define essentials. As we all know, sound is a wave motion. That is proved in text books about a yard thick, but they seem to me to prove nothing else except that it is a wave motion. I have never been able to find a text book on sound that told me anything I wanted to know. One has only got to realise that some of the newest halls that have been built for public debating are apparently designed so that no speaker can be heard to indicate the paucity of knowledge of the subject of building acoustics.

It is a complicated subject; since it does not lend itself to measurement, there are no " sound " ammeters, as it were. However, one can at least define amplitude of sound wave and its meaning is obvious; pressure definitions I cannot so readily grasp.

If you start a tuning fork vibrating without harmonics and make it vibrate at twice the amplitude, it probably gives you twice the amplitude of the sound wave.

A Definition.

The first thing to define is the relationship between amplitude and equal audibility over a range of frequencies. For equal audibility whatever frequency of audible sound is created it should, to the average human ear, sound equally loud.

On a basis of equal audibility over a range of frequencies from 0 to 20,000 the curve might be shown in Fig. 1. Generally the amplitude for equal audibility increases towards the bass and naturally at very high notes, since the human ear cannot apprehend sound vibrations above a certain maximum frequency.

The function of the microphone is to convert these sound waves into corresponding electrical variations. There is some confusion with regard to the term microphone. The microphone was first invented as a loose contact device for converting sound into electrical vibrations. The term " magnetophone " has been used for the electro-magnetic types of " sound to electricity " converters, but it strikes me that the time has come for a real definition because although we may differentiate exactly between a microphone with carbon granules and a magnetophone, there is a danger of getting confused with many other types of apparatus flame, 'photo electric devices and so on; a single word is required to embrace all types. For want of a better word I will continue loosely to talk of a microphone.

I want you to think of a perfectly flat and wide piece of paper which is wound with a coil of wire, as in Fig. 2.

Consider that the wire is in a magnetic field and you will see that if the paper and coil is perfectly free in space, the sound impulses hitting it will make it wobble up and down, and you will get certain electrical impulses.

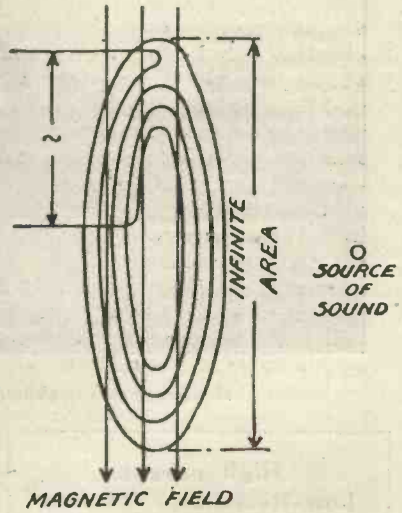


Fig. 2.—An explanation of the magnetophone.

It is interesting to study what happens if equal sound amplitudes A impinge normally at the surface of the armature.

Let F = force on the armature.
M = mass of armature.
V = velocity of armature.
E = voltage produced by armature.

Then $F = M\frac{d^2v}{dt^2}$ but $F = A \sin pt$.

$$\therefore \frac{dv}{dt} = \frac{A}{mp}\cos pt = E.$$

If there is equal amplitude of sound impulses impinging on the armature, the voltages produced (E) will be inversely proportional to the frequency. In other words, it will increase all the electrical amplitudes of the lower tones to the detriment of the higher tones.

Supposing you were to connect the theoretical microphone to an exactly similar coil acting as a "loud speaker," you will have no possible means of distortion and you will have a system which approximates to perfection. The movements of the loud-speaker armature will be proportional to p, and so a perfect system will be achieved.

Turn now, however, to practical conditions. As a public address system, the system described is hardly what I would call practical. Consider a public address system where wireless does not enter into it at all, where I am talking into a microphone which is attached to wires, and somebody is in another room listening to me. One of the first questions is that of amplification. The thermionic valve gives us the opportunity of amplifying distortionlessly. I think it would be worth while to go into the question of amplifying by means of the thermionic valve.

In Fig. 3 is illustrated a curve of a theoretically perfect valve for distortionless amplification, and if you apply a certain negative

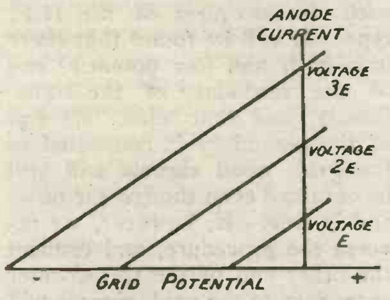


Fig. 3.—Curve of a theoretically perfect valve.

permanent bias to the grid and superimpose on that bias an alternating current, you get reproduced an alternating current of an exactly similar sort in the anode circuit, but magnified. That is obvious. The point which I am almost ashamed to bring to your notice, and yet it is one which is frequently lost sight of, is the fact that every valve amplification system has its limits, and there is an amplitude for a given valve past which you cannot go without distortion and blasting.

Let us therefore now connect a microphone as shown in Fig. 4. In dealing with a system of amplification for this microphone, one does not want the amplitude of the electrical impulses to be inversely proportional to the frequency, because this places a limitation on the overall possible control with a given amplifier. Therefore, you cannot take this moving coil and connect it across the grid filament of the first valve of your amplifying chain and leave it at that; it is necessary to impose a practical connection.

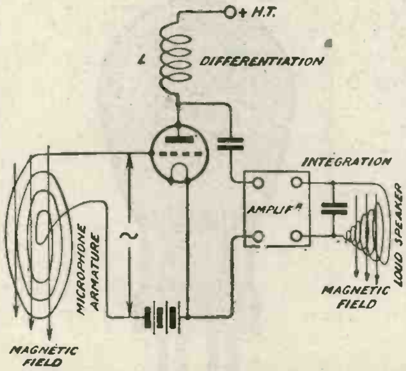


Fig. 4.—Microphone connections.

Thus in the anode circuit of the first valve connect an inductance (L), the impedance of which is small compared with the impedance of the valve. The voltages across this inductance will be proportional to the frequency of electrical impulse across the grid and filament of the valve, but these in turn for equal amplitude of sound are inversely proportional to the frequency. The result is that by a process called differentiation we can arrive at a state of affairs where for *equal audibility* (sound impulses greater in amplitude for bass tones) one can have fed across the differentiating inductances equal electrical impulses. (Obviously a double differentiate is required.)

It now remains to convert back in the loud-speaker system (Fig. 4). You can do that in a number of ways, the simplest being to put a condenser across the loud-speaker, the impedance of the condenser *increasing* for higher frequencies. This process is called integration.

Thus, first your microphone was connected by differentiation so as not to limit your amplification, and therefore your loud-speaker had to be integrated for perfect reproduction.

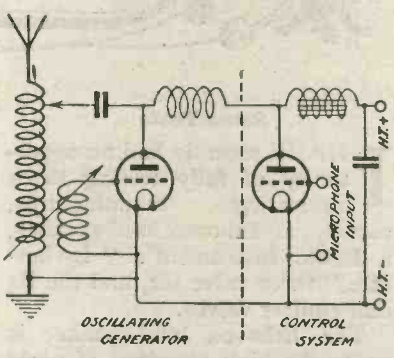


Fig. 5.—The choke control system.

What is the next step? The next step, so far as we are concerned to-night, is to substitute wireless for wire connection. Everyone apparently knows how to set up a wireless telephone transmitter, but not everyone knows how to control it. I have listened. (Loud laughter.) There are two general types: one where the control system requires but little energy to control the output fully; the other where for full control an equal power is required for both oscillator generator and for control system. The former we may call a trigger system. Such a system, however, may be once and for all ruled out for broadcasting, because of the trickiness in handling and the difficulty of receiving by unskilled people.

The only system which we have been able to put into effective use so far—I am not dogmatising and saying it *is* the only system; there may be hundreds of others, but I have not used or tried them—is illustrated in Fig. 5. It is called the choke control system, and equal power is expended in the control system as in the oscillator generator. Its action is so well known as to require no explanation from me.

(To be concluded.)

Valve Notes

By

JOHN SCOTT-TAGGART,

F.Inst.P., A.M.I.E.E.

Some Tests

I HAVE recently had an opportunity of fully testing three interesting manufactures, namely, an Ethovox loud-speaker, a Radio Instrument's "Lyrianette" three-valve set, and the B4 dull emitter valves.

The Ethovox loud-speaker is up to the high standard of parts and sets manufactured by Burndept, Limited. The tone is a trifle lower than that of some other popular loud-speakers on the market, but very many will prefer the mellow results obtainable. The last six months has effectively broken down any tradition that any particular make of loud-speaker is the best. As matters stand at present, there are a number of loud-speakers on the market all equally good and it would be an impossibility to state which particular one was the best. Before purchasing a loud-speaker the tendency is to ask one's friends which is the best, but no real answer can be given to this now, whatever the position was six months or a year ago.

Loud-Speaker Tones

Some loud-speaker manufacturers are, perhaps, a little more enterprising in appealing to the wireless public (to whom the non-technical listener always looks for advice), but there is no striking difference between several well-known makes, although they vary somewhat in their average tone. Even here, many people differ in their opinions as to what sounds the most pleasant.

As regards the Lyrianette set, this is an all-enclosed receiver containing dull emitter valves, a high-tension battery and dry cells to heat the filaments. A loud-speaker is also included in the set which presents a very handsome appearance indeed. I have carried out innumerable tests with this set, and it can certainly be recommended with the greatest of confidence to those who wish to treat a wireless set like a gramophone. The reproduction is loud and clear, and the set will work on the smallest of aerials within 20 miles of a broadcasting station.

The B.T.H. B4 Valve.

As regards the B4 valves, these were asked for to carry out tests for a certain purpose, but the results were so very pleasing that the valves may be recommended for all low-frequency amplification work, as well as for power amplification. Unlike some loud-speaker valves, the degree of amplification is better than an ordinary valve, and the emission is high, giving a high output. The characteristic curve is very straight, and most experimenters will find that the use of these valves in stages of low-frequency amplification will give a marked improvement when signals are strong.

As high-frequency amplifiers they are almost too good, and self-oscillation is very readily obtained, due, no doubt, largely to the high capacity between the electrodes, as well as the high amplification factor.

For public demonstrations at radio society meetings, etc., and wherever the experimenter desires to get the last ounce out of his set, the B4 should prove very popular.

Intervalve H.F. Transformers

With reference to my remarks last week about the importance of variably coupled H.F. transformers being connected the right way round, I am prompted to remind readers that when using H.F. transformers whose windings bear a fixed relation to each other, as in the case of the bought article, it is desirable to try altering the connections. For example, it is rather a good plan to try the effect of simply connecting one side of the secondary of the transformer to the grid of the following valve, leaving the other end open. This idea was suggested in these columns a long time ago in connection with low-frequency transformers, and it is a good plan to do the same thing with transformers of the H.F. type. It will be found that there is a high and low potential end of the secondary of the transformer, and that when one end of the secondary is connected to the grid, good signals will still be obtained even though the other end is free. If, however, we reverse the procedure, and connect the other end of the transformer secondary to the grid, signals will be very weak unless the opposite terminal of the secondary is actually connected to the filament.

Having found which end of the secondary, when connected to the grid, will give best signals with the other end loose, it will usually be found best to make this arrangement permanent, connecting the other end of the secondary to the filament.

High-Tensionless Circuits

I have carried out a large number of tests with the different high-tensionless circuits we have published. With the standard Dutch and French circuits using double-grid valves with one of the grids, usually the inner grid, connected to the positive terminal of the accumulator, good results are obtainable. Connecting an iron-core choke between the inner grid and the positive terminal of the accumulator, which is one of Mr. Cowper's suggestions, made no difference whatever in my own experiments, although another member of my staff did under certain conditions, get an improved effect. The use of a transformer for coupling the anode circuit to the second grid circuit did not give promising results in my case.

Some Trials

As regards the ordinary standard arrangements, I did not find that it was necessary to introduce special coils or capacity reaction to get the double-grid valve to oscillate. All the reaction required could be obtained on an ordinary constant aerial tuning circuit with an aperiodic reaction coil.

The Cowper circuit, using an ordinary valve with audio-frequency feed-back, gave excellent results—the best I have yet had with any H.T.-less circuit. Under certain conditions the full degree of reaction did not seem to be obtainable. The use of a larger reaction coil (say, No. 100) will usually help, but if not, a No. 50 (or No. 75, above 420 metres) shunted by a variable condenser, enables full reaction to be obtained.

I have listened on Mr. Harris' set, using the Cowper circuit, to 2LO at nearly 20 miles, and the results were excellent for an H.T.-less circuit.

A Sub-Panel Series Parallel Switch

THOSE who like to mount as many components of their sets as possible beneath the panel will find the rod-actuated series parallel switch to be described in this article a neat and handy little gadget. A glance at Fig. 3 will show the principle. A three-point switch with parallel arms is required. To one of the arms is soldered rigidly a contact piece A, which may be made of stiff sheet brass. Through a standard brass bush

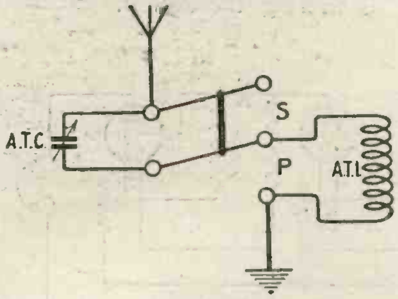


Fig. 1.—Arrangement for series-parallel.

inserted into the panel is passed a short length of 2 B.A. studding whose upper end is provided with a knob. The lower end is split with a fine-bladed hacksaw, the contact rod being placed in this slot and secured with a pin, so that a flexible joint is made. The length of the 2 B.A. studding should be arranged so that when the knob is pushed down until the nut below it is touching the bush the switch is pulled right over to the position shown in the drawing as parallel. A second nut is placed on the studding below the panel, being arranged so that it will not allow the arm when the knob is pulled

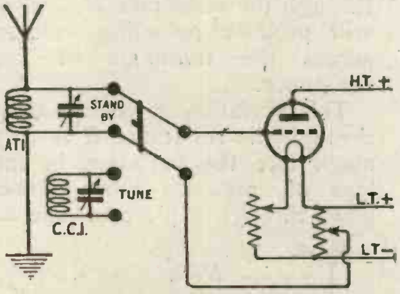


Fig. 2.—Circuit for "Std-bi-tune."

up to travel farther than the series position. This lower nut, unless it fits the threads very tightly, should be secured by a lock nut as well. Fig. 1 shows the wiring of the device as a series-parallel switch. It may also be used as a tune-stand-by switch, but in this case four contact points instead of three will be required. The wiring will be as in Fig. 2. A series-parallel switch is an essential attachment to any set that is used for both the short and medium wave work, whilst the tune-stand-by arrangement is a most convenient fitting. The idea underlying its use is that whilst searching is in progress the set should be made as *unselective* as possible by employing simply a single-circuit tuner. As soon as the desired signal has been picked up and tuned in with A.T.I. and A.T.C. alone, the switch is thrown over to the tune position, which brings in the closed circuit. By suitable adjustments of the coupling and of the C.C.C. interfering signals on nearby wavelengths may then be tuned out, and the desired signal read without difficulty.

R. W. H.

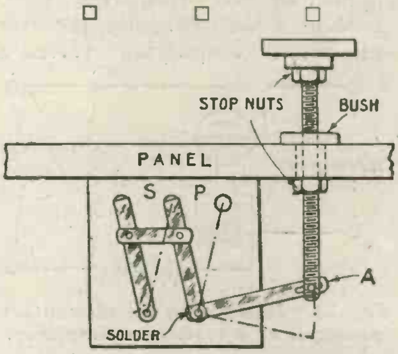


Fig. 3.—Underpanel arrangements.

The Wireless Valve and How it Works

By Professor JOHN H. MORECROFT, E.E., Professor in Electrical Engineering, Columbia University, New York City.

The fifth of a new and exclusive series of articles by this world-famous expert dealing with the principles of valve working.

ONE of the most important roles played by the triode in radio work is that of increasing the strength and making audible signals that would otherwise be too weak to affect the receivers. It is this use of the triode as an amplifier which makes it possible to telephone, by wire, from New York to San Francisco. By the use of proper amplifying valves a speaker in one place may be heard from loud-speaking horns by thousands of people gathered in halls many miles away. It is perfectly possible to-day for a political candidate to address at the same time hundreds of meetings, and the people in each of the halls where the loud-speaking horns and valve amplifiers are located may hear him more distinctly than if the speaker himself were in the hall with them. Actually he may be in his study at home.

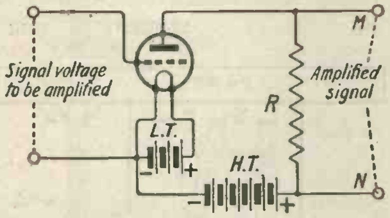


Fig. 13.—Illustrating the elementary principle of a resistance amplifier.

How the Valve Amplifies Received Signals

By using a very small amount of power to affect the potential of the grid of a valve, large amounts of power may be controlled in the plate circuit. The large amount of energy controlled does not come into the receiving circuit from the receiving aerial but from the H.T. battery in the valve circuit. The flow of this large amount of energy through the loud-speaking horns makes no noise as long as the flow is uniform, but if a signal is impressed on the grid of the amplifying valve the flow of energy from the H.T. battery is made to fluctuate, and the form of the fluctuations resembles the signal voltage, and so the voice which is to be reproduced.

Resistance Amplifier

In Fig. 13 is given the elementary idea of amplification using a resistance in the plate circuit of the valve. The signal voltage to be amplified is impressed between the grid and filament of the valve, and, as we know, the variation in the grid potential will produce a corresponding variation in the value of the plate current. This pulsating plate current flows through the resistance *R*, and so will produce pulsating voltage across the terminals of this resistance.

This variation in voltage drop through the resistance *R* is very much like the variation in the loss of pressure when water flows through a piece of pipe or hose. If the water system to which the pipe is attached has a pressure of 100 pounds per square inch there will also be this much pressure at the end of the piece of pipe, provided no water is flowing through the pipe; that is, if the valve at the end of the pipe is closed. But if the valve at the end of the pipe is open, so that water can flow, the pressure at the open end of the pipe will now be less than 100 pounds, because of the loss of pressure in the pipe itself. This loss of pressure will depend directly upon the amount of water which is allowed to flow through the pipe; if the valve is nearly closed so that but little water can flow, the pressure at the end will be nearly 100 pounds, but if the valve of the pipe is opened wide so that much water can flow, the pressure at the end of the pipe will be almost nothing. But if the pressure at the of the pipe is less than 100 pounds the difference must have been used up in forcing water through the pipe. So we get the idea that the drop in pressure through the pipe is proportional to the amount of water flowing through it. In the same way the drop in electrical pressure, or voltage, through the resistance *R* of Fig. 13 is proportional to the plate current which is flowing through it.

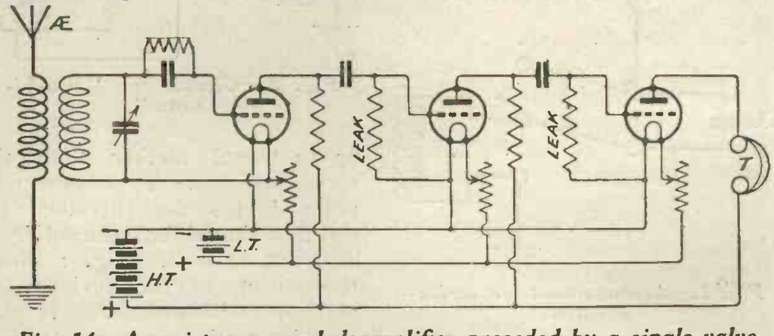


Fig. 14.—A resistance coupled amplifier preceded by a single valve detector circuit.

If the valve circuit given in Fig. 13 is operating properly the pulsation in voltage across *R* will be of the same shape as the signal voltage but much larger; with the ordinary valve and suitable resistance, about four times as large. The amount of power used by the grid in changing the plate current, it must be remembered, is practically nothing.

Much the same action might be produced with a flow of water instead of a flow of electrons. If a fire hose were equipped with a valve about the same as the ordinary tap it would be very easy to shut off or start the powerful stream of water. A small child, by vibrating the valve handle, could produce corresponding pulsations in the stream of water, and the power in the pulsations of the water stream would be thousands of times as great as the child could possibly exert. The grid in the triode performs the same function as the valve. permitting weak voltages to control powerful streams of electrons.

Adding Valves to Obtain Greater Amplification

Instead of being satisfied with the amount of voltage amplification which can be obtained from one valve, it is quite feasible to connect points *M-N* of Fig. 13 to the grid and filament of another valve. The voltage impressed on the grid of the second valve would be then four times as great as the voltage of the signal which was impressed on the grid of the first valve. The points of the resistance of the second valve, corresponding to points *M-N* of the first, may be connected to the grid and filament of a third valve. As the voltage impressed on the grid of the third valve has been increased *four* times by the first valve and then again *four* times by the second valve, the third valve will have impressed on its grid a voltage 16 times as large as the original signal voltage.

Such a scheme is shown in Fig. 14; the whole arrangement is called an *amplifier,* and some such arrangement is used in every good receiving set. An amplifier is said to be "two-stage," or "three-stage," etc., according to the number of valves used. The one shown in Fig. 14 consists of one detector valve and two amplifying valves, or we might say of a detector and a two-stage resistance coupled amplifier.

By such an arrangement it is evident that the signals, which, with a one-valve receiving set, are only faintly audible, may be made very loud. This question will at once occur to the reader: If such a connection of valves will amplify weak signals, why not use more of the same arrangement and amplify signals several million times.

By How Much can we Amplify?

By means of such an amplifier just described it should be theoretically possible to amplify the sound made by a fly walking on the diaphragm of a telephone receiver, so that it would sound like the blow of a trip hammer, and such is really possible if necessary. In radio receiving sets it does not pay to amplify more than a certain amount because not only is the signal voltage amplified by the valves but also all similar voltages, from any cause whatever.

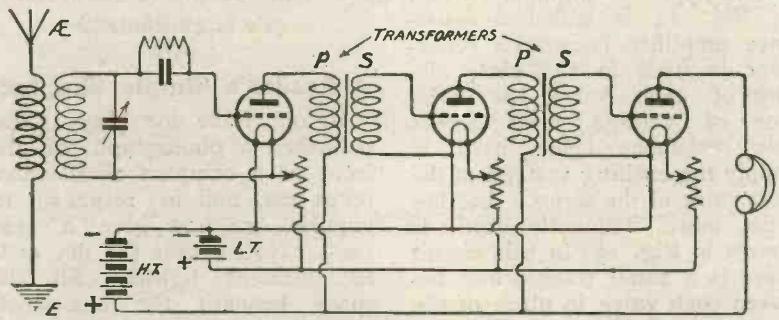


Fig. 15.—A single valve detector followed by two L.F. transformer coupled valves; a more generally used arrangement.

There are continually present in the air electrical disturbances which resemble, to some extent, the electro-magnetic waves of radio. The wind blowing through the tree tops generates electrical signals and sends them out in all directions. Whenever moisture in the upper atmosphere condenses to form clouds, electrical impulses are sent out in all directions. Wherever one wind runs contrary to another, so that there is friction between the two air currents, electrical impulses are also generated and sent out. Of course, a lightning flash sends out tremendously powerful radio waves, so that even if it is several thousand miles away it may give appreciable currents in a receiving aerial.

All these electrical signals that Nature is continually generating produce noises in the telephone receivers which, if loud enough, will drown out the real radio signal. The currents set up in the ordinary aerial by these natural electrical disturbances, generally called "atmospherics," are small compared to those set up by a neighbouring transmitting station, so that we only know they exist by a hissing and crackling which can be heard when there is no signal coming in.

But now suppose we want to hear a signal from a distant transmitting station, which, because of the distance, can set up but feeble currents in the receiving aerial. It may well be that these signals are so weak as to be inaudible, and so we have to resort to an amplifier of some kind to make them audible. The noises due to atmospherics will also be amplified, and it may be that atmospherics are so much stronger than the signal that the signal itself remains inaudible no matter how much amplification is used.

The question is often asked:—How much can we usefully amplify? The answer is:—It depends entirely on the amount of atmospheric and other disturbing effects present. The writer has an amplifier that can increase the signal strength 2,500,000,000 times, and even this is not the limit, by any means. If the amplifier were properly connected to other higher powered valves and a loud speaking horn it could be increased thousands of times more.

But such amplification would be of no real value because of the excessive crackling, hissing, etc., which atmospheric disturbances would produce. And even if there were no atmospherics at all, such a great amplification would result in received signals or speech of poor quality, because of noises due to the irregularity with which the electrons boil off from the filament of the first valve of the amplifier. Yes, it is possible to hear the tumult of electrical activity as the electrons are violently ejected from the surface of the hot filament. Just as hot soapy water gives off steam in spurts, so the surface of the hot metal gives off electrons in spurts and thus makes the plate current in the first valve vary to a slight extent even though no voltage at all is being impressed on the grid. This slight irregularity will be amplified in the successive stages of the amplifier until it produces audible noises in the telephone receivers at the end of the amplifier. Also, as the electrons move over from the hot filament to the plate of the first valve they bump violently into the air molecules that happen to get in their path, and this bumping will also produce irregularities and disturbances that will produce audible noises.

We have spoken about irregularities in the first valve of the amplifier. The same thing is going on in all the valves, but the effect is amplified more for the first valve. Hence in this first valve most of these "internal noises" originate.

The question might well be asked:—How can the electrons bump into air molecules if the valve has been evacuated, and so freed from air? It must again be pointed out that with the very best evacuation possible to-day, using the most modern and thorough methods for getting out all the gas, there is still so much gas left that each cubic centimeter of space in the tube still contains about 100,000,000 molecules of air—certainly enough to permit many collisions with the rapidly moving electrons.

How Amplification Sometimes Distorts Received Speech

If a radio broadcast station is properly adjusted so that the signal being sent out does accurately represent a voice, let us say, then a small crystal receiving set within perhaps 25 miles of the sending station will give remarkably clear reproduction of the voice, much better, for example, than would be the case if the voice were transmitted the 25 miles by ordinary wire telephony. Frequently the writer, when listening to radio signals, has recognised the voice of one of his former students in the first few words of conversation; the enunciation of words and syllables is much clearer than is the case with ordinary telephony.

Now when we use an amplifier and loud speaking horn for giving out the signal, the results are generally disappointing. Although much more volume is obtained than when using a crystal receiving set, the quality of the speech is very much poorer. This is due to the fact that the complex shaped electric waves, representing the voice, have their shape changed as they go through the amplifier. Not only is the magnitude of the current increased by the valves, but the complex forms are so altered (unintentionally, of course) that the resulting voice sounds are much modified. This effect is called distortion.

Transformer Amplifier

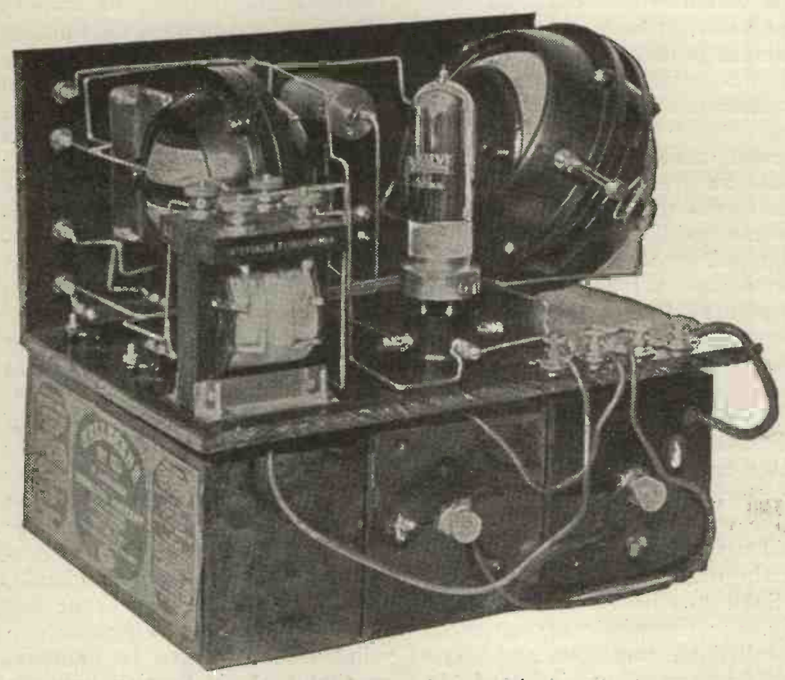
The type of amplifier shown in Fig. 14 is called a resistance amplifier because a resistance is used in the plate circuit of each valve, the variation of voltage drop across this resistance being used to supply the exciting voltage of the next valve of the series. Another type, more frequently used, is shown in Fig. 15; in this circuit there is a small transformer between each valve in place of the resistance of Fig. 14. The signal voltage, impressed on the grid of the first valve makes the plate current of this valve vary; this variation of current in the one coil of the transformer (called the primary) will produce a voltage at the terminals of the secondary coil of the transformer. This secondary voltage is theoretically of the same form as that impressed on the grid of the first valve, but it may be much larger, using the ordinary transformer sold for such use, with the ordinary amplifying valve, perhaps 10 to 15 times as great.

The secondary winding of the transformer is connected to the grid circuit of the second valve and so causes fluctuation in the plate current of this valve. In the plate circuit of this second valve is another transformer which supplies the voltage for the grid of the third valve, and in the plate circuit of this third valve are placed the telephone receivers.

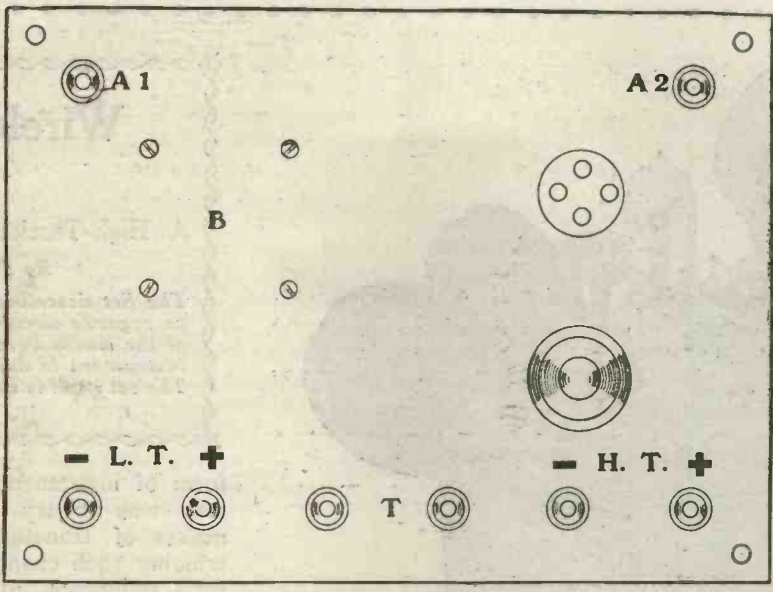
(To be continued.)

A Reader's Simple Simplex

In our issue for May 14 we published a photograph of the front of a compact single-valve reflex set, and in response to inquiries we now give a rear view. Notice that the dry cells for filament lighting fill the space beneath the box-panel. Variometers are used for aerial and anode circuit tuning. The valve shown is a D.E.3.



Rear view of the set illustrated in our issue for May 14th (p. 36).



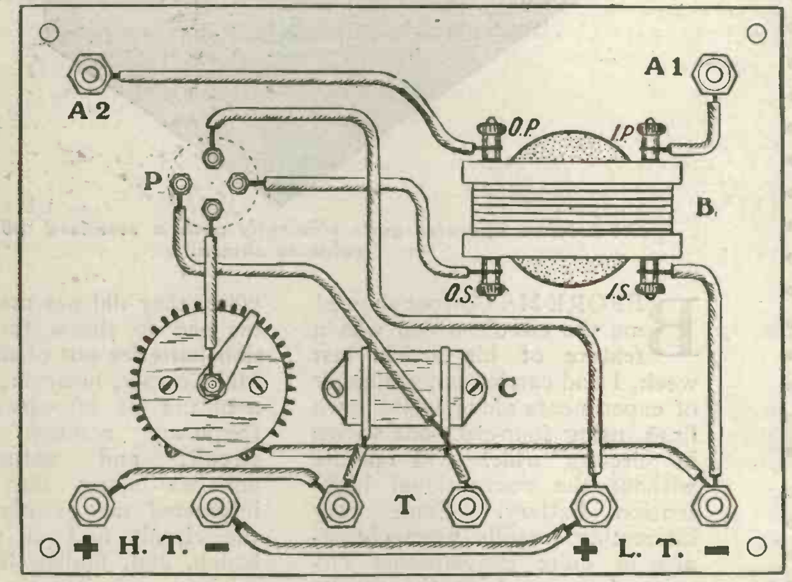
The layout of the panel.

Practical Back-of-Panel Wiring Charts.

By
OSWALD J. RANKIN.

Single Valve Low-frequency Amplifier.

A simple L.F. amplifier or note magnifier suitable for use with a valve or crystal receiver. The telephone terminals of the receiver are joined to the terminals A1 and A2, which are connected to the primary side of the L.F. intervalve transformer B. If no telephone condenser is provided on the receiver to which this amplifier is to be connected it may be found advisable to shunt the primary winding of the transformer with a fixed condenser of about 0.001 μF capacity. The value of C is 0.002 μF.



Showing disposition of the components and the connections to their various terminals.

The Use of a Vernier Condenser

It is generally found, when using a set possessing sharp tuning (such as those employing critical reaction), that correct adjustments are extremely difficult to obtain on wavelengths below about 500 metres, the reason being that very minute movements of the variable condensers produce quite considerable wavelength changes.

To enable one to make the necessary fine adjustments easily it is a good plan to connect in parallel with each of the large variable condensers a very small one, commonly (though incorrectly) called a vernier condenser, having, say, three fixed and two moving vanes. The desired station can then be searched for with the main condensers, and tuned-in accurately with the verniers when found. G. P. K.

A VALVE BAROMETER

Quite a useful barometer can be made from an old burnt-out valve. Hold it beneath the surface of a basin full of water, and with a pair of pliers break off the " pip." Owing to the vacuum within water will rush in, entirely filling the bulb, with the exception of the tiny space occupied by air left behind during the process of pumping out.

Now dry the bulb and suspend it upside down by means of a turn of wire made round the neck just above the cap. If the filling is done when the barometer stands at its normal height of 30 inches the lowered air pressure which causes a fall in the mercury of the glass will be duly recorded by the water - filled valve. When the pressure is decreased the surrounding atmosphere can no longer sustain the whole of the water contained within the bulb. Hence a drop will make its appearance at the pip.

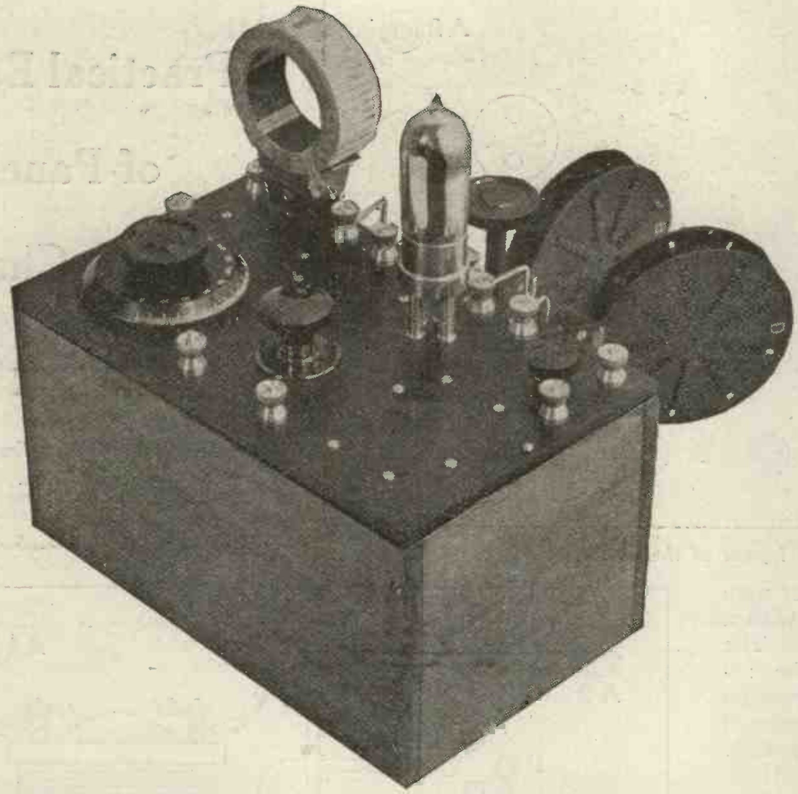
If the pressure subsequently rises it will be drawn back again; but if there is a further fall it may part company altogether with the valve.

Wireless from Bat

A High-Tensionless Receiver

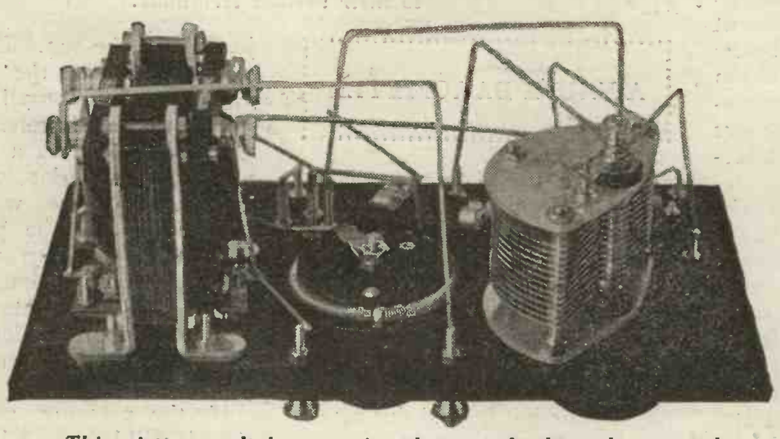
By PERCY W. HARI

The Set described in this article as regards circuits and designs, of the Radio Press organisation. instrument is due to Mr. A. D. The set itself is Mr. Harris's pract ci



The receiver operates quite efficiently with a standard '06 ampere valve as shown.

BEFORE Mr. Cowper showed me the circuit which was a feature of his article last week, I had carried out a number of experiments along well-known lines, using four-electrode valves in circuits which will operate without the conventional high-tension battery. Some very interesting results were obtainable in quite conventional circuits, but, good as the results were, they did not make me feel inclined to throw the high-tension batteries out of the window. Mr. Cowper, however, has found a means of introducing audio-frequency reaction into his circuit, and naturally any advance along the new line interested me greatly. I tried the circuit first of all on the bench, and, finding it very promising, made it up in a practical form of instrument. The next step was to try out different makes of transformers to see whether such changes made any vital difference, after which I tried it with different valves. In the first built-up set, I used, not a potentiometer, as shown in Mr. Cowper's circuit and as is included in the present instrument, but a variable anode resistance shunted between the grid and the positive low-tension terminal, the IS lead from the intervalve transformer being taken, not to the slider of the potentiometer, but to the negative end of the filament battery. Without the resistance shunted across as explained, the instrument set up a continuous audio-frequency howl. The resistance was then placed in circuit, and varied until the howl just ceased. Very good results were obtainable with this arrangement, but I have found it better to use the potentiometer.



This picture and the opposite photograph show the general lay-out of parts.

The Circuit

I have not reproduced the theoretical circuit diagram in this article, as it is practically the same as that given by Mr. Cowper last week.

Practical Construction

The present instrument is the second I have made up on this circuit. In most circuits, and particularly in those in which any form of reflex action is included, the actual layout of component parts and the wiring is very important. Notice particularly the short leads in all the vital parts of the circuit. The following are the components required :—

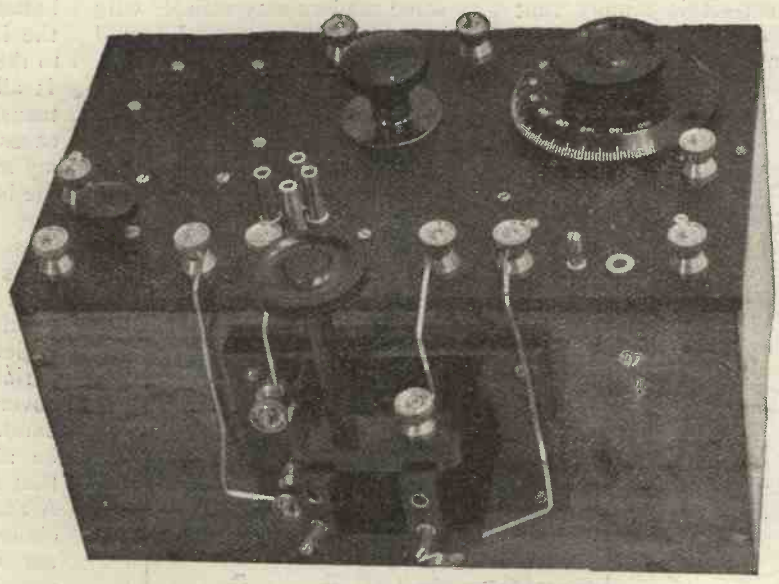
1 ebonite panel measuring 10 in. by 6 in. by ¼ in. thick.

a Flash Lamp
tery

for Standard Dull Emitters.

RIS, Assistant Editor.

is an example of the co-operation, between experts, which is a feature The circuit incorporated in the Cowper, and was given last week. tical interpretation of Mr. Cowper's uit.



A rear view showing the two-coil holder.

1 box for same not less than 5 in. deep.
10 terminals.
1 two-coil holder.
1 socket for plug-in coil.
1 valve socket (preferably the low-capacity type).
1 good intervalve transformer.
1 300-ohm potentiometer.
1 resistance for bright or dull emitters.
1 .0001 μF fixed condenser.
1 .0003 μF fixed condenser.
1 .002 μF fixed condenser.
1 variable condenser .0005 μF.

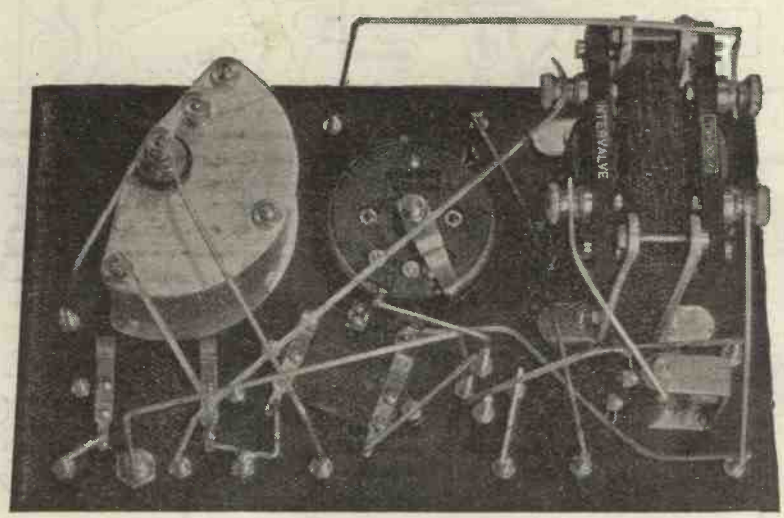
Notes on Components

It will be noticed that the set makes up in very small compass, and for this reason it will be necessary to exercise care in placing the parts. The potentiometer used in this set was a T.C.B., owing to the fact that this particular pattern occupies a very small space. If the Igranic, Burndept or other types of potentiometer are used, the panel will inevitably require to be larger. I have used a double resistance of the Burndept pattern owing to the fact that it is suitable for use with either bright or dull emitter valves. If you intend to confine yourself either to the bright or to the dull emitters, you can use one of the cheaper filament resistances. As the set works just as well with the .06 type of valve as with any of the bright emitters, it is just as well to have some means of utilising these economical valves. The particular intervalve transformer used in this set is a Woodhall, but the set does not appear to be at all critical in transformers, provided they are of good substantial make and well designed. I have personally used in the circuit the Woodhall, Eureka, McMichael, Ferranti, and Mr. Cowper has used the R.I. Do not imagine that any back-street nameless transformer will do. If a set is worth making up at all it is worthy of a good transformer, and there are enough good makes available to make it totally unnecessary to buy the nameless types.

Construction

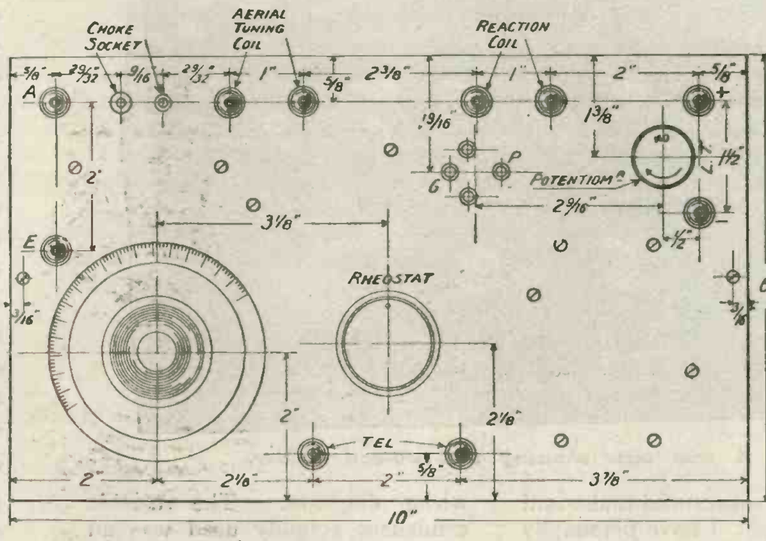
The construction of the set is quite simple, and should be apparent from the photographs and wiring diagram. The variable condenser actually used was an Ormond with one hole fixing. Practical experience with the set shows that tuning is rather critical, and if I were building it again I think I should include a vernier adjustment with this condenser.

Follow as closely as possible the layout given, and wire up with stiff wire, so as to reduce capacity effects to a minimum. Remember the more you depart from an author's design the bigger are your chances of getting poor results. It is not



The small space available on the panel makes careful arrangement necessary.

that we technical writers think we have in each case evolved a perfect set—it is simply that our sets *do* work and your arrangement *may not!* The fixed condensers are secured to the panel by 6 B.A. metal screws passed through clearance holes in the panel, the condensers being held in place by nuts. The .002 fixed condenser is placed exactly underneath the intervalve transformer so as to economise space. The particular pattern I used in this case is not standard, and happens to be secured by screws in two corners. I mention this, as some readers may wonder why it is held in this way. I would recommend you to use good fixed condensers in this set (and for that matter in any other you build). Once more, buy a fixed condenser with a name on it.



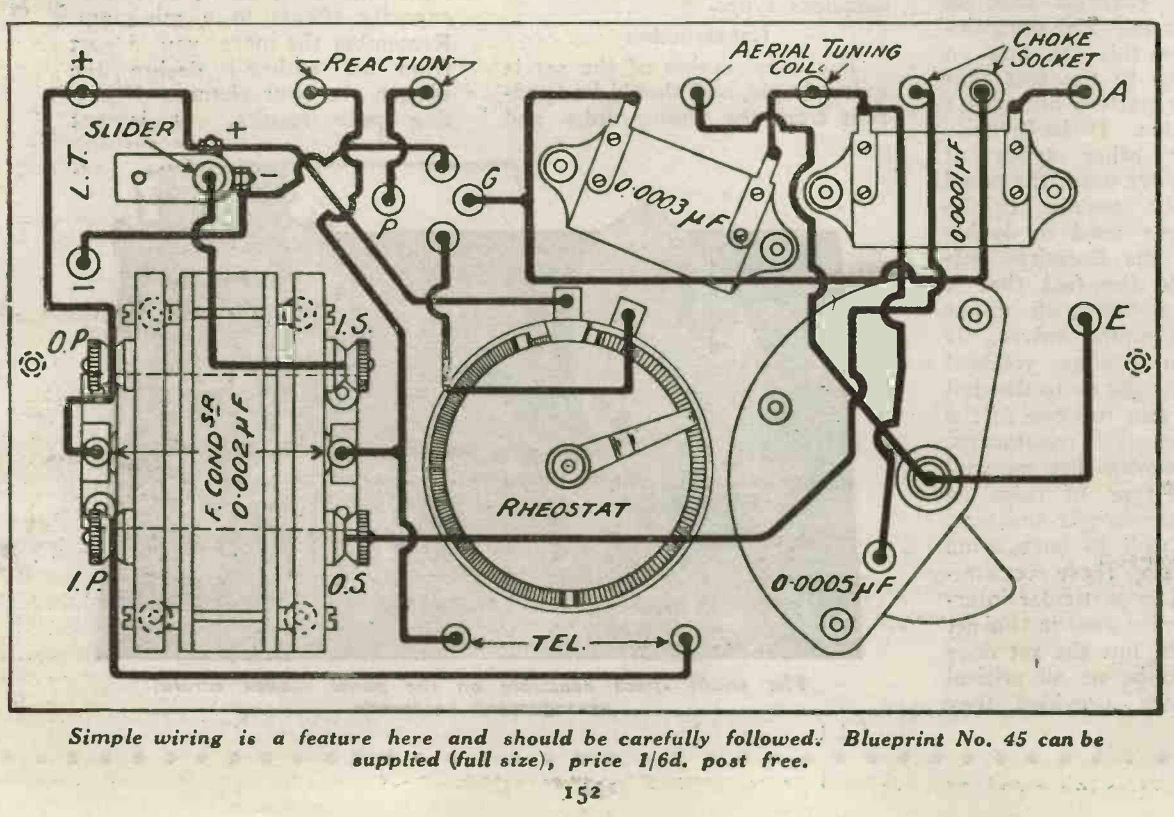
Drilling diagram of top of panel.

Transformer Connections

Note particularly the way the transformer windings are connected. Try this way first, and if you use the same transformer as I have used adhere to this method. Some transformers, however, may work slightly better by having, for example, the IS to the choke and the OS to the slider of the potentiometer. It all depends upon the way the transformer is made. In most cases I think you will find that my method of wiring should give the best results.

Operation

As constant aerial tuning is used in this set (it improves the reaction effects here) you will find either a 50 or a 75 coil in the aerial tuning coil socket will cover the British broadcasting band. The reaction coil should be about two sizes larger than that in the aerial tuning socket. A 250 coil should be placed in the choke socket. You will find the set will work quite well with practically any valves, and, in fact, I think you will find that it will work better than any previously published single-valve high-tensionless receiver using either a 3 or a 4 electrode valve. Of course, the signal strength is not equal to that obtainable with a high-tension battery, but it is still very good. I have a good aerial six miles from 2LO, and on this I was able to use this set to give loud-speaker results sufficient to be enjoyed in comfort in

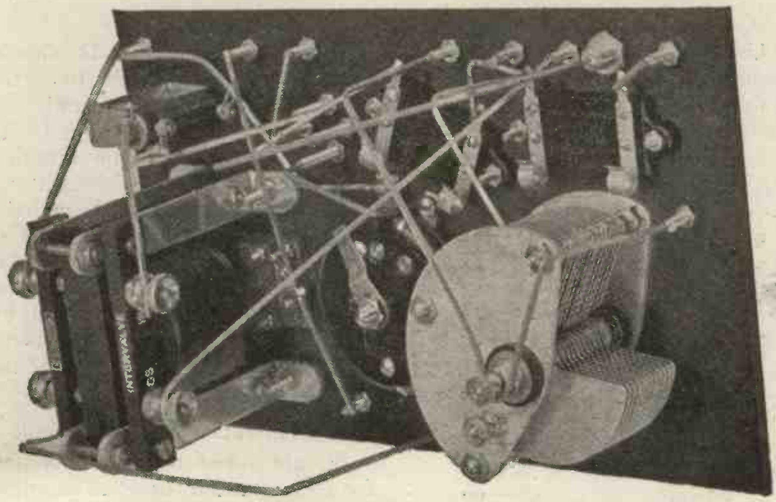


Simple wiring is a feature here and should be carefully followed. Blueprint No. 45 can be supplied (full size), price 1/6d. post free.

a small living room, using a D.E.3 valve with a flash-lamp battery as the sole current supply! I would not, however, call it a loud-speaker set, but it gives admirable 'phone signals in a number of pairs of telephones up to 10 or 15 miles from a broadcasting station, and when conditions are favourable will give two or three of the others at least in the 'phones. I have heard Birmingham and Aberdeen quite well on it. I should say the sensitivity is half way between that of a really good crystal set and a first-class well adjusted single valve reaction set using correct high tension for the valve used. This view is confirmed by the experiences of several members of the editorial staff who have tried the set in different conditions and at different distances up to 25 miles from London.

Tuning-in

Tuning is quite simple, and you will soon find if you have the reaction coil the right way round by practical trial. You will notice that the two-coil-holder is mounted on the back of the cabinet and leads are taken from it to the set, so that it is an easy matter to reverse the reaction coil if you find you have it the wrong way round. On one position of the potentiometer, when it is screwed right down you will hear an audio-frequency howl due to the feed-back being too great. Now turn the potentiometer knob until this howl stops, and then vary your reaction coupling and your condenser tuning until you get best results from your local station. Do not expect to get best results in the first five minutes. The set has a little way of its own which requires a small amount of practice, but you will soon "get the hang of it" and will find it very interesting to work.



This picture shows the potentiometer connections clearly.

Your Results

If you make this set and it works well I should be much obliged if you would drop us a postcard with the following particulars:—

Name and address.

Distance of nearest broadcasting station.

Number of stations you have heard.

How the set compares with single-valve reaction sets you have used (specify whether "straight or dual").

Information of this kind regarding *Wireless Weekly* sets is of great value to our Information Department, and enables us to tell other readers what they are likely to get on the set at given distances.

Some Simple Questions Answered

Why is it that a continuous subdued rustling and crackling noise is heard in the intervals of the programme of a Broadcasting Station?

Various phenomena may assist in producing this sound, such as microphone-rustles at the broadcasting station, or "line noise" from induction effects in the underground cables used in broadcasting public entertainments, but the usual cause is partial heterodyning of the more or less continuous stream of minor atmospherics by the carrier wave. A similar faint rustling is heard when a receiver is kept in continuous oscillation by means of reaction. If the noise is very pronounced, and is accompanied by occasional louder clicks and bangs, it may indicate either a defective H.T. battery or a bad night for atmospherics. To distinguish between these possible causes, disconnect aerial and earth from the set and note whether the noise continues; if it does the H.T. battery is implicated, although it may also be due to a loose or otherwise faulty connection somewhere, leaky insulation or a defective grid-leak.

In the absence of a convenient main water pipe, what alternative earth connection can be used?

An old galvanised iron bath or bucket, perforated with holes, should be buried a foot or two beneath the surface of the soil, underneath the aerial and as close to the "leading-in" point as possible. A stout copper wire should be soldered to the upper edge of the bath or bucket, which should be almost filled with cinders or preferably broken coke. Three or four bucketfuls of water should then be poured in and the earth shovelled back.

The ST100 with an Extra H.F. Amplifier on the Omni Receiver

A further circuit to experiment with upon this popular receiver

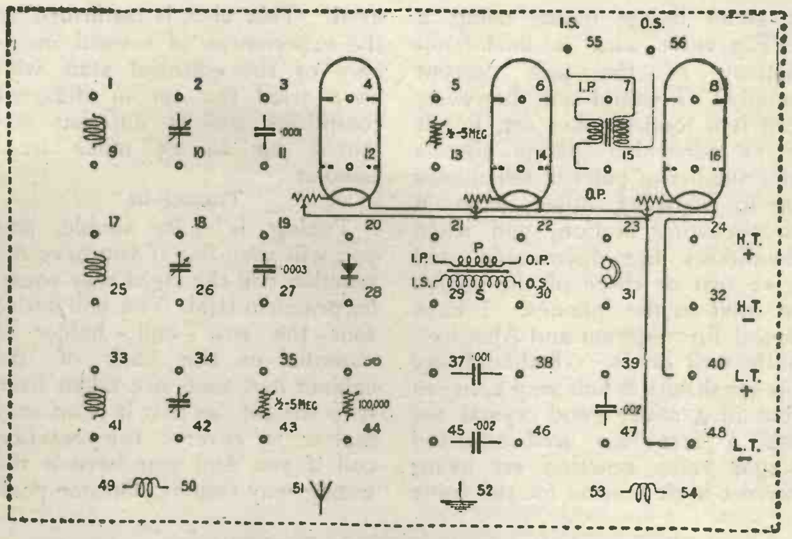


Fig. 1.—The terminal board.

With the publication of a circuit embodying one extra high - frequency amplifier on to the ST100 circuit, those who have made the Omni receiver will, no doubt, desire to try out this new circuit. The circuit, which was published in the June issue of *Modern Wireless,* and which was recommended to us by Mr. H. L. Meyer, of Cavendish Square, is seen in Fig. 2, which shows the 3-valve circuit in use, with constant aerial tuning applied.

The aerial circuit comprises the coil L1 and the variable condenser C1, of 0.0005 μF capacity, constant aerial tuning being introduced by means of the 0.0001 μF condenser C.A.T. V1 is the additional high-frequency amplifier, V2 and V3 being the first and second valves, respectively, of the ordinary ST100 circuit.

The valve V1 is coupled to V2 by means of the two coils L2 and L3 acting as a high-frequency transformer, reaction being applied by coupling L4 to L3, these three coils being accommodated in the 3-coil holder on the side of the Omni cabinet. The aerial coil L1 is plugged in to the left-hand socket on the front of the panel.

For the British broadcast band of wavelengths the coil L1 may be a No. 50 for wavelengths below 420 metres, above which a No. 75 may be used. L2 should be a No. 75, L3 a No. 50 below 420 metres, above which a No. 75 may be tried, and L4 should be a No. 50 below, and a No. 75 above the wavelength of 420 metres.

Using the Omni receiver, the circuit may be easily wired up by making the following connections:—

51—11	33—34
3—2	34—28
3—50	28—6
3—12	41—42
10—49	42—21
49—52	38—15
52—48	15—21
4—1	7—24
9—24	8—31
17—18	31—39
18—14	47—23
25—26	23—24
26—30	32—40
29—48	56—16
30—46	55—48
29—45	37—16
22—20	

A No. 50 (or 75) coil is plugged into the left-hand socket on the front of the panel, leaving that on the right with no coil in it. The coil at the back of the 3-coil holder is a No. 75, the middle coil is either a No. 50 or No. 75, according to the wavelength to be received, as explained above. The front coil of the 3-coil holder is either a No. 50 or No. 75, as above.

Operating the Receiver

Keeping L2 close up to L3 (i.e., the coil at the back close to the middle one) and with L4, in the front, well away from L3, tune on the variable condensers, adjusting each to the best point, when signals are received. The connections to the coil L2 should be reversed by changing over the leads to terminals 1 and 9, note being taken as to which way gives the best results. The crystal detector D should then be adjusted to the most sensitive point, and the condenser C4 readjusted to the best position. The reaction coil L4 may now be brought up closer to L3, retuning on the variable condensers C3 and C4. If this does not result in an increase in signal strength, the leads to L4 should be reversed, by changing over the connections to 33 and 41, when the procedure may be repeated.

Experiments with the Circuit

Should there be any tendency for the circuit to howl at audible frequency, one or both of the following experiments may cure the trouble. In the first place, the leads to one of the intervalve transformers may be reversed: this is done by disconnecting the leads between 56 and 16 and between 55 and 48, and joining 56 to 48 and 55 to 16. If there is still a tendency towards buzzing, a 100,000 ohm resistance may be inserted across the grid of the second valve and the positive of the low-tension battery. This is done by joining 36 to 14 and 44 to 40. Adjusting the knob of this resistance, which is on the front of the panel, should result in absolutely eliminating any low-frequency buzzing.

Use of Grid Bias

When a high-tension voltage of over 70 volts is used, a few volts negative bias may with advantage be applied to the grids of V2 and V3. This is done by inserting a small battery, such as a pocket lamp battery, between the "inside secondary" of both low-frequency transformers and L.T. negative. The following alterations to the master key will be necessary: Take out the links between 29 and 48 and between 55 and 48. Join 29 to 55 and join 29 to the negative of the grid bias battery by a flexible lead, the battery being external to the set. The positive of the grid battery is connected to L.T. negative, terminal 48. In this connection it may be pointed out that the best results with this circuit will be obtained when the high-tension voltage is pushed up to 100 volts or more, the value of the grid battery being suitably adjusted.

The condenser C5, which is joined across the OP and OS of the transformer T3 T4, was found necessary in the original design of this circuit to increase the purity of the received signals. In the master key, this condenser is a 0.001 μF, but different values may be tried, and quite possibly no condenser may be required with the transformer in use. This condenser was tried in the original design of the circuit, and was found necessary in that instance, but it must not be looked upon as an essential in all cases. To omit this condenser, the leads 37 to 16 and 38 to 15, in the original master key, are taken out.

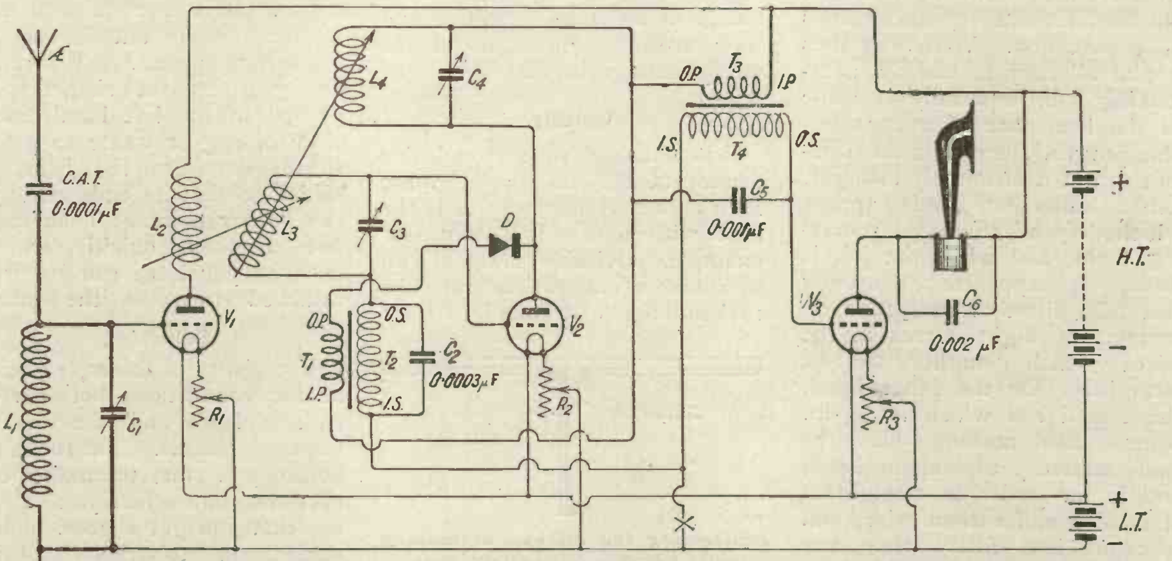


Fig. 2.—This is a very interesting circuit on the Omni Receiver. A battery for grid bias may be inserted at the point x if desired, the positive of this battery being connected to L.T. negative.

Finishing Panel Edges

MANY amateurs find it a little difficult to get a good finish on to the edges of their panels. Either they are left projecting a little beyond the cabinet all round, or, if they are taken right down, they show tool marks, and frequently the colour is bad, being a kind of greenish grey. Here is a method which the writer uses, and which he finds very successful for the purpose. Not being very fond of woodwork, he usually has cabinets made for him, and has them delivered unpolished. The panel, which is cut about 1/16 in. too large all round, is then mounted upon the cabinet by means of half-a-dozen screws, and the edges are attacked first of all with a medium rasp. When they have been taken down to about 1/32 in. over size this tool is discarded in favour of one which does not find a place in many wireless workshops — a corundum knife sharpener! These can be obtained from ironmongers for about a shilling apiece, and they make very useful trimmers. The sharpener is held in both hands rather like a spokeshave and is worked away from one, over the ebonite edge, which is very quickly rubbed down. The corundum tool obliterates all marks made by the rasp, and gives a fairly smooth surface. The next step is to rub thoroughly with *worn-out* emery cloth until the edges are exactly level with the wood. Finally both wood and ebonite are finished together with the finest grade of glasspaper—do not touch the ebonite with the glasspaper until it has first been used upon the wood: even glasspaper of the finest grade is too fierce for finishing ebonite.

This completes the trimming. The next step is to polish the edges, the best way of doing it being to use the palm of the hand moistened with a very little turpentine. A good rub with the hand gives the ebonite a fine dull black finish, and makes the edges look very well indeed. The wood is not, as a rule, French polished, even if it is mahogany. It is found that well-sandpapered wood, polished with a piece of silk and then oiled, takes a beautiful finish, though the process may have to be repeated after the oil has soaked in, for it sometimes causes the grain to rise. Should this happen you sandpaper once more until the wood is quite smooth, and then apply a finishing dressing of linseed oil.

R. W. H.

An Informal Meeting of the Transmitter and Relay Section of the Radio Society of Great Britain will be held at the Institution of Electrical Engineers, Savoy Place, W.C.2, at 6 p.m., on Friday, 6th June, at which Captain A. G. St. Clair Finlay will give a lecture upon "Modulation Systems." Apparatus will be used to illustrate the lecture.

An Informal Meeting of the Radio Society of Great Britain will be held at the Institution of Electrical Engineers, Savoy Place, W.C.2, at 6.30 p.m. on Wednesday, 11th June, at which Mr. A. H. Ninnis will give a talk on "General Observations on the Radio Situation, and the development of Broadcasting in New Zealand."

Wiring with Square Rod

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

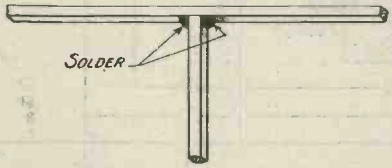
THOSE who have never previously used anything but wire of No. 16 or No. 18 gauge for making the connections below the panels of their sets, will find that the square-tinned rod which can be obtained from advertisers comes as a revelation. With wire it is not at all easy to make a neat-looking job, especially if some of the leads are of a considerable length, since it is so difficult to get it absolutely straight. Little kinks or bends appear which defy all efforts at removing them, and when the job is done its appearance usually just falls short of perfection on account of slight curves in the wires which ought to be straight. On the other hand, the tinned rod which is $\frac{1}{16}$-in. square, has nothing like the same tendency to kink or bend, and is far easier to straighten. It is also stiffer than wire, and therefore less likely that any rod will be accidentally bent whilst the soldering of another is in progress. Apart from its advantages from the purely workshop point of view, square-tinned rod provides a larger surface area and therefore offers a very low resistance path to high-frequency currents.

Hints as to Bending

To begin with, it is perhaps a little more difficult to use than wire, partly on account of its greater stiffness, which makes the job of shaping less easy, and partly because it requires a little more solder at the joints to make all secure. As soon, however, as the knack has been acquired one swears by the square rod and uses it in preference to anything else. To do the best work with it three pairs of pliers are required, round-pointed, flat-pointed, and cutting. For the last the writer prefers to use end-nippers about five inches in length. With these the rod can be cut with the greatest ease, and they enable the ends to be cut off short after soldering. The round-nosed pliers are required for making loops where the rod is attached to the terminals of the transformers and so on if soldering is not possible, as is sometimes the case. Flat-nose pliers enable bends to be made neatly, and they are also most useful for straightening the rod.

Cutting

When using square rod one cannot tackle things in quite such an easy-going way as is the case with wire. It is not, for example, advisable first of all to solder a connection and then to bend the lead round to meet the next point of contact. This can be done with wire, but the rod is too stiff. By far the best method is to measure it and shape each connecting piece before either end of it is soldered. The writer's method before he starts any of the wiring is to work out a rough scheme of connections deciding which of the main leads are to come close to the surface of the panel, which next above these, and which are to be highest of all. It will be found as a rule that all wiring can be done in three layers. The lowest layer will contain usually the high- and low-tension busbars, the connections of gridleaks and grid condensers, the filament circuits and connections to L.F. transformer condenser and phone condenser. In the second layer any connections to switches, whilst the highest of all will be the leads from variable condensers and from transformers. This is, of course, only a rough indication, and the constructor will naturally choose his own method.



Illustrating the method of making joints between two square rods.

When wiring, begin, of course, with the lowest layer and deal first of all with the longest and straightest wires in it. Shape and fit one or two of these at a time, then solder them into place. When shaping connections it is best to use a foot-rule, by the aid of which one can measure the exact amount that a wire will have to bend in any direction, the distance it must rise above the panel, and so on. It is then quite an easy matter to shape out the required connecting pieces. When soldering grasp the shaped piece of rod in the left hand, use a piece of rag or waste to protect the fingers from the heat, and hold it so that its ends rest upon the proper points. Then solder one of them quickly, and as soon as you have got it firmly attached turn to the others.

Soldering

Use plenty of solder, especially at the connections between the ends of leads and the tips of terminal shanks. Tin these tips before you start to make connections, and when you do so see that you get a good blob of solder on to them. Joints between wires are best made in the way shown in the drawing. This makes a very neat job, indeed, and it is perfectly secure.

The leads in the upper layers will be rather more complicated than those in the lower, since they may have to be bent in several ways, but with the help of the foot-rule and by getting these in position as you shape them, you will not find that the process is at all a difficult one. There are two ways of doing bare wiring. You may work on the "short cut" method, taking the leads straight from one point to another. Or you may use the right-angled system, in which all leads run parallel with the edges of the panel or are perpendicular to its surface. Provided that you allow plenty of clearance between crossing wires and do not allow them to cross at too small an angle, there is not a great deal to choose between the two methods, though the writer prefers the second as making a better looking job when the wiring is done.

THUNDERSTORMS

SOME INTERESTING FIGURES

By E. H. CHAPMAN, M.A., D.Sc., Staff Editor

DURING the severe thunderstorms which passed over these islands in the middle of May, many listeners-in must have been amazed at the strength and persistence of the resultant "atmospherics." So loud were these disagreeable noises in telephone receivers and loud-speakers in some districts that the programmes of the broadcasting stations were badly interfered with, and at times almost completely obliterated. The electrical condition of the atmosphere during the passage of one of these thunderstorms over Essex may be judged from the fact that at Romford it was possible to get visible sparks across an aerial earthing switch which was not quite closed.

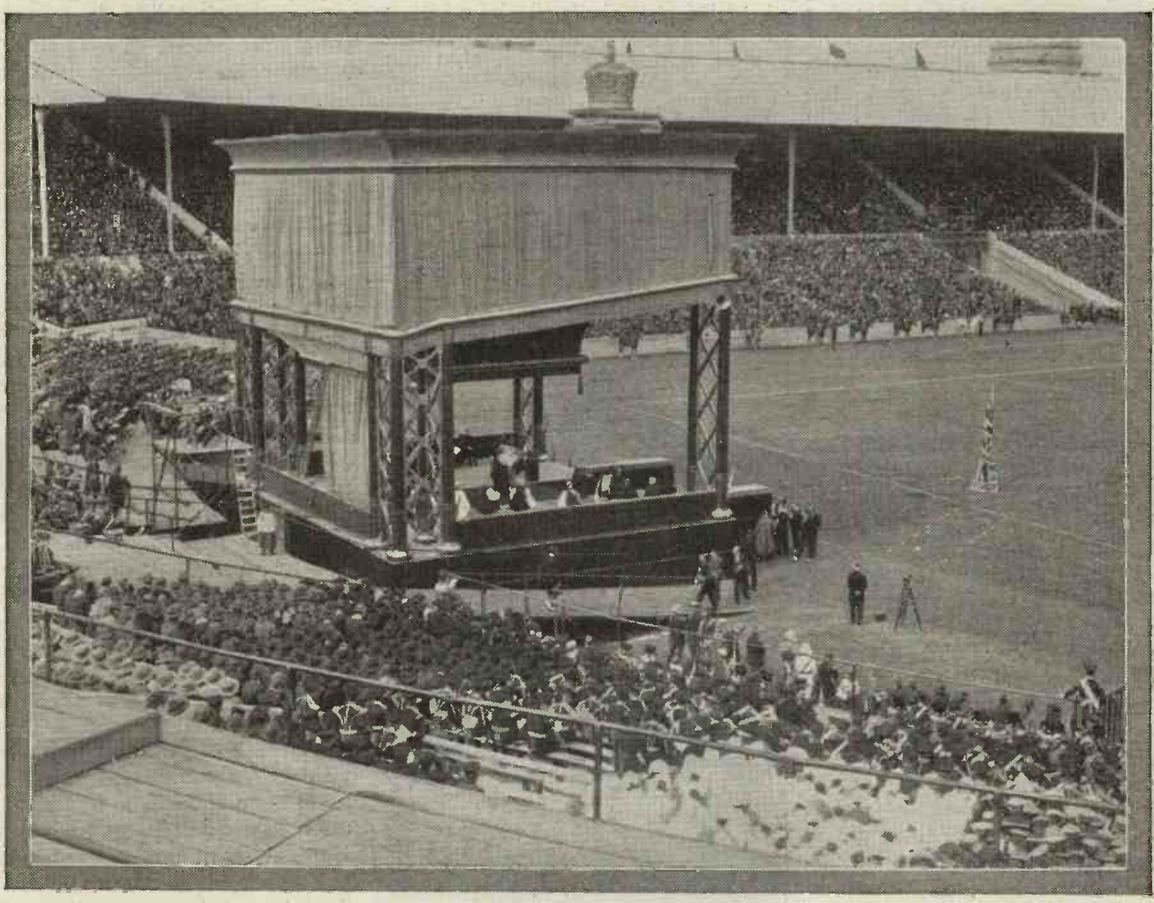
Although May of the present year was pretty bad for thunderstorms, it was no worse than some of the summer months are likely to be. It is interesting to note that of the broadcasting areas, Manchester has the worst record for thunderstorms, although the records for London and Birmingham are very little better. Judging from the available records for Wales and South-West England, it appears that Cardiff has a smaller number of summer thunderstorms than any of the other broadcasting towns.

The following are the official figures showing the average occurrence of thunderstorms over the different broadcasting areas :

Area.	Odds against a thunderstorm on any particular day in summer.
Manchester	8 to 1 against.
London	11 to 1 against.
Birmingham	12 to 1 against.
Bournemouth	17 to 1 against.
Newcastle	20 to 1 against.
Aberdeen	20 to 1 against.
Glasgow	26 to 1 against.
Cardiff	30 to 1 against.

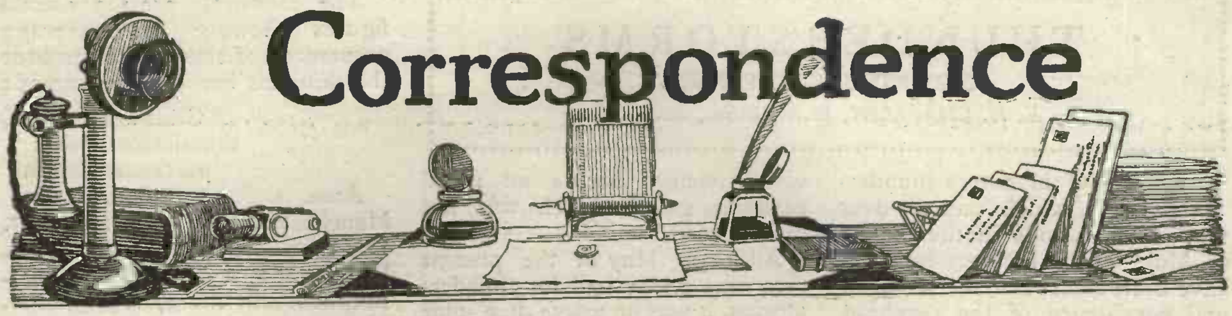
For the sake of comparison, it is worth mentioning that the odds against a thunderstorm on any particular day in winter at Manchester are over 100 to 1 against, while at Aberdeen it is over a 1,000 to 1 against there being a winter thunderstorm on any particular day in winter.

BROADCASTING THE EMPIRE THANKSGIVING SERVICE



An excellent general view of the Stadium at Wembley showing the Archbishop of Canterbury delivering his oration. The broadcasting microphone (on a tripod) is seen on the grass on the right of the dais with Mr. Rex Palmer standing nearby. Many newspapers published photographs of the Archbishop, showing a microphone immediately above his head, referring to the instrument as the "broadcasting microphone." It was, however, the "public address system" microphone—a different instrument.

Correspondence



THE UNIDYNE CIRCUIT

SIR,—I enclose herewith a copy of a letter sent to the editor of *Popular Wireless*, with reference to the editorial statements on the subject of the "Unidyne" circuit.

In view of the not inconsiderable publicity that has been given, directly and indirectly, to this matter, it appears to be of some importance that the challenge to accepted scientific principles made therein should be dealt with by those competent to do so; a definite statement by Sir Oliver Lodge, F.R.S., in his capacity of "Scientific Adviser" to *Popular Wireless* on the matter would be very welcome to those who are interested in the scientific side of wireless. Such statements are read by a wide public, not all of whom have the necessary scientific training and experience to make sound judgment in such a case.—Yours faithfully,

D. F. STEDMAN B.A.Sc.

The Editor,
Popular Wireless.

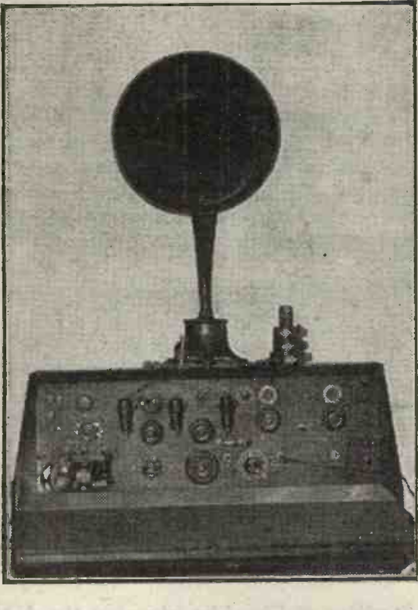
DEAR SIR,—In view of the fact that the statements on pp. 338, 374, and 407, Vol. 5, of *Popular Wireless*, as to the *modus operandi* of the Dowding-Rogers "Unidyne" circuit appear to challenge the well-known scientific principle of the First Law of Thermodynamics: in that a build-up of signal-energy is claimed merely by the use of a particular arrangement of a telephone transformer in the plate-circuit of a four-electrode valve, with the secondary winding short-circuited across the primary and 'phones, the circuit being otherwise a normal Dutch four-electrode circuit, such as that published in *Experimental Wireless*, Vol. I, No. 2, p. 78 (November, 1923); it would be of great interest to the public if these statements were submitted to the Scientific Adviser to *Popular Wireless*, Sir Oliver Lodge, F.R.S., D.Sc., for an explanation of this apparent discrepancy.

It would be acceptable also if precise experimental details were given as to the manner in which the superior results were demonstrated, which are claimed in the articles over the well-known Dutch circuit.

Many interested in scientific radio progress are finding some difficulty in reconciling the account given with well-established scientific principles. It is to be hoped, therefore, that the eminent physicist who acts in advisory capacity to *Popular Wireless* will be so good as to give his views on the question.

A copy of this letter has been sent to each of the principal radio journals.—Yours faithfully,

D. F. S., B.A.Sc.



A reader's "Transatlantic" receiver made up to include the note magnifying stages. A very neat arrangement.

FOUR-VALVE FAMILY SET

SIR,—You invite those who have constructed the "Four-valve Family Set" (Radio Press Envelope No. 2) to advise you as to results obtained.

I constructed one of these sets about six weeks ago, and have had very good results with it. At the time of construction I wrote to you asking whether a three-valve set in this part of the world would carry a loud-speaker. The reply was to the effect that Envelope No. 2 would supply my needs, so I constructed a four-valve set. As a matter of interest I may say that I practically never use more than three valves. Bournemouth is a good station, Cardiff next best, and the remaining B.B.C. stations about the same. We can never rely on getting any of them, and the fourth valve helps very little. On occasions I have had Glasgow, and London I can get when conditions are favourable, though practically no one else in the district can do the same.

But the best station of all for us is Radiola, Paris. We use three valves always for them, and get most beautiful reception—absolutely perfect. The speaker is a five-guinea Amplion. I have even had Radiola on two valves on the speaker; not loud enough to fill a room, but pleasantly loud if one sits close to it. Brussels also we have had, but only once. Obviously, that was under very favourable conditions. That also was on three valves, and as loud as Bournemouth. I happened upon it when trying to find an English station.

The chief components are:—Aerial condenser, Silvertown; anode, a McMichael vernier adjustment; Silvertown transformers; Igranic coils for the B.B.C. stations, and Burndept for Radiola (200 for aerial and a pair of 300 for the reactance).

Considering the fact that I knew, and still know, nothing about wireless, I feel that the results we have got are a tribute to your excellent and detailed instructions for making the set. —I am, etc., yours faithfully,

R. BAKER,
Devon. Sub.-Lt. R.N.

SIR,—I am taking this opportunity of writing to inform you of my successful completion of your 4-valve family receiver, which I have constructed from the envelope No. 2. I should state that I have never touched wireless before, and had doubts as to the results I should obtain. Deciding to put in the best work and material I could, I first chose a suitable mahogany case and ebonite panel, and found no difficulty at all in following out the blue prints as to fitting the components and also wiring. I recently listened to Bournemouth transmitting the Savoy band relayed from London, and found reception much more distinct than from London direct. In fact, on a later occasion it was so loud that I had to switch off one note magnifier. My aerial is perfect, and consists of 100 feet of wire placed very high. I have recommended your circuit to everyone here, and I am making a set for a friend. You must remember when reading these remarks that we are a long way from any broadcasting station, being 120 miles west of Dublin.

With very many thanks for your explicit explanation,—Yours faithfully,

BASIL D. SCOTT HAYWARD.
Galway.

SOLDERING

SIR,—I have noticed on several occasions in your valuable paper your remarks regarding the use of "fluxite" when soldering, your advice being to thoroughly clean the panel when finished. I have found a better plan as follows: Before commencing to make connections, press a sheet of brown paper over valve pins, terminals, etc., when these can be tinned without fear of the "fluxite" spraying on the surface of the ebonite. The paper can be removed easily after the wiring is completed.—Yours faithfully,

G. H. KINGSTON.
Burton-on-Trent.

THE OMNI RECEIVER

SIR,—As an Omni-Circuit enthusiast, I have been very disappointed by the paucity of circuits given in your publications. So far a circuit has not appeared for the person who lives fifty or sixty miles from a broadcasting station and also wishes to get Continental stations. A two H.F. and detector circuit would be extremely useful. I see that it is your intention to publish a circuit for adding a H.F. valve to the ST100 in the next issue of *Modern Wireless*. Would it not be possible to give the key, so that the large number of people who have Omni-Circuit receivers could straight way couple up to the new circuit? I may say that the ST100 set as given for the Omni-Circuit gives very fine results.—Yours faithfully,

INMO.
Barnsley.

[EDITORIAL NOTE: This circuit is given on another page.]

ROUND-SHANK DRILLS FOR A JOINER'S BRACE

SIR,—It often happens that a small drill with a round shank, or a broken drill, is just the one that is used most, and those of us who cannot afford an American brace have to be content with the old joiner's type in which our favourite drill invariably slips at the critical

The device referred to in the letter.

moment. A gag which has never failed yet to grip the drill is shown in the diagram. It is simply a piece of No. 16 iron wire wrapped around the drill so that in the act of turning the drill is gripped by the spring and is held fast.—Yours faithfully,

Blyth. M. ALLISON.

TUNED ANODE EFFICIENCY

SIR,—At a slight extra cost in time and money your excellent system described in May 28 issue can be still further improved. The main tuning condenser may still be .00025 or more, the lead to the plate side can be opened, but across the inductance is kept permanently fixed a billi of max. .00004.

I have a tuned anode coil which reads down to Cardiff (4¼ in. diam., 70 turns) run on these lines. With main condenser *in* at 0 deg. and billi at 0 deg., this coil will not touch Bournemouth, but the billi runs from 345 metres up to the point when the other begins.

Go on educating the amateur to avoid stray capacities.—Yours faithfully,

J. H. REEVES.

London, S.W.5.

WIRELESS WAYFARER

SIR,—In your Correspondence columns we have read many appreciations of your various excellent circuits and articles, but have not yet seen any reference to the sound advice proffered by Wireless Wayfarer.

While the articles by his colleagues offer wide scope for heated arguments (à la Ponderby and Co.), we always agree with Wireless Wayfarer.

After reading his notes in the current issue—where he really excels—we cannot refrain from sending a few words of appreciation and encouragement, and hope that in time he will rival the efforts of Mr. A. D. Snooper.—Yours faithfully,

R. A. BELL,
P. STIMPSON,
GEO. SMITH,
Buxton. H. TOWNLEY.

THE OMNI RECEIVER

SIR,—I would be very interested in an "Omni-Receiver" for five valves with provision for both intervalve transformers and variable-resistance capacity low-frequency amplification, and perhaps other readers may also find this so. Such an arrangement would save so much soldering work, at the same time permit many systems to be tried out by busy people.

I would mention here that I have found your publications to be the most practical and helpful in my own experience. — Yours faithfully,

H. H. FROST.

Swaffham Bulbeck.

Don't worry it out yourself —let an expert help you

PERHAPS you have built a Set and you cannot get it to work—don't worry, let a Radio Press expert help you. Probably you have made some little slip in the Circuit—maybe you have mis-read the wiring instructions. All you need is a copy of

Pictorial Wireless Circuits

By Oswald J. Rankin.

(Radio Press Series No. 8.)

This Book contains scores of different Circuits, each one of which is shown in pictorial form instead of the more technical diagrammatic manner.

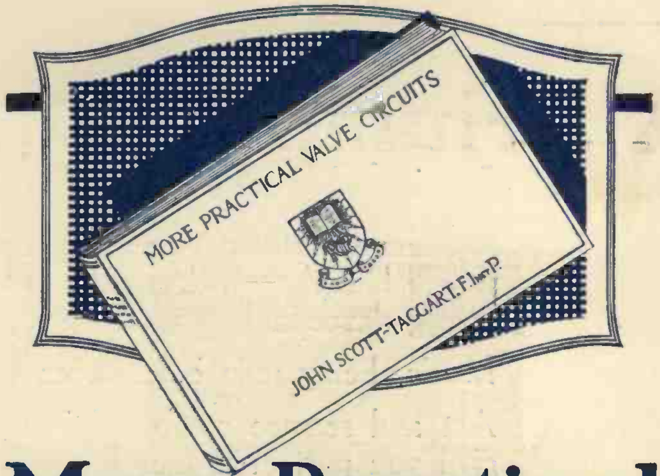
Thousands of beginners have bought it and have been able to appreciate for the first time how easy it is to wire up a Set when the Circuit diagram is understood.

No matter which type of Set you are building, whether Crystal or multi-valve, and whichever type of tuning you will use, variometer or plug-in coils, you will find a wide variety of practical circuits shown in a manner even the veriest novice can readily understand.

From all Booksellers or sent post free 2d. extra direct from Publishers. **1/6**

Radio Press Ltd
PUBLISHERS OF AUTHORITATIVE WIRELESS LITERATURE
DEVEREUX COURT, STRAND, W.C.2.

G.A. 912.



More Practical Valve Circuits.

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

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, one you will find useful almost daily. Get a copy from your Bookseller to-day.

Post free 3/8.

Sold by all Booksellers and published by RADIO PRESS, Ltd., Devereux Court, Strand, W.C.2.

3/6

Cloth-bound.

RADIO PRESS Series No. 15.

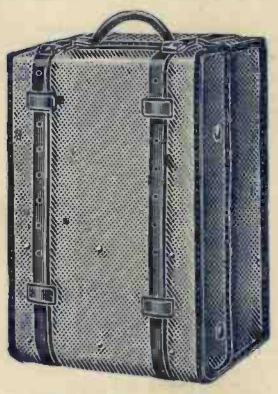
G.A. 913.

"While we live let us enjoy life"

GIVE us the open country, sunshine, cool breeze and blue sky—with music clear and sweet that we may dance in happy mood or dream, mayhap, at rest.

Music, being man created, comes from man.

Art and science combined in the R.I. Lyrianette can give you perfect music. Light in weight and strong in design and reproduction this achievement built on 25 years' experience is the only satisfactory means of obtaining complete joy of life for summer days.



The Lyrianette Receiver for B.B.C. Wave-lengths. 3 Valve set. Price complete

£25 18 0

B.B.C. Tax £1.

In case with cover, £2 2 0 extra.

Complete portable Wireless Receiver, Standard Loud Speaker, D.E. Valves, Batteries, 2 Valve set. Price Complete.

19 Gns.

B.B.C. Tax 15/-

Quality of the R.I. standard has always been received without consideration for price, but our extensive facilities enable us to supply this perfect portable set at a price below anything on the market.

Send for our new 50-page catalogue (W.W.) free on request.

RADIO INSTRUMENTS LTD.

Managing Director : J. JOSEPH, M.I.E.E.

Chief Designer : W. A. APPLETON, M.B.E., M.I.R.E., *late Admiralty Technical Research Officer.*

Works, Offices and Showrooms :

12, HYDE STREET, NEW OXFORD STREET, W.C.1.

Telephone : Regent 6214-6215-6216. *Telegrams : "Instradio, London."*

Printed for the Proprietors, RADIO PRESS, LTD., Devereux Court, Strand, W.C.2. by THE AVENUE PRESS (L. Upcott Gill & Son, Ltd.), 55-57, Drury Lane, London, W.C.2. Published on Wednesday of each week at 3, Bolt Court, Fleet Street, London, E.C.4. Address for Subscriptions and Editorial Communications :—Devereux Court, Strand, London, W.C.2. Advertisement Managers :—THE SCHEFF PUBLICITY ORGANISATION, LTD., 125, Pall Mall, London, S.W.1. Registered as a newspaper and for transmission by Canadian Magazine Post. Subscription rates :—32/6 per annum, 16/3 for six months, post free. Sole Agents for Australasia :—GORDON & GOTCH, (Australasia), LTD. For Canada :—IMPERIAL NEWS, LTD. For South Africa :—CENTRAL NEWS AGENCY, LTD. For Japan :—SALE & FRAZAR, LTD.

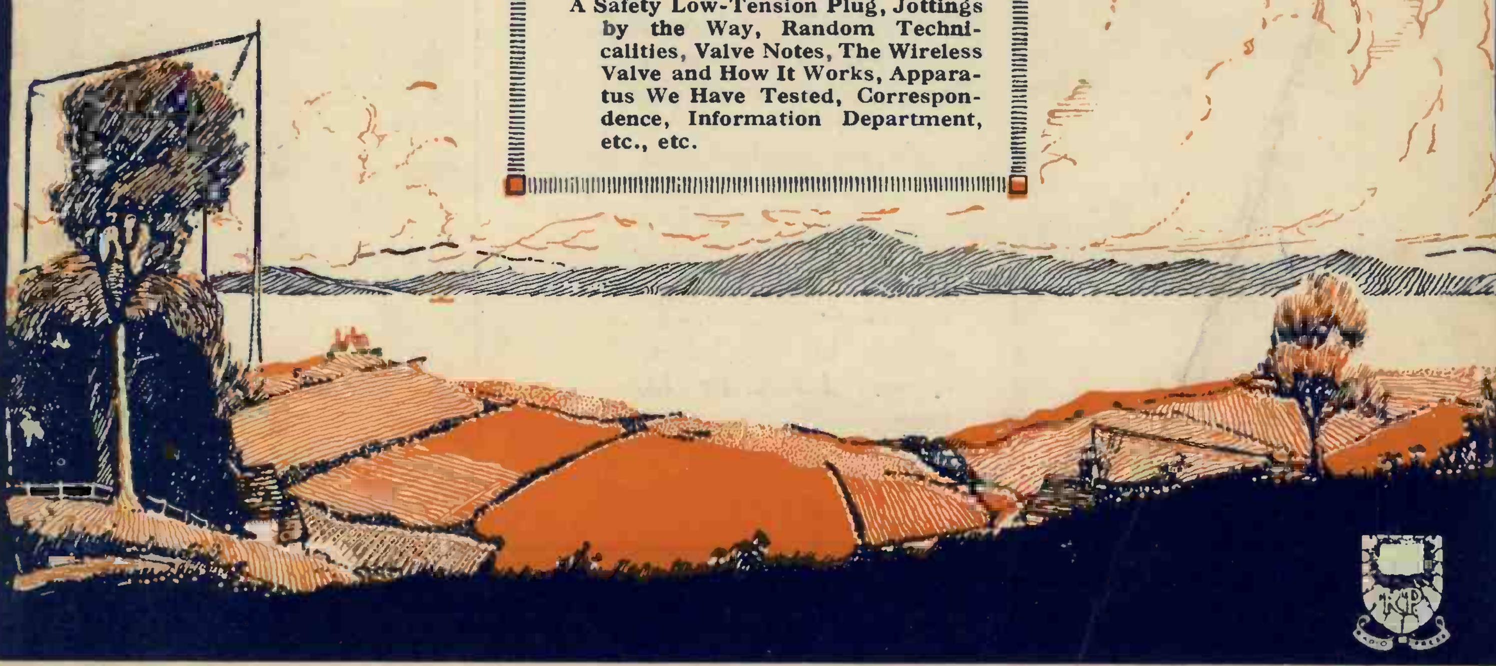
Wireless Weekly, 6d. Net. Wednesday. June 11th, 1924

Wireless Weekly

and the Wireless Constructor.

Vol. 4.
No. 6.

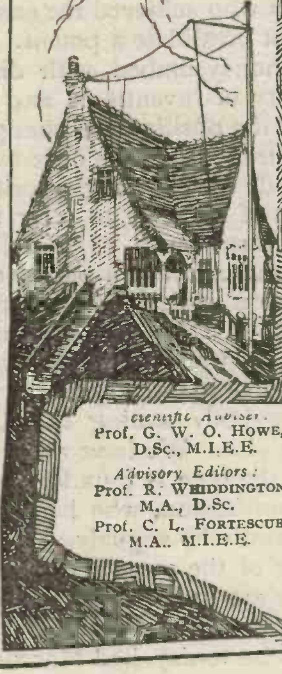
CONTENTS



Fault Finding in Reflex Circuits

Wireless Weekly

Vol. 4, No. 6
June 11, 192



CONTENTS

Editor: JOHN SCOTT-TAGGART, F.Inst.P., A.M.I.E.E.
Assistant Editors: P. W. HARRIS. E. REDPATH.

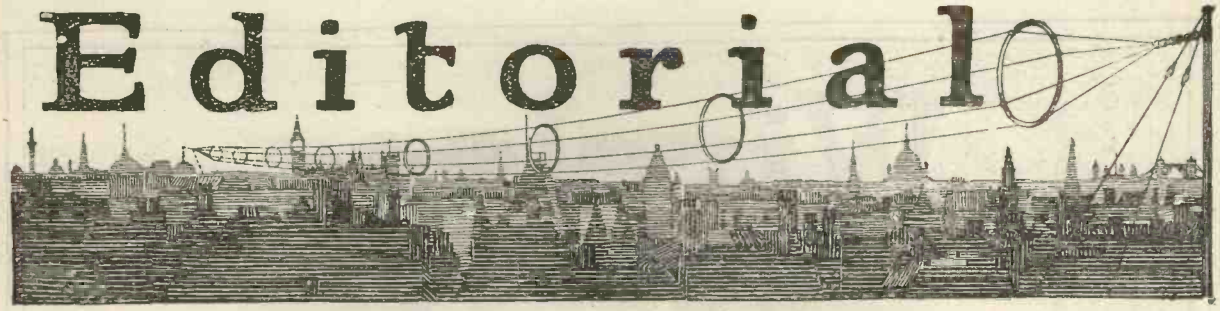
Radio Press, Ltd.
Pubishers of Authoritative Wireless Literature.
DEVEREUX COURT, STRAND, W.C.2.
Tel.—Central 3763.
Advertisement Managers: SCHEFF PUBLICITY ORGANISATION, LTD., 125, Pall Mall, London, S.W.1
Tel.—Regent 2440.

Scientific Adviser:
Prof. G. W. O. HOWE, D.Sc., M.I.E.E.
Advisory Editors:
Prof. R. WHIDDINGTON, M.A., D.Sc.
Prof. C. L. FORTESCUE, M.A.. M.I.E.E.

Staff Editors:
E. H. CHAPMAN, M.A., D.Sc.
A. D. COWPER, M.Sc.
G. P. KENDALL, B.Sc.
R. W. HALLOWS, M.A.
S. G. RATTEE, Member I.R.E.

All correspondence relating to contributions is to be addressed to the Editor of "Wireless Weekly."

Nothing contained herein is to be regarded as permission or encouragement to infringe any patent rights.



The Priority of Inventions

ELSEWHERE in this issue will be seen an article we have received from America on the result of recent litigation involving such well-known names as Lee De Forest and Edwin H. Armstrong. Dr. De Forest, of course, is the inventor of the three-electrode valve, while Major Armstrong is well known for several wireless inventions. He appears to be the first to have made practical use of critical reaction for wireless reception, and his American patents were recently upheld as master patents governing not only critical reaction for reception, but any use of a valve to obtain a reaction or oscillating effect. This very important judgment, given by the Court of Appeal for the district of Columbia, will completely alter the whole situation in America, but it will not affect the position in this country where the situation and the patent law is entirely different. Dr. De Forest's success is of particular interest to the writer, who acted as patent adviser on this side for his American attorneys in this litigation.

On this side the first reaction patent specifically pointing out the advantages of the reaction effect is that of C. S. Franklin, the well-known Marconi engineer who has done so much in this country to further radio science. Franklin seems to have done entirely independent work, but as so often happens, other research workers in other countries were tackling the problem at the same time.

In point of time, Armstrong has always been accepted as the first one to appreciate the use of the critical reaction effect in receivers, but now Dr. De Forest is held to be still earlier, although there is no indication that he appreciated the full extent of the effect he had obtained.

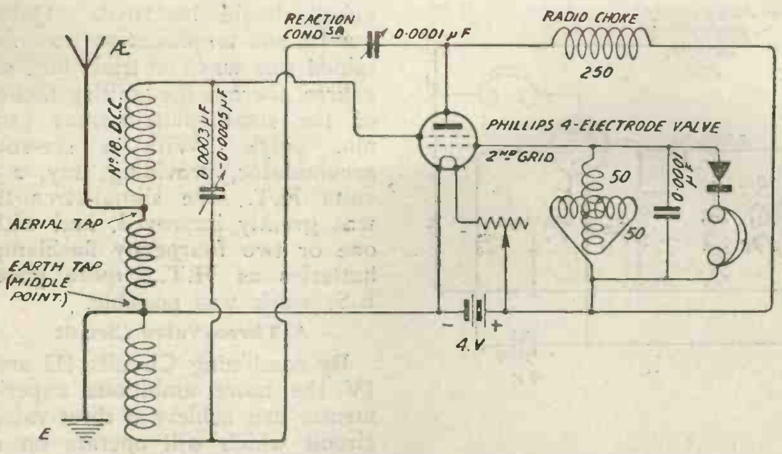
There is a great deal of difference between producing the germ of an idea and carrying it out. Frequently patents, and good patents, are obtained for apparatus which has no practical use at the time, and the value of the patent is only appreciated when some other investigator produces a practical development which, however, to some extent rests on the previous invention.

In America the position is peculiar, and in many respects very unsatisfactory. A patentee really never knows, and often has no idea, whether his invention is valid or not. Obscure notebooks, in which private experiments have been recorded, frequently become of vital importance when establishing priority. In this country, fortunately, the position is extremely simple. Patent priority dates simply from the date the patent application was filed and not from any earlier date when experiments were made. This is eminently satisfactory, and if a good invention has been made it is probable that it can only be invalidated by a prior user by someone else. This is very often very difficult to prove to the satisfaction of the Court, because mere private experiment by somebody who achieved the same result earlier would not invalidate a patent.

Radio history is honeycombed with disputes about the priority of inventions, and it is highly unlikely that the position will change in any way in the future. There are only two real substantial grounds for claiming priority in an invention; one of these is to refer to some published document, such as a radio periodical, or some publication of a paper, or to a patent specification which has a very definite date attached to it. The mere fact that some obscure experiment was carried out and then abandoned, or subsequently ignored, is no justification for anybody stating that he was prior to someone else. We have all met the type of man, and the type is found in the highest ranks of the profession, who believes that nothing is new, and who vaguely asserts that he did something of the same kind long ago. Such statements are useless unless they are backed by proper documentary evidence.

Where would radio be to-day had Marconi conducted his experiments privately without giving the world the benefit of his practical work? The real credit should go every time to those who appreciate what they have done and carry their invention to a practical conclusion.

J. S. T.



Circuit I.—A high-frequency amplifying circuit with crystal detector.

More High-Tensionless Circuits

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

Although we have continually pointed out the limitations of high-tensionless circuits, we appreciate the desire of the experimentalist to see exactly what can be done, and these notes should therefore prove of interest

A MODIFICATION of the four-electrode valve circuit in common use by the Dutch amateurs for reception with extremely low values of anode voltage has been shown by the writer and others to be applicable to the extreme case where all the H.T. available is that provided by the potential drop in the filament resistance, when a six-volt accumulator is used with a four-volt valve with the resistance in the positive lead. The fourth electrode—an inner, second grid—is given a positive charge by connecting to the positive side of the battery, and by partly neutralising the effect of the "space-charge," allows a moderate filament emission without a powerful H.T. battery to overcome the reluctance shown by the electrons emitted from the filament in passing this barrier.

CIRCUIT I

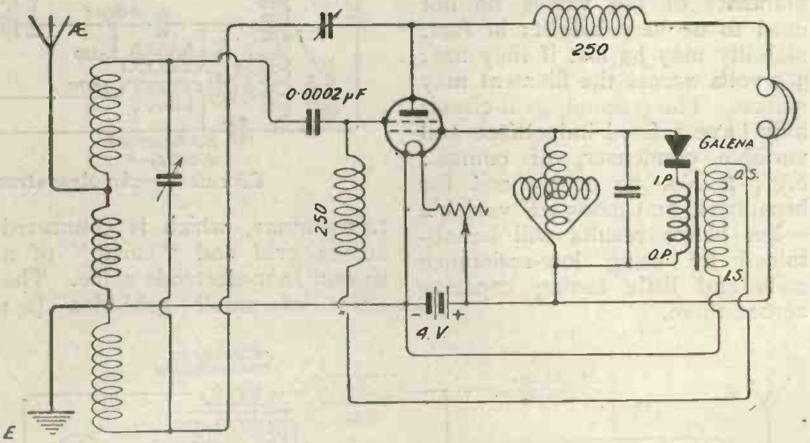
Even with a four-volt accumulator as sole supply of current and H.T., with the ordinary Phillips four-electrode valve, which may take 3.5 volts on the filament, there is enough emission produced in this way (some .03 milliamperes) to give fair 'phone signal-strength when properly modulated by the rectifying action of the grid-condenser in the reception of signals. The writer has shown that quite good results can be obtained by a special transmitter type of circuit, arranged so as to oscillate with the greatest ease and with extremely loose coupling to the aerial.

Further investigation showed that a radio-frequency reaction effect could be obtained by placing a tunable circuit across the same second grid and L.T.+, as in Circuit I. The circuit now oscillated even more easily than before, so that considerably less electrostatic reaction was required from the plate. In fact, at times the filament had to be slightly dimmed in order to hold the circuit down with the minimum capacity of a low-minimum .0001 μF reaction-condenser in use!

An obvious step is then to put a crystal rectifying circuit across this second tuned grid circuit—which corresponds in a way to an ordinary "tuned anode"—resulting in Circuit I. This was found to be quite effective, and gave appreciable H.F. amplification. Actually the tuned circuit was a variometer of 50-50 turns of No. 22 S.W.G. d.c.c. wire, wooden ball rotor and 3½-in. tube stator; with a fixed .0001 μF condenser across it. With a good galena crystal it was pleasant to work with, and (given a low-minimum in the reaction-condenser) quite sufficiently stable. The primary tuning arrangements were as previously described: of extremely low resistance and low damping.

CIRCUIT II

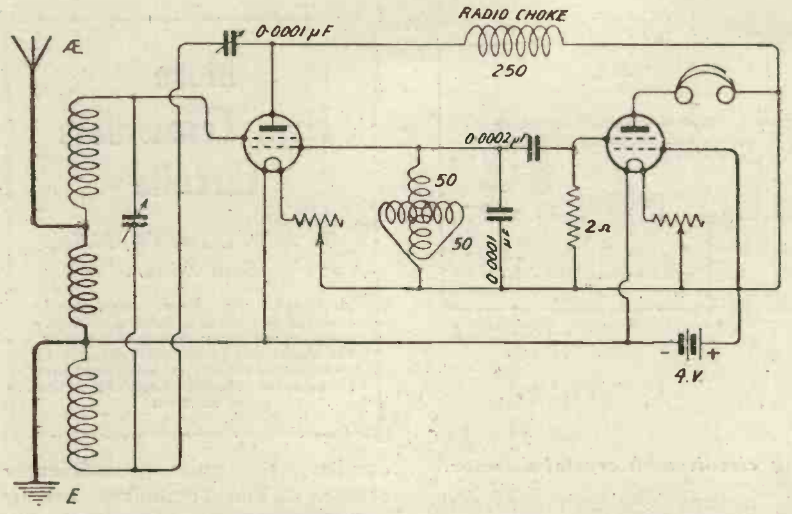
Following in the footsteps of the Marconi four-electrode circuit we get the dual Circuit II. The transformer terminals are indicated for the R.I., Igranic and others of similar markings; some, as the Pye No. I, are differently connected, in which case the right arrangement is a matter of trial. The galena crystal comes next to the (second) grid; the O.S. is nearly always to be connected to the first grid, through a radio-choke, as shown. The choke is the customary coil of about 250 turns of low distributed capacity. On trial this circuit gave quite good results considering the small power available, and was almost free from unpleasant noises associated with powerful dual circuits.



Circuit II.—A practical valve-crystal dual circuit.

CIRCUIT III

The same H.F. coupling can



Circuit III.—A two-valve circuit comprising one high-frequency valve and detector.

be applied to a second valve (detector) by substituting a grid-condenser and earth or filament lead for crystal and 'phones (or transformer). Circuit III results. Used in this way, quite a reasonable measure of H.F. amplification results; and with a low-minimum reaction-condenser on the first valve, the circuit is stable and tunes sharply. The filaments of the valves do not need to be very bright; in fact, stability may be lost if they are; 3.5 volts across the filament may suffice. The (second) grid circuit may have a fixed inductance and variable condenser, of course; e.g., a No. 50 or 75 coil for broadcast, and .0005 µF variable —but better results will be obtained by using low-resistance coils and little tuning capacity across them.

CIRCUIT IV

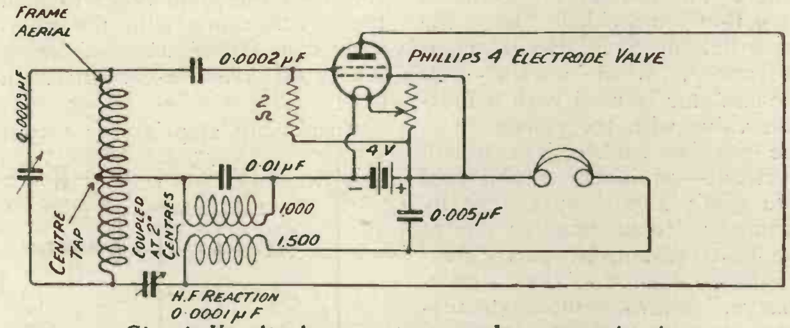
Circuit IV is a detector-note-magnifying circuit, the 'phones of the simple detector circuit being substituted by an ordinary L.F. transformer, which is connected across grid and "earth" of a second four-electrode valve. The effect of small grid-bias (1-2 volts) should be tried. Quite good audio amplification was obtained this way, on trial; but, of course, there is the limiting factor of the small plate-current (.03 ma. only). With a six-volt accumulator, providing, say, 2.5 volts H.T., the signal-strength was greatly improved, and with one or two fourpenny flashlamp batteries as H.T., quite good L.S. work was possible.

A Three-Valve Circuit

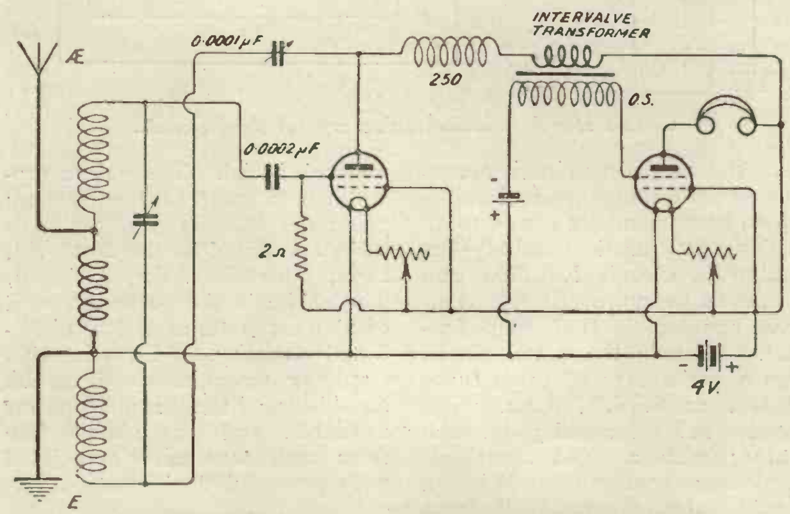
By combining Circuits III and IV the more ambitious experimenter can achieve a three-valve circuit which will operate on a single four-volt accumulator. But the limiting effect of the small plate-current in the last valve will be very evident, except on the most distant stations.

CIRCUIT V

A four-electrode valve Armstrong "flivver" circuit has been worked out with very encouraging results by Mr. D. F. Stedman, with a reasonable H.T. supply. A different type is shown in Circuit V, which will actually operate without external H.T. on a four-volt accumulator. This has been developed, in principle, for use with ordinary R valves quite recently by the writer, and with the latter gives excellent results with ordinary values of H.T. In this case, as the available power is so small, the coupling between the Armstrong coils must be rather looser than usual—say at 2-in. centres—and a No. 1,500 reaction coil is used, with a No. 1,000 oscillator coil bridged by a .01 (one-hundredth microfarad) fixed condenser. The latter coil also acts as radio-choke for the H.F. reaction. The circuit should be tried first with no H.F. reaction and Armstrong coils closely coupled, when a steady faint whistle should be heard; second,



Circuit V.—An Armstrong one-valve super circuit.



Circuit IV.—An arrangement whereby a detector and note magnifier circuit is obtained.

with the Armstrong coils well apart, e.g., swung at right angles in a two-coil tuner, and with the H.F. reaction-condenser at maximum, receiving a wavemeter transmission. Then the coils should be swung up and separated again until the whistle is just on the point of quitting, when, on cautiously increasing the H.F. reaction from minimum, the great increase of signals (in the continued presence of the whistle) due to super-regeneration should be obtained. Final small adjustments may improve these. The filament does not need to be very bright. No details are given for the centrally-tapped frame-aerial, as these vary so much. One might try, for example, 25 turns of No. 22 on a two-foot frame, spaced ¼ in., for the broadcast belt. Many more than the usual number of turns are needed in this mode of connecting and tuning the aerial. The tuning capacity must be kept small.

A Transmitting Circuit

It might be noted that a single-valve detector circuit of the type indicated (Circuit IV, left-hand part) if the secondary of a modulation step-up transformer is introduced into the second (inner) grid-circuit, and in series with the primary, an ex-Army trench-'phone microphone is inserted (also in series with the four-volt accumulator), will act as an effective telephony transmitting circuit over very short distances, e.g., between neighbouring aerials. A suitable transformer is the 250 three- or six-volt bell-ringing transformer, such as the Ferrix. The modulation leaves something to be desired. (It should be remembered that a special licence is necessary for even absurdly low-power transmission experiments.)

Listening-In for the Big Bang

By "OLD CHAP."

"WHAT about listening-in for the big bang to-night with an amplifier, Old Chap?"

"Splendid idea. I've got a two-valve amplifier which is just the very thing."

"That's why I mentioned it to you, Old Chap."

"Your tuning seems as sharp as usual. You'd better be careful, though. We shall want your loud-speaker. My valves, I suppose?"

"Certainly. Those two-year-old French valves of yours ought to be about the best thing in valves for picking up a French explosion. I'll come round to your place at 7.15 sharp. If you are listening-in as usual and fail to hear my knock, I'll unscrew the aerial wire from the lead-in."

By 7.30 we had our apparatus rigged up. To the input terminals of the amplifier the loud-speaker was connected, and there were two pairs of telephones (both mine) connected to the output terminals. The loud-speaker, with its horn pointing due south, was fixed on the flat roof of a garden tool-shed. The amplifier was placed on a small box, and we sat at our ease in deck-chairs. At 7.45 we donned the 'phones and we listened until 8.30. Our apparatus was efficient, our patience was inexhaustible. Everything was as perfect as one could wish. There was just one little flaw in the proceedings. We heard nothing of the explosion.

Still, we heard lots of other things. The notes of a thrush singing away in the distance came through magnificently. The bark of a dog half a mile away was pleasantly distorted into a noise like a tired Westinghouse brake. Old man J—— next door, walking down his garden path, appeared to make as much noise with his feet as a regiment of soldiers.

Many interesting scraps of conversation floated to us from considerable distances *via* the amplifier. We heard what neighbour B—— said to his wife when she pulled up a root of poppies under the impression that they were thistles. We also heard what neighbour R—— thinks of the new people who have taken the furnished house across the road, and who have brought with them a dog which yaps half the night.

But if you would really like to know what the peace and quietness of an evening in the back gardens of a respectable suburb sounds like, put up a loud-speaker and an amplifier, and listen-in on the telephones. You can always make the excuse that you are listening-in for a big bang.

Should an Aerial be parallel to the ground or may one end be higher than the other?

It is not essential that the aerial should be horizontal, though such a one is very effective and usually convenient for mechanical reasons relating to its suspension. If the two points of suspension are not at equal distances from the ground, however, the free end of the aerial should be attached to the higher point.

AERIALS

Is it possible to arrange Aerial and Earth terminals in several rooms so that the Receiving Set may be used whenever desired?

This is possible, but, whatever care is taken with regard to insulation, the necessary lengths of wires inside the building, all permanently connected to the aerial, will greatly reduce its efficiency. A much better plan is to arrange the aerial and earth connections in one particular room, instal the receiving set there and run telephone leads to the other room. Only those leads which are to be used should be connected to the set, and, if telephone plugs and jacks are employed, changing over can be done with ease and rapidity.

JOTTINGS BY THE WAY

Still Going Strong

You may remember that I told you a week or two ago the life story of a wireless jest which I perpetrated some years since. I really thought that after its travels from one end of the world to the other and its appearance in all kinds of papers, the poor old thing was dead. But it appears that it is very much alive. There is an American paper which offers each month a prize for the best joke with a scientific atmosphere. The conditions of entry are stringent. You are warned in large type that no threadbare, second-hand, part-worn, or otherwise battered joke will stand an earthly chance. Yet someone greatly daring sent in the old stager for the competition. There were dozens of others—about thirty are printed upon last month's page devoted to this kind of thing in the aforesaid paper. But the old one still full of life put them all to flight, and if you will believe me, won the prize of many good dollars! Yet it appears not as a variation of the original theme, but in its pristine form :—

Ray : " Who was the first wireless enthusiast? "

Dio : " Adam, of course. A loud-speaker was made from his spare parts."

And there you are! Would you believe it? My only regret is that knowing the old fellow's persistent refusal to die I did not send him in myself as a candidate for the prize.

A Base Deceiver

The other evening, feeling full of energy, I resolved to devote myself to the pages of a very technical French wireless journal. My enthusiasm began to wane a little as I glanced at article after article and saw that each lead off with the most appalling formulæ stuffed full of cos ϕ and sin θ and of the most cabalistic mathematical signs. French I can tackle for, as I mentioned some time ago, that language has obligingly borrowed a large number of our wireless terms; but the higher mathematics I frankly loathe. However, as I turned despairingly from one contribution to another a ray of hope suddenly dawned. I came upon an article upon rather an abstruse subject which began in the most encouraging way by stating that all previous explanations had had recourse to the most threatening mathematical formulæ and that the writer proposed to eschew all these things, giving his exposition in the clearest and most straightforward language. Here was a man after one's own heart. I embraced him, metaphorically, of course, and plunged into the article.

Disappointment

For the first three pages all went as merrily as could be desired. It was a little deep perhaps, but by making strenuous efforts one could follow where he led. And then on turning over the page my eyes were horrified to behold something rather worse than the usual array of figures and squigly signs and Greek letters. It was a nasty blow, but as the man had promised so well, I resolved to see the thing through. Pulling up my socks and concentrating as I have never concentrated before, I wade through these grisly horrors with the aid of a slide rule, a log table and other accessories. Yes, eventually it is done, I grasp the whole thing; my efforts are not wasted. But stay; of the article there remains one short paragraph. Is this the tail wherein lies the sting? Indeed and indeed it is, for I read that, ingenious though these calculations are, they are quite useless, since the results that they give do not in the least accord with observed facts. Now do you think that it is fair to treat an earnest striver after the great truths in this way. After practical experience I am quite convinced that it is not.

Blow after Blow

But this kind of thing is always happening to the man who endeavours to improve his mind upon the subject of wireless. By making superhuman efforts he masters explanations and fills his mind with a huge store of facts. He passes some on to his friends, receiving others from them in exchange. He is firmly convinced that certain things are essential to good reception because everybody whom he has read said they are, and has given the fullest details why they should be so. He accepts such statements as fundamental truths of wireless and builds upon them. But one fine day his edifice of knowledge comes tumbling down like a pack of cards. It may be that he does something which should by all the rules of the game be fatal to results, only to find that they are in no way affected by his breaking all recognised rules. Or it may be that in a wireless publication he finds some of his most cherished theories shattered and their futility proved to the hilt by the writer of an article.

Shattered Ideas

Let me give two cases in point. It has been instilled into us since the day when we began our wireless education, that if you erect a T-aerial you must make the arms thereof precisely equal, for otherwise all kinds of dreadful things will happen. Recently it was pointed out in some paper or other that you can make your T as lopsided as you like without spoiling the quality of your reception. In fact the worst that could be said of an unequal T is that it does not look so nice as one that is perfectly proportioned. Then there is the condenser across the telephones. We used to cling to that condenser as our sheet-anchor, pointing out to beginners who had not got one that their bad reception was due entirely to its absence. Then somebody began to whisper that it was not always necessary. We arose in our wrath, of course, anathematising the man as a heretic of the most pernicious type. And then we tried the effect of removing the said condenser and found that he was right after all. Things are coming to such a pass that I quite expect to find definite proof appearing before long that a bad earth is far more efficient than a good one, or that high-tension batteries are much improved by an occasional hearty short circuit. For the benefit of those who cannot banish the old ideas from their memories, I am thinking of starting a kind of inverse Pelman course in the art of forgetting.

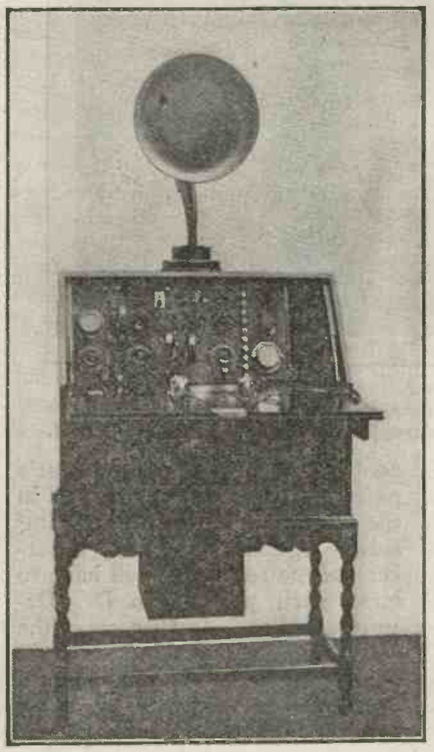
What's Yours ?

What is your pet form of wireless absentmindedness? I presume that you have one, unless you are one of those unfortunate people who never by any chance do anything wrong. I say unfortunate, since for them life must be rather a flat thing, for it is just the occasional *contretemps,* the little adventures, that make it really interesting. It is, of course, inadvisable to make a hobby of the particular form of absentmindedness which leads to a confusion between high tension and low tension leads. If by any chance a man is given this way you will generally find that after a time he becomes a hearty supporter of crystal reception and strives to impress all who will listen that if you use valves you must have distortion. Should you be one of the afflicted, dull emitter valves are certainly not for you, though when you burn out one you may find a consolation in the thought that for one second at any rate you have been living at the rate of several millions a year.

My own mental aberration usually takes the form of omitting to attach the lead-in to the terminal which is waiting to receive it. I try out a new circuit. Nothing whatever happens. I make all kinds of tests, I rush for screwdriver and pliers, I disembowel the thing, singing a hymn of hate the while. After a hectic time I suddenly remember the lead-in and kick myself heartily.

The Critic Criticised

I was not a little amused to read in one of the dailies a criticism by their musical expert of the concert which the B.B.C.



A reader's "Transatlantic Receiver" made up in cabinet form, including the note magnifying stages.

gave in the Central Hall, Westminster, and broadcast direct therefrom. To put it mildly, he arises in his wrath and slays wireless as a musical medium with a pretty heavy hand. He was unable, he asserts, to recognise the various instruments, the pieces sounded all wrong; in fact one gathers that altogether his delicate ears were assailed with what he regarded as a pretty putrid performance. Now as it happened I turned on my set on that particular evening and with me was one who knows a very great deal about music. He had never heard wireless before, having always had something of a prejudice against it; therefore it cannot be urged that he had become acclimatised to such imperfections as it may possess. I live out in the country and must use both high and low frequency amplification, whilst the critic aforesaid was employing a crystal set unaided, which should have given him a very distinct advantage. Be it as it may, my musical friend was delighted with the performance and expressed his wonder that the sounds of the various instruments could come through with such wonderful perfection. At first sight it might seem that this was a case of doctors disagreeing, but really I think that the critic who writes in the strain that I have described does not realise that he is passing strictures not upon wireless in general, but upon his own set. Nothing is perhaps so unpleasant to listen to as a bad receiving set's performances when the devastating effects of distortion utterly ruin the finest transmission. This is a point to be considered. 2LO's transmissions certainly, and those of most of the other stations, are nearly always above reproach, though there are, of course, times when something goes wrong. If therefore you find that they do not come in with perfect purity, take my tip and suspect your own set.

Judicious Borrowing

This is not to say that you should forthwith pull it to pieces or hurl it through the window. Much can be done to improve it by a judicious process of exchanging or borrowing. If, for example, you feel that the 'phones are not all that they might be you can probably plant them on some beginner in exchange for his own in a very easy way. When you hear that he is about to buy a set ask him to let you be present when it is tried for the first time. Get him out of the room on some pretext and whilst he is absent give the 'phones a good bend so that when he puts them on the receivers will grip his ears like the jaws of a vice. Later on it will be perfectly easy for you to say "My dear fellow, you cannot possibly use these infernal things. I dare say, however, I could manage to make them better; if you care to exchange a very comfortable pair of my own for them I shall be only too glad to help you." This is called diplomacy.

WIRELESS WAYFARER

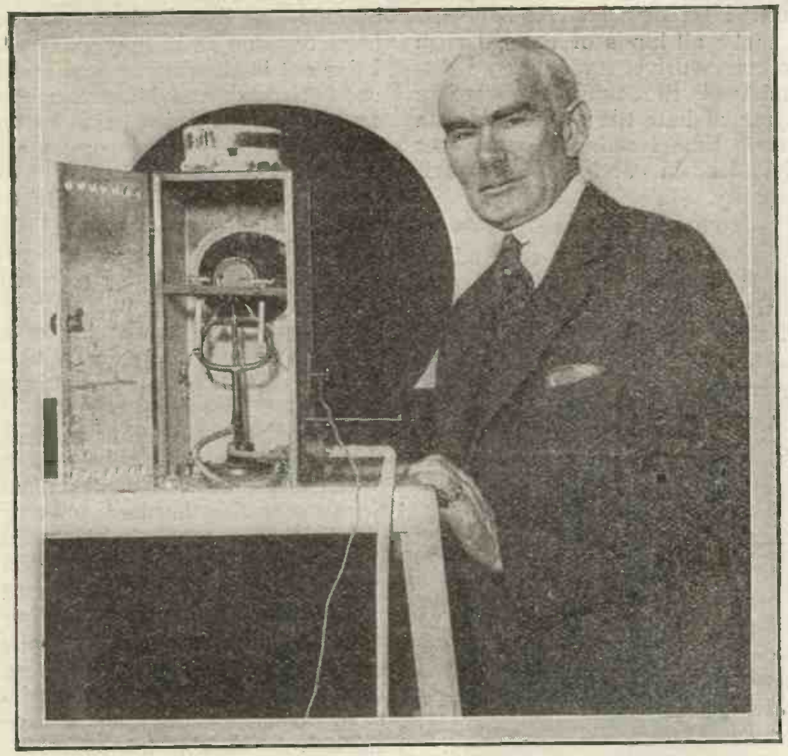


Fig. 1.
Dr. Lee DeForest and the flame microphone which he developed for the Phono film. A description of this microphone was given in Vol. 1, No. 14.

Dr. Lee DeForest and Reaction Patents

By W. B. ARWIN

THE radio industry in America, if not throughout the world, was deeply interested early last month when Dr. Lee DeForest was given control of the oscillating valve patents by the Court of Appeals for the District of Columbia. The decision giving Dr. DeForest these rights culminated a seven-year legal battle and affects vitally practically every part of the radio industry of the United States.

According to the decision given Dr. DeForest gets not only the control of valve oscillators as used for transmitting, but also exclusive patent rights over the so-called feed-back circuit, which will bring the reaction feed-back regenerative circuit and the super-heterodyne circuits under his control. As a matter of fact, attorneys are well agreed that in any case where a valve is used as a generator of alternating currents of any frequency, that use will be subject to the DeForest patents.

The Effect of the Decision

The effect of this decision is obvious, since, at the present time, all valve transmitting stations being manufactured and installed in the United States will come under the control of Dr. DeForest's patents. Those firms engaged in the manufacture of transmitting sets, regenerative and super-heterodyne receivers, will have to make their peace with Dr. DeForest and their further use of the oscillating audion in any form will depend entirely on the doctor's goodwill. Whether they will be granted licenses to continue their manufacture or not is a question that cannot be answered at present writing. It is positively certain that there will be no end of litigation brought with a view to straightening out this tangle, and it is a tangle, since all future valve transmitters—this includes all broadcast stations—must be made only with the sanction of Dr. DeForest.

History of Litigation

The history of the litigation which resulted in this decision is by no means uninteresting. The fight started in March, 1917, with the filing of an infringement suit in New York against Dr. DeForest by the Westinghouse Company which, at that time, was in control of the Armstrong patents for generating continuous waves by means of a valve—the patent which was given to Dr. DeForest by the decision. Shortly after this case was filed, a third claimant went before the patent office in Washington, claiming the discovery of the same idea. At that time there was still a fourth claimant contesting his own discovery. The result was that the Commissioner of Patents issued a writ of Interference which directed all four of the claimants concerned to take their case to court and obtain a legal decision as to the rightful ownership of the feed-back oscillator idea. These four claimants were Dr. DeForest, Mr. Alexander Meissner, a German inventor, Dr. Irving Langmuir, of the General Electric Co., and Mr. Edwin H. Armstrong.

The first decision against Dr. DeForest was given by Judge Mayer of New York. The case was appealed and Dr. DeForest lost again. It was then taken before the Appelate Division in Washington, D.C., from where it was appealed to the Court of final authority which gave last month's decision.

The question was never one of invention. From the first entry of the litigation it was admitted by all the attorneys concerned that Dr. DeForest had originally discovered the idea. The most important single piece of evidence in the case is the two-page excerpt from the notebook of Dr. DeForest's assistant, Mr. Logwood, which shows the original circuit and gives the oscillation results obtained from the circuit. These two pages are reproduced herein.

The lower courts all maintain that the patent rights should go to Mr. Armstrong, beause the lapse of time between Dr. DeForest's original conception of the idea, August 6, 1912, and the time of his filing application for a patent covering it was sufficient proof to establish the fact that he

The report covering Dr. DeForest's success in winning, after a seven-year fight, the patent rights of the oscillating circuit patents

had abandoned the idea. One of the greatest points in favour of Mr. Armstrong seemed to be that Dr. DeForest did not mention the use of the oscillatory circuit for radio work at the time of discovery. Mr. Armstrong's application for patent contains specifically the radio application of the system.

The court which gave the latest decision, however, took the position that since Dr. DeForest was investigating the use of the valve as a telephone amplifier and repeater in order to obtain funds to carry on his other research work at the time of his discovery, that the lapse of time before the filing of the patent application did not actually constitute abandonment.

Difficulties

It might be of interest here to relate a few of the Doctor's experiences and some of his difficulties encountered at this period of his experimental work. Other litigations caused the failure of his company and his own financial embarrassment just about the time of the invention in question. He was forced to give up his own laboratory and experiments in order to make a living. He took a post as engineer with the Federal Telephone Co., of California. During the time of his connection with this company, however, he carried on his own experiments with the valve as a telephone repeater and relay. On several occasions he made attempts to market this idea to some of the large companies, and in the face of several failures kept up his work, both along this line and in the investigation of the audion as an oscillator.

Dr. Stone

A little over a year after the original conception, Dr. DeForest came to New York in an attempt to sell the telephone amplifier idea, and met Dr. John Stone, consulting engineer for the American Telephone and Telegraph Co. He showed Dr. Stone a sketch of the oscillator at the time. Subsequently this was to play a very important part in the patent litigation.

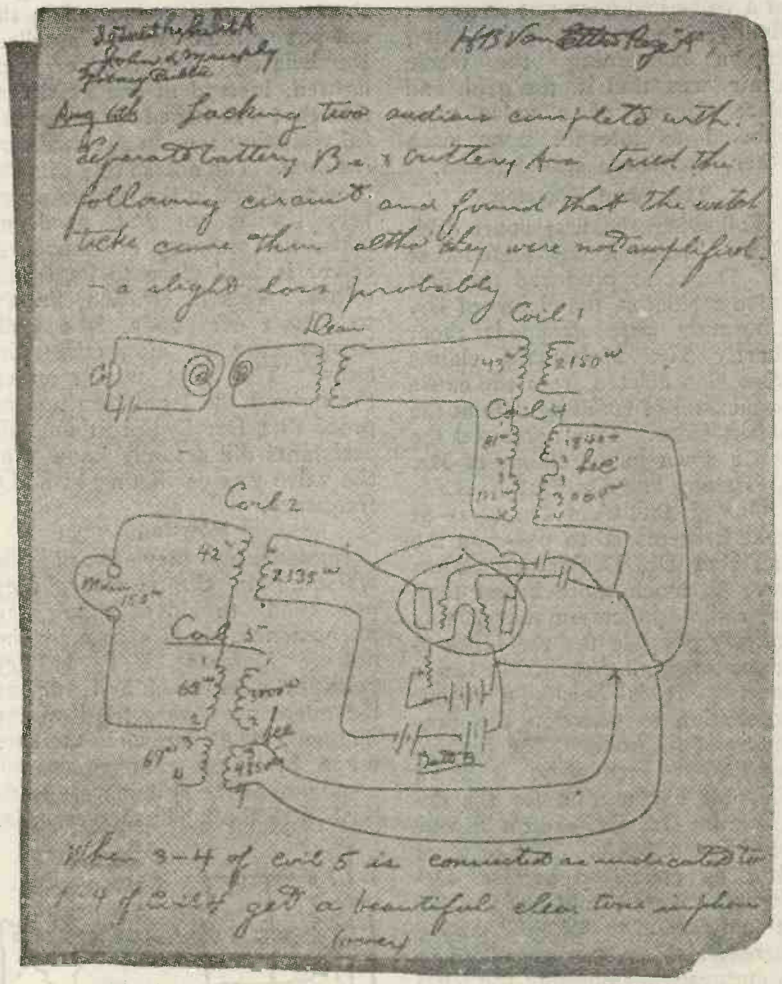


Fig. 2.

The page from Dr. DeForest's note-book shown here, played a very important part in the litigation which has finally given him control of the oscillating valve and regenerative circuit

Meissner Circuit

Another point stressed very strongly by Mr. Armstrong's attorney was that Dr. DeForest did not have a particularly clear idea of the use of the circuit. This notion possibly grew because no direct application of it was made until after the beginning of the legal squabble herein detailed. In the final court which gave the decision, the fact that Dr. DeForest explained, in detail, his circuit to Mr. Stone upon the occasion of their visit in 1913, was taken to mean that Dr. DeForest had a pretty clear idea of his circuit's actions. The attorneys opposing Dr. DeForest also brought forward the fact that the Meissner circuit, which had become known in America about this time, failed to work under Dr. DeForest's hand. The only difference between the Meissner circuit and the original DeForest one, as shown to Mr. Stone, was that the Meissner circuit, including coils P1 and S2, Fig. 3, was shunted by a capacity. If the condenser giving this capacity is too large the circuit will not operate and the conjecture of attorneys in court—about the only way to settle the question, under the circumstances—was that Dr. DeForest had simply selected a condenser for this circuit, the capacity of which was too high. It must be remembered that at the stage of radio investigations discussed in this proceeding, none of the mathematics concerning the oscillating characteristics of a valve had been put on paper. Really, about the only thing known concerning the whole affair was that if the grid and plate circuits of a valve were allowed to interact upon each other, oscillation would result.

The Final Decision

Following the first court decision in which it was stated that Dr. DeForest produced the first valve oscillator, the claims of Dr. Langmuir were dropped; then, shortly Mr. Meissner's claims were also deleted from the cause on account of his filing date at the patent office. This narrowed the battle down to the claims of Mr. Armstrong and Dr. DeForest.

One of the chief troubles—at least it seems so to us—was the fact that Dr. DeForest's claims were so much more broad than the radio application that it was entirely possible for the issue to be mistaken all through the lower courts. It is hardly a fitting occupation to question the processes of its honour, the judicial mind, but seemingly, it is a plausible explanation for the decision in Dr. DeForest's favour after seven years. The original idea, as conceived by Dr. DeForest, covers the use of a valve as a *generator of alternating currents.* May one be so bold as to suggest that possibly the legal lights were lead into some entangling bypaths on account of the now extensive use of valves as generators of *high frequency* alternating currents, as used, in radio?

A Brief Account

A short history of how the oscillating property of valves came to be discovered may be of interest. Fig. 2 shows the laboratory sketch of the circuit which produced the first oscillations. Mr. Logwood, Dr. DeForest's assistant, working directly under the Doctor's supervision, set up the apparatus illustrated in the diagram. The experiment was primarily one looking toward the production of a telephone amplifier. The instruments used were for the most part pieces of telephone apparatus. The input circuit from the microphone was lead to the grid side of the valve and the out-put with the receivers connected was taken from the plate. In the course of the experiments, the two leads running from the grid connection to one winding of the transformer connected in the out-put circuit were installed. Immediately the valve was lighted, instead of the amplification that was hoped for, a beautiful whistling tone in the receivers resulted. The notes state that the tone produced in the receivers was very similar to that produced when the ordinary telephone receiver is held close to its transmitter. This illustration, known to almost everybody, is a well-known case of interacting circuits. This fact was stressed throughout the legal hearings as proof that Dr. DeForest and his assistants did actually know that the valve was oscillating at audio frequency.

Howling

Immediately they heard this whistling in the receiver, they proceeded to investigate the phenomenon, as is shown by the notes. Different H.T. battery voltages were used and various incandescences were tried on the filament. The changes in the note made by these changes in the constants of the circuit were transcribed to the laboratory records.

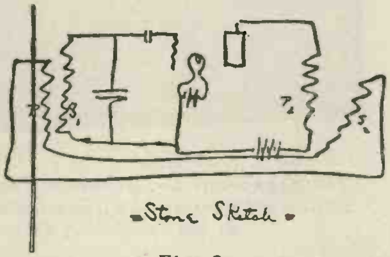


Fig. 3.
The oscillating circuit as drawn by Dr. Stone two years after it was revealed by Dr. DeForest.

The placement of the coils, and the two coils which are open, shown in the sketch, are simply the result of the fact that telephone apparatus was used in the experiment. Coils 4 and 5 were both standard telephone transformers. The Stone sketch shows that Dr. DeForest thoroughly understood just what was making the circuit oscillate.

Results of the Decision

The results of this decision are impossible to state at this writing. In view of the fact, however, that there are 17 companies manufacturing regenerative receivers under the erstwhile Armstrong patents and that there are some large firms engaged on a large scale in the manufacture of radio transmitters and receivers using valves, it is almost obvious that on-lookers will be furnished with a grand show at someone's expense in the near future.

Mr. Samuel E. Darby, Jun., a member of the firm of Darby and Darby, Dr. DeForest's attorneys, states that it will probably be some time before the whole matter can be straightened out on account of the ramifications extending through half a dozen industries and twice as many companies. He says, however, that the question of patent ownership on the oscillating audion is settled once and for all, and that further litigation on the subject is almost impossible. Mr. Darby has carried the legal battle from its inception to the present victory for Dr. DeForest.

ST75-76

SIR,—I am one of those who consider that ST75-76 circuit is the best you have yet devised. It, however, appears to suffer from the defect that reaction comes on with a "ploink," which is very distressing to the operator's ears and head.

If you will give a cure for this in either of your splendid magazines (*Wireless Weekly* or *Modern Wireless*), and, in fact, on articles on "Overlap in Receivers in General," which is, I believe, the technical term for this malady, I think it would be very much appreciated. This "sudden reaction effect" is the only thing against a splendid circuit, and if it could be obviated I think more people would use it.—Yours faithfully,

M. R. HORNSBY, Ph.Chem.
(A reader of both your mags. from the beginning.)

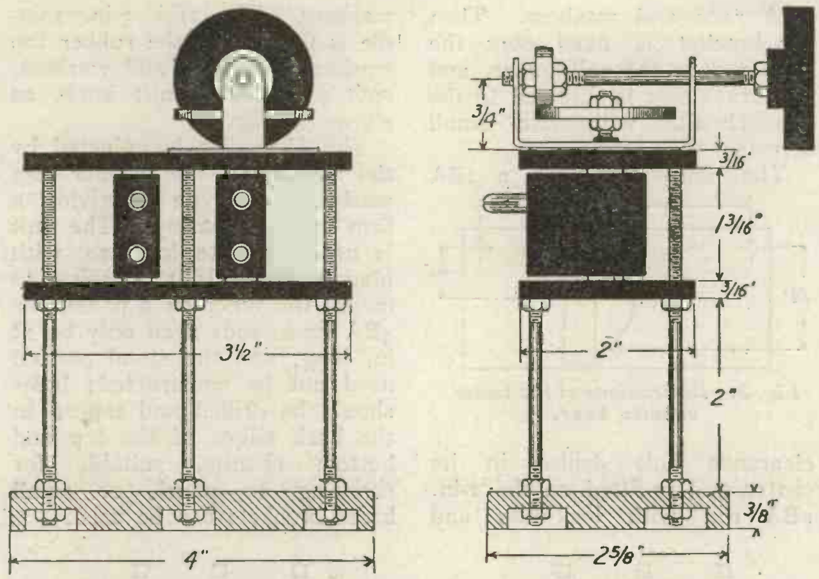
Manchester.

[We shall deal with this matter shortly. Try a lower anode voltage.—ED.]

ERRATUM

WIRELESS FROM A FLASH-LAMP BATTERY.

Referring to the above receiver which was described in Vol. 4, No. 5, it should be noted that a connection should be made from the earth terminal to the L.T. negative. If it is desired not to alter the construction of the set an external connection may be made from the L.T. negative terminal of the set to the earth terminal.



Figs. 1 and 2.—Constructional details of the coil holder and its stand.

The Construction of a Novel Tuning Unit

By P. J. BOUCHER

Those readers who are possessed of a little mechanical skill will find in this article full details of how to make an efficient two-coil holder

It is the object of this article to describe a tuning unit designed by the writer with the idea of its being as simple as possible to construct and requiring a minimum expenditure of cash. It can be relied upon to give as much satisfaction as the most expensive apparatus.

There are one or two novel features in this tuner, particularly the arrangement whereby the operating spindle may be swivelled round to any position desired for mounting purposes.

Although the tuner is designed as a separate unit, by a slight modification, later described, it may be adapted for mounting either on the front or back of a panel. A further point is that the control can be adapted to most tuners which have a vertical spindle for adjustment.

It is not essential that the actual measurements be adhered to, but they may be used as a guide, and any suitable material which the experimenter has already in stock can be utilised.

Components

The following is a complete list of material actually used in the construction of the tuner described:—

Two pieces of 3/16-in. ebonite $3\frac{1}{2}$ in. × 2 in.

Two ebonite plug and socket coil-holders.

Three brass 4BA rods $3\frac{7}{8}$ in. long.

One brass 2BA screwed rod 3 in. long.

One brass 2BA screwed rod 1 in. long.

One strip of brass 4 in. × $\frac{1}{2}$ in. × 1/16 in.

One brass disc $1\frac{1}{2}$ in. dia., $\frac{1}{8}$ in. thick.

One rubber tap washer $\frac{1}{2}$ in. dia., 3/16 in. thick.

One 2BA ebonite knob.

One brass boot eyelet.

One split pin.

One wooden base 4 in. × $2\frac{5}{8}$ in. × $\frac{3}{8}$ in.

Five 2BA nuts and washers.

Nine 4BA nuts and washers.

Two small wood screws.

Three 2BA cheese-headed screws $\frac{1}{2}$ in. long.

On reference to the diagrams it will be seen that the method of altering the coupling of the coils is by rotating the 2BA spindle carrying the rubber tap washer, which by its friction bearing on the fibre disc moves one of the coil-holders.

Construction

The construction is as follows: The two pieces of ebonite should first be drilled, the top piece with three 4BA tapped holes, two 2BA clearance holes (one being countersunk) and two 1/16 holes.

The bottom ebonite has three 4BA clearance holes and two 2BA clearance holes, the latter being countersunk.

The positions are indicated in the drilling plan, Fig. 3.

The two coil-holders are drilled and tapped 2BA centrally opposite and $\frac{3}{8}$ in. from the back end of the coil-holders.

Three pieces of 4BA brass rod are cut, each $3\frac{7}{8}$ in. long and screwed $1\frac{3}{4}$ in. one end and $\frac{5}{8}$ in. the other end. If desired, screwed rods may be used.

Two pieces of 2BA brass screwed rod are cut 3 in. and 1 in. long, a small hole being drilled in the 3-in. length 1/16 in. from one end to take the small split pin.

The Bracket

The bracket is constructed with a 4-in. length of brass $\frac{1}{2}$ in. wide and 1/16 in. thick, which is bent at right-angles 1 in. from each end as indicated in Fig. 2. A 7/32 in. hole is drilled in the centre of the base of the bracket, and a 2BA clearance hole is drilled in each of the verticals of the bracket, central and $\frac{3}{4}$ in. from the base of the bracket.

A brass disc 1/16 in. thick and $1\frac{1}{2}$ in. diameter, having a 7/32-in. hole in its centre, is fixed to the bracket by passing an ordinary brass boot eyelet through the 7/32-in. holes and turning over the edge by tapping it with a hammer until the bracket rotates with a firm bearing on the brass disc. The boot eyelet should be of such size as to fit over the 2BA brass rod.

The wooden base has three 4BA clearance holes recessed on the underside to allow the 4BA nuts to nest as shown in Figs. 1 and 2.

The assembly is carried out as follows:—

The 1-in. length of 2BA rod is screwed tightly into one of the coil-holders. The top and bottom ebonite pieces are fitted together as indicated in Fig. 1. The right-hand coil-holder is fitted with washers and a 2BA cheese-headed screw at the bottom and the 1-in. length of 2BA rod at the top. The left-hand coil-holder is fitted with washers and a 2BA cheese-headed screw top and bottom. A reference to the diagrams will make the assembly clear.

The base is next fitted with 4BA nuts and washers. Then the bracket is fixed over the 2BA rod in the coil-holder, and the brass disc is screwed to the top ebonite with two small screws.

The fibre disc has a 2BA

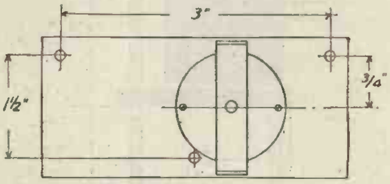


Fig. 3.—Dimensions of the lower ebonite base.

clearance hole drilled in its centre and is fitted on the 1-in. 2BA rod with lock-nuts and washers. The 2BA 3-in. spindle is fitted with the rubber tap washer, lock-nuts, and washers, split pin, and ebonite knob, as shown in Fig. 2.

The fibre disc is adjusted by the nuts until the rubber tap washer presses on it, giving a firm friction bearing. The unit is now complete for use with plug in coils. If it is desired to mount the tuner on a panel, the 4BA brass rods need only be 1¾ in. long, and the stand portion need not be constructed; holes should be drilled and tapped in the back edges of the top and bottom ebonite, suitable for screwing to panel, or small brass brackets can be used.

□ □ □

Keep Your Aerial Earthed

HAVE you ever heard of telegraph wires being struck by lightning? Probably not, for such a thing, if not absolutely unknown, is of the rarest possible occurrence. There is probably just as little chance of an aerial being struck during a thunderstorm. During the record storm which raged one night last summer over the south country, trees and houses were struck in the town in which the writer lives and animals were killed in the neighbouring fields; but though there were even at that time large numbers of aerials, not one of them was damaged in any way. The only danger that is to be anticipated during the summer-time is from those aerials which are not earthed when a thunderstorm comes along. Should the lead-in or earth lead be connected to the set the very high potentials induced in the aerial may easily result in the complete wrecking of the apparatus. So long as the aerial is earthed you are perfectly safe. It is advisable therefore always to make a rule either of turning over the earthing switch or to hook the lead-in and earth lead together when the set is not in use. It seems hardly necessary to warn people against actually using their sets when thunderstorms are about, yet one or two misguided enthusiasts actually did so during last year's great storm. This is a most dangerous proceeding, for quite apart from the possibility of damaging the set there is always the risk of receiving a powerful shock through the headphones.

R. W. H.

Easier Tapping

IT is curious to find how many constructors shy at the simple job of making a tapped hole in ebonite. One of the most widely read writers upon wireless topics told me not long ago that he never designed any set or piece of apparatus with a single-tapped hole in it. The reason he gave was that the very mention of a tap was quite enough to frighten away a large number of would-be constructors! I can verify this statement from personal experience, and I think that it is a thousand pities that it should be so, for there are any amount of jobs which are far better done when threaded holes can be made. As a matter of absolute fact there is little, if any more, difficulty in tapping a hole in ebonite than there is in making it with a breast drill. Nor is the outfit expensive, for best quality B.A. taps do not cost more than 8d. or 9d. apiece and a tap wrench can be bought for a 1s. or so.

If anyone finds any difficulty in using a tap it is probable either that his taps are of the wrong kind or that he is drilling the holes a little too small. The proper kind of tap to use for ebonite is one with a slight taper at the point. This can be used by itself for any holes which go right through the material, but where it is desired to thread holes which go only a little way into the ebonite, two taps must be used. The thread is started with the tapered tap and then the job is finished with a plug tap. As regards the sizes of holes for tapping, those given in tables are usually theoretical; for practical purposes it is more satisfactory to use a drill a little larger than that stated for any particular size. For example, you will find that the tapping size for 4B.A. is usually given as No. 34. If you use instead a number 32 drill you will find that the tap goes in with the greatest ease, though when the job is finished the hole will have a full thread and be a good fit for a 4B.A. screw.

R. W. H.

THE OMNI RECEIVER

In next week's issue will be given the connections for the new Cowper High-Tensionless Circuit using ordinary valves.

The Wireless Valve and How it Works

By JOHN H. MORECROFT, E.E., Professor in Electrical Engineering, Columbia University, New York City.

The sixth of a new and exclusive series of articles by this world-famous expert dealing with the principles of valve working.

A transformer amplifier is more effective than a resistance amplifier, two valves with transformers giving as much increase in signal strength as three or four valves connected with resistance in their plate circuits. The distortion is generally greater, however, with a transformer amplifier and there is more likelihood of the amplifier generating internal noises of its own, resulting sometimes in a shrill squealing noise in the telephone receivers even when no signal at all is coming in. If a transformer amplifier is to be much good, care must be taken in getting a transformer suited to the valves used; a transformer which works well with one type of valve may not amplify at all when used with another.

Radio or Audio Frequency Amplification

As has been pointed out several times, the current set up in the receiving aerial by the power from the transmitting aerial is of very high frequency, so high that even if the telephone diaphragm could vibrate at the same speed the note would be so high that no human ear could detect any sound. Such high frequency currents (from 10,000 to 3,000,000 oscillations per second) are said to be of *radio frequency*. The amplitude, or strength, of the radio frequency current varies at a lower frequency, in fact at the same frequency as the voice sound which actuates the transmitter; such a low audible frequency is said to be of *audio frequency*.

Distortionless Amplification

So far, in our discussion of the reception of radio signals, we have shown that the action of the valve is to rectify the high frequency current in such a manner that the current through the telephones in the plate circuit of the detecting valve is not of radio frequency but of voice frequency. This voice-frequency or audio-frequency current is then sent through a series of valves and amplified.

It is possible, although not easy, to amplify the radio-frequency current, before rectifying it; such a scheme is said to use *radio frequency amplification*, which has at least two great advantages over audio frequency amplification; it is distortionless and it is somewhat selective, amplifying the high frequency signal more than it does atmospheric disturbances. It may then be wondered why radio frequency amplification is not used more extensively than it actually is.

Limiting Factors in the Valve

All of the reasons cannot be analysed here, but the fact may be taken for granted that to get a certain amount of amplification of

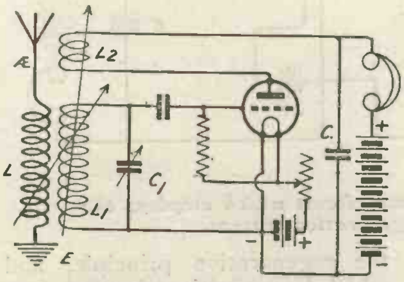


Fig. 16.—The "feed-back" circuit. The reaction coil L2 by reacting back in the grid circuit gives the signal a very large amplification.

the signal voltage requires about three times as many valves, with their associated apparatus, if the amplification is to be at radio frequency than if it is to be at audio frequency. Certain features of a valve which have a negligible effect at audio frequency limit very much the usefulness of the valve when used at a million cycles. This difficulty in high frequency amplification is so marked that an amplifier may apparently be designed correctly, but so far from failing to increase the high frequency current as much as expected will give actually less signal strength after it has gone through the amplifier than at the beginning!

The Regenerative "Feed-Back" Circuit

It is possible to make a special connection in the ordinary single valve receiver and by proper adjustments to increase its sensitiveness perhaps 25 times. In this special connection the plate circuit of the valve is connected to the grid circuit in such a way that the changes in plate current tend to reinforce the signal itself.

One of the easiest ways of using this idea is given in the connection scheme of Fig. 16. It will be seen that this connection is practically the same as has been previously given with the exception that there is now an extra coil placed in the plate circuit. This coil, known as the "reaction" coil, is connected magnetically to the coil in the local tuned circuit. By "connected magnetically" we mean that the two coils are placed in such positions with respect to each other that when the magnetic field of one changes, it induces a voltage in the other.

Connections of Reaction Coil

It will be noticed that this reaction coil is connected in the plate circuit directly next to the plate. In many home-made sets using reaction coils this coil is put between the filament and the telephone, so that either the H.T. battery or the telephone is connected directly next to the plate. This should not be done, because it makes the tuning of the set much more erratic. It is because of this connection that peculiarities of tuning are noted. A friend of the writer reported, that to get the best tuning in his receiving circuit he had to place his feet a certain distance from the radiator! The effect he reported was not a fake effect, but one which will always be obtained if the reaction coil is not placed directly next to the plate. The effect is due to the electrostatic capacity of the operator's body. With the telephone connected next to the plate the capacity of the operator's body has an appreciable effect in tuning the circuit, so that getting closer or more distant from the radiator the circuit was actually being tuned. If the circuit is connected, as shown in Fig. 16, no such peculiarity in the tuning of the circuit will be found.

How the Reaction Coil Works

A simple explanation of the action of the reaction coil is as follows: Signal currents flowing in the aerial induce voltages in the local tuned circuit L_1-C_1, which is tuned to the signal frequency. Current is thus caused to flow in the L_1-C_1 circuit and it is to be remembered that this current is really caused to flow because of the effect of the changing magnetic field, set up in L by the signal current, acting on coil L_1 to produce voltage in L_1. The grid potential will go up and down at the same frequency as the signal current and so will cause the plate current to rise and fall correspondingly. This changing plate current flowing through coil L_2 will give here a correspondingly changing magnetic field which reaches out from L_2 into L_1 because of their proximity. This changing magnetic field in L_1, from L_2, will give a voltage in L_1, which helps out the initial voltage induced in L_1 by the signal current in the aerial. In other words, the changing plate current, caused indirectly by the signal current in the aerial, so acts as to help the signal current in the aerial to produce bigger currents in L_1-C_1. It is the amount of current in L_1-C_1 which determines the strength of signal heard in the telephones.

Controlling the Regenerative Action

The "regenerative action," as it is called, is controlled in amount by the proximity, or relative positions, of coil L_1 and the reaction coil L_2. The closer these two coils are together the greater is the regenerative action and the louder is the signal, up to a certain limit. If the magnetic coupling of L_1 and L_2 is made too tight the valve circuit may give all kinds of queer noises, sometimes a series of "clucks" at the rate of one or more per second, or singing, or squealing noises, depending principally upon the size of the grid condenser and grid-leak. If such noises are obtained the coupling between the reaction coil and L_1 should be reduced until they disappear.

Short Wave Reception

Another scheme which uses the regenerative principle, and which is a sensitive circuit for receiving short waves, is given in Fig. 17. Besides the coil L_1 for coupling the valve circuit to the aerial two variometers are used, L_2 and L_3; one in the grid circuit and one in the plate circuit. When these variometers are each adjusted to just the right amount, the signal is increased to a wonderful degree. This is a rather more difficult circuit to adjust than that given in Fig. 16, but is generally a more sensitive one for short wave receivers.

A suitable regenerative connection, properly adjusted, will give an amount of amplification equal to that obtained by a little under one stage of transformer-coupled, audio-frequency, amplification.

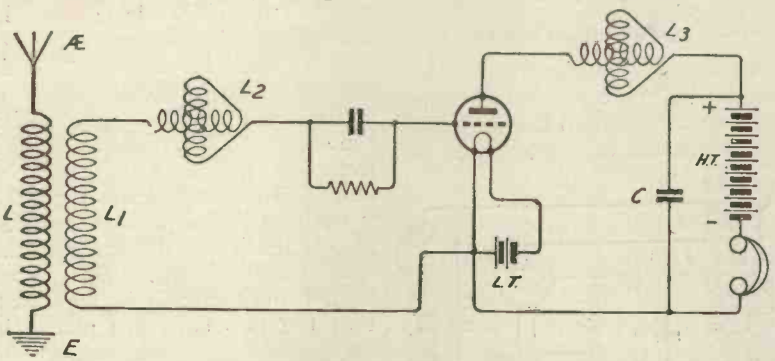


Fig. 17.—A sensitive short wave circuit which employs the "feed-back" or regenerative system.

C.W. Reception

The connection schemes shown in Figs. 16 and 17 are both useful for receiving continuous wave (generally abbreviated C.W.) telegraph signals. In such transmission there may be sent out from the transmitting station a high-frequency current of continuous strength as long as the key is held down. It will be noticed that this is different from spark telegraphy (or *damped wave* telegraphy) which sends out a series of high-frequency wave-trains as the key is held down, the number of wave trains per second being fixed by the number of sparks per second at the transmitter, generally about 1,000. The ordinary valve receiver when used for spark reception gives a musical note in the telephones, the pitch being determined by the number of transmitter sparks per second.

Straight C.W.

If such a receiver is used in listening for straight C.W. signals (sometimes another scheme for C.W. than that assumed above is used) nothing will be heard because there is no such thing as spark frequency to determine the pitch of the received signal; the current in the receiver is one of constant amplitude high frequency and therefore inaudible. To make it audible its amplitude (or strength) must change at regular intervals so that its changes will give in the telephones an audible note.

The Heterodyne Effect

This can be done by a scheme due to R. A. Fessenden, known as the heterodyne, or beat, method of reception. If the incoming signal has a frequency of 1,000,000 cycles per second and if there is continually in the receiver circuit another current of frequency either 1,001,000 cycles or 999,000 cycles per second, this local high frequency current and the current set up by the signal will act together to give a combination high frequency current, the amplitude of which changes 1,000 times per second. But if there is in the local tuned circuit a high-frequency current the amplitude of which is changing at audible frequency the valve so acts (as previously explained), that there is heard in the telephones a musical note, the pitch of which is fixed by the frequency of the amplitude variation. Hence in the above case the continuous wave signal of 1,000,000 cycles would, with the assistance of the other high-frequency current, produce a musical note in the telephone of 1,000 cycles per second. As soon as the signal stopped coming in there would be present only one high frequency current, beats could not be formed, and so nothing would be audible in the telephone.

By those who have studied the operation of the ordinary pipe organ it will be recalled that the low notes are produced in a manner similar to that just described for the continuous wave receiver. To get a musical note of pitch 32 (that is 32 vibrations a second) two other notes are sounded in unison, say 64 and 96: the combination of these two gives a beat note, the pitch of which is equal to the difference between the two notes sounded, in this case the desired pitch of 32 vibrations per second.

Local H.F. Current

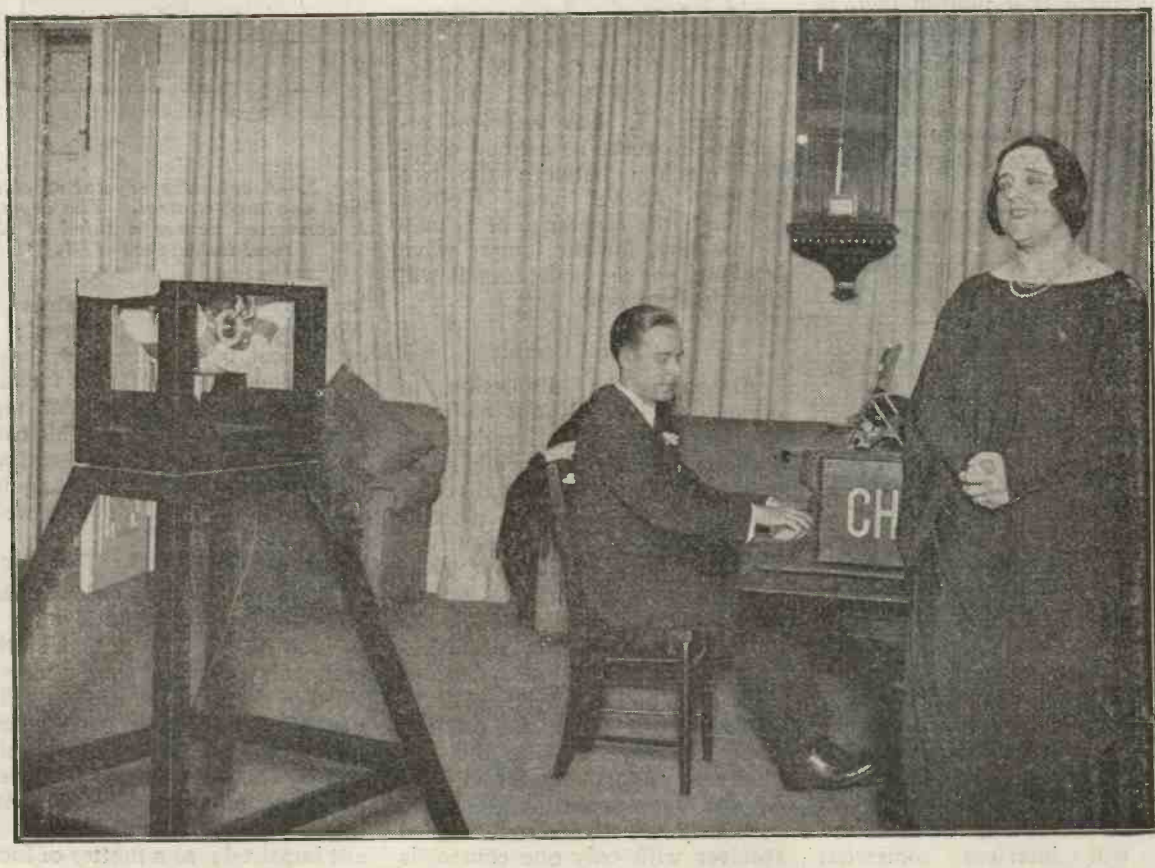
The local high-frequency current required for C. W. reception is obtained by using a scheme like that of Fig. 16. increasing the magnetic coupling between L_1 and L_2 somewhat more than usual. In such a case the valve, when acting properly, will generate high frequency currents in circuit L_1-C_1, the frequency of these currents being fixed by the natural period of the circuit. The valve is said to be "oscillating."

By changing the setting of condenser C_1 the frequency of the local oscillations can be changed at will, and hence the pitch of the musical note heard in the 'phones will correspondingly change. The interaction of the incoming signal and the local oscillation gives rise to a peculiar whistling noise as C_1 is continually changed, if some radio station is sending out continuous wave radiation at the time.

Changing Note

As C_1 is varied, from a very small value upwards, a very high note is heard which, as C_1 is changed very slowly, comes down the whole musical scale and below it, passing below the audible range. As the increase in the value of C_1 is slowly continued the note again appears, very low in pitch, and then ascends through the whole musical scale. finally disappearing into the inaudible range of frequencies about 15,000 vibrations per second. This whole change in the pitch of the note will generally take place as C_1 is changed over perhaps only two or three of the smallest divisions on its scale.

MADAME D'ALVAREZ



Our photograph shows Madame D'Alvarez, the world-famous contralto, broadcasting from 2LO.

Valve Notes

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

Combined Couplings

THOSE interested in designing sets to cover a wide range of wavelengths may find it useful to use a resistance of the order of 75,000 ohms in series with a tuned anode circuit.

Fig. 1 shows an arrangement of this kind. It will be seen that the usual tuned anode circuit L C1 is provided, but that there is also a resistance R in the anode circuit. This resistance sometimes helps to stabilise the tuned anode circuit, but it also enables long-wave stations to be received without an inductance. In such cases the inductance L, which we will assume is a plug-in coil, is taken out of its socket and a shorting plug inserted in its place. The sole coupling will then consist of the resistance R, and this arrangement may be employed for wavelengths over 1,000 metres.

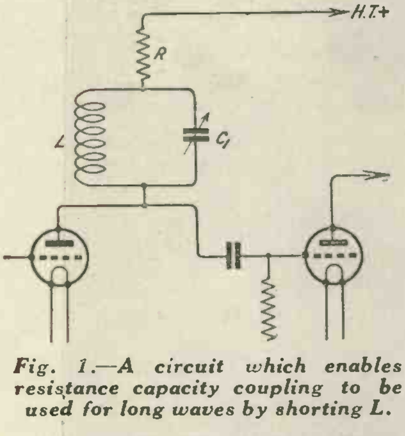


Fig. 1.—A circuit which enables resistance capacity coupling to be used for long waves by shorting L.

It may possibly be that in some arrangements the resistance R will prevent a full establishment of oscillatory currents in the circuit L, C1, in which case R may be shunted by a very small capacity. Only the tiniest value will be found necessary, and although this will interfere somewhat with the reception of signals having a wavelength of the order of about 1,000 metres (when no inductance is employed), the difference will not be noticeable on, say, 2,600 metres and over.

Omitting the Condenser C1

As a matter of fact, very interesting results may be obtained without the condenser C1 at all, the inductance L being connected in series with the resistance R. The inductance L may be, for example, a No. 200 or No. 250 plug-in coil, and under these conditions the combined coupling arrangement will cover all wavelengths. Although the resistance coupling is not much good below 1,000 metres (although, by the way, I suppose you noticed that Capt. Eckersley used it in the King's set), the inductance L has sufficient reactance to serve as a good coupling medium between the two valves. Above 1,000 metres, although the reactance of L may be too low, for the longer wave stations, yet the resistance R will then do the work.

A Crystal Circuit

Although the discussion of crystal receivers is not common in these columns, yet readers are frequently requested to advise on suitable circuits for crystal reception. Of course, where there is no interference, the variometer, or slider, type of receiver gives practically as good results as any other, and the fixed condenser in series with the aerial often improves matters still further, although not always. When, however, we come to produce really selective circuits there is plenty of opportunity for ingenuity and experiment.

A very selective direct-coupled receiver with only one control is that shown in Fig. 2. It will be seen that constant aerial tuning is employed, which, by the way, is being extensively advocated by the Chief Engineer of the B.B.C. as a means of improving selectivity. The condenser C2 has a value of 0.0001 μF, while the condenser C1 has a capacity of 0.0003 μF, or 0.0005 μF. The inductance L1 may be a No. 50 plug-in coil with a tapping to the crystal detector taken off about one-third its length. For wavelengths above 420 metres a No. 75 coil may be used; a cylindrical inductance will, however, usually be preferred for circuits of this kind for which tappings are necessary. In this case 70 turns of No. 26 double cotton-covered wire wound on a 3½ in. cardboard tube will do very well.

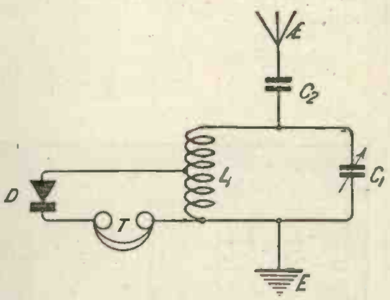


Fig. 2.—A selective crystal receiver with one knob control. The crystal is connected across a third of the total inductance of L1.

The Position of the Detector

It will be seen that the crystal detector is connected across a portion of the bottom end of the coil, this portion being about a third of the total inductance. The use of this tapping greatly improves the selectivity of the circuit by lessening the damping on it. Not only is the selectivity improved, but signal strength is not impaired; as a matter of fact, frequently it is improved.

Absorbtion Circuits

Although we hear a lot about rejector circuits, yet we hear considerably less about absorption acceptor circuits. Many of the selective wave trap arrangements depend for their principle on providing a short circuit path for all wavelengths except the particular one to be received, which latter is rejected and simply serves to operate the receiver.

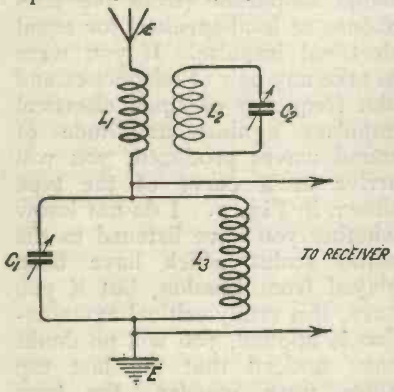


Fig. 3.—An acceptor circuit for the elimination of local interference.

The absorption circuit depends upon the sucking out of signals of a particular wavelength from the aerial circuit, if that is the circuit where interference is to be eliminated (as it is a very good place to insert your rejector, or wavetrap, or other device).

In Fig. 3 a small inductance L1, consisting of a few turns of a small plug-in coil, is coupled to a circuit L2, C2 which is tuned to the jamming wavelength. The aerial circuit as a whole is tuned by means of the condenser C1 to the desired signal. When it is desired to listen to a distant broadcasting station, for example, and interference is experienced from a certain spark station, or from the local broadcast station, a circuit of this kind is very useful, and the circuit L2, C2 is tuned to the nearby broadcast station which is to be eliminated. Such a circuit has the great advantage that it results in practically no variation of tuning of the main circuit, whereas many wavetraps alter the wavelength of the receiver and a continual juggling backwards and forwards is necessary to get the proper result.

Another Absorption Circuit

The rejector circuit, of course, possesses, on the other hand, the advantage that it will theoretically reject all signals other than the desired one, whereas the absorption circuit of the kind shown in Fig. 3 will only reject signals of a particular wavelength.

Fig. 4 shows another absorption circuit in which a condenser C1 and an inductance L1 in series

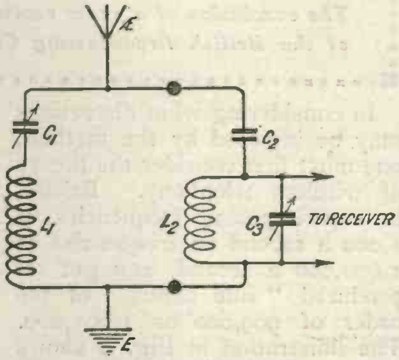


Fig. 4.—Another acceptor circuit in which the unwanted signals are absorbed in the circuit L_1 C_1.

are connected across the receiver terminals. A receiver using constant aerial tuning is illustrated in this figure. For broadcast wavelengths the condenser C1 and the inductance L1 may be a 0.0005 μF and a No. 75 plug-in coil respectively. The adjustment of the condenser C1 is made so as to absorb the interfering signals from the aerial circuit.

5WA

Our Photograph shows the new studio recently opened at the Cardiff Broadcasting Station.

Faithful Reproduction by Broadcast

By P. P. ECKERSLEY, M.I.E.E.

The conclusion of a paper recently read before the Radio Society of Great Britain by the Chief Engineer of the British Broadcasting Company, the discussion following the paper will appear next week.

In considering what distortions may be imposed by the method, one must first consider the theory of wireless telephony. Briefly, in superimposing frequencies of 1,000 a second on frequencies of 1,000,000 a second, you get reproduced " side bands " of the order of 999,000 or 1,001,000. The illustration in Fig. 6 shows the superimposition of a number of " audible range " frequencies on the carrier wave. The breadth of side bands that you notice from a wireless telephone station is an indication of how much it is controlled in the higher frequencies. I have heard many people say that it is wrong to have many side bands, and that they cannot " tune out " a station with such a broad band. In effect, it must be a good station. Theoretically, it is the heterodyning of the side bands with the carrier wave K that produces telephony. Distortion may occur due to the unwanted heterodyning of A and B or S in the picture instead of A, B, S and K only, and to minimise this distortion it might be useful to cut out one set of side bands altogether.

The Receiving End

We come next to the receiving end. High-frequency magnification is practically distortionless. From the purely mathematical point of view detection is liable to some grave errors, owing to square law rectification, but I do not think there need be (although there frequently is) serious distortion between the microphone and the telephones or loud-speaker if proper precautions are taken. No doubt there will be some distortion when we have a proper criterion for judgment, but at the moment I do not think it is serious compared to other distortions, and this being an imperfect world, people have not got much money to spend on receivers. Therefore, the manufacturers in supplying receivers have had to rely, to an extent, upon getting a loud signal. There is a great craze for loud signals, and ambition seems to lead people to try to get Australia on half a valve. This tendency is inimical to the progress of the art. If people would only use as many valves as they are miles away, we might get nearer to perfection, because then no valve will be working outside its limits. (Renewed laughter.)

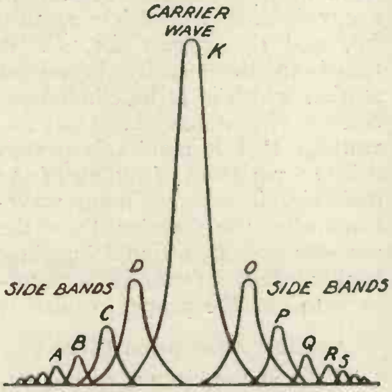


Fig. 6.—Showing speech frequencies superimposed on the carrier wave K.

The electric impulses copying the sound waves, as I have shown you, have been differentiated and put out as equal electrical variations for equal audibility, and they have arrived undistorted at the receiving apparatus and are put into a pair of telephones or loud-speaker. Efficient telephones, unfortunately, depart a long way from reproducing even equal sound for equal electrical amplitude. What is required for perfect conversion is, of course, greatly increased sound amplitude (from the telephones or loud-speaker) for equal electrical impulse. If you were to take any pair of telephones and plot frequency of *equal* electrical impulses against amplitude of sound waves produced, you will arrive at a curve of the type shown in Fig. 7. I do not know whether you have listened to the piano scales which have been played from London, but if you have, if a really critical examination is applied, you will no doubt have noticed that the last top notes were wooden, the bass notes woolly, and the middle ones had a harsh barking sound. That is undoubtedly due to the effect of the accentuation of certain frequencies. Capt. Round, whose most inadequate interpreter I am, has devised a most ingenious method of overcoming this telephone resonance, and one which it would be well worth your while to try. If you have a circuit which works a loud-speaker, you want to connect on to its output terminals a circuit such as is shown in Fig. 8.

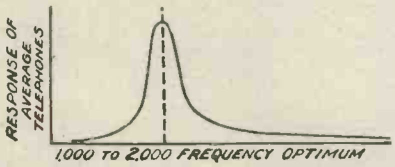


Fig. 7.—Illustrating frequency of equal electrical impulses in a pair of telephones against amplitude of sound wave produced.

The telephones are efficient only because they are resonant about certain frequencies, and thus when they are corrected through a rejector circuit which cuts out those frequencies, they will not give such efficient results. It is amazing to listen to corrected telephones pressed closely to the ears. Barking notes become mellow and natural; the bass becomes warm; the high notes are sweet with harmonics.

The Loud-Speaker

Now, loud-speakers. Loud-speakers have been partially corrected, and no rejector circuit will benefit them. It really requires a thoroughly bad loud-speaker for correction to be really effective, and, of course, there are none on the market. (Loud laughter.) Loud-speaker curves (I draw from memory) may be of this shape (Fig. 9), and it is interesting, but not effective, to use rejectors as for telephones. Some loud-speakers improve with integration, but a condenser across their terminals does not always do this directly.

The question of the use of horns is interesting. It has been stated that I am a protagonist of those loud-speakers which do not use a horn. I do not mind what is used as long as you get the theoretically perfect result. Those "behind the nose" barking sounds can be obtained with a horn just as easily as without. A horn is not necessarily a distorter. There is no doubt that by using a long horn bass resonance might be obtained, and then the horn would be an extremely valuable adjunct.

That, I think, deals in a very

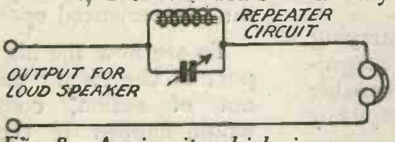


Fig. 8.—A circuit which improves the quality of the reproduced music.

brief and very loose way with the problem of quality as I see it, from a theoretical point of view. Before leaving the subject, a few further points of interest arise in connection with the transmission.

In the first place, there is the question of echo. Many people seem to think that we ought to have more echo in our studios. Unfortunately, due to the wrong tone scale given by the average receiving 'phones, the effects of the sweet echo such a room might give are badly reproduced. In order not to give too much echo, in a place like Covent Garden we have to place the microphone right down on the footlights, because otherwise the sounds would be so blurred that the ultimate result would not be worth transmitting. If you had a perfect receiver we could put the microphone away back in the stalls, and you would hear in the auditorium. As it is, we have great difficulties in faking balance. There is another point about echo. If we had a large echo in our studio and if there was a loud speaker in a room which had an echo, you would have two echoes in series, and that would give distortion to a certain extent, and you would deviate to a certain extent from reality. This is an argument against an echoy studio, but we do "remember the poor 'phone user," and we realise an overdraped studio is uninspiring for the artist.

Finally, to achieve a practical system we have to depart from perfect amplification systems and use transformers. There has been a lot of talk about transformers, and one can see that people are beginning to realise that transformers which give them the loudest notes are not the best transformers necessarily for quality. By means of measurements we have proved that we do not depart from our ideals between 200 and 5,000 frequency, and after that there is not serious distortion.

The receiver has got to be improved before we can level serious accusations against the transmitter. When we shall attain the ideal of recording a dynamite explosion or a bat's squeak I do not know, but at any rate I do feel that the weak point in the chain now is at the receiving end. When the next great advance takes place I think it will be a

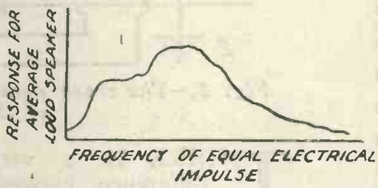


Fig. 9.—Illustrating how the loud-speaker responds to the incoming impulses.

revelation, and then there will be no criticism to level against the system in any particular. That is my ideal, and I am sure it is the ideal of many people who are working at the other end of the problem. I have spoken from my heart, and I admit that I know very little about the subject, and that others far wiser than myself have largely inspired my remarks which, if they only provoke a basis for discussion, have at least achieved something.

(The discussion will follow next week.)

Series-Tuned Anode

SIR,—It may be of interest to your readers to hear of some good results obtained with the Cowper Circuit (may I here be allowed to congratulate Mr. Cowper on his excellent circuit), which appeared in *Wireless Weekly*, Vol. 2, No. 19. The circuit, as described in *Modern Wireless*, Vol. 2, No. 4, consisting of only two valves, H.F. and detector, was first tried using an iron bedstead as aerial, and a poor earth. Bournemouth and Cardiff were both received very distinctly, every word of the announcers being clearly audible; reception, though weak, was exceedingly pure. Next was tried a small indoor aerial with but slight increase in signal strength; also much trouble was experienced from the lighting mains (A.C.). An outdoor aerial of good height (70 to 80 feet at both ends), consisting of a single wire 30 feet at the horizontal and a lead in of about 25 feet, was next tried; this aerial was not strictly directional. The results obtained with this were amazing, nearly all the B.B.C. stations being received at incredible strength, audible in the case of Bournemouth 18 inches from the phones, three pairs being employed (all this still using 1 H.F. and 1 det.). Trouble from morse was rather noticeable at times, but this was largely due to local ships, etc.; also the A.T.I. is direct coupled.

Yours faithfully,

C. W. BIDDULPH.
T. G. BROWN.
J. S. INNES.

Carcavellos, Portugal.

IMPORTANT ANNOUNCEMENT

Readers will be interested to know that sets described in "WIRELESS WEEKLY" and "MODERN WIRELESS" will, in future, be actually on view for a short period immediately after description, at the offices of Radio Press Service Department (a new separate organisation) at 19, Devereux Court, Strand, London, W.C.2 (exactly opposite the main entrance to the Law Courts). The following sets are now on view, but those who visit the offices are requested to limit their visit to an inspection.

"MODERN WIRELESS"
3-Valve Dual Set (April issue).
June issue:
ST100 with extra H.F. Valve Set
2-Valve H.T.-less set.
Transatlantic 5-Valve Set.
Selective Crystal Set.
2-Valve Cabinet Set.

"WIRELESS WEEKLY"
W.W. H.T.-less Set.
Omni Receiver.
Cowper H.T.-less Set.
Envelopes No. 1. ST100 Set.
" No. 3. Simplicity 3-Valve Set.
" No. 4. All Concert-de-Luxe

Common Faults i

By G. P. KENDALL

The experience of the Radio Pre
to show that faults in the commo
divided into certain main classes
faults are responsible for the gr
This article should therefore p
reflex r

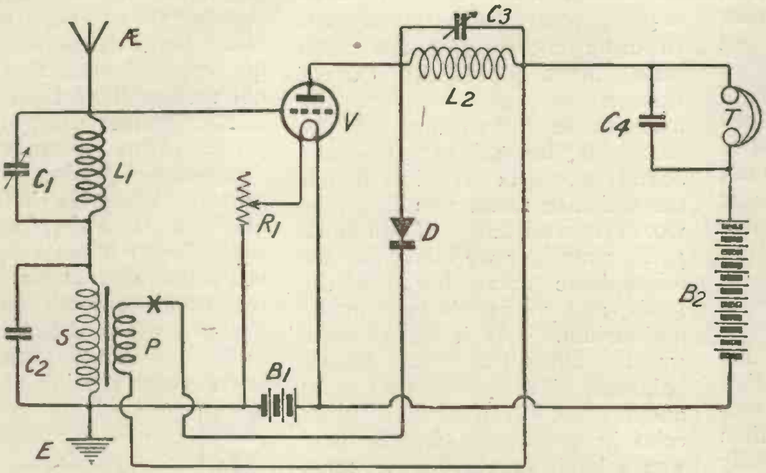


Fig. 1.—The cross denotes a break in the connection to the primary of the intervalve transformer.

THERE is a very vital difference between fault-finding in a "straight" circuit and a reflex, however simple the latter may be, that difference being that as the valve whose circuits may contain the fault is doing a double duty, the usual tests may entirely fail to indicate which function is not being properly performed, whereas in the straight circuit they would give a conclusive indication of the nature of the trouble. For example, in Fig. 1 is represented a simple single-valve reflex circuit in which a fault might occur which would have the effect of entirely preventing the valve from carrying out its function as a note magnifier, while leaving it quite capable of acting as a high-frequency amplifier.

Use of Milliammeter

Suppose that there were a break in the primary (P) of the L.F. transformer: a milliammeter would show that a normal plate current was flowing, the circuit would oscillate if the coils L1 and L2 were coupled together, atmospherics and probably a certain amount of humming from A.C. mains would be heard, but signals would be entirely absent unless it chanced that the valve were so adjusted as regards its plate and grid voltages that it functioned as a rectifier (quite incorrectly, of course). A similar effect might be produced by a bad specimen of crystal, and these two faults are actually of common occurrence, and prove very puzzling to the inexperienced operator.

To see how the high-frequency part of the circuit might be put out of action, consider what would happen if the telephone condenser C4 were one of the cheap and nasty variety which often prove to have a capacity 0.0 μF, as a result of an internal disconnection. If it also happened that the telephones in use chanced to be of low internal capacity, they would form an effective barrier to the high-frequency component of the anode current, and the result would be weak signals, refusal to oscillate, and abnormally flat tuning in the anode circuit.

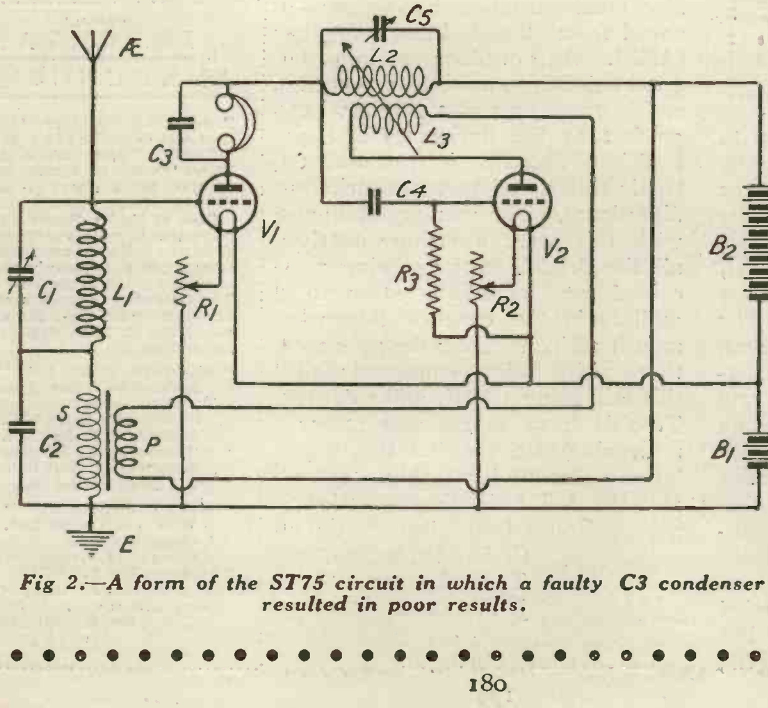


Fig 2.—A form of the ST75 circuit in which a faulty C3 condenser resulted in poor results.

Methods of Testing

The standard methods of testing, then, are commonly of little help, and it is necesary to fall back upon hit-or-miss methods dependent upon the skill and experience of the tester in recognising the symptoms of each type of fault. Some helpful generalisations can be made, however, regarding the principal types of faults, which will probably assist the novice in making a preliminary diagnosis. Those faults which result in a complete absence of signals or any kind of sound are usually of a similar nature to those which produce the same effect in straight circuits, and painstaking checking and testing (with 'phones and dry cell) of the wiring and components must be resorted to, since

n Reflex Circuits

, *B.Sc., Staff Editor*

s Information Department goes ier types of reflex circuits can be and that a few easily recognised at majority of cases of trouble. ove of much value to users of ceivers

the usual testing of entire circuits will not be possible, as a rule.

Most minor faults, however, are more puzzling than this when they occur in reflex circuits, because the usual result is some kind of a howl or roar, or else most perplexing behaviour of the reaction adjustment. We saw one possible cause of the latter symptom in considering the circuit of Fig. 1, where a bad telephone condenser produces just this effect. Incidentally, the same symptom would result if the by-pass condenser C2 were similarly defective, with the additional indication of very flat tuning in the aerial circuit. The extent of this effect, of course, would depend upon the type of low-frequency transformer in use; one whose secondary winding was of a high self-capacity might function quite well without a by-pass condenser at all.

By-Pass Condensers

These two examples lead us to the first and most useful generalisation : if tuning is very flat and the set refuses to oscillate, the *probable* fault is in one of the by-pass condensers arranged across one of the points where some piece of audio-frequency apparatus opposes a barrier to radio-frequency currents. Flat tuning or no tuning at all in a particular circuit will often indicate the location of the offender.

Howling is a somewhat less definite indication, since it may be caused by such a great variety of faults. In fact, almost anything which upsets the equanimity of a reflex receiver causes it to howl, and therefore this symptom is best regarded as merely a general warning that something which may or may not be serious is wrong. Common causes are breakdown of stabilising devices, such as the 100,000 ohm resistance in the ST100, the existence of undesired capacities across windings, which ought to act as chokes, use of unsuitable L.F. transformers, crowding of parts, the use of a nearly run-down H.T. battery, etc.

These points will probably be most clearly understood from a discussion of typical cases, but before doing so I should like to place especial emphasis upon a trouble which can scarcely be described as a fault, but which nevertheless is capable of causing a great deal of annoyance to the inexperienced. I refer to the phenomenon, which first came to my notice in the case of the ST100, of rectification by the dual amplifying valve, so that the rectifier proper, whether crystal or valve, becomes inoperative. In the ST100, for example, it is sometimes found that the cat-whisker can be lifted from the crystal without diminishing the strength of signals, while in sets employing a valve for rectification the filament of the detector can be extinguished without affecting the signals, which are much below the proper strength, it should be added.

The explanation is simply that the first valve is rectifying, usually as a result of unsuitable plate and grid voltages, and upon the obvious adjustments being

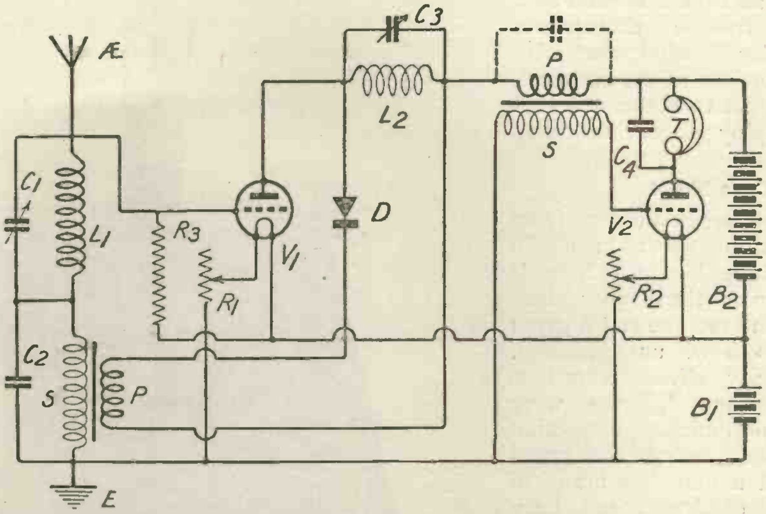


Fig. 3.—An ST100. The fault in this instance was the presence of a condenser connected across the transformer primary and shown dotted.

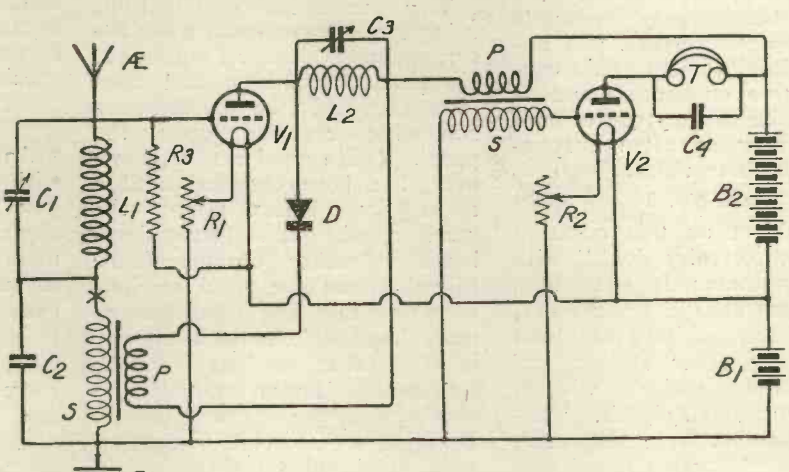


Fig. 4.—Another ST100 which would not work, the trouble being subsequently revealed as a break in the transformer secondary as indicated by X.

made (another 30 or 40 volts on the plate is all that is needed as a rule) the trouble disappears. This difficulty is often met with when soft foreign valves are used, and it is safest to make it a rule *not* to employ them in reflex circuits.

Case No. 1

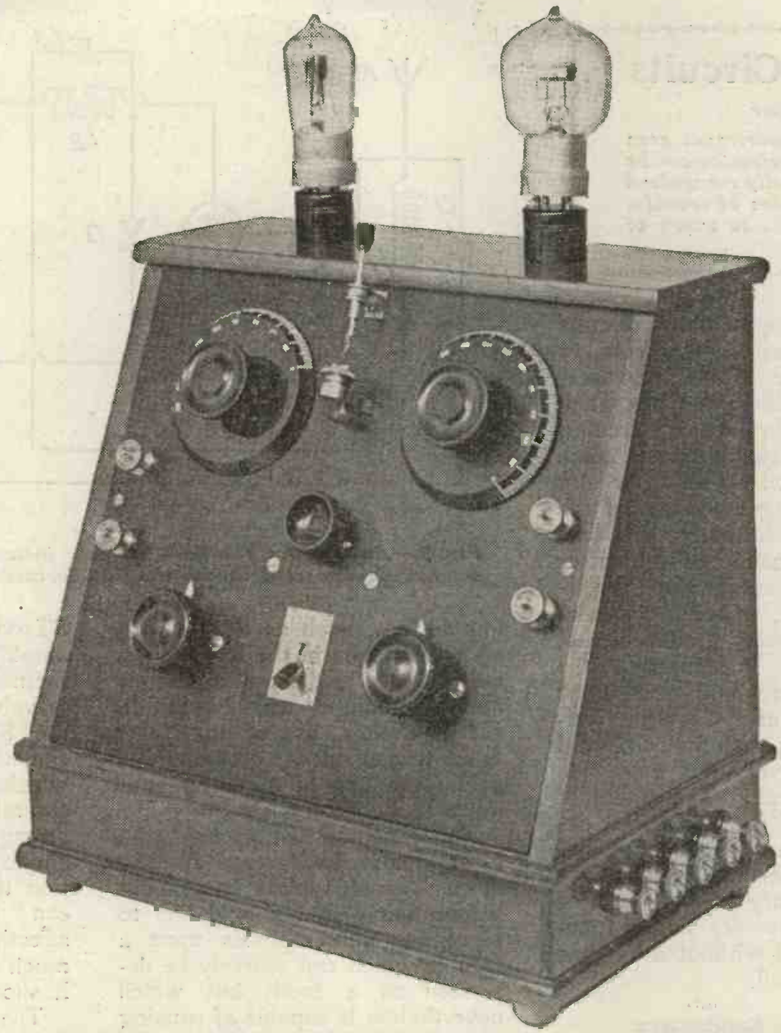
An ST100 set made up from the instructions given in Radio Press envelope No. 1. Signals were not up to the proper standard, and the set showed a great tendency to howl unexpectedly. Body capacity effects were also very bad when 'phones were worn. A preliminary inspection of the underside of the panel showed that a nameless brand of cheap fixed condenser had been used across the telephone terminals, and as a first test this was replaced by one of proved capacity. The set immediately became a model of good behaviour, and a postmortem held upon the defective " condenser " revealed the fact that it contained a quantity of black wax, but no plates!

Case No. 2

This set was one using the ST75 circuit, a form of which is reproduced in Fig. 2. It gave exceedingly poor signals, entirely refused to oscillate with any size of reaction coil, and it was almost impossible to use high resistance 'phones, because hand capacity effects were so bad. Low resistance 'phones and a transformer practically cured this, and therefore suspicion fell at once on the condenser C3, confirmed by the fact that the tuning of the anode circuit was very erratic and uncertain. Replacement again condemned this condenser, and it proved to be of the type of zero capacity now so often responsible for such troubles.

Case No. 3

The subject on this occasion was a " three-valve dual " with these symptoms: It gave loud signals from 2LO at seven miles, but refused to oscillate, would not pick up any other station, and seemed to be entirely without tuning in the anode circuit. Various components were suspected, but it was ultimately found that the H.F. transformer was at fault, since it was not one of the makes for which the set was originally designed, and required a different scheme of connections.



The ST100 receiver referred to by Mr. Kendall as having been made by himself. Constructional details of this receiver were given in Vol. 3, No. 1.

Case No. 4

This receiver had been built up, using the ST100 circuit, when the arrangements was first published. No particular design had been followed, and the parts were somewhat crowded upon the panel. Quite good results, however, had been obtained until a short time before I saw the receiver, when it suddenly developed a rather obscure fault. Signals from the local stations were only fair, and it had become quite impossible to pick up any of the other stations for the reason that it was impossible to obtain any reaction effects. Bringing the coils together *reduced* signal strength, whichever way the coils themselves were connected in circuit. This effect, which I have observed more than once in ST100 receivers, is one which seems rather difficult to explain, and in this instance is particularly puzzling because all that was needed to correct the trouble was a new specimen of crystal.

Case No. 5

An ST76 receiver. This set, with all three valves in use, gave very bad distortion, weak signals, and a variation in filament current of the third valve seemed to make very little difference to the signals. The high-frequency side of the set, however, seemed to be functioning correctly, since tuning was sharp and the reaction was behaving normally. Since the trouble seemed in some way connected with the third valve, the first step was to cut this out of circuit, thereby reducing the receiver to the ST75 circuit, whereupon it was found that the first two valves were behaving normally, since the results were such as would be expected. Closer investigation of the circuits of the third valve failed to reveal any trouble, and the intervalve transformer was replaced without result. Previous experience then suggested that the valve sockets might be defective, and upon replacing this the whole trouble disappeared. The socket in question was made of a crumbling black material, which only bore the slightest resemblance to ebonite, and proved to be of the poorest insulation upon test.

Case No. 6

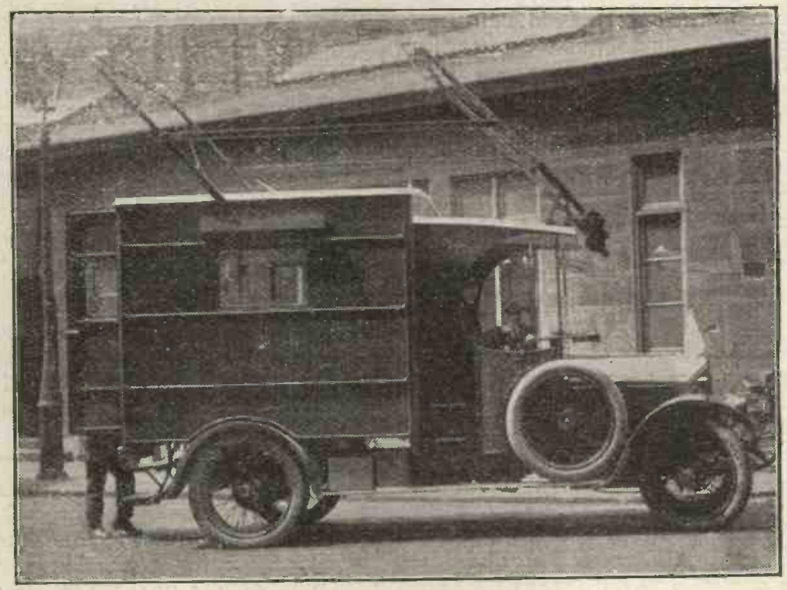
The fault in this case was perhaps a somewhat unusual one, but I include this example because it may perhaps provide a key to one of the reasons why certain types of low-frequency intervalve transformers do not function satisfactorily in the ST100 receiver. This receiver had never given signals, but presented the most obstinate and ineradicable case of howling which I have met with in this circuit. All the usual tests were tried, including the replacement of the 100,000 ohm stabilising resistance with one of only 20,000 ohms, but without results. It was then observed that the second intervalve transformer was of an unknown make, bore no name, and was mounted in a wooden box. Since the telephones and dry cell test when applied to the primary winding of this transformer gave a somewhat peculiar type of click, rather louder and duller than the usual, the wooden box in question was opened, and it was found that connected across the primary windings of the transformer was a fixed condenser marked .004 μF. This fixed condenser had therefore been connected in circuit, as shown dotted in Fig. 3, and had been the cause of the whole trouble, since when it was removed from this transformer perfect results were obtained and the set would not howl even when the stabilising resistance was completely removed.

Case No. 7

Another ST100 receiver. This set was in use within three miles of the Birmingham station, and the symptoms were an entire refusal to oscillate, only the weakest of signals upon a full-sized outside aerial, and an overpowering roar of interference from A.C. mains. There was no tuning whatever in the aerial circuit, and the signals were almost as loud when the aerial coil was pulled from the socket. The absence of tuning in the aerial circuit seemed to indicate that there was a break in the pass to earth of the high-frequency oscillations, and the by-pass condenser across the transformer secondary was suspected as usual. Replacement of this gave no improvement, however, and it was then noted that the A.C. noises were cut out when the end of the secondary winding of the transformer, which was wired to the lower end of the aerial tuning inductance, was touched. With this as an indication, tests were applied to the transformer secondary itself, and this was found to be broken.

Case No. 8

It may perhaps be as well to confess at the outset that this receiver was my own! This receiver is illustrated on page 182 of this issue, and it may perhaps be recognised as one which I described some time ago in *Wireless Weekly*. It had given exemplary service up to quite recently, when it began to develop the habit of breaking into a high-pitched howl without any warning, and as suddenly ceasing. Finally, the howl became continuous, and the following symptoms were observed. The set only howled when the aerial was connected to it, and the same effect was produced if the aerial terminal was touched after the aerial itself had been disconnected. Various points upon the aerial circuit produced this howl, and it was ultimately found that the earth terminal also led to howls when touched, after the removal of the earth. Touching the filament circuits, however, produced no ill-effects, and therefore the first transformer was suspected. Replacement of this, however, gave no improvement, and the mystery deepened. All the usual tests were tried, including the substitution of other valves and batteries, and an investigation of the windings of the loud-speaker, since the high resistance here will often lead to just these troubles. As a last resort the second low-frequency transformer was replaced, although it appeared to show up quite successfully when tested with telephones and dry cells, and the trouble was immediately removed. Further investigation then indicated fairly certainly a *partial* break in the secondary windings of this transformer.



One of the new cars used by Scotland Yard for the control of traffic by wireless on Derby Day. The car has a receiving range of 105 miles and a 50 mile range for transmission.

A Safety Low-Tension Plug

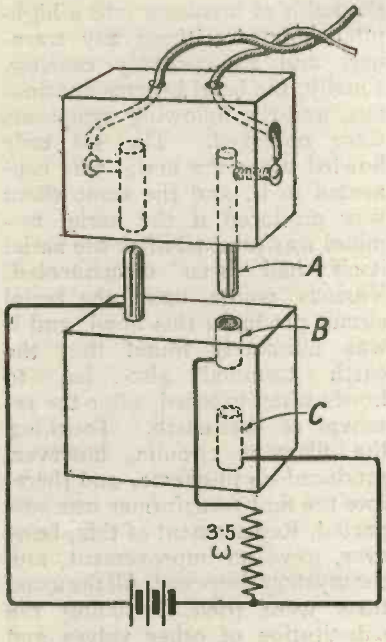


Fig. 1.—The connections.

MOST of us like to have some form of plug which enables the low-tension current supply to be switched on or cut off in one movement. Once the correct filament potential for high- and low-frequency amplifiers and rectifiers has been found by the use of individual rheostats it is most convenient to be able to leave these adjustments where they are and simply to throw in the low-tension supply when the set is to be brought into use. If one switches off each valve by turning the rheostat to its off position one has to waste quite a lot of time before reception can begin in adjusting the potential of every valve. As both rectifier and high-frequency amplifiers are often very critical as regards their filament potential this may mean a considerable delay.

Further, few things are worse for either valves or accumulators than suddenly to put them under full load. To raise the output of the low-tension battery instantly from zero to perhaps 4 or 5 amperes throws a considerable strain upon its plates which may in time lead to damage. The delicate filaments of the valves are liable to give under the sudden rush of current—in fact, more valves that have seen a good deal of service give out just as they are switched on than at any other time. Switching off is almost as important for a very rapidly cooling of the filament makes it extremely fragile.

For these reasons it is desirable to use a plug which does things gradually, so to speak. In the wiring diagram shown in Fig. 1 is seen a simple method of accomplishing this desired end. It will be seen that as the upper portion of the connection is pushed home its plug (A) first makes contact with the socket (B) which is connected to the negative terminal of the low-tension battery through a fixed resistance with a value of 3.5 ohms. As the process of insertion continues the plug passes through B and makes contact with the second socket (C), which is connected directly to the negative terminal of the battery. Hence both the switching on and switching off processes are gentle

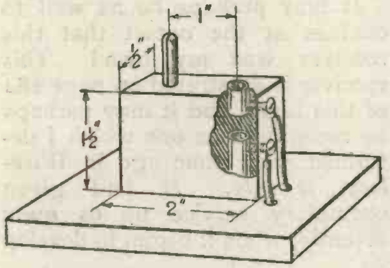


Fig. 2.—The lower portion of the connector.

instead of abrupt, the load being taken up in two stages.

This type of plug connection is very easily made. The lower portion (Fig. 2) is made from a piece of ½ in. ebonite measuring 2 by 1½ ins. In this are drilled two ¼-in. holes 1 in. apart for the plug and socket. The plug hole need not go right through the block, but the socket hole should do so. Two 4 B.A. holes are drilled and tapped in the lower edge of the block to take the screws which secure it to its base.

For the plug of the lower portion and the socket of the upper standard parts obtainable at 2d. a pair from advertisers in this journal may be used; but the socket of the lower portion and the plug of the upper are best made in the workshop. The small socket (B) is a piece of ¼ in. *outside* diameter brass tubing ⅜ in. long. This is driven into the top of the hole made in the ebonite by tapping it lightly with a mallet until its edge lies flush with the surface. A 4 B.A. hole is then drilled and tapped from the edge of the ebonite into the brass, a 4 B.A. screw being inserted to fix the tube in position. The end of the screw must not protrude at all into the tube, but must be trimmed off with a round file.

The second socket (C) is a 1 in. length of the tubing driven in from the other end of the hole and fixed as before. The inner ends of the tubes will be ⅛ in. apart within the ebonite. The lower portion of the connector can now be mounted upon a small wooden block, such as electricians use for switches, by means of two 4 B.A. screws driven up into the ebonite from the underside of the block.

Within the hollow switch block is a fixed resistance made by winding a block of slate or ebonite ½ in. thick and 2 in. wide as closely as possible with No. 18 gauge enamelled Eureka wire for 3½ in. As this wire will carry a current of 4 amperes without overheating, the factor of safety should be great enough for all ordinary purposes, especially as the resistance will usually be thrown in only for a second or so at a time. If the total load is always considerably less than 4 amperes, the size of the fixed resistance may be reduced by using thinner wire. No. 20 will

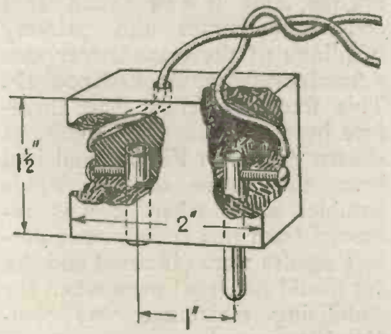


Fig. 3.—The upper portion of the connector.

carry 3 amperes and 5 yards will be sufficient. If No. 22, which has a safe load of 2.3 amperes, is used, 3½ yards will suffice. As

No. 20 makes 26 and No. 22, 33 turns to the inch, the size of the former necessary is easily calculated.

The upper portion of the connection is seen in Fig. 3. It is made from a piece of ½-in. ebonite of the same dimensions as that used for the lower portion already described. Its plug is made from a piece of 3/16-in. round brass rod 1½ in. in length. It is inserted into the upper portion, so that ¾ in. protrudes, and its protruding part is split with a fine-bladed hacksaw. The drawing also shows the way in which the flex leads from the set can conveniently be fixed. They are brought from the top through oblique holes to the sides, where they are connected to the screws which hold plug and socket in position. R. W. H.

The Cross-Coupling Question

MANY amateur constructors have trouble with both high- and low-frequency amplification simply because they do not lay out their sets so as to place inductances and transformers in the best positions. It is almost an accepted canon of wireless that to control two tuned anodes without causing serious interference to other people, is so difficult as to be nearly a matter of impossibility. The writer regularly uses a pair of these couplings on a five-valve set, and he is open to wager that unless the potentiometer, rheostat and anode potential adjustments of the set are interfered with, it cannot be made to oscillate upon broadcast wavelengths. It should be said that no reaction is employed. The stability of the set is attributed almost entirely to the way in which the inductances are placed. It is not always realised that if inductances are parallel to one another, as in Fig. 1, they must be separated by very great distances before the effects of coupling cease to be felt. Hence, if the A.T.I. and one of the anode inductances are placed in this position there will be a cross coupling between them, even if they are placed far apart on the panel. One sometimes reads in text books that the point of minimum coupling is reached when the coils are placed at right angles to one another. This is a slightly misleading statement, for it might induce the constructor to place the A.T.I. as at *a* in Fig. 2, and the anode inductance in the position shown at *b*. This will not give anything like zero coupling, as you can easily prove by experiment, if you have a 2-coil holder which allows the moving inductance mounted on it to be turned through an angle of ninety degrees. The position which does give a minimum coupling is shown in Fig. 3. Here, if *b* is directly opposite the centre of *a* the coupling between the two will be so nearly zero that the effects of interaction will not be felt. Thin coils, such as baskets, can be arranged, as shown in Fig. 4, without there being any great degree of cross coupling. Where it is desired to mount an A.T.I. and two anode inductances, the only method of keeping them all at right angles is that shown in Fig. 5. Here, *a* may be the A.T.I. mounted on one side of the cabinet, whilst *b* and *c* are the anode inductances mounted upon the panel. Exactly the same rules apply to low-frequency intervalve transformers, which are frequently wrongly placed in the position shown in Fig. 2, with a bad effect upon reception.

Fig. 1.—Two coils coupled.

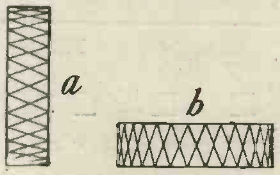


Fig. 2.—Even in this position there will be coupling.

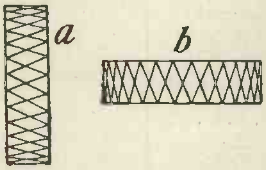


Fig. 3.—The position for minimum coupling.

Fig. 4.—How to arrange basket coils.

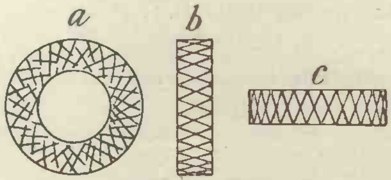


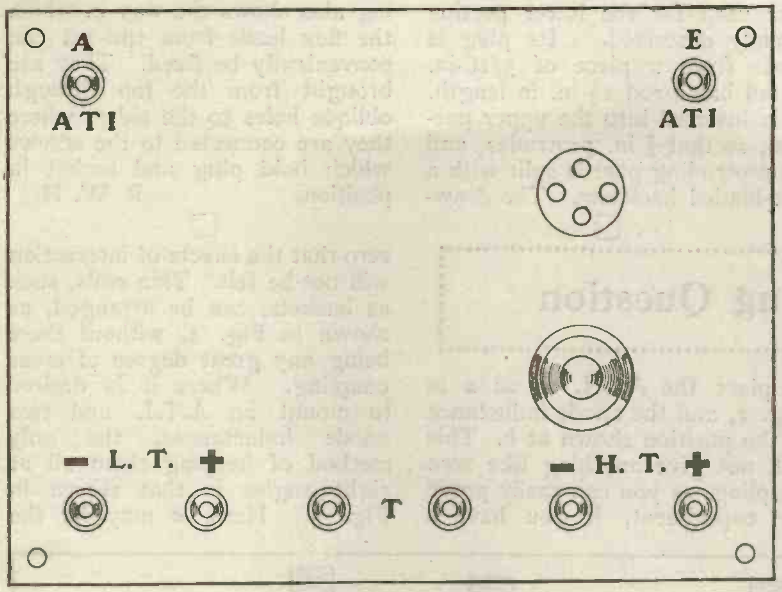
Fig. 5.—How to arrange A.T.I. and two anode coils.

Intervalve Coupling

SIR,—I read with interest the "Valve Notes" in *Wireless Weekly* for April 23, and especially the one relating to the Simpson connection for L.F. transformer. I hitched up the arrangement and with quite a cheap transformer I found distortion cut down to a minimum when using full reaction. Further, the loud-speaker lost all its usual tin-like vibration on the upper and extreme lower notes. I thank your paper for bringing this circuit to our notice.—Yours faithfully,

N. ASHLEY BIRD.

Southport, Lancs.



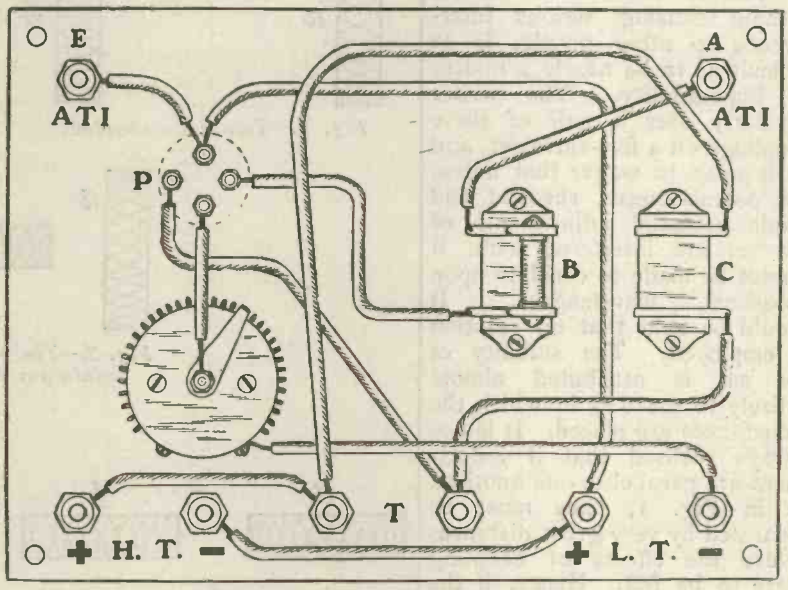
The lay-out of the panel.

Practical Back-of-Panel Charts

By
OSWALD J. RANKIN.

A Simple Single-Valve Receiver.

A very simple non-reacting single-valve receiver suitable for the reception of telephony and spark signals. The tuning inductance is connected in shunt with the terminals marked A.T.I., the aerial side going to the grid-leak of 2 megohms resistance and condenser B of 0.0003 μF, and the earth side to the L.T. positive line. C is the telephone condenser which has the usual capacity of 0.002 μF.



Practical wiring diagram and lay-out of the components.

Some Simple Questions Answered

How is the name Valve arrived at ?
Valves, either two-electrode, or three-electrode, possess the property of permitting current to flow through them in one direction only, namely, negative electricity will flow from the heated filament or cathode to the positively charged plate or anode. The valve thus acts in a manner similar to a non-return valve in a waterpipe system.

Why are the pins at the bottom of a Valve placed unequally ?
In order to prevent the user inserting the pins into the wrong socket of the valve holder, which might easily result in applying the high-tension voltage to the valve filament and burning it out.

What is a Two-electrode Valve ?

Essentially an evacuated glass vessel containing a metallic filament which can be heated by the passage of an electric current, and a metal plate, usually in the form of a cylinder surrounding the filament, and having a leading-out wire sealed in the glass wall of the vessel. The heated filament emits negatived charges of electricity called electrons which are attracted by and flow to the plate or anode when the latter is positively charged with respect to the filament.

What is a Three-electrode Valve ?
The introduction of a third electrode, known as the grid, and consisting of a perforated metal plate or, more usually, a spiral of wire, between the filament and the anode, transforms a two-electrode into a three-electrode valve.

What exactly is meant by rectifying ?
Rectification consists in the conversion of oscillatory currents into uni-directional pulsating currents. *In effect,* one half of the oscillating current is permitted to flow through the rectifying device, and the other half is stopped.

Random Technicalities

By PERCY W. HARRIS, Assistant Editor.

Some notes of interest to both the home-constructor and the experimenter.

DURING the last twelve months we have seen many new types of aerials and the exploiting of a number of substitutes for ordinary wire, such as the strip aerial, the gauze aerial, and the net aerial. Advocates of each new kind have, as usual, claimed miracles, but practical tests show that, so far as the majority are concerned, there is practically no difference between them and the old-fashioned wire. In earth connections, however, very few novelties have been produced, although, in my opinion, this is a direction where a great deal of useful experimental work can be done.

* * *

About a year ago I carried out some experiments in earths and earthing systems which showed me quite conclusively that for receiving sets there is nothing to beat a number of wires buried beneath the aerial. Three or four parallel wires separated about 10 ft. from one another and running in what has been termed the "electrical shadow" of the aerial, give admirable results, particularly on very short wavelengths, where differences between various earthing methods show up very clearly. The object of the present note is to suggest to experimenters that they try copper strip, sold for aerials, in their earthing systems, burying lengths of this strip three or four inches below ground in the manner explained above. The ends of the strip near the lead-in should be brought together to the earth terminal, or they may quite conveniently be soldered together and a single heavy earth wire taken from the point of soldering to the lead-in point.

* * *

The interest in high-tensionless receivers has brought about a considerable demand for four-electrode valves, of which the most easily obtainable are the "Phillips" of Dutch origin. Unfortunately a certain amount of profiteering is going on amongst dealers (not the leading houses, of course), and I have seen these valves boldly advertised in shop-windows at a guinea each. This charge is much too high, as the valves in question can be sold at a good profit by dealers at 17s. 6d., which is the most that should be charged. The Marconi tubular four-electrode valve is, however, a much more expensive proposition, costing considerably more than double the figure mentioned.

* * *

Cardboard inductance tubes might appear to most readers to be quite unlikely to give trouble in radio circuits. Nevertheless, there are on the market inductance tubes of straw-board, painted with a black varnish, so that they resemble, superficially, pieces of ebonite. Some of the black varnishes are quite good, but I have recently heard of several cases where the particular varnish contained material which is conducting, with the result that serious leakage has occurred. In one instance a variometer shown to us was wound with good wire but painted over with a wretched black varnish in such a way that the whole coil was practically short-circuited. In any case, it is wise to avoid black varnishes of whatever make, although some are quite innocuous. The straw board tubes which have obviously been impregnated with wax are the best to use, and I am inclined to think that we cannot do better than to use d.c.c. wire for the coil without any varnish or wax applied afterwards. True, there may be losses due to the absorption of moisture from the air, but it is doubtful whether these losses are greater than those occasioned by the self-capacity introduced by wax and shellac. Personally, I have given up impregnating my coils after winding, as I look upon the reduction of the self-capacity in coils as more important than almost any other factor.

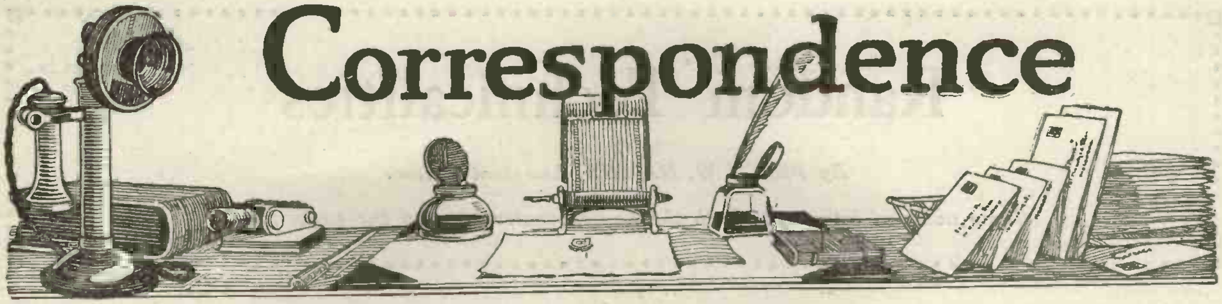
* * *

Readers of *Wireless Weekly* may be interested to know that it is possible to obtain from several firms handsome Jacobean or polished mahogany cabinets originally built for gramophones, but now adapted for the panels of wireless sets. Some of these cabinets have a built-in horn to which can be attached a loud-speaker fitting made by one of the loud-speaker manufacturers. Such a cabinet in what is known as "Jacobean oak," standing about 3 ft. 6 in. high by 18 in. wide, with built-in metal horn and cupboards beneath for accumulators, can be purchased for about £6 15s. or £7. Loud-speaker attachments for gramophone horns cost about £3 each (I am not referring to the ordinary telephone adapters, which are practically useless for great volume), so that a ten-pound note will cover the cost of the complete cabinet and loud-speaker.

* * *

By the way, a correspondent recently asked me how to convert a 4-valve Family receiver into a high-tensionless set. The answer is that it cannot be so converted. High-tensionless sets are very interesting, and I have experimented with them probably as much as most people during the last few weeks. In last week's issue was given a description of the latest set of the type I have made, but I can say quite frankly that I have no intention of abandoning the use of high-tension batteries, nor is it possible satisfactorily to convert any of my previously published designs to get rid of the high-tension battery without sacrificing considerable signal strength.

Correspondence



CONCERNING OURSELVES

SIR,—Have just looked over the May 28 issue of your valuable paper, and I see our friends of the correspondence columns are on the warpath again, this time the subject being your remarks about the "Unidyne."

Your correspondents in many cases fail to realise that *Wireless Weekly* is a really strong wireless paper, and is therefore bound to analyse and criticise the various innovations, etc., that come into the wireless world.

Personally I have found nothing out of order in the editorials, either about this present subject or concerning the "Cardiff announcer."—Yours faithfully,

J. R. ATKINS.

Seymour Road, Oldbury.

ST34

SIR,—I shall be very glad if you would be good enough to allow me a little space in your most excellent paper to let your readers know what wonderful results I am getting *daily* with a receiver I have constructed, employing your most admirable ST34 circuit. I have experimented with numbers of circuits, but can say perfectly frankly that for almost *incredible* range, together with remarkable signal strength and purity, to which I would add perfect selectivity and stability, the ST34 is streets ahead of any other. Tuning-in is ridiculously easy, the very furthest stations, such as Aberdeen, Stockholm, Paris and other Continental stations, can be picked up nightly. It is an autocrat of the highest order, which scorns freak reception! Signals even at these distances are really almost too loud for the phones, using the two valves only. While, of course, with two L.F. valves, coupled to the circuit the strength and purity leaves nothing to be desired, although, in my case, the last stage is only resistance-capacity coupled.

My nearest broadcasting station is Manchester at 60 miles, and I can get this, also Birmingham, 80 miles, just comfortably audible on the loudspeaker, using *two valves only*.

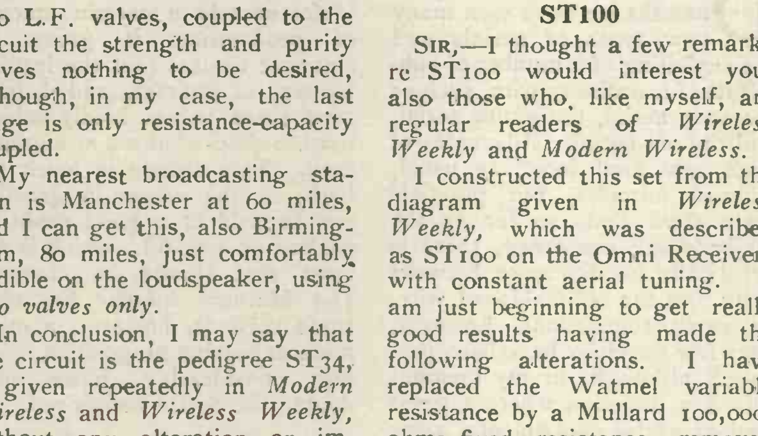
In conclusion, I may say that the circuit is the pedigree ST34, as given repeatedly in *Modern Wireless* and *Wireless Weekly*, without any alteration or improvement (the latter, of course, is not possible).

I am enclosing a photograph of the receiver and amplifier which I have designed and constructed, so that if any of your readers care to copy it, they are, of course, quite at liberty to do so. Further, I shall be pleased to send you a photograph of internal arrangement, showing valves inside cabinet, if it would be of greater assistance.

With many thanks for such a magnificent circuit.—Yours faithfully,

A. J. SWEENEY.

Newark-on-Trent.



The ST34 receiver referred to by Mr. Sweeney coupled to a two-stage amplifier. The general appearance and neatness of the apparatus leave nothing to be desired.

ST100

SIR,—I thought a few remarks re ST100 would interest you, also those who, like myself, are regular readers of *Wireless Weekly* and *Modern Wireless*.

I constructed this set from the diagram given in *Wireless Weekly*, which was described as ST100 on the Omni Receiver, with constant aerial tuning. I am just beginning to get really good results having made the following alterations. I have replaced the Watmel variable resistance by a Mullard 100,000-ohms fixed resistance, removed the 0.0001 fixed condenser, placed the A.T.C. in series, and substituted basket coils in place of honeycomb coils (Igranic). I am next going to put in polar variable condensers in place of the cheaper variety.

Since completing the set in its present form two days ago, I have received Manchester, Newcastle, and Birmingham at loudspeaker strength at respective distances of 30 miles, 85 miles, and 100 miles.—Yours faithfully,

FIREMAN P. WILD.

Bradford City Fire Brigade.

A CRYSTAL NOVELTY

Sir,—Enclosed I send you a sketch of an alteration easily made to the ordinary crystal detector.

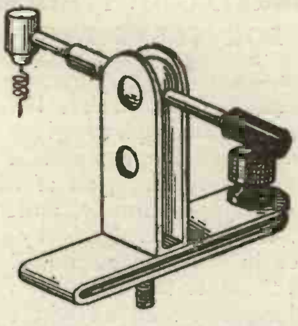
A piece of strip brass about ⅛ in. wide and 1/16 in. thick is bent as shown.

There are two tapped holes in the underside, one to receive a piece of screwed brass for mounting purposes, and the other at the end to take another piece of screwed brass, soldered in the bottom and passing through a clearance hole in top part.

An insulated terminal screwed on this permits an extremely delicate but firm adjustment of the wire on the crystal.—Yours faithfully,

Salford. C. Appleton.

P.S.—I am very glad to find *Wireless Weekly* so sound on the subject of high-tensionless circuits.



The arrangement referred to by Mr. Appleton.

THE PROOF OF THE PUDDING

Sir,—A short time ago I purchased your book, "How to Make Your Own Broadcast Receiver," by Mr. J. Scott Taggart, F.Inst.P., and from the instructions have constructed the Broadcast Receiver No. 3, mounting the parts, however, on ebonite. I am 42 miles from Birmingham and 54 from Manchester, but despite the distance I am from a broadcast station, I can hear 5IT perfectly and 2ZY quite well—especially the music.

Needless to say I am very proud of my work, and can thoroughly recommend the set to anyone desirous of making a crystal receiver.—I am, yours faithfully,

Edwin E. Howse.

West Hallam, nr. Derby.

IP OR OP

Sir,—In your issue of *Wireless Weekly* of April 16 you printed some remarks under the title of "Valve Notes" relating to the connections to intervalve transformers.

I have lately used a 3-valve set, 1 H.F., D., 1 L.F. (straight circuit), using at different times transformers of different makes.

The first transformer was an Army type from a Mark III 2-valve receiver, and the only connections with this which gave good results were IS to grid, IP to plate.

The next was a Powquip unshrouded type, and this at first was connected IS to grid, IP to plate, the results being good. On changing OS to grid, however, amplification was greater without distortion; changing the primary connections did not affect results at all.

The next transformer to be tried was a Radio Instruments, and was connected in the same way as in previous cases, subsequently being changed round. In this case the best connections, both as regards amplification and clearness of signals, were OS to grid, OP to H.T. positive.—Yours faithfully,

WALTER J. COCKS.

Reading.

AN INEXPENSIVE 2-VALVE AMPLIFIER

SIR,—May I write my appreciation of Mr. Percy W. Harris' "Inexpensive 2-Valve Amplifier," as published in the May 7 issue of your excellent paper? I have just completed this set, and it is highly satisfactory. I am situated 8 miles from 2ZY, and the strength is all that could be desired, whilst the purity of tone exceeds anything I have ever known. The components are Dubilier resistances and grid leaks, Cossor P.I. and Marconi Osram valves respectively, Lissenstat minor filament controls and Mansbridge .25 condensers. I am sure that anyone who is out for purity of tone would be highly delighted with this simple and inexpensive amplifier.—Yours faithfully,

W. E. ENTWISTLE.

Altrincham.

MARKING OUT HOLES FOR VALVE LEGS

SIR,—On page 119 of the May 28 issue of *Wireless Weekly* there are some plans given for marking out the position of the holes for valve legs, all of which are only approximate, and this fact is acknowledged by the writer in his advice to drill the holes " rather large."

I have not seen anywhere the plan I adopt, and with this there is no need to drill the holes over size. I may say I have been bitten with the bought template. I got one and trusted it and drilled several panels only to find that the valves could only be induced to enter by using force. I then tried a valve in a valve-holder I had by me similar to the attached, and found that no force was required to put the valve in. Here was a solution of the difficulty, and I drilled through the valve-holder with a 4 B.A. clearance drill, and used the valve-holder as a jig. First drill the top hole in the position desired and then fix the prepared valve-holder in position with a long screw and nut, or, if no screw long enough is at hand, a length of studding and two nuts, and then drill the remaining holes through—with the certain knowledge that the valve will fit—and this without any sloppiness in the fit of the legs in the panel, which is useful when wiring up the panel, and using the nuts to make the connections.

It may be contended that this is an expensive way of procuring a jig, but it has this advantage: that the valves can be tried in the holder before the alteration, which cannot be done in the case of bought jigs as the holes are too large—they are 4 B.A. clearing and the valves may enter these larger holes freely and still not fit the valve legs when in place.—Yours faithfully,

D. G. TAYLOR.

Ilminster.

[After experience of many readers' sets we have found that the usual valve legs with nuts are a very fruitful source of trouble. We are now unhesitatingly recommending the special types of holders which result in less capacity and less leakage.—ED.]

Apparatus we have tested

Conducted by A. D. COWPER, M.Sc., Staff Editor.

Radiohm Ribbon Aerial

From Messrs. Sparks Radio Supplies we have received for practical test samples of their copper-strip aerial material. These ribbon aerials are made, as the name implies, of a thin strip of copper either one-half or one-quarter inch in width, and in coils of 100 and 50 ft. length. As the thin strip offers so much more surface than solid wire and high-frequency currents flow principally in the surface layers of a conductor, it would be anticipated that such strip would offer considerably less H.F. resistance than wire or cable of equal weight.

In order to make a test of any real significance, the strip was compared directly with the customary bright 7/22's copper stranded aerial cable, with actual measurement of signal-strength by two different methods, an aerial of exactly the same height, length and position being erected with each, receiving the same transmission (2LO at 13 miles) alternately with the briefest possible time intervals between the tests. A 70-foot straight single-wire aerial was available, about 17 ft. above a grass lawn, in a position fairly favourable for reception but with about the average degree of screening for a surburban aerial, provided with a direct lead-in at an open window. Both earth connection and tuning devices were of unusually low resistance, and valve reception was arranged to give high efficiency and extremely finely controlled reaction.

In order to bring out the more clearly any difference due to the lower H.F. resistance of the ribbon aerial, the half-inch strip was used, though this size is suggested more particularly for indoor aerials, the greater weight and wind-resistance making it less suitable for an outdoor large aerial.

Tested this way, both aerials, 7/22's and ½-in. strip, gave identically the same signal-strength on a good galena crystal by repeated measurements, 10 microamperes being recorded each time with optimum crystal-setting. On single-valve-with-reaction reception, again identical figures were obtained repeatedly, the effective signal voltage, measured after the manner of the Moullin voltmeter, being 1.6 in each case.

The capacity of the strip aerial was noticeably higher than that of the cable, being .00025, in comparison with .000205 μF of the stranded wire. As the aerials were otherwise identical, this difference must be attributed to the larger area of the ribbon. The reaction requirements were also considerably higher — measured on an arbitrary scale of capacity-reaction-effect roughly twice as much was required for the strip: presumably indicating a considerably higher radiation-resistance.

The results obtained confirm measurements made some time ago by the writer with heavy copper strip as material for indoor aerials, no difference being noticeable in signal-strength by actual measurement (mere casual observation is futile in such experiments) between strip about 1-16 in. thick and much thinner cable. The resistance of the ordinary cable is already so low that it is in effect negligible in comparison with other factors; so that any difference observed qualitatively through replacing the latter by strip must be due to other uncontrolled factors.

With this proviso, the Radiohm ribbon aerial material is quite excellent for the purpose indicated, the narrow type being preferable for outdoor aerials (which should be of the single variety and well supported), and will give an aerial of exceedingly low H.F. resistance.

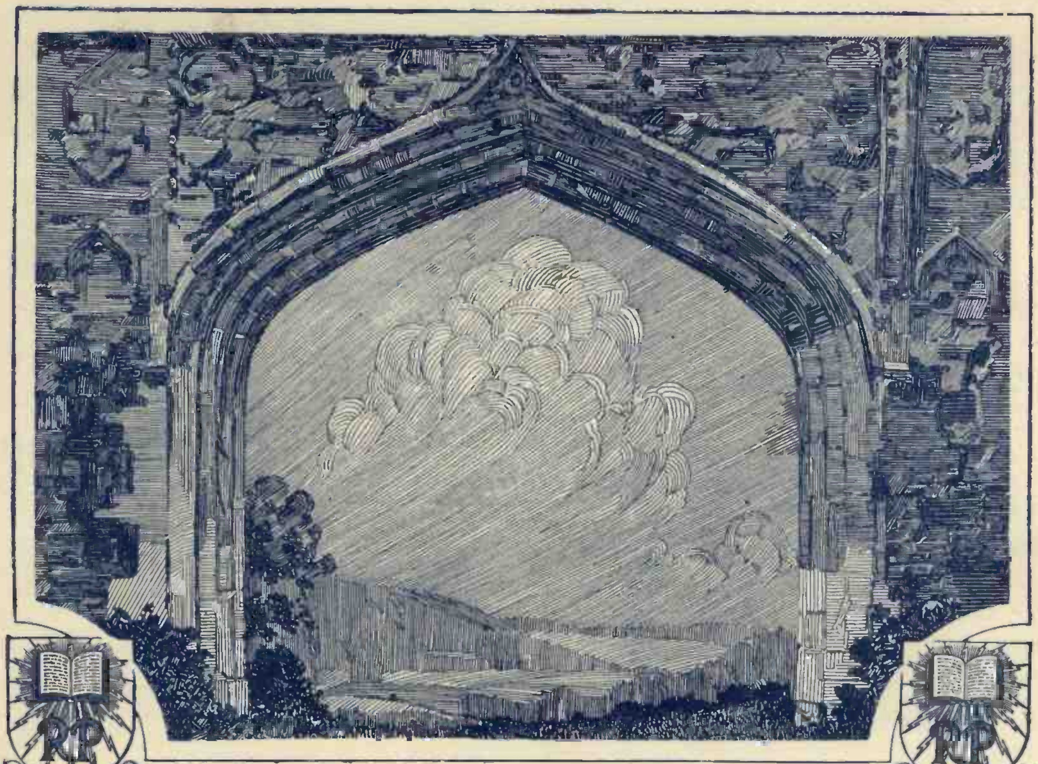
Tuned Anode and Reaction Unit

Messrs. Midland Radiotelephone Manufacturers, Ltd., have sent for test a sample of their "Mellowtone" plug-in tuned-anode unit with variable reaction, covering the range from 300 to 500 metres wavelength.

This unit has an anode inductance wound in a slot in an ebonite disc 2½-in. diameter, which plugs into a valve-socket holder in the ordinary way, two connections going to the plate of the first valve and to H.T. plus, the other two being for reaction-connections. The reaction-coil is a similar small coil mounted eccentrically on a pivot, and swinging at will over the first. A long insulated handle is provided for the control of this coil.

On test, the tuning range was found to be as stated, with a .0005 μF (actual) parallel condenser. With direct-coupled circuit on a P.M.G. aerial, and arranged according to the maker's instructions, with a good R valve and suitable value of H.T., Birmingham (on 475 m.) was read clearly in London, but as the reaction coil appeared to be inadequate with this arrangement (it made but little difference when reversed and put at full coupling) selectivity was not noticeably great, as London, 13 miles away, could not be cut out below 450 metres. With a .0002 μF series condenser in the aerial, and reaction-coil short-circuited, with moderate H.T., some 4 volts positive grid-bias had to be applied to prevent self-oscillation; in these circumstances London was cut out above 450 metres, and a moderate degree of H.F. amplification, compared with a single valve with critical reaction, was measured, using the Moullin voltmeter method. It should be noted that the makers do not suggest this arrangement.

The unit is neatly made and finished, and with a rather more powerful reaction-coil should be useful for the home-constructor.



The Gateway to Knowledge.

	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
14 **12 Tested Wireless Sets** .. .. By P. W. HARRIS.	2/6
15 **More Practical Valve Circuits** .. By JOHN SCOTT-TAGGART, F.Inst.P.	3/6
16 **Home-Built Wireless Components**	2/6
17 **Wireless Sets for Home Constructors** .. .. By E. REDPATH.	2/6
18 **Tuning Coils and How to Wind Them** .. .. By G. P. KENDALL, B.Sc.	1/6

RADIO PRESS ENVELOPES.

No. 1. **How to Build an S.T.100 Receiver** By JOHN SCOTT-TAGGART, F.Inst.P.	1/6
No. 2. **How to Build a 4-Valve Receiver** By P. W. HARRIS.	2/6

Nos. 3 and 4 to be issued shortly.

SIMPLEX WIRING CHARTS.

No. 1. For 2-Valve Set	1/-
No. 2. For 3-Valve Set	1/-
No. 3. For 4-Valve Set	1/-

The library of Radio Press Books is assuredly a very real gateway to knowledge.

If you are a beginner you will be able by its aid to appreciate something of the miracle of Radio—how its waves travel at the speed of light and penetrate even the depths of a coal mine. You will readily learn how the voice is "converted" into these wireless waves at the Broadcasting Station and picked up by your Aerial and "reconverted" by your Receiving Set in your own home.

If, on the other hand, you are anxious to build a good Set, then you will find a wide choice of Instruments available in this Series of Books. The man making his first Set (if he lives within 20 miles from a B.B.C. Station) will probably select a Crystal Set from R.P. Book No. 3, while the more expert will want to select Receivers from R.P. Book No. 14 or No. 17.

The new Series of Radio Press Envelopes are an endeavour to make the building of Sets the simplest possible operation—one involving no technical skill or knowledge.

All these Radio Press Books are written by experts and their contents are accurate and reliable. You can purchase them at any Bookseller's, or we will post any of them direct (postage 2d. per Book or 3d. per Radio Press Envelope extra).

RADIO PRESS LTD.,
The largest wireless Publishers in the world,
Devereux Court, Strand. W.C. 2.

If it is an R.P. Book — you can depend upon it

Gilbert Ad. 940.

Printed for the Proprietors, RADIO PRESS, LTD., Devereux Court, Strand, W.C.2. by THE AVENUE PRESS (L. Upcott Gill & Son, Ltd.), 55-57, Drury Lane, London W.C.2. Published on Wednesday of each week at 3, Bolt Court, Fleet Street, London, E.C.4. Address for Subscriptions and Editorial Communications :—Devereux Court, Strand, London, W.C.2. Advertisement Managers :—THE SCHEFF PUBLICITY ORGANISATION, LTD., 125, Pall Mall, London, S.W.1. Registered as a newspaper and for transmission by Canadian Magazine Post. Subscription rates :—32/6 per annum, 16/3 for six months, post free. Sole Agents for Australasia :—GORDON & GOTCH, (Australasia), LTD. For Canada :—IMPERIAL NEWS, LTD. For South Africa :—CENTRAL NEWS AGENCY, LTD. For Japan :—SALE & FRAZAR, LTD.

Wireless Weekly, 6d. Net. Wednesday. June 18th, 1924.

Wireless Weekly

and the Wireless Constructor.

Vol. 4.
No. 7.

CONTENTS

Hints for the Flat Dweller

By PERCY W. HARRIS.

Wireless Weekly

Vol. 4, No. 7
June 18, 1924

CONTENTS

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

Assistant Editors: P. W. HARRIS. E. REDPATH.

Radio Press, Ltd.

Publishers of Authoritative Wireless Literature.
DEVEREUX COURT, STRAND, W.C.2.
Tel.—Central 3763.

Advertisement Managers: SCHEFF PUBLICITY ORGANISATION, LTD., 125, Pall Mall, London, S.W.1
Tel.—Regent 2440.

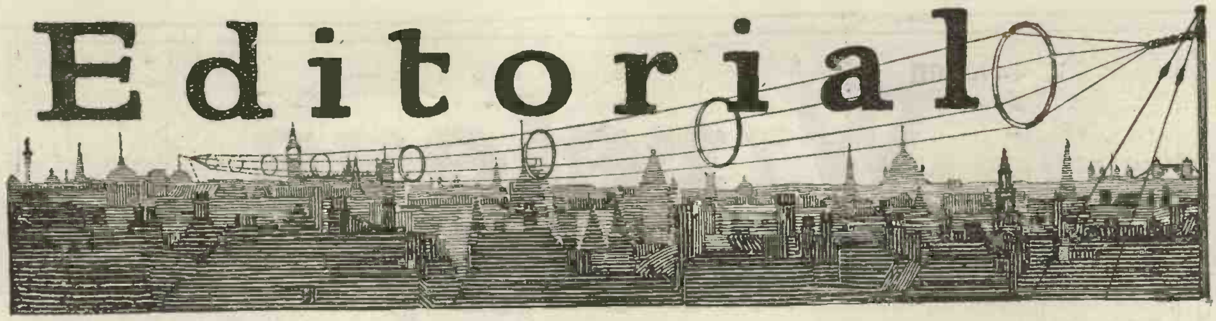
Scientific Adviser:
Prof. G. W. O. HOWE D.Sc., M.I.E.E.

Advisory Editors:
Prof. R. WHIDDINGTON, M.A., D.Sc.
Prof. C. L. FORTESCUE, M.A., M.I.E.E.

Staff Editors:
E. H. CHAPMAN, M.A., D.Sc.
A. D. COWPER, M.Sc.
G. P. KENDALL, B.Sc.
R. W. HALLOWS, M.A.
S. G. RATTEE, Member I.R.E.

All correspondence relating to contributions is to be addressed to the Editor of "Wireless Weekly."

Nothing contained herein is to be regarded as permission or encouragement to infringe any patent rights.



Promise and Practice

IN the early days of this month an announcement was made of the successful transmission of speech by wireless telephony between Great Britain and Australia, surely one of the most remarkable achievements of radio science. Senatore Marconi, working at Poldhu, and Mr. Ernest T. Fisk, who managed the Australian end, are both to be congratulated upon their success, particularly when we consider that only 20 kilowatts were used to bridge the distance. Long since the wireless telephone has outstripped its elder sister, the wire telephone, in the distances it can cover, for the first transatlantic telephony—an achievement of some nine years ago—has still to be equalled by the wire telephone. It is certainly remarkable, when we come to think of it, that after so many years the wire telephone is still impracticable for transatlantic communication, not a single intelligible word ever having been transmitted by cable across the " herring pond."

In some quarters the Australian transmission has been hailed as the beginning of a new era, but before building high hopes upon this achievement, we should consider for a moment the great difference which exists between tests on days and times which have proved most suitable, and the day-and-night, week-in and week-out, communication necessary before such long distance telephony can be called commercial. As early as 1915 communication was established between Washington and Paris by wireless telephony—this being a one-way transmission, and since that time very many successful attempts at transatlantic telephony have taken place. Nine years is a long time in the progress of any science, most of all in one which is growing as rapidly as radio, yet we still await the inventions which will turn transatlantic radio telephony into a commercially practicable proposition. It is still easier to exchange a few words occasionally with the Antipodes than to speak regularly to New York.

Thus we come once again to the main outstanding problem of radio, the discovery of the full causes of, and the elimination of the effects of, the fluctuations of signal strength which are such a hindrance in both wireless telegraphy and wireless telephony. An allied problem is the elimination of atmospheric disturbances, although a certain amount of progress has been made along this line. At present we are faced with the fact that on favourable occasions a power of, say, 5 kw. will satisfactorily bridge the Atlantic, whilst an hour or two later 200 kw. may be expended at the transmitting end without appreciable energy reaching the receiver. The problem is likely to be solved, not by any spectacular invention, but by the slow and painstaking accumulation of data, the sifting of the evidence so obtained, and ultimately the formation of a theory which will prove the key of the problem. It is here that the serious wireless amateur may play an important part, and all those followers of the science who have the opportunity should make a careful note of the various changes in signal strength, and other phenomena, which they know to originate outside their own receiving instruments.

Those readers who have passed the stage when the reception of any broad-casting whatever is sufficient to give them full satisfaction should consider what they can do in this way. Fading effects are far worse in the summer months than in the winter, so that the present is indeed a good time to start.

An Elaboration of the "Ordinary Valve" High-Tensionless Circuit

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

Those readers who have experimented with these H.T.-less circuits will find interest in the improvements indicated below.

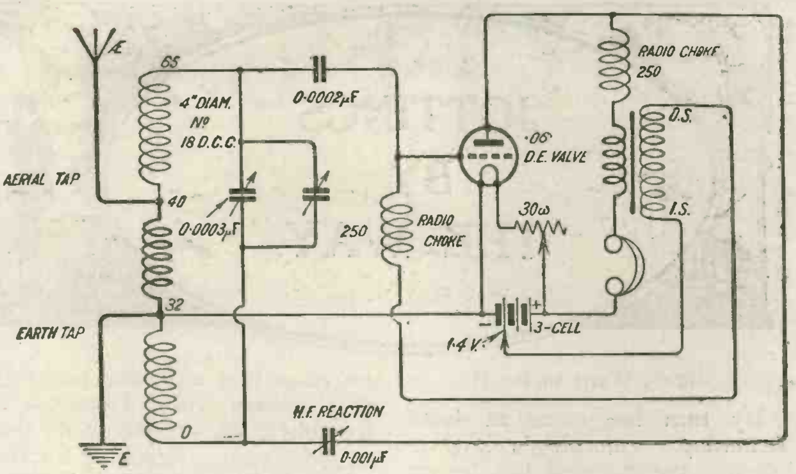


Fig. 1.—The modified Cowper circuit using ordinary valves and no high-tension battery.

IN the form of "high-tensionless" circuit using ordinary valves described by the writer in *Wireless Weekly*, Vol. 4, No. 4, and worked out in practical constructional form by Mr. P. W. Harris in No. 5, the "Constant Aerial Tuning" type of coupling to the aerial was indicated, with a series condenser in the aerial of .0001 μF capacity and ordinary types of plug-in coils.

While this arrangement has given excellent results up to 40 miles or more, and quite loud reception at close quarters, with ordinary plug-in coils of appreciable H.F. resistance, and a series aerial condenser of .0001 μF, it may be found that the circuit will often not oscillate, so that the reaction-effect may be insufficient for long-distance reception. The writer used, in developing the circuit, a basket-coil of No. 20 S.W.G., d.c.c. wire in the aerial-circuit, and actually a variable series condenser of .0001 μF *maximum;* at times he was using only about .00003 (thirty micro-microfarads) of this in series with the aerial, giving thus extremely slender coupling to the latter, and great ease of oscillation. With these, and a good "liberal" R valve, the distant stations could be picked up with ease; though, of course, not loud in any sense of the term. The circuit oscillated more readily when the audio-reaction was in use than without it. Close regulation of the mean grid-potential by means of the potentiometer was essential—the writer used a T.C. Ball potentiometer for this purpose.

Audio Reaction

The type of "transmitter" circuit illustrated in *Wireless Weekly*, Vol. 4, No. 2, by the writer was found to give excellent results, when adapted to this principle of audio-reflex, when using the .06 type of dull-emitter valve. With these valves there is a considerable range of adjustment of filament-temperature possible. As the positive grid-bias found necessary to control the audio-frequency reaction is between 1 and 2 volts usually, as applied by a potentiometer in the original circuit, the idea arose to try if this could be obtained simply by tapping the L.T. battery of three dry cells after the first cell (giving 1.2 to 1.4 volts positive), and regulating by the variable filament resistance. This was found to be possible with these D.E. valves, so that the circuit shown resulted. It should be understood that this is only suitable for D.E. valves operating from dry cells; with other valves the original potentiometer should be used. The very large reaction-condenser is necessary on account of the low power available; a .001 μF Raymond was used in some experiments. As the tuning is exceedingly fine with this circuit, a .0003 Jackson Bros. variable condenser with vernier adjustment was found suitable for the A.T.C. In order to keep the H.F. resistance to a minimum the A.T.I. is wound with 65 turns of No. 18 S.W.G. d.c.c. wire on a 4-in. former.

Radio Chokes

The radio-chokes can be thin slab coils of No. 32 enamel wire, 3 in. diam. and 1 in. deep, wound in a narrow slot, about 300-400 turns.

The ordinary .06 dull-emitter worked excellently in this circuit with a pocket flash-lamp battery for sole source of power. By adding a single extra cell (i.e., 4 in all) from another flash-lamp battery, as external H.T., the circuit oscillated readily with a small portion of the reaction condenser in use; so that three could listen to the Savoy Band on the loud-speaker in a London suburb; Newcastle was just audible on the L.S.; and Bournemouth, Glasgow, and Birmingham were audible in the head-phones, faint but distinct; all on a good P.M.G. aerial.

Gas-Pipe Earths

THE danger of earthing to a gas-pipe, which has so frequently been emphasised in this journal, is confirmed by an occurrence which took place at Alnwick, Northumberland, during a thunderstorm on May 25 last. An aerial which was earthed in this way was struck by lightning, the gas-pipe was pierced and the gas ignited.

The Alnwick Town Council decided at their monthly meeting that, in view of this danger, proper means of earthing must be adopted by all their tenants using wireless apparatus, and that, in the event of preventable damage taking place, the tenant should be called upon to make good the damage. A. J. W.

JOTTINGS BY THE WAY

I Didn't Want to Do It

My turn has come at last. Yesterday morning's post brought me a small but heavy parcel, upon opening which I found a note—"Will you please test out the enclosed transformer carefully, and send in a full report at once, or earlier if possible." I think I told you before that I am by nature a rather indolent person, whose motto is "Never do to-day what you can put off till to-morrow." Had I been a woman my guiding device in life would have been, I think, "One stitch in nine saves time." Proverbs are quite useful things if you know how to treat them properly! Ordinarily I should have postponed my tests for a little while so as to give me time to think them out properly, and then to await the arrival of the right mood in order to be able to apply them with due care and artistry. But, in face of that peremptory note, I gave a little sigh of resignation, and prepared to get to work. The enclosed transformer turned out to be the Watto, whose makers, to judge by the literature sent with it, appeared to have found it quite a good thing. The secondary windings were stated to contain 5,000 turns of No. 38 S.W.G. and the primary 17,500. These were splendid figures, but I decided to leave the verification by counting until I had applied the other tests called for.

The Task Begins

The first step of putting a transformer through its paces is to discover what the insulation resistance is. The fact that the number of megohms obtained conveys nothing to more than about one person in a million does not matter in the very least. Transformers always have been tested in that way, and probably they always will. Therefore it was obviously my job to do this straight away. Reaching for the telephone, I rang up Poddleby, who is the proud possessor of a megger. Why he acquired such a thing is known only to himself, for he certainly never uses it, though he displays it with great pride to all who visit his wireless den. The explanation given in Little Puddleton of how the megger got into Poddleby's possession is that he once attended a sale of disposals goods, intending to buy a pair of headphones, and that he came away without these useful articles, but with a varied assortment of gear including a batch of half-a-dozen 1,000-volt generators and a transmitting set that would not transmit.

A Make-Weight

The megger appears to have been thrown in as a kind of make-weight. If Poddleby had to carry it home I should imagine that it made weight quite well. Anyhow, I rang up Poddleby. His wife answered the 'phone, and I was relieved to hear that he was out. This meant a respite. Obviously I could do nothing without the megger. I therefore lit a pipe, and with a clear conscience settled down comfortably to the morning paper. I had hardly closed my eyes when I was rudely aroused by the chattering of my own telephone bell. "Is that Wayfarer? This is Poddleby. Did you want me, old chap?" "Not a bit. . . . that is to say, could I borrow your megger?" "Delighted," said Poddleby. "I am coming down your way in about an hour and I will bring it along." Apparently the idea of using that megger rather tickled Poddleby, for he arrived with it almost at once.

Poddleby Becomes Useful

He placed the thing upon the table, remarking brightly, "Well, there you are; now what are you going to do with it?" I explained that I was about to test the Watto, and if he wished to learn how these things should be done I would allow him to stay and help. I then attached a couple of leads to the transformer, and explained to Poddleby that, as I had been forbidden by the doctor's orders to take exercise on hot days, it should be his privilege to grind the handle. Poddleby, I regret to say, was quite rude about it. If, he protested, he had lugged the megger down, it was surely up to me to do the donkey work. I registered an expression which ardent filmgoers would have recognised at once as that of a man almost resigned to his fate, but at the same time determined to put it across his adversary at the earliest possible moment.

A Lost Chance

Had any Los Angeles producer seen it I am sure he would have offered me a large salary on the spot; but it was lost on Poddleby, who said that I must expect to suffer from indigestion if I breakfasted heavily and then did nothing all the morning. Disdaining to offer any reply, I seized the handle and directed Poddleby to connect up. He had got one lead screwed home, and was engaged with the other, when I gave a rapid twirl. His gazelle-like bound into the air would have done credit to any Russian dancer. The pointer on the dial indicated that Poddleby's insulation resistance was of a very low order indeed, and I advised him to have the matter seen to. When he had recovered the powers of speech he at once resigned his job of chief connector.

Precautions

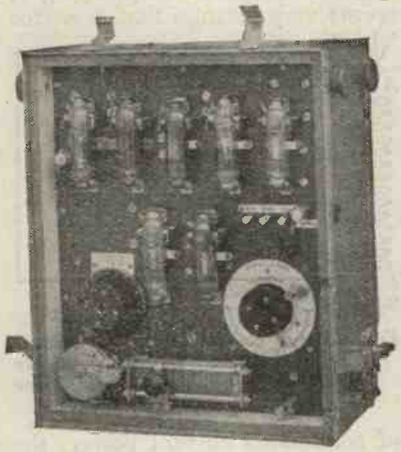
Seeing a nasty gleam in Poddleby's eye (it was probably in both eyes, but what I saw in the right one was quite enough for me), I left the room hastily, and returned wearing a pair of rubber gloves, which I had acquired at a sale of surplus wireless stock in much the same way as Poddleby obtained his megger. Poddleby insisted that this was not playing the game, whereupon I reminded him that we had serious work in hand, and requested him if possible to refrain from frivolity. All was now ready for the great test, and the work would have begun instanter had not Gubbsworthy chosen that moment to blow in. He, it appeared, is rather an expert on meggers—at least, he told us that he was, and he ought to know—and he insisted upon casting an eye over the machine to see that all was in perfect order before he would allow us to use it. "Lucky thing I came round," he said, "or you fellows might have had a bit of a bust up. Just lend me a screwdriver and a pair of pliers, will you?" I sank once more into my armchair whilst Gubbsworthy proceeded to eviscerate the megger. Things were really going very well indeed.

Progress

At the end of about an hour I looked up to ask how they were getting on. Poddleby had his coat off by this time, and was looking hot and distinctly soiled. Gubbsworthy, too, had a jaded and rather worried appearance. The table was littered with coils of wire, screws, nuts and little wheels. I gathered from their remarks that they had successfully got the thing to pieces, and were now engaged in the much more difficult business of putting it together again. "Carry on," I said. "Carry on, and don't mind me. You fellows have, of course, all the day before you to play about in, but I have work to do when you have finished messing things about." A little later I was startled by a scream from Gubbsworthy, the end of whose finger had been nearly bitten off by the gear wheels. Having rendered first aid, I ventured to cast polite doubts upon his intimate knowledge of the interior economy of meggers. This, of course, spurred him on to new efforts, and I then returned to my chair once more. Eventually they announced that all was ready, and the three of us proceeded without further delay to go on with the good work.

A Problem

The first test gave rather remarkable results, for it appeared that the winding-to-winding resistance of the Watto was about minus 17 megohms, and the winding-to-earth reading was even more remarkable, for here the figure was still more megohms and still more minus. Gubbsworthy said that we need not go further, since the transformer was an obvious dud, but I referred him to the makers' modest remarks about it, which proved conclusively that it was by far the best transformer that had ever been invented or ever would be. He retaliated by saying that it was probably wound on the new negative-megohm principle, but this seemed hardly likely. A careful examination of the megger disclosed the fact that Gubbsworthy had got it together in such a way that to make it work you had to turn the handle backwards. This accounted for our weird readings and knocked on the head a brilliant idea for an article on "Observations on the Curious Behaviour of a Transformer under Test," which might well have won me a Fellowship of the Royal Society, or the Czecho-Slovakian Order of the Ineffable Rabbit (with Gridleaks), or something of that kind. The necessary alterations having been made without the loss of further fingertips by Gubbsworthy, we obtained excellent readings; but, as each of us thought that the other was writing them down, I have quite forgotten what they were, and, anyhow, they do not really matter.



The seven valve Marconi aircraft receiver.

An Interval

The first test being thus satisfactorily disposed of, Gubbsworthy and I decided that we would lunch with Poddleby, taking the Watto with us with a view to conducting further tests in his wireless den. The lunch was excellent, and as the day was hot we all of us took a little nap in deck-chairs on Poddleby's lawn, being awakened at half-past four by the tinkling sound of teacups. Directly tea was over we decided that the Watto should be for it. I really think it would have been if Professor Goop had not come in at that moment and started a most interesting discussion upon the subject of hysteresis losses in potentiometers. When the professor had quite finished I exclaimed: "Good heavens! I have only a quarter of an hour before dinner. Come on, you fellows, let's get that Watto done." Hastily we fixed it to Poddleby's set, which we tuned to the wavelength of 2LO. Alas! 2LO was not working. Neither was 5WA, whilst 5IT was equally silent. Thunder was, however, rumbling in the distance and atmospherics were coming in pretty well. It was obvious from the strength of these that the Watto was amplifying exceedingly well, and we decided that we could give it a thoroughly good report.

The Last Lap

The only task that remained for me now was to count the turns in the windings; having done this, I could feel that I had carried out my work in the most thorough and conscientious manner. However, after dinner I found that I had but a brief twenty minutes in which to catch the post. This led me to decide that, as the makers appeared to be truthful people, I might accept their figures practically as they stood.

WIRELESS WAYFARER

The Wireless Valve and How it Works

By JOHN H. MORECROFT, E.E., Professor in Electrical Engineering, Columbia University, New York City.

The seventh of a new and exclusive series of articles by this world-famous expert dealing with the principles of valve working.

Zero Beat Frequency

If C_1, Fig. 17, is set to be in the middle of the region where the beat note is below audibility, the local frequency is the same as the incoming frequency. Hence there are no beat notes; this is said to be the condition for "zero beat frequency." The detecting valve is generating high frequency currents but they are inaudible as they have the same frequency as the signal. If, with this condition, the coupling between L_2 and L_1 is decreased as much as possible, still keeping the valve in the oscillating condition, the detector is set in its most sensitive condition for reception of radiophone signals. To determine whether or not the valve is oscillating with the coupling used, C_1 should be increased a very little; if a low note is heard from the radiophone transmitting station, besides the music or conversation, the valve is oscillating and C_1 can be safely decreased to make the beat note go below audibility with the valve still oscillating.

Controlling the Beat Note

If the receiving station is close by the transmitting station from which the beat notes are being obtained, low-pitched beat notes are in general impossible; as C_1 is changed, the beat note decreasing from high values, there will be found a value of C_1 below which no beat note is audible. Thus a certain setting of C_1 gives a beat note of 1,000; somewhat less gives a note of 400 and if C_1 is further decreased, the note suddenly disappears completely. This is because the powerful, near-by station is trying to make the little receiver valve oscillate at the same frequency as itself and when the frequency of the little valve gets too close to that of the transmitter station it is able to do it; the frequency of the current in the L_1-C_1 circuit suddenly changes from that fixed by L_1 and C_1 to that of the transmitter station, and so the beat note at the same time disappears.

Using the Valve to Generate Electro-Magnetic Waves

As has been mentioned in the previous section, if the plate circuit of a valve is suitably coupled to the grid circuit, there will be set up in the grid circuit high-frequency alternating currents, the frequency of which is fixed by the natural period of the grid circuit, that is, by the L and C in this circuit. To the student who has mastered the first principles of electrical engineering it seems very strange that a source of continuous current power, the H.T. battery, can generate alternating current power, and indeed a really accurate explanation requires a fairly exhaustive analysis.

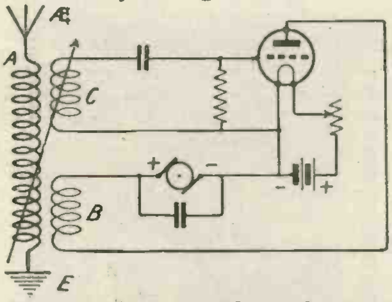


Fig. 18.—A commonly used circuit for making a triode generate sufficient high-frequency power to excite a transmitting aerial.

What Makes a Violin String Vibrate?

It is possible to point out, however, instances of common occurrence in which a nearly similar phenomenon is taking place. What makes a violin string vibrate? How does the continuous steady drawing of the bow across the string make it oscillate back and forth (the mechanical equivalent of an alternating current) a thousand or more times a second? Certainly the violinist is not actually pulling the string back and forth with that frequency. He merely gives a uniform, steady pull to the bow, and this steady pull of the bow corresponds to the steady, continuous current power supplied to the valve by the H.T. battery. Analysis of the action of the violin string shows that the changing of the steady pull of the bow into the vibratory motion of the string is due to the peculiar friction between the resin-covered bow and the stretched string. The string, it will be noticed, vibrates at its natural frequency, that is, at the frequency with which it vibrates when plucked and left free to vibrate by itself. This corresponds exactly to the fact that the frequency of the alternating current generated by an oscillating valve is fixed by the natural frequency of the oscillating circuit.

The Balance Wheel of a Watch

Another instance from everyday life is the motion of the balance wheel of a watch. The mainspring can evidently push the balance wheel in only one direction, yet the wheel continually works back and forth—oscillates. In this case the essential feature in the problem is the action of the escapement; this allows the mainspring to push the balance wheel in one direction and then prevents it from pushing against the balance wheel when it is on the other part of its swing.

A flexible stick in a smoothly running stream of water provides another illustration. When canoeing in a swift, smoothly running river the writer has often noticed sticks, anchored at the lower end in the bed of the stream with the top projecting above the surface, continually oscillating back and forth, for hours at a time. In this case the peculiar friction between the smoothly flowing water and the stick permits the uni-directional push of the river water to maintain the stick in its oscillatory motion.

A uni-directional flow of steam through a whistle sets the air into vibratory motion, the frequency of the vibration being fixed by the length of the whistle tube. The wind, blowing through tightly stretched telegraph wires, gives the humming noise with which we are all familiar.

So we see that there are many cases in every-day life in which a source of continuous power is able to maintain a body in vibratory motion. These cases differ from that of the oscillating triode only in the fact that they are more difficult, to the trained scientist, to explain and solve accurately; to one skilled in the art the operation of an oscillating valve is an exact and predictable phenomenon.

The Triode as a Power Generator

The amount of alternating current power developed by the small detecting valve used to receive continuous wave signals, is only a small fraction of one watt. To develop much alternating current the valve must be supplied with more power than the ordinary H.T. battery can give and be able to absorb this greater power without overheating, or suffering other injurious effects. So, valves designed to give enough power to operate a transmitting station are much larger and better evacuated than are the valves used for detectors and amplifiers. The filaments are much larger, use much more power for heating and evaporate a much greater number of electrons. The plate circuit is supplied with power, not from a few small dry cells, but from a small direct current generator, to give an appreciable fraction of an ampere at from 300 to 1,000 volts.

Small Valves

These figures are for the small valves used in amateur stations; the commercial station, using triode oscillators, have valves using as much as 100 watts or more to heat the filament, and in the plate circuit are used direct current generators which give many amperes of current at as high as 15,000 volts or more. The amount of power generated by a small valve at an amateur station is about five watts, whereas the large valves mentioned can each generate a kilowatt (1,000 watts) or more.

Efficiency of Valves as Generators

The efficiency of the small valve is about 25 per cent.; that is, of the amount of power supplied by the generator in the plate circuit about one quarter is changed into high frequency, alternating current, power. If we allow also for the power used in heating the filament of the valve, generally supplied by a storage battery, the efficiency of the small valve is only about 10 per cent. The larger valves, using much higher

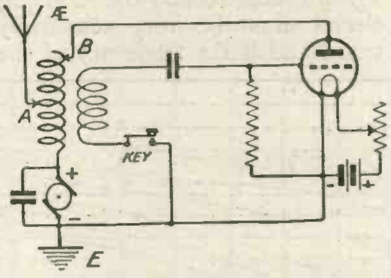


Fig. 19.—Another transmitting circuit known as the "reversed feed-back" circuit.

plate voltage, have efficiencies as much as 60 per cent. to 80 per cent., depending upon the voltage used; the higher the voltage of the plate circuit machine the more efficient is the valve as a converter of the continuous current power into alternating current power.

Heating of the Plates

Anyone who has worked with transmitting valves knows that the plates of the valves are likely

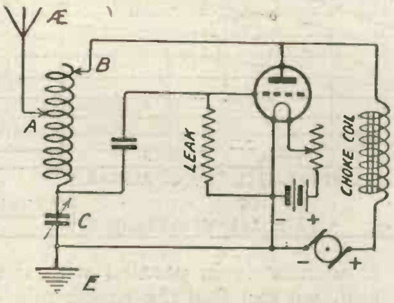


Fig. 20.—A low-power generator circuit of H. F. oscillations which can be modulated in various ways.

to get red hot, when in operation. What causes this heat? We have previously said that the temperature of a body is fixed entirely by the amount of agitation of its molecules. The more rapidly they are bumping back and forth the hotter is the body. If several hundred volts are used in the plate circuit of a valve oscillator, the attraction of the plates for the electrons evaporating from the filament is so great that when they arrive at the plate they are moving with an almost inconceivable velocity, measured in many thousands of miles per second.

These high-speed electrons are stopped when they bump into the plate, and in stopping they naturally stir up the molecules of the plate with which they collide. The collisions result in an increase in the zig-zag motion of the molecules of the plate. Hence the plate is heated. It is perfectly possible to get a metal so hot by this bombardment of electrons that it melts.

Typical Circuits Used

Various circuits have been used to excite an aerial by an oscillating triode. They are all nearly equally good if the proper adjustments are made for each case. Fig. 18 shows one in which the valve is not directly connected to the aerial at all. Both plate and grid circuits are coupled magnetically to the loading coil of the aerial. The grid is excited through a grid condenser and grid leak, the values of which must be suitably chosen for the type of valve used. It is well to use such a grid connection with transmitter valves because there is less likelihood of the plates being overheated during use. If the plates do get too hot, gas comes out of them, lessens the vacuum, and the valve may be completely spoiled.

Another Transmitting Circuit

In Fig. 19 one coil is used in the aerial circuit and another is coupled magnetically to it for exciting the grid. In this circuit the wavelength sent out from the aerial is controlled by the position of contact A, while contact B has to be properly adjusted to get maximum output from the valve. The key by which signals are sent out is shown in the grid circuit. Because of the extremely small power taken by the grid, this is always the best circuit in which to introduce the sending key; with the smaller valves, however, it is possible to open the main oscillating circuit itself by a small hand key, if desired. A small Morse key in the grid circuit of a large power valve may safely be used to control several kilowatts of power.

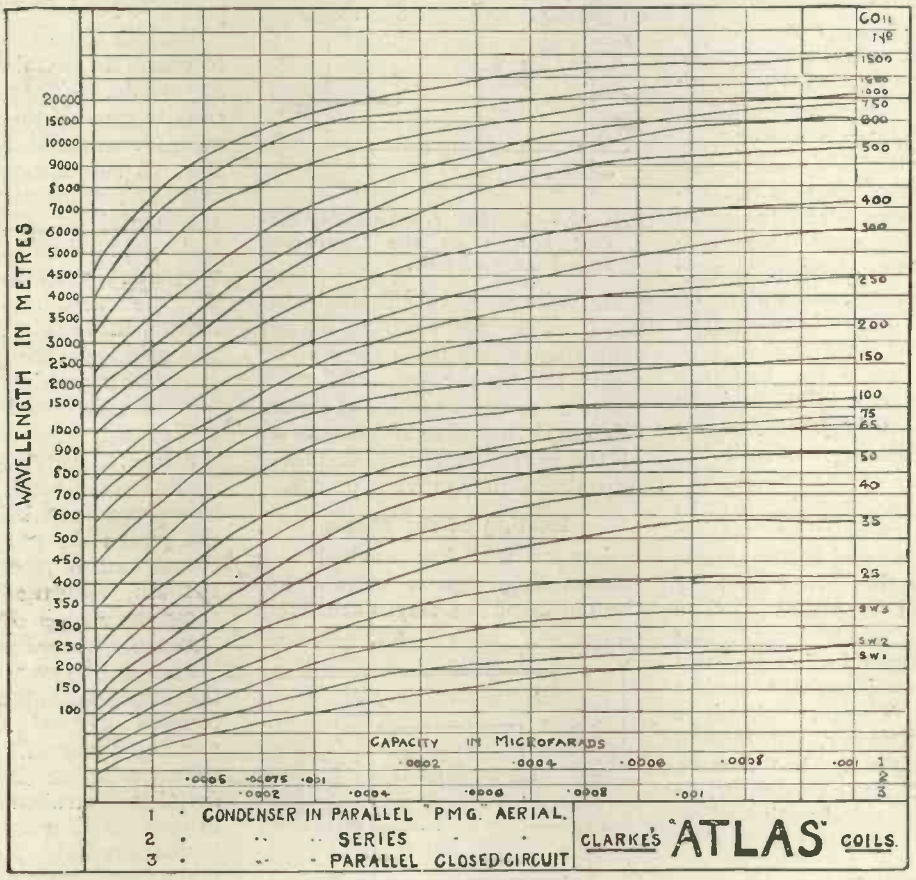
A scheme used extensively by amateurs for short-wave generation is that shown in Fig. 20. The plate is supplied with power from the B machine through an iron-core choke-coil, the function of which is to maintain the current furnished by the H.T. machine as uniform as possible (hence called "choke" as it chokes out variations in this current). The wavelength is controlled primarily by the position of contact A, and the maximum output of the valve is obtained by changing both the capacity of condenser C and the position of contact B. The condenser C should, for the average valve, be about twice the capacity of the aerial itself.

Master Oscillator

In Figs. 19 and 20 the frequency of oscillation is controlled directly by the capacity of the aerial; if this changes so does the wavelength radiated by the station. Now as an aerial swings in the wind its capacity does actually change, and hence the wavelength of the station will vary as the wind blows. This has a very serious effect in limiting the transmission range of the station. To cover much distance with a low-powered station the receiving circuit must be very sensitively tuned and if the frequency of the transmitting station is varying this cannot be done.

The best stations set their frequency by a small oscillating valve connected to a closed tuned circuit, which has a frequency entirely independent of any changes in the aerial capacity. The grids of the valves furnishing power to the aerial get their excitation by magnetic coupling to this closed circuit. Both the aerial circuit and that of the small exciter valve must be accurately tuned to the wavelength it is desired to radiate.

(To be continued)



We have received so many queries from readers asking what coil to use for a particular wavelength or wavelength range that we think the accompanying selection chart will prove widely useful. The figures in the left-hand column show wavelength in metres, and those on the right the numbers of various coils. Along the bottom line are marked various capacities.

The capacity of the average amateur aerial is about 0.0003 microfarads, and if no variable condenser is in parallel with the coil, we can find the rough minimum wavelength to which the particular coil will tune in the aerial circuit by taking a vertical line from 0.0003 on the baseline to the point where it intersects the coil curve. Then a horizontal projection to the left-hand scale will give the wavelength minimum. The maximum is easily found by adding the maximum capacity of the variable condenser to 0.0003 microfarads and reading from the chart. Thus a 100 coil with a 0.0005 microfarad condenser in parallel will tune to a maximum of approximately 1,500 metres.

It must be remembered, however, that condensers have a certain definite minimum capacity which must be taken into consideration when choosing to use the bottom range of a coil.

For tuned anodes an approximate reading can be taken from the capacity of the anode condenser and the coil number on the wavelength. Loose-coupled secondaries are calculable in the same way. Reaction coils are best found by trial.

Valve Notes

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

Dual Circuits and Beginners

IT is surprising the fascination which a dual circuit has for the average beginner. He will tackle in the most light-hearted manner a three-valve dual circuit, or something of that kind, without being the least experienced in constructing wireless receivers or operating them.

The self-confidence of some people is amazing, and no amount of warning seems to turn the beginner away from circuits and apparatus and designs which are meant for the more experienced. I personally would never advise any but the fully qualified to work a reflex receiver. When only one valve is used, a reflex is fairly simple; when two are used new problems arise, and when three are employed all sorts of additional difficulties occur. The ordinary reflex circuit is not really as valuable as many people imagine. It certainly saves you a valve, but whether the extra trouble is really worth while is a matter for individual judgment. The one-valve user is, no doubt, anxious to get the effect of two without having to buy an additional valve. Frequently, however, his experience is not large, and when he starts trying different dual circuits he probably experiences the very common buzzing trouble.

The Home Constructor

An organisation such as ours which caters so largely for the home constructor is always more or less in a dilemma regarding the giving of different designs. If we give straightforward circuits, and designs for straightforward sets, the largest proportion of successes would be obtained. There are, however, many people who wish to get away from the beaten track and to get the maximum results with the minimum number of valves. For these people we give designs which give excellent results, but when these designs are published, not only are they made up by those for whom they are intended, but a large number of entirely inexperienced beginners, on seeing what good results may be obtained with a dual receiver, seize on the design and start to construct the set.

A Revelation

It would be a revelation to readers of *Wireless Weekly* if they knew the simple little troubles which occur through inaccurate following of instructions. The more experienced man, if he does not get results the first time, generally knows where to look for the trouble and puts it right himself, but the beginner simply fails and is disappointed, and the chances are that he blames the author. We have even known some people question whether the set has been made, in spite of the actual photographs given and our offer to show readers the sets, provided they apply early before the sets are dismantled by the authors.

The whole question is a problem which is concerning us very much at present, and I hope that readers of *Wireless Weekly* who are looked up to by their friends for advice on set design will recommend the beginner to work the simplest set possible to start with. For the user of a single valve I always recommend, myself, a simple reaction detector circuit, such as that illustrated in Fig. 1. The use of constant aerial tuning I very strongly recommend, not because it gives any better signals (it doesn't), nor because it gives improved selectivity (it often does), but because you can definitely tell a man that he should use so-and-so a coil in the aerial circuit, no matter what size of aerial he is employing. For example, with a 0.0001 μF fixed condenser in the aerial lead it is possible to state that a No. 50, shunted by a 0.0005 μF condenser, will cover the wavelengths of all the broadcasting stations, although a No. 75 should preferably be used when wavelengths over 420 metres are to be received. A reaction coil, consisting of a No. 75 coil, may also be employed, and definitely specified.

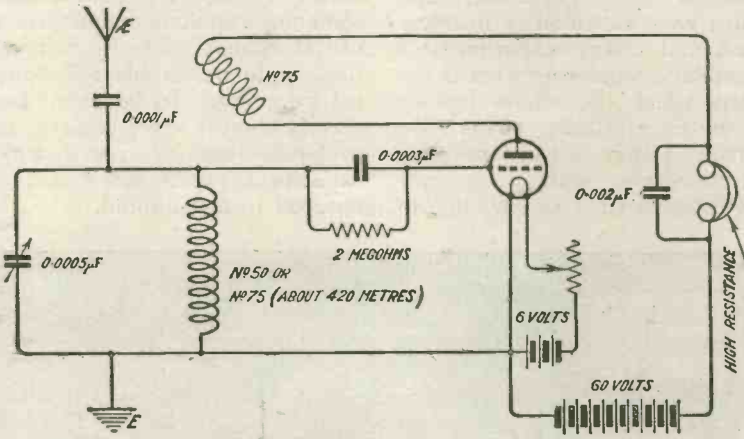


Fig. 1.—A simple single valve reaction circuit with constant aerial tuning.

I am not at all sure that I would advise the beginner to use a variable gridleak; it only adds complications, and I cannot say that the variable gridleaks on the market to-day are unqualified successes. In any case, the beginner will probably have the leak completely "out," and wonder why he doesn't get proper results. I would therefore advise the use of a fixed gridleak, a really good guaranteed make being purchased. Here, again, I would ask you to tell your friends not to buy cheap, nameless stuff; it never pays in the end. I have, in fact, on more than one occasion found condensers sold in shops which contained absolutely no plates whatever, but simply two terminals.

Cheap Components

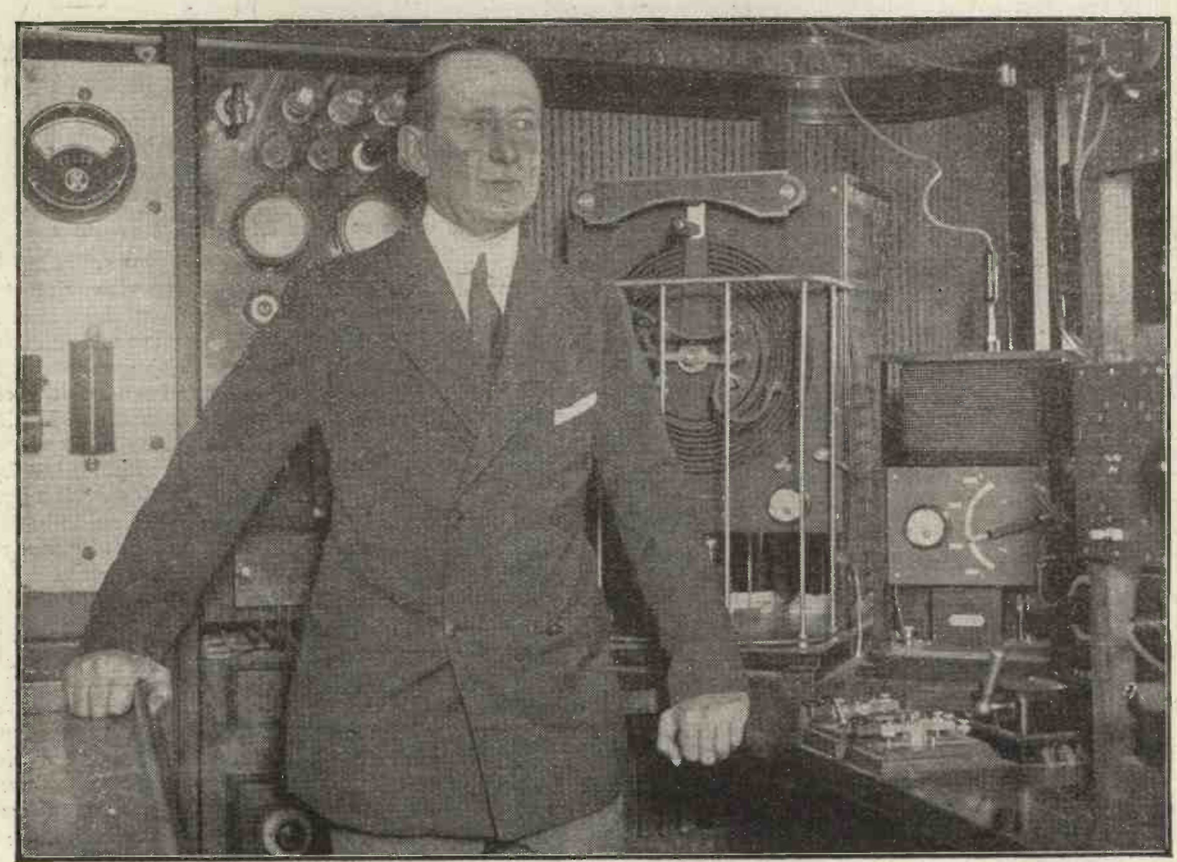
As for cheap gridleaks, their values vary enormously in many cases, and many experimenters spend days wondering what is the matter when the whole trouble lies in the gridleak. There are so many things which possibly can go wrong with a receiver that it saves time and trouble to get a sound article. A variometer which is very widely sold in shops to-day is fitted with three terminals, the windings being wound on cardboard tubes which have been varnished with some compound containing a black powder conductor. The result is that a very poor imitation of ebonite is produced, but the conducting varnish reduces the efficiency 50 per cent., and extensive leakage occurs.

Valve Holders

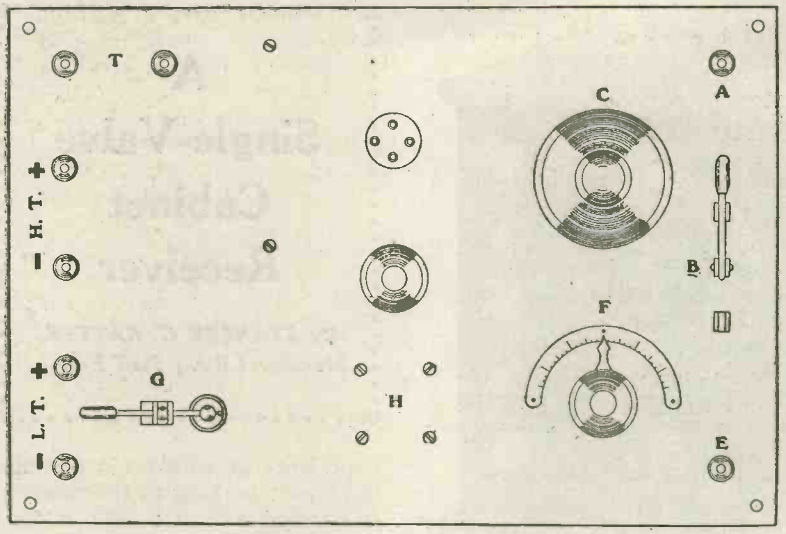
Take another case: A large number of experimenters buy moulded valve-holders. I strongly urge the purchase of real ebonite valve-holders, rather than the moulded composition article. I say this, not because there is anything wrong with a good moulded component, but because some unscrupulous manufacturers use absolutely rubbishy composition, quite unsuitable for electrical purposes. To be safe, then, specify ebonite valve-holders, and preferably use the type in which capacity between the sockets is reduced to a minimum.

An excellent article is produced by one or two different firms, and your friends are much more likely to be satisfied if they use these. If they employ valve sockets, and fit them on the ebonite panel, they may have considerable trouble in getting the position right, and the chances are that they will use nuts on the ends of the sockets, and also washers. The sight of valve legs fitted with nuts and washers makes me shudder. The grid socket washer is usually about 1-6th in. from the filament socket washer. The result is that the slightest amount of dirt, flux or moisture will short-circuit the grid circuit, quite apart from other possible losses. Constructors, however, are slow to learn these things, in some cases, and it is only by reiterating these facts time and again that successful results will attend our efforts to increase the percentage of absolute successes.

Next week I will give details of further circuits I would recommend for the man of small, or medium, experience.



Experiments recently carried out by Senatore Marconi at Poldhu resulted in successful telephony reception being obtained in Sydney, Australia. Our photograph showing Senatore Marconi in the wireless room of his yacht "Elettra."



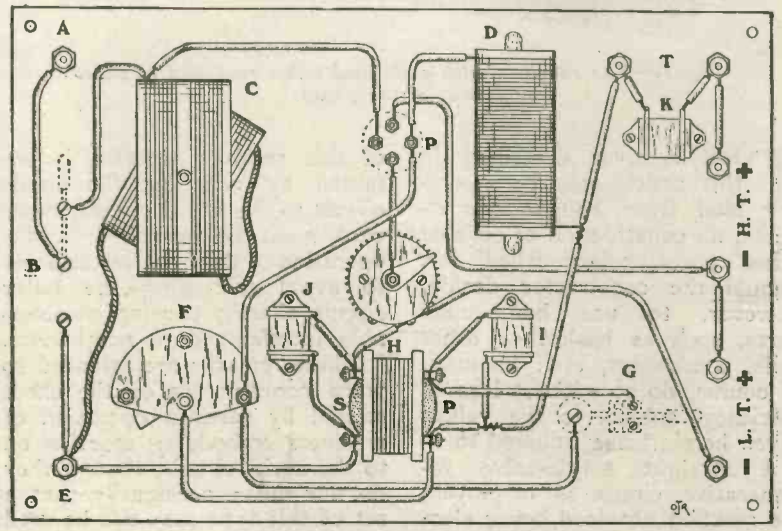
The lay-out of the panel.

Practical Back-of-Panel Wiring Charts

By OSWALD J. RANKIN

A Single Valve Reflex Receiver

THE coil D, which is shunted with a 0.0003 μF variable condenser F, should tune to the same frequency as the variometer C in the aerial circuit. The fixed condensers I and J, connected across the primary and secondary windings of the L.F. intervalve transformer H, have capacities of 0.002 and 0.0005 μF respectively. The telephone condenser K is of 0.003 μF capacity. B is the aerial to earth change - over switch, and G the crystal detector. Better results are sometimes obtained by connecting the I.S. transformer lead to the arm of the rheostat instead of to the helix, as shown in the practical wiring diagram here given.



Practical wiring diagram.

Some Questions on Reaction

How is it possible to tell when the valve set is radiating ?

In the first place, the possibility of actual radiation depends upon the point in the circuit at which the reaction effect is introduced. According to the Post-office regulation, reaction, electro-magnetic or electrostatic, may be applied to the aerial or aerial secondary circuit; but for safety, there should always be one valve between the aerial circuit and the point at which reaction is applied.

From this, it will be gathered a valve receiving set may be oscillating and yet not radiating, although it is certainly the safest and most considerate plan to avoid oscillation of any kind on broadcasting wavelengths during broadcast hours. If radiation is suspected, remove the reaction coil to a distance or short circuit it and touch the aerial terminal with the moist finger tips. Note carefully the sound in the telephones. Replace the reaction coil in its normal position and again touch the aerial terminal.

If radiation is occurring a noticeably different sound will be produced in the telephones.

What is super-regeneration, and how does it differ from ordinary reaction ?

When ordinary reaction is applied to a tuned circuit, a point is soon reached beyond which it is inadvisable to go because the receiving set then breaks into self-oscillation. It appears, therefore, that the very powerful effect of reaction could not be made full use of. Major Armstrong conceived the idea of applying reaction at full strength, but arranging that a kind of braking effect should be introduced with just sufficient rapidity to avoid the production of a noticeable audible note and to prevent continuous self-oscillation actually occurring.

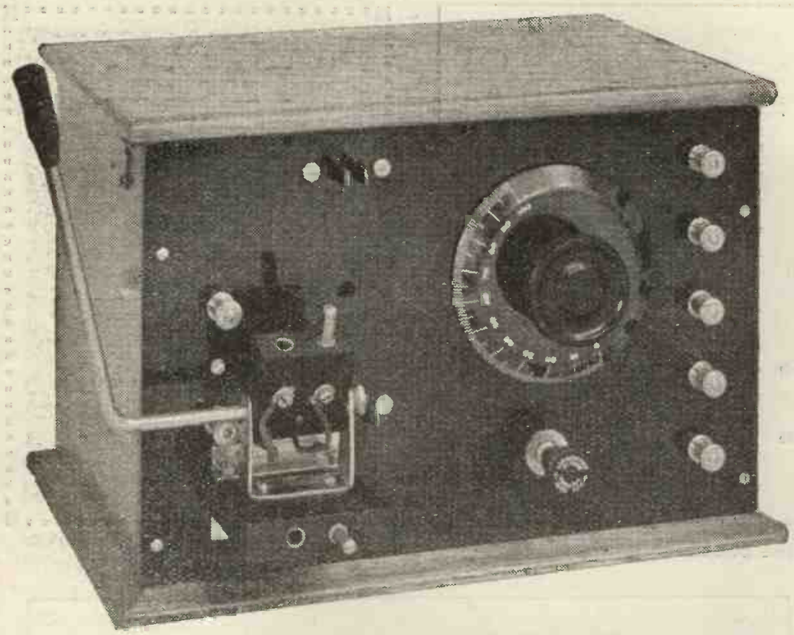


Fig. 1.—The receiver with coils and valve removed to show layout of the panel.

A Single-Valve Cabinet Receiver

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

THE receiver described in this article may be assembled from bought components, no construction of coils or other parts being called for. Should the constructor decide, however, to use home-made parts, such as basket or other coils, condensers, etc., he may, of course, do so without loss of efficiency, subject to the values given herein being adhered to.

A straight single-valve regenerative circuit is employed, the reaction obtained being electro-magnetic. Since in the case of this receiver reaction is obtained by coupling the anode circuit to the aerial circuit, every care must be exercised in the operation of this receiver in order to avoid energising the latter circuit, thereby causing considerable interference to neighbours.

These remarks are intended to warn constructors of the effect caused by careless operation of receivers embodying reaction on to the aerial circuit, though they do not mean necessarily that a set of this type may not be used by the broadcast listener whose experience of wireless is perhaps but short. So long as the receiver is handled with due care, a condition which applies to all receivers, there is little fear of causing local interference.

The photograph, Fig. 1, shows the receiver in such a way that the disposition of the components may be seen. The two terminals on the left are for the aerial and earth, whilst those on the right, reading from the top downwards, are the two telephone terminals, the H.T. positive, the L.T. positive and H.T. negative (a terminal common to both) and the L.T. negative.

Valves

It will be seen from the photographs that a Myers valve is used, but those readers who are already in possession of four pin valves, and who do not care to go to further expenditure in purchasing a valve of the type

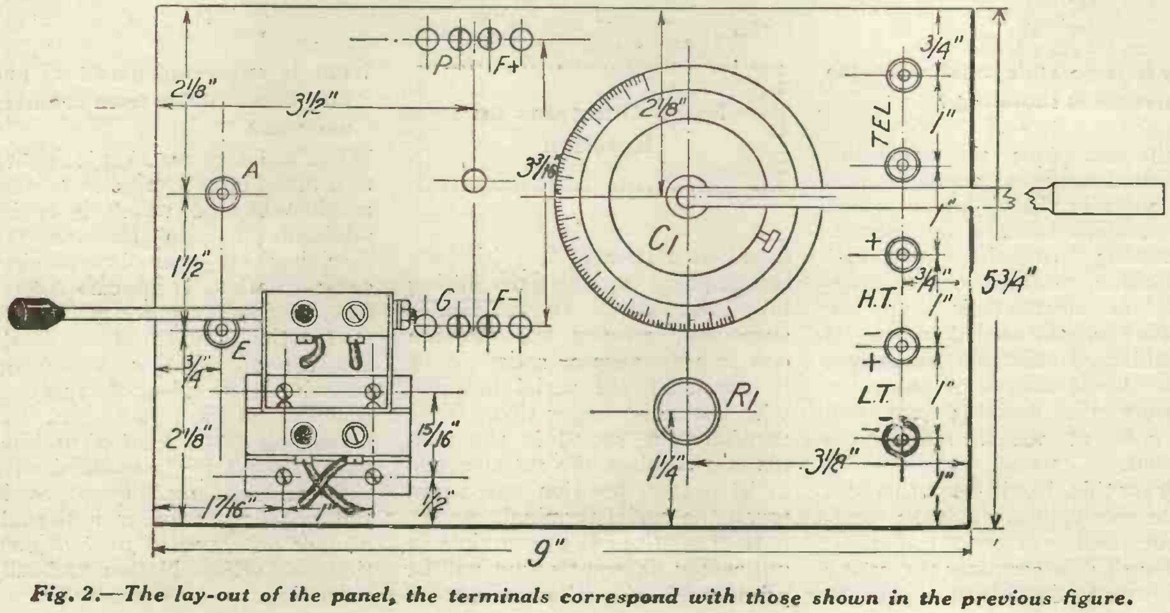


Fig. 2.—The lay-out of the panel, the terminals correspond with those shown in the previous figure.

Full constructional details are given of how to build an efficient single-valve receiver, capable of covering the whole of the telephony wavelengths.

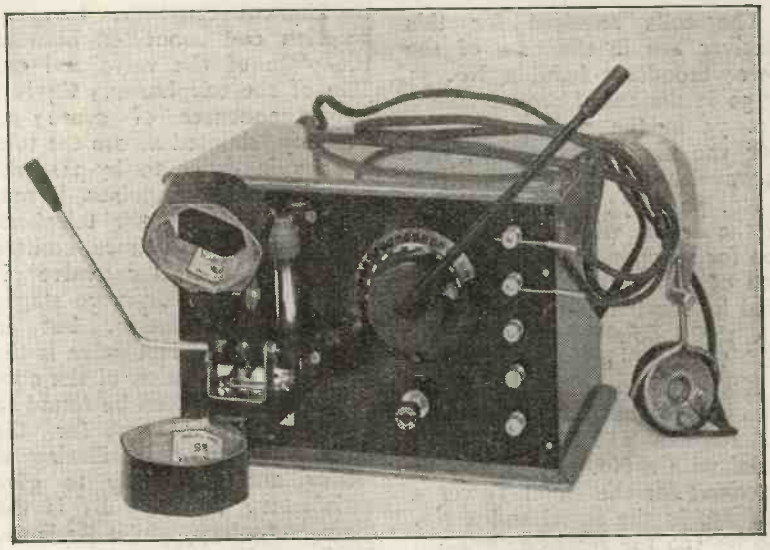


Fig. 4.—This illustration shows the neat arrangement of parts on the panel.

shown, may, of course, use the ordinary valve.

Components and Materials

The materials and components embodied in the receiver, as illustrated, are given hereunder, and for the guidance of readers, names of manufacturers are also indicated; it is, however, not intended that constructors should necessarily restrict themselves to these makes. Components of any reliable manufacture will serve the same purpose with equal efficiency.

One ebonite panel, measuring 9 in. by $5\frac{3}{4}$ in. by $\frac{1}{4}$ in.

One variable condenser of 0.0005 μF capacity (The Bowyer-Lowe Co., Ltd.).

One Lissenstat minor (Lissen, Ltd.).

One two-coil holder (Burne-Jones).

Seven terminals.

One fixed condenser of 0.0003 μF capacity (Dubilier).

One similar condenser of 0.002 μF capacity (Mansbridge).

One gridleak of two megohms resistance.

Quantity of No. 16 tinned copper wire; as an alternative square rod may be used.

One containing box to the specification given in Fig. 7. The box illustrated was supplied by the Bowyer-Lowe Co.

One 4-volt 30-amp. actual accumulator.

One 75 v. H.T. battery.

One pair 2,000-ohm telephones.

One valve holder will also be required if a valve other than Myers is chosen.

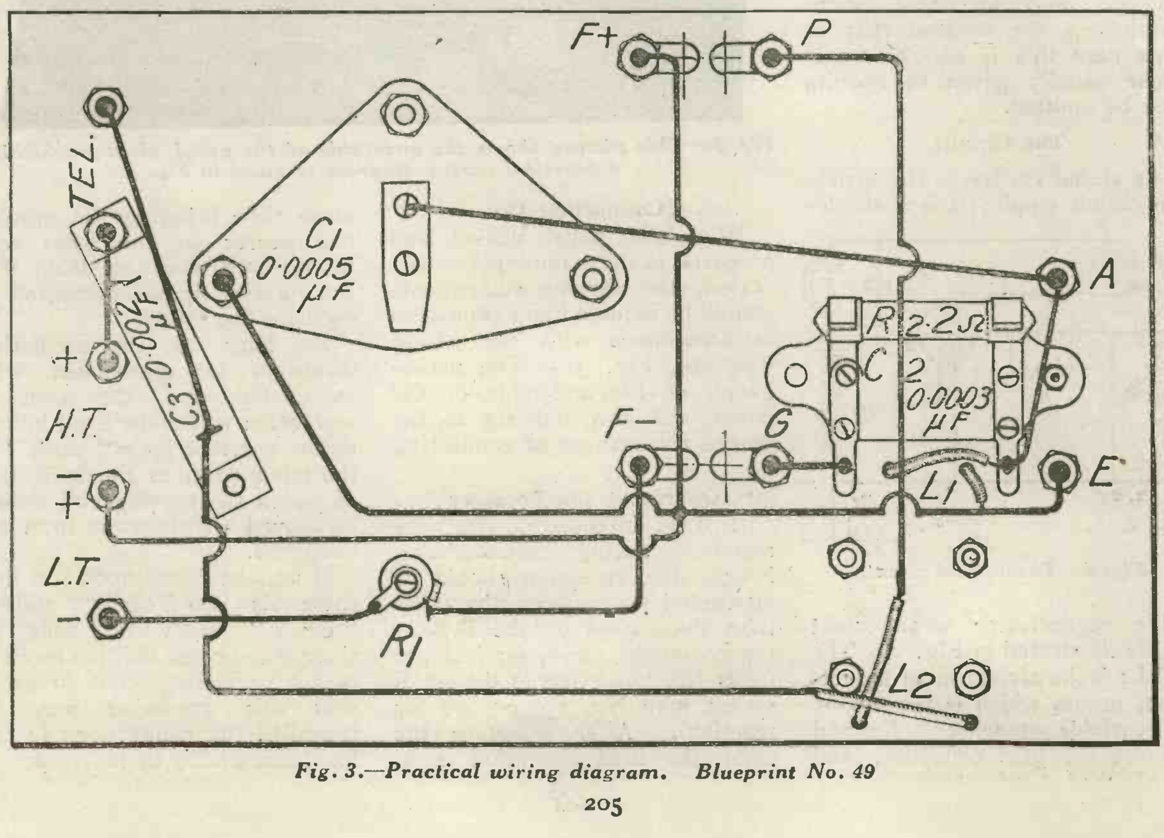


Fig. 3.—Practical wiring diagram. Blueprint No. 49

Plug-in Coils

The coils required for this receiver are in the case of the lower broadcast band a No. 35 or 50 in the aerial socket with a No. 75 in the reaction socket. For the higher waveband, that is, wavelengths above 400 metres, a No. 50 or 75 will be required in the aerial, with a No. 75 or 100 for reaction. For the reception of wavelengths above those used by the British Broadcasting Co. the following coils for aircraft telephony should be used:—A No. 75 or 100 coil in the aerial with No. 150 or 200 for reaction; for Radiola a No. 150 in the aerial with a No. 250 or 300 for reaction; for the Eiffel Tower a No. 250 in the aerial and a No. 400 or 500 for reaction.

The Panel

This is made from ebonite sheet to the dimensions given and drilled in accordance with Fig. 2. With the panel drilled the glossy finish on both sides should be removed by means of fine emery cloth, as it is often found that this glossy surface is a cause for poor insulation between components.

There are, however, certain manufacturers who are supplying highly-polished ebonite guaranteed to be free from surface leakage, and in cases where purchasers are assured that in their case this is so, the treatment usually given to ebonite may be omitted.

The Circuit

As stated earlier in the article the circuit employed is a single-

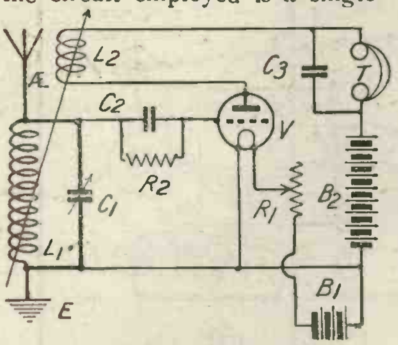


Fig. 5.—Theoretical circuit.

valve regenerative arrangement and is illustrated in Fig. 5. The coil L1 is the aerial tuning inductance, across which is the 0.0005 μF variable condenser. C2 and R2 are the grid condenser and leak respectively, whilst R1 is the filament resistance. L2 is the reaction coil connected between the plate of the valve and one side of the telephones. C3 is a fixed condenser of 0.002 μF capacity, shunted across the telephones in order to by-pass the radio-frequency impulses. It may be observed that the telephone condenser is sometimes omitted when the detector valve is followed by one or more stages of note-magnification, but in cases where the last valve is the detector the omission of the condenser C3 will often be found to be sufficient reason for the receiver either not oscillating at all or not sufficiently to give satisfactory results. B1 is the filament battery, whilst B2 is the H.T. supply.

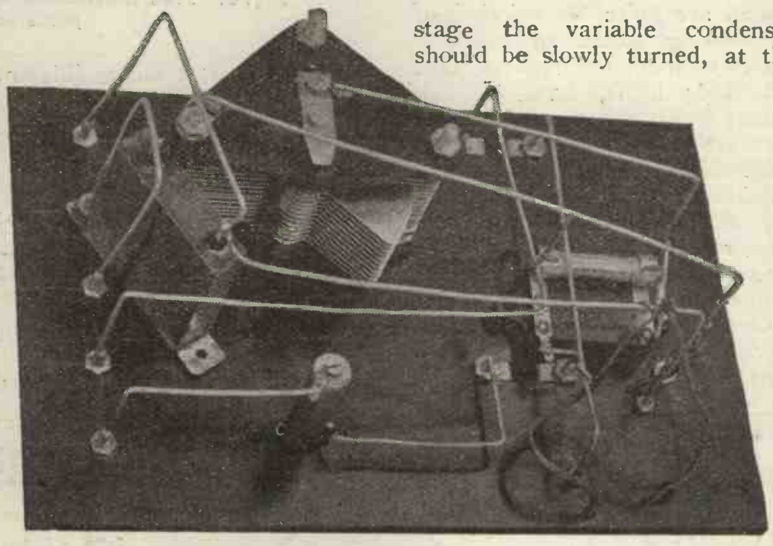


Fig. 6.—This picture shows the underside of the panel photographically; a practical wiring diagram is given in Fig. 3.

Connecting Up

With the panel drilled and prepared in the manner previously stated, the various components should be mounted and connected in accordance with the wiring diagram, Fig. 3. The photograph of the underside of the panel will also indicate to the reader the manner of connecting up.

Operating the Receiver

If it is intended to test the receiver during broadcasting hours, then reception should be attempted on wavelengths other than those used by the B.B.C., the 900-metre wave, for instance (coils No. 75 or 100 in the aerial socket with No. 150 or 200 for reaction). After inserting the coils the next operation is to move one coil away from the other, connect the H.T. battery, and then light the valve to a suitable degree of brilliancy. At this

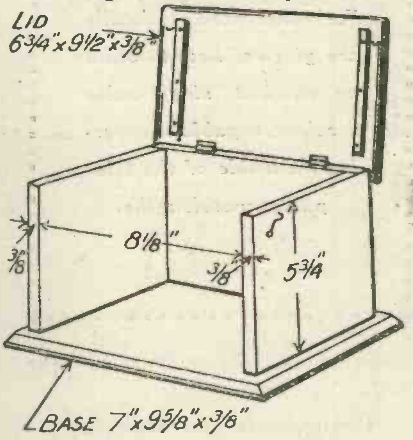


Fig. 7.—Dimensions of the containing box.

stage the variable condenser should be slowly turned, at the same time bringing the moving coil nearer to the fixed coil, taking care whilst so doing that the receiver is not permitted to oscillate too freely.

So long as the oscillating condition is approached with reasonable care, the point of oscillation will make itself known to the operator by a "cluck" in the telephones, at the indication of which the moving coil should be moved a little away from the fixed coil.

It may be found upon test that there is no easily audible "cluck," in which case its absence indicates that the receiver is not oscillating, and in order that this condition may be remedied the connections to the fixed coil should be reversed.

Results

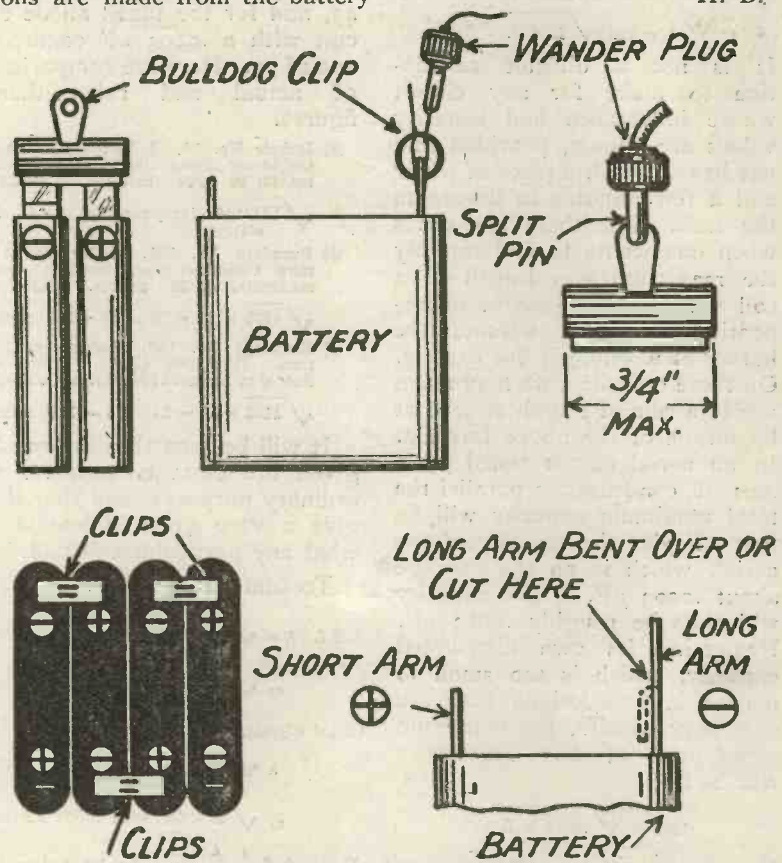
With the receiver, as illustrated, using an average-sized aerial, there is little difficulty in receiving even the farther B.B.C. stations in S.E. London, whilst with an indoor aerial in the same district, Cardiff, Bournemouth, Birmingham and Newcastle are equally simple to tune, though reaction is, of course, critical, on account of the small dimensioned aerial.

Though this receiver does not aspire to be an H.T.-less arrangement, nevertheless, with the H.T. terminals short-circuited, 2LO is easily received at a good, comfortable telephone strength on both outdoor and indoor aerials.

An Effective High-Tension Battery

Many readers no doubt make use of the high tension batteries which are built up from 4.5 volt pocket batteries. These have several advantages, in that they are cheap and can be replaced in sections, thereby entailing no great outlay at any time. There is, however, one point on which they are sometimes troublesome, and that is making the connections. Soldering is effective, but in this case it has its faults when one desires to take out a dead cell and replace a new one. On the other hand faulty connections cause leakage and losses which considerably shorten the life of the entire battery and also are liable to set up strange noises in the headphones when the set is in operation. Several types of clips on the market (which the writer has tried) are not effective, and do not grip the battery tags in a very satisfactory manner. The diagram given shows the ideal battery clips; they have no weak points, they grip almost as good as solder—they are neat—they are cheap, and they are quickly adjusted. The diagram shows plainly how they are used to connect a series of batteries passing from negative to positive alternatively. It should be remembered by those not accustomed to the use of these batteries that the short brass tag is the positive, and the long brass tag is the negative. For adjusting the bulldog clip, the long tag should be bent over, or preferably cut off, to a length corresponding with the short tag, not forgetting that the cut tag is the negative one. Small bulldog clips are best, and in any case they should not be more than ¾-in. wide. Connections are made from the battery to the set by employing the use of wander plugs, or valve pins, the latter being insulated. As both take the form of split pins, they will be found to slip tightly into the lever of the bulldog clips, as shown in the drawing.

H. B.



Illustrating the battery clips for connecting flash-lamp cells for H.T. batteries.

Give Your Valves a Chance

Would you buy a motor car and expect to be able to keep it in perfect running order without the aid of the makers' book of instructions? Obviously not, yet thousands who read these lines do something very similar with their valves. It is *not* giving a valve a fair chance to insert it in any socket of the receiver which comes handy regardless of any special characteristics which it may possess, give it any sort of L.T. and H.T. supply which chances to be available, and then give it no further thought. To do so is akin to pouring something which you *think* is the right kind of oil into what you *hope* is the right orifice on a new car, and giving no further thought to the question of lubrication, until it forces itself upon your notice in the form, perhaps, of a tendency upon the part of certain bearings to become red-hot.

The proper course in the case of wireless valves is to apply for instructions, not to the makers, but to some such source as "Radio Valves and How to Use Them," by John Scott-Taggart, F.Inst.P., A.M.I.E.E. (Radio Press, Ltd., 2s. 8d. post free), which contains an enormous amount of theoretical and practical instruction in every phase of valve practice. Incidentally, it is the biggest half-crown book published by Radio Press, Ltd.

A Wavelength Rule of Thumb

EVERYONE knows the rule, perhaps the most useful of wireless formulæ,

$$\lambda = 1885\sqrt{L \times C}.$$

It is not a difficult calculation to make for any circuit whose inductance and capacity values are known, provided that one has a pencil, a piece of paper and a few minutes to devote to the task. But there are times when one wants to find roughly the maximum wavelength of a coil whose inductance in microhenries is known without the bother of working it out exactly. On these occasions we may make use of a rule of thumb arrived at by means of the above formula. In an aerial circuit tuned by a .001 μF condenser in parallel the total maximum capacity will be .001 μF *plus* the capacity of the aerial, which is on the average about .0003 μF. The capacity will thus be roughly .0013 μF. Neglecting its own distributed capacity, which is too small to matter in calculations that are only approximate, the maximum wavelength of any inductance will be :—

$$1885 \sqrt{.0013 \times L}$$

$$= 1885 \times .0362 \times \sqrt{L}$$

$$= 68.24 \times \sqrt{L}$$

From this, using round figures, we obtain the rough-and-ready rule for A.T.I.'s with .001 μF condenser :—

$$= 70 \times \sqrt{L}$$

If the capacity of the A.T.C. is .00075, the factor will be 60 instead of 70. Though this is admittedly only a rule of thumb, it will be found that the results obtained by it are remarkably accurate. Two examples follow :—

(*a*) Burndept S1. Inductance 36 mics. Actual maximum with .00075 μF condenser 380 metres. Calculated

$$\sqrt{36} \times 60 = 6 \times 60 = 360 \text{ metres.}$$

(*b*) De Forest 75. Inductance 297 mics. Actual maximum with .001 μF condenser 1175 metres. Calculated

$$\sqrt{297} \times 70 = \text{(approx.) } 17 \times 70 = 1190 \text{ metres.}$$

In closed circuits such as those of the secondary and tuned anode the capacity of the aerial does not, of course, come in. We may take for the secondary with .0005 μF condenser a factor of 45, and for the tuned anode circuit with a .0003 μF condenser one of 35. Here are comparisons of actual and rule-of-thumb figures.

(*a*) Igranic No. 50. Inductance 134 mics. Condenser (Sec.) .0005 μF. Actual maximum 510 metres. Calculated

$$\sqrt{134} \times 45 = \text{(very roughly) } 12 \times 45 = 540 \text{ metres.}$$

(*b*) Burndept No. 300. Inductance 4770 mics. Condenser (Sec.) .0005μF. Actual maximum 3250 metres. Calculated

$$\sqrt{4770} \times 45 = 70 \times 45 = 3150 \text{ metres.}$$

(*c*) Burndept No. 150. Inductance 1193 mics. Condenser (T.A.) .0003 μF. Actual maximum 1196 metres. Calculated

$$\sqrt{1193} \times 35 = 34 \times 35 = 1190 \text{ metres.}$$

It will be seen that the results given are close enough for all ordinary purposes, and that they give a very good indication of what any particular coil will do.

To sum up we have :—

A.T.I. $\lambda = \sqrt{L} \times 70$ with .001 μF condenser.

or $\sqrt{L} \times 60$ with .00075 μF condenser.

Closed Circuit.

$\lambda \sqrt{L} \times 45$ with .0005 μF condenser.

or $\sqrt{L} \times 35$ with .0003 μF condenser.

Round figures are to be taken in every case. R. W. H.

Spanners for B.A. Nuts

WHEN one is inserting terminals into a panel, the best tool to use for tightening down nuts which secure them is a pair of nut pliers—do not use ordinary pliers or you may spoil the edges of the nuts through their slipping. With nut pliers you can make your terminals, valve legs, and so on very tight indeed. It happens sometimes, after soldering has been done, that nuts come loose owing to the heating up of the ebonite. It is often difficult to use nut pliers here, since there is not room for them amidst the many leads upon the panel. For dealing with awkward nuts the writer has recently acquired spanners of two kinds which are exceedingly useful. The first was bought in a semi-completed state and finished off in the workshop. It consists of a nest of four magneto spanners joined together by a pivot pin. When bought, these will not fit any size of B.A. nuts, but it is a very simple business to file them out in the workshop and to make them fit 2, 4, 5 and 6 B.A. nuts. As the metal is not hard, the work can be done very easily with a fine, flat file and a small triangular file. With these little fellows one can get at nuts in all kinds of odd corners and they save a heap of trouble.

The second set is a series of B.A. box spanners. Luckily, these can now be acquired in the correct sizes and require no alteration in the workshop. They are excellent for nuts tucked away in odd corners, for they can be pushed down between leads and then worked either with a tommy bar or with an adjustable spanner applied to their tops. To any constructor who does not possess a set of B.A. box spanners the soundest advice is to acquire one at the earliest possible moment.

R. W. H.

Soldering Hints

MANY constructors experience some difficulty in soldering a wire to shanks of terminals, with the result that the panel becomes covered with flux and pieces of solder, thus destroying, to a large extent, its insulating properties.

When the set under construction is ready for wiring, the shanks of all terminals should be thoroughly cleaned with a file or a piece of emery cloth, the former for preference, in order to remove any lacquer which may have been put upon the terminals; this lacquer forms a covering layer over the metal, preventing the solder from taking properly. When this is cleaned off, the terminal shank should tin very easily.

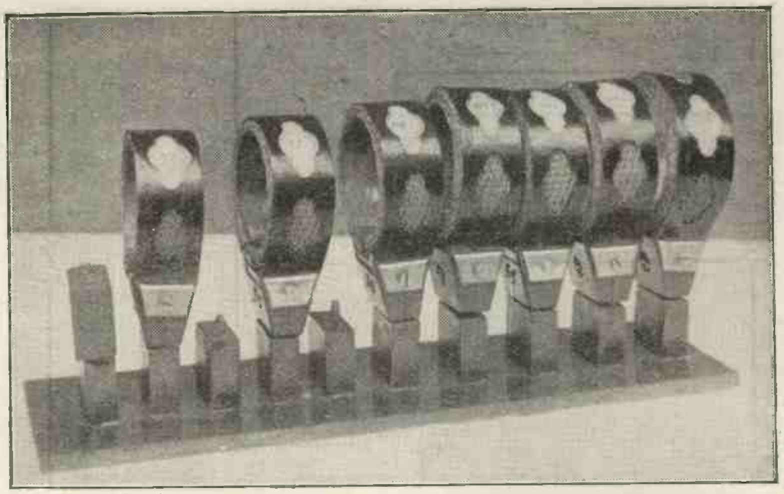
In this connection it may be mentioned that a good tip is to tin thoroughly all terminal shanks and other points to which a wire has to be soldered before actually commencing to wire up.

A Spare Coil Holder

By

J. H. FALCONER.

A useful constructional note which, if acted upon, will add to the tidiness of the experimental bench.



A cure for untidiness.

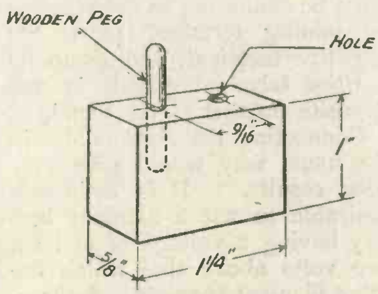
THE most popular form of tuning amongst amateurs at the present time is by means of interchangeable fixed coils. These are of various types, basket, honeycomb, or the well-known Duolateral. Whichever type is used several of these are required to cover the band of wavelengths from 300 to 4,000 metres, and where a loose-coupled type of tuning is employed in conjunction with tuned anode H.F. coupling, more than one of each winding is required, so that one soon finds that quite a fair number of coils are necessary.

The question then arises as to how to store those coils not actually in use. How often do we find that they are usually reposing in an untidy pile all round, and even behind, the receiver! When you suddenly decide to listen in on a different wavelength there ensues a hurried search through the spare coils until the proper ones are found. These are then substituted for the ones formerly in use, while the discarded set find their way back to the pile of loose coils at the back of the instrument.

Coils kept in this manner soon lose their utility, especially in the case of the delicate basket pattern as they become broken or detached from their holder and the set may refuse to function.

A small coil stand, as shown in the photograph, is easily made, and as it keeps all the coils in their proper order and takes up very little room beside the receiver, the coils are instantly accessible when wanted.

The size of the stand will, of course, depend on the number of coils it is desired to carry. Room should be left for additional coils to be added later on.



Details of the plug. It may be entirely of wood.

The base of the one illustrated measures 12 x 3½ inches and carries ten coils.

The plugs into which the coils fit could, of course, be purchased ready made in ebonite, but as such cost about 1s. each it was decided to copy them in wood.

First a piece of prepared wood 1¼ x 1 x 12 ins. was obtained. From this pieces were sawn off, each ⅝ in. thick, and each of these pieces was then bored with two holes 9/16 in. apart to correspond with the plug and socket of the coils (Duolateral). A small wooden plug was then fixed in one of the holes and the sockets were complete. These plug holders were then screwed down to the baseboard, and the whole was given two coats of mahogany stain and left to dry. Care should be taken to prevent the varnish from running into the holes in the plugs as it will stick to the pin of the coil when this is inserted.

Connecting Stranded Aerial Wire to a Lead-In

WHEN connecting stranded aerial wire to a lead-in, the method most frequently used is to wrap the wire once round the lead-in metal shaft and then to screw down the screw-head firmly. A better method, and one which gives a firmer and more lasting contact, is to separate the strands of the aerial wire for about an inch at the end and to make a loop with three strands on one side and four on the other. This loop is passed over the lead-in screw-shaft; the ends of the loop are then twisted together to close the loop as much as possible and to make it grip the screw-shaft. Lastly, the screw-head is screwed down tightly over the closed-up loop. Contact made in this manner between the down-lead of an aerial and a lead-in is very firm and, what is more important, the contact is likely to remain good, even if there is considerable play on the down-lead and consequent swinging in the wind.

E. H. C.

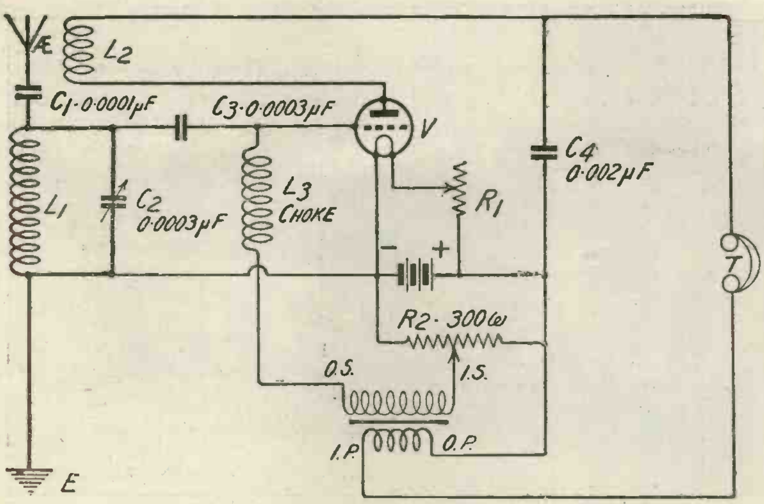


Fig. 1.—The Cowper H.T.-less circuit as used in the Omni Receiver.

The Cowper H.T.-less Circuit on the Omni Receiver

A further chat upon the circuits obtainable with this popular receiver.

An excellent high-tension-less circuit, using an ordinary three-electrode dull or bright emitter valve, is that shown in Fig. 1, a reproduction of the "Cowper circuit" which appeared in the May 28 issue of *Wireless Weekly*. It will be seen that constant aerial tuning is employed by the condenser C1, of 0.0001 μF capacity. The aerial tuning condenser C2 has a capacity of 0.0003 μF, and C3, the grid condenser, 0.0003 μF. C4 (0.002 μF) is placed across the telephones and transformer primary. The aerial tuning coil (L1) may be a No. 50 or 75, while for L2 a No. 75 or 100 should be used. The action of the coil L3 is important, since it offers a high impedance to radio frequency currents, which would otherwise flow betwen grid and transformer secondary. R2 is a potentiometer of 300 ohms resistance, which provides an effective grid bias control.

To adapt this circuit to the Omni receiver, the following connections will be necessary :—

51— 3	52—40
11—19	50—30
17—18	4— 9
18—19	1—45
25—52	45—31
25—26	23—21
27—12	22—48
27—49	48—46

There being no potentiometer on the Omni receiver, one is to be added externally. An alternative to this will be described later. The potentiometer should have a maximum resistance of about 300 ohms, and is connected to the set by joining the two ends of the resistance winding across the L.T. terminals 40 and 48, whilst the sliding contact is joined to terminal 29.

An important point to notice is that the filament accumulator must be connected to the receiver by joining terminal 40 to its *negative* terminal, and 48 to its *positive* terminal, which is the opposite manner to the usual.

Connecting the accumulator in the usual way would give very poor results. It is eminently desirable to use a filament battery having a voltage of at least two volts above that which the valve filament requires. A three-and-a-half to four-volt valve used in conjunction with a six-volt accumulator makes an excellent combination.

No. 50 or No. 75 coil should be plugged into the middle socket of the three-coil holder, and a No. 75 or 100 in the reaction coil socket which is the moving holder at the back. The No. 100 coil will probably give best results. The choke coil, a No. 250 of good make, is plugged into the fixed socket on the left of the panel.

Operation of the Set

The aerial tuning coil and the reaction coil should be brought close together, since reaction is not so easily obtained when using no high tension. A liberal voltage should be allowed across the filament. If howling occurs, vary the potentiometer knob until the howl just ceases. If the set will not oscillate the connections to the reaction coil must be reversed. This is effected by disconnecting the leads 9—4 and 1—45, and joining 9—45 and 1—4.

Tuning is accomplished by adjustment of the middle variable condenser, and by varying the

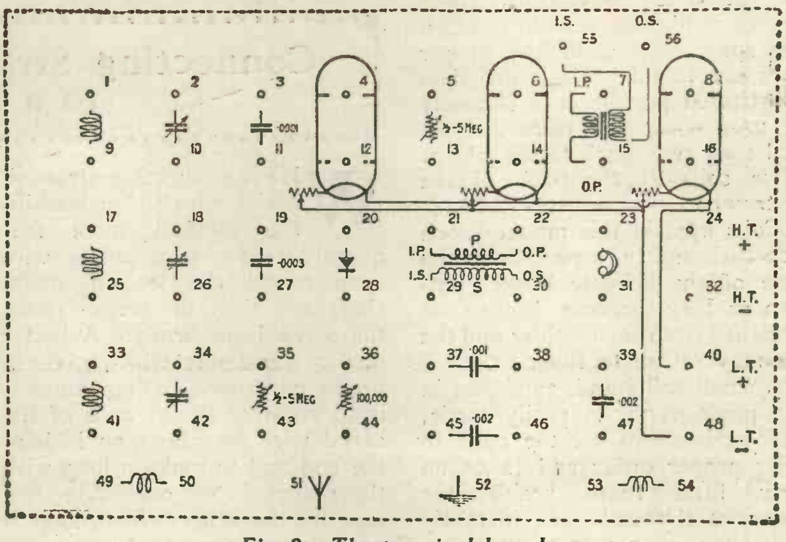


Fig. 2.—The terminal board.

coupling between aerial and reaction coils. The local broadcasting station should be tuned in with ease, but the best results cannot be expected immediately. A few experiments are advisable, and the following may be carried out.

Experiments which may be Tried

A variable anode resistance may be placed between grid and positive filament leg to take the place of the potentiometer as a "damping" control. The potentiometer is the more efficient instrument for this purpose, but for those who wish to avoid the external potentiometer connections the resistance control will be found useful. The resistance used should be that in the centre on the Omni receiver, and the following connections additional to those given in the list will be necessary :—29 — 40, 36 — 12, 44—48. The resistance should be adjusted in the same way as described for the potentiometer.

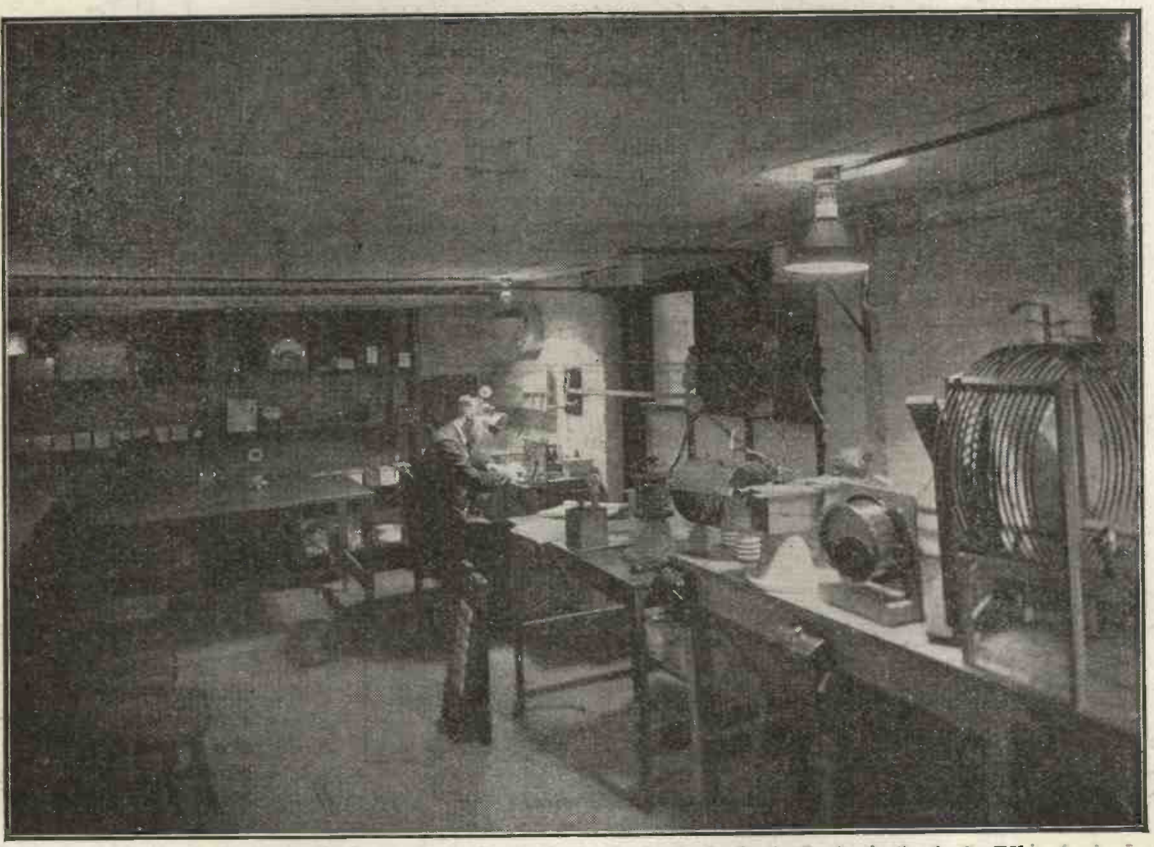
If difficulty is still experienced in getting the receiver to oscillate a condenser of lower capacity may be substituted for the 0.0001 μF series condenser by placing in series with it the 0.0005 μF variable condenser on the right of the panel, and the following alterations on the terminal board must be made :—Disconnect 3—51 ; join 51—10 and 2—3. Instead of the fixed series condenser, we now have a variable condenser with a maximum capacity of about 0.000085 μF. The lower the capacity of this condenser, the greater will be the tendency of the set to oscillate; but, unhappily, a falling-off of signal strength is also brought about by the same means, so that a compromise must be effected.

Both the maximum and minimum capacities of the aerial tuning condenser C_2 may be reduced by connecting in series with it a fixed condenser of 0.001 μF. This is effected by disconnecting 26 — 25, and joining 38—26 and 37—25. The maximum capacity of the variable condenser is now a little over 0.0003 μF, and besides enabling finer tuning to be obtained, it will be found that the circuit works better with the lower capacity across the aerial coil.

New Radio Press Envelopes

As announced in recent issues, two new envelopes have been added to the Radio Press Series of Envelopes. These two sets will be of great interest to the constructor, representing as they do the product of two designers working upon widely divergent lines. Envelope No. 3 concerns a three-valve set which has been christened the "Simplicity" receiver, which was designed on the assumption that the average user will obtain actually *better* results with a very simple set than with one of more elaborate design and difficult operation, while Envelope No. 4 gives instructions for making a "de Luxe" model of the well-known "All-Concert" three-valve receiver, with totally enclosed valves, switching devices, square-law condensers, and other refinements.

The author of Envelope No. 3 is G. P. Kendall, B.Sc., Staff Editor, *Wireless Weekly*, and No. 4 is the work of Percy W. Harris, Assistant Editor, *Wireless Weekly*. The price of each is 2s. 6d., post free 2s. 9d.



A general view of the interior of the Radio Society of Great Britain's Station 6XX.

Hints for Fla

By PERCY W. HARRIS

It is sometimes said that the flat dw advantages of broadcasting. This a simplest apparatus, those dwelling in broadcasting station can enjoy the prog are fortunate enough to possess

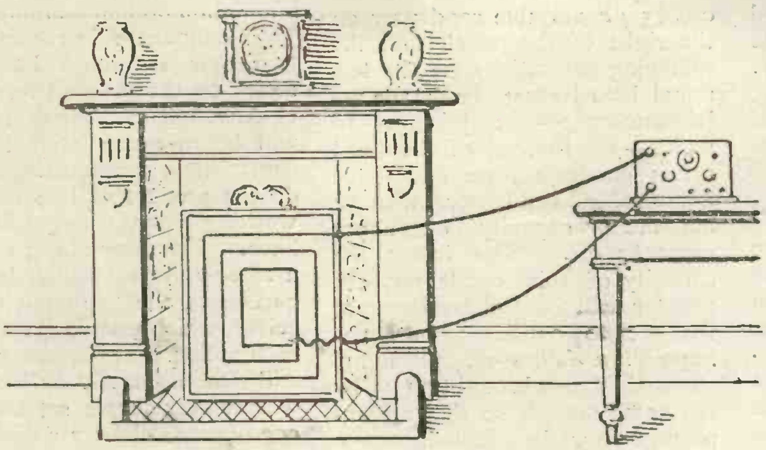


Fig. 1.—A Fire-screen frame aerial.

THREE of the great broadcasting centres — London, Edinburgh and Glasgow—are situated in localities where the residential flat is becoming increasingly popular. Glasgow, in particular, has a huge number of such homes. So many inquiries have been received by this journal from readers who are living in situations where they cannot possibly erect an outdoor aerial that it is thought the following hints will be of use to the great majority of these querists.

What Can We Receive in a Flat?

It is interesting, first of all, to consider what are the actual receiving capabilities in the average flat, using, of course, an indoor aerial of some kind. Can we receive all of the broadcasting stations, and, if so, what kind of apparatus is necessary? The answer to the first half of this question is in the affirmative, for, with suitable apparatus, there is no difficulty in receiving both British and Continental broadcasting. The apparatus, however, is more elaborate and more expensive than most of our readers will desire to possess, for it can be said that to get really first-class reproduction from all of the British broadcasting stations—not merely a whisper in the phones after much adjustment — requires at least four valves, two of which must be high-frequency magnifiers. For loud-speaker work from all the stations, five are really necessary, although occasionally when conditions are very favourable it is possible to work a loud-speaker from several of the stations with only four valves. So much, then, for long-distance reception.

The great majority of people, however, are quite content if they occasionally, with careful adjustment, are able to receive the distant stations in the telephones. What they really want is good, reliable reception from the nearest broadcasting station. It so happens that flats are generally built in areas where land is expensive, and such places are invariably in, or near, the great cities. We can say, then, with some degree of safety that the great majority of flat-dwellers are within but a few miles of a broadcasting station, and for the reception of this quite simple apparatus will do.

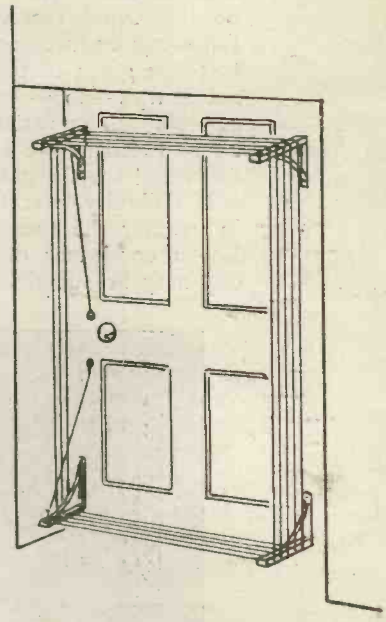


Fig. 3.—A cupboard

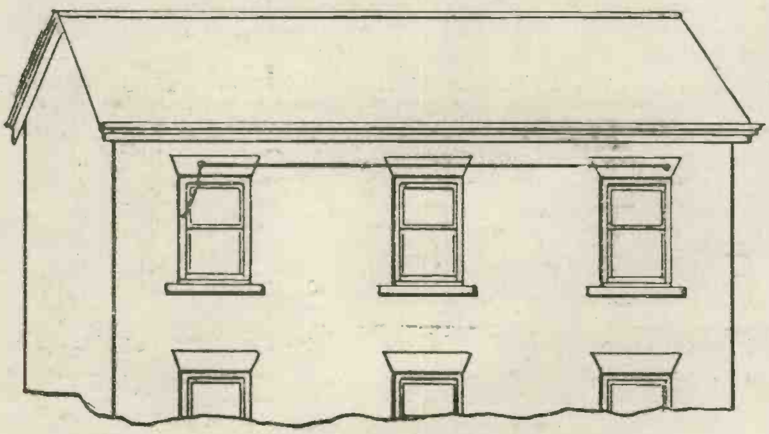


Fig. 4.—A convenient outside wire.

Apparatus Required for the Reception of Local Broadcasting

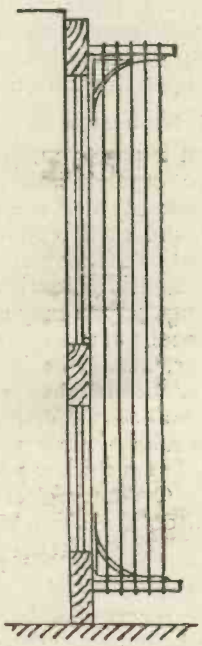
The first thing to consider is, what are the available facilities for erecting an indoor aerial? Has the reader access to the roof above his room, and can he erect among the rafters a suitable

...t Dwellers

..., Assistant Editor.

...eller is deprived of most of the ...rticle shows how, even with the ... flats within a short distance of a ...grammes just as well as those who ... their own outdoor aerial.

aerial? If he has such access the best plan is to drive a few nails as high as possible in the rafters of the roof and to take a wire round three sides of the available space, leaving the fourth side blank. The lead-down should now be taken by the shortest possible route to the aerial terminal



...door frame aerial.

of the set, the earth terminal of which should be connected, if possible, to the nearest water-pipe connected to the main supply. If a water-pipe is some distance away you may try, as an alternative, connecting it to the gas-pipe. There is no harm in using a gas-pipe earth with an indoor aerial, but it should never, in any circumstances, be used when the wire projects out of doors, as the aerial may be struck by lightning and the gas main ignited. I heard only a few days ago of a case where a fire was caused through the lightning

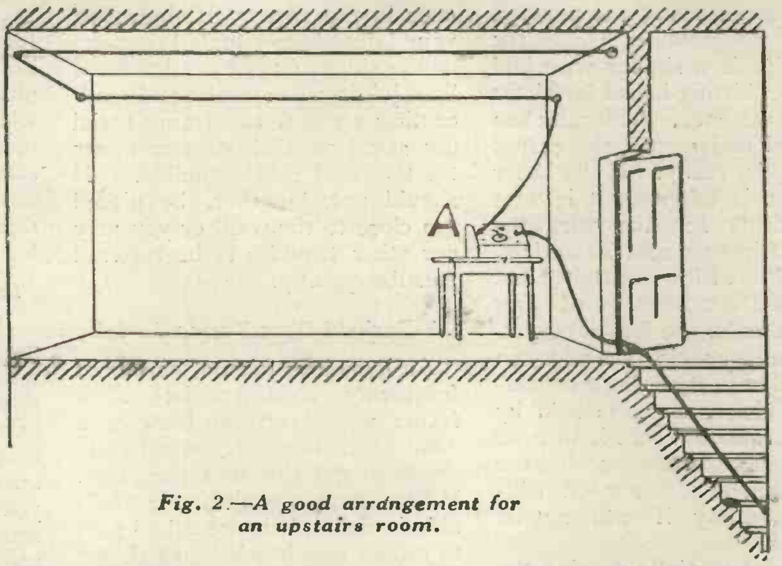


Fig. 2.—A good arrangement for an upstairs room.

striking the aerial of a set, the earth terminal of which was connected to a gas-pipe.

Crystal Sets

Within three or four miles of a broadcasting station a roof aerial, as described, brought into a room immediately below the roof with a good sound earth connection, should operate a crystal set and give quite comfortable telephone strength. A two-valve amplifier added to this crystal set will work a loud-speaker excellently, whilst one stage of high-frequency, a detector valve, and two-note magnifiers will probably bring in the second nearest station quite comfortably, and, in favourable conditions, two or three of the others.

Where Roof Aerials are Not Possible

A large number of flat dwellers, however, have not access to the roof, and must content themselves with wires in their own apartments. The illustrations accompanying this article show several methods of utilising space to good advantage. It is an excellent plan, if the room is lofty, to place a wire round three sides of the room, using for this purpose hooks on the picture rail, the lead-down being taken to the aerial terminal of the set and the earth connection made as before. If the flat is an upstairs one it is quite an interesting and efficient experiment to use as an earth wire, not a connection to a water- or gas-pipe, but simply a lead about 20 or 30 ft. long, which passes from the earth terminal down a staircase, the further end being free.

A Parallel Arrangement

Where the room in which the receiving apparatus is situated comes at the end of a long passage or corridor, the scheme

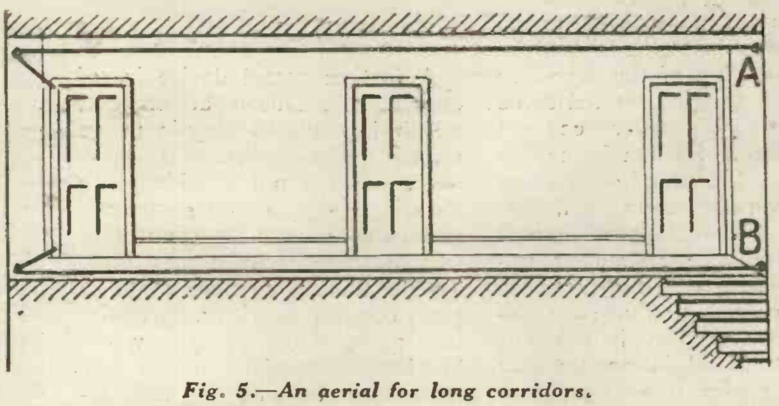


Fig. 5.—An aerial for long corridors.

shown in Fig. 5, can be tried, the aerial, in this connection, being a wire carried along the passage as high as possible, while the earth wire is a similar wire laid along the skirting board for about the same distance. This wire can be placed underneath the carpet or lino quite easily. If the latter expedient is adopted, it is wise to substitute for the wire the copper strip now sold for aerials. This will be of low resistance and will have the advantage of lying quite flat under the lino or carpet. For all indoor aerials the wire can quite well consist of single rubber-covered flex, such as is sold by all electricians. There is then no need to use insulators, and if the wire chosen is of the good silk-covered variety it will not be unsightly.

An aerial partially outside the building, and useful in certain circumstances, is one consisting of a wire taken out of the window frame and along between the first and last windows.

Most of the aerials described above will not generally work satisfactorily with a crystal set unless we are within a mile or two of the station. They will, however, give excellent results with single-valve reaction sets carefully used, and, of course, better still with sets using one stage of high-frequency, a detector and reaction.

Frame Aerials

Frame aerials are often helpful when the set used with them has one or more stages of high-frequency preceding the detector. A very simple frame can be made of two pieces of wood about 3 ft. long and 6 in. wide cut egg-box fashion in the middle so that they can be fitted into one another in the form of a simple cross. Evenly spaced notches should be cut in the edge of the wood to enable you to wind on ten turns of single indiarubber covered flexible wire. Such a frame can be made and mounted on a stand by the average handy man, but, of course, unless the work is well done it will be somewhat unsightly. Owing to the fact that frame aerials will only give satisfactory results when the plane of the frame aerial is on the line connecting the receiving room with the broadcasting station, it often happens that the angle at which the frame must be worked is the cause of some inconvenience in the room. If, however, your house is so situated that one of the sides of the room is on the line joining you and the broadcasting station, the frame aerial can stand parallel with, and near to, the wall most suitable. It should not, however, be placed too close to the wall, or you may get other troubles to be referred to subsequently.

A Back-of-Door Frame Aerial

An ingenious form of aerial not frequently used consists of a frame wound on the back of a door which is swung open to any angle to get the best reception. Where such a cupboard is available in a flat, it is not a bad plan to attach four brackets, as shown in the drawing, four pieces of wood or ebonite being attached to the top of each of the brackets. For the average door with the brackets placed as shown it will be necessary to have about five turns only, the leads for the ends of the frame aerial being brought through, say, the keyhole, or in any other suitable manner. The leads should be thoroughly flexible, so as not to upset adjustments when you are changing the angle of the door. Of course, such an arrangement is best when the door is on the line joining you and the broadcasting station. This aerial has the advantage of being out of sight when the cupboard door is closed during non-broadcasting hours.

When using frame aerials with sets having the A.T.C. in parallel with a plug-in coil, the ends of the frame should be taken to the aerial and earth terminals, the coil being withdrawn.

Plug-In Attachment

A further useful device is, of course, the Ducon attachment, which is made to plug-in to an electric light socket. If, however, you are not provided with electric light, you can sometimes get good results by connecting this attachment to a gas pipe. To do this, you must make a good connection with a bare wire to a piece of the gas pipe which has been scraped clean and take this wire to one of the terminals of an ordinary electric lamp-holder. The wire from the receiving set is attached to one or the other screws at the side of the Ducon (depending on which gives the best results) and the device plugged-in to the socket to try which way round gives the best result. The usual earth wire, of course, is necessary, and should not, in this case, go on to the same set of pipes as those used for the aerial connection.

Troublesome Humming Noises

It will sometimes be found, particularly in houses and flats where alternating current is supplied, that bringing an aerial or frame up against a wall sets up a very irritating buzz. If this buzz is heard in the telephones, you may try placing the aerial or frame in different parts of the room, and you may also try changing the pipe on which you have made your earth connection.

Aerial Resistance

You will find it pays you, particularly where crystal sets are used, not to use too fine a wire for the aerial and earth connections. As mentioned above, the single electric lighting flex is as good as anything, or you may use the conventional aerial wire, which, however, should be insulated wherever it touches the hooks or the wall. Of course, you will get results of sorts with very fine wire, but a thicker wire is far better. Ordinary electric bell wiring will do if nothing else is available.

A Fire-Screen Aerial

As wood fire screens for home decoration can be purchased quite cheaply nowadays, one of these will form a good support for a frame aerial in those cases where one side of a room with a fireplace is in the plane of a broadcasting station. Ten turns of wire wound in the form of a spiral will give about the right size; flexible leads can be taken to the two terminals.

Need for Experimenting

Really we know very little about the best forms of indoor aerials, and there is plenty of scope for experiment with them. The reader should try every possible way of erecting his indoor aerial, and is quite likely to find some new arrangement which will be of great help to others.

Making Switch Arms Adjustable

THE laminated arms for selector switches sold by advertisers have usually a radius of $1\frac{1}{2}$ inches. This is a fairly convenient measurement, taken all round, but when we have not much room upon the panels we frequently wish to use

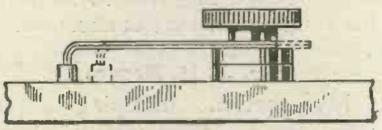


Fig. 1.—Explaining the action of the switch.

arms with a radius of only $1\frac{1}{4}$ inches or less. It occurred to the writer some time ago that it would be much better to make the switch arm accommodate itself to the size of the circle on whose circumference studs are arranged than to have to lay out this circle willy-nilly to suit the switch arm. A very simple way of reaching the desired end is shown in the drawings. About $\frac{1}{4}$-inch from the existing hole a second is drilled to 2 B.A. clearance (No. 12 drill); the two are then "run together" by means of a small round file. The writer makes a practice of treating all his switch arms in this way when they are purchased; it does not take more than a few minutes to do, and it makes them adjustable to any radius between 1 inch and $1\frac{1}{2}$ inches. Thus when designing components such as grid-biasing batteries, one can lay out one's row of studs on the circumference of a circle of the most convenient size without having to bother about the length of the switch arm. When the switch is made up the arm is simply adjusted to the proper length, and then clamped up against the knob by means of the round nut put on the spindle below it. Another way of dealing with the arms is to cut a slot about $\frac{1}{2}$-inch deep and 3-16-

Fig. 2.—Constructional details of the switch arm.

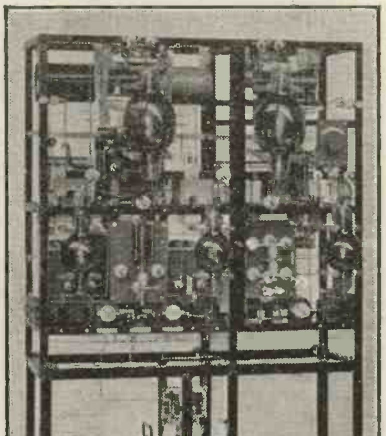
inch wide from the inner end with a hacksaw or with the edge of a flat file. In this way the end is made forked, and the arm can be moved in and out at will.

R. W. H.

Is it Atmospherics?

FREQUENTLY, when you go round to hear what a friend's set can do, you find him complaining bitterly about atmospherics. As soon as he switches on you hear crackling and tearing noises, which become worse and worse as he tunes the set sharply to a strong transmission. The same thing may, of course, happen when friends come round to hear your set, but it seemed more tactful to put it the other way! The beginner at wireless accepts these noises without hesitation as being due to atmospherics, but the old hand is a little sceptical. In nine cases out of ten continuous noises of this kind are due, not to atmospherics, nor to the transmitter, but to the receiving set itself. To see whether the set is guilty is quite a simple business. Disconnect the aerial and earth, and then see whether you can still hear anything. As a rule, you will hear some sounds, though they will be very much fainter than they were before. When the set is tuned to the neighbourhood of the oscillating point upon a strong signal, all noises within it are immensely amplified and therefore produce very loud sounds in the receivers. The aerial and earth having been disconnected, the set is no longer near oscillation and the noises become fainter. You have not far to go in your search for the culprit; you are pretty safe in blaming the high-tension battery every time. We can make sure by switching off all valves but the note magnifiers. If it is the high-tension battery the noises will still be heard, though they will be very faint now. The reason why the high-tension batteries become noisy is that people will use those of a size far too small for the work that they have to do, or that they take too much current from them. By the use of grid-biasing cells the plate current of the note-magnifying valves can be cut down to something very small without affecting signal strength. This immensely lengthens the life of the battery and prevents it from becoming noisy before its time. To show what can be done in this way, the writer may mention that he was recently working a five-valve set (2H.F., R., 2L.F.) with a small power valve (LS5) in the last holder, and that by the use of negative bias on the grid of the two note magnifiers the total high-tension consumption of the set was reduced to under five milliamperes. With no grid bias upon either L.F. valve the milliammeter showed eleven milliamperes, which is far more than any small battery can give, except for the briefest period without a rest.

R. W. H.



The Marconi 3K.W. Type "U" Transmitter.

Faithful Reproduction by Broadcast

By P. P. ECKERSLEY, M.I.E.E.

The discussion following upon the paper recently read before the Radio Society of Great Britain.

DISCUSSION

Admiral Sir Henry B. Jackson, opening the discussion, said :—

I certainly have no intention of opening discussion on this very practical problem by raising theoretical points. I should, however, like to congratulate Captain Eckersley on the results at the recent opening of the Wembley Exhibition. From all accounts, it was a triumph for the British Broadcasting Company. Perhaps we have hardly appreciated the amount of work that it has been necessary to put into this problem, which some people think is not very difficult, and is only a matter of a few troublesome adjustments. After the lecture we have heard to-night, however, we can clearly see what the difficulties are. The lecture has been of such a practical nature that I think every word must have appealed to us. To judge from my own listening—I have several sets of different sorts—that microphone is not quite perfect, but it is getting nearer. The loud-speaker, too, is not quite a pleasure to hear, although a year ago it was very much worse. With good telephones and a good receiving set, then broadcasting is very nearly perfect.

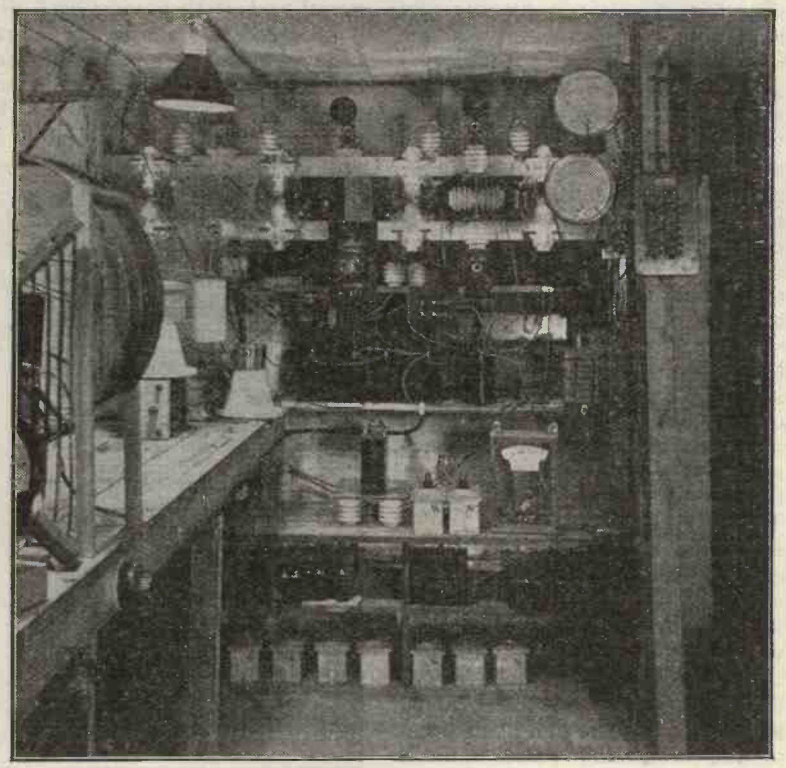
Mr. P. R. Coursey

I scarcely know what points in the lecture can be discussed properly now, as Captain Eckersley has dealt with the whole subject so fully that one really wants to sit down and think it over in detail. There is one thing, however, which particularly struck me, viz., that he lays more blame on the loud-speaker, as a rule, as a source of distortion than on the receiving set. That may be so in some cases, but in the case of a good many sets it is not quite so true. A great many of the so-called low-frequency amplifiers on the market to-day are *amplifiers,* but they are really no more than that, and when they are used for receiving speech I think they are, perhaps, more to blame than the loud-speaker. Both contribute to distortion, but the bulk of the distortion may not necessarily be in the horn or the diaphragm.

One might, perhaps, if anything, wish for a little more detailed comparison of the different types of loud-speakers. Captain Eckersley has been talking to us on the subject of reproducing broadcast transmissions, and the loud-speaker, as he has said, is of great importance. Therefore, perhaps, he may be able to amplify what he has already told us about the relative merits of different methods of reproducing sound. One might judge from his second diagram that the method utilising the same principle as is employed in the microphone itself, viz., the electromagnetic principle with a coil moving in a magnetic field, would, from the theoretical point of view be much more perfect than any other method. Captain Eckersley has studied the subject throughout in such great detail that I would beg him to amplify his remarks in that connection.

Mr. J. H. Reeves

My experience of trying to get good loud-speaker results dates back to the time when, week by week, we used to look forward to a choice half hour from Writtle. The methods I was then employing appear to-day in four pages of the *Wireless World and Radio Review,* so that my contribution this evening will take up very little time. I am pleased to say, however, that I am now getting loud-speaker results which are as good as I have heard anywhere, but there is one little point about the loud-speaker which we actually accidentally discovered. I had a very expensive loud-speaker, but



The valve panel of the R.S.G.B. Station 6XX showing the two rectifying valves, together with the two oscillator valves.

the volume was poor and the quality bad. Mr. Child had heard of this, and he had just got out an apparatus by which he could re-magnetise a magnet, and he offered to treat mine. We took the loud-speaker apart and found it was a disgraceful piece of mechanical imperfection. Neither of the pole pieces was true, and one was considerably nearer the diaphragm than the other. Mr. Child kindly put these pole pieces right for me, and I have never seen a man more delighted than he was when he subsequently heard the sounds out of that loud-speaker. The mere perfection of the mechanical detail in the loud-speaker converted it into one in which I should say the amplitude is two or three times what it was, and the quality improvement was wonderful.

Mr. Fogarty

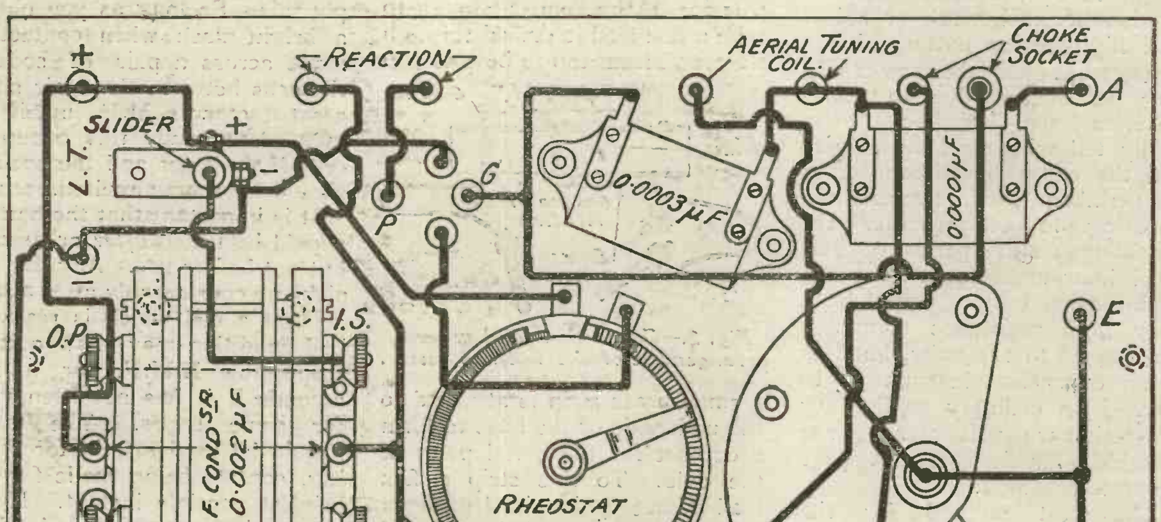
I should like to add my thanks to those of the previous speakers to Captain Eckersley for his interesting lecture. I certainly have learned a great deal that I did not know before. I am not sure whether it is relevant to the lecture, but I believe that Captain Eckersley is strongly of the opinion that as far as the low-frequency amplifier is concerned it is best to dispense with the transformer and to utilise capacity and resistance methods. I should like to ask him if he believes that resistance capacity methods are better than the intervalve transformer, because I think a good many of us would be interested to know whether we may expect to get a great deal less distortion this way than with the method which we now so largely adopt.

Mr. R. E. H. Carpenter

I should like to ask Captain Eckersley if he will deal a little with the question of detection. The detectors that we use at present are said to obey square laws, but I doubt whether, in fact, that is always the case. I think that one of the reasons why crystal detectors give more satisfactory detection than some valve detectors is due to this fact; the crystal does not obey Ohm's law, and one result is that as the amplitude increases the damping effect of the crystal on the receiver circuit increases also. It follows that the ratio of amplitudes in the receiving circuit does not necessarily follow the ratio of amplitudes, on a time basis, that take place in the transmitter. That is to say, let us suppose that the transmitter at one moment is giving a particular amplitude; the detector circuit has an amplitude of some very small fraction of this. If the amplitude in the transmitter circuit now doubles, the amplitude in the receiving circuit, which has a crystal connected across it, will not necessarily double because the effective resistance of the crystal is decreasing with increasing amplitude, and I think that fact offsets the square law to some extent. I think that is also a reason why grid currents, of which Captain Eckersley spoke so unkindly, are not always harmful. In using a valve detector, if the mean potential of the grid is slightly positive, the same sort of effect will come in there, *i.e.*, the increasing power absorption due to grid currents with increased amplitudes will, to some extent, tend to off-set the square law which the detector otherwise obeys. I would like, also, to oblige Captain Eckersley by telling him that on one point he is entirely wrong. He is quite wrong in suggesting that a lot of people will get up and tell him he is wrong, because he has dealt with the subject so lucidly that any man who gets up to heckle him would be very rash.

(*To be continued*)

WIRELESS FROM A FLASH-LAMP BATTERY



Owing to the amount of interest taken in this receiver, we reproduce above a practical wiring diagram, including the correction announced in last week's issue.

Lamp Testers for Batteries

THERE are signs that users of wireless sets are now beginning to pay much more attention than they did to the high-tension battery. Its condition is certainly one of the most important factors in reception, for if it is not up to the mark parasitic noises of various kinds will be very much in evidence. Time was when amateurs regarded the high-tension battery as an unimportant component which was so simple that it could not go wrong. In purchasing them they would simply ask for a high-tension battery, and take the first that was offered, provided that it was "guaranteed" to give the desired voltage. It was then yoked to the set and nothing further was done until possibly a year later, when it might occur to the user that it would not be a bad idea to have a new one. Nowadays most of us are particular about the make of the high-tension battery which we purchase, but for some reason it is still usually one of the last things to be suspected (though it ought to be the first) when reception becomes weak or noisy. The high-tension battery should be tested at once whenever crackling noises not due to atmospherics are heard—you can easily tell whether atmospherics *are* the cause by disconnecting the aerial and earth terminals and listening to see whether the cracklings still persist. The ideal instrument for testing the high-tension battery would be a very high resistance voltmeter reading up to 120 volts, but this is an expensive instrument to buy. An ordinary medium or low-resistance voltmeter is not suitable, for it will not give accurate readings.

The best method for the amateur is to make use of some simple tester and to try the battery out between each pair of plug-sockets at regular intervals. It will frequently be found that, though most of the cells show a good enough voltage, one or two have fallen off very badly. When this happens, a very high resistance is introduced with a varying value. The result is that the total E.M.F. of the battery drops off and also fluctuates, each fluctuation being registered by a click in the telephones.

A simple tester is shown in the drawings. The first requirement is the holder portion of a discarded pocket flashlamp battery. This part, which is shaped as

Fig. 1.—Showing method of mounting the lamp holder.

shown in Fig. 1, is removed from the case and two holes are made in the flat portion for the wood screws, which will be used to secure it to its base. The base is a piece of hard wood 1 in. wide by ½ in. thick, through which is drilled a ½-in. hole to take the screwed portion of the holder's socket. In order to avoid splitting the wood it is better to make this hole before reducing the width of the wood to 1 in. A hole large enough to take a flex lead is drilled through the wood from top to bottom and

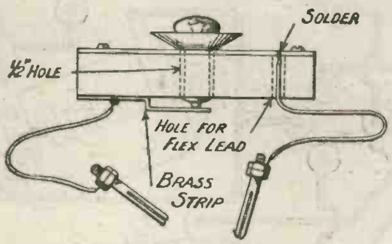


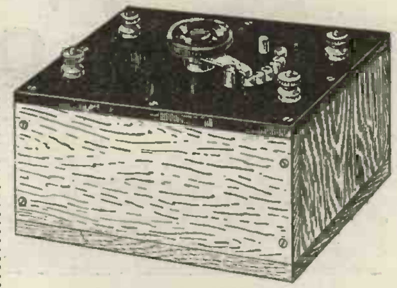
Fig. 2.—Connections and general arrangement of the finished tester.

a small brass strip is attached to the underside of the base to form a contact for the metal point of the bulb. To this strip a flex lead about 4 in. in length is soldered, a second being passed through a hole in the wood and soldered to the metal holder. The holder is then screwed down to the wood. The free ends of the flex are each provided with a valve pin, connections being made either by a pair of nuts or, better still, by soldering. An improvement upon a pair of valve pins would be a pair of high-tension wander-plugs with insulated tops—but before you purchase these make sure that they will fit into the sockets of the high-tension battery; there are a good many on the market just now that will not!

The tester is now ready with the exception of the bulb, which must be chosen with care. You may take it as a good general rule that dry cells should be discarded when their E.M.F. has dropped to less than two-thirds of what it originally was. Most high-tension batteries are arranged with wander-plug steps of 3, 4½ or 6 volts. The corresponding minimum voltages will therefore be 2, 3 and 4. It is possible to purchase from advertisers in this journal flashlamp bulbs requiring 2.5, 3.5 and 4.5 volts, which will do excellently for the purpose. Care should be taken in choosing these to see that their amperage is as small as possible. All of them can be obtained with a consumption of .3 ampere, though there are makes which take as much as .6 ampere. The cost of suitable bulbs is sevenpence apiece. Select a bulb whose voltage is appropriate to the steps of your high-tension battery, and fit it to the tester. The principle is simply this. So long as you obtain a bright flash when contact is made across a pair of sockets the cells between that pair show a satisfactory E.M.F., but if the bulb glows dully this group of cells is done for and the sockets should be short-circuited.

It is important that the battery should be tested *after* or *during*, but not before use. Any dry cell picks up considerably after a rest, so that a cell which is really in bad condition may show quite a respectable E.M.F. for a few seconds if it has not been used for some hours. The tester should be used merely for flashing, contact being made for the briefest possible instant. If the valve pins were pushed right home in the sockets the cells would be damaged for even .3 ampere is far too much current for them to supply except for an instant. If a 6-volt bulb with the same amperage (which costs a shilling) is provided the tester can also be used for trying the accumulator. R. W. H.

A Useful Testing Device



Complete instrument.

MOST of us make use of the telephones pretty frequently for testing continuity of windings, searching for short circuits, and making sure that condensers have not broken down. Other tests we may make with the galvanometer or milliammeter; but whatever kind of instrument we use we need a battery to provide the current, whose passage or failure to flow will give us an indication of the condition of the piece of apparatus under trial. It is just this battery which generally gives trouble in the middle of a series of experiments. Some people use the accumulator, whilst others keep a dry cell handy upon the bench; but in either case the process of connecting up is rather a nuisance. The best way of ensuring that time is not wasted, that the temper is not unduly tried is to make up the small testing battery described in the present note. This consists of three small cells contained in a box on the top of which are four terminals connected as shown in Fig. 1. All that one has to do in making a test is to connect the telephones to those marked A and B and the apparatus under suspicion to C and D. Contact can then be made or broken at any of the terminals in order to see whether current is flowing or not. A four-stud selector switch provides an off position and regulates the voltage by 1½-volt steps from 1.5 to 4.5. Dummy contact studs are placed alternatively between the main contacts to prevent short-circuiting of individual cells.

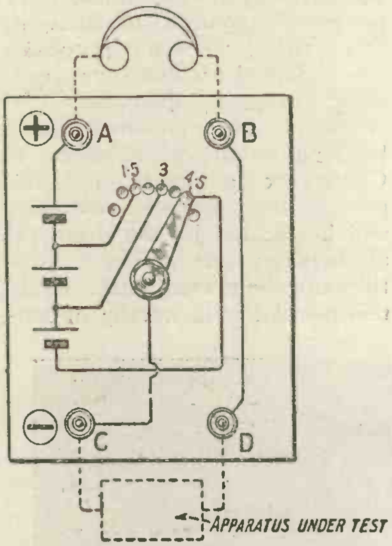


Fig. 1.—The circuit used.

The best battery to use is that known as the No. 15, made by the Ever-Ready Dry Battery Co., and sold at 1s. 6d. It consists of three cells 1¼ in. in diameter and 2¾ in. long contained in a cardboard box measuring approximately 3⅞ in. by 1⅜ in. by 3 in. Owing to their comparatively large size these cells will stand up to a good deal of work, especially if use, that is, only occasional, gives them plenty of time for recuperation. But one of the best points about the battery from a wireless point of view is the ease with which it can be tapped. When the cardboard top is removed, the cells are found standing side by side in separate compartments, with small brass strips connecting the positive of one to the negative of the next. All that one has to do is to solder a short length of insulated wire to each of the two connecting strips. This can be done in a moment if the brass is scraped with a knife and touched with Baker's soldering fluid. It is better to connect to the strips than to the "blobs" of solder on the top of the positives, for, unless one is quick and skilful, damage may be done in this way. Further leads are soldered to the two end strips, which are marked respectively + and −.

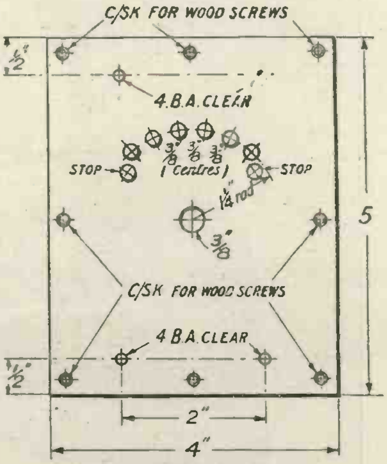


Fig. 2.—The box top.

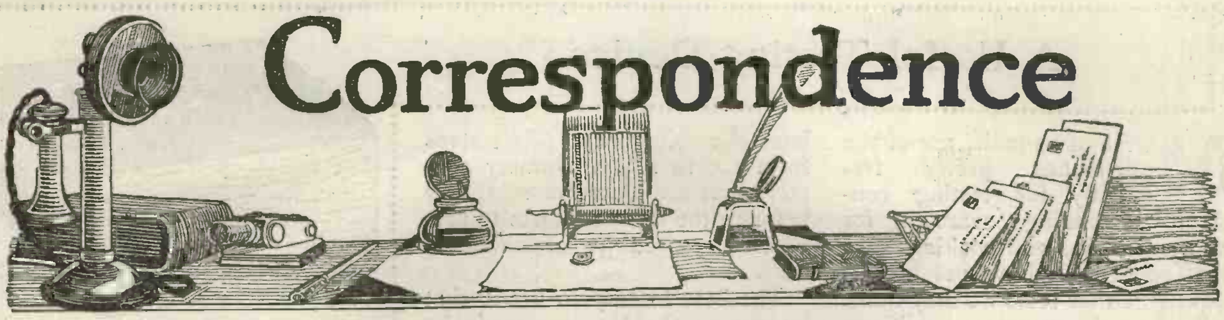
To contain the battery a box is made, whose inside measurements are 4¼ in. in length by 3¼ in. in width by 2½ in. in depth. Any wood will do for this, though hard wood is, of course, preferable, since it takes a better finish. The wood should be ⅜ in. thick. The battery is inserted lying on its side, a strip of rubber cut from an old inner tube being so placed as to insulate the tops of the cells and the contact strips from the side of the box. This rubber also serves to wedge the battery firmly in place.

The top of the box is a piece of ¼-in. hard wood thoroughly well seasoned and drilled as shown in Fig. 2. In the middle is a ⅜-in. hole for the bush of the selector spindle, four studs ⅜ in. apart being arranged upon the circumference of a circle with a radius of 1¼ in. Four other 4 B.A. holes are made for the terminals and either four or eight countersunk holes to take the wood screws which fix the top to the box.

Besides its use as a testing battery, this simple device can be employed in several other ways. It makes a very good negative grid biasing battery, where potentials not exceeding 4½ volts are required. It can also be used very handily for supplying the positive grid bias, which is sometimes necessary when Weco-valves are worked as high-frequency amplifiers. One might exclaim at first sight at the very idea of using a positive biasing battery on the high-frequency side; but when it is remembered that the maximum E.M.F. available from the single cell from which these valves are worked is only 1.5 volts, even when quite fresh, the need for it in certain circumstances becomes apparent.

R. W. H.

Correspondence



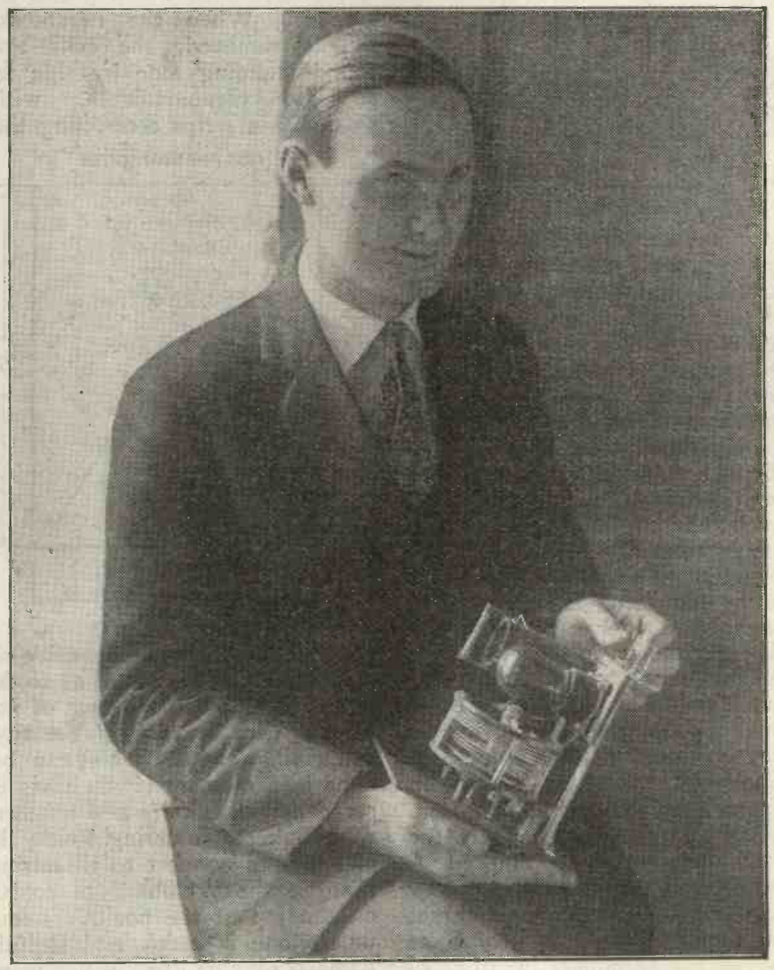
POSITIONS FOR ALL WIRELESS OPERATORS

SIR,—With reference to the letter published in your April 23 issue, signed by Messrs. James H. Webb and J. R. Schofield, criticising the accuracy of certain statements issued from this office, we desire to make the following comments :—

The particular paragraphs, the accuracy of which is questioned, are abridged forms of certain other paragraphs contained in that part of a pamphlet published by this Association, dealing with an historical survey of the Marine Wireless Service. In the process of condensation it was not possible to state in detail the precise application of the figures, and hence it is quite possible that your correspondents have read into them something that was not intended. In our original article it is stated " the total number of British ships licensed *is* approximately 3,388, while the approximate surplus of operators over actual requirements *was* 2,898." Note the past tense. This figure is shown in the pamphlet referred to as representing the calculated effect of the manning scale laid down by the Merchant Shipping W/T Act, 1919, in comparison with the scale required under D.O.R.A. at the time of the introduction of the former, viz., 1920. The question of an erroneous statement as suggested by Messrs. Webb and Schofield therefore does not arise, inasmuch as the figure 2,898 refers to a state of affairs calculated to be brought about by new legislation in 1920, while the other figure, 1,800, refers to a later date.

During the interim it is quite likely that a large number of qualified men had become tired of waiting for vacancies in the wireless service which did not exist, and, finding other occupations, definitely gave up all intention of entering W/T. Many such cases are known to us. Others who commenced training when about the age of 23 or 24 found themselves over the age limit of the largest employers of operators, and have likewise entered other professions or trades.

The idea underlying the historical survey of the service was to show that during the brief period in which W/T has been in use at sea, from periodic violent fluctuations in the number of personnel required to staff it, and that if the proposals are adopted which are now being pressed upon all Governments of maritime states by the International Shipowners' Conference, a further and unprecedented surplus of operators will be created by the dismissal of between one-half and two-thirds of the present staff. Surely this possibility is worthy of con-



Our photograph shows Mr. A. H. Grebe, the inventor of the receivers which bear his name. The apparatus seen in the photograph is a new form of wave-trap recently designed by Mr. Grebe, and of which particulars are not yet available.

sideration by anyone contemplating entering a service thus threatened.

In conclusion, and in view of the statement contained in the penultimate paragraph of the joint letter, may we be allowed to ask—

(*a*) The number of students who have qualified for the First Class P.M.G. Certificate at the School since January, 1923, and who have obtained appointments as seagoing *operators*, and the period they have had to wait between qualifying and obtaining an appointment as *operators*?

(*b*) The number of fully qualified students who have been appointed through the B.S.T. as "probationary operators" at a rate of £3 per month, or as wireless watchers; and if it is on this account that more precise details as to the nature of employment which "we have had no difficulty in obtaining" are withheld?

The Bournemouth and Cardiff Colleges :—

(*a*) What percentage of the berths found by the Colleges for the students shown in the appointment list issued by the Colleges for the year 1923 were on foreign-owned vessels, and were of a permanent nature, and not for one or two voyages only.

Both the B.S.T. and the Bournemouth and Cardiff Colleges :—

If by "we can further state that there is no difficulty whatever in obtaining positions for all future students who obtain the said certificate," they mean that there *will* be no difficulty in the future, are they referring to positions as *operators* on British ships offering some degree of permanence, and if they are so sure of being able to do this, why does the B.S.T. state in its official prospectus ". . . . we do not guarantee . . . ." and the Bournemouth and Cardiff College deliberately ink out a sentence commencing "We do not guarantee appointments . . . .," and by the context of the particular paragraph leave the issue very vague?—Yours faithfully,

E. R. Tuck,
Association of Wireless and Cable Telegraphists.
London, W.C.

APPARATUS WE HAVE TESTED

Sir,—We thank you for the report on our tuned anode and reaction unit, as described in last week's issue.

We note you criticise the amount of reaction obtainable with the upper coil.

It may interest your readers to note these coils are made in two types, one of which is for use with series aerial condenser or for cases where two stages of high-frequency are in use, and the other for use as a single stage of amplification with parallel aerial tuning condenser, and it was the former type that was sent you.

Our reason for making the two types is owing to the undesirable effects of too much reaction, including instability, howling and awkward adjustment.

We appreciate the open and unprejudiced reports that appear in your pages, as we feel the newcomer to Radio is in considerable difficulty in the choice of sets and components, and eventually there is an excellent chance of his becoming cynical towards claims in advertisements.—Yours faithfully,

p.p., C. H. Gardner, F.R.A., Managing Director.
Midland Radiotelephone Manufacturers, Ltd.
Stourbridge.

COWPER "ORDINARY VALVE" H.T.-LESS CIRCUIT.

Sir,—Please allow me to congratulate you on the Cowper H.T.-less circuit.

I wired this up on my Omni receiver (which, by the way, I have much enlarged and improved, as I have a large number of fixed condensers fitted, an Igranic potentiometer, and Vernier filament resistance, Vernier condenser, two two-coil holders, constant aerial tuning condenser, S.P.D.T. and D.P.D.T. switches, micrometer crystal detector, provision for separate H.T. to valves, etc., grid-bias battery, of which I will give you a description if desired), and obtained very good results. Some six miles from 2LO I worked a home-made loud-speaker sufficient for a small room, using a four-volt accumulator.

The circuit was as described in *Wireless Weekly*, using a 50-lattice coil for A.T.I. and 100 for reaction R.T. transformer and Igranic potentiometer.

I obtained the best result with an Ediswan A.R. valve; a Phillip hard Dutch was not quite so good, whilst a soft Dutch valve taking about 25 volts on plate was very poor.

I have a very poor aerial, so the picking up of other stations is difficult, but I got several spark stations.

On a single valve set with H.T. wired as given in *Modern Wireless* (June) I got slightly better results, and picked up Birmingham and Newcastle, so that I consider the H.T.-less circuit only slightly inferior; it was, however, easier to control, and inclined to be much clearer.—Yours faithfully,

G. Jewell.

London, S.E.

IMPORTANT ANNOUNCEMENT

"How Every Crystal User may become a Valve Expert"

A series of Six Special Articles by E. REDPATH, Assistant Editor of this journal and "Modern Wireless," will commence in the JUNE 25th issue of "WIRELESS WEEKLY."

The articles will deal in a particularly clear and easily understood manner, with the theoretical and practical considerations governing the use of valves, as additions to existing crystal receivers and when used alone. The complete series will thus form a progressive guide to beginners and to more or less experienced users of crystal sets whose interest in their hobby demands the natural development from crystal to valve sets.

Whilst some experimenters hesitate to embark upon the wider sea owing to lack of confident knowledge of the subject, many are deterred by the supposed high cost. The forthcoming articles will supply the essential and practical information, whilst the economical aspect of the question will by no means be neglected.

Instruct your newsagent to supply you with "WIRELESS WEEKLY" regularly,

COMMENCING JUNE 5th.

An informal meeting of the Transmitter and Relay Section of the Radio Society of Great Britain will be held at the Institution of Electrical Engineers, Savoy Place, W.C.2., on Friday, 20th June at 6.30 p.m., when Mr. J. Ashton-Cooper will speak upon "Tuning Coils."

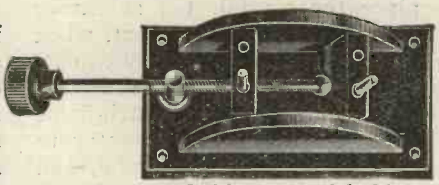
Apparatus we have tested

Conducted by A. D. COWPER, M.Sc., Staff Editor.

A Coil-Holder of Novel Design

IN some of the several types of two-coil holders on the market a fine-control motion for close adjustment of reaction-coupling is provided by giving a separate motion, suitably controlled, to both of the two coils; one, a rapid motion for coarse adjustment and rapid tuning; the other, a fine slow-motion action for minute adjustment of the receiver to the most sensitive condition.

In the two-coil holder of Messrs. Ward & Goldstone the two motions are combined in an ingenious manner, by using a simple geometrical device, of a "tangent"—screw acting on a rotating holder. Thus a brass knob is advanced against a plate on the side of a pivoted coil-holder, the latter being kept up against the knob by a spring which opposes its rotation. The effect is that when the moving coil is nearly at right angles to the spindle (and very close to the fixed coil), a certain advance of the knob by rotation of its screwed spindle produces only a small motion of the moving coil; whilst near the other extreme of its range of movement the same amount of advance of the knob produces a considerable displacement of the moving coil. Hence fine adjustment is provided just where it is needed, when the two coils are close together, and rapid motion where this is possible and desirable.



The Ward & Goldstone coil-holder.

The sample of this type of coil-holder submitted for test showed, on practical trial, the convenient features indicated, close control of reaction-coupling being possible, while at the same time rapid rough adjustment of the reaction was given, and several different coils, e.g., could be tried in quick succession. The reaction-coupling could not be reduced to zero, so a little care had to be taken in choosing a suitable reaction-coil.

The instrument measured 4 in. by $2\frac{5}{8}$ in., being on a flat ebonite base suitable for mounting on the side of a cabinet; in this (vertical) position it would take the largest sizes of coils.

The finish, workmanship, and smoothness of operation were all that could be desired, and the insulation was excellent, on test.

A Coil Former

A coil-former for winding inductance coils has been submitted by the Watmel Wireless Co. This is in the form of a turned aluminium tube of stout gauge, 2 in. diameter and $1\frac{1}{2}$ in. wide, carrying two rows of screw-in aluminium spokes, eleven in each row, the rows being about $1\frac{1}{8}$ in. apart, and staggered in relation to one another. Thus the former is available for any of the popular types of low-capacity windings, either on the one row of spokes or using the two sets for wider coils. The outside diameter is about $4\frac{1}{2}$ in. On trial, the instrument was found convenient in use, and rigid, whilst the spokes could be easily removed when the coil was completed, and the latter slipped off the former.

The utility of the former would be greatly increased if a second row of screw-holes were available for the spokes, so that narrower coils could be wound, suitable for the lower wavelengths.

A Plastic Crystal Fixer

We have received for test a sample of "Gold Seal Plastic Metal Crystal Fixer," for fixing crystals in position in the cup without the use of screws, Wood's metal, etc.

The Plastic Metal is a dark brown plastic substance, with fine metallic particles, which softens readily in the heat of a match-flame. The instructions for use are to warm it and fill into the crystal cup, then to embed the crystal firmly. To replace the crystal, the substance is merely softened by heat, when the old crystal can be pulled out.

On trial, the material was found easy to use, a match-flame being all that was necessary to obtain a firmly-held crystal, and there was no difference noticeable between the signal strength obtained with a galena crystal mounted in this way and in any standard manner. The crystal could be readily removed, and, for example, reversed in the cup; apparently the sensitive surface had not suffered by contact with this fixing material, which is not generally the case with the usual devices.

It might be thought that this plastic material would introduce an unnecessary resistance in the circuit; on actual trial it was found that the resistance between two brass plates cemented together by about the usual amount that would be taken, and at the usual distance that there would be between the crystal and the cup, was just over 200 ohms—an amount negligible in comparison with the impedance of the phones. It was noted also how firmly this plastic material held even two smooth pieces of brass. It was impossible to shake a crystal loose out of the cup when once well imbedded.

We can certainly recommend this crystal-mounting material as effective, as well as kind, to the crystal used.

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 was found necessary some months ago to enlarge our special staff. In view of the expense incurred we are reluctantly compelled to make a charge of 2s. 6d. for replies, according to the rules below. All queries are replied to by post, and therefore the following regulations must be complied with:— (1) A postal order to the value of 2s. 6d. for each question must be enclosed, together with the coupon from the current issue and a stamped addressed envelope. (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. (4) Queries should be addressed to Information Department, Radio Press, Ltd., Devereux Court, Strand, London, W.C.2, marking the envelope "Query."

H. T. R. (GUILDFORD) states that he has obtained a pair of second-hand telephones which possess an adjusting screw at the back, and inquires the proper use of this device. He adds that the telephones have completely enclosed diaphragms, the sound emerging through a series of small holes.

The description identifies these 'phones as those known as Brown's, and the method of adjusting is as follows:—With the 'phones upon the head, withdraw the adjusting screw of one earpiece until a dull click is heard, which indicates that the moving reed inside the earpiece has been drawn down against the permanent magnets. A fraction of a turn in the other direction will then release the reed again and leave it adjusted to its position of maximum sensitiveness. Similar operations should then be performed upon the other earpiece. If no click is heard upon withdrawing the screw the whole distance, it must be assumed that the reed was already touching the pole pieces, and therefore the screw should be advanced until the click is heard which denotes that it has been freed. If none of these sounds of adjustment can be obtained, it indicates some serious trouble in the receivers themselves, and they should be returned to the makers for overhaul.

L. T. C. (PONTYPRIDD) states that he is very much troubled by a grating and crackling noise which is heard in the 'phones whenever the wearer turns his head. His set is a single high-frequency valve and rectifier, with reaction upon the tuned anode, and he reports that the reaction is also becoming very difficult to control.

The trouble is almost certainly a partial break in the cords of the telephones, although the trouble may be at the point where the cords are attached to the windings inside the earcaps. Probably the best course to adopt is simply to replace these cords with a new pair, and then investigate as to what effect it has produced upon the trouble. If the noise continues, the interior of the caps should be investigated, and the windings tested through with a dry cell and another pair of 'phones.

P. C. I. (CULLERCOATS) states that he is limited to a frame aerial by the problem of interference from the nearby 600 metre station, and asks us what set we think would be most suitable for the reception of all the B.B.C. stations upon a loud-speaker.

The problem is certainly a very difficult one, and we are inclined to think that a combination of wavetrap and frame aerial will probably be necessary. The receiver must certainly incorporate at least two high-frequency valves, and preferably two low-frequency stages for the loud-speaker operation. A suitable set is the Transatlantic receiver described in the November and December numbers of *Modern Wireless*, which is composed of two separate units. If you desire to build a receiver with all the valves upon one panel we should advise you to consult the June number of *Modern Wireless* for particulars of the Transatlantic Five receiver.

R. J. H. T. (ROMFORD) states that he has an ebonite panel, bought last summer, which has been stored in a rather hot cupboard, and he finds that it is badly warped and is wondering whether it is any further use.

Provided that the warping is not too severe, the panel can be flattened fairly easily. Obtain two flat pieces of board a little larger than the panel, and clamp it tightly between these with four joiner's clamps. Then place the whole arrangement in a moderately hot oven, and heat it for some half-hour or so. Upon taking out and cooling, still in the clamps, the desired truing will have been produced.

T. M. S. (EPSOM) states that he is building a Neutrodyne receiver, and proposes to use high-frequency transformers of a certain make, which are tapped to cover the wave-length range of 150 to 600 metres. He inquires whether these are likely to give satisfactory results.

The whole principle of the Neutrodyne receiver is based upon the use of certain special transformers, which are absolutely essential to enable the proper neutralising of the circuits to be performed. This will be quite impossible with the type of transformer which our correspondent refers to, and he is advised that he must stick closely to his original design.

Why not build some of your own Components?

This Book shows you how to build:

- Frame Aerials of different types.
- Various types of Coils.
- Coil Holders and Tuners.
- Crystal Detectors.
- Grid Leaks.
- Fixed and Variable Condensers.
- High Frequency and Low Frequency Transformers.
- Switches of various types and sizes.
- Valve Panels.
- Resistances.
- Potentiometers and Rheostats.
- Wave Meters, etc.

THE man who takes pleasure in building every component in his Set will obtain a lot of information from this Radio Press Book, ***Homebuilt Wireless Components.*** It gives a vast amount of information on how to make such components as those shown on the accompanying list. And every article, if made according to the directions, has been actually made up and tested. Most of them are illustrated where necessary with working drawings, so that there should be no difficulty in building them up.

Considering the immense scope of the Book and the fact that more than 130 illustrations are given, its cost is most moderate and will be saved by the first component made up.

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

2/6

Homebuilt Wireless Components

Radio Press Series No16.

G.A. 961

Inferior workmanship makes itself evident sooner or later—usually accompanied by disaster. In every field of production the value of discrimination when purchasing is becoming a vital consideration. Safeguard yourself against breakdown or burning out by purchasing the highest standard in materials, design and finish.

The **R.I. Transformer** fulfils these requirements to such a degree that its use has become standard all over the world. Wireless Engineers and Experimenters know and obtain the best—that is why they stipulate **R.I. Transformers.**

Write for 50 page Catalogue T 2, free on request.

RADIO INSTRUMENTS LTD.

Managing Director: J. JOSEPH, M.I.E.E.

Chief Designer: W. A. APPLETON, M.B.E., M.I.R.E., *late Admiralty Technical Research Officer.*

Works, Offices and Showrooms:

12, HYDE STREET, NEW OXFORD STREET, W.C.1

Telephone: Regent 6214-6215-6216. *Telegrams:* "Instradio, London."

NORTHERN DEPOTS: 19, *Hopwood Avenue,* MANCHESTER, *and Trinity House, Commercial Street,* LEEDS.

Printed for the Proprietors, RADIO PRESS, LTD., Devereux Court, Strand, W.C.2, by THE AVENUE PRESS (L. Upcott Gill & Son, Ltd.), 55-57, Drury Lane, London, W.C.2. Published on Wednesday of each week at 3, Bolt Court, Fleet Street, London, E.C.4. Address for Subscriptions and Editorial Communications:—Devereux Court, Strand, London, W.C.2. Advertisement Managers:—THE SCHEFF PUBLICITY ORGANISATION, LTD., 125, Pall Mall, London, S.W.1. Registered as a newspaper and for transmission by Canadian Magazine Post. Subscription rates:—32/6 per annum, 16/3 for six months, post free. Sole Agents for Australasia:—GORDON & GOTCH, (Australasia), LTD. For Canada:—IMPERIAL NEWS, LTD. For South Africa:—CENTRAL NEWS AGENCY, LTD. For Japan:—SALE & FRAZAR, LTD.

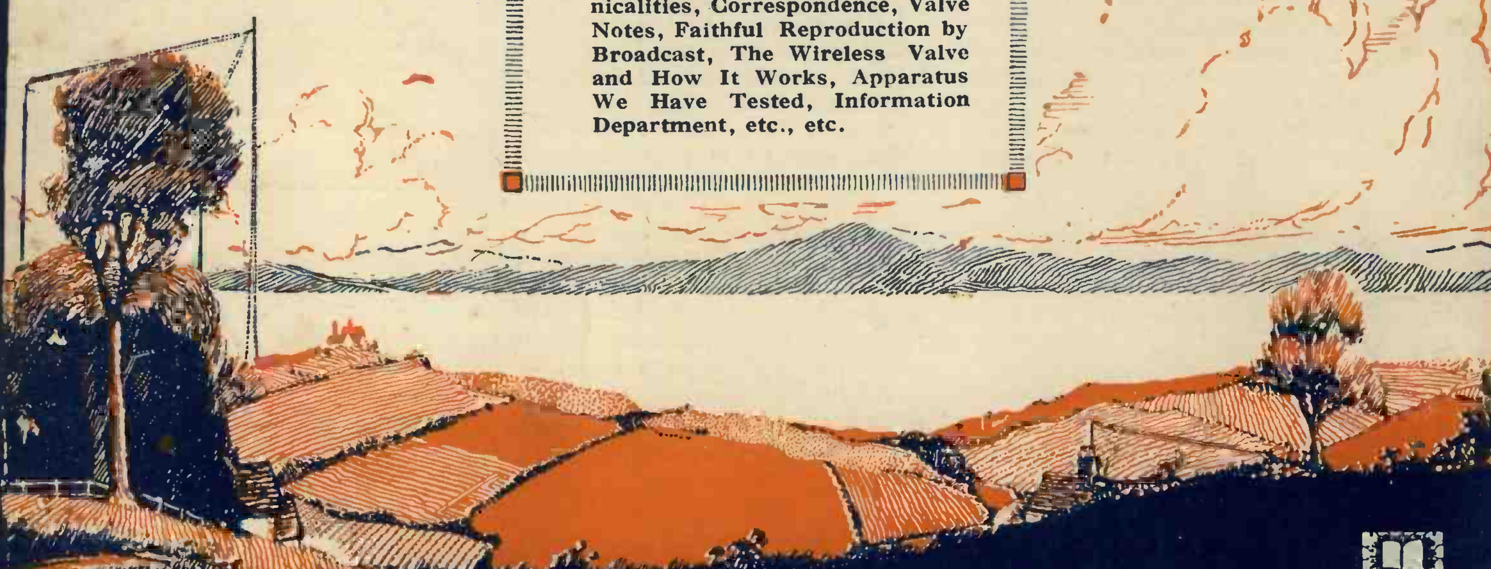
Wireless Weekly, 6d. Net. Wednesday. June 25th, 1924.

Wireless Weekly

and the Wireless Constructor.

Vol. 4.
No. 8.

CONTENTS



Crystal to Valve

NEW SERIES BEGINS IN THIS ISSUE.

Wireless Weekly

Vol. 4, No. 8
June 25, 1924

CONTENTS

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

Assistant Editors : P. W. HARRIS. E. REDPATH.

Radio Press, Ltd.

Publishers of Authoritative Wireless Literature.
DEVEREUX COURT, STRAND, W.C.2.
Tel.—Central 3763.

Advertisement Managers : SCHEFF PUBLICITY ORGANISATION, LTD., 125, Pall Mall, London, S.W.1 *Tel.—Regent* 2440.

Scientific Adviser :
Prof. G. W. O. HOWE, D.Sc., M.I.E.E.

Advisory Editors :
Prof. R. WHIDDINGTON, M.A., D.Sc.
Prof. C. L. FORTESCUE, M.A., M.I.E.E.

Staff Editors :
E. H. CHAPMAN, M.A., D.Sc.
A. D. COWPER, M.Sc.
G. P. KENDALL, B.Sc.
R. W. HALLOWS, M.A.
S. G. RATTEE, Member I.R.E.

All correspondence relating to contributions is to be addressed to the Editor of "Wireless Weekly."

Results with Oscillating Crystals

DETAILS of the work of M. Lossev, the young Russian radio engineer, described in this issue, will be of interest to all engaged in the art. It has been the dream of every investigator to produce a "cold" valve, or other equivalent device, which would oscillate and amplify with precision and without the necessity for some of the adjuncts necessary to a valve apparatus.

Our usual self-imposed task is to investigate all new devices capable of use by the experimenter with a view to stating exactly what may be expected.

Experiments were carried out with different crystals operating on different voltages, and it was found that oscillation could be fairly readily obtained with zincite and a steel point. Galena, of the kind commonly used in wireless detectors, was found unsuitable, although low-frequency oscillation was obtained, but the oscillation died down after a very short time, and fluctuated in frequency. The zincite-steel combination oscillated very well on low-frequencies, although considerable difficulty was experienced in getting results on higher frequencies corresponding to shorter wavelengths. The adjustment for a suitable spot was found much more difficult than the operation of an ordinary crystal detector in a receiver, and unless a suitable spot was obtained the frequency fluctuated considerably, which, of course, would make the apparatus quite unsuitable for practical use. An apparently perfectly steady note was obtained for an hour, when a suitable adjustment of the crystal was found, and the low-frequency currents generated were quite powerful, and were capable of operating a loud-speaker.

It was found that the voltage applied to the crystal was about 12 to 15 volts, and the steady current flowing through the contact was of the order of 6 or 8 milli-amperes. A good circuit to try out the oscillating properties of the zincite-steel combination is as follows :—

A battery, which may be varied between 10 volts and 20 volts (preferably with the aid of a potentiometer), has its negative terminal connected to the steel point of the detector. The positive terminal of the battery is connected to one end of an 800 ohm resistance; the other end of this resistance is connected to the crystal cup of the detector; one side of a 0.25 μF or 0.5 μF Mansbridge condenser is connected to the steel contact side of the crystal detector, and the other side of the condenser is connected to one end of a 1,250 plug-in coil. The other end of this coil is connected to the zincite-crystal side of the detector. By suitably operating the crystal point and adjusting the voltage, this circuit produces low-frequency oscillations which may be detected by connecting a pair of high-resistance phones across the 1,250 coil.

The operation of the circuit when properly adjusted is quite satisfactory, but the achievement of oscillation on higher frequencies is much more difficult, and there are practical difficulties in the way of effective operation on broadcast wavelengths.

For the reception of long wave continuous wave signals, using the oscillating crystal as a heterodyne appears to be quite practical, but an oscillating valve is not very much use to the broadcast receiver. If, however, the device is so adjusted that it is just off the oscillation point, a "reaction" effect will increase signal strength, but reliable operation is essential to carry out this effect. This means that by the use of the oscillating crystal device an effect similar to valve reaction is obtainable with a crystal receiver. Carried out to a practical conclusion, this would mean a great increase in the sensitiveness and range of crystal receivers. If the device may be practically arranged, its scope of usefulness seems distinctly limited, whereas the ease with which a valve may be manipulated for all sorts of purposes is proverbial. A perfected arrangement would be of principal interest to the crystal user; he who already has a valve will naturally only be interested technically.

The result of attempts to produce a practical receiver using these principles will be published in due course in this journal.

Oscillating Crystals.*

By I. PODLIASKY.

A Valve-less Oscillator-Amplifier.

SEVERAL experimenters have found that certain crystal-metal, or crystal-carbon contacts, customarily employed as detectors, can be used for the production of continuous oscillations of all frequencies, just as can a 3-electrode valve. The same contact can be utilised further as a true amplifier. The question does not seem very new, but it is only during the last few years that a Russian engineer, M. Lossev, has come to give to crystal generator - amplifiers several interesting applications in the reception of radio telegraphy and radio telephony. The construction of apparatus based on this principle is easy, and the results obtained certainly merit the attention of our readers.

Among the different contacts studied (carbon-pyrites, chalcopyrite-zincite, carbon-galena, and zincite-carbon) the contact of zincite-carbon or zincite-steel seems to give rise more easily than the others to the production of relatively powerful oscillations. The construction of the contact is exactly that of an ordinary crystal detector. We utilise a carbon point derived from the filament of an old carbon lamp, or simply a steel wire of .2 millimetres thickness. The zincite-crystal can be selected in the ordinary way; experience shows that a mediocre crystal becomes good after fusion in an electric arc, followed by the scraping away of the black-coloured badly-conducting layer. The fusion can take place in the presence of dioxide or peroxide of manganese.

To find the optimum conditions for employing the crystal we can trace out characteristic curves.

These curves show us that, under suitable electrical pressure, the contact behaves as a negative resistance. In this way one explains its ability to act as an amplifier or generator of oscillations; it can be compared to the Poulsen arc or the dynatron.

It is very simple to place the contact in a circuit in such a way

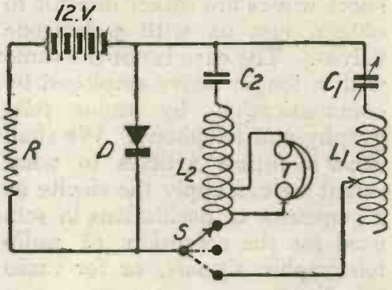


Fig. 1.—The arrangement of the oscillator for test purposes.

that it will function as a generator of musical frequencies, which are easily observed in the telephones. Once these conditions are found, the low-frequency oscillation circuit is replaced by a high-frequency oscillation circuit; the contact

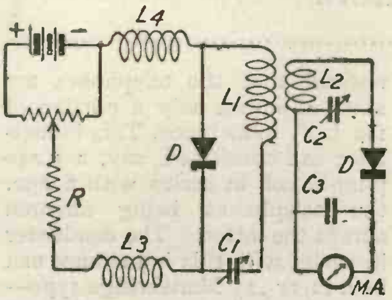


Fig. 2.—A circuit for very short waves together with a special wavemeter.

then functions as a true heterodyne. In this way the connections shown in Fig. 1 are used. As a source of continuous current one can conveniently utilise a dry cell battery (not too high a resistance) of 40 volts, such as one finds in the ordinary market. The electrical pressure to apply to the contact is, in general, rather feeble, and varies between 5 and 30 volts, according to the quality of the crystal. The resistance R is a variable rheostat of 1,000 ohms, approximately. L_2 C_2 is the oscillating circuit (low-frequency); L_1 C_1 is the high-frequency circuit. One switches in one or the other by means of a switch S. Here are a few practical constants: L_2 .1 Henry, C_2 .2 μF, C_1 .01 μF, L_1 5 microhenries.

It is useful to employ in this arrangement low-resistance telephones of the order of 300 ohms. On switching in the circuit L_2 C_2, and when varying the voltage of the battery and the resistance R, the oscillations audible in the telephones are damped. In order that the change to the circuit L_1 C_1 may quench the high - frequency oscillations sharply, it is necessary that the switch should have a dead stud between the two extreme positions; it is further necessary that the high-frequency resistance of the circuit L_1 C_1 should be at least lower than the resistance of the circuit L_2 C_2. It is further necessary that the ratio of the co-efficients of self-induction of the two circuits be equal to the ratio of their respective capacities. One can deduce by this rule the practical values which precede, in arranging the value of C_1 and the two frequencies, high and low.

(It is convenient to maintain automatically the necessary proportion between the self-inductances and the capacities in the two circuits by making the winding L_1 in the form of a variometer, the knob of which controls by rigid connection the knob of the condenser C_1; in this way, in operating the common handle one can maintain practically constant ratio between the values of L_1 and C_1.)

We can obtain in this way extremely rapid oscillations, and it is possible to descend to wavelengths round about 25 metres. Fig. 2 represents the circuit which allows us to obtain this result. Here the resistance R is 2,300 ohms; the inductance L_1 of the oscillating circuit being made of 5 turns of copper wire, 2 millimetres in diameter wound as a

* Reprinted from "Radio Electricité" Paris.

solenoid of 5.5 centimetres radius. The air condenser C1 has a maximum value of .0003 μF. L3 and L4 are chokes, wire of 0.1 milli-

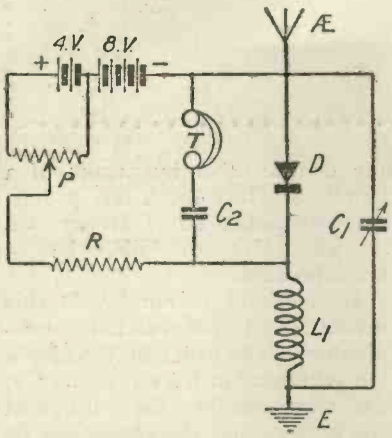


Fig. 3.—Circuit for autodyne reception of long waves.

metre diameter wound as a single layer solenoid. Their purpose is to prevent the penetration of high-frequency oscillations into the circuit containing the rheostats and batteries. We provide ourselves, for tuning, with a wavemeter made of a coil L2 (a single turn of wire of 2.2 millimetres wound on a radius of 5.5 centimetres) and by an air condenser C2 of .006 microfarad. A galena detector D allows us to find the maximum voltage on the galvanometer (micro-ammeter of 100 microamperes). The galvanometer is shunted by a condenser of .0003 microfarad.

At the present moment very short waves are rather difficult to obtain, just as with 3-electrode valves. The case is not the same with a longer wave employed by communication by radio telegraphy and telephony. We shall show in future articles to what extent we can apply the zincite as a generator of oscillations in sets used for the reception of radio telegraphic signals, or for radio telephony.

Certain crystals, such as galena, do not generate powerful oscillations well, but they can, at times, give rise to oscillations of low-power, even in the absence of any battery in the circuit. This

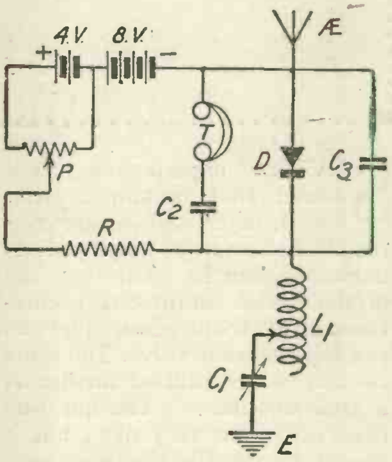


Fig. 4.—Circuit for reception of short waves.

clearly observed phenomenon explains very simply the occasional reception of continuous waves on a galena detector.

The Experimenter and Crystal Oscillators

From the article by M. Podliasky, printed above, the reader who is so inclined will be able to commence a series of most fascinating experiments. We have already reproduced the phenomena, and the following hints of a practical nature may help.

Circuit in Fig. 1.

Resistance R.—This may well be a Post Office plug-in resistance box, many of which are available secondhand from such firms as Leslie Dixon, Ltd.

Crystal Detector.—It is probable here that the old-fashioned type of crystal detector stand having a "micrometer" adjustment through levers would be helpful, as fine adjustment is necessary. A gramophone needle will serve as the steel point, being set in wood, metal, or held in any convenient grip. For a carbon point a piece of hard lead pencil can be used.

L.F. Inductance.—It will be noticed that the telephones are shunted across only a portion of the L.F. inductance. This inductance can consist of, say, a 1,250 plug-in coil in series with a 250, the telephones being shunted across the latter. The condenser in series with this inductance can be a .2 or .25 Mansbridge type—the other inductances and condensers are specified in the article.

An interesting line of work might be undertaken in investigating the use of crystal detectors in parallel, so as to reduce the total resistance.

Battery.—If the crystal is to be made to oscillate, then the battery may be a variable H.T. battery, with as many tappings as possible. If reaction effects are desired on telephony then the adjustment of battery voltage will be critical, and a potentiometer of standard pattern (say 300 ohms) can be connected across 4 volts of the battery, as shown in Fig. 3, control of oscillation and the pre-oscillation stage being made on this potentiometer control. The circuit shown in Fig. 3 is taken from our contemporary *Radio Revue* (Paris) and shows an arrangement stated to be suitable for the reception of long waves. Fig. 4, from the same source, is given for short waves.

In these days of fancy names, the title "Cristadyne," which has been given to the arrangement, seems particularly happy. M. Lossev is stated to have been able to transmit by means of a crystal oscillator over distances of about 800 metres, using for reception a similar arrangement without valves. With valve amplifiers, of course, the distance would have been much greater.

Amplification is carried out by adjustment of the potentiometer, as described. Great patience, and a good supply of crystals, would appear to be necessary in these experiments, for all specimens of zincite will not suit, and all parts of a crystal are not equally good.

Radio Press experts are investigating the whole question experimentally, and the results of their tests will be published shortly.

P. W. H.

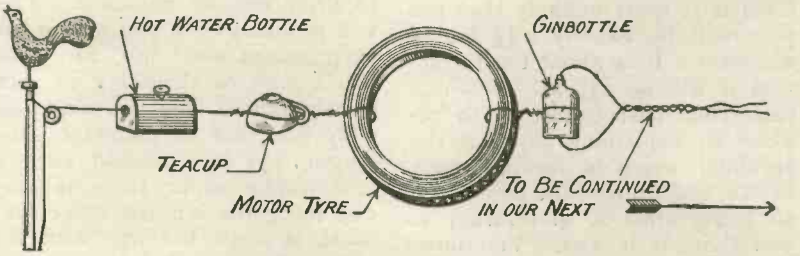
I TOLD you something recently of the wonderful new super-eliminated circuit which Professor Goop and I evolved. I am now happy to be able to give you a description of something still more startling, infinitely more complicated, far more epoch-making, and altogether more super. This circuit is Goop-Wayfarer No. 761. The one published recently, you remember, was No. 1, so that you will gather that between that and this lies an enormous amount of experimental work representing no less than 759 circuits. I would like to describe all of these to you in detail, but I refrain from doing so for three reasons which are : (a) That the Editor would kick; (b) that there is a limit even to the patience of readers; and (c) that I really cannot work in this hot weather. Among these 759, however, were some of which I trust to give an account later on for they are too magnificent to be allowed to elapse into oblivion.

The Professor's Own Handywork

There is, for example, the one designed by the professor alone, for I can claim no share in this, which makes use of a valve containing seven grids and three plates. This, however, has not got beyond what we may call the pencil and paper stage, for he has been unable to find any maker sufficiently enterprising to tackle the task of making the Goop valve. I shall confine myself, therefore to No. 761, which may be described quite simply as the most perfect thing that has ever been brought out.

The Way to Do It

Now if you have a really good thing and you are a true journalist, the way to set about getting it off your chest is not to consider how to give it to the world in a concise and compact form, but rather to plan out how much paper you can possibly make it cover without exasperating your readers. You must not give the whole show away at once. That would never do. First of all you work them up to the proper pitch of enthusiasm by throwing out dark hints about what you are going to tell them when once you get going. Then you let them a little deeper into the mystery, but only sufficiently far to make them desire to go further, and if you are skilful you keep them hanging on from week to week until finally you reach the last article in which all is revealed. Working on these lines I can claim to be introducing now an entirely new note into wireless journalism. This is the " To-be-continued-in-our-next " circuit diagram. After all, one must give circuit diagrams, otherwise the thing would not look like a wireless article. There is only one diagram to this particular circuit, and if one gave it all at once there would be no further instalments. I could, of course, plan it out quite well by starting from the beginning and writing quite a lot about electrons and how the valve works, and things of that kind, but I do not think that that would be really playing the game. I am going to plunge, therefore, straight into the middle of things by giving you the first instalment of that wonderful circuit, Goop-Wayfarer No. 761.



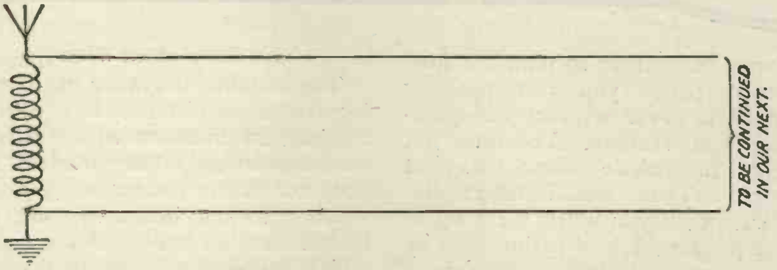
Some suggestions for aerial insulators.

The Instalment Plan

The instalment system of drawing wireless circuits has other merits than those to which reference has already been made. It does not fluster the reader by presenting to his bemused gaze a horrid cat's-cradle of wiring which takes him hours to disentangle. It takes him on by simple easy stages from the beginning of the circuit to its climax at the end. Also, it enables him to make up the apparatus as time and the state of his finances permit. This week, for example, all that is required is an aerial, an inductance, and an earth. Almost any aerial will do, though it is desirable that it should be not less than 3 ft. from the ground at the lowest part, and a few insulators may be added to advantage. There is no need to purchase these at exorbitant prices from dealers in wireless goods; old bottles, broken tea cups and bits of motor tyre will answer very well. Here, however, I should like to give one word of warning. The necks of all bottles must be carefully closed and the tea cups must be inverted, otherwise the fowls of the air may select them as nesting places.

Circuit Details

To return to the circuit, I think that I had better give a few details in order that there may be no misunderstanding. The coil itself is of enormous importance, and the experimenter should spare no pains in getting it just right. To make it obtain a 3-in. length of curtain pole precisely $2\frac{15}{16}$ in. in diameter. The best way of doing this is to persuade the mistress of the house that heavy curtain poles are out of place in the drawing-room, and to offer to fit a lighter one for her. Having obtained her consent to the project you can then remove the pole from the drawing-room and, pleading a sprained wrist, tell her to get the local handy man in to finish off the job. Having thus acquired the pole take it to your workshop and cut off the required length. Unless your lucky star was in the ascendant at the hour of your birth it is most unlikely that the pole will be exactly $2\frac{15}{16}$ in. in diameter. It is about ten to one that it will be $2\frac{13}{16}$ in., in which case your best course is to replace it, explaining (a) that the sprained wrist is feeling much better, and (b) that the pole is not so heavy (this is quite true) as you thought it was. You must then look round the house for something that will do. If bed-posts are unavailable you may be able to cut a chunk off one of the legs of the dining table, the missing 3 in. being compensated for by a volume of "Encyclopædia Britannica," or some other solid work.



The first instalment of the Goop-Wayfarer 761 circuit.

Making the Former

Having sawn off the required length of curtain pole, bedpost or table leg, the next process is to reduce it to the proper diameter. If you have a lathe you must not use it, for if you do so you will get the work done long before next week's instalment appears. The process which I strongly recommend is the following. Obtain a long strip of the finest emery cloth and fasten one end to the wall by means of a pair of nails, screws, or staples. Grasp the other in the teeth and stretch it tight. If this should produce a slightly gritty feeling the mouth may be filled with linseed oil before work is begun. Now seize the former between the two hands and move it to and fro on the strip. Should you feel discouraged at any time by the progress that you are making do not forget the little proverb which tells you that even the hardest rock is worn away in time by little drops of water. It may also be helpful to repeat six times every hour, "Every day in every way it is getting smaller and smaller."

Finishing Touches

When the former has been reduced to size it should be thoroughly baked in a hot oven to drive out all moisture. This will probably give you one of the surprises of your life, for wood has a way of shrinking in such circumstances, and you may possibly find that its diameter is no longer $2\frac{15}{16}$ in. Should such a catastrophe occur there is only one thing for it: the home fires must be kept burning with the aid of the discarded former, and you must set about making a fresh one. By carefully measuring the amount of shrinkage which took place in the first you will now know precisely what to allow in the second. When the former has been baked and seasoned to taste with a dressing of shellac the carpentering and culinary parts of the process are ended, and we can get down to winding. For this you will require some wire.

Barbed Wire Inductances

For a long time the Professor and I could not make up our minds what type of wire to use. Amazingly good results were obtained with barbed wire, but this was found a little hard on the hands when the construction was in progress, and this type of inductance was finally discarded when the Professor kicked one in an absent-minded moment. We tried wire hawser, but gave it up owing to its nasty habit of flying at you when you are uncoiling it. We are firm in opinion that there is nothing to beat No. 16 gauge d.c.c., which is perfectly tame, and may be kicked with complete impunity. The wire when purchased will probably come to you in a roll. To get it nicely on to the former it is as well to enlist the services of the local curate, whose experience in wool winding will be invaluable. He should stand in the position of attention so far as his feet and body are concerned, but with his hands inserted into the coil and the thumbs holding down any bits of wire that may desire to err and stray.

So Easy

Take your seat in an easy chair and direct the curate to maintain an even pressure whilst you slowly turn the former. When $43\frac{2}{3}$ turns have been put on you will make all fast and dismiss your assistant. The greatest care must be taken not to inform the curate that you are making a wireless coil, otherwise he may become inquisitive and ask lots of troublesome questions. It may even happen that he will become infected with the radio microbe, and that a little later he will endeavour to get his own back by coming round and pressing you into *his* service for the purpose of winding coils. Be on your guard against anything of this kind.

WIRELESS WAYFARER

(To be continued in our next.)

The Radio Society of Great Britain

The next Ordinary General Meeting of the Radio Society of Great Britain will be held at the Institution of Electrical Engineers at 6 p.m. on Wednesday, the 25th June, when Mr. J. Hollingworth will deliver a lecture entitled "A Resume of Modern Methods for the Measurement of Radio Signal Strength."

An Informal Meeting of the Radio Society of Great Britain will be held at the Institution of Electrical Engineers at 6 p.m. on Wednesday, the 9th July, when Mr. P. R. Coursey will give a talk, illustrated with lantern slides, on the manufacture of condensers.

How every Crystal User may become a Valve Expert

By E. REDPATH, Assistant Editor.

This special series of articles, the first instalment of which appears below, will form a simple but complete guide to all readers who have not yet added valves to their receiving equipment.

PROBABLY no modern scientific hobby yields to its devotees such immediately satisfactory results for a minimum outlay as wireless. Especially is this true in view of the present - day development of broadcasting.

Owners of even the simplest receiving sets purchased at a very reasonable figure or home-constructed at even less expense, together with a modest aerial, are almost certain to obtain more or less satisfactory results at practically the first trial, provided, of course, that they are within 20 to 25 miles of a main broadcasting station.

Limitations of Crystal Sets

Whether the crystal receiving set is the crudest home-made affair, or a more ornate instrument of the cabinet type, essentially the same limitations apply. Long-distance reception cannot be attained (apart from occasional freak reception involving considerable skill and patience in the adjustment of the receiver), nor is the strength of the received signals (speech, music, etc.), sufficient to operate a loud-speaker in a satisfactory manner.

The construction and operation of a simple crystal receiver is, in the writer's opinion, undoubtedly the proper beginning, enabling the learner to become familiar with constructional details, with the operations of tuning the receiver and adjusting the detector, and generally teaching him how to make the utmost of the very limited amount of energy available.

Sooner or later, however, enthusiasm for the hobby, or perhaps desire to present the entertainment on a better scale, will demand the provision of improved apparatus in order to overcome the limitations inherent in the crystal set.

The Valve Stage

In the circumstances just mentioned most present-day users of wireless receiving sets will recognise that they have arrived at the valve stage. In the absence of any theoretical or practical knowledge of valves, advice is probably obtained to the effect that, for long-distance reception a valve should be used as a *high*-frequency amplifier, whilst, if increased volume of sound is desired, a valve should be used as a *low*-frequency amplifier. Alternatively, the suggestion may be made that the original crystal set should be scrapped and a valve receiver be constructed or purchased.

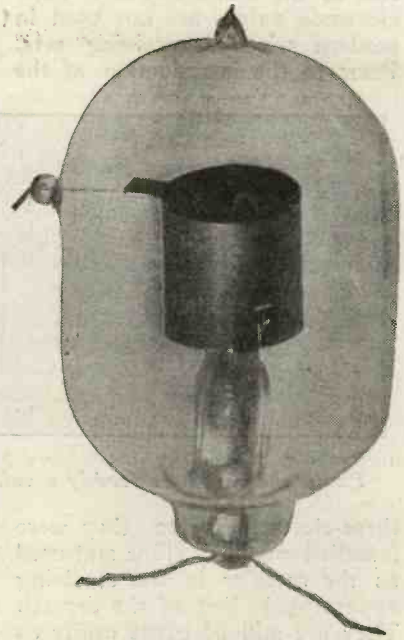


Fig. 1.—An early 2-electrode or Fleming valve.

This advice may be excellent in its way, and strictly correct according to circumstances, but the point which it is desired to emphasise here is that the greatest amount of interest and pleasure is to be derived from a further development of the hobby by an understanding of the theoretical and practical considerations which govern the functioning of valves.

Contrary, perhaps, to the opinions of many, a practical working knowledge of the subject does not necessarily demand heavy study or mathematical agility. It will, no doubt, be appreciated, of course, that there must be some "theory work," and that certain elementary facts must be grasped; but, once the mere rudiments are dealt with, the writer will endeavour in the present series of articles to combine theory and practice in such a manner that the reader will not only be able to understand the functioning of the valve and its associated apparatus in any particular circuit, but will be able to apply the theoretical knowledge gained to a solution of his own particular difficulties, present and future.

Elementary Theory of the Valve

Preliminary to a consideration of the valve itself, it is necessary to refer to the electron theory, as this upsets the old conventional ideas with regard to the flow of electricity.

It was customary to speak of a flow of positive electricity from a point of high potential or voltage to a point of lower potential. According to the electron theory, however, the free or movable electric charge is *negative*, and consists of a movement of minute negative charges of electricity, termed electrons.

A body possessing equal positive and negative charges is electrically neutral. Add electrons to the same body and it becomes electrically *negative*, being attracted towards another but positively charged body and repelled from a body charged negatively.

Remove electrons from the previously neutral body, and *it is left positively charged.*

An electric current in a conductor (such as a copper wire for instance) really consists of a movement of negative electrons, and the flow is *from negative* (surplus of electrons) *to positive* (shortage of electrons).

An easy way to reconcile this theory with preconceived ideas is to remember that an electron flow from negative to positive is exactly equivalent to a flow of *current* in the old order of things from positive to negative.

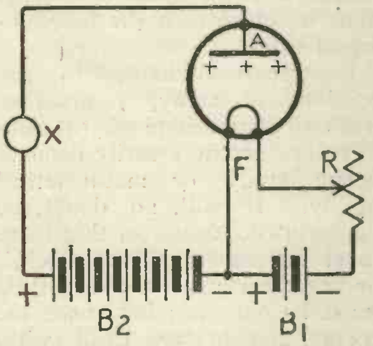


Fig. 2.—Theoretical diagram illustrating the action of a 2-electrode valve.

Under normal conditions electrons move from atom to atom along a conductor, but evince no desire to leave the surface of the conductor itself. If the conductor be raised to a high temperature, however, free electrons may be emitted from its surface and, under certain conditions, may be collected or absorbed by a positively charged body adjacent to the conductor. Incidentally, it may be noted that the heat generated in a conducting wire carrying a heavy "current" of electricity is due to the greatly increased movement of the electrons within the wire.

The Two-Electrode Valve

The above-mentioned principles were employed by Dr. Fleming in his original two-electrode valve, which consisted of a closed glass vessel, exhausted of air, containing a loop of platinum or tungsten wire (the filament), which could be raised to incandescence by the passage of an electric current from a battery, and a cylinder of thin nickel surrounding the loop and provided with a leading-out wire sealed in the wall of the glass vessel.

Fig. 1 is a photograph of a Fleming valve, the major portion of the loop or filament being, of course, hidden by the metal cylinder or anode, further names for which are plate and sheath, though the latter name is not in common use nowadays.

Fig. 2 is a theoretical diagram of the arrangement, showing the filament-heating battery B1, the variable resistance R, which limits the amount of current flowing through the filament, and consequently the temperature to which it is raised; the plate or anode A, maintained at a positive potential by means of the battery B2, to the positive side of which it is electrically connected. A low-reading ammeter or sensitive galvanometer introduced in the anode circuit at (for instance) X indicates the electron flow from filament (F) across the space to the anode (A) and round the external circuit back to the filament.

The flow of electrons across the space in the valve can only be in a direction from filament to anode, which, of course, gives rise to the name valve. Two-electrode valves are not used in modern wireless receiving sets. Prior to the introduction of the three-electrode valve they were installed on many ships and used as the rectifier in the receiving apparatus in lieu of the crystal. They are still of great utility as rectifiers, but mainly in connection with transmitting apparatus where alternating current supply is available and direct current is required for the operation of valve-transmitting apparatus.

Suppose the battery B2 in Fig. 2 were a source of alternating current. Every time the anode A was made positive to the filament F a flow of electrons would take place through the valve, but when A was made negative and F positive no flow would occur. Thus the ammeter at X (or other apparatus connected in a similar position) would receive pulses of *direct* current, the process of converting an alternating current into a direct current being known as rectification.

Factors Governing Electron Flow

The passage of electrons across the space between the filament and the anode of the valve is governed by three factors, namely :—

The temperature of the filament—which determines the actual emission of electrons.

The strength of the electric field, or, in other words, the potential of the plate or anode with respect to the filament.

The gas pressure within the valve, that is to say, the degree of vacuum obtained during the process of exhaustion.

If an appreciable amount of gas remains in the valve (*i.e.*, poor vacuum), electrons emitted from the filament will probably not reach the anode before colliding with a gas molecule. The result of such collision depends upon the velocity of the electron at the time, which in turn is dependent upon the strength of the electric field between anode and filament and the distance travelled by the electron prior to the collision, known as the "mean free path."

If the velocity of the electron is low, it adheres to the molecule, forming what is known as a negative ion (*i.e.*, a gas molecule with excess negative charge).

As the density of the gas is reduced, the distance travelled by the average electron before colli-

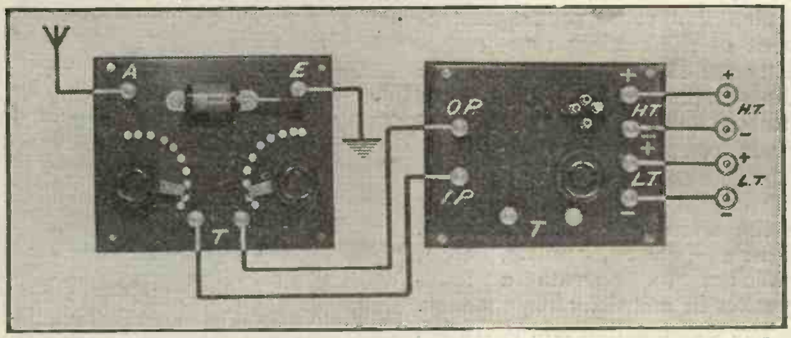
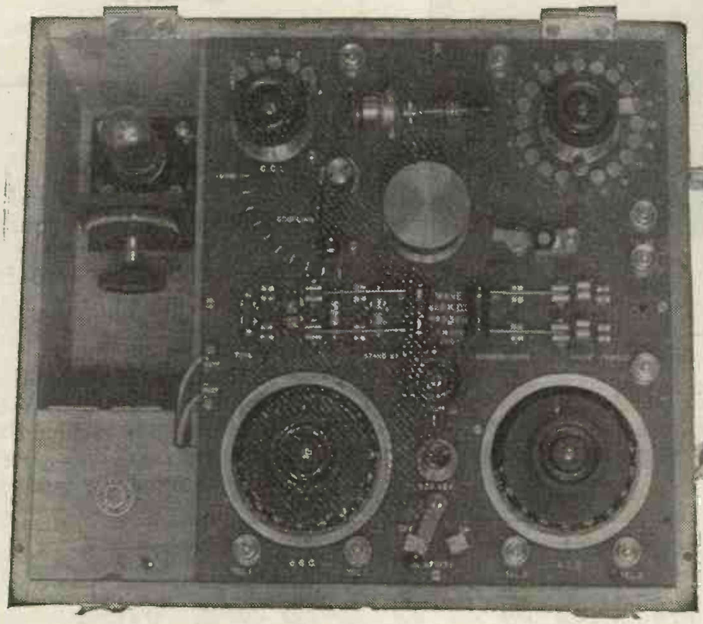


Photo showing how readily a valve may be added to a crystal set.

sion (mean free path) will increase, and, as the acceleration is very rapid, even with electric fields of moderate strength, a sufficient velocity may be attained to cause ionisation of the gas, which means that each electron striking a molecule of gas either glances off from or penetrates it and passes on, taking with it some other electrons detached from the molecule.

sion is increased, and owing to the cumulative action if the condition is allowed to continue the filament will probably be disintegrated, being literally knocked to pieces by the bombardment of positive ions.

Valves which contain an appreciable quantity of gas, and which therefore are liable to ionisation, are known as "soft" valves.



A Mark III Crystal Receiver with valve added to give high-frequency amplification. (Practical details will be given in a subsequent article).*

The net result of such ionisation, therefore, is that the number of electrons travelling towards the anode is greatly and progressively increased, whilst the gas molecules are transformed into positive ions (molecules with a shortage of electrons, equivalent to an excess positive charge) which are attracted towards the filament.

Soft Valves

Strong ionisation taking place in a valve is indicated by a bright blue glow, which in extreme cases fills the valve. For this reason ionisation is often spoken of as "blue glow," and the valve is said to be "blueing." The flow of electrons across the space increases tremendously, as not only are additional electrons detached from the gas molecules, but, owing to the impact of the positive ions upon the filament, the temperature and the rate of emis-

Hard Valves

If the density of the gas is reduced to extreme limits the number of gas molecules remaining within the valve will be so few that the electrons, though obtaining very high velocity, may reach the anode without a collision at all, and consequently without causing ionisation. This arrangement gives what is called a pure electron discharge, and is employed in practically all modern valves, being rendered possible by greatly improved methods of exhaustion, by which a very high degree of vacuum is obtained.

Further articles of this series will deal with the theory and action of the three-electrode valve and with various methods of utilising its properties in conjunction with crystal receiving sets. The construction of the necessary apparatus or modification to existing sets will also be fully explained.

A Condenser Tip

Many of the variable condensers at present on the market have one hole fixing and one attaches the dial by screwing it down on to a nut affixed to the centre spindle.

Now the problem is how to grip the nut whilst the dial is screwed down on to it. If one is mounting the condenser behind a panel the problem becomes quite serious, for although, theoretically, holding with a spanner seems satisfactory, practically, one generally finds that one cannot get a spanner to fit, or if one uses one of the adjustable type the worm-wheel will not clear the dial, and one cannot withdraw the spanner. Soldering seems an obvious solution, but where the clearance may be only ¼-in., it is a very difficult job to get a soldering iron in, and if one can, the chances are that one will burn the ebonite. However, a satisfactory job may be made by spoiling the thread upon the spindle below the position in which the nut is required to stay. This may be done with a pair of pincers or pliers. Screw on the nut, which when it comes to the part where the thread has gone, will refuse to turn. All one now has to do is to screw the dial down upon it, when a firm locking grip is effected.

E. A. W.

An All-Wave Tuning Unit

By H. BRAMFORD

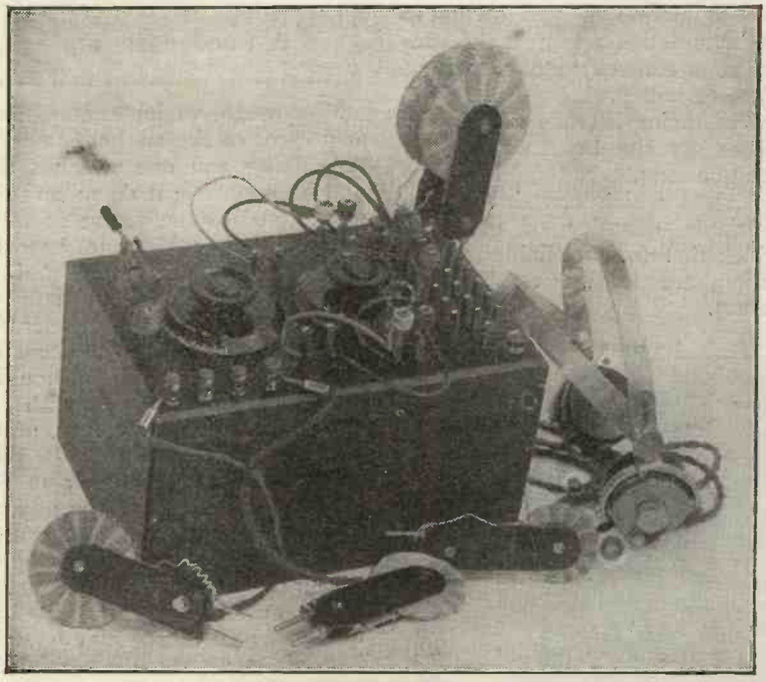


Fig. 1.—The receiver connected to give a loose-coupled circuit.

THE instrument about to be described may be used either as a crystal receiver or as a tuning unit, to be used in conjunction with any receiver. The principal interest in the design lies in its adaptability to different types of tuning, embracing almost any wavelength. Both the plug-in basket coils with which the instrument is equipped, and the variable condensers may be arranged to suit many different circuits, as will be described later. The unit may be used for aerial tuning, plate tuning, or reaction, with perfectly good results, particular thought having been given to the dispositions of the components for this purpose. The constructional details will, however, be first described. Photos of the complete unit are given, Figs. 1 and 6 being the front and back views of the panel respectively.

Materials Required

Single hole mounting:
1 ebonite panel measuring 9 in. by 6 in. by 3/16 in.
1 variable condenser, 0.001 μF capacity.
1 variable condenser 0.0001 μF capacity.
1 set of basket coils (not shellacked).
16 valve sockets.
16 valve pins.
17 Clix panel sockets.
4 telephone terminals.
8 Clix plugs, with insulators in 5 colours.
3 terminals.
Small quantity of each:
Insulated flex.
No. 22 S.W.G. d.c.c. and Systoflex, or 1/16 in. square tinned copper wire (bare).
Wood for cabinet 3/16 in. thick by 5 in. wide

Panel Drilling

Full details and dimensions of the panel drillings are shown in Fig. 2. The holes to receive the variable condenser spindles are to clear the single mounting bushes.

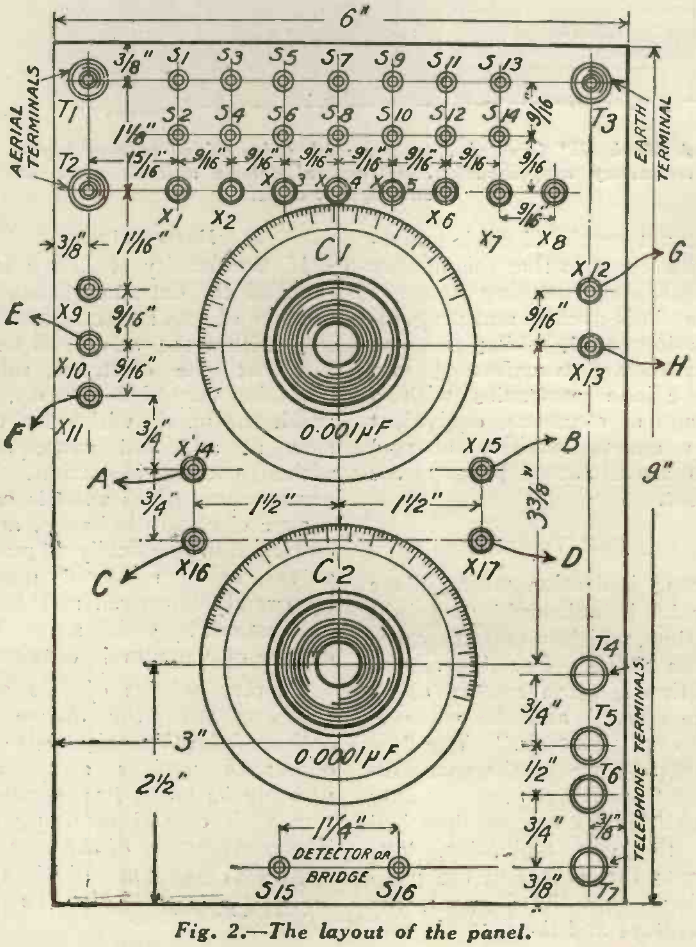


Fig. 2.—The layout of the panel.

The following article provides something new in tuning units, which should prove of considerable interest and utility to all wireless experimenters.

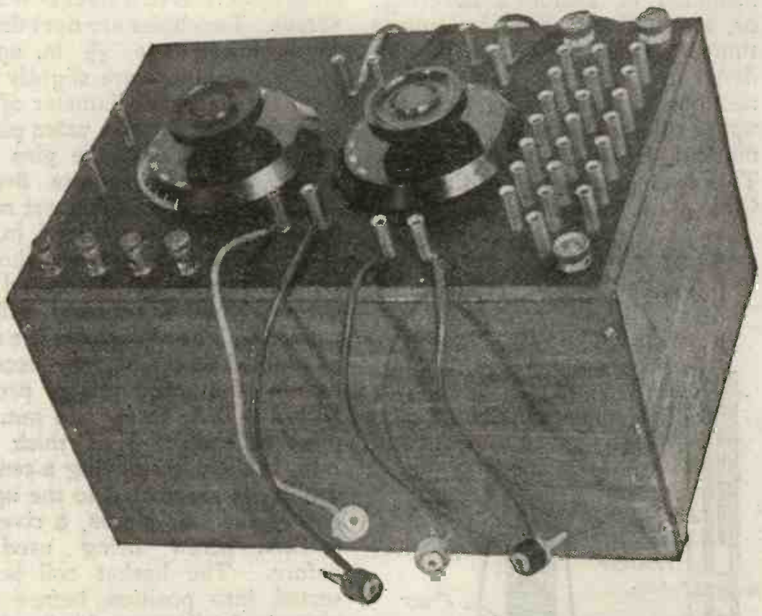


Fig. 6.—In this photograph all coils are removed to show the layout of the panel.

The Clix holes are drilled 3/16ths whilst all others are drilled to clear 4 B.A. screws, the terminal holes being numbered and marked with an S, and the Clix socket holes numbered and marked with an X. Valve sockets may be used in place of Clix sockets and will be found a little cheaper.

Assembling

The assembling of the panel from the front is also shown in Fig. 5. First mount upon the panel the terminals T1—T3, and next the telephone terminals marked T4—T7. Next mount the valve sockets, commencing with those which are to receive the plug-in basket coils. These are numbered S1—S14. The sockets numbered X1—X8 provide for plug-in connections from the circuit leads. Sockets X9—X11 and X12—X13 provide for plug-in connections from both circuit and condenser leads. Sockets X14—X17 provide for plug-in connections from the condenser leads only, enabling the condensers to be placed either in series or in parallel with each other. Sockets S15—S16 are to receive the plug-in type of crystal detector, described later. The assembly of the two variable condensers in the positions shown completes the panel mounting.

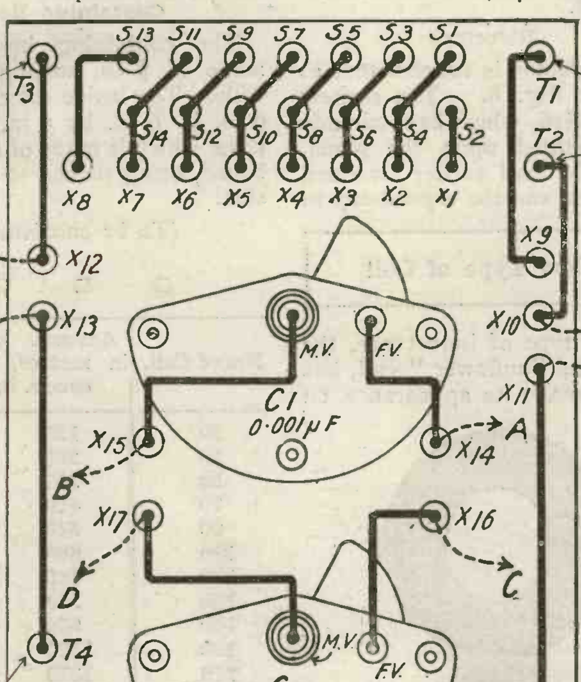


Fig. 5.—Practical wiring diagram of the receiver.

Making the Connections

The various connections to be made are shown in Fig. 5, representing the back of the panel. The terminals and sockets are marked, as before, to correspond with those shown in the previous diagram. First link together the sockets marked S2—X1. Next connect S1—S4—X2, and proceed on these lines, finishing S13—X8. Terminal T1 is connected to X9, T2—X10 and X11—S15. Socket S16 is connected to T7, and T6 to T5. Terminal T4 is then connected to X13. X12 is connected to T3. The fixed vanes of the variable condenser C1 are connected to X14, and the moving vanes to X15. The fixed vanes of C2 are then connected to X16, and the moving to X17, to complete the underside of the panel connections. All the wires should be insulated in systoflex covering, or, alternatively, 1/16 in. square tinned copper wire may be soldered from point to point. Connections are next made from the upper side of the panel. The lead marked E is taken from X10. This lead is provided with a red Clix plug, indicating the aerial

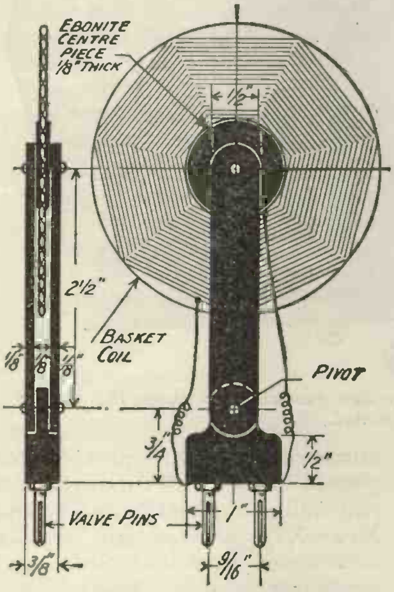


Fig. 7.—Constructional details of the coil holder.

lead. Lead G is taken from X12, and is provided with a black Clix plug, indicating the earth lead. Lead F is taken from X11, and lead 8 from X13. Both of these leads are provided with blue Clix plugs, indicating the circuit leads. Lead A is taken from X14, and lead B from X15. Both of these leads are provided with green Clix plugs, indicating the condenser C1 leads. Lead C is taken from X16, and lead D from X17. Both of these leads are provided with white Clix plugs, indicating the condenser C2 leads All these leads are made from insulated flex.

Coils

Each of the basket coils comprising the set is equipped with an ebonite holder, complete details of which are shown in Fig. 7. The plug-in portion of the holder is made from some $\frac{3}{8}$ in. ebonite. First cut off a piece 1 in. square, and then shape as shown, with a fretsaw. The part which acts as a bearing for the two side pieces is then cut away each side with a fine tenon saw, to a depth of $\frac{1}{8}$ in. each side, leaving a centre piece $\frac{1}{8}$ in. thick. A bearing hole is drilled, as shown, to receive a rivet or 6 B.A. screw. Two holes are next drilled in the lower edge $\frac{9}{16}$ in. apart. If these drillings are slightly less than the external diameter of the threaded portion of a valve pin, it will be found that the pins will screw into the ebonite firmly. The two side pieces are next made from some $\frac{1}{8}$ in. ebonite $\frac{1}{2}$ in. by 3 in. These are drilled as shown. By drilling a pair clamped together, greater accuracy will be ensured. The side pieces are now assembled to the plug-in piece by means of a soft rivet, or preferably a 6 B.A. screw and nut. A piece of ebonite $\frac{1}{8}$ in. thick and 1 in. in diameter having a central drilling is assembled to the upper end of the side pieces, a rivet or 6 B.A. screw being used as before. The basket coil is inserted into position before this piece is finally assembled. This completes the construction of the basket coil holders. Tuning may be effected between two coils by means of the pivoted arm of the holder, in addition to the use of the variable condensers embodied in the set.

Detector

The detector is constructed, as shown in Fig. 8. The sockets S15 and S16, which have already been mounted upon the panel, receive the ball socket standard in one case and the crystal cup in the other. An ordinary ball socket standard may be purchased and equipped with a cut valve pin, as shown. This is then plugged into socket S15. The crystal cup shown is of the spring grip type. A cut valve pin will be found to screw into the cup, as shown, which is then plugged into S16. The standard and the cup act independent of each other, and the crystal is easily and quickly changed. The standard has the advantage of a radial movement in the socket in addition to the ball socket movement. The detector may be completely removed when the set is not in use, thereby ensuring that the catwhisker and crystal are well preserved.

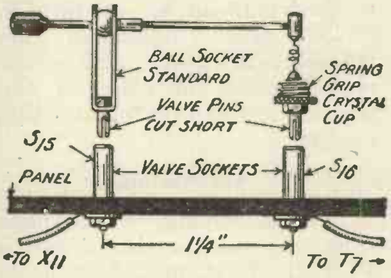


Fig. 8.—Illustrating the make-up of the crystal detector.

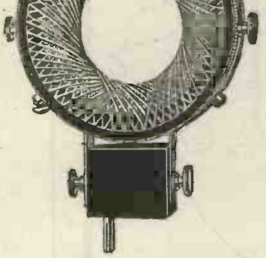
Containing Box

The containing box may be made of $\frac{3}{8}$ in. mahogany 5 in. wide. The inside dimensions are 9 in. by 6 in. by 5 in. deep, the base, which is made of stout cardboard, being tacked to the underside.

(To be continued)

A New Type of Coil

A new type of inductance, the "Diamond Sunflower" coil, has recently made its appearance on the market, and for the guidance of readers we give wavelength ranges herewith.



The new coil.

No. of Coil.	Approx. wavelength in metres, with .001 condr. in shunt.	
20	120	330
30	200	450
50	300	550
70	420	820
90	540	1090
110	660	1350
130	780	1600
150	880	1820
170	960	2000
190	1120	2400
210	1370	2780
230	1510	3160
250	1640	3520
275	1820	3860
300	1980	4200
350	2120	4530
400	2260	5060
450	2370	5790
500	2480	6520

Valve Notes

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

A Simple Two-Valve Circuit

CONTINUING my last week's discussion on simple sets which may be recommended to the beginner, I propose to add one and two note magnifiers to the circuits given last week, which consisted of a simple detector circuit using reaction.

The circuits given this week are undoubtedly the best the beginner can use, because they are very simple to work and it is almost impossible to go wrong. In addition, the circuits are excellent for all-round use, and may be employed for the reception of telephony, spark stations or continuous wave stations with equal success.

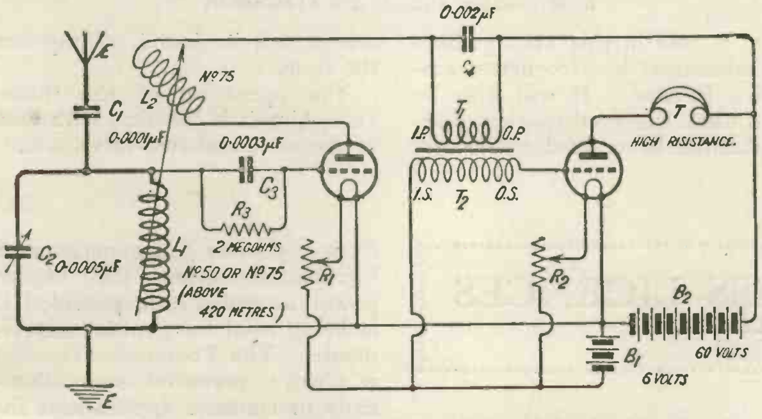


Fig. 1.—A two-valve circuit which is particularly suitable for a beginner. All working values are given.

The First Circuit

All the apparatus for these circuits may be used again and again in other sets. No trouble whatever should be encountered, either in the construction or operation of sets using these circuits, but I would like to give the old warning about buying cheap, nameless material. Condensers and transformers are the great source of weakness in a set, although resistances, such as gridleaks, etc., are also very troublesome, unless a good sound make is purchased. It might almost appear that we are emphasising this point too much, but every day sets are brought to us which do not give the proper results and which won't work because some inferior material has been used. After all, a good component will last practically for ever, and it pays in the end to use a good article, and usually pays in the beginning.

The first circuit is illustrated in Fig. 1, and different values have been given to the different components. The coil values are given for the broadcast wavelength from about 300 to 600 metres, but larger coils may be used for the reception of Eiffel Tower, Radiola, etc. The Ecole de Postes et Telegraphes may, of course, be received on the coils specified. Constant aerial tuning is also illustrated, a condenser C1 of 0.0001 μF being connectel in series with the aerial. This condenser is for the purpose of enabling us to state that with a certain coil and condenser a certain station should be received on any ordinary aerial, whereas, if this condenser were missing we would have to give our readers an alternative size of coil to use. The beginner, therefore, particularly greatly appreciates the constant aerial tuning condenser, and experimenters, generally, find it very convenient to tune in immediately without having to fiddle about with different coils.

Connections to the Reaction Coil

It will be seen that reaction is introduced from the reaction coil L2 into the grid coil L1, and the only point here to notice is that the reaction coil should be connected the right way round. If, on bringing L2 closer to L1 and retuning on the variable condenser C2, the signals do not become stronger, but on the other hand, weaker, the leads going to the coil L2 should be reversed. If the coil L2 is brought too close to L1, the first valve will oscillate, and this, of course, will cause interference with neighbours. The moment any tendency to oscillate is noticed, the reaction coil should be moved further away from L1.

Size of Reaction Coil

Different sizes of reaction coil may be tried, and when constant aerial tuning is employed, very frequently a quite small reaction coil will do; a No. 50 is usually ample, but a No. 75 is shown in the circuit, because many experimenters will want to try connecting the aerial directly on to the junction point between the top of the condenser C2 and the inductance L1, instead of the currents having to go through C1. By doing this, the damping of the circuit L1 C2 is increased, and more reaction will be required.

Another advantage of using a fairly large reaction coil is that the coil need not be too close to the grid coil, with the result that a finer adjustment of reaction is possible. If the reaction coil is a small one and has to be very close to the grid coil, then it is impossible to get very fine reaction effects, because the slightest movement of the reaction coil will cause big changes in the reaction, whereas, when a large reaction coil is used it may be kept well away from the other coil, and small movements do not make very much difference to the reaction.

How to Connect the Transformer

The IP and OP and IS and OS terminals of the transformer T1 T2 are connected as shown. The experimenter may try reversing the leads to the primary, but he cannot do better than make the OS connection of the secondary always go to the grid. It is important always to see that the IS terminal of the secondary is connected to the negative terminal of B1. If connected to the positive, practically only a quarter of the signal strength will usually be obtained.

The circuit given will work a loud-speaker up to 10 miles from a broadcasting station without much difficulty, but, of course, very much louder results are obtained by the addition of an extra valve.

Such a circuit is given in Fig. 2, and in this arrangement an additional low-frequency amplifier is used. It will also be seen that the loud-speaker L.S. is shunted by a fixed condenser, which may have a value of 0.004 μF. This condenser, in the case of some loud-speakers, is not necessary, but in the case of others will be found to improve the tone.

The operation of the three-valve circuit is identical with that of the one and two-valve sets.

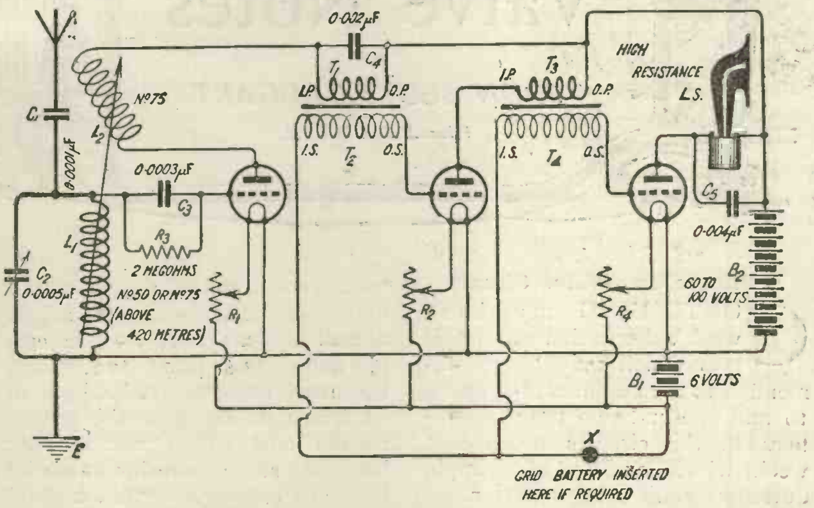


Fig. 2.—By the addition of another valve to the circuit of Fig. 1, good loud-speaker signals are obtainable.

□ □ □

THE NEW WIRELESS LICENCES

Experimental Limits.

SOME time ago the Postmaster-General announced that the conditions under which licences would be issued to wireless experimenters with transmitting powers were to be revised, and the new form of licence, which is now being issued, has caused some perturbation.

The chief alteration is a restrictive clause stating that "messages shall be transmitted only to stations in Great Britain or Northern Ireland which are co-operating in the licensee's experiments, and shall relate solely to such experiments. The use of apparatus for general calls, or the transmission of news, advertisements, or similar matter is expressly forbidden." The use of spark transmission is also forbidden on the ground that there is little value now in experimenting further in this direction, and a considerable body of amateurs will not regret the disappearance of the very flat tuning and interference which arise from this form of transmission. Continuous wave transmission can still be used, and so the facilities which amateurs have enjoyed for employing Morse wireless telegraphy to reach long distances will not be interfered with. It will be noticed, as the old licences are renewed, that the power to be used is now definitely printed in the licence as ten watts. In practice this has been the standard limit, although hitherto the figure has been written in, indicating that it is not necessarily an arbitrary amount. Actually certain amateurs have been allowed to use higher powers than ten watts for transmission, and a representative of the *Times* was informed at the General Post Office that there is no intention of withdrawing that privilege from any *bona fide* experimenter legitimately using the higher power accorded him, provided it is being used for genuine experiment. The Postmaster-General is always prepared sympathetically to consider applications for the use of a higher power if he is satisfied that a genuine scientific purpose is being served.

The object of the revised conditions is to reduce, as far as possible, interference with broadcast and other wireless transmissions, while at the same time allowing liberal facilities for experimental work, and the wave bands used by the experimenter have recently been reinforced by a wave band of from 150 to 200 and 115 to 130. The Radio Society of Great Britain has not yet had an opportunity to consider the new regulations, but they will come before the council of the society in due course.—*The Times.*

PERSONAL

Owing to the increasing pressure of business, due to the development of Radio Press, Ltd., Mr. John Scott-Taggart has relinquished all consultative appointments, patent and technical, hitherto held by him.

Doubtful Contacts

I HAVE always thought it a rather curious thing that we should pay such a great deal of attention to connections made beneath the surface of the panel and so little to those which are above it. If on removing the top of a beginner's set you find that he has not soldered his joints, but has connected wires simply by means of nuts to the shanks of terminals and valve legs, you will probably say at once, "Oh, well, there is no need to look much further; if you do not solder your joints you can hardly expect the thing to work." Yet this same beginner could with perfect justice point to a very great number of important connections upon your own set which are entirely innocent of any touch of the soldering iron!

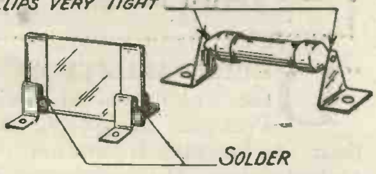


Fig. 1.—Illustrating the points of contact in certain types of fixed condensers and grid leaks where the connection should be made with care.

Your lead-in, for example, from the aerial comes to a terminal, as does your earth wire. The battery connections do not greatly matter so long as they are moderately good, but what about those of the grid condenser? You very possibly use those excellent little clip fitting condensers which are becoming so popular nowadays. If you do, the contact at either end is merely that made by pushing the condenser into a spring clip. The gridleak again is most probably held by another pair of clips. In addition to these you have certainly another group of unsoldered connections whose number is four times that of the combination of valves which you use; I mean the contacts between valve pins and valve legs.

I suppose that the principle which leads us to make soldered joints wherever possible beneath the panel is that we should make as many connections as we can quite secure, and that we must regard a certain number of chancy connections as inevitable. At the same time, in a really carefully made set we can reduce both the number of these unsatisfactory connections and the degree of their chanciness to an absolute minimum. To begin with, it is, I think, better to solder condensers of the kind referred to to their clips. The idea of having clip-in condensers is that one can have an outfit of various capacities and can try one against the other until the most suitable is found by experiment. This is a most useful system, but its usefulness comes to an end once the best capacity has been discovered. Therefore there is no reason why, after making our preliminary trials, we should not finally solder the condenser into place. The method of doing this has already been described in *Wireless Weekly*. The important points are to get both condenser and clips perfectly clean and to make a quick job of it with a very hot iron. In this way there is no risk of doing any damage at all to the condenser.

Gridleaks are a rather more difficult problem, for some kinds are certainly liable to suffer under the influence of heat. It is as well, perhaps, to ascertain from the makers whether the particular gridleaks that you use will stand soldering. If they will, well and good; but if not, the only thing for it is to make the contact as good as possible. This can be done, firstly, by enlarging the holes into which the pointed ends fit, so that they go well in and make contact with a large surface of the clip, and, secondly, by using clips of stiffish material so spaced that the leak is very tightly held in them. I may say that more than once I have traced noisiness in the receiving set to a loosely fitting gridleak or to dirty contacts between its points and the clips.

It is not always realised how bad is the contact even when two perfectly smooth pieces of metal are pressed together. When viewed under a microscope the smoothest surface has very much the same appearance as a portion of the seashore that is covered with jagged boulders of various sizes. Place two such surfaces together under pressure and you will still have a contact that is really very poor indeed. Some of the jags on the under surface will touch some of those upon the upper, but there will be quite large gaps and really very few points where a proper meeting takes place. The surfaces of terminals and of the contact points of wireless components are very far from being smooth; hence, we cannot expect our screw-down or spring contacts to be very good unless we take some trouble over them.

Take terminals first of all. The opposing surfaces of their nuts can be smoothed down by placing them in a lathe, if one is available, or otherwise in the chuck of the drill and polishing first with worn emery and afterwards with a soft cloth. See that

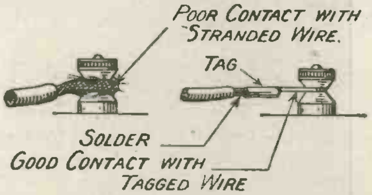


Fig. 2.—Showing how flexible wire should be connected to terminals.

the top nuts are fairly tight in their threads and reject any terminal in which there is a pronounced wobble. The contact between a heavy stranded wire and a smallish terminal may be very poor indeed. It is of little use to fit an expensive lead-in of say 36/40 wire if only a few of the strands actually come into touch with the nuts. For this reason the lead-in and earth wire should always be tagged—the tags themselves being well smoothed down and polished—it is best to do the same with every lead which makes contact with a terminal.

Valve contacts are very frequently a source of trouble. As is so often the case in wireless we suffer here again from lack of standardisation. Not all valve pins are of the same diameter, and there are slight differences in the spacing in various makes of valves. Some of them will be a tight fit in the holder of standard dimensions, whilst others may be comparatively loose. The points where trouble is most likely to occur are the grid and plate legs, the former especially, for the slightest uncertainty in a grid circuit contact is sufficient to produce noisiness or weak signals, or both. Everyone knows the old tip about opening out valve pins occasionally with the blade of a pocket knife, but not everyone puts it into practice. But this will not do everything. If a valve has been used for some time its pins are apt to get dirty and then results may be very poor. It is an excellent plan to keep a small strip of worn emery cloth in one of the drawers of the wireless table with which to give valve pins an occasional polish up. Another way of obtaining really good contact for the grid and plate legs is that shown in Fig. 3. The plate and grid legs have each a 6 B.A. tapped hole made into them, and into these are inserted the small set screws used in telephone terminals. With this arrangement one can always be sure that the valve contact is as it should be.

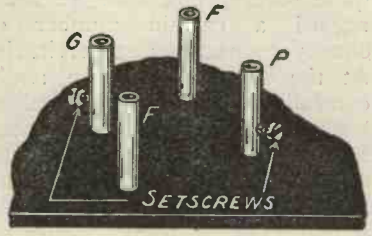
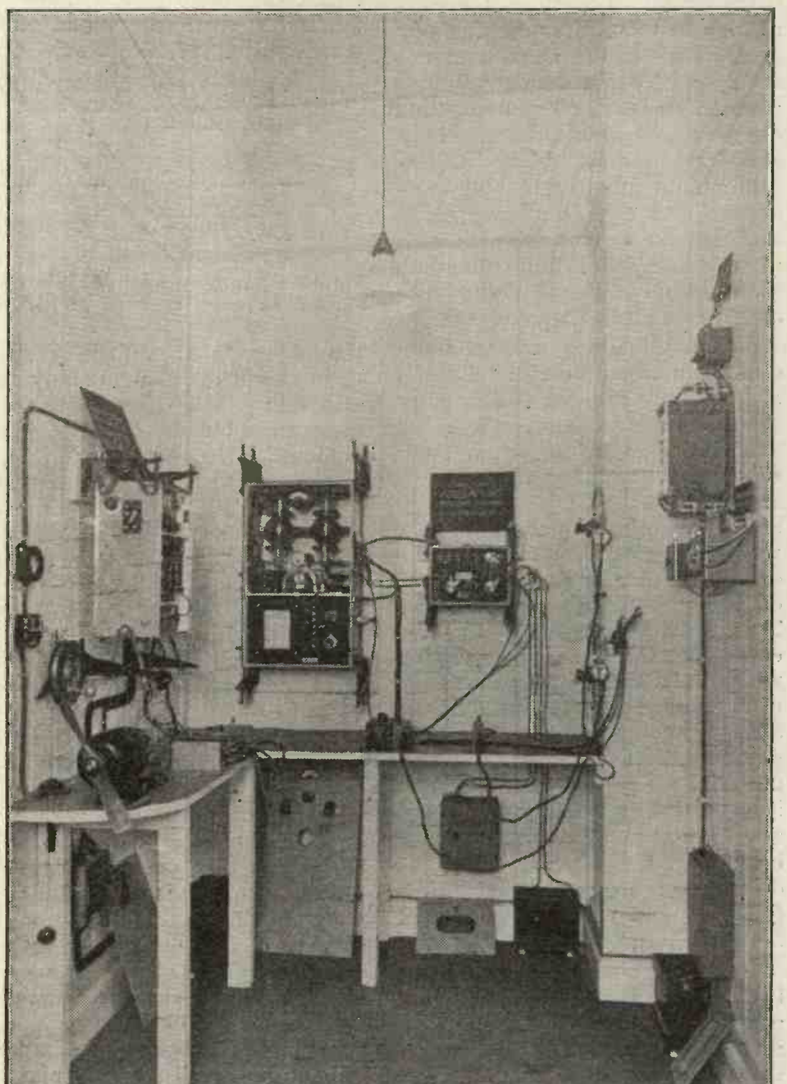


Fig. 3.—How to ensure good plate and grid connection in the valve legs.

Tubular valves of the V24 type are also liable to give a little trouble, as most of those who use them will have found by experience. Here all contacts are made between little bosses on the valve and spring clips. Those for the filament do not as a rule go wrong, but I have on several occasions known a mysterious falling off in signal strength to be traced to chanciness in grid or plate contacts. Here again the strip of worn emery cloth is an excellent preventive of trouble. It should be applied every now and then to the surfaces of both clips and contact bosses. The clips should also be given a slight bend inwards whenever the valve is removed. When using valves of this kind I generally place a small, thick rubber band round them just above the plate and grid contacts. The band is twisted on itself so that it goes twice round the valve. Loops of the band are then pulled out and slipped over both plate and grid clips, thus reinforcing their natural springiness and holding them very tightly against the bosses. R. W. H.



Tested Designs

"DEPENDABILITY" is the watchword of Radio Press set designers, and their technical reputation is staked upon the efficiency of every set they turn out. The reader is thereby assured that if he follows instructions *exactly,* wires up correctly, and uses components of tested reliability, *the set will work.* The only trouble, sometimes, is to decide *which* set to make, and that fact is probably one of the reasons why "Twelve Tested Wireless Sets," by Percy W. Harris (Radio Press, Ltd., 2s. 8d. post free) has had so great a success. Here are presented twelve designs so arranged and described that their suitability for given conditions is easily ascertained, and every one conforms to the Radio Press standard of reliability.

WIRELESS ON AIRCRAFT

On the left-hand wall is shown a Type AD6 Marconi combined transmitter and receiver with aerial winch, wind-driven generator, etc. At the back is a ½-kw. transmitter Type AD8 with receiver in a separate box. The aircraft D.F. Type AD14 is on the right-hand wall.

A typical ground installation is shown on another page.

Random Technicalities

By PERCY W. HARRIS, Assistant Editor.

Some notes of interest to both the home-constructor and the experimenter.

I HAVE recently come across several cases where beginners have been misled on the subject of sharpness of tuning in their own sets as compared with those of friends. Without giving a scientific definition of sharpness of tuning, it may be said that when comparing two different receivers on the same transmission, if de-tuning one of the receivers by 10 metres reduces the signal strength to a half and de-tuning the other by 10 metres reduces it to a quarter, then the second instrument has the sharper tuning of the two. Notice particularly that the de-tuning is in terms of *wavelength* and not in condenser degrees. Let me tell you how two friends were recently given quite a false impression when comparing a couple of sets.

* * *

Both sets were crystal receivers tuned with variable condensers. They were tried side by side one after the other on the same transmission and the same aerial. Set A was found when de-tuned by 4 degrees, not appreciably to reduce the signal strength. Set B, on the other hand, when de-tuned by the same number of condenser degrees, almost completely eliminated the broadcast station. Set B was immediately claimed to be a far sharper tuning receiver, and was praised for this reason, yet actually neither was better than the other. The error was in comparing sets on condenser degrees. Had the friends investigated further, they would have found that the set which seemed to tune much more sharply had a variable condenser of much greater capacity; the result was that de-tuning by four degrees on this set meant de-tuning by many more metres than was the case with the other. Actually the beginner will find difficulty in comparing two sets unless he has a wavemeter, an instrument, of course, very helpful in making any wireless tests of this kind. Be careful, then, in making comparisons to see if the sets are equally de-tuned in wavelength, not merely in arbitrary readings of condensers which will de-tune to a greater or lesser degree, depending on the capacity.

* * *

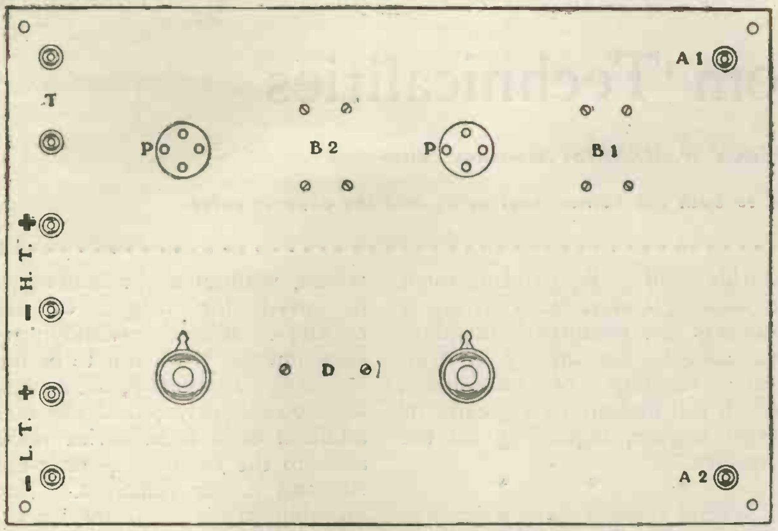
Several readers have written in appreciation of the small tip regarding the addition of Hudson's soap to frothy accumulators. One who has evidently made a considerable study of the subject states that no harm will come to the accumulator. Further experimenting has shown him that almost any soap will give the same effect. In order that bubbles may form, it is necessary that the liquid in which the bubbles are set up should have a certain "surface tension," as it is called. The effect of adding soap in this particular case is to reduce the surface tension of the acid, and so the froth breaks down. I should like to remark that so far none of the accumulator manufacturers has written on the subject, and I still await a line from any one of them. They should at least know what happens, and I think it is their duty to enlighten the public on this frothing problem, which does not seem to be referred to in any of their little pamphlets. Perhaps they do not like to admit that it occurs, but my correspondents seem to find a good deal of it.

* * *

Every week we see new types, shapes and forms of crystal detectors, very few of which show any striking novelty or particular utility compared with existing models, yet the one component which seems to me at the present time to be most useful is practically overlooked by manufacturers. I refer to filament resistances which can be used for bright or dull emitters. There is, of course, the carbon compression type, but of the wire type there seems to be only one which, without any addition, can be used for bright or dull emitters. It is very annoying in experimental work not to be able to change from, say, a .06 valve to a power valve, and the mere addition of a fixed series resistance to the existing 4- or 5-ohm rheostat is not sufficient. Such an addition gives the total resistance in the circuit well enough, but the variability is confined to a very small portion of this total resistance, namely, the 4- or 5-ohm part. Maybe there is a manufacturer who, unknown to us, is producing one of these resistances. If so, all who make sets would like to see it. Even the Burndept pattern, an excellent resistance in construction and action, needs a change of voltage if we are going from a power valve requiring a 6-volt accumulator to a .06 valve, as the dull emitting portion of this resistance only works satisfactorily with a 4-volt accumulator. The carbon compression types are the only ones at present which enable a 6-volt battery to be used for either type of valve, and even with the best of these you are never sure of reproducing the same voltage twice by the same number of turns of the knob. With the semi-circular wire type of resistance you are always sure that by turning to, say, 10 degrees, you will insert a certain amount of resistance in circuit.

* * *

Several excellent commercial sets are now sold complete with frame aerials for the reception of local, and even distant, broadcasting stations. If you should purchase one of these sets it is well to try it in the different rooms of the house, for some rooms will give far better results than others. Sometimes it is found that three times the signal strength is obtainable in one room, compared with that obtained in another. Try as many experiments as possible to find which is the best spot.



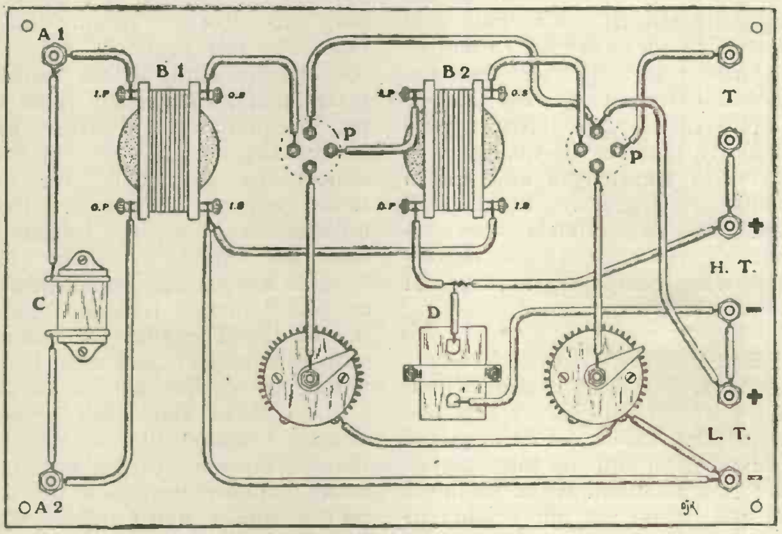
The layout of the panel.

Practical Back-of-Panel Wiring Charts

By OSWALD J. RANKIN

A Two-Valve L.F. Amplifier.

A very simple 2-valve note magnifier suitable for a valve or crystal receiver. A1 and A2 are the in-put terminals, which are connected to the telephone terminals of the receiver, B1 and B2 are the L.F. intervalve transformers, C is a .001 μF fixed condenser connected in shunt with the primary winding of B1, and D is a 2 μF Mansbridge condenser connected across the H.T. battery terminals. Valve plate sockets are indicated by the letter P, as in all other diagrams.



Practical back-of-panel wiring.

A Question on H.F. Amplification

What are the respective uses and advantages of the different methods of High-frequency Intervalve coupling?

The method which commonly gives the greatest amplification per valve is that known as the tuned anode method, which consists of a tuning coil and condenser connected in the plate circuit of the valve, tuned to the received wavelength, and coupled to the grid of the succeeding valve by means of a small grid condenser and leak. For a single high-frequency valve this method is probably the best, since it is uniformly efficient upon all wavelengths and is fairly easy to handle. Where more than one high-frequency valve is used, however, this type becomes somewhat unstable and difficult to operate, and it is then usually preferable to employ the tuned transformer method, which consists of a high-frequency transformer, one of whose windings, either primary or secondary, is tuned by means of a very small variable condenser. Such transformers can be easily designed to introduce a certain amount of damping in the intervalve circuits and thereby one can stabilise the receiver to any desired degree. Where more than two high-frequency valves are employed, or where it is desired to have a receiver of extreme simplicity, it is usual to employ the semi-aperiodic type of transformer, which is wound with very fine resistance wire to flatten the tuning of the windings so that no tuning condenser is needed. This type does not give so much amplification, but it is very easy to handle. For long wave reception above about 1,000 metres the resistance-capacity method is extremely useful, since it is very stable and easy to handle, there being no tuned intervalve circuits. This method operates by virtue of the fact that if high resistances are connected in the anode circuits of the valves, fluctuations in the plate current caused by incoming signals will produce fluctuating voltages across the ends of these resistances, which can be transferred to the grid of the next valve by the usual grid condenser and leak. The amount of amplification given by this method, however, is not very high.

A Grid-Biasing Switch for Two Valves

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

IF you want to get the most out of your low-frequency valves, obtaining the loudest signals in combination with the greatest purity, use a high anode potential for them, and apply a suitable negative bias voltage to their grids. A common practice which I strongly recommend where two low-frequency stages are employed is to use for the last one a small power valve such as the LS5 or the Mullard D.F. A1, and for the penultimate stage an ordinary receiving valve such as the Ora, R5, or any other type which has a sufficiently long straight portion to its curve and will stand a fairly high plate voltage. Where only one kind of valve is used for both stages the same anode voltage and grid biasing potential can be applied to each, but if, as suggested, the last two valves are of different kinds, it is advisable to be able to adjust the grid potentials independently so that each valve is properly balanced at its best working point.

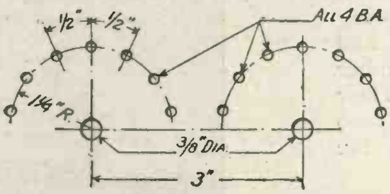


Fig. 1.—Details of the panel drilling.

The writer has recently fitted to one of his sets a double grid battery switch, which he has found very handy indeed. The cost of making it up is trifling—the matter of half-a-crown or so—and it makes an immense amount of difference to the quality of the reception. It is also perfectly easy to make, since its construction demands no more than the drilling of fourteen 4B.A. holes and two ⅜-inch holes, together with the soldering of connections, which is quite a straightforward job. The double switch may be mounted either upon the panel of the set or upon a box provided with three terminals which serve to house the grid battery. In the last case the three terminals should be marked LT, V1 and V2 respectively.

The materials required are two selector switches, obtainable from advertisers at about a shilling apiece, fourteen 4B.A. screws with countersunk heads, and for the battery two Ever-Ready No. 15 4½-volt units. These last are chosen in preference to small pocket flashlamp batteries for two reasons: In the first place, they contain much larger cells, and therefore last longer; and, in the second, by simply removing the cardboard top of the case the cells and the brass strip connections between them are exposed. Soldering is thus a simple business, and one has not to chip away any pitch covering with the chance of breaking the thin wiring connections between cells whilst doing so. Fig. 1 gives the drilling layout of the switches. The centres of the ⅜-inch holes which take the spindle bushes are 3 inches apart, whilst those for the countersunk screws which take the place of the more usual studs are placed on the circumference of a circle with a radius of 1¼ inches. These holes are spaced ½ inch apart, so that the arm may not be able to touch two at once—if it did so it would short-circuit one cell of the battery. The 4B.A. holes may be either clearance or tapped according to the preference of the constructor. The writer prefers to make them tapped, for then the screws can be so adjusted that all are exactly level. Each of the 4B.A. holes should be countersunk, so as to allow the head of the screw to lie flush with the panel. Fig. 2 illustrates the switch, showing the spindle, the arm and one of the screws in position. Screws are used instead of studs, so that the action of the switch arm may be perfectly smooth even though there are considerable gaps between the connections. If for any reason the constructor prefers to use studs he must place a dead stud between each pair of live ones.

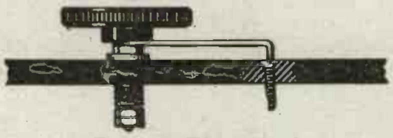


Fig. 2.—The switch.

The wiring is shown diagrammatically in Fig. 3. The first step is to connect the corresponding studs of the two sets, which is best done by short lengths of bare wire on the underside of the panel. The writer's method of connecting the switches to the battery is as follows:—Seven equal lengths of flex wire with an inner rubber covering are prepared, the outer silk or cotton sheath being slipped off. Both ends of the first length are then bound with, say, red silk, blue being used for the second, green for the third, and so on. One is thus able to distinguish the different leads at a glance. Do not begin by soldering leads to the battery; if this is done short circuits are almost sure to take place, whilst the later stages of the work are in progress. Solder them to the bare wire connections between the pairs of studs. Now connect the two batteries in series and solder a wire from the zero stud to the plus terminal. Continue with the remainder, soldering in the proper order to the brass strips between cells until the 9-volt lead is reached which is soldered to the minus terminal of the battery. The flex leads can now be bundled together into a cable and wrapped round with Empire tape or sticking-plaster. When the battery runs down, as it will after many months of service, it is a simple business to unsolder the various leads from the brass strips and to connect up the new battery, for the coloured bindings show at a glance the proper connection for each wire. R. W. H.

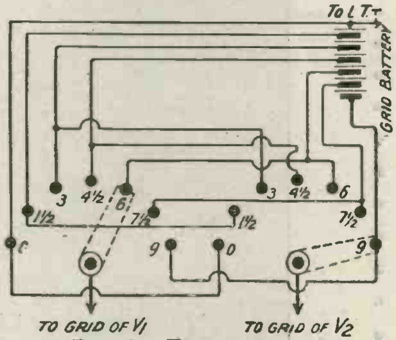
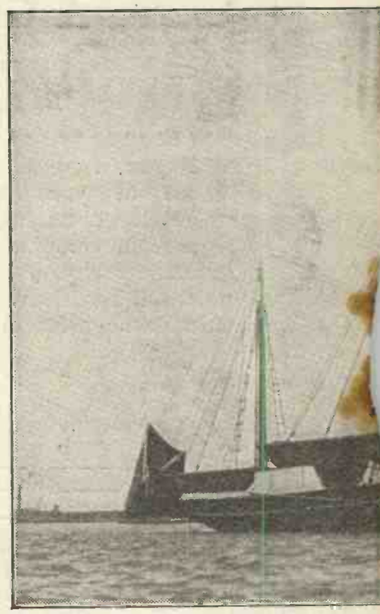


Fig. 3.—The connections.

The Omni Receiver in the Arctic

A GOOD deal of public interest has been aroused by the Algarsson Expedition, now about to sail from the Thames for the Arctic circle. The frail nature of the craft and the smallness of the crew alike appeal to the imagination, more especially when it is realised that after the work is finished in the Arctic the vessel will return direct across the Atlantic to New York. The Expedition is a Scandinavian one, but is going to carry out hydrographic and other survey work for a number of different Governments. Their destination is a point some 200 miles from the Pole, and the

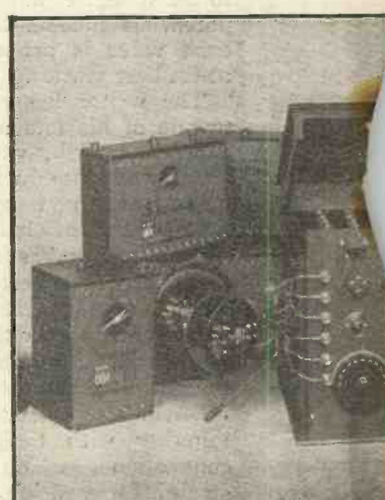


The Ketch "Belt

Mr. John Scott-Taggart, the designer of the Omni receiver, operating the set.

cruise is regarded very largely as a preliminary to another attempt next year, when it is hoped that the Pole will be reached.

For some weeks the "Beltai" has been lying in the Thames off Erith, Kent. She is a small vessel of 23 tons, and some idea of the difficulty of the erection of the aerial will be gathered from the photograph of the vessel herself. She is of the type known as a ketch, and possesses two masts, between which it was quite impossible to string the aerial in



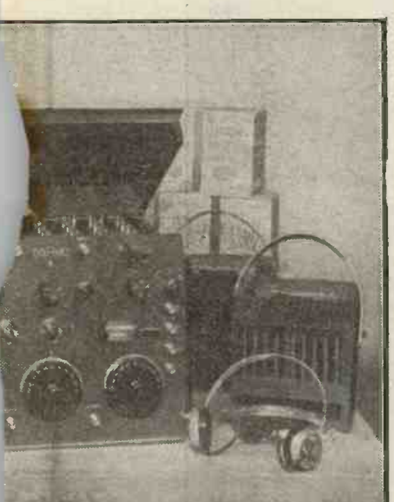
A general assembly of the equipm
on the

...t lying off Erith.

possible point from which the downlead could be taken proved to be the upper end of the aerial, and a most difficult problem arose as to how this was to be brought down to the level of the deck. It could not be brought in the obvious manner straight down the mast, because it would have interfered with certain of the running rigging, and the only possible route for it proved to be down the steel ratlines, no doubt a very undesirable method, but the only possible compromise in the circumstances. Even after its arrival upon deck the lead had to follow a somewhat devious route for some distance

It is noteworthy that the leaders of the Algarsson Arctic Expedition have chosen the Omni receiver to take with them into the Far North. This article describes the installation.

the usual position, because certain of her sails would have fouled it, however it was arranged. Furthermore, a downlead at any intermediate point between the two mast heads was entirely ruled out by the arrangement of the rigging. The only possible position for the span of the aerial proved to be that visible in the photograph, that is to say, between the mast head and a point in the bows, the aerial being of the twin type with 6 foot spreaders. The only



...ent provided, before being installed ... vessel.

Left to right: The Doctor, Navigating Officer, Editor of "Wireless Weekly," Secretary of the Expedition, Felix—the mascot.

along under the bulwarks, and then across the deck and through a skylight. Since a great part of the route of the downlead was liable to be wetted by spray at any time, and also to be submerged at intervals by seas breaking inboard, the question of the type of wire to use for this and for the aerial itself whose lower extremity was liable to similar treatment, was naturally a serious problem. Remembering the corrosive action of sea water, it was obvious that an extremely durable form of insulated wire was necessary, and recollections of its enduring qualities in Service days led to the choice of the telephone cable now being sold for the erection of aerials by The New London Electron Co. This wire has great mechanical strength and resistance to corrosive influences, and was used for the whole of the aerial and the downlead. A joint was unfortunately necessary at the point of attachment of the downlead to the twin aerial, since only a single downlead was possible. The joint was carefully soldered, bound with pure rubber tape, and then with adhesive insulating tape, and finally tarred.

The Receiving Set

The receiving set supplied to the Expedition (no transmitter is carried) was a three-valve *Wireless Weekly* Omni Receiver built from the original specifications in *Wireless Weekly* by Messrs. Burne-Jones, this receiver being chosen because it was very difficult to predict the particular circuit which would be needed in the very bad conditions which the installation would have to work under, and it was thought that only by trying a variety of circuits would it be possible to obtain satisfactory results. Furthermore, the interest of experimenting with the different circuits was expected to prove a great source of interest to those of scientific inclinations among the Expedition.

The Marconi Company very kindly gave the members of the Expedition permission to use any of the circuits covered by Marconi patents, in the course of the voyage.

The suppliers of the various apparatus are as follows:—

Omni Receiver.
Burne-Jones & Co., Ltd.

(B5, 0.06) Valves.
B.T.H. Co., Ltd.

Accumulators.
Hart Accumulator Co., Ltd.

Dry Batteries.
Siemens & Co., Ltd.

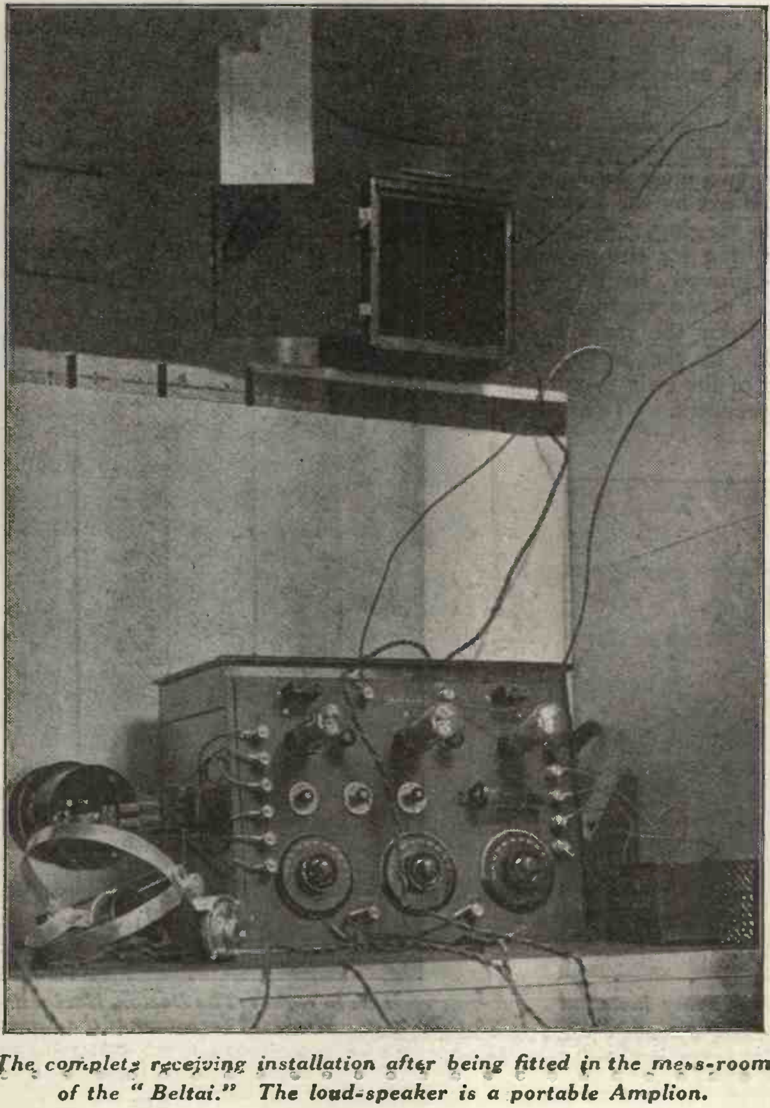
Telephones.
S. G. Brown & Co., Ltd.

Loud Speaker.
Alfred Graham & Co., Ltd.

The actual installation of the receiving apparatus proved a far from easy matter, because the space in which it had to be fitted was naturally exceedingly small and the accommodation for the operator is naturally very limited.

But notwithstanding all these drawbacks, it proved that quite good results could be obtained with a very simple circuit once the set was actually installed, and it is hoped that time signals from Paris and Nauen will be obtained throughout the voyage and also from some of the American high-power stations towards the end of the cruise, since it is the intention of the Expedition to return direct to New York when their work in the North is finished. Time signals are naturally their principal object for navigational purposes, but they also hope to be able to pick up some of the B.B.C. stations to while away the tedium of life on so small a craft.

They hope to keep the set in constant use throughout the voyage, notwithstanding the extremes of temperature to which the apparatus will be exposed.



The complete receiving installation after being fitted in the mess-room of the "Beltai." The loud-speaker is a portable Amplion.

The Wireless Valve and How it Works

By JOHN H. MORECROFT, E.E., Professor in Electrical Engineering, Columbia University, New York City.

The conclusion of a new and exclusive series of articles which began in Vol. 4, No. 1.

Modulating the Voice with the Valve

In radio telephony it is necessary to vary the amplitude of the high-frequency current in the aerial according to the voice-frequency which it is desired to transmit. This is best accomplished by using an extra valve as a so-called modulator; the function of the extra valve is really to use up more or less power from the oscillating valve and hence to make the aerial current vary. The best arrangement for this purpose is shown in Fig. 21; it is due to Heising and is the well-known Heising scheme for modulation.

Both oscillator and modulator draw their plate-current from the same machine and through the same iron core choke-coil, shown in Fig. 21 connected directly above the plate circuit generator Eh. This choke-coil prevents the current supplied to the combination of two valves from varying appreciably; that is, they both together draw a constant current from Eh. The microphone M, is used to control the potential of the grid of the modulator valve through a step-up transformer N. The variation of the potential of this grid will make the plate circuit of the modulator valve take more or less current from the plate circuit of the oscillator valve, as the sum of the two plate circuit currents must be essentially constant. As the amplitude of the high-frequency current supplied to the aerial by the oscillator depends directly upon the amount of current supplied to it by the H.T. machine it is evident that the action of the microphone M will control the amplitude of the aerial current, making the envelope follow the voice sound action at M.

"Wired Wireless"

A new use of the triode in wire telephony makes it possible to send many telephone conversations over the same pair of wires at the same time. The scheme used is the invention of Major-General G. O. Squier and makes it essentially a radio telephone set, both sending and receiving, but instead of broadcasting the waves in all directions they are sent along ordinary telephone wires.

The frequency of the currents used are not as high as those used in radio, being generally between 5,000 and 30,000 cycles per second. A transmitter generating, let us say, 20,000 cycles is connected by two telephone wires to a receiving circuit tuned to receive 20,000 cycles, and regular communication is established by the same electrical circuits and actions as though the two stations were using actual radio waves. A detector and amplifier are necessary at the transmitting station just as they are in a radio receiving station.

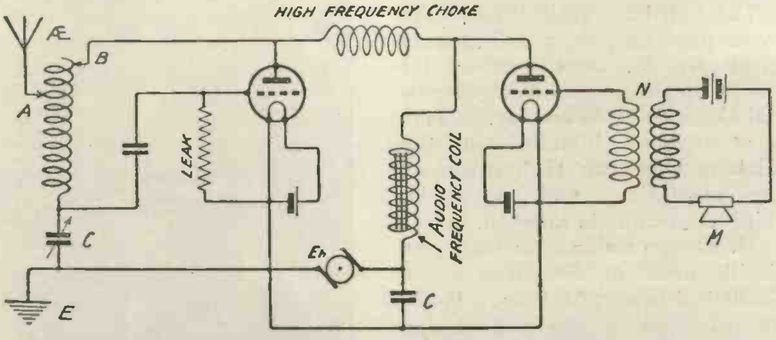


Fig. 21.—The circuit diagram of the Heising modulation system. Note: For simplicity the filament resistances have been omitted. The transformer N has an iron core.

Such "carrier telephony" or "wired wireless," as it is variously called, will probably never have the vacuum valve apparatus located on the subscriber's premises; it will be installed only in the telephone exchanges, as at present. The carrier current is sent out only between exchanges, that is, over trunk lines. Thus, when subscriber *A* talks into his microphone, ordinary audio frequency currents are sent to the exchange with which he is connected. Here a carrier frequency oscillator is operating and the voice of subscriber *A* modulates (varies the amplitude of) this carrier frequency wave, whereupon the modulated wave is sent to the next exchange with which subscriber is connected. In this second exchange are installed a detector and amplifier and the detected current is sent out from the exchange to subscriber *B* as ordinary audio frequency current, just as though *A* had been talking directly to *B* by ordinary telephone currents.

It is feasible, commercially, to send over a trunk telephone line about five carrier frequencies as well as one audio frequency current at the same time without interference. This increases the possible number of calls handled between exchanges by six times as many as would be possible without the scheme, and without installing any more telephone cables.

Radio Telephony and Wire Telephony Combined

It will also be seen by the imaginative reader that he may, while sitting at home, carry on a telephone conversation with a friend in America, or anywhere else in the world, by such apparatus as has been described. He may, for example, talk into his microphone in London; the current started in his microphone will be transmitted by wire to a large radio central station. In going the hundred or two miles from London to the sea coast, where the radio central would be located, however, it would be necessary for the voice current to be amplified by valves used as amplifiers at various points in the wire telephone system. These are called "valve repeaters," or merely "repeaters." At the radio central station the voice current would control the grid potential of a small valve, this resulting in corresponding changes in the plate current. This would be successively amplified by valves until it was powerful enough to control the output of a 100-kilowatt valve oscillator. This modulated, powerful, high-frequency wave would be hurled into space for thousands of miles in all directions. It could be picked up by an aerial in America, changed from a modulated high frequency current to audio frequency current, put on the ordinary telephone wires and thus transmitted to the friend in question. And even after the tremendous changes which would have been imposed upon the weak current generated in the microphone at London, the received speech in America would very likely be clearer than if it had been transmitted over only a few miles of poor telephone line.

It will be noticed that at every step of this miraculous accomplishment, to-day possible even though expensive, the ubiquitous three-electrode valve, first built by DeForest, then perfected by the workers in research laboratories and finally fitted with the remarkably functioning circuit connections of Armstrong, is quietly playing the all-important parts. Even a Jules Verne, with all his wonderful imagination, would find it difficult to predict all the feats which this device will undoubtedly be carrying out at the end of the next decade.

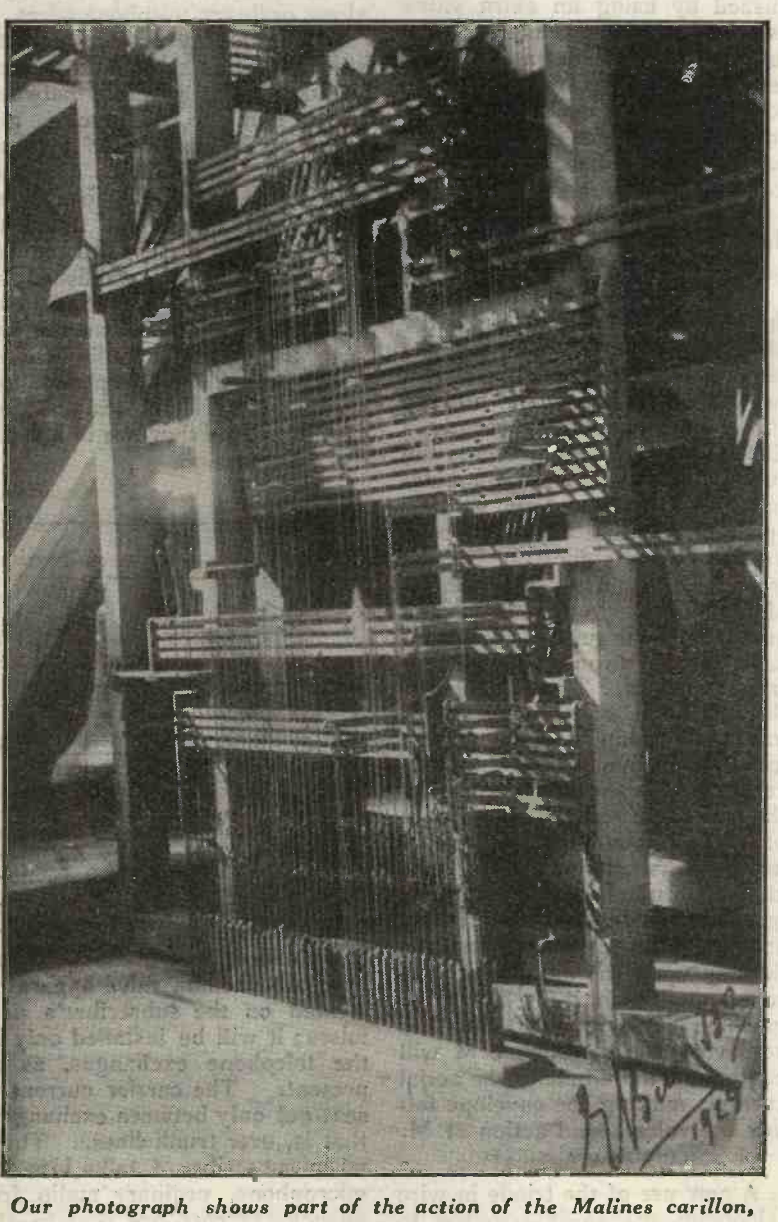
Broadcasting the Malines Carillon

The broadcasting of the carillon from Malines Cathedral has practically been settled. Captain West has been over to Brussels, and has arranged that on June 30 the Brussels broadcasting station will broadcast the carillon, when it will be conveyed by land line from Malines to Brussels, be picked up by wireless at Biggin Hill, and then relayed to London and broadcast from the Studio in the usual way. The bells will be rung by M. le Chevalier Jef Denyn.

The half-hour recital from 9.30 to 10 p.m. on July 5 will also be given by M. le Chevalier Jef Denyn on the Simcoe War Memorial Carillon at Wembley. This is at present installed in the Vickers Research Hall tower at the exhibition, and is to be shipped to Canada later on.

M. Denyn follows his father as Carillonneur at St. Rombold's Cathedral tower, Malines. He is the principal of the School for Carillonneurs which has been set up under the auspices of the Belgian Government in that town, and is acknowledged to be the foremost carillonneur of the day. Some few years ago King Albert attended one of his recitals, and about that time he was created Chevalier of the Order of Leopold.

Until the New York Carillon of 53 bells, which is under construction, has been completed, that at Malines still takes precedence as being the heaviest and most important carillon in the world.



Our photograph shows part of the action of the Malines carillon, equivalent to the mechanism of a piano between keyboard and wires.

Faithful Reproduction by Broadcast

By P. P. ECKERSLEY, M.I.E.E.

The discussion following the paper recently read before the Radio Society of Great Britain.

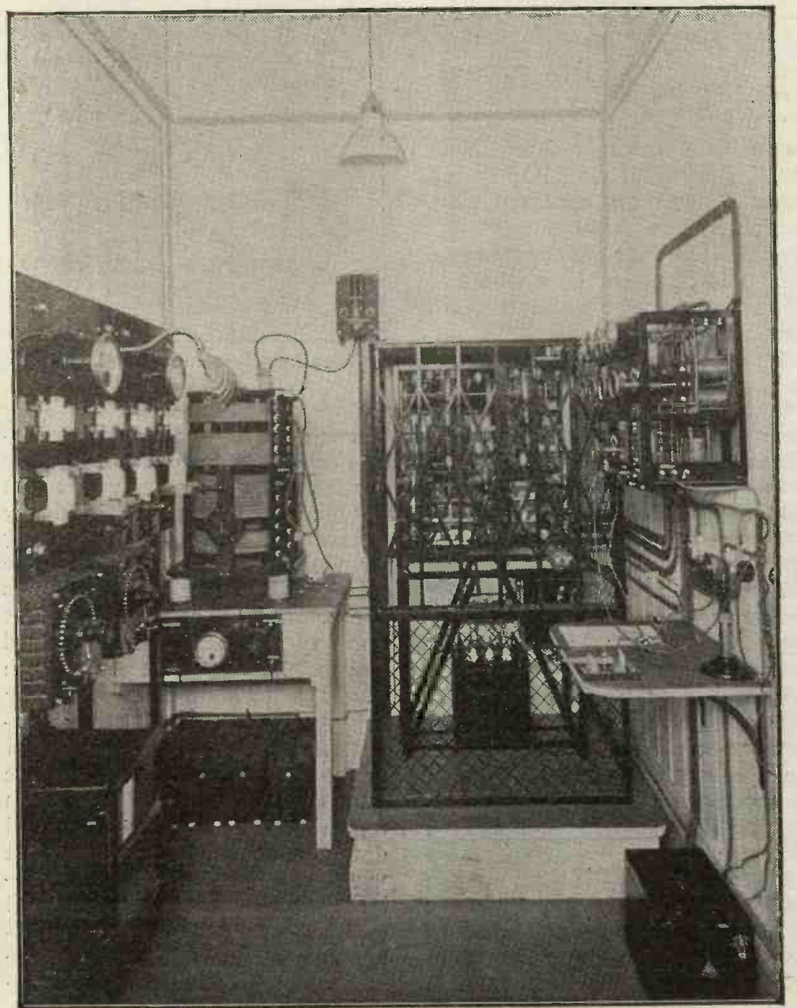
(Continued from page 217.)

Earl Russell

I have just whispered to my neighbour that probably in his reply to the questions that have been put Captain Eckersley will give amplification without distortion. (Laughter.) I have been interested in wireless just long enough to know that I know nothing about it. Possibly in five years time I shall begin to have a view on the subject, but I shall certainly not express one to-day.

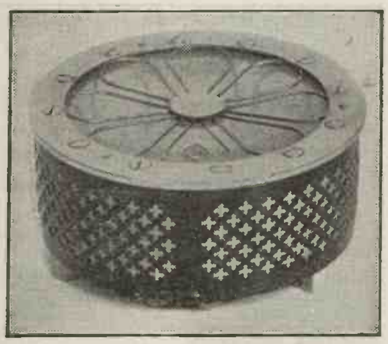
Mr. P. G. A. H. Voigt

Captain Eckersley has tried to make things so simple by putting everything down to amplitude that I think he has run off the rails a little. Like most other people, I have been thinking of the subject of the perfect loud-speaker for a long time, and I believe I have got a certain stage of perfection. It has not been published yet, because it is not far enough advanced. Most people begin by considering the ear, but my own opinion is that in the transmission of sound the ear has got nothing to do with it, except at the finish. Imagine you have got a studio and that you have bored a hole in the wall of the same diameter as the mouth of your loud-speaker. You are listening in the next room through that hole; you can put a fan in it if you like, but so long as you have got a hole, sound is coming through it. What we have got to try to imitate is the exact way in which that sound comes through. Sound is an air vibration having amplitude, pressure, and velocity. I worked things out in my head—I am not good at maths., although I had to be once—and came to the conclusion that the maximum pressure varies directly as the maximum velocity and is in phase with it, and the relation is the same at all frequencies, but if you try to get the relation between amplitude and velocity it is not the same. At a lower frequency the velocity lasts a longer time, and therefore the amplitude is greater, so that if you go an octave lower, and keep the same velocity or pressure, you have double the amplitude. If you watch a man in a brass band hitting his drum, you can see the drum diaphragm move about half an inch. That means he is setting into motion a good many cubic inches of air, and that, more or less, seems to prove that at the lower frequencies you get a much bigger amplitude and a much bigger volume displaced through that hole. If you try to transmit that, your very low frequencies will use the whole carrier wave and the top frequencies will be washed out. Therefore I rather fancy that by leaving pressure out of it and getting electric current of equal amplitude for equal sound amplitudes your lowest frequencies are going to drown everything. If you "differentiate" it, as Captain Eckersley has said, so that as your frequency gets lower the electrical amplitude gets less for a given sound amplitude, you get the same state as if you have equal electric amplitudes for equal pressures. The pressure output of



The Marconi 1½ kw. Type "U" transmitter for aerodrome ground stations, for telegraphy and telephony transmission. The station can be controlled by the switch board on the extreme right or by remote control methods at a distant receiving station.

your loud-speaker should then be proportional to your electrical input. As the horn is an unknown quantity I have, for preference, left that out. I have used a conical diaphragm, but that resonates, and I am making a diaphragm that I hope will not. It is not conical and it is not flat; it is something else, and it does not work from the centre. The driving part has not got a reed in the ordinary sense with a natural frequency. Captain Eckersley has drawn some curves in which he has taken frequency as a base. Now what happens on a frequency curve? The whole musical scale covers 8 to 11 octaves. If you have frequency as a basis, the highest octave, say, 5,000 to 10,000 cycles, is going to occupy one-half of your graph paper. If you use wavelength—sound wavelength—for a base, the lowest octave—between 30 and 60 cycles—occupies again half of your graph paper. But there is no need to waste all that paper and crowd all the useful octaves into the margin. The correct method is to have octaves as the base, but I suggest it would be convenient to use an apparent scale which has its mid-point at 512 cycles. On the right-hand side of that mid-point the base would be the sound wavelength (that means that the highest frequencies would all be crowded into the margin because they are not very important, and the important frequencies from 512 to 1,024 would occupy one quarter of your graph paper). Below 512 your base could be frequency. (Then you crowd your lowest frequencies into the left-hand margin and leave the 256 to 512 octave occupying one quarter of the page on the left side). Then you have a base in which frequencies of 256 to 1,012, *i.e.*, the octaves which are most useful, occupy half of your paper. The remainder is also on the paper, but roughly in the proportion in which it is required. As for the one valve per mile, I do not agree with Captain Eckersley at all. If you live ten miles away and have ten valves, I should think the distortion would be something terrible, even if you have valves the size of a football and H.T. to match. With regard to grid current, perhaps it might be of interest if I mention an experiment. I was working with a loud-speaker and tried to amplify further, but found I could not do so without distortion, so I began to measure things. In the place of the telephone transformer I used an inter-valve transformer. The peak voltage on the secondary was 50 volts, and I applied that voltage to the grid-filament in the usual way without grid bias. On the positive side the maximum voltage was 3 instead of 50. That is the reason for the distortion, and it is the reason why most people who build up sets from books, or who have not a suitable milliammeter in circuit, do not know that they are distorting, and are responsible for some of the results which have been indicated by Captain Eckersley. With regard to the hornless loud-speaker, I tested quite recently a loud-speaker of



A hornless loud-speaker.
("The Ultra.")

French origin—not a Lumiere—having a very large conical paper diaphragm, and I was very much astonished to find the efficiency was about half that of the big Brown loud-speaker, so that those who say that the horn increases the volume by 150 times are a bit short of the mark. With regard to echo, it seems that people with loud-speakers do not want any echo, and those without loud-speakers want it, and therefore I suppose the B.B.C. have to judge what to do for the best. With regard to detection, a crystal detector was once measured. It was put on to a 2-volt accumulator, and the current was found to be only 1/20th of a milliampere. Then we changed the accumulator over and the needle did not move, but we found we should have reversed the milliammeter. (Laughter.) When we did that we found the needle went right across the scale to 4 milliamperes, so that the rectification ratio was of the order of 80 to 1. After one stage of high-frequency, the rectified voltage across the blocking condenser is of the order of 4 volts, and if you have a rectification ratio of 80 to 1 there is not much room left for the square law. As long as you have got micro-volts to deal with you can have the square law, but when you get within 20 miles of the B.B.C. with high-frequency it is a straight line law, and that is one of the reasons why a set with crystal detection is better than a set with a valve detector.

Mr. E. Cudden

I think it would be much better if loud-speakers were not curved or made with metal horns. It is often the endeavour to get the curved form which introduces distortion. I have got over the difficulty by using a gramophone attachment to a loud-speaker and using a wooden gramophone horn 22 ins. long, which is straight. It has a rubber connection, and there is no distortion on account of curvature. Mr. Fogarty has asked Captain Eckersley a question with regard to the use of the capacity and resistance coupling in low-frequency amplification. I have tried it and found it very satisfactory, and, provided you increase the value of your H.T. to the proper potential, the amplification is very little less. Then the choke method is also satisfactory. With regard to rectification, a good many people use high-frequency when near to 2LO, and there is a tendency to introduce distortion here. If you want the best results with a loud-speaker, do not use H.F. when near a broadcast station. I do not use reaction or H.F., and I do not use an earth. I do not know how it is, but I get perfectly satisfactory results without one. I have got a 40-ft. lead to the loud-speaker, and that seems to act as an efficient capacity earth. A resistance of 120,000 ohms is also satisfactory across the transformer secondary. The lecturer was sceptical about obtaining the best results from tuning on the secondary of the intervalve transformer, but I have found it very satisfactory, and it is far better than putting the loud-speaker across the terminals. If your capacity is more than 0.001 you will get distortion, but if not you can vary the tuning in the loud-speaker and get a beautiful effect from music or speech. The only curious thing about it is that the best setting of the condenser is not nice for speech.

Mr. Robinson

I am surprised that in connection with distortionless reception no mention has been made of the push-pull effect. There is the push-pull amplifier and also the Western Electric double-button microphone, in which the same effect is made use of. I wonder if Captain Eckersley can expound somewhat the idea of push-pull amplification. I take it that the idea is to balance out the curved components of a valve system or eliminate the output currents which are proportional to the square of the input voltage instead of being a linear function. In any case, it would be interesting to know something about the push-pull amplification effect and the extent to which its use is justified. I would also like to have some information, if it is available, as to whether there are any methods for converting electrical energy into sound energy by any means other than the mechanically-moving diaphragm. Is there any method of causing variations in air pressure directly by the action of an electrical current, an ionised gas stream or anything like that? It occurs to me that the ideal loud-speaker made on such lines would dispense with mechanical distortion caused by mechanically-moving parts. The thing which has come to mind is the Simon talking arc, which I have given a trial, but I found the sound feeble owing to the low amplification I was using. I thought it might be of interest to see what I could do with such an arc, using a Bunsen flame very highly charged with sodium vapour and applying good beefy L.F. speech currents across the flame, and I obtained good speech in that way. There was a little distortion owing to the irregular discharge of the flame, but at times the higher harmonics were exceptionally good, and I have not heard anything quite like it from any other loud-speaker.

Captain Plugge

I should like to ask the lecturer why he has decided on such a high-pitched note for the tuning signal of his stations. It appears to me that in order to provide means for sensitive tuning a lower frequency, acoustically speaking, would be preferable. Another point arises out of the interesting lecture this evening. I think we all appreciate that most of the distortion, if not all, is to be found at the receiving end, and a good deal of the remarks to-night have been directed towards the loud-speaker. Personally, I am very much in favour of the hornless loud-speaker, and I am sorry to say that I do not think manufacturers in this country have devoted enough attention to this type of instrument as compared with Continental manufacturers. I brought back a loud-speaker from Paris some six months ago —hornless—and having compared it with several good makes of horn loud-speakers, I am satisfied that the hornless loud-speaker, everything else being equal, gives better reproduction. It appears to me, since our lecturer to-night has pointed out the difficulties encountered when dealing with acoustics, that it is preferable to perform all the work possible in the electrical field, and do as little work as possible in the acoustic field. If a powerful signal is required at the receiving end, it is preferable to have a diaphragm large enough to produce such a signal, and amplify the current sufficiently before it reaches the loud-speaker, leaving the sound vibrations untouched. The ear is a delicate organ which is hurt by any unnatural sound. If a horn is used the mind is continuously conscious that some mechanical device is being employed. Therefore, I think that the future of perfect reproduction greatly lies in the development of the hornless loud-speaker.

(To be continued)

Successful Wireless Test with South America

Tests made by Senatore Marconi from Poldhu to Buenos Aires in the Argentine Republic have been eminently successful. The first message transmitted was from Senor Le Breton, Minister of Agriculture of the Argentine Republic, who is at present in London, to General Justo, Minister of War, Buenos Aires. The message was in Spanish, of which the following is a translation :—

" Marconi, who combines great power of realisation with his Latin genius, favours us by selecting Buenos Aires for his first experiment of absolutely direct communication. I avail myself of his generous offer to tender a most cordial salutation to the steadfast defenders of our national flag."

This is the first message which has been transmitted to the Argentine by the Beam system, and according to telegraphic advice just received by Senatore Marconi the message was received practically instantaneously in Buenos Aires upon a single transmission.

There is now every reason to expect that we shall soon be provided with a direct telegraph service to the South American Republics ensuring the delivery of messages within a few minutes of their transmission and at substantially reduced tariffs.

□ □ □

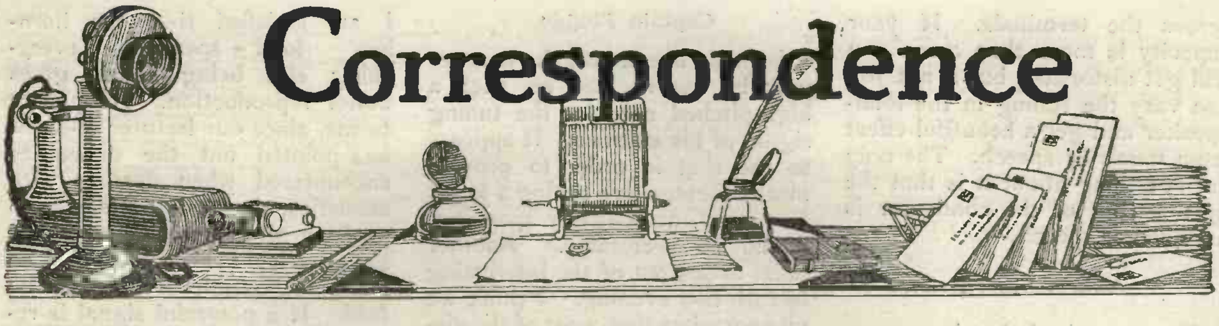
B.B.C. NOTES

It is not generally known that Captain Eckersley is the grandson of Professor Huxley. It would be very interesting to know what his distinguished grandfather would have had to say about the educational possibilities of broadcasting. It is more than probable that he would have been somewhat sceptical.

* * *

Mr. H. L. Kirk, on the development side of the B.B.C., has been responsible for the improvement in quality of the Edinburgh transmissions. There is no doubt that the problems met with there were something outside the ordinary experience of the B.B.C. so far as relay stations are concerned.

Correspondence



RECEPTION WITHOUT AN AERIAL

SIR,—Your readers may be interested in the following results obtained without an aerial. Two earth connections are used. C1 is a 0.001 μF. variable condenser. L1 is a plug-in coil (about 40 turns for 2LO) variably coupled to the receiver. L1 is chosen to keep the amount of C1 in use fairly large.

For best results the earths must be good, so that E1, C1, L1, E2 forms a low-resistance circuit. My arrangements are as follows :—

Case 1.—Set in first floor room near window. First earth lead about 5 ft. of wire to a main water-pipe in same room—the pipe drops down direct into ground immediately below. Second earth about 14 ft. to a second pipe on same water system in yard below. It is necessary for the best results that the pipes enter the ground in different places. In this case the distance is 6 ft.

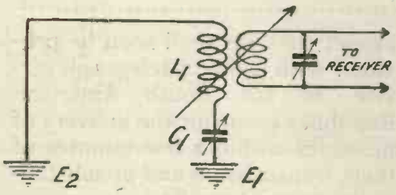


Fig. 1.—The circuit used by Mr. Mickle.

Results : 2LO ($3\frac{1}{2}$ miles), good strength on crystal only. Savoy items can be recognised some feet from Amplion Junior in quiet room.

With a single-valve reaction set pleasant loud-speaking on 2LO. 5IT is readily received on phones. Also 2ZY and 6BM are quite pleasant when 2LO is off. Brussels on his shorter wave is very good. On 200 metres and below many local amateur phone stations come in well, as well as C.W. from many British and Continental amateurs (all before 11.30 p.m.).

The arrangement appears more efficient on lower waves, but this is probably controlled by the distance between earths.

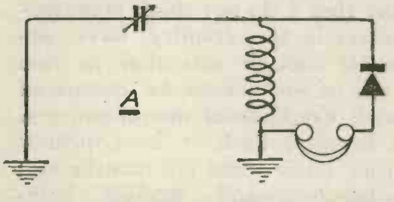


Fig. 2.—Another arrangement of the circuit which gives a similar result to Fig. 3 circuit.

Case 2.—In a yard under an iron roof. A water-pipe about a foot beneath a concrete floor rises at two points about 24 feet apart. Connections are made 18 inches above the ground in each case. Crystal receiver midway between earths and 12 inches from ground. Results as in Case 1, but valve tests have not yet been made.

Presumably two buried plate earths would be suitable if resistance was kept very low, but I have yet to try this. The essential point seems to be to keep the earth circuit a low-resistance oscillatory circuit ; I am therefore inclined to think that the water-pipe system may prove best.

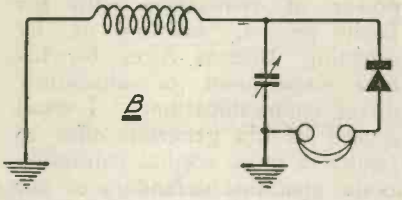


Fig. 3.—Though giving similar results to the Fig. 2 circuit this arrangement is more selective.

Tuning on C1 is fairly sharp, and selectivity better than with my high aerial.

No directional effects were observed.

Direct coupling is possible with the A and B arrangements, but results are much inferior.

It will be noted that no very extraordinary reception results are claimed, but signals are very considerably stronger than those which can be obtained on the same receivers when using similar lengths of wire disposed as normal indoor or outdoor aerials.

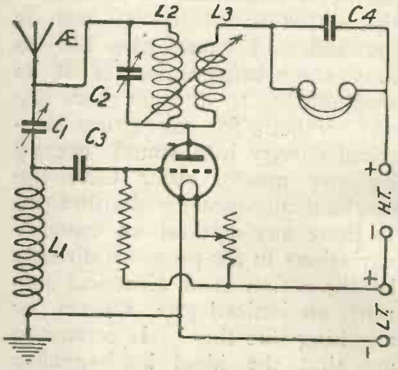
—Yours faithfully,

NORMAN MICKLE.

Chelsea, S.W.

A READER'S CIRCUIT

SIR,—I have pleasure in enclosing herewith a circuit of a receiver which I do not remember having seen published in your excellent medium, and may therefore interest your readers. Its particular value lies in even regeneration over the w/l scale and its strength and purity of signals. Reaction once adjusted for the particular value of H.T. used may then be fixed. I think you will find it well worth a trial if you have not already done so. It will be seen that C1 must essentially be perfectly insulated, and the one I have used is a Polar. A moving vane type might prove disastrous to the valves, should the vanes touch.



The circuit referred to by Mr. Webber C1, 0.001uF, C.2 0.0003uF, C3, 0.00025 uF, C4, 0.002. L1, No. 50 or 75 plug-in coil. L2, 65 turns No. 28 d.c.c. 3in. former. L3, 28 turns No. 28 d.c.c. 2¾in. former tightly fitting within L2

Congratulating you on the sustained excellence of *Wireless Weekly* and *Modern Wireless*.—Yours faithfully,

F. HAROLD WEBBER.
Devon. 5YR.

A CURIOUS COINCIDENCE

SIR,—May I point out a curious coincidence in connection with the article which appeared in your issue dated June 11, headed "Keep Your Aerial Earthed"? The following I quote from your article:—

"Have you ever heard of telegraph wires being struck by lightning? Probably not, for such a thing, if not absolutely unknown, is of the rarest possible occurrence. . . ."

The following paragraph appeared in the June 12 issue of the *Daily Express*:—

"Several mourners at a funeral at Brooklands, near Sale, in Cheshire, received shocks when lightning struck telegraph wires near by."

Hoping this is of interest to you.—Yours faithfully,

E. D. G. BARNBY.
Clapham, S.W.4.

THE "ALL-WAVE" TUNER

SIR,—I have read with great interest the article on the "'All-Wave' Tuner," by J. L. Reinartz, in your issue of May 31, and would like to know if you publish a blue print of the circuit, as I have no doubt this would appeal to a number of other experimenters.

I may say that I have a set made according to your instructions given in February 20 issue, "A Sharp Tuning Crystal Set," by Mr. P. W. Harris, and another described in February 27 issue, "A Long Distance Receiver," by Mr. S. G. Rattee, and from both of these I have most excellent results from the local station.

Wishing your valuable papers every success.—Yours faithfully,

ALEX. BRUNDRETT.
Sheffield.

EDITOR'S NOTE.—Blue prints of this circuit are not yet available.

COWPER H.T.-LESS CIRCUIT.

SIR,—In response to Mr. Harris's invitation, I am writing *re* Mr. Cowper's H.T.-less circuit.

Made up on a panel 5 in. by 10 in. almost identical spacing of components as article. London at 13 miles S.E. is audible anywhere in average size room on Amplion A.R.39.

Used Penton H.E.4, Cossor and Myers valves on test, the last two gave slightly better results.

0.0003 μF condenser, Igranic A.F.T. Edison-Bell fixed condensers, T.C.B. potentiometer and cylindrical, basket and honeycomb coils all A1; 75 and 100 turns correct on aerial used.

I can honestly say this is by far the best H.T.-less circuit I have tried.

Thanking you for giving it to us.—Yours faithfully,

F. W. WELLBELOVE, 6VN.
Erith, Kent.

SIR,—I wired up this circuit last evening as a flat board experimental set, and after locating a faulty fixed .0003 condenser, the set functioned surprisingly well. Using an indoor aerial ten miles from London, and the undermentioned components, I received the London 7-7.30 p.m. daylight transmission at a strength about 100 per cent. better than a standard crystal set used on the same aerial, but very considerably less than a single valve reflex set, used also on the same aerial and employing the same valve. I was unable to continue the test later, but hope to continue with the bright filament valve during week-end. The potentiometer control was very critical, but the experiment was most interesting.

Components.—Aerial of 7/22 wire slung in form of a horizontal frame of seven sides on a square, 14 ft. each side under roof; earth lead, 15 ft. to buried tin box.

Coils. — A.T.I. — 50 Igranic (or middle-size Oojah coil).

Reaction.—100 Igranic gave best results, with 50 Igranic in A.T.I., although 75 seems to work moderately well. The next larger size Oojah coil also proved very good.

Variable Condenser. — Precision new type .0003 with Vernier.

Fixed Condensers. — Dubilier .0003 grid. .002 between reaction return and Fil. +.

Valve.—Mullard Weco (at 1 volt).

Transformer.—Eureka Concert Grand.

Rheostat.—10 ohms.

Filament Battery. — Two partly-used Radio A dry cells.

'Phones.—4,000 ohms Sterling.

Potentiometer.—Igranic.

Connections were made without any variation from details shown in Mr. Cowper's original diagram; but it is noticed in Mr. Harris's published diagram for wiring, *Wireless Weekly* of June 4, that there appears to be no lead from Fil. – to earth or V.C. I do not know if this is intentional, but I found on disconnecting these two points that the set still functioned, but with a distinct loss in signal strength —Yours faithfully,

Hanwell. T. E. FOWLER.

A TRIPLE UNIT

SIR,—I wish to write to you about the Triple Unit designed by Mr. S. G. Rattee, and published in *Wireless Weekly* of April 30.

We made up this set on the day it was published, and obtained excellent results with it immediately.

We only took up wireless at Christmas, gaining our knowledge from your excellent books, *Modern Wireless* and *Wireless Weekly.*

Our first set was your H.F. and crystal unit by Mr. Harris, but we did not obtain the results we expected.

To the Triple Unit we have added a one-valve L.F. amplifier, and obtain the following results :—

Aerial: About 50 ft. long; average height, 18 ft.

Clearly on phones : All B.B.C. stations; le Petit Parisien, School of Posts, etc.; several amateurs.

Clearly on L.S. : Manchester, Birmingham.

Audible on L.S. : London, Bournemouth, Cardiff.

We are using Cossor valves, home-made basket coils, 45 turns and 75 turns; McMichael condensers instead of Dubilier.

I think it a very excellent circuit; we are very pleased with it, and wish to thank Mr. Rattee for publishing it.—Yours faithfully, WILLIAM H. RIDER.

Stoke-on-Trent.

Apparatus we have tested

Conducted by A. D. COWPER, M.Sc., Staff Editor.

Polar Micrometer Condenser

Messrs. Radio Communication, Co., Ltd., have submitted for test a very neat two-plate or "vernier" condenser, of the cylindrical type with concentric semi-cylindrical plates, for one-hole panel fixing. As it occupies but little space on a panel, being less than an inch in diameter and about 3 in. long beneath the panel, it is eminently suitable for addition to existing sets, where fine-tuning will be an advantage.

A single ⅜-in. clearance hole is required in the panel; a large nut outside the panel holds the instrument securely. Small terminals are provided behind for connections.

In addition to the ordinary rotational movement for varying the effective area of the plates, the outer moving plate is mounted on a spindle which has a longitudinal sliding motion, so that the length of the portion of the plates engaged can also be controlled. Thus a wide range of fine and extremely fine adjustment is given.

On actual measurement the capacity range differed somewhat from the figures given by the makers, being from about 7 to 51 micro - microfarads (*i.e.*, .000051 μF maximum). The insulation resistance was excellent, and the instrument operated smoothly and conveniently. The minimum value proved a little too high for use in ordinary Neutrodyne circuits, though in one modification of the same it sufficed when fully "out." For fine tuning in parallel with a larger condenser it was extremely satisfactory.

The general finish and workmanship were excellent.

Fixed Condensers

Messrs. Peto-Scott Co., Ltd., have submitted for test a sample of their new pattern fixed condensers, which have a plug-and-socket terminal device. Thus more than one can be placed in parallel by plugging in a second on top of the first, and so on; or they can easily be interchanged. The terminal plugs are of the standard valve-leg split type, and will fit into an ordinary valve-socket, but are spaced at 2-in. centres. The condenser is enclosed in a neat composition case, 2⅝ in. by 1 in., with the actual value engraved on the top.

The sample submitted, of .0015 μF nominal capacity, on measurement showed a value near enough to the nominal value for any ordinary purposes—which is not any too common an observation with fixed condensers of moderate price—and with the "Meg" tester on 500 volts D.C. showed excellent insulation resistance. The losses in a H.F. circuit did not appear to be sensibly greater than with ordinary air-dielectric condensers.

The makers point out that the actual capacities are determined after manufacture on a "capacity bridge," and marked on the unit. Accordingly when a particular size is specified the nearest actual value to that would be supplied (as, *e.g.*, .000103 for .0001 μF), instead of lumping together under a common label all that were even aproximately of a particular round-number size, as is commonly done. We are glad to welcome this step towards scientific accuracy in marketing condensers.

Tapped Anode Inductance

From Eric J. Lever comes a tapped anode inductance for tuned-anode H.F. coupling. This is arranged for panel-mounting, with one-hole fixing, a neat ivorine scale and knob with pointer being provided for the outside of the panel. The actual inductance is contained in a cylinder 1¾-in. dia. and 2 in. long (a clearance of 2¾ in. below the panel is needed). The switch with its 8 switch-points is mounted on the lower end of this cylinder the spindle passing through the middle.

The tuning-range determined with a .0003 μF parallel tuning condenser was from 270 to 2,940 metres (nominally 300-3,500 m.), and the eight switch-points showed convenient overlap throughout this range. On actual trial in reception, with direct-coupled aerial and critical reaction, the selectivity was found to be fair, Paris P.T.T. being obtained at good strength with London (at 13 miles) very faint in the background. The amplification-factor, on measurement, came out at about the usual figure for such compact inductances.

The unit is strongly made and well finished. Convenient terminals of reasonable size are provided for connections. We were glad to note the substantial grub-screw provided for securing the knob on the spindle, and the rigidly-attached pointer; these are matters which are most prolific of trouble in amateur construction. For experimenters who desire to cover a large range of wavelength with minimum apparatus, this tuned-anode unit will have a good appeal. The price is more reasonable than that which is often asked for tapped devices of wide range.

Information Department

Readers will facilitate the work of this department if STAMPED ADDRESSED ENVELOPE is enclosed in their letter.

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 was found necessary some months ago to enlarge our special staff. In view of the expense incurred we are reluctantly compelled to make a charge of 2s. 6d. for replies, according to the rules below. All queries are replied to by post, and therefore the following regulations must be complied with:— (1) A postal order to the value of 2s. 6d. for each question must be enclosed, together with the coupon from the current issue and a stamped addressed envelope. (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. (4) Queries should be addressed to Information Department, Radio Press, Ltd., Devereux Court, Strand, London, W.C.2, marking the envelope " Query."

J. Q. (MANCHESTER) enquires how tuned anode and reactance capacity intervalve couplings compare as regards selectivity and signal strength.

Under proper conditions the tuned anode method is certainly very much more selective than the semi-tuned method known as reactance capacity. The tuned anode is also usually superior as regards signal strength, although the difference here is less marked, and unless the tuned anode is very carefully and critically adjusted, the difference may not be at all noticeable. A further advantage of the tuned anode method of coupling is that it is quite easy to incorporate reaction into the intervalve circuit in such a way that radiation from the set when in the oscillating condition is considerably reduced.

D. W. J. (BLACKBURN) states that in the intervals of the programme of any broadcasting station which he may happen to be listening to, he hears a continuous rustling and cracking noise, and enquires as to the cause of this sound.

Various phenomena may assist in causing this sound, such as microphone rustles at the broadcasting station or line noise from induction effects from the underground cables used in broadcasting public entertainments, but the usual cause is partial heterodyning of the more or less continuous stream of minor atmospherics by the carrier wave.

You will find that a similar noise is heard when the receiver is kept in the oscillating condition by means of reaction. If the noise is particularly pronounced, and varies in intensity, with occasional much louder clicks and bangs, it may indicate either a defective high-tension battery or a bad night for atmospherics. You can distinguish between these two causes quite easily. Disconnect the aerial and earth from the set, and note whether the noise continues. If it does so the high-tension battery is fairly clearly indicated as the cause of the trouble. It may also be due to a bad connection somewhere, leaky insulation at some point upon the panel, or a bad gridleak.

W. T. O. (MAIDSTONE), states that he had been advised to build a receiver consisting of a crystal detector and two low-frequency amplifying valves, and enquires whether we think this is suitable for his requirements, which he stated.

Such a circuit as this is suitable for operating a loud-speaker within about ten miles of a broadcasting station, assuming that a reasonably good outside aerial will be used. Up to about 30 miles with a good outside aerial the receiver should give quite good headphone signals, but at such a locality as Maidstone we think it would be found quite useless. Since all you require is fairly good signal strength in the telephones, we think that a two-valve set employing one high-frequency amplifier and rectifier would suit you best.

A. P. M. (DOVER), enquires as to the object in placing what is known as a reservoir condenser across the high-tension battery.

The purpose of this condenser is to act, as its name inplies, as a reservoir, from which the pulses of current required by the valves can be drawn regardless of the internal resistance of the battery. This is most important with an old battery whose internal resistance is rising, and a further use of the condenser is to lessen the minor fluctuations of voltage of the battery, these fluctuations being a common cause of rustlings and other noises in the receiver. The condenser further serves the useful purpose in a receiver employing more than one low-frequency valve of eliminating low-frequency howling as a result of coupling between the anode circuits produced by the resistance of the high-tension battery.

I. P. S. (DURHAM), states that he has been warned against the use of unnecessarily high anode voltages with his three-valve receiver, and enquires whether there is any risk of shortening the life of a valve as a result of such excessive voltages.

Provided always that the voltage is not increased to such an extent as to cause a blue glow to occur in the valve, a high anode voltage does not appear to have any effect in practice upon the life of a valve. This, of course, applies only to the ordinary type of high-temperature valve, since the makers of the dull-emitter type issue a warning against excessively high-plate voltages, their effect being ultimately to destroy the dull-emitting property of the valve.

Western Electric

LOUD SPEAKING
:: EQUIPMENT ::

This Loud Speaking Equipment is now universally acknowledged the most perfect piece of apparatus of its kind ever placed on the market. As the operation of this outfit requires more power than can be economically provided by dry cells, a 6 volt accumulator for filament heating and a 120 volt H.T. Battery for the plate circuit should be used. By means of a fine-point switch the volume of sound can be adjusted to meet every requirement, that is, from a quiet conversational tone to an intensity sufficient for dances in comparatively large halls. To obtain the best results possible with this Equipment a detector such as the Western Electric No. 44081 Detector Set, is strongly recommended,

Western Electric Company Limited.

CONNAUGHT HOUSE, ALDWYCH, W.C.2.

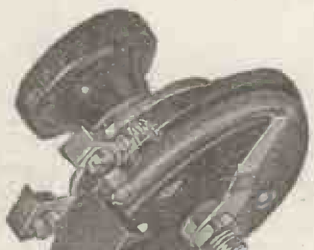
Telephone: CENTRAL 7345 (9 lines).

Branches: Birmingham, Leeds, Glasgow, Newcastle, Cardiff, Manchester, Southampton, Liverpool and Dublin,

Loud Speaker - £8

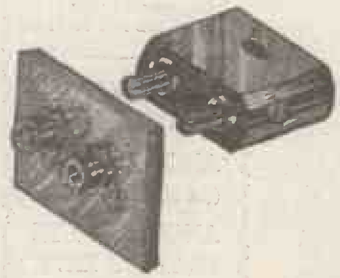
Amplifier - - £24

The Prices of "Low Loss" Condensers have been considerably Reduced



Burndept Accessories of special interest to home constructors

Both these Burndept accessories, the Dual Rheostat and the Telephone Plug have unusual features. Their convenience appeals particularly to those who build their own sets.



THE Burndept Dual Rheostat is specially designed for use with either bright or dull-emitter valves. No alteration to set or Rheostat is needed, when the one type of valve is changed for the other. The first half of the element is wound with 25 ohms of fine wire, and the second with 5 ohms of heavy wire. The whole 30 ohms of the rheostat controls a 4½-volt cell lighting a "D.E.3" valve, and the 5 ohms resistance controls a 6-volt accumulator lighting an "R.4" or "R.5" valve. The Rheostat brush moves very smoothly over the element because of the special construction of the former on which the wire is wound. The Dual Rheostat can be mounted behind any panel from ⅛ to ⅜ in. thick.

No. 222. Dual Rheostat for panel mounting, complete with drilling template, **7/6.**

No. 223. Dual Rheostat mounted on engraved ebonite panel, in polished walnut box, **15/-.**

THIS Plug is designed primarily for connecting telephones, but other uses for the useful accessory will suggest themselves. The ebonite Plug is non-reversible and fits into two sockets which can be easily and quickly mounted on any panel. The leads of the telephones are connected to the Plug by means of set screws. Those who appreciate neatness will admire the appearance of a panel fitted with these very convenient Plugs. This Burndept accessory is finding favour with both amateurs and experimenters everywhere. The Telephone Plug is supplied complete with sockets, nuts, drilling template and full instructions.

No. 190. Telephone Plug complete as described .. .. **3/9.**

Visit our Stand at the British Empire Exhibition, Wembley, in the Palace of Engineering, Avenue 13, Bay 13.

BURNDEPT
WIRELESS APPARATUS

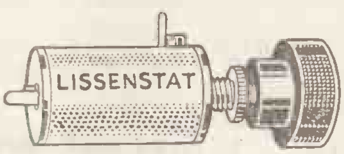
BURNDEPT LTD.
Aldine House, Bedford St.,
STRAND, W.C.2.
'Phone: Gerrard 9072.

Unique Filament Control—

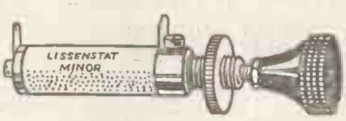
its effect on distant telephony.

DISTANT radio telephony is an elusive thing which depends a great deal upon critical control of electron emission. It is now generally known that **LISSENSTAT** control improves fine detection of long distance telephony in a truly remarkable manner. All those who use **LISSENSTAT** control appreciate its unique characteristics and its effect upon critical electronic flow—and those who realise the importance of critical control of electron emission use **LISSENSTAT** control—in other words, **LISSENSTAT** CONTROL IS NOW RECOGNISED AS AN INDISPENSABLE PART IN THE BUILDING OF ANY EFFICIENT RECEIVER.

EVERYWHERE users of **LISSENSTAT** control are telling others how much finer their tuning has become—how the valve seems to do more—how stations that could not be tuned in or only faintly, now come in easily WITH NO ALTERATION IN THE RECEIVER BEYOND THE INTRODUCTION OF LISSENSTAT CONTROL. The difficulty of getting acute tuning, control of oscillation, and so on—these handicaps disappear with the advent of the **LISSENSTAT.**



THE LISSENSTAT (prov. pat.) The unique filament control device **7/6**



LISSENSTAT MINOR (prov. pat.) Provides a high degree of the beautiful **LISSENSTAT** control, and at a popular price. No inefficient rheostat need longer be tolerated. The **LISSENSTAT MINOR** makes it worth while discarding any existing device. For dull emitter and all valves **3/6**

TO THOSE WHO THINK LISSENSTAT CONTROL IS THE SAME THING AS AN ORDINARY RHEOSTAT — LET THEM TRY THE DIFFERENCE.

Have you got an unreliable Grid Leak?—

If so, it is impossible for you to properly regulate the charge that should accumulate on the grid, because the negative charge left on the grid of the valve by each radio frequency oscillation of radio wave will leak away too quickly.

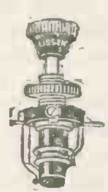
If you put a fixed grid leak in circuit you forget to consider that a leak resistance which may be correct for one valve in a particular circuit may be quite unsuitable when you change your valve. You should preferably fit the LISSEN Variable Grid Leak—you know then that you have a control which will give you a correct grid potential for any valve or circuit you choose to employ. The unique resistance element gives a constant value and an accurate variation of resistance throughout the whole range covered.

LISSEN ONE-HOLE FIXING, OF COURSE — POSITIVE STOPS BOTH WAYS — continuous variation ½ to 6 megohms. **2/6**

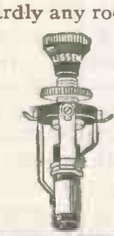
LISSEN Variable Anode Resistance, 20,000 to 250,000 ohms resistance, same outward appearance as the LISSEN Variable Grid Leak. **2/6**

You just gently pull or push—

and you hear these little switches "make" with a reassuring click. The contacts do not short when changing over—they are self-cleaning—there are no neater or handier switches. LISSEN ONE-HOLE FIXING, OF COURSE. Take up hardly any room.



LISSEN Two-way Switch, **2/9**



LISSEN Series-Parallel Switch, **3/9**

Is this your nightly problem?

Puzzling how to cut out your interference, so that distant stations may come in uninterrupted? How easy it is with LISSENCEPTOR, broadcasting and Morse, although there is some type of Morse which is more difficult to eliminate. Even this, however, can be so subdued that it ceases to be troublesome.

A separate tuning condenser should be used with the LISSENCEPTOR—diagram with each shows easy connections.

LISSENCEPTOR Mark 1 type, for 600 metres **7/6**

„ „ 1 „ „ broadcasting **7/6**

LISSENCEPTOR Mark 2 type, for broadcasting and 600 metres (combined with switch for more selective tuning) **15/6**

The LISSENCEPTOR acts as a sentinel beside your Receiver.

BUILD—*with all LISSEN PARTS* and you can be sure that your receiver will give results which would never be possible with a receiver built with mixed parts.

Text book of LISSEN parts, post free, 8d., gives a good deal of useful information. Free to the trade.

LISSEN LIMITED

30-32, WoodgerRd., GoldhawkRd., Shepherd'sBush, London, W.12

BUILD — With the Best Parts

Phones: Hammersmith 3380, 3381, 3382, 1072. *Grams:* "Lissenium, London."

HULLO EVERYBODY!!

POST FREE COLUMN

Valve Windows (gauze) Nickel .. .. 8d.
Empire Tape ½ in. doz. yds. 9d.
Phone Cords (double) 72 in. 1/11
Ebonite Coil Plugs 2 for 1/6
Shaped (Edison Bell) 2 for 2/4
Terminals with Nut—
Large Pillar, W.O. 12 for 1/4
Telephone, 4 B.A. 12 for 1/3
Telephone, 2 B.A. 6 for 1/-
Small Pillar .. 12 for 1/1
Valve Sockets, complete 12 for 1/1
Ditto, with shoulder (bost) 12 for 1/3
Brass Plugs and Sockets 6 pairs 1/-
Screw Spade Terminals doz. 1/2
Pin Screw Terminals doz. 1/-
Brass Spade Tags doz. 5d.
Wander Plugs (red, black) pair 6d.
Lightning Switches—
S.P.D.T. on porcelain .. 2/-
D.P.D.T. " .. 2/6
S.P.D.T. on ebonite .. 1/8
D.P.D.T. " .. 2/8
Basket Coil Holders, with Plug 1/6
Ditto, 2nd quality 1/2
Battery Clips .. doz. 11d.
Ebonite Valve Holders .. 1/-
Ditto, Cut from Solid Rod 1/4
Enclosed Perikon Detector 2/6
Ditto, Smaller Size .. .. (with 2 Crystals) 2/-
2-way Coil Holder for Basket Coils 5/11
2-way ditto, for Igranic, 3/11, 4/6
For Extra Specials, see other columns.
Nugraving (Titles) .. .. 8d.
Nugraving (Scales, etc.) 8d.
Tungstalite Crystal.. .. 1/-
Midite .. .. 9d.
Shaw's Genuine Hertzite 1/-
Gecosite 1/3
4 Electrode Valve for Unidyne Circuit 12/6
10 to 1 Telephone Transformer 15/-
H.F. Plug in Transformer 250/700 .. .. .. 3/9
Raymond Intervalve Transformer 11/9
Accumulator, 4 v. 40 amp. 17/9
Burndept Crystal Detector 5/3
Mic-met Micro Patent .. 6/3
Choke Coils "R.I." .. 10/-
Skinderviken Buttons .. 5/-
Brunet 4,000 ohm Single Phone 8/6
Skinderviken Transformer 15/-
POLAR VAR. CONDENSERS.
·001, ·0005, ·0003 each 10/6
Watmel gd. lk. 2/6
Watmel anode 3/6
Variometer Crystal Set .. 10/-
Brown's Featherweight Phones.. .. .. .. 25/-
Copper Foil .. foot 6d.
Loud Speaker Horn and Fittings .. complete 7/6
Earth Clips (Ajd.) .. 8d.
Coil Plug and Clips .. 1/-
English 4·5 Batteries doz. 7/-
Screwdrivers .. .. 9d.

LOUD SPEAKERS. "BABY" MODELS

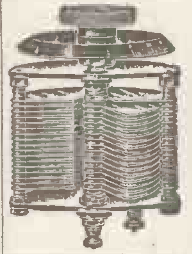
Sterling 55/-
Brown 48/-
Raymond.. .. .. .. 30/-
Sidpe.. .. .. 25/-
Post 6d. each.

RAYMOND VARIABLE CONDENSERS

NATIONAL LABORATORY CERTIFICATE FOR GUARANTEED CAPACITIES.
NEW MODEL.

Rigid Construction Throughout. Electrically & Mechanically Perfect. Accurate Constant Capacity. Narrowest Possible Spacing.

NEW MODEL. Aluminium end plates.
Beautifully finished. All parts Nickelled.

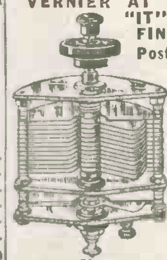


Capacity.	No. of Plates.	Price.	Height without connections.
·001	49	6/11	3½ in.
·00075	37	5/11	2¾ in.
·0005	25	4/11	2 in.
·0003	15	4/6	1¾ in.
·0002	11	4/-	1½ in.
·0001	5	3/6	1 in.

·00005 3-plate vernier, 2/6 (no dial)
Ebonite Dial 6d. (not sold separately).
A handsome dial with scale 0.180 given free. POST 3d. SET.

NEW MODEL

WITH THREE PLATE VERNIER AT BOTTOM "IT" FOR VERY FINE TUNING. Post 6d. Set.



·001 8/11
·0005 6/11
·0003 6/6

With Vernier at Bottom. Complete with 2 knobs. Ebonite Dial 6d. extra (not sold separately).

EBONITE COIL STANDS for IGRANIC.

2-way ex.-handles, Nickel Fittings 4/6
3-way Ditto .. 5/11
2-way .. 3/6, 3/11
3-way .. 4/9, 5/11

FRANCO (MICRO.)
2-way 12/6
3-way 17/6

CAM. VERNIER.
2-way .. 8/6, 10/6
3-way .. 12/6, 15/-

IGRANIC PATENT.
2-way 10/-
3-way 15/-

BASKET COILS.

200/3,600 waxed (6) 1/8
200/2,000 waxless (5) 1/11
2 Waxless ST100 .. 1/-
1,750 metres (1) 10d.
Post 5d. set extra.

CRYSTAL DETECTORS.

Glass Enclosed. Post 6d. each.
Small 1/-, 1/2, 1/4
Large 1/4, 1/8, 2/-
Very Handsome Designs. Splendid Quality.
Mic. Met 6/-
Burndept 5/-
Micro Movement 2/6
All on Ebonite Base.

VARIOMETERS.

Ebonite 200/650 3/11
Ebonite Ball Rotar 5/11
Impregnated Board 2/9
Inside Winding 9/11 (Edison Bell Type).
Post 6d. each.

LIGHTNING SWITCHES.

On Porcelain. Post 6d.
D.P.D.T. 2/3
S.P.D.T. 1/6

ACCUMULATORS.

Summer Time Prices.
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 .. .. 34/6
Post 1/- each.

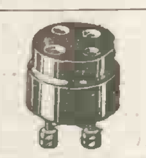
FIXED CONDENSERS DUBILIER.

.001 up to .006 3/-
.0001 up to .0005 2/6
Grid Leak 2/6
80,000 Anode .. 5/6
Minicap Switch 8/-
Edison Bell—
.002 to .006 .. 2/-
.001 to .0005 .. 1/3
Grid Leak 1/3
Raymond—
.001 to .0003 .. 10d.
.002 to .004 .. 1/-
.006.. .. .. 1/3
.01, .02 .. .. 1/6
.05 .. .. .. 3/6
TCC. 1 MFD. .. 4/-
TCC. 2 MFD. .. 4/6

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 Switch Arm, with 12 Studs, 12 Nuts, 12 Washers.
To callers .. 10½d
By post set 1/6



EBONITE VALVE HOLDER.

Cut from Solid Rod, Hand-turned, 8 Nuts, and Washers each 1/3

RHEOSTATS.

Ormond 2/-
Raymond 1/6
Ditto, with Dial 2/-
Extra Value ditto 2/6
Igranic 4/6
T.C.B. 6 ohms .. 4/-
Ditto, 15, 30 ohms 4/-
Potentiometer, " T.C.B. 5/-
Ajax, 25.5 .. 4/-
Ajax Potentiometer, 464 ohms 6/6
Filostat 2/-
(For D.E. or R. Valves).

McMICHAEL H.F. SPECIAL TRANSFORMERS.

50—150 .. .. 8/-
150—300 .. .. 7/-
300—600 .. .. 7/-
500—1,200 .. 7/-
1,100—3,000 .. 7/-
Post 6d. each.

VALVES.

PHILLIPS .04 FV. 1·6 to 1·8, AN.V. 30-75 18/6

FRENCH METAL. FV. 3-3·5, F.C. ·06, AN.V. 20-80 17/6
Post 1/- each.

Cossor P.1, P. 2.. 12/6
Mullard Ora .. 12/6
Ediswan 12/6
Marconi R. and R.5 .. .. .. 12/6
A.R.D.E. Ediswan.. .. .. 21/-
D.E.R. 21/-
D.E. 3.. .. .. 30/-
All Valves Stocked.

LISSEN PARTS.

Var. Grid Leak .. 2/6
Anode Res. .. 2/6
Lissen Minor .. 3/6
Lissenstat 7/6
Do. Universal .. 10/6
2-way Switch .. 2/9
Series Parallel .. 3/9
Lissen T.1 L.F. .. 30/-
T.2, 25/-; T.3 16/6
Coils and all Parts always Stocked.

HEADPHONES.

N. and K., 4,000 ohms Original pattern. Leather Head Bands.
Lightweight .. 9/11
Standard 11/6
Non-rust Diaphragms .. 12/9
Post 6d. pair.

4,000 ohms.
B.B.C. Sterling .. 25/-
B.B.C., B.T.H. .. 25/-
B.B.C. Premier .. 16/6
Brunet Type D .. 14/6
Brunet De Luxe 18/11
Brunet, Single, 4,000 7/9
8,000 Brunet, Double, for Crystal Sets .. 19/11
Post 6d. pair.

FRENCH THOMSON HOUSTON.

Genuine, Original. 4,000 ohms 13/11

ERICSSON E.V. (Continental) Ebonite Earcaps (small).
4,000 ohms .. 12/-
Post 6d. pair.

L.F. TRANSFORMERS

Radio Instruments 25/-
Igranic, Shrouded 21/-
Powquip, Shrouded 18/-
Formo Shrouded 16/6
General Radio 14/11
Brunet Shrouded 11/9
Formo, Open .. 11/9
Powquip, 2—1 or 4—1 .. .. .. 14/6
Raymond 10/-
Eureka Concert Grand 30/-
Ditto, 2nd Stage 22/6

EBONITE, 3/16 in. STOCK SIZES.

6 × 6 .. .. 1/6
7 × 5 .. .. 1/6
8 × 6 .. .. 2/-
9 × 6 .. .. 2/3
10 × 8 .. .. 3/4
12 × 9 .. .. 4/6
12 × 12 .. .. 6/-
Also Cut to Size while you wait.

THIS COLUMN IS FOR CALLERS ONLY.

(Nett Prices.)
No Post Orders from it, Please.

Spade Tags .. 4 a 1d.
Empire Tape, ½ in. 2 yds. 1d.
D.P.D.T. Panel Switches 1/3
S.P.D.T. Panel Switches 10½d
D.P.D.T. on Porcelain .. 1/11
S.P.D.T. on Porcelain .. 1/5
Filament Dials 0–10 .. 4½d.
Ditto, with knob, 0–10 .. 5½d.
Easi-Fix Cups each 1d. & 1½d.
Valve Holders, Ebonite.. 8d.
Ditto, cut from Solid Rod 1/3
Valve Sockets, Nut & W. 2 for 1½d.
Ditto, with Shoulder each 1d.
1/16th in. sq. Tin Copper 4 ft. 2½d.
Best Sleeving (large) yd. 4d.
Large Pillar Terminals .. 1d.
W.O. & Telephone each 1d.
Small Pillar .. 4 for 3d.
2 B.A. Phone .. 2 for 2½d.
(Above with nut).
Phone Wood Screw 2 for 2d.
Adhesive Tape .. roll 3d.
Copper Foil .. .. ft. 2½d.
Washers 2 and 4 B.A. doz. 1d.
Nuts, 4, 5, 6 B.A. 3 doz. 4½d.
Nuts, 2 B.A. .. 3 doz. 5d.
Brass Plug and Socket pair 1d.
Ebonite Coil Plugs .. .. 4d.
Ditto, Very Superior, 7d. 8d., 9d.
Ebonite Bushes .. 2 a 1d.
Aerial Wire 7/22 100 ft. 1/11
Ditto, Extra Heavy 100 ft. 2/3
Spade Screw Terminals .. 1d.
Pin Screw Ditto 2 for 1½d.
72 in. Phone Cords 1/5
English 4.5 Batteries .. 4d.
Battery Clips .. 2 a 1d.
Shaped Coil Plugs .. .. 8d.
Ditto, Edison Bell 1/-
2 Top Pins and Nut 2 a 1d.
Electron Aerial 100 ft. 1/4
Filostat (D.E. or R. valve) 1/9
Spearpoint Whisker .. 2d.
Gold or Silver Ditto .. 2d.
5 in packet (one gold) .. 3d.
Crystal Tungstalite.. .. 9d.
Crystal Midite .. .. 8d.
Crystal Gecosite 1/3
Shaw's Genuine Hertzite 8d.
Large Ditto 1/-
Rubber Lead in .. yd. 1½d.
Extra Heavy .. yard 2d.
Wander Plugs.. .. pair 2½d.
30 v. H.T. Battery 4/6
60 v. H.T. Battery 7/6
Variometers, 250/600 .. 1/6
Switch Arms .. .. .. 6½d.
Contact Studs Complete 2 a 1d.
Nickel Gauze Valve Windows .. .. 5d.
Twin Flex .. 4 yds. 6d.
Ditto, red and black 4 yds. 7d.
Bell Wire, D.C.C., I.R.C., 10 yds. 5d.
Ditto .. .. 5 yds. 4d.
One Hole Fixing, Fil. Res. 1/3
Dutch Valves Tubular .. 4/9
Dutch Valves, "R" Type 5/3
Phillips' "R" Valves .. 7/6
French "R" Valves .. 6/6
Best Fixed Condensers .. 8d.
Ditto, Ebonite Base from 10d.
Microphone Button .. 4/3

WHEN VISITING WEMBLEY CALL HERE. WE

PAY YOUR FARE

up to 2/6 in 8 on Ordinary Prices.
(N.A.R.M. and Fixed excluded).

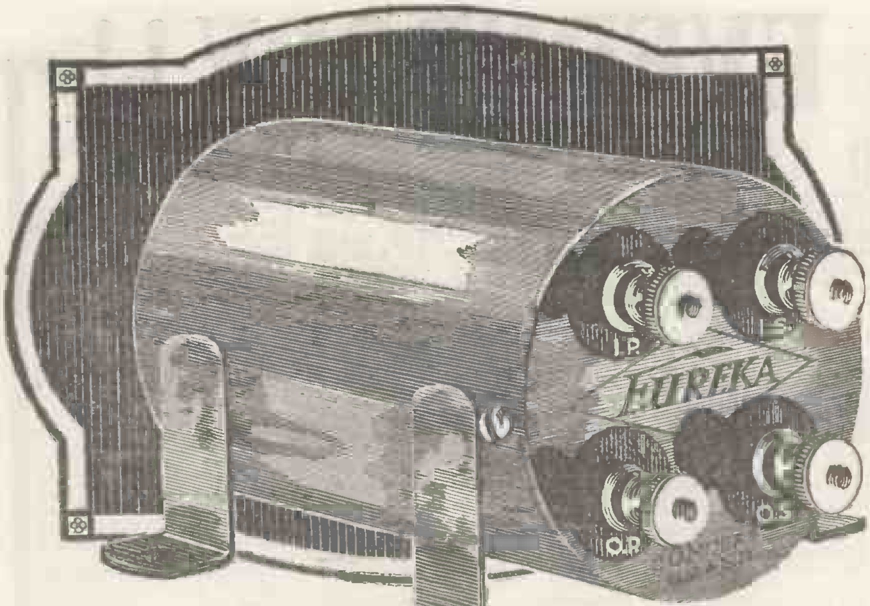
Right Opposite DALY'S Gallery Door

K. RAYMOND

27, LISLE STREET, W.C.2

'Phone: Gerrard 4637.

HOURS OF BUSINESS:
Daily - - 9 to 7.45
Sundays 10 a.m. to 1 p.m.



Winning its Spurs!

WITHIN five months from the release of the Eureka Transformer, it has won its spurs and, by its romantic success, completely vindicated the popular (and erroneous) idea that Wireless Experimenters are influenced entirely by first cost.

The Eureka Concert Grand is the highest priced L.F. Transformer in the Country. We know it—but we know that its **raw material alone costs more than the price of many other finished Transformers.**

For instance, every Concert Grand contains the phenomenal total of 2½ miles of fine insulated wire. You can't get pure amplification without generous induction coils although it is perfectly true that a high step up ratio will give loud signals. No manufacturer who makes prime costs his fetish can produce a Transformer capable of giving half the purity and volume of a Concert Grand. Then again, every Eureka is built to last a lifetime—it is hermetically sealed in a coppered steel case. Even 14 days in a tumbler of water won't have the slightest effect upon it.

Its insulation—as tested by Faraday House—was found to withstand the terrific pressure of 2,000 volts before collapsing. The majority of other Transformers break down on a voltage of 500.

Even two Eureka Transformers bolted together touching will not interact. Have you ever heard of any other Transformer able to withstand this test?

Finally there is the incontrovertible fact that one Eureka Concert Grand when used with a generous plate voltage (say 120 volts) **and** the correct negative grid bias, will give equal **amplification and much better tone** than two cheap transformers. Thus an investment of 30/- saves the cost of another valve and its upkeep.

Sold by all Dealers and manufactured only by

Portable Utilities Co., Ltd.,
7 & 8, Fisher Street, London, W.C.1.
Scottish Agents: FULLER, BLACKIE & RUSSELL Ltd., 30, Gordon St., Glasgow.

Made in two types

Concert Grand 30/-
Eureka No. 2 .. .. 22/6
(For second stage)

EUREKA
Low frequency Transformer

Gilbert Ad. 978.

Gives a Fine Vernier Control to your Condenser, Variometer, etc. Post Free. 2/6

Coil Plugs and Sockets for Flush Panel Mounting. 8d. pair. Post Free.

Valve Sockets for Flush Panel Mounting, set of 4. 8d. Post Free.

1/16" Square Bus Bar, as used on several "Wireless Weekly" Sets. 2/- dozen with 1 doz. special Tags. Post 3d. extra.

"Radiohm" Ribbon Aerial. The long range aerial. 3/- 100 ft. on reel. Postage 5d. extra.

SPARKS RADIO SUPPLIES
(*Dept. W*),
43, GREAT PORTLAND STREET, W.1.
Telephone: Langham 2463.

THE MIRACLE LOUDSPEAKER
CRYSTAL—Positively vibrates with energy. No blind spots—Sensitive all over. Packed with special spear-point catwhisker. A boon to Crystal Set Owners. Post free 1/6
The WORLD'S WIRELESS STORES, WALLINGTON.

ONE VALVE RECEIVING SET
The celebrated Glebe Circuit. Receives all B.B.C. Stations. Loud Speaker 15 to 20 miles. Genuine Bargain. Plus Royalties 35/-
The WORLD'S WIRELESS STORES, WALLINGTON.

SIGNALS WEAK?
Our Super-sensitive Double Headphones instantly and energetically respond to the smallest possible signal strength. A boon to all Listeners. Worth 30/- Post Free. 13/6
The WORLD'S WIRELESS STORES, WALLINGTON.

A good R.P. Book you should read

Tuning Coils and How to Wind Them

Series No. 18. *By* G. P. Kendall, B.Sc.

There is probably no single Component in any Receiving set able to exert so much influence as an Inductance Coil. A highly efficient Coil (or Coils) will often make all the difference between mediocre results and really clear and loud reception.

Even if you feel that your present set is giving tolerably good results, the chances are that it will be worth your while—presuming that you are using plug-in coils—for short wavelengths to use a set of home-made basket coils. Such coils as these have particularly low self-capacity.

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

Obtainable from all Booksellers. or post free 2d. extra direct from Publishers.

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

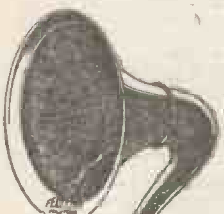
"Your 'Vantage"

It is to your advantage to buy Fellows apparatus because you get both quality and low price.

Few parts, simple assembly operations and straightforward design are the reasons why we can give you

Quality Apparatus at Low Cost.

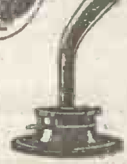
Seeing (and hearing) is believing; go to your nearest wireless dealer and examine it yourself.



THE VOLUTONE LOUD SPEAKER.

Gives really large volume of sound without sacrificing the quality of reproduction. The diaphragm is adjustable.

£4 : 10 : 0



THE JUNIOR LOUD SPEAKER.

A remarkably efficient small loud speaker for medium sized rooms.

£1 : 17 : 6

THE LIGHTWEIGHT HEADPHONES.

Highly finished, good workmanship and extreme sensitiveness. They are very comfortable, headbands are duralumin and will not rust or tarnish. Weight with cord, 6 ozs. Resistance 4,000 ohms.

18s. 6d.

We make complete sets, including the Fellocryst Super, the Fellophone Super 2 Valve Set and Amplifier, the Fellophone Super 3 Valve Set and Amplifier, the Fellows Portable Three, etc., and the keynote of them all is

Quality at Low Cost.

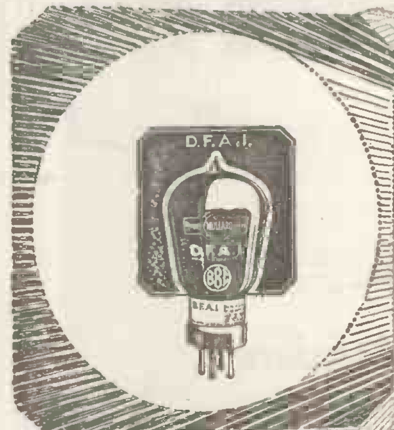
FELLOWS WIRELESS

Advt. of the Fellows Magneto Co., Ltd., Park Royal, London, N.W.10.

E.P.S. 73.

A Valve for Every Wireless Circuit

D.F.A. 0, 1 & 2



THE MULLARD D.A.F. TYPE VALVES are designed to give loud speaker volume without distortion requiring only the low anode voltage of 50-100.

The D.F.A. 0 and 2 operate on a 4 volt battery with filament currents of ·35 and ·25 ampere respectively, while the D.F.A. 1 with a 6 volt battery requires only ·2 filament ampere.

The volume, clarity and economy of these valves will repay your enquiry for leaflet V.A. 3 Dept. W. W., giving full information.

For Perfect Reproduction

Mullard

THE · MASTER · VALVE

Advertisement of—The Mullard Radio Valve Co., Ltd. (W.W.), Nightingale Works, Nightingale Lane, Balham, S.W.12.

British Empire Exhibition, Palace of Engineering — Avenue 14 — Bay 13.

164

E.P.S.59

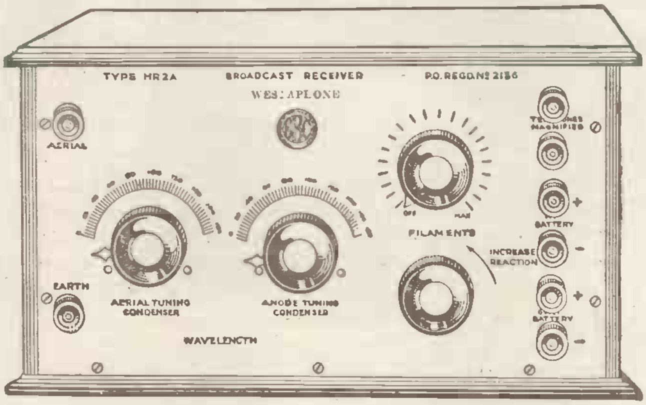
ADD WIRELESS TO SUMMER JOYS

Perfect Outdoor Reception Now Obtainable at Negligible Cost and No Exertion.

The "NEW WESTAPHONE" Two, Three and Four Valve

BROADCAST RECEIVERS

These Superlative Wireless Receiving Models are without a doubt the ARISTOCRATS of the wireless world. Manufactured by one of the foremost Wireless Manufacturing Firms in Great Britain entirely of all British Components, these instruments are guaranteed perfect and faultless in every detail. Test one in your own home and if the slightest cause for dissatisfaction occurs at any time within Two years of purchase we will either replace the instrument or rectify it at once.



PERFECT LOUD SPEAKER RESULTS Guaranteed with the "New Westaphone" Receivers.
Every Machine is beautifully finished in solid Mahogany highly polished Cabinet of superb workmanship. The Valves and Coils are enclosed in the cabinet out of harm's way always.
The simplicity of the tuning and adjustments are an outstanding feature. Every British Broadcasting Station and all Continental Stations are easily brought in and reception is sweet, clear, and absolutely undistorted.

Two Valve Cabinet (Royalty & Tax Paid) **£10 10 0**
Three Valve Cabinet (Royalty & Tax Paid) **£16 0 0**
Four Valve Cabinet (Royalty & Tax Paid) **£21 5 0**

Full instructions are enclosed with each machine.

If desired, our Expert Wireless Engineer will erect at a small inclusive charge.

Call during Broadcasting hours and have the New Westaphone Receivers demonstrated free of any obligation on your part. Deferred Payments can be arranged on payment of a small deposit. Price of Complete Stations, including all valves, coils, accumulator, H.T. batteries, earth and aerial wires, lead in tubes, insulators, etc., as follows:—

"NEW WESTAPHONE"	2 VALVE	£14 0 0	These prices include all Marconi royalties and B.B.C. tax. Loud speakers and headphones extra.
Do.	3 ,,	£19 18 6	
Do.	4 ,,	£25 12 6	

The New Westaphone Receivers will work efficiently with dry cells and dull emitter valves in place of accumulator.

Call or Post your Order at once to

THE WESTERN UNION WIRELESS COMPANY,

Dept. W.W., 5 & 6, Regent Place (adjoining Sainsburys), Regent Street, LONDON, W.1

Phone—Gerrard Seven Thousand. *Remittance refunded if not satisfactory and instrument returned within eight days.*

When you assemble your set, ask for—and fit GENTS'

"Tangent" Tuning Coils

Built on firm cylindrical frames with air-spaced Coils.
Guaranteed highest electrical efficiency combined with sound mechanical strength.
In 8 sizes for wavelengths from 250 to 3520 metres——PRICES 4/3 to 7/6 each

Complete set of 4 Coils—250 to 1070 metres 16/-

Complete set of 8 Coils—250 to 3520 metres 40/-

No second-rate effects will satisfy the intelligent purchaser for whom "TANGENT" fitments are designed.

GENT & CO. LTD.
Manufacturing Electrical — Engineers —
FARADAY WORKS,
LEICESTER.

London: 25, Victoria St., S.W.1.
Newcastle-on-Tyne: Tangent House, Blackett St.

Enjoy true music.

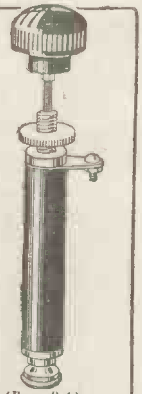
You can — with the TrueMusiC Junior Loud Speaker.

The horn has no seam or joint, being fashioned of purest copper, electrically deposited on a mould, and the patented adjustment gives simple control of volume.
This unique construction will be found *only* in TrueMusiC Junior Loud Speakers.
Look for the burnished and lacquered copper horn.
If unable to obtain locally, write to us direct.

TrueMusiC Junior.
£2 : 17 : 6

The Telephone Manufacturing Co., Ltd.,
Hollingsworth Works, Dulwich, London.

British Empire Exhibition, Wembley, Palace of Engineering, B.E.A.M.A. Section, Stand C1. Avenue 11, Bays 6 and 7.



A Reference Library for 2/6.

WITH the large number of really good Books on Wireless published by Radio Press Ltd., it is a little difficult for an enthusiast to pick out the most useful of them. The Book ***500 Wireless Questions Answered***, however, by its immense sales, has already proved itself as being the most popular — two editions having been exhausted since last November.

Its wide scope—coupled to the fact that it deals only with live and useful information—is rendering it indispensable to every Broadcast listener and experimenter.

Certainly, previous to its publication it would not have been possible to have obtained one half of the information contained within its two covers under an expenditure of several pounds. And even then the information would not have been given in such a concise and compact form, well indexed, and available at a moment's notice.

Such a Book as this will save its cost many times over—it can certainly be described as a *Reference Library for half-a-crown.*

Contents

Aerials.
Amplifiers.
Crystals and Crystal Sets.
Earths.
Frame Aerials.
Grid Leaks and Condensers.
Interference.
Loud Speakers.
Morse.
Primary Batteries.
Ranges.
Reaction.
Secondary Batteries.
Sounds and Signals.
Telephone Receivers
Tuning Coils.
Tuning Condensers.
Valves.
Wavelengths.
Waves.
Wire.
Miscellaneous problems.

Post free 2/8

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

2/6

500 Wireless Questions Answered

By G.P. Kendall & E Redpath. *Post free 2/8*

RADIO PRESS SERIES No. 13.

Gilbert Ad.

ORDER FORM.

Complete this form and hand it to your newsagent *without delay*.

PLEASE SUPPLY ME WITH WIRELESS WEEKLY FOR SIX WEEKS COMMENCING WITH THE .... ISSUE, VOL....... NO. ...... AND UNTIL FURTHER NOTICE.

Signature..

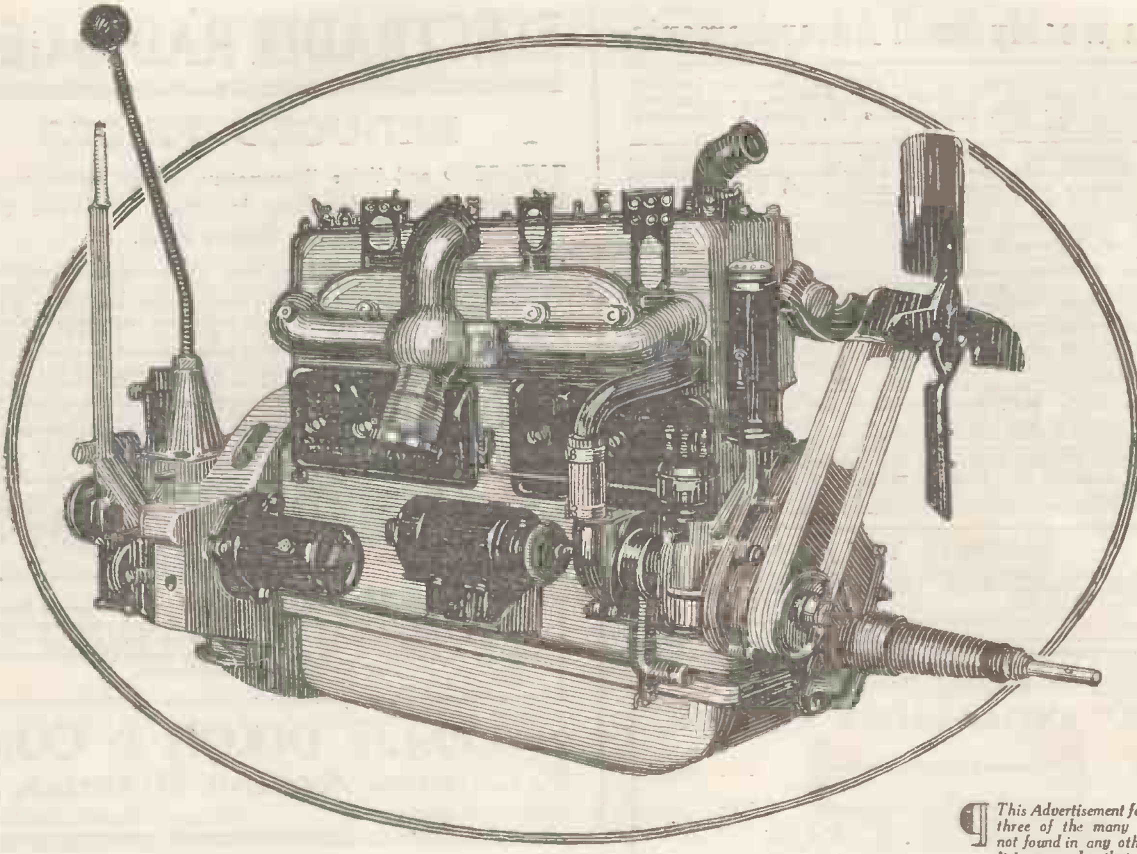
Address...

....

Radio Press Information Dept.

2/6 QUERY COUPON 2/6

WIRELESS WEEKLY. Vol. 4. No. 8. June 25, 1924.
(This coupon must be accompanied by a postal order of 2/6 for each question, and a stamped addressed envelope.)



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

The Power Unit

THE pleasure a man gets out of his Car depends mainly upon the quality of its Power Unit. If the engine is efficient—if its design embodies the fruits of years of experience—if cost of construction is not made a primary consideration—then he can place the utmost reliance upon its performance.

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

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

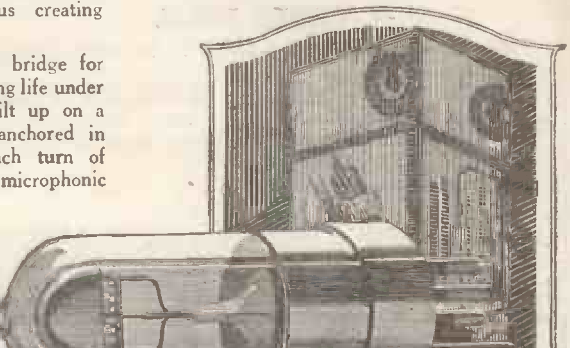
There is no substitute for a Cossor Valve. The secret of its success lies entirely in its unique design and superior construction. The hood-shaped Anode and Grid encloses, and makes use of, practically the whole of the electron stream——thus creating superior rectifying properties.

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

Prices:

P.1	(For Detector and L.F. use)	**12/6**
P.2	(With Red Top for H.F. use)	**12/6**

From all Dealers.

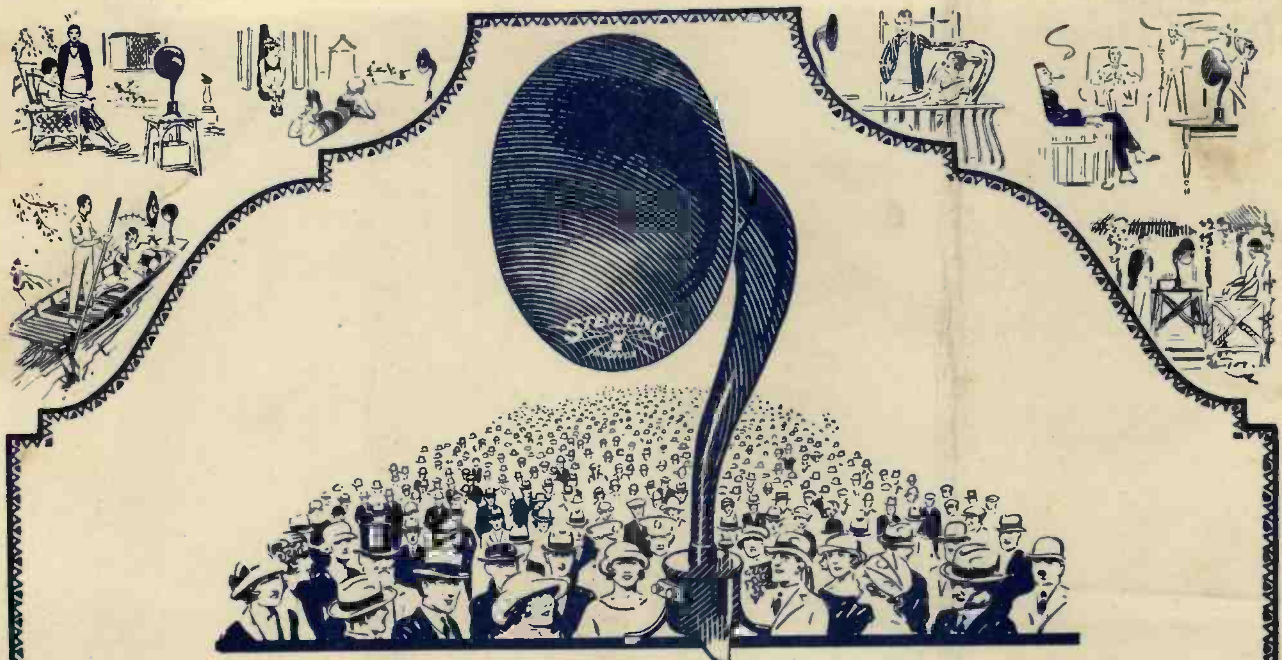


Cossor

A.C. COSSOR, Ltd., HIGHBURY GROVE, LONDON, N.5.

Valves

Gilbert Ad. 977



Printed for the Proprietors, RADIO PRESS, LTD., Devereux Court, Strand, W.C.2, by THE AVENUE PRESS (L. Upcott Gill & Son, Ltd.), 55-57, Drury Lane, London, W.C.2. Published on Wednesday of each week at 3, Bolt Court, Fleet Street, London, E.C.4. Address for Subscriptions and Editorial Communications:—Devereux Court, Strand, London, W.C.2. Advertisement Managers:—THE SCHEFF PUBLICITY ORGANISATION, LTD., 125, Pall Mall, London, S.W.1. Registered as a newspaper and for transmission by Canadian Magazine Post. Subscription rates:—32/6 per annum, 16/3 for six months, post free. Sole Agents for Australasia:—GORDON & GOTCH, (Australasia), LTD. For Canada:—IMPERIAL NEWS, LTD. For South Africa:—CENTRAL NEWS AGENCY, LTD. For Japan:—SALE & FRAZAR, LTD.