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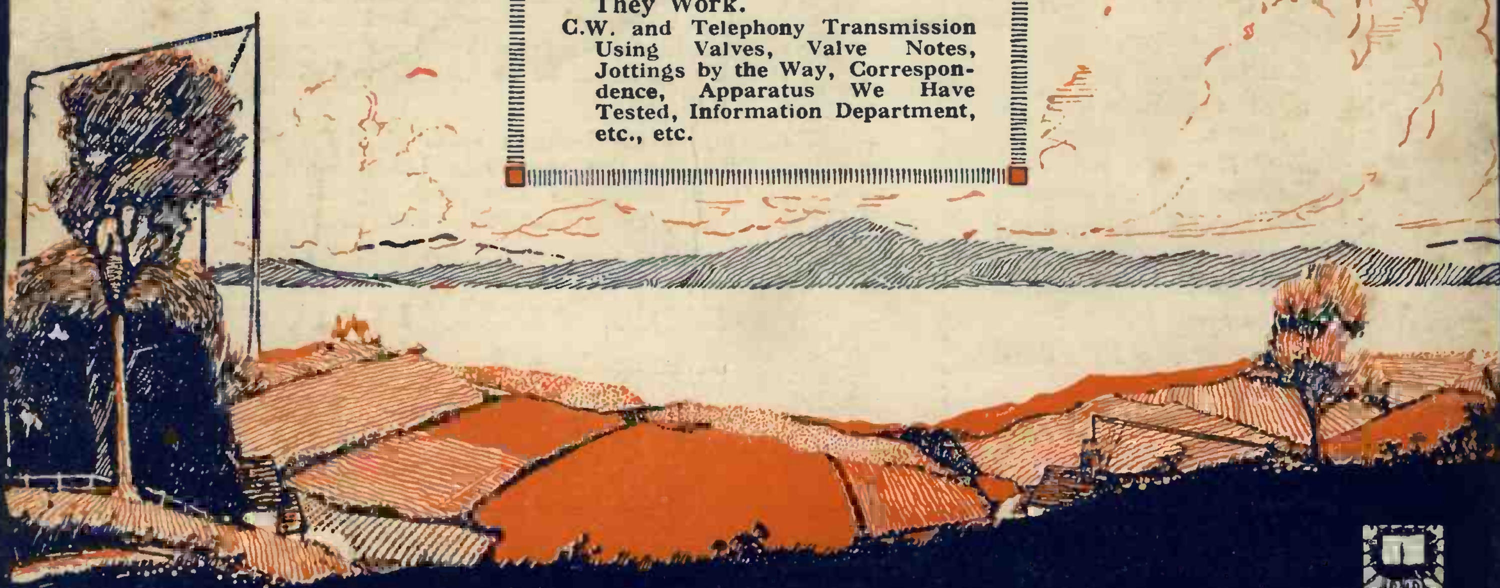
Wireless Weekly

and the Wireless Constructor.

Vol. 4.
No. 1.

CONTENTS



Broadcasting Wembley. By Capt. P. P. Eckersley

Why not build some of your own Components?

This Book shows you how to build:

- Frame Aerials of different types.
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- Coil Holders and Tuners.
- Crystal Detectors.
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- 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.

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Homebuilt Wireless Components

Radio Press Series No16.

G.A.800

Wireless Weekly

Vol. 4, No. 1
May 7, 1924.

CONTENTS

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RADIO PRESS

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The New London Station

FOR some time past the British Broadcasting Company has realised the desirability of changing the present site of the London broadcasting station. There are two main reasons why such a change should be effected, the first being that at the moment the station is almost on top of the Air Ministry station in Kingsway, and cannot increase its power without causing considerable interference with this latter. The second is that the British Broadcasting Company, being a combine of many wireless companies, should not identify itself too closely with the premises of any one company. The studio of course, has already been removed from its original position at Marconi House to the present premises in Savoy Hill, land line connections being made between the studio and the transmitting apparatus itself.

The British Broadcasting Company in the past has been scrupulously careful to maintain an attitude of strict impartiality, and for this reason we view with surprise the reported intention of the company to build the new transmitting plant on the top of a leading London store. No doubt the particular premises which have been freely named in the daily press would form an admirable site in the heart of the West End, but we sincerely trust that the company will reconsider the matter before taking a step which would undoubtedly do much harm to themselves and the trade. We do not wish to cast the slightest reflection upon the store in question, nor upon any other business house of this type. Our criticism is directed solely to the fact that a huge and gratuitous advertisement would be given to one store in such a way as to cause intense irritation to all other similar institutions. Let us imagine there are three stores which we call Smith's, Brown's, and Robinson's. All three. we will assume, have wireless departments. If, now we place the transmitting apparatus on the roof of Smith's store what is more likely than that the public will first think of Smith's when going to buy their apparatus? Demonstrators in Brown's and Robinson's stores, if questioned, would be forced to admit that the programmes are being sent out from a station on the roof of a rival, and no amount of explanation would convince the average "man-in-the-street" that there was no connection between the store chosen as the site and the Broadcasting Company itself. Once more we urge the company to reconsider its decision before it is too late.

OBITUARY.

We have to record with deep regret the death of Mr. John St. Vincent Pletts, the well known wireless expert and adviser to the Marconi Company. Mr. Pletts, who was but forty-four years of age, joined the Marconi Company in 1899, and became head of that Company's Patent Department in 1910. During the War he acted as expert in cryptography to the War Office. His loss will be deeply mourned in many quarters.

Quality First

We are very glad to find that the wireless public is at last waking up to the fact that cheap and shoddy components are the most expensive in the long run. It is quite a mistake to imagine that the minor components of a wireless set can be of inferior quality without sacrificing efficiency. Every component forms a link in a wonderful chain, and each contributes its own share towards general efficiency. The intimate contact established between our Information Department and the wireless experimenters has shown that a very large percentage of the faults in home-built sets can be traced to shoddy components. It should be apparent to every home constructor that the builder of, for example, a good intervalve transformer is only too anxious to attach his name to his products. We make it our business to see that the wireless public is supplied with good components, and the section of this journal devoted to reports on "Apparatus we have Tested" is open to any manufacturer who cares to send his apparatus for test. The reports so made are the result of most careful investigation and are published without fear or favour.

THE EDITOR TO BROADCAST.

Readers of WIRELESS WEEKLY will be interested to hear that Mr. John Scott-Taggart, F.Inst.P., A.M.I.E.E., will be broadcasting a message to members of the Radio Society of Great Britain on Thursday next, May 8th, at 7.10 p.m.

As is usual in the case of the Weekly Bulletins, the message will be sent broadcast from all stations.

THE KING'S SPEECH

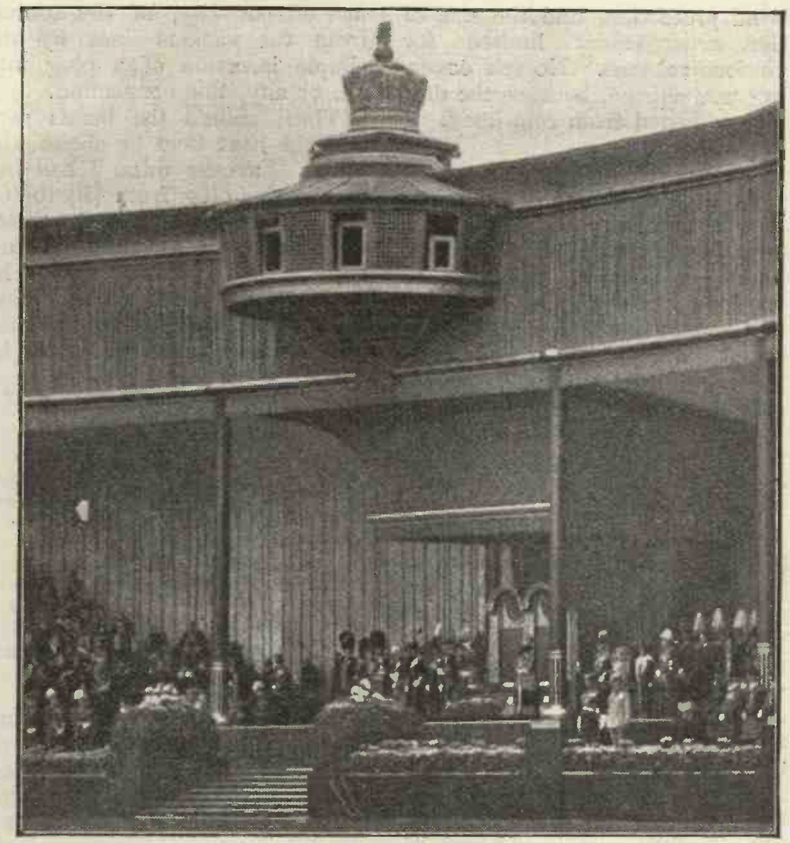
By P. P. ECKERSLEY, M.I.E.E.

Chief Engineer of the British Broadcasting Co.

The technical arrangements of the Broadcast at the Stadium, Wembley, on the occasion of the opening ceremony of the British Empire Exhibition.

THE achievement of the broadcasting of the opening ceremony of the British Empire Exhibition at Wembley may be historical, and I am glad to accept Mr. Scott-Taggart's invitation to record in this article the arrangements that were made.

There were three microphone points, as indicated on the plan. The (C) point was for the collection of the massed choirs; (B) served as the massed band point and all the incidental crowd noises; while (K) indicates the Royal Dais from which the King, the Prince of Wales and the Bishop of London gave their speeches.



The Royal Dais. The microphones were concealed beneath the flowers.

An Open Air Problem

For the first time we had to face the question of using a moving-coil microphone in the open air, subject to rain and wind disturbances, which might, without precautions, have marred the clarity of the broadcast. The microphone is illustrated in the second diagram, and relies for its action upon the sound waves creating sympathetic movement of the free coil suspended in a magnetic field. Should the wind be free to blow upon the coil, the sudden large excursions so caused produce sudden devastating impulses, which would not only cause serious parasitic noises, but which might easily so vastly over-control the system as to produce flash-over and consequent breakdown.

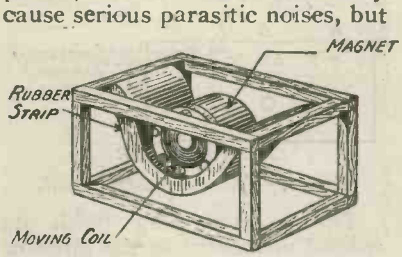


Fig. 2.—How the microphones were suspended.

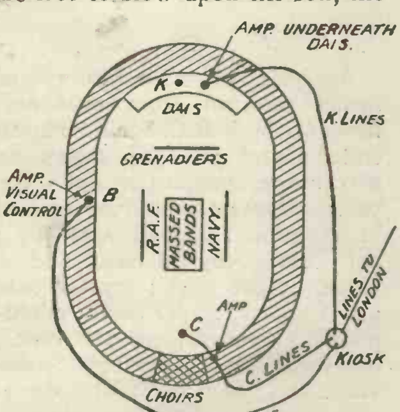


Fig. 1.—Plan of Stadium, showing the three microphone points.

Microphone Suspension.

The microphone as usually used hangs in a stirrup of sponge rubber, the stirrup again being supported by a wooden framework (see Fig. 2). The framework obviously can be used as a support to a wind-screen, and thus we covered five sides of the cube formed by the framework with copper gauze, covered with silk and stuck together by vaseline smeared on the silk. Furthermore, fitting over the front or business end of the microphone, a cap of the same type (copper gauze and silk) made assurance doubly sure. By means of this wind-screen, any violent effects of wind were shielded from the delicate coil. The results were excellent, a quite stiff breeze blowing at the time of the broadcast, which, however, failed to disturb the sounds which found their way easily to the moving coil, thanks to the great disparity in the character of the rapidly-changing sound pressures and the more gradual variation of wind pressure.

Rain Shield Troubles

Tin shields were obviously impossible for rain shields, as a rain-storm during the performance would have largely resembled a transmission from America with bad X's thrown in by a crackling atmosphere. Felt was therefore used as a shield, but luckily its need was never manifest; grey skies never crystallised into rain. Our system might have been tested to the utmost had we attempted to broadcast the Cup Tie!

The microphones for the Royal Dais were treated in the same way, but golden silk was used as wind protection, and the size of the arrangement limited for obvious reasons. No felt covering was needed, because the dais was screened from rain itself.

Separate Amplifiers

At each of the separate points it was necessary to arrange for amplification close to the microphone—it is quite impossible to run long leads carrying the feeble non-amplified magnetophone currents; the slightest electrical induction, for one thing, would mar the clarity of the broadcast. Thus, at the edge of the Stadium, railed off from the surrounding crowd, a little space was reserved for an amplifier, a telephone, and attendance. The band microphone (B) stood on the edge of the Stadium a few feet from the ground above the running track; the choir microphone was mounted on the raised dais from which Sir Edward Elgar conducted his choirs. The (B) amplifier was just in the edge of the spectators' enclosure, not a foot from the microphone; but the (C) amplifier was necessarily further away, also at the edge of the spectators' pen. The (K) amplifier was located in the inky blackness below the Royal Dais.

Reliability

Reliability was the next important consideration, and thus the (K) microphone was duplicated in every detail: two microphones, two lines, two amplifiers with two sets of high tension and low tension, and spares ready on change-over switches for these. Besides, at the (K) point we tapped from the Western Electric's supply. The B and C microphones, except for an array of spare valves, were not duplicated, skilled attendance being available.

From each microphone amplifier output ran wires to the B.B.C. Kiosk, and these wires terminated on an exchange board, as shown in Fig. 4. Instructions were issued that throughout the ceremony *all* systems were to be switched on permanently and left alone, the operators only seeing that the systems were continuously live.

With a programme of the event in front of him, a telephone connecting to all points, K, B and C, the master mind had full powers to switch on to the second amplifier all, or any, of the sounds from the various lines by the simple insertion of a plug into all, or any, line connection.

Thus, should the bands stop and the next item be choirs, the Kiosk "master mind" had but to slip this plug from (B) to (C) and the conversion was complete, no other man anywhere taking any action whatsoever. The master mind alone could initiate a telephone call, except in case of unforeseen emergency, and he

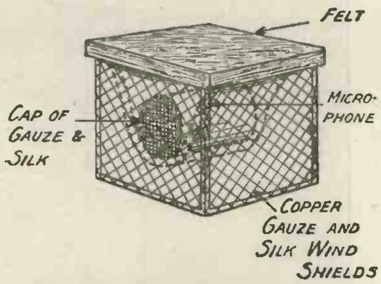


Fig. 3.—The wind screens.

was kept in touch with a visual controller in the Stadium at point (B). The master mind then held his selector plug to accept broadcast from any point, and should, say, the King's microphone fail, two more were immediately available, and no one need miss but a fraction of a second of the speech.

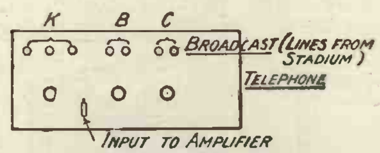


Fig. 4.—The exchange board.

The selector plug (with its spares) connected to the input of another amplifier in the Kiosk with a controller for rough control of strength. This amplifier was duplicated, the spare being continuously active and immediately available by the movement of one switch.

Post Office Co-operation

There were six available lines to London, and all along the route to the Post Office (*their* master mind ready in the Kiosk with his telephones and his code). In London two amplifiers were immediately available, so you will see that not a great deal was left to chance!

The Public Address System

Our last problem was the Western Electric's public address system echo from the Stadium walls, the "blow back" from the giant loud-speakers possibly marring the clarity of the speech. This, to an extent, did occur (the lag was in some cases 2 seconds, as far as I compute it), but not seriously enough to mar the clarity of the speech.

Criticism Invited

This system took a considerable amount of time, trouble and planning; but if any reader can see any serious flaw, I should be extremely interested to hear from him. It is often so easy for an outsider to see a fault not apparent to one who cannot see the wood for the trees, and as we shall doubtless have to do similar shows in the future, it would be enormously helpful to have technical help from our always stimulating and helpful co-enthusiasts.

Thanks!

To all who so kindly have written and congratulated us on the success of the undertaking, the engineers' best thanks; it was truly an engineers' show, and as they used to say in the war: "Great credit devolves to all ranks."

BROADCASTING NEWS

The new high power station at Chelmsford is proceeding satisfactorily, and signals should be sent over at an early date. Captain Eckersley, a piano, and a gramophone will probably constitute the programmes, so that they will be a return to the old Writtle days.

□ □ □

Analysis of the returns of tariffs received from members' firms of the B.B.C. for the month ended March 31, 1924, shows the percentage proportion of the various types of receiving sets to be as under: Crystal sets, 65.3 per cent.; crystal sets and 1 valve, .5 per cent.; crystal sets and 2 valves, .3 per cent.; microphonic amplifiers, 4.0 per cent.; one-valve sets, .7 per cent.; two-valve sets, 12.0 per cent.; three-valve sets, 2.4 per cent.; sets over 3 valves, 3.6 per cent.; valve amplifiers, 11.2 per cent.

How to Buy Valves

I HAVE just been buying a valve, and I feel that perhaps you would like a hint or two as to the way in which these things should be done. The reason why I required a valve was that on the previous evening Pondersby's admiration for my set rather got the better of him. He was standing besides it enthusing to Gupplesby, a cold man, who seldom really lets himself go. Pondersby had several shots at drawing some appreciative comments from him, but he met with only moderate success. At last becoming rather worked up he tapped Gupplesby lightly on the chest with his left forefinger, crying "Now *that*, my friend, is what I call a wireless set." This remark was accompanied by a graceful gesture with the right hand which decapitated my most cherished valve and effectively put an end to reception for the evening. A kindly fellow Pondersby, well meaning, but apt to be violent when he is enthusiastic. Being in need then of a substitute for the valve, which had so nobly fallen a victim to Pondersby's right arm, I turned into one of our emporiums, which I happened to be passing. Not knowing my way about, I went up to a magnificent shopwalker and said, just like that, "I want a valve." "Certainly, sir, certainly," said he. "Bicycle, safety, feeding bottle or wireless?" "The second and fourth," I replied in a flash. "I want a safety wireless valve that even Pondersby cannot smash."

Borne Skywards

He assured me that he was confident that they had the very thing. If I would proceed in such and such a direction I would find a lift which would bear me skywards. At the fourth floor I must get out of it and there straight before me I should find the wireless department.

An Embarrassing Choice

Following his directions, I duly reached my destination and was taken charge of by an alert young salesman. I repeated my question. "Yes sir, transmitting? receiving? bright emitter? dull emitter? power? Peanut?" Now when you have questions fired at you like bullets from a maxim gun it is a little disconcerting. To gain time therefore, I replied, "Oh, well, just let me see what you have." I was taken to a vast show-case crammed with valves, dozens and dozens of them, each different from the other. I did not know there were so many valves in all the world. When we had narrowed down our search to the bright emitter general purpose receiving valve, I thought that the task would a fairly easy one.

Each One the Best

But no; this stout fellow laid a score or more of them upon the counter for my inspection. And the difficulty was that each and every one of them was guaranteed to be the best of the lot. I demanded to see specimens of their curves. When these were produced I cast a knowing eye over them and again found that each was undoubtedly the best. In despair I asked the salesman's advice. He counselled urgently that I should purchase one of each, in which case I should be sure of getting the one which was the finest performer. This, however, seemed to be rather a large order, for even if valves are to be gesture fodder for a man like Pondersby you, or at any rate I, cannot afford to lay them in by the score. I asked if there were any he could guarantee Pondersby-proof, but it appeared that there were none. The only thing to do was to lay the twelve best looking ones in a row, then to shut one's eyes and dab with a finger. Unfortunately my first dab, though well directed, was a little too powerful and cost me 12s. 6d. This method is therefore not one that I recommend to the would-be purchaser.

The Enthusiasm of the Game

The salesman entered into the spirit of the game, and foreseeing possibilities of great trade, suggested that I should go on dabbing until only one was left. I could then purchase this one without the slightest hesitation. Except to millionaires, I am not prepared to recommend the process of elimination by dabbing. The methods that remain as possibilities are not very many. One might, of course, toss for it, though this would possibly create a sensation in a crowded shop. Or one could choose the valve with the prettiest name or the most shapely bulb. It is all very difficult. The only way, I think, is to borrow a piece of paper from the salesman, to tear it into as many little pieces as there are valves and to write the name of one of them upon each. You then place these in your hat, shake it up well and invite him to select one. Even here, however, a little caution is necessary, for in my case the salesman selected three of them, declaring they had stuck together. In face of this I could do no less than to purchase the trio.

The Art of Salesmanship

This brings us to the great art of salesmanship, which you have no doubt studied from one side or the other; I mean either as a seller or as a sellee. Time was when your wireless salesman was a beautiful young man with a languid air, who seemed to know little and care less about the goods which he had to offer. If he had a three-valve set working and you desired to hear the performances of a smaller one, he would say, " Well, yes, I *can*, of course, wire it up if you *really* want to hear it." But he gave you such a strong impression that the slightest exertion would injure irreparably his already delicate health, that you could not bring yourself to press the point. Now everything is very different. You enter, requiring a condenser, and before you know where you are, you are in the midst of a spirited discussion upon capacities, dielectric coefficients and hysteresis losses. He shows you type after type, and you feel that you have given him such a lot of trouble that you must buy at least a couple of condensers, and probably a good many other things. The wireless man should be on his guard against the wiles of the modern salesman.

" Prenez Garde "

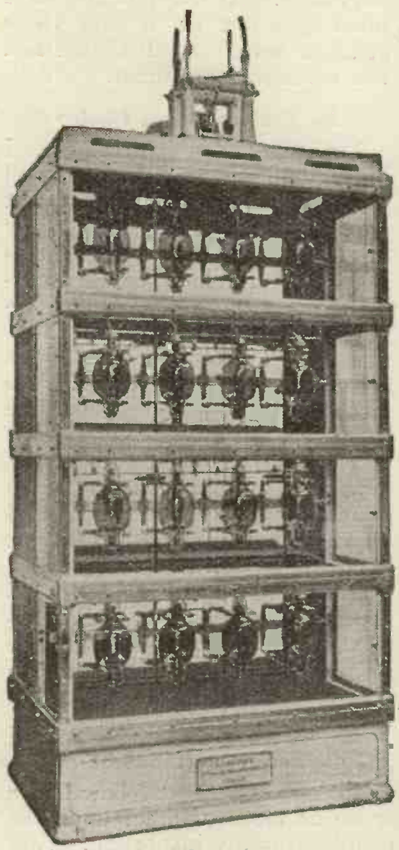
It is just as well before entering the shop to go to the nearest post office and to despatch to yourself at your own address by registered letter the entire contents of your note case, with the exception of a single Fisher. I know a man who went to buy a gridleak and came away with three loudspeakers, a couple of potentiometers and a complete set of expensive inductances, for none of which he had any possible use.

Odds and Ends

Just to show you what may happen if one is not careful, I may mention that a recent stocktaking of the cupboard in which I keep odds and ends of apparatus disclosed the rather alarming fact that I possess no less than nineteen variable condensers. There is nothing wrong with any of them, and five is as many as I can use even on the biggest set, yet the odd fourteen I appear to have acquired at various times solely through the blandishments of engaging salesmen. For this reason I am thinking of practising the art of salesmanship myself and seeing whether I cannot send Poddlesby, Gubbsworth and other local enthusiasts home weighed down with condensers and lighter in pocket.

Wireitus

No one in our wireless club ever listens to broadcast transmissions now. It is not that they are the authors of letters to the press upon the quality of the programmes signed " Disgusted " and " Fed-up " or that as holders of experimental licences their consciences have smitten them. It is simply that they have no time for broadcatching or indeed any other form of listening in. All of them are busily engaged in rewiring their sets. The whole thing was started by Breadsnapp, who lectured one night upon the proper principles of wiring, and exhibited his own set as an example of how it should be done.



The Marconi "Valve Pillar"—A method of assembling transmitting valves which is both neat and safe.

Clapham Junction Wiring

He had wired it bare on the bridge system, which he assured us was a vast improvement upon the Clapham Junction go-as-you-please method practised by the rest of us. It certainly looked very jolly, but as we all hastened to point out, its appearance would have been vastly improved if he had made his corners squarer.

How it Should be Done

Each of us thereupon resolved to show Breadsnapp how it should be done. Accordingly we spent many hours in wiring up our sets with bare copper wire, endeavouring to introduce as many right-angles as possible, and to make the whole look like an overdone proposition in Euclid. Then we rushed round to each other's houses and after passing disparaging remarks about each other's work returned to do it all over again. Our local Whiteley is constantly wiring for fresh hundredweights of solder and five mile reels of wire to meet the demand. The Gas Company is declaring an increased dividend owing to the enormous consumption of gas for heating soldering irons, and except for the members of the wireless club, little Puddletonians are enjoying a prosperity such as has not been known for years. Things were just beginning to settle down, as most of us had produced sets with which we were almost satisfied and were quite certain that our next efforts would achieve perfection, when that ass Broggsworthy upset the whole applecart by coming home one night with a consignment of square copper rod, which he displayed at the wireless club.

Tearing Sets Asunder

Naturally everyone tore his set to pieces at once, and next morning frantic wires were sent off for supplies of this material. Now we have got to begin all over again, and I am only praying that somebody else will not go and discover triangular or hexagonal wiring in about a month's time.

WIRELESS WAYFARER.

LOUD SPEAKING AT WEMBLEY.

We have been asked to point out that the only apparatus used for the broadcasting of the speeches and music to the 150,000 people in the stadium on the occasion of the opening of the Exhibition, was designed, manufactured and installed by the Western Electric Co., Ltd., and no apparatus of any other manufacture was used.

THE WIRELESS VALVE AND HOW IT WORKS

By JOHN H. MORECROFT,

Professor in Electrical Engineering, Columbia University, New York City.

In this, the first of a new and exclusive series of brilliant articles, Professor Morecroft, the famous American radio expert, and author of "Principles of Radio Communication," explains to "Wireless Weekly" readers the whole basis of valve working in a manner which, we think, is unique. The articles will appear each week.

IN studying the action of the valve it is very necessary to get a clear idea of the modern scientific concept of the constitution of matter. What does a piece of metal, such as the filament of a valve, consist of? Is it as dense and solid as it appears? A piece of tungsten wire such as is used for the filament of most valves is made up of a tremendous number of separate particles called atoms, or molecules, and there is much empty space between, and in, these atoms.

Each atom consists of a central portion, called a nucleus or *proton,* and around this proton are grouped many smaller particles called *electrons.* A simple atom may be much like our solar system, the sun corresponding to the proton and the planets, whirling around the sun, to the electrons of the atom.

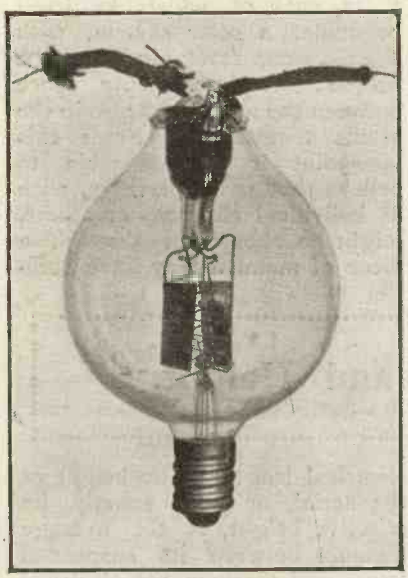
Many atoms are much more complex than this picture would lead one to believe. Thus the tungsten atom has 74 negative electrons grouped about a cluster of nearly 200 positive protons, together with over 100 other electrons tightly held together. A solar system to be similar to such an atom would have to have about 25 times as many planets revolving about the sun, as has our present system. The hydrogen atom, however, has only one electron revolving about its proton, so that it is very much like the combination of our earth and the moon. The electrons are probably in no closer contact with the proton than are the planets with the sun.

An analogy

If we imagine a piece of tungsten, the size of a ball, like those used in the ordinary ball bearing, magnified to the size of the earth, then the atom would be as large as a cricket ball, and an electron would be less than one thousandth of an inch in diameter. That is, the whole group of electrons and proton making up the atom would occupy as much space as a cricket ball, but most of this space would be empty as there would be in it, besides the small central nucleus, nearly 100 small particles much less than one thousandth of an inch in diameter.

Insulators and Conductors

In general the electrons that belong to a certain atom stick to it very tightly and cannot be taken away by another atom; in the same way none of the planets which revolve around the sun are taken away by other systems in the stellar universe. In certain substances, however, principally the metals, it seems that one electron per atom is more or less free to leave the atom and wander about at will among the other atoms and electrons, sometimes attaching itself to one atom and sometimes to another. In other substances, such as glass, rubber, bakelite and porcelain, all the electrons are rigidly attached to their atoms and cannot move about. These substances we call *insulators,* whereas the others, like the metals, are called *conductors.*



An original De Forest Audion, the first three electrode valve. The plate and grid leads issue from the top of the bulb.

The Electric Current

If a wire is connected with a battery, so that one end becomes positive with respect to the other, the free electrons, really negative electricity, will be attracted towards the positive end of the wire, and they will gradually drift along through the crowd of atoms from one end of the wire to the other. This drift of the free electrons through the substance of the wire is called an *electric current.* This motion of the electrons resembles that of a troop of men advancing through a wood; the individual men go in very irregular fashion, going sideways, and backwards even, to avoid rocks and trees, but on the whole the troop moves slowly forward. The electrons drift in much the same manner; they bump into the atoms and into one another, sometimes going sideways and sometimes being bumped backwards, but on the whole drifting from one end of the wire to the other.

We can apply this idea of current to the ordinary electric lighting system. An individual electron starting out from the generator in the power station may take a month or more to make a circuit of the system and get back to the generator; in the meantime it has been bumping its way along through the wires hung on poles in the street, through the house wiring, then through perhaps an electric iron or lamp, and so back through the wires to the station.

Motion of Atoms and Electrons

At ordinary temperatures the atoms of which a body is composed are not stationary but have a very rapid to and fro motion, going zigzag fashion in all directions. They bump into one another and bound away much as would a lot of tennis balls shaken about in a big box. Between the atoms, the free electrons, if there are any, bound back and forth with even greater velocity. It is this velocity of the atoms and electrons that gives the body its temperature; at absolute zero temperature (about 460 degrees below zero on the Fahrenheit scale) all the atoms of a body are at rest.

At ordinary temperature the average velocity of the atoms is several hundred feet a second. There is a fundamental law of physics which says that the free electrons in a metal must have the same amount of energy of motion as do the atoms. As the electrons are so small and light when compared to the atoms, the average velocity of the electrons must be correspondingly high. This average velocity of the electrons at ordinary temperatures proves to be about 50 miles a second.

Why Things Get Hot

Although we cannot attempt to prove it in a non-mathematical article of this kind, it is a fact that the temperature of a body is measured directly by the amount of energy expended by the motion of the atoms that make up the body; the greater the motion of the atoms and electrons the hotter is the body. Anything that increases the average velocity of its atoms will correspondingly raise the temperature of the body; if a piece of iron is hammered vigorously the iron and hammer both heat up, because the average speed of the atoms of which each is composed has been increased by the blows. If two bodies are rubbed together, as in a bearing, the shaft and bearing metal both get hot because the friction between the two has increased the average velocity of the atoms.

Metals are Porous

Anyone who has grasped the ideas set forth thus far will have reached the conclusion that what seems to be a hard and dense metal is really nothing of the sort, but a collection of complex particles, each of which in itself resembles a solar system, with the electrons revolving about the proton; there is an empty space between the atoms and also in the atoms themselves. From this viewpoint it is reasonable to believe that small particles, such as individual electrons or atoms, might be shot right through a piece of metal if they have sufficient velocity. Such is really the case; atoms and electrons are shot off from radium with tremendous velocities as it decomposes, and these high-speed particles go right through sheets of metal a quarter of an inch or more in thickness. They shoot through the spaces between the atoms or perhaps right through the atoms themselves.

Why an Electric Current Heats a Wire

When a wire is carrying current, the free electrons are forced to drift along the wire. Hence, in such a conductor, the electrons have an additional velocity as well as the irregular motion due to the temperature of the body. As the electrons crowd their way along the conductor they bump into the atoms and other electrons more vigorously than they would if there were no current in the conductor; due to this effect the average velocity of the atoms will increase when the conductor carries current and will increase with the amount of the current. This accounts for the heating of a wire carrying current, such as the filament of an incandescent lamp; in such a filament the intense heat is caused merely by the electrons pushing their way along the wire and so bumping the atoms and speeding them up.

(To be continued.)

Aerial Length and Height.

THERE is some confusion in the minds of many people as to what is meant by the length and height of an aerial. The electrical length is not the same as that between the end supports. It is the distance from the insulator at the free end of the aerial to the point at which the lead-in is taken off, plus the length of the lead-in from this point to the aerial terminal, plus the length of the earth lead from the earth terminal of the set to the connection with the ground. The natural wavelength of aerials varies very greatly according to their design, but, speaking generally, it may be said that the fundamental of the twin-wired aerial is about 4½ times its electrical length. The height of the aerial, or more exactly its effective height, is the average distance between its suspended wires and earth in the electrical sense. This does not necessarily mean the ground itself for buildings, trees and so on are earthed, and if the aerial passes over any of these its effective height is reduced. This last fact is often lost sight of by amateurs, who point proudly to their 30 ft. masts, but omit to take into account, say, a 20 ft. building and two or three 15 ft. fruit trees over which the wires pass. In such cases the effective height, even though tall masts are used, is often quite small.

R. W. H.

The Radio Society of Great Britain

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, 14th May, 1924, at which Mr. G. G. Blake, M.I.E.E., A.Inst.P., will open a discussion upon "Some suggested lines for Experimental Research."

Practical Back-of-Panel Charts

A new and useful guide to the Home Constructor.

By OSWALD J. RANKIN.

WHEN building a receiver there are three important factors to be considered: (1) Good insulation; (2) efficient contact, and (3) the avoidance of induced current effects, and only by carefully combining these three essentials can any degree of efficiency be obtained.

No matter how simple or how elaborate the receiver may be, success will depend on good workmanship, a little careful thought, and the use of components and materials of the best quality.

Ebonite Troubles

Many early failures are due to a faulty ebonite panel. During the process of manufacture the ebonite is rolled between sheets of tinfoil, and, as it too often happens, thin deposits of tin compounds are left on the surface of the ebonite, thus causing an undesirable leak between terminals. Ebonite which is guaranteed matted by the sand-blasting process will be quite ready for use when purchased, but where the cheaper grades are concerned the surface, on both sides, should be well rubbed down with powdered pumice stone and water. Matted ebonite is always preferable.

Avoid Pencil Lines

Lead pencils should never be used for marking off the panel. If a mere graphite pencil line will function as a gridleak it will also act as a leak in any other part of the circuit. Always mark off the panel on the under side, using a sharp steel scriber which has been well rubbed on an oilstone, and when drilling the holes place the panel on a piece of perfectly flat board to avoid fracturing the portion of the surface round the holes on the face of the panel.

Choice of Screws

The choice of bolts or screws for fixing the components will depend chiefly on the thickness of the ebonite. Small bolts are always preferable if the heads are neatly countersunk in the ebonite. Wood screws may be used as improvised bolts, the "nuts" consisting of small blocks of wood. They may also be used for fixing rheostats, condensers, etc., if holes are first drilled in the components and plugged with wood.

When fixing a rheostat the hole for the neck of the centre bush is first drilled, the rheostat then being placed in position while the screw holes are marked off by means of a sharp pointed bradawl.

> *Most of the illustrations to be given in this series of articles represent back-of-panel layouts or practical working drawings of receiving circuits which have been successfully tried out from time to time by the author, and it is hoped that the idea of presenting a collection of accurate circuits in a thoroughly practical way will be appreciated by all who are interested in wireless.*
>
> *Only the most useful circuits have been selected, these being arranged progressively from a simple crystal set to a multi-valve set in an endeavour to meet the requirements of any individual case.*
>
> *It is, of course, impossible to indicate all the different modifications and combinations of the various circuits shown, but the reader will no doubt appreciate the fact that the principles shown in one circuit can be embodied with those found in another, and thus he is afforded scope for experiments.*

Marking Out Valve Holders

Marking off the holes for a valve-holder is a fairly simple matter if a template is made by taking an impression of the valve pins on a piece of blotting paper. Alternatively, a small spot of oil may be placed on the end of each valve pin, the valve then being firmly pressed down on the panel and the holes marked off in the centre of each oil spot.

For Many Connections

Where a number of connecting wires are to be joined to one terminal it is best to provide a small bus-bar, which may consist of a strip of sheet brass or copper to which the wires are soldered, a hole being provided in one end for the purpose of clamping same to the terminal shank. Alternatively the bus-bar may be fitted with several small terminals.

Dangling flex should always be avoided, the connections from movable arms being made by means of small strips of spring brass being attached at one end to the panel and made to press firmly against the ends of the movable spindles. Spring washers and lock-nuts will be found indispensable.

Leads should never be run in parallel for any great distance, and although a sharp bend is sometimes considered bad practice, it is better thus if it is likely to avoid induced currents in the neighbouring leads. Ordinary No. 18 tinned copper wire is used throughout, each lead being covered with insulated sleeving.

Test Your Parts First

Before fitting the components to the panel, each one should be thoroughly tested. They should then be assembled on the table and connected up to form the selected circuit. The values of fixed condensers, resistances, etc., should be varied until maximum results are obtained, when all components used for the most satisfactory test may be mounted on the panel, as far apart as possible, and finally connected up.

A Soldering Hint

Soldered joints are always to be preferred, but great care should be taken to see that they do not develop into "dry joints," which, although being capable of passing low-frequency currents, will not pass high-frequency currents

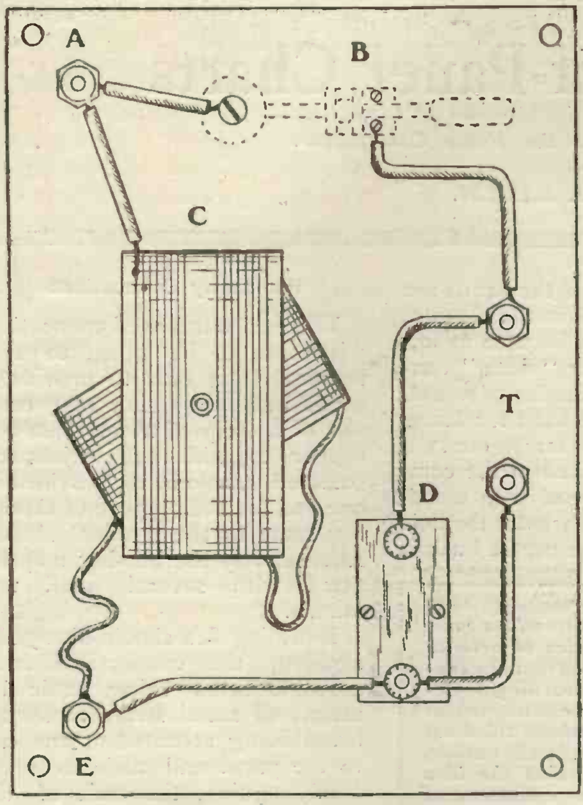


Fig. 1a.—Back-of-panel view of a variometer-tuned crystal set.

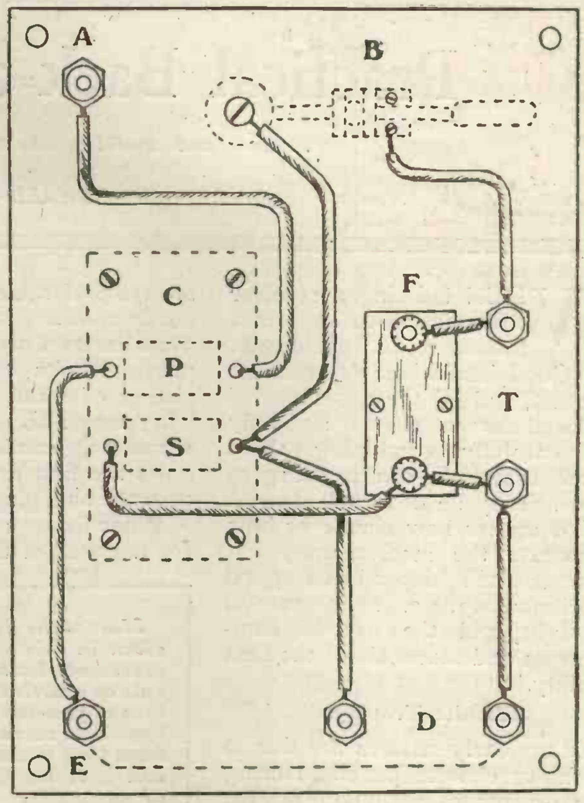


Fig. 2a.—Back-of-panel view of a loose-coupled crystal set using plug-in coils.

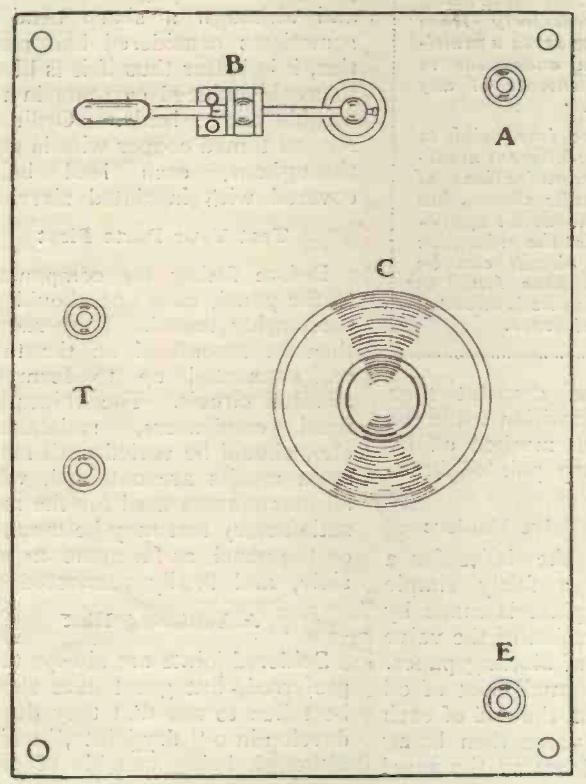


Fig. 1b.—Top-of-panel arrangement of variometer set.

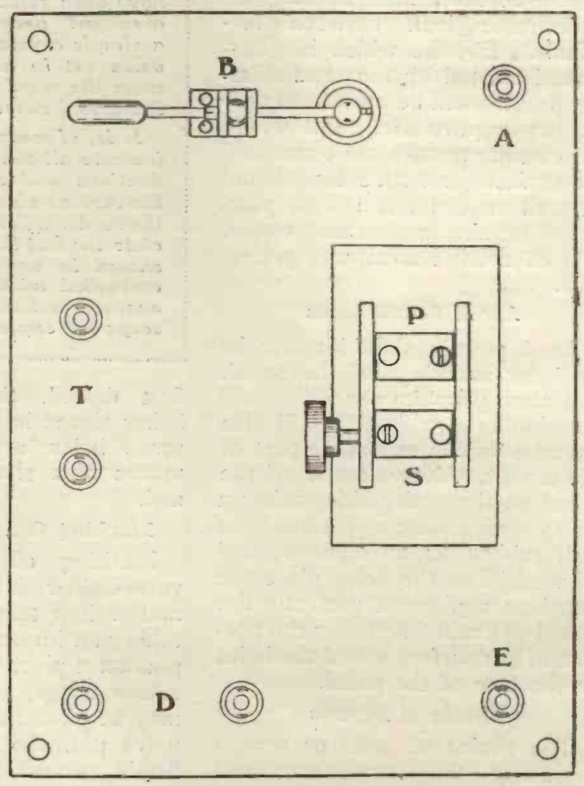


Fig. 2b.—Top-of-panel arrangement of loose-coupled set.

satisfactorily. Visibly, a "dry joint" is difficult to detect, and if trouble is encountered each joint should be tested by exerting a slight pressure on the wire near the joint, with the finger. If possible, all components should be mounted on the panel, as this permits the whole system to be wired up and finally tested before fitting the panel to the cabinet, but, where space is limited, transformers, coil holders, and other well-insulated components may be mounted on the walls of the cabinet.

Three Systems

The choice of either of the three systems of arranging a receiver, i.e., (1) panel and cabinet self-contained outfit, (2) ordinary unit system, and (3) separate component system, will be a matter to be decided upon at the outset. The first-mentioned is, of course, more appropriate to a drawing room, has the advantage of being practically dustproof, but cannot be conveniently altered should the owner decide that it is not quite suitable for his purpose. The ordinary unit system, where the H.F. detector and L.F. units are arranged separately, is not quite so compact, and although permitting the addition of an extra stage of H.F. or L.F., with the minimum of trouble, the problem of altering the actual circuit arrangements again presents a difficulty, since each unit is self-contained. The separate component system, being essentially experimental, is only to be recommended where the enthusiast intends to carry out experiments with different types of circuits. For this purpose it is ideal, but as the external maze of connecting wires cannot be avoided it is not a system which is likely to appeal to anyone confined to the drawing room, for it might aptly be described as the "workshop system."

About Switching

The initial tuning arrangements of any of the circuits shown in the following pages may, of course, be modified at will. Complicated switching systems have been avoided for sake of clearness, but such refinements may be included as desired. As it is not possible to specify the exact values of all components, owing to the prevailing dissimilarity of geographical situations and general conditions, the reader is left to carry out a few experiments to ascertain the correct values for his own particular purpose. The values given in the texts may be taken as generally accurate, but it should be clearly understood that the ultimate success of any combination of components will depends on experiments.

Crystal Receiver with Variometer Tuning—Fig. 1a

One of the most simple and efficient types of crystal receivers. The detector B is shown dotted, this being mounted on the upper side of the panel. A, E, and T represent the aerial, earth, and telephone terminals respectively, as in all other diagrams. C is the variometer, which may be of the standard commercial type or made up from two cardboard formers each wound with about 18 ft. of No. 24 D.C.C. copper wire. D. is a .002 mfds. fixed condenser connected in shunt with the telephone terminals. High resistance headphones should be used.

Crystal Receiver with Honeycomb or Basket Coils Fig. 2a

The two-coil holder (shown dotted) is mounted on the upper side of the panel, P representing the socket for the primary coil, and S the socket for the secondary coil, which is shunted with a .0005 mfds. variable condenser, via the two terminals D. A .001 mfds. variable condenser may be tried first in series and then in shunt with the primary coil. B is the crystal detector, and F the telephone condenser. It may be necessary to earth the lower 'phone terminal, as indicated by the dotted line.

NOTE.—Further "Back of Panel" diagrams will be published in these pages from time to time.

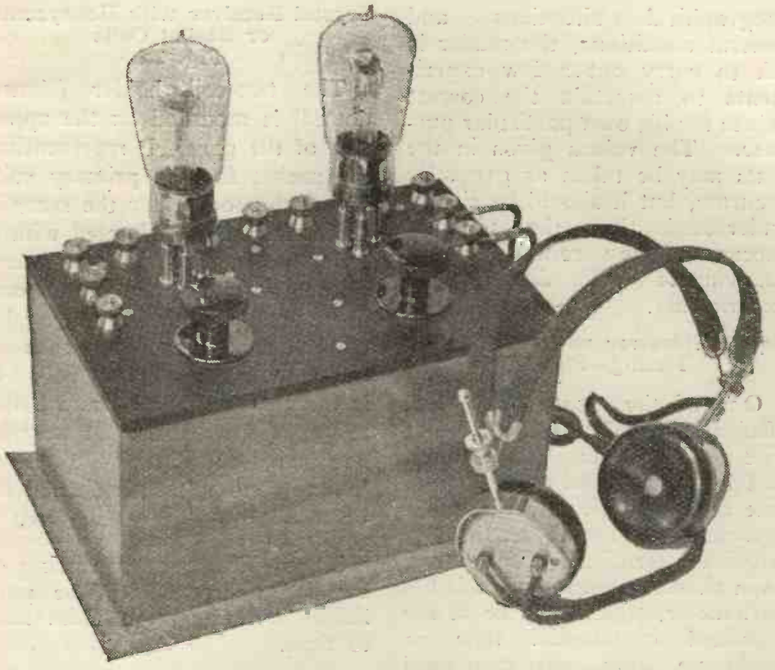
We are given to understand that in the advertisement of the Edison Swan Electric Co., Ltd., in our April 23rd issue, the price of the A.R.D.E. valve appeared as 27/6 instead of the correct price which is 21/-.

BROADCASTING THE KING'S SPEECH

One of the large Amplion loud-speakers used in various parts of the country to broadcast the opening ceremony at the British Empire Exhibition.

An Inexpensive 2-Valve Amplifier

By PERCY W. HARRIS, Assistant Editor.



For a two-valve set, the space occupied is small.

WHEN broadcasting first began there was so much of novelty and interest about it that we were inclined to overlook many defects in the apparatus originally available. Furthermore, at the beginning of broadcasting the modulation of the transmitter was not of the highest quality. For some months, however, the quality of modulation has been so high as to be, for all intents and purposes, distortionless at the transmitting end, and such imperfection of reproduction as is now evident is in the main due to faulty receivers. Much has been done to improve the quality of intervalve transformers—one of the most frequent causes of distortion in receiving sets—so that now we have a number of excellent makes capable of giving, when properly used, exceedingly fine reproduction. There are, however, many experimenters who pin their faith to transformerless amplifiers, *i.e.*, those which utilise resistance capacity coupling.

Range Required

We have in broadcasting audio-frequencies ranging from 60 to 6,000 vibrations a second, to mark out the rough limits. The ideal amplifier would magnify all frequencies within these limits equally. Poor intervalve transformers will magnify some frequencies more than others in such a way that if we were to plot the magnification against the frequency in the form of a curve, this curve, instead of being a straight line would have a sharp hump in the middle, the hump corresponding with that frequency which is most highly magnified. Well designed transformers have very flat curves over a wide band of frequencies.

Resistance capacity coupling, however, has the merit of amplifying all frequencies equally.

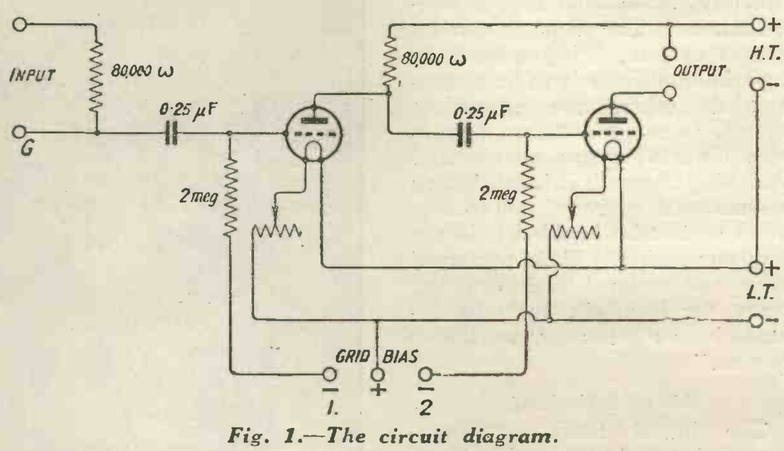


Fig. 1.—The circuit diagram.

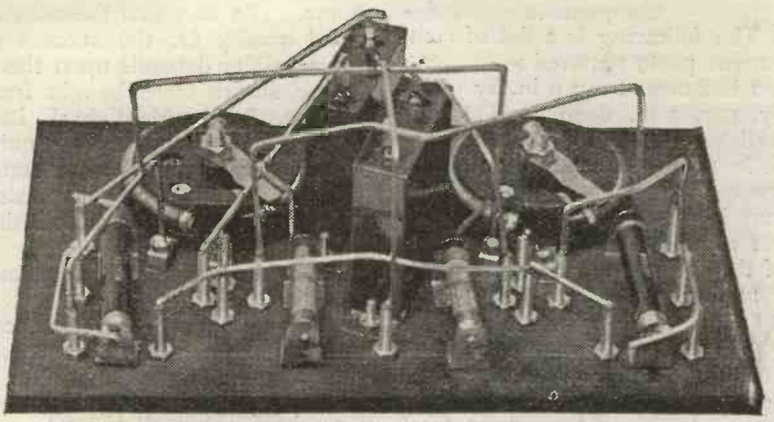
The principle of resistance coupling is fairly easy to understand. Between the plate of the valve and the high tension battery we insert a resistance of say 50,000 to 100,000 ohms, so that the fluctuating plate current flows through it. Ohm's law tells us that the current flowing in the circuit is dependent upon the electromotive force and the resistance, so that if we have a fluctuating current in the plate circuit, due to the modulations of voltage on the grid set up by the received signals from the broadcasting station, there will be variations of voltage across the resistance. These variations of voltage can be applied to the next valve by connecting this latter across the resistance. This is done in the case of the resistance-capacity-coupled amplifier.

Resistance Coupling Explained

If, however, the second grid were connected straight to this resistance the high voltage from the plate battery would reach the grid, making it strongly positive. For this reason we place a fixed condenser between the grid and the resistance to act as a " stopper " to this steady plate voltage, while not impeding the fluctuating signal voltages. We thus get a circuit in which first of all the incoming signals set up voltage fluctuations between the grid and the filament of the first valve, controlling the plate current of the first valve, causing it to fluctuate in sympathy. These current fluctuations set up differences of pressure

Much interest has recently been displayed in resistance coupled low-frequency amplifiers, largely due to the fact that the King's set and the apparatus used by the British Broadcasting Company for the relaying of American signals both utilise such amplifiers

across the ends of the high resistance, setting up in turn magnified voltage changes between the grid and the filament of the second valve. Here again the plate current is modulated, and in the plate circuit of the second valve we get modulated current of much greater amplitude than that set up in the plate circuit of the first valve. If necessary we can cause the plate current of the second valve to set up voltage changes across a resistance and thus add a third or even a fourth valve. Owing to the fact that the magnification is quite independent of the frequency the resulting signals in telephones or loud-speaker will be very pure, only equalled in quality by the best of the transformers. There is, however, one great disadvantage to resistance-capacity coupling, *i.e.*, there is less amplification per valve than is obtainable with a good transformer coupling. Against this must be offset the fact that as there are no resonant circuits in the amplifier there is far less chance of audio-frequency reaction and howling. Furthermore, resistance capacity coupling is cheap. It should be mentioned that owing to the voltage drop through the resistance we must use about 50 per cent. higher plate voltage with a resistance amplifier.



The wiring is simple and well spaced.

A Useful Unit

I have recently built a compact two-valve resistance-capacity-coupled amplifier, shown in the photograph herewith, which serves excellently to amplify signals from a crystal set or from a valve receiver. Excluding, of course, the valves, the cost of building this two-valve amplifier is no greater than a single-valve transformer-coupled amplifier, whilst the magnification—not so great as obtainable with two transformer-coupled valves, is yet greater than that obtained by a single transformer-coupled valve.

Many Uses

Added to a crystal receiver it retains the original and characteristic purity of this form of instrument and near a broadcasting station, say up to 6 miles, it will give enough volume to work a loud-speaker from a crystal set. It also seems to differ from the average transformer amplifier in increasing the *range* of a crystal set, for whilst I have not found in most transformer amplifiers that added to a crystal set they bring in signals which are not otherwise audible, with the present instrument I have been able to listen to both Birmingham and Cardiff (when 2LO was not working) the words of the announcers being quite distinct, although listening with a crystal set alone one could not hear the slightest sign of telephony. Birmingham is well over 100 miles from me and I suppose Cardiff would be more than that. As the amplifier has no tuning control, being purely an audio-frequency device, the set with a crystal receiver and the two valves added is just as simple to use as the ordinary straightforward crystal set whereas if a valve is used to precede a crystal as a high-frequency amplifier, at least two tuning controls are necessary.

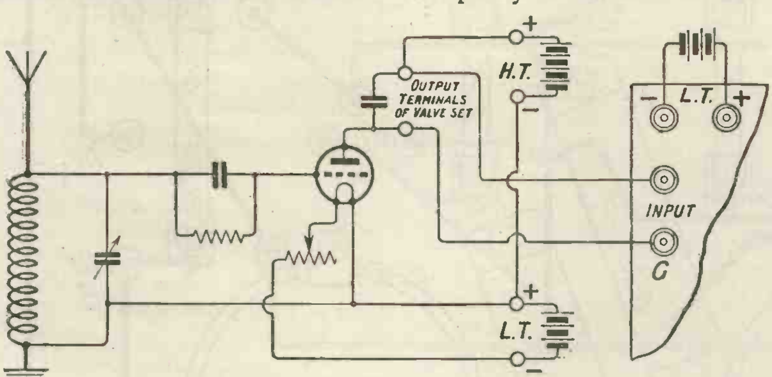


Fig. 2.—How to connect up a valve detector to the amplifier. The whole of the detector circuit is shown for clearness.

The Circuit

The circuit is shown in Fig. 1 wherein will be seen the terminal arrangements. The two grid leaks are brought out to terminals, so that adequate grid bias can be used to keep the valves working on the right part of their characteristics. It will be seen that with these terminals it is possible to place a different grid bias upon each valve. The object of this is to enable higher grid voltage to be placed on a second valve as, owing to the fact that there is no resistance to the plate circuit of the second valve, the effective voltage on this will be higher than on the first valve. Furthermore, as will be seen later, we can make the first grid positive, thus helping it to rectify when using the set as a detector with note magnifier.

Components

The following is a list of component parts required :—

1 box measuring 9 in. by $5\frac{1}{2}$ in. by, say, 5 in. deep. (This can well be larger, for there is very little room to spare, and with some components more room may be required).

1 piece of ebonite to fit the top of this box and $\frac{1}{4}$ in. thick.

11 terminals.

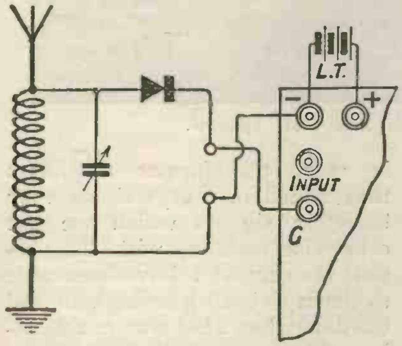


Fig. 3.—Connections for a crystal set.

2 filament resistances. (Those shown are the Burndept dual pattern to enable both bright and dull emitter to be used. Of course if bright emitters are chosen then one of a cheaper pattern can be utilised).

2 sets of valve pins for the sockets.

2 Mansbridge condensers .25 μF.

2 anode resistances 80,000 ohms. (Be sure that these are of good quality for the success of the amplifier depends upon them. Those shown were bought from Messrs. Leslie McMichael, Ltd. The variable patterns work quite well in such a circuit and better still are the large Dubilier resistances, which look like elephantine grid leaks.)

2 grid leaks (2 megohms, Dubilier).

4 sets of clips for resistances and leaks.

Square bus-bar wire.

Constructional Details

Before marking out the panel, collect your components and see if you can arrange them in the space given. Follow as closely as possible the general arrangement shown in the photograph and diagram, as this enables the wiring to be kept short. There is no particular virtue in the rather peculiar angle of the Mansbridge condensers in the set illustrated. This arrangement was made to enable the condensers to fit in the space available.

There are no particular constructional peculiarities except perhaps that one clip of each of the grid leaks is secured by a nut on the terminal shank by which the negative bias is applied. The terminals themselves are arranged $\frac{3}{4}$-in. from the edge of the panel and 1 in. apart. The centres of the filament resistances are about $2\frac{1}{2}$ in. from the end of the panel and about $1\frac{3}{4}$ in. from the bottom line. Keep all these well apart when wiring up.

Use of Set

When the set is completely wired up and ready for test, connect a 6-volt accumulator (if you are using bright emitters) or

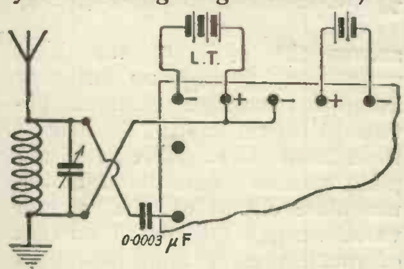


Fig. 4.—Using the set as a detector and amplifier.

a 4-volt for dull emitters (for dull emitters, of course, you can use 3 dry cells of good size in place of the accumulator) to the L.T. terminals, and a suitable high-tension battery to the H.T. terminals. For bright emitters (practically any of the well-known valves serve equally well) use 100 to 120 volts. For dull emitters do not use more than 100 volts. In most cases a $4\frac{1}{2}$-volt dry battery will suit for the grid bias, the two negative terminals being

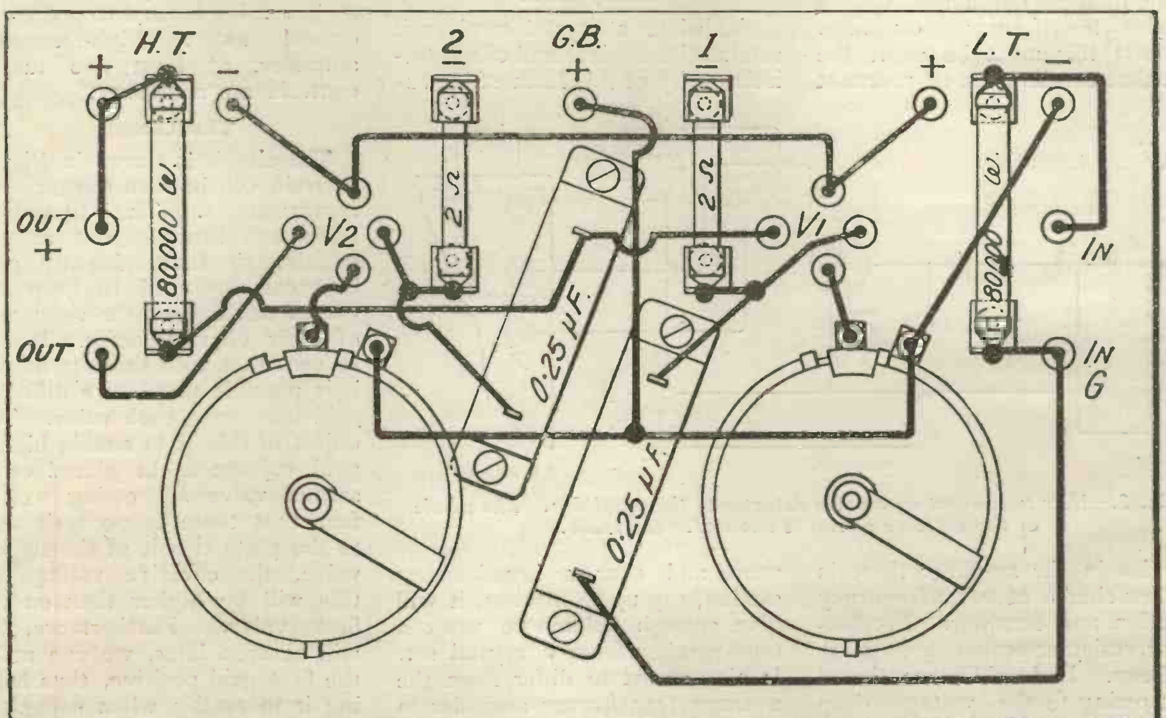


Fig. 5.—The detailed wiring diagram. Blueprint No. 38.

connected together and to the negative lead of the grid battery, the positive lead of the battery being connected to the central grid bias terminal. If you are connecting up a crystal receiver make the connections as shown.

How to find the Correct Connection

If you do not know which of the output terminals of your crystal set is connected to earth and which to the crystal, try one way and then the other. One way you will hear signals and the other you will not, so it is quite a simple matter to find which is the right way round. The valve detector connections are also shown in the diagram. When you have become accustomed to handling the set it is well to try a few experiments with different grid bias values. In order to place a different bias upon the two valves a very good way is to take one of the 15-volt tapped units, connecting the positive socket to the middle terminal and having two wander-plugs connected to the two negative bias terminals of the set. You can then plug-in say 4½ volts on to the first valve, and at, say, 9 volts, on to the second. If you want to use a power valve in the last socket you will need to use a greater value of high tension. This can be done by connecting say another 100 volts between the upper output terminal and the loud-speaker. In this case be sure that the negative terminal of the additional high-tension battery goes to the upper output terminal, and the positive end of this battery to the telephones or loud-speaker. The voltage on the last valve will then be 100 volts (or whatever is the value of the additional unit) greater than the high-tension battery connected to the standard high-tension terminals. For example, if you are using an L.S.5 valve, it is well to use 200 volts on the plate and about 15 or 16 volts negative on the last grid. This you can easily arrange by means of terminals provided.

Used as a Detector

To use the unit as a detector followed by one note magnifier, it is merely necessary to connect a .0003 grid-condenser, as shown in the diagram. This condenser should not have a leak across it.

Honeycomb Coils and How to use them

We reproduce below an interesting leaflet showing combinations of Honeycomb Coils for receiving the various European Telephony broadcasting stations. Copies of this leaflet may be obtained upon application to the Igranic Electric Co., Ltd.

Showing combinations of HONEYCOMB COILS necessary for reception when using a P.M.G. aerial.

Station.	Call Sign.	Wave Length in Metres.	Aerial Circuit with Variable Condenser in parallel.		Secondary Circuit with .0005 mfd. Variable Condenser in parallel.	Tuned Anode Circuit with .0003 mfd. Variable Condenser in parallel.	Reaction on	
			.001 mfd.	.0005 mfd.			Aerial.	Tuned Anode.
B.B.C. Stations ...	—	300/400	25	35	50	50	75	75
,, ,, ...	—	400/500	35	50	75	75	75	100
Croydon & Aircraft Telephony	—	900	75	100	150	150	150	200
Paris (Ecole Superieure)	—	450	35	50	75	75	75	100
,, (Radiola) ...	SFR	1780	150	150	200	200	100	150
,, (Eiffel Tower)...	FL	2600	200	250	300	300	200	200
Lyons...	YN	3100	250	300	400	400	250	250
Brussels (Radio Electrique)	—	410	35	50	75	75	75	100
,, ...	BAV	1100	100	100	150	150	150	200
The Hague	PCGG	1050	100	100	150	150	150	200
Ijmuiden	PCMM	1050	100	100	150	150	150	200
Amsterdam	PA5	1050	100	100	150	150	150	200
,, (Vas Diaz)	PCFF	2200	200	250	300	300	200	200
Lyngby	OXE	2400	200	250	300	300	200	200
Berlin (Königswusterhausen)	LP	2800	250	250	300	300	200	200
,, (Vox Haus) ...	—	400	35	50	75	75	75	100
Eberswalde	—	2930	250	300	400	400	250	250
Prague	PRG	1800	150	150	250	250	100	150
Kbel	—	1000	100	100	150	150	150	200
Geneva	—	1100	100	100	150	150	150	200
Lausanne	HB 2	1100	100	100	150	150	150	200
Madrid	—	1650/2200	200	200	250	250	150	200
,, ...	PTT	400/700	50	50/75	75	75	100	100
Rome	ICD	3200	250	300	400	400	250	250

The above figures will be found correct in almost all cases, though local and other conditions may cause some slight variations therefrom.

Some Useful Wireless Figures

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

WHETHER one is doing practical wireless work or is engaged in making up wireless apparatus, there are certain formulæ and certain standard figures that are always being required. Some of the formulæ can be very much simplified where absolute exactness is not needed, as we shall see. The figures are concerned chiefly with the diameter, weight, and resistance of wires and with the sizes of drills required for certain purposes. As regard wires, it is quite easy to find, either from makers' catalogues or from wireless books, the number of yards which go to a pound, the resistance of one pound, and the number of turns which can be wound in one inch; but, so far as I know, nobody has yet published a table showing the figures that the amateur most needs, and he has therefore to find them for himself by calculation, a process which does not appeal to those who are not particularly good at figures. Suppose, for example, that you wish to wind an auxiliary resistance for dull-emitter valves to have a value of 25 ohms and to be able to carry .2 ampere. The figures hitherto available will show you that No. 38 Eureka wire will carry this current, though to be on the safe side it might be better to choose No. 36. But they do not tell you how many ohms go to the yard of wire, which can be found only by dividing the yards per pound into the resistance per pound.

Soft Copper Wire

The first table gives useful data for soft copper wire.

In this, and in all other tables, round and not exact figures are given for the sake of simplicity. It will be found that the figures are quite sufficiently accurate for all practical work.

Winding Inductances

Table 2 is most useful for inductance winding.

TABLE 2.—*Windings.*
D.C.C. Wire turns on 3 inch Former.

Wire S.W.G.	Length of Windings. Inches.	Weight required. Ounces.
16	7.7	16
18	5.9	9.0
20	4.8	5.0
22	3.9	3.0
24	3.25	2.0
26	2.9	1.25
28	2.5	1.0
30	2.3	0.75
32	2.0	0.6
34	1.8	0.4
36	1.6	0.3
38	1.4	0.2
40	1.3	0.15

It shows the length of the windings and the weight of wire required to make a 100 turns of double cotton-covered wire of all sizes from 16 to 40 on a 3-inch tubular former. The weight needed for winding a similar number of turns on tubes of different sizes can be found in a moment, since it is always proportionate to the diameter; thus for 100 turns on a 2-inch tube the weight needed would be two-thirds that of a 3-inch tube, and for a 4-inch tube four-thirds. Similarly the weight of wire and the length of windings for any number of turns can be worked out almost instantly.

Eureka Resistance Wire

Table 3 gives all the figures required for Eureka resistance wire.

TABLE 3.—*Eureka Wire.*

Gauge	Ohms per lb.	Ohms per yd.	Inches per ohm.	Cur. car. cap. amps.
16	5.6	0.2	180.0	6.0
18	0.17	0.35	105.0	4.0
20	0.56	0.66	55.0	3.0
22	1.50	1.0	36.0	2.5
24	4.00	1.9	19.0	1.5
26	9.00	2.6	14.0	1.0
28	20.00	4.0	9.0	0.75
30	40.00	5.7	6.3	0.60
32	70.00	7.4	5.0	0.50
34	132.00	10.0	3.5	0.40
36	284.00	14.0	2.5	0.30
38	730.00	24.3	1.5	0.20
40	1800.00	37.5	1.0	0.15

With its aid the length and gauge of wire for making any kind of potentiometer, rheostat, or fixed resistance can be arrived at with the minimum of trouble. It should be noted that this table applies to *Eureka* wire only.

Other Resistance Wires

There are several other kinds on the market with different resistance constants, which appear in Table 4.

TABLE 4.—*Resistance Constants.*

Metal.	Constant.
Advance	19.2
Calido	39.3
Climax	34.7
Constantan	19.3
Eureka	18.5
Excello	36.0
Ideal	19.3
Manganin	16.5
Nichrome I	38.8
Nichrome II	42.6
Resistan	29.9
Superior	34.3

A Quick Method

Table 5 is a short cut for the application of the figures in Table 3 to any kind of resistance wire. It gives the factors by which figures in the first two columns in Table 3 must be multiplied in order to fit them to any kind of resistance wire. In the case of the third column, division is, of

TABLE 1.
SOFT COPPER WIRE.

Size S.W.G.	Yds. per lb. (bare).	Res. per lb. (ohms).	Turns per Inch. Enamelled.	D.C.C.	D.S.C.	S.C.C.
16	27	0.2	15	13	14	15
18	48	0.6	20	17	19	20
20	85	2.0	26	21	25	26
22	140	5.5	33	26	31	33
24	220	14.5	42	31	40	42
26	340	32	50	35	47	50
28	500	70	61	40	56	60
30	720	140	73	44	67	72
32	950	250	83	50	75	81
34	1,300	470	98	55	85	93
36	1,900	1000	116	64	102	110
38	3,000	2600	143	71	121	133
40	4,800	6400	180	78	142	160

course, necessary, not multiplication.

TABLE 5.—*Factors for other Resistance Wires.*
EUREKA = 1.

Metal.	Factor.
Advance	1.038
Calido	2.124
Climax	1.875
Constantan	1.043
Eureka	1.000
Excello	1.946
Ideal	1.043
Manganin	0.892
Nichrome I	2.097
Nichrome II	2.305
Resistan	1.616
Superior	1.854

Drills (Morse)

TABLE 7.
Drills for B.A. Sizes.

B.A.	Tapping.	Clearing.
0	12	"B"
1	19	3
2	26	12
3	30	19
4	34	26
5	39	30
6	43	34
7	48	39
8	51	43

Tapping Drills

It will be seen that the tapping drill for any B.A. size is the same as the clearance drill for two sizes smaller; thus a No. 12 drill is right for tapping 0 B.A. or for clearing 2 B.A., whilst No. 34 will tap 4 B.A. or clear 6 B.A. The fact that this is so reduces the total number of drills required in one's outfit. The whole of the B.A. sizes may be covered by 11 drills, Nos. "B," 3, 12, 19, 26, 30, 34, 39, 43, 48 and 51. If the reader confines himself in his constructional work to the three sizes, 2, 4 and 6 B.A., which are all that are really needed for doing any wireless job, he can cover all his requirements in the way of drills with four sizes, Nos. 12, 26, 34 and 43.

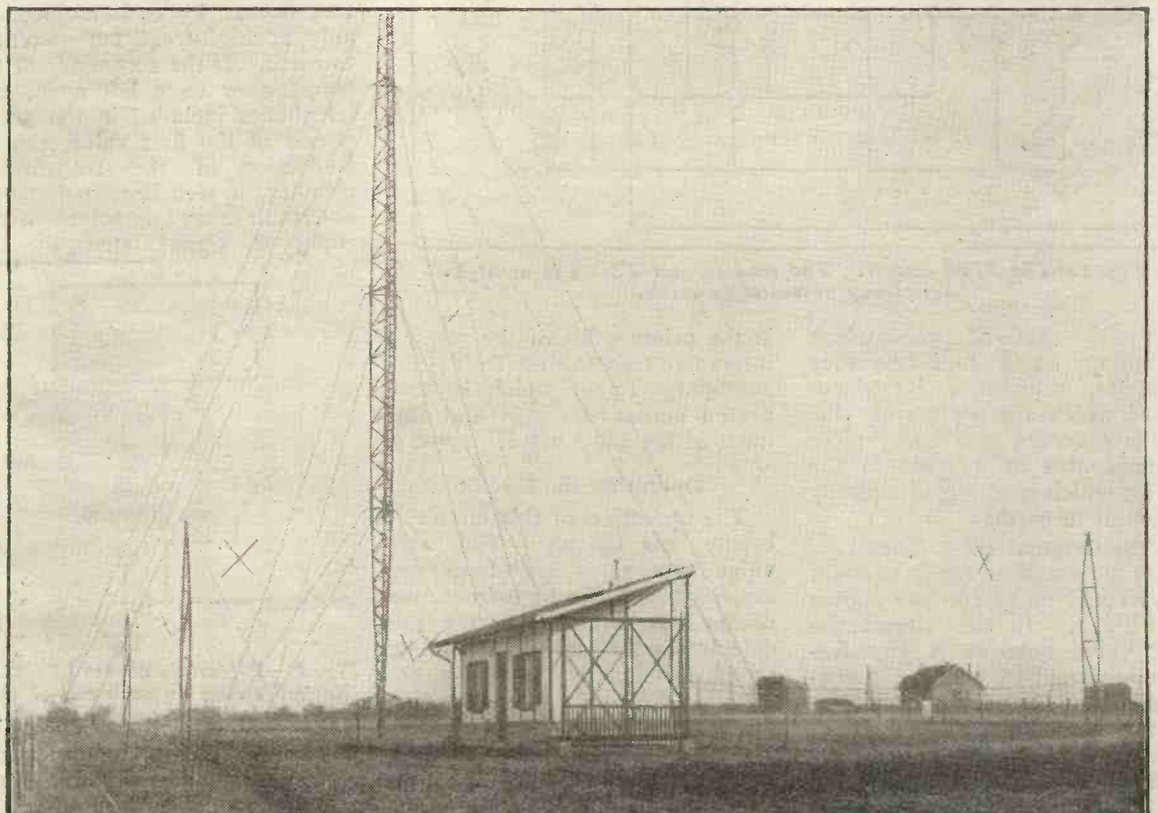
Odd Numbers

There is no reason why the odd numbered sizes should ever be used at all; in fact, one representative body of engineers passed a resolution some time ago that they should be discontinued altogether. Certain makers, however, do use these sizes to a considerable extent. It is a matter entirely for themselves if they choose to do so, for the screws used for putting together the various fixed parts of their apparatus. But one wishes that they would consult the convenience of the purchaser by making the clearance holes for bolts and the tapped holes for screws, which must be inserted to fasten apparatus to the panels of the set 4 B.A. There is every reason in favour of the adoption of this size as the standard for the purpose.

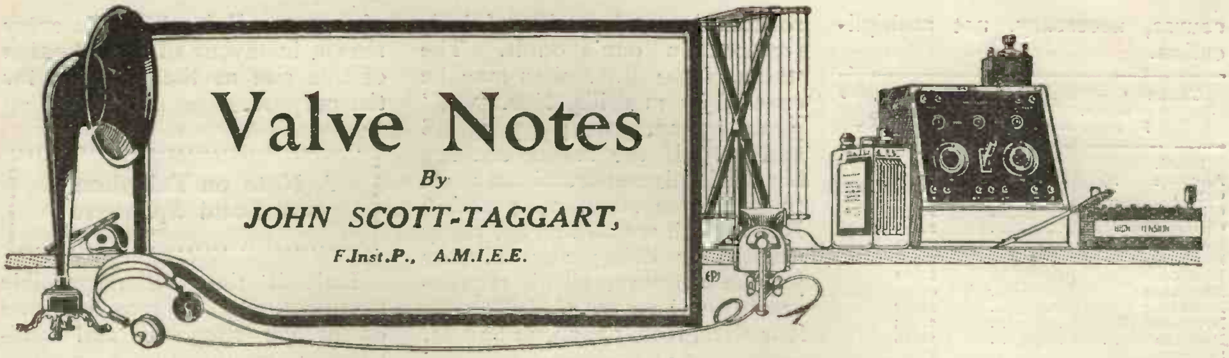
A Note on Telephones and Loud Speakers

Isn't it time *all* responsible manufacturers of receivers and *all* of the telephone and loud-speaker manufacturers marked their instruments to show the positive connection? Unless we know this there is danger that the steady anode current from the valve will flow through the windings in such a direction as to reduce the permanent magnetism. If the telephones are connected the wrong way round the permanent magnets will be steadily demagnetised and the instrument reduced in sensitivity. We have just tried several of a new line of loud-speakers made by one of the biggest firms. The leads are not marked in any way.

Of course the instruments with which the telephones and loud-speakers are used must also be properly marked.



Exterior of the well-known French experimental station 8Aé. Details of the calibration waves sent out by this station were published in our issue for 23rd April. The interior is shown on another page.



Valve Notes

By

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

Improving the ST76 Circuit

AN effect which is obtainable on one or two dual amplification circuits, such as the ST76 and ST151, is that the introduction of a transformer next to the anode of a valve which is acting as a high-frequency amplifier, sometimes introduces losses which are not merely due to the presence of a bulky piece of apparatus at a point in the circuit which is at high-frequency potential to earth.

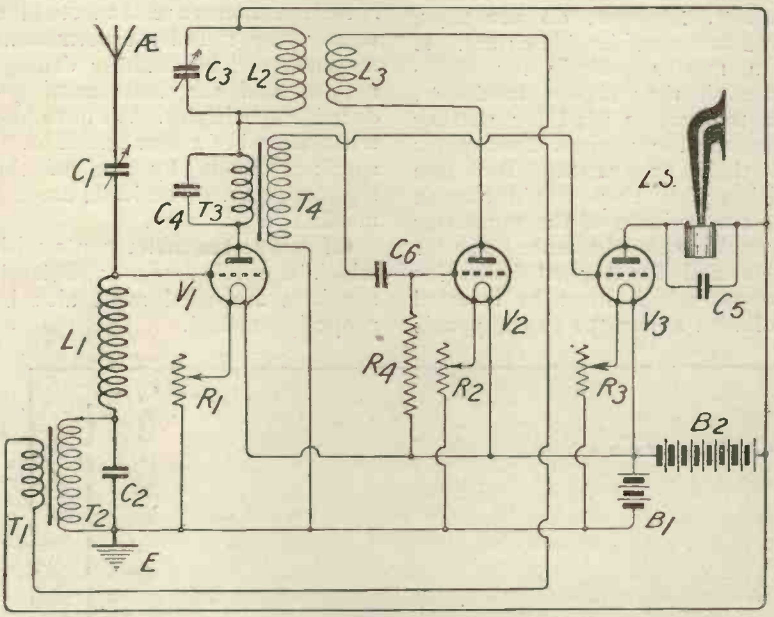


Fig. 1.—The ST76 circuit. The transformer T3 T4 is at high-frequency potential to earth.

The Original ST76 Circuit

Let us examine for a moment the ST76 type of receiver shown in Fig. 1. In this circuit the first valve acts as a high-frequency amplifier, and the potentials set up across the circuit L2 C3 are communicated to the grid of the second valve, which acts as a detector. In the anode circuit of this second valve is the reaction coil L3 coupled to L2, and also the primary T1 of a step-up intervalve transformer T1 T2, the secondary of which is included in the aerial circuit of the first valve. In between the anode of the first valve and the beginning of the oscillatory circuit L2 C3 is the primary T3 of the step-up intervalve transformer T3 T4, the secondary T4 of which is connected across the grid and filament of the third valve.

Operating the Circuit

The operation of this circuit is briefly as follows:—The first valve acts as a high-frequency amplifier, and the high-frequency oscillations across L2 C3 are detected by the second valve. The rectified currents are now re-introduced into the grid circuit of the first valve which acts now as a low-frequency amplifier and the low-frequency currents passing through T3 are communicated by means of a transformer T3 T4 to the grid of the third valve, which acts simply as a low-frequency transformer.

Trouble experienced with ST76

The trouble with the ST75 circuit is that when telephone receivers are used the introduction of an instrument, such as a pair of telephone receivers next to the anode of a valve, causes varying damping and varying tuning in the anode circuit and a fine adjustment of reaction is not possible. It is, of course, a well accepted rule that telephones, batteries, potentiometers, transformers and similar apparatus should not be put in a circuit at a point at high-frequency potential to earth. Now, in the ST76, as illustrated in Fig. 1, the transformer T3 T4 is unquestionably at high-frequency potential to earth. If the secondary of the transformer were left open, and telephones included in the anode circuit of the first valve, the introduction of the transformer primary, if well insulated, would not result in an appreciable weakening in signal strength, but when the secondary of the transformer is connected across grid and filament of a third valve, as shown in Fig. 1, a complication is likely to arise which may lead

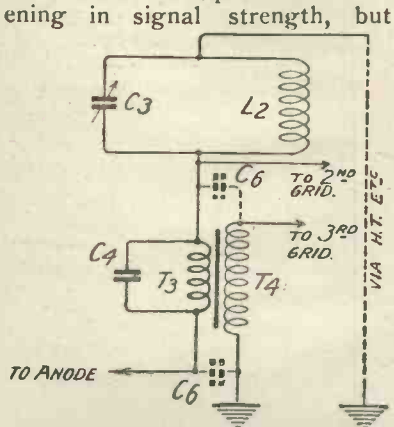


Fig. 2.—Potentials across L2 C3 are limited owing to each end of the circuit being at earth potential.

to peculiar and sometimes undesirable effects. The reason is that the secondary of the transformer is really earth connected at one end, being connected to the negative terminal of the filament accumulator. When this is remembered, and when it is considered that the secondary T4 is wound over the primary T3, and that there is a very large capacity effect between the primary

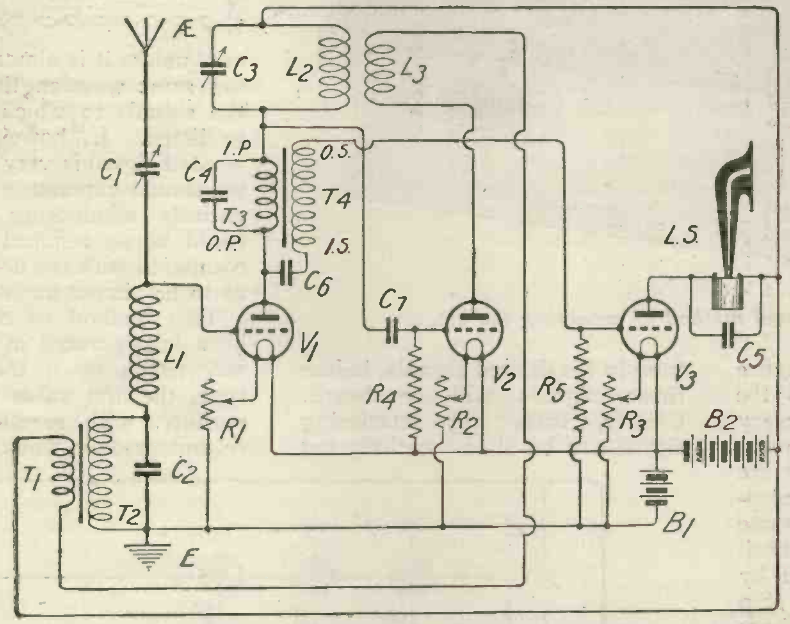


Fig. 3.—The ST76 circuit, with the Simpson connection of the low-frequency transformer incorporated.

and secondary of an intervalve transformer, it will be seen that we are limiting the potentials which may be set up across the circuit L2 C3. The capacity effect between the two windings of the transformers will result in an additional capacity being connected across L2. This, in itself, is undesirable, but if a readjustment of C3 is made signals can still be tuned in. On the other hand, the large capacity effect between the anode of the first valve and the earth, acting *viâ* the transformer T3 T4, will weaken the oscillations in L2 C3.

Tying down the Potentials

Now, the variation of high-frequency potentials of the anode of the first valve should be entirely unfettered to get the best results, but the transformer in its present position certainly tends to tie the potentials down, so to speak.

High-frequency Losses due to the Transformer

Fig. 2 gives some indication of what is happening. The top end of L2 C3 is connected to earth, *viâ* the high-tension battery, etc. The bottom end of L2 C3 is also partially at earth potential because of the capacity, shown in dotted lines by C6, between the primary and secondary.

It is also very likely that other high-frequency losses occur in the transformer, and the disadvantage of this form of connection will be readily seen.

Capacity between Transformer Windings

The capacity effect in a transformer has already been analysed in previous valve notes, and it was seen that the maximum capacity effect was between the O.P. and I.S. terminals. It is therefore not surprising that the Fig. 1 circuit works best when the I.S. terminal of the transformer winding T4 is connected to the grid of the third valve, and the O.S. terminal to the filament.

An Improved ST76

The recent description of the Simpson connection for the intervalve transformer suggested a method of getting over the difficulty which, in practice, proved very effective.

Fig. 3 shows the improved circuit using the Simpson transformer connection which entirely eliminates a second connection to earth on the transformer winding. It will be seen that the high-frequency potentials on the anode of the first valve are not tied down by the fact that the secondary of the intervalve transformer T3 T4 has one end connected to earth, as is the case in Fig. 1. In Fig. 3 the secondary has neither end connected to earth, the I.S. terminal being connected through a condenser C6 of 0.002 μF capacity to the anode of the first valve. The correct connections to the primary winding T3 are found by trial, but the letters indicated in the figure have given good results with the transformers tested. The condenser C4 has a capacity of from 0.0005 μF to 0.002 μF, and merely serves to by-path the high-frequency currents. It may frequently be omitted without any ill-effects.

The circuit, of course, is equivalent to a four-valve receiver, and the results are certainly very much more pleasing than those usually obtained with the ordinary ST76.

A Marconi portable receiver for waves from 300 to 6,000 metres. It is resistance capacity coupled.

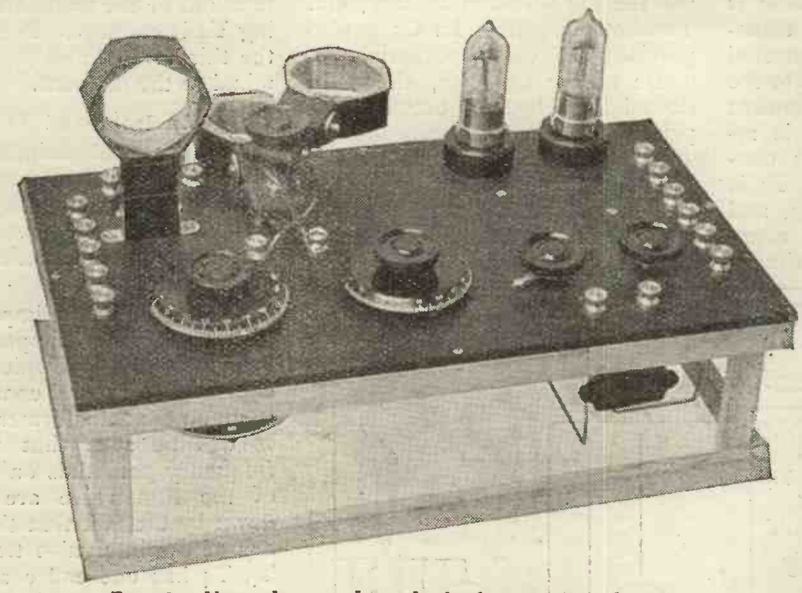


Fig. 1.—Note the novel method of mounting the set.

A Two-Valv
Unusua

TYP

By HERBERT

Where the amateur is confront
the set described below will be

THE problem of interference is one which engages the attention of each and every user of the ether. Experimenter and broadcast listener alike are troubled by the thought of reception spoiled by signals from some other station. Those who dwell near the coast are troubled by spark signalling between ship and shore stations, while those living near some high power station further inland have their reception upset, quite often, by "mush" from that station.

Many forms of tuning the aerial circuit have been tried, with a view to eliminating these unwanted signals, and some have proved successful to a certain extent. Usually, however, these methods involve the use of specially-wound inductances, and this, in itself, is a deterrent to some.

A method which, perhaps, has only rarely been incorporated in a set is one which employs a fixed, loose coupling between a coil in the aerial circuit, and a secondary coil in the grid circuit of the first valve. These coils may conveniently be of the plug-in type, thus rendering large changes of wavelength possible, with the minimum of inconvenience. Such a method of coupling the receiver to the aerial circuit gives great selectivity, as it is necessary that both the aerial and secondary circuits shall be in tune to the desired signals, before those signals will be heard. Clearly, then, any interfering signal can be almost entirely cut out, unless it is almost of exactly the same wavelength as that of the signals to which we require to listen. If, however, the unwanted signal is very flatly tuned, we should experience difficulty in entirely eliminating it, but it could be so reduced in volume, compared with the desired signal, as to be almost unnoticeable.

This method of coupling has been incorporated in the present set, which is of the two-valve type, the first valve acting as a rectifier, with reaction into the secondary coil, while the second

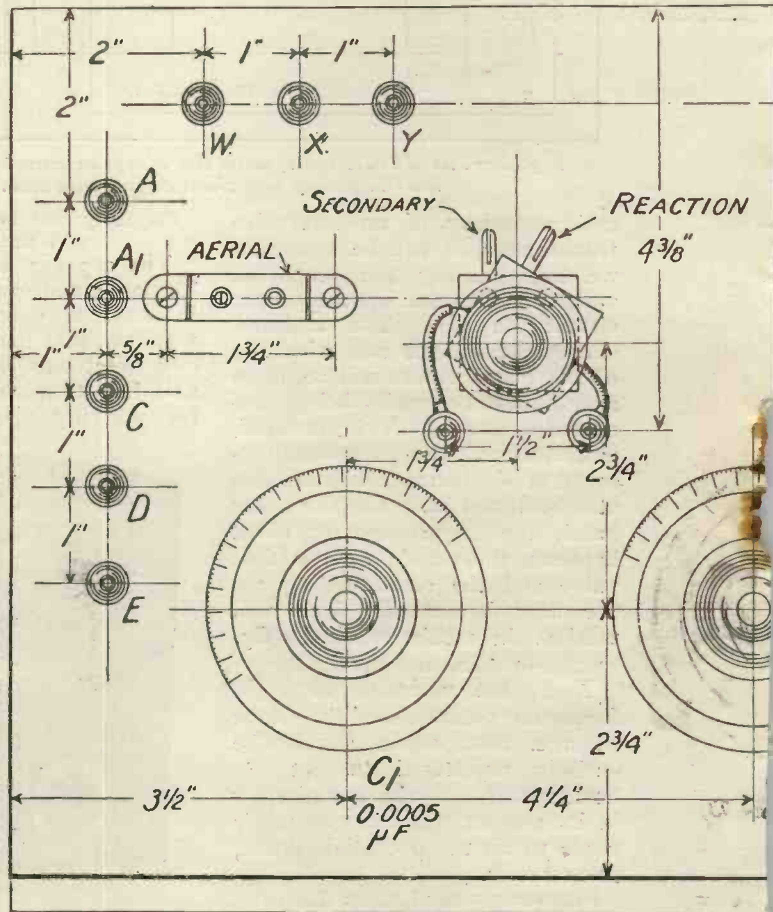


Fig. 3.—A half-size drawing of the top of the panel, with all the nece

e Receiver of
l Design

E W.6.
K. SIMPSON.

d with strong interfering signals, found of considerable advantage.

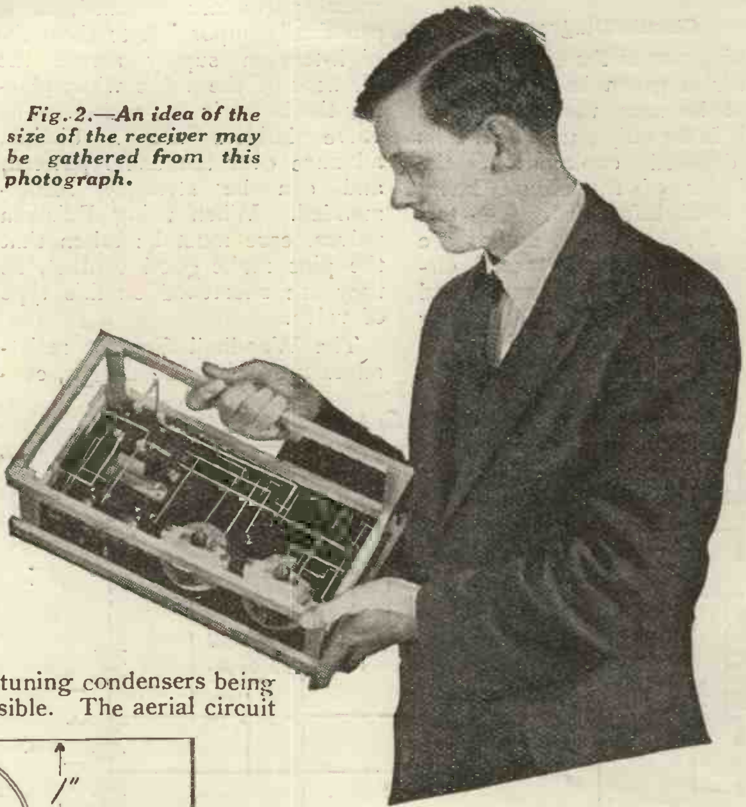


Fig. 2.—An idea of the size of the receiver may be gathered from this photograph.

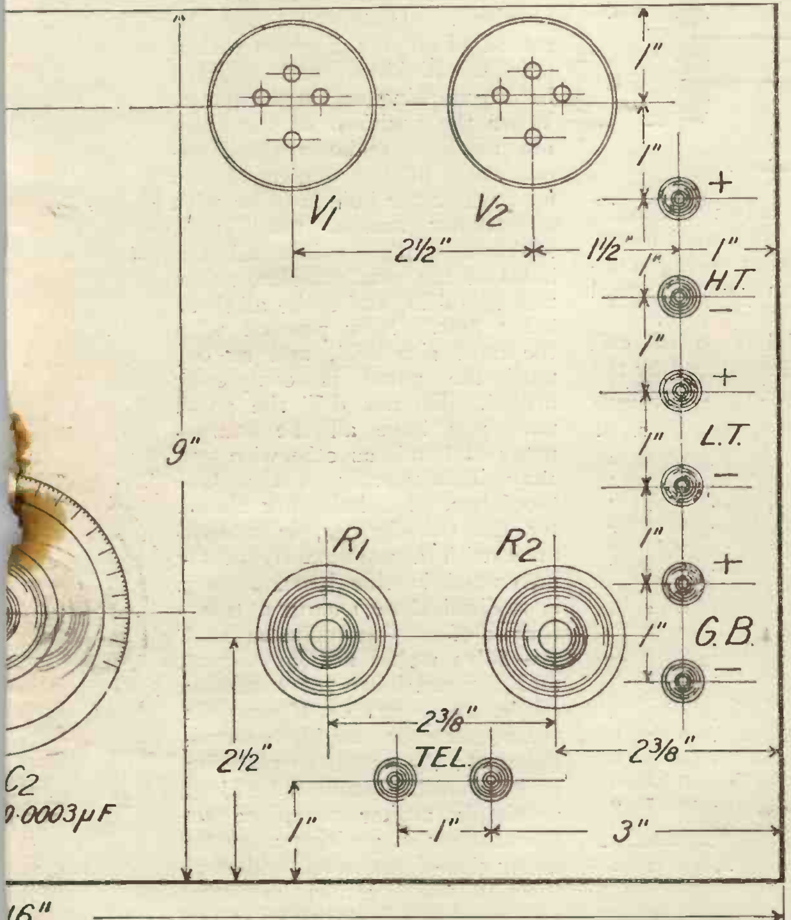
valve is purely a note magnifier. Terminals for grid bias are provided, in order that the constructor may be sure he is operating his second valve as a pure amplifier.

Constant aerial tuning may be applied to this circuit, and also it is possible to operate the set as a direct-coupled two-valve receiver, with or without constant aerial tuning.

The Finished Set

A photograph of the finished receiver is seen in Fig. 1, the coils and tuning condensers being clearly visible. The aerial circuit inductance is the vertical coil on the left of the set; the lower coil in the two-coil holder is the secondary circuit coil, and the reaction coil is plugged into the upper socket. As will be seen from the photograph, the set is mounted upon a framework, or skeleton box, thus permitting easy access to the underneath. This frame may, of course, be replaced by the ordinary box, at the discretion of the constructor.

The framework method of mounting up a set possesses considerable advantages over the more conventional manner of fixing in a box. All the parts and the wiring are visible, and easily accessible for the purpose of examination, change of components, and so on. Other panels, also mounted on framework, may be placed beside the first, thus permitting the original set to be added to, the whole presenting a uniform appearance. It is a simple matter to verify connections, when the set is working, without disconnecting leads to batteries, etc., by turning the set on to its side, whereas, with a



ssary dimensions for drilling the necessary holes. Blue Print No. 39a.

boxed-in set, all external connections would have to be taken off.

Circuit Diagram

A diagram of the circuit of the receiver is given in Fig. 4, and it will be seen that the aerial circuit is the only part which calls for detailed explanation, the remainder of the circuit being quite straightforward. The terminals A, A1, C, D, and E are those controlling the aerial circuit, when the loose-coupled arrangement is used, enabling various connections of aerial circuit to be tried (see next issue).

time, the advantage of low capacity between the legs. As no metal parts are exposed, it is practically impossible to short the high-tension supply across the filament of the valve when placing the latter in the socket. The valve holders are a distinct advance over the usual pattern, and can be strongly recommended. When using Ediswan valves, care must be taken that the pins make good contact, as they are shortened on this type of valve.

The Woodhall filament resistances are of a good design, con-

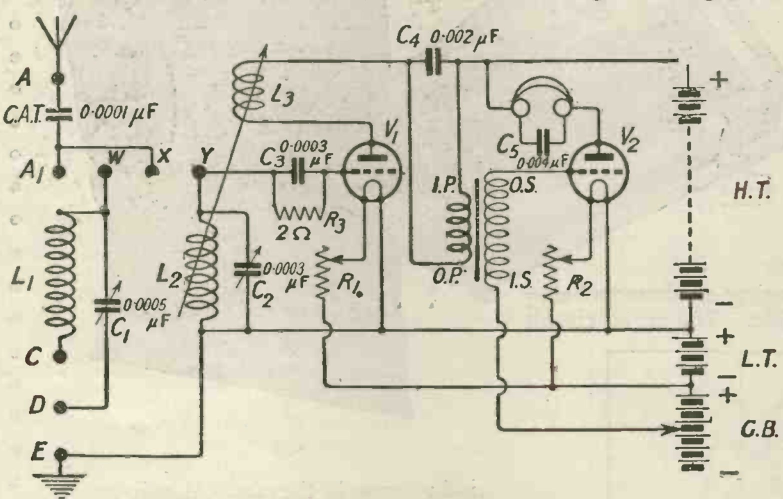


Fig. 4.—The circuit arrangement of the receiver.

Components and Cost

The materials used in the receiver are listed below, and, although it is not essential that the parts specified should be always used, the constructor is advised to use components of reliable make.

tact being made to two terminals, one of which is connected to the winding, the other being connected, by means of a spiral spring, to the moving arm.

A new special type of coil holder, recently introduced by the Goswell Engineering Co., Ltd.,

Components	£	s.	d.
Panel, 16 ins. by 9 ins. by ¼ in.	0	6	0
One 0.0005 Variable Condenser (K. Raymond, New Type)	0	5	11
One 0.0003 Variable Condenser (K. Raymond, New Type)	0	5	3
2 H.T.C. Valve Holders, Type A.	0	3	6
1 "Tangent" L.F. Transformer (Gent & Co.)...	0	17	6
2 Woodhall Filament Resistances	0	6	0
Fixed Condensers:			
One 0.0001 μF	0	2	6
One 0.0003 μF	0	2	6
One 0.002 μF	0	3	0
One 0.004 μF	0	3	0
One 2 Megohm Grid Leak	0	2	6
One Coil Socket for Panel Mounting	0	1	6
One Two-Coil Holder (Goswell Eng. Co., New Type)	0	7	6
18 4 B.A. W.O. Type Terminals	0	3	0
9 ft. 10 ins. of ¾ in. by ⅜ in., wood, say	0	1	0
Square wire (Sparks Radio Supplies)	0	1	0
Screws, Brads, etc.	0	0	6
Total	£3	12	2

The new type of H.T.C. valve holders are of extremely neat appearance, giving, at the same

has been used in this set, and will be found very useful in cases where a neat two-coil holder is required. Connection is made from the moving coil-holder to a pair of terminals upon the panel, by means of rubber-covered flexible leads, ending in spade terminals, thus permitting the reaction coil to be easily reversed.

A "Tangent" low-frequency transformer has been used, and is found to be very efficient in working. The variable condensers are K. Raymond's new type, and are of a good design for ordinary use.

Drilling the Panel

The panel, which is of ebonite, measures 16 in. by 9 in., and should be ¼ in. thick. It should be thoroughly "matted" on both sides, by rubbing with fine emery cloth, until all evidence of the glossy surface has been removed. The positions of the necessary holes should then be marked out, and the holes drilled. A half-size drilling diagram is given in Fig. 3, from which the positions of all the components, with the exception of the transformer, may be obtained. Distances may be measured off this diagram with a pair of dividers, and doubled before marking off on the panel. When the positions of the holes are marked, make a small indentation at the centre of the spot where the hole is to be with a hammer and a small nail. Make a mark against all the holes of the smallest size, select that size drill, and make all these holes first. Now proceed with the next size drill, and so on, until the panel is completely drilled. Do not drill the panel until you have all the components at hand, as otherwise you may inadvertently drill a hole too large. No holes are shown for the transformer, in accordance with a practice frequently advocated in this journal, as it is realised that, should a transformer of another make be used, the holes would not be correct, and the possibility of confusion might easily arise. If possible, the constructor should, however, adhere to the actual specification given. It will, however, be found a simple matter to place the transformer in position upon the under side of the panel, and mark through the holes in its frame with a sharp instrument, afterwards drilling to these marks.

(To be continued.)

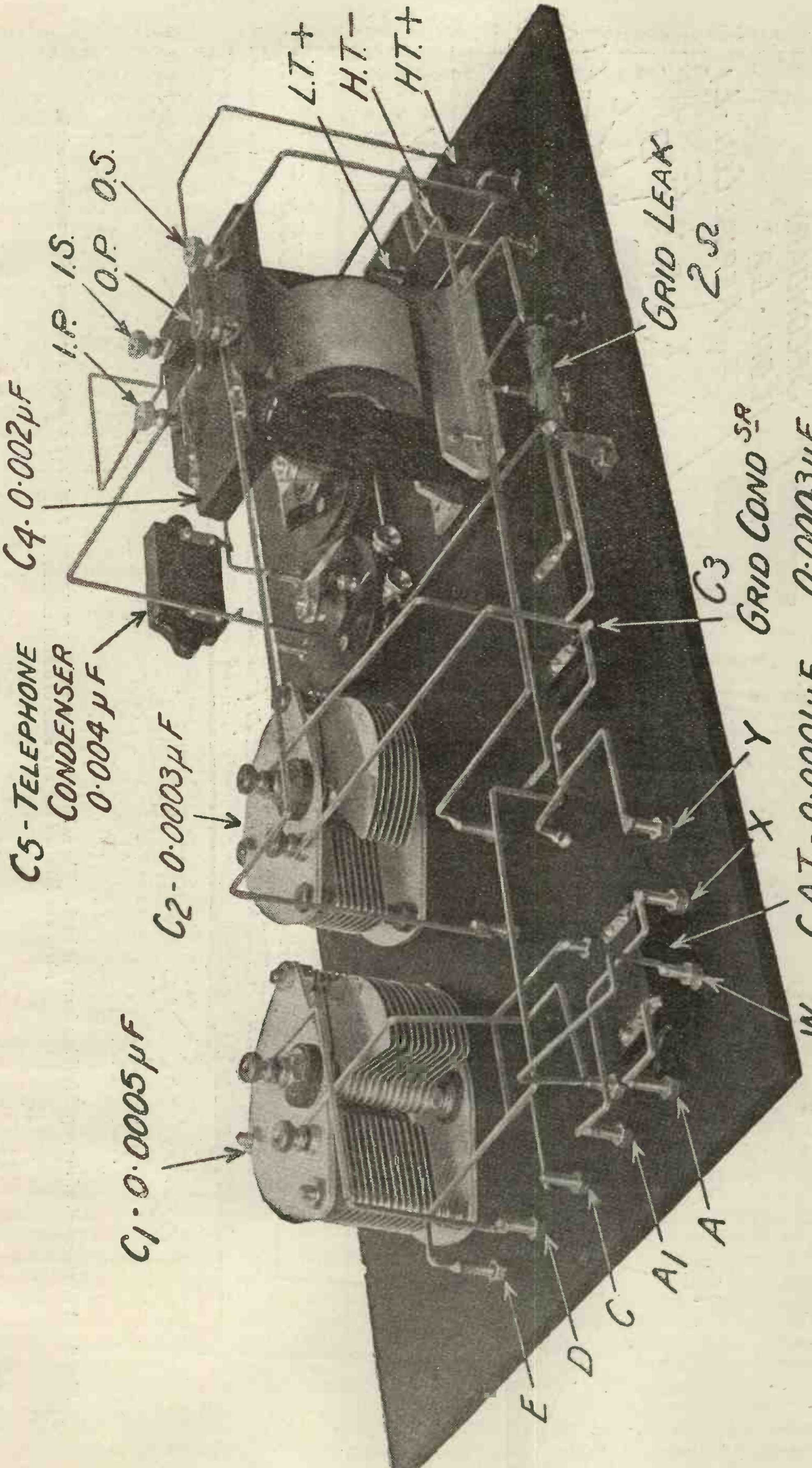


Fig. 5.—The underside of the panel, showing the layout of the components and wiring.

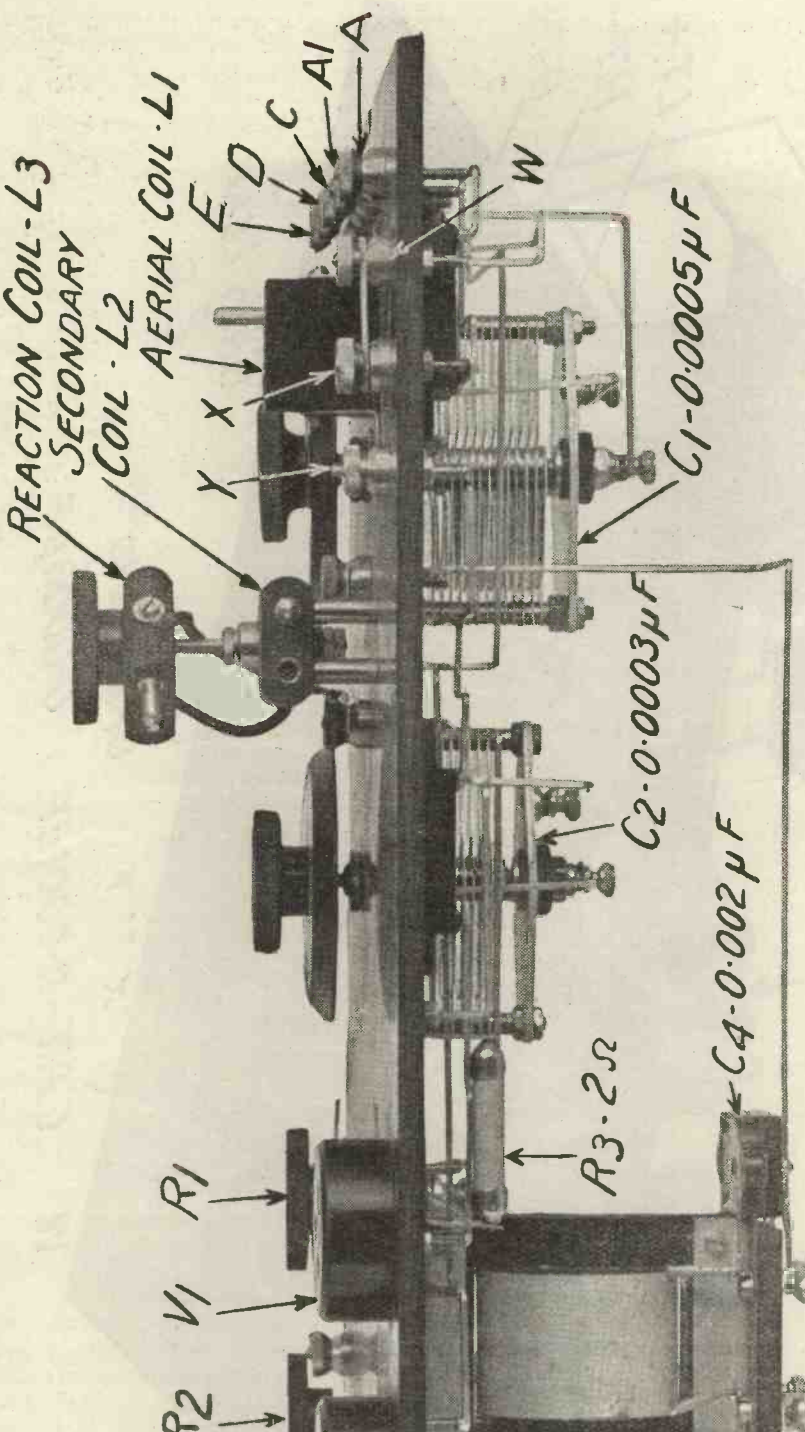


Fig. 6.—A photograph of the panel looking from the back. The relative positions of the component parts are clearly seen, and the majority of the parts are labelled for the sake of added clearness.

Eliminating the H.T. Battery

Some general observations regarding the possibility of eliminating the high-tension battery

THE recent notices in the general Press regarding an apparatus stated to operate effectively without a high-tension battery have drawn attention once more to what is undoubtedly an important problem in wireless reception. The high-tension battery is probably the greatest nuisance in a wireless receiver, and newcomers invariably complain that the trouble about modern wireless reception is that the set requires so many auxiliary pieces of apparatus. This is perfectly true, and any attempts to solve the problem are of interest.

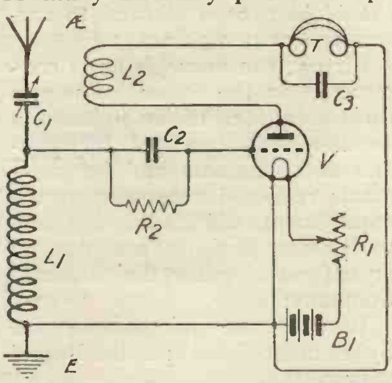


Fig. 1.—A circuit without H.T. battery, which works well with special valves.

To state that a receiving set operates without a high-tension battery may sound a little sensational, and in a sense it is a theoretical and practical impossibility to work a set without a high-tension battery.

A Common Battery

What is actually meant is that instead of having two batteries the filament battery and high-tension battery carry out both functions. It would be equally accurate to say that the valve works without an accumulator and operates simply with a high-tension battery. What, in fact, is done is to use the 6-volt accumulator, or other battery used to heat the filament, as a high-tension battery. Any experimenter with a valve receiver will have found that if he connects the anode of his valve to the positive terminal of the accumulator, telephones and other apparatus being interposed, of course, signals, but only weak signals, will continue to be received. In this case the high-tension voltage is 6 volts, and the anode is made to have a potential of +6 volts with respect to the negative end of the filament. The voltage with respect to the other portion of the filament diminishes; the result is that electrons are principally drawn from the negative end of the filament to the anode.

Various apparatus which might be said not to use a high-tension battery has been proposed during the past few years; a service heterodyne wavemeter in which an oscillating valve is used was designed by the Air Force, and in this case the high-tension voltage was simply the voltage across the filament accumulator, and this voltage was sufficient to make the valve oscillate.

Military Application

Another example is that illustrated in Fig. 2, which is the design of a trench set used with

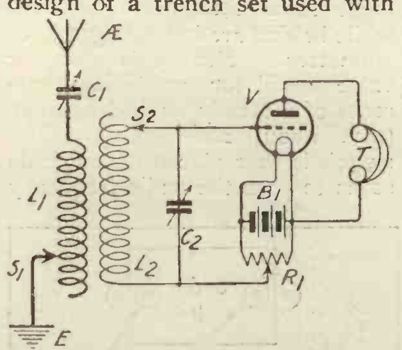


Fig. 2.—A successful trench set operating without a high-tension battery.

great success by the present writer on the Western Front during 1918. This circuit gave remarkably good results with the valves then employed, and at the conclusion of the war all the trench sets in the British Army were going to be converted over to this arrangement. The absence of the high-tension battery was of particular value from a military point of view.

In Fig. 1 appears a circuit which is of a quite ordinary pattern but which uses no high-tension battery. When ordinary valves are employed the results are not very good, but the General Electric Company of America developed some valves in which the anode and grid were of very narrow diameter, with the result that this circuit gave quite good results. Using these special valves, it was possible to use one or two together to give an amplification of the signals.

Double-grid Valves

An alternative arrangement which has been proposed is to use a double-grid valve and to lessen the space charge effect by giving the additional grid a positive potential with respect to the filament. This positive poten-

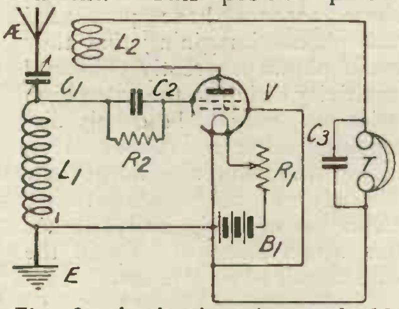


Fig. 3.—A circuit using a double grid valve.

tial may be given by a separate battery, or the actual voltage of the accumulator may be employed to increase the number of electrons flowing to the anode. This arrangement, however, is virtually equivalent to the ordinary three-electrode valve in which the grid and anode are made of small diameter.

The principle of reducing the space charge in a valve by means of a grid electrode at a positive potential was used in a special valve designed by the writer, in which the anode and grid were formed of one structure.

The main trouble about "eliminating the H.T. battery" is that a certain amount of watts are required to energise a loud-speaker, or telephones, and that if the voltage on the anode is reduced, the electron current must be increased. Unfortunately, results hitherto have not enabled any appreciable signal strength to be obtained, and it is very doubtful whether it is possible to obtain really good signal strength with a low anode voltage.

RANDOM TECHNICALITIES

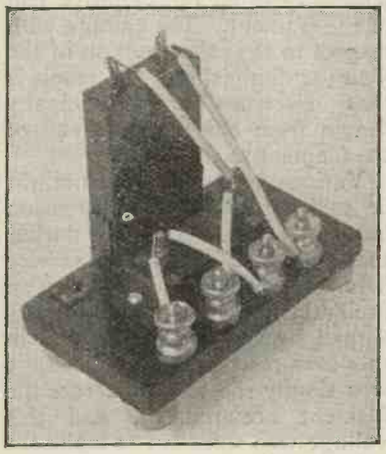
By PERCY W. HARRIS, Assistant Editor.

PRACTICALLY all the telephones now sold for wireless reception are wound either to 2,000 or to 4,000 ohms resistance, and can be safely used in valve circuits. There are, however, a number of 8,000 ohms telephones available which will work satisfactorily with crystal sets but cannot safely be trusted on valve sets, as with these, in addition to the signal currents, we have the steady anode current passing continuously through the windings. I have heard of a number of cases where readers have purchased such phones imagining that they would obtain a greatly enhanced sensitivity owing to the extra high resistance, only to be deeply disappointed after a week or so on finding the windings burnt out. The only safe rule is never to use telephones of a higher resistance than 4,000 ohms directly in the plate circuit of a valve set.

* * *

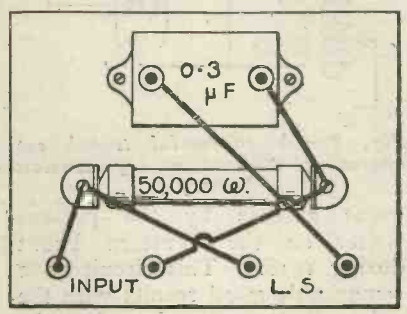
There is an indirect way in which such telephones can be used quite safely without the slightest risk of injury to their winding even in valve sets using 150 volts or more on the plate. This is by using a filter such as those illustrated by Mr. G. P. Kendall in his recent article on "Filters for Loud Speakers." A practical form of such filter is very readily made up, and one form is illustrated in the accompanying photograph and diagram. It was made up in a few moments from odds and ends I had on hand, the 80,000 ohms resistance being one of the "Marconi Scientific" pattern, and the condenser an ordinary Mansbridge of about .3 μF capacity. A Watmel, Dubilier or any of the other 100,000 ohms resistances will do quite well in place of that shown. When the telephones or loud-speaker are connected up to such filter, only the signal current flows through the windings, the steady anode current being bypassed through the resistance.

I saw recently at the Brandes Factory a most highly ingenious testing apparatus for matching the ear pieces in a pair of telephones. Fastened in the base of the testing instrument is a single ear piece chosen as a standard, above which can be placed and connected in circuit



The finished filter.

any single ear piece it is desired to test. In front of the instrument is a change-over switch, while behind are indicating microammeters. Nearby is placed a valve oscillator producing currents of a steady audio-frequency (say, about 200 cycles). The switch is first placed on one side so as to pass the audio-frequency



Wiring is but a matter of minutes.

pulses through the standard ear-piece, immediately above which is clamped the ear-piece to be tested. The diaphragm of the standard ear-piece vibrates, and sound waves impinge upon the diaphragm of the ear-piece to be tested and minute currents are set up in the windings of the tested ear-piece. These are measured by the micro-ammeter and the value of the current generated is noted. If all ear-pieces are exactly alike, the same current in micro amperes will be set up. Any ear-pieces which do not produce currents within certain limits are thrown out.

The 2LO Microphone.
A Letter from Captain Round.

DEAR EDITOR,—I have read with interest your article about the 2LO microphone and I should like to be allowed to correct one or two points.

Firstly, the microphone is constructed on the basic principles evolved by Mr. Adrian Sykes in a number of patents of his—certain detail patents and improvements rendered necessary by the requirements of broadcasting, and the present designs are due to myself working for the Marconi Company.

We call the microphone the Sykes microphone, not the Round microphone.

Secondly, I should like to correct the statement that speech is not audible on telephones connected to the microphone direct. If a correct transformer is inserted, then with speech at one-foot distance the standard microphone gives R8 to R9 signals—and more powerful microphones which I have are capable of giving this strength at 10 feet from the microphone.—Yours, etc.

H. J. ROUND.

Marconi House, W.C.2.

[Capt. Round's tribute to Mr. Sykes in no way minimises his own very valuable work in developing the microphone for broadcasting. As regards the signal strength in the phones, it is to be remembered that artistes are usually several feet from the microphone. The actual facts in our article were supplied by Capt. P. P. Eckersley, who repeated at the meeting of the R.S.G.B. on April 30 that the microphone was not sensitive enough to work a pair of telephones.—EDITOR.]

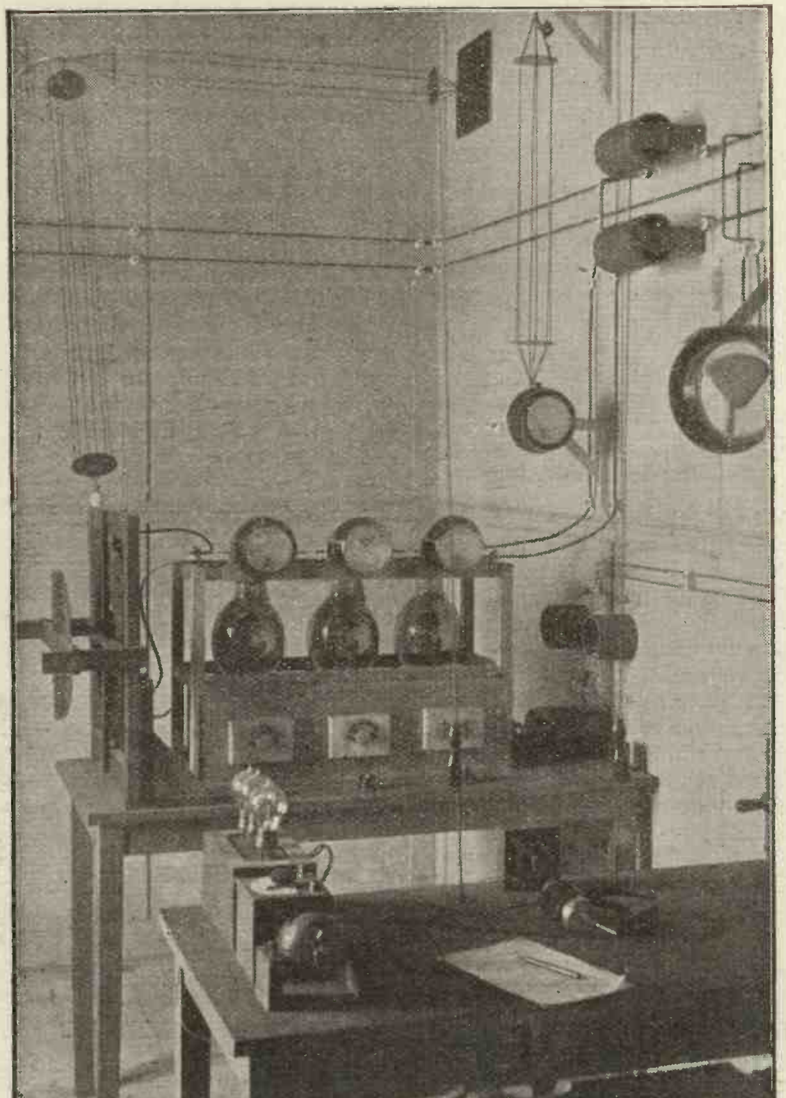
Experimental Sending Licences

THE Postmaster-General has recently been considering, in consultation with the various interests concerned, the question of revising the conditions applicable to experimental sending licences, with the view of reducing as far as possible the risk of interference by amateur stations with the reception of broadcast programmes, while, at the same time, affording liberal facilities for *bona-fide* experimental work.

The conclusion has been reached that there is now little need for experimental work in spark transmission, and it has been decided that no licences for such work should in future be granted. Existing permits will be amended as soon as possible. It has for some time past been the practice, when granting new sending licences, to prohibit the use of the 440 metres wave during the main broadcasting hours; and it has been decided to apply this restriction to all licensees.

As a set-off against these restrictions authority will be granted for the use of wavelengths between 115 and 130 metres (c.w. and telephony only) in cases where the Postmaster-General is satisfied that *bona-fide* research work is carried on and that the circumstances justify the concession.

The Postmaster-General takes this opportunity of pointing out that, under present conditions, it is impossible to ensure that broadcast programmes shall be completely immune from interference, but that much may be done to minimise the difficulties by using receiving sets which are capable of close tuning to the wave which it is desired to receive. If the receiving set is broadly tuned, and is consequently capable of receiving wireless signals within a margin of, say, 50 metres on each side of the desired wave, the number of extraneous signals likely to be intercepted will obviously be much greater than if the margin is only 5 metres.

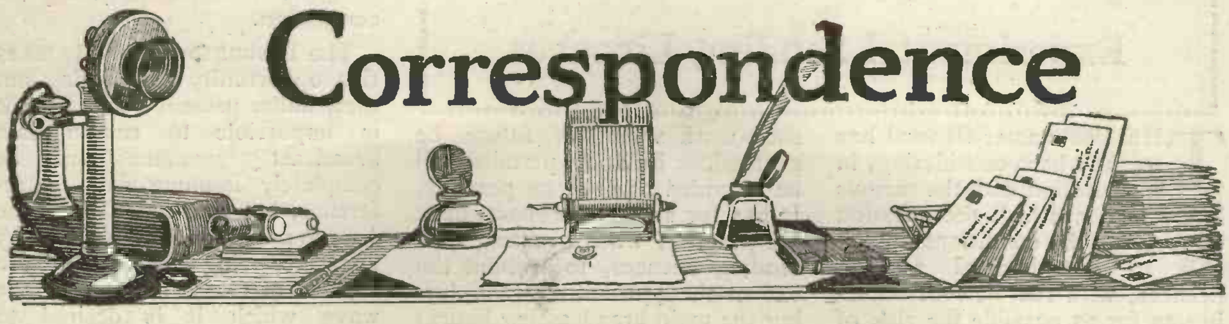


Interior of the French experimental station 8Ae, operated by our contemporary, "T. S. F. Moderne."

A Craze for Noise

THERE is much to recommend a cheerful noise at times, but there are many amateurs who go in for the noise rather than the cheerfulness in their reception of broadcast programmes. The younger wireless enthusiasts especially are often more intrigued by a raucous roaring than by a perfectly pure reception of smaller volume. The golden rule in wireless, as in so many other matters, is not to overdo things, and loudness should certainly not be made a fetish. Anybody can rig up two stages of low-frequency amplification that will set up an ear-splitting din upon the transmission of a near-by station, but it takes an expert to arrange the stages so that reception shall be mellow and free from distortion. Here are a few useful "don'ts." Don't push reaction to its limit, don't overwork your valves by running their filaments too brightly and putting too high a potential on the anodes. Don't neglect the grid biasing battery and don't try to get a big volume of sound from an ordinary general purpose receiving valve. Its grid potential anode current has not a long enough straight portion to enable it to do the business properly. If you must have loudness, use a small-power amplifier. R. W. H.

Correspondence



THE COWPER CIRCUIT

SIR,—You may be interested to hear about my results with the Cowper circuit. My aerial is poor, being 40 ft. high one end and about 20 ft. high the other, the lead-in being taken from the middle, and badly screened. The earth is made to a buried bath (small) at the end of a 26 ft. lead.

Using two valves (Cossor), 1 H.F. and det., I can get all B.B.C. stations with ease, also the Ecole Superieure and Brussels. London (at eight miles) comes in at moderate loud speaker strength, using a home-made L.S. of plywood.

I have heard WGY twice, once at 11.30 p.m., and on the morning of April 13th I got Madrid (411 m.).

For the anode I am using the "frame aerial" type coil (72 turns 20 S.W.G.), tuned with a .0001 condenser. For the A.T.I. I am using home-made basket coils (20 d.c.c.). As you state, the circuit is remarkably stable; in fact, with any value of H.T. (up to 66 volts), or L.T., or even with a small series condenser, the circuit is far below the oscillating point all the time.

With a loose coupler at work I can get Bournemouth without a murmur of London—this at eight miles from 2LO.

With an indoor aerial—five strands of aerial wire across the ceiling—I have managed to get Bournemouth, Birmingham, Newcastle, Aberdeen, and the Ecole. London comes in nearly as loud as with the outside aerial.

Numerous amateurs are received, 6IM in particular coming in on the loud speaker.

I really must thank you for giving us such a splendid circuit. —Yours faithfully,

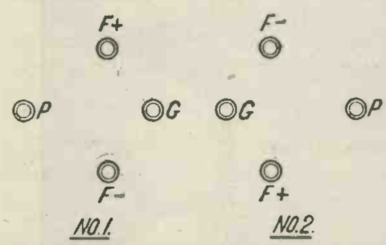
A. S. AKEHURST.

London, N. 13.

FILAMENT SAG

SIR,—Here is an item which may be of interest to readers of *Wireless Weekly* and *Modern Wireless.*

Sloped panels look well, and are more convenient for manipulation than the "flat" type, but the fact that in many sets the valves, being also on the incline, the tendency of the filaments to sag is greater. A very useful idea to counteract this, and which I have had in use for some time on a 2-valve set, is to arrange the valve holders in opposite directions.



The arrangement of valve holders referred to by Mr. McArdle.

When the filaments sag I simply take out the valves and exchange places, *i.e.*, put No. 1 valve into No. 2 holder and No. 2 valve into No. 1 holder, which gradually brings the filaments back to their normal position. At a further remote period should the occasion arise they can again be reversed.

Trusting this small contribution may be of use.—I am, yours faithfully,

JOHN L. MCARDLE.

Coatbridge.

OMNI RECEIVER

SIR,—After the success I have obtained with the Omni Receiver, I feel that some small acknowledgment is due to you for the idea. I have altered slightly the original, inasmuch as I have four valves and have included several components, which I had lying about. I had the set working within a week of seeing the first article, and must say results have been beyond all expectations. I seem to have transgressed nearly all ordinary laws of wireless. My aerial is 25 ft. high—screened on two sides. The lead-in is laid under the carpet of one room, through the wall to the set. The earth is to a water pipe 12 ft. away. The wires from the components to the terminal board are much longer than in your set, owing to the fact that I have brought the valves and coils on to a shelf inside the cabinet. With all these faults I get Birmingham *really loud* on the loud-speaker, using three valves only—H.F., D., L.F., straight circuit. This is a revelation to me, as I have this same circuit wired in the orthodox way—short leads everywhere, and get Birmingham on the 'phones only.—Yours faithfully,

E. H. PIKE.

Nottingham.

SIR,—I have constructed a "Super Omni," which differs in many points from the wonderful "machine" described in your excellent journal.

It has a divided top with 84 terminals. It contains, *inter alia*, the following :—

4 Valves.
Crystal.
Plug in H.F.T.
2 L.F.T.
3 Coil Holders.
2 Single Coils.
2 Grid Bias Batteries.
3 .0005 μF.
1 .00075 μF.
1 .00005 μF.
2 Variable Anode Resistances.
2 Variable Gridleaks.
Potentiometer.
Separate Resistances.
Telephone Transformer.
And various Blocking Condensers.

The whole is in a single box, about 18×10×8 (mahogany).

I have tried with success almost every circuit published, and have to thank you for the original idea.—I am, yours faithfully, E. B.

Cardiff.

SIR,—I completed your Omni receiver about a fortnight ago, after selling my old commercial 4-valve set, and I have no regrets, in fact, quite the reverse.

I have tried out several circuits on it, and have nothing but praise for the receiver. It fills a long felt want, and is, to my mind, most excellent in every respect.

I had never used the ST100 circuit until I tried it on the Omni, and it is undoubtedly the very best existing 2-valve circuit for reception of local broadcasting. It stands in a class by itself, and I have never heard anything that approaches it for signal strength and purity of tone.

Please give us a circuit regularly every week, and can we have your "key" to the best circuit for the Omni employing two valves as H.F. and one as detector?

Wishing you and your excellent periodicals every success.—Yours faithfully,

R. T. WARING.

S. Kensington.

THE NEW STATION

SIR,—The station picked up by your correspondent, Mr. Lill, on March 22 was probably that of *Le Petit Parisien*, a Paris newspaper which has its station on its own premises at 18, Rue d'Enghien, Paris, and was the first newspaper in Europe to have erected a broadcasting station. The power is 500 watts, and the wavelength 340 metres, sustained modulated wave.

I am not aware of any call sign, but the name is announced at intervals.

I am informed that as soon as the experiments are completed, concerts will be broadcast every evening at an hour to be made known through the paper.—Yours faithfully,

F. OXENHAM.

[Communications of a similar nature to this have been received from Messrs. R. Ball, jun., of Southport, and Jas. MacIntosh, of Inverness.—ED.]

A NEW SINGLE-VALVE CIRCUIT

SIR,—It has been a matter of surprise to me that one has not seen more appreciations in your columns of Mr. Kendall's one-valve set, for use with earth connection alone, described in your issue of November 21 last.

I made up this set with components as described, with the exception that I put in a Lissen variable gridleak, and was glad that I had done this, as I found that both with D.E.R. and Peanut valves I had to screw the leak down to the tightest, *i.e.*, 0.5 megohms, to get good results.

As to results, I have got 2LO at readable strength from pretty well everything in the house—water pipe, spring mattress, electric bell wire, kitchen range, gas stove, 10-foot indoor aerial, and even from the mangle, though somewhat faintly from this last. When 2LO is coming in well, I have got it at quite audible strength with the set on the table and no connection whatever, and on two pairs of 'phones.

At one time and another, by very careful tuning and adjust-

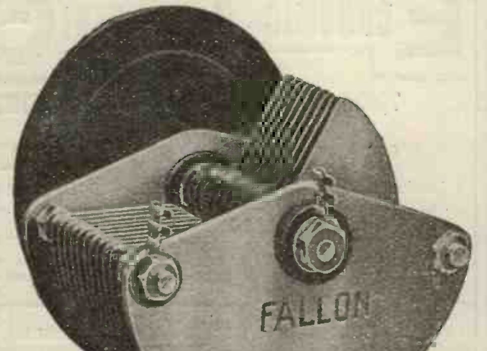
Fine Results from Fine Components

Where FALLON products are used there are no failures.

This is our NEW MODEL All Condenser—right up to FALLON standard and will appeal to thousands of constructors who prefer the following points which are included in same:

One Hole Fixing
TagConnections
Heavy Aluminium Top and Bottom Plates

The Best and nothing but the best British material and workmanship are put into this New Fallon Condenser. Metal to Metal adjustable bearings.



Stout, well-cut aluminium vanes. Complete in every respect and exactly as illustrated.

.001	.. 57 Plates	Price	8/-	.00025	.. 15 Plates	Price	5/-
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.0003	.. 19 „	..	5/6	Vernier	.. 5 „	..	4/-
				Vernier	.. 3 „	..	3/6

For those who prefer it, we still supply our well-known All model, which is exactly the same as above, except that instead of having Aluminium ends, it has composition ends and is supplied with our special feature, the Aluminium Screening Disc, which Disc is also supplied with the model above illustrated. We have the courage of our convictions. We put our name "FALLON" on every Condenser we manufacture.

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was the first popularly priced Twin Condenser placed on the market. There are many imitators but there are no superiors. Amateurs now receive America every night in the week with the "Duanode." In a recent article in "Modern Wireless" on the subject, Mr. Percy Harris gave very favourable reference to the "Duanode."

The "Duanode" consists of two matched condensers operated by one knob, thus by using matched COILS it is possible to tune BOTH circuits perfectly with one operation only. This Condenser can be used for other purposes. The two halves (each of .00025 mfd.) can be used in series or parallel, giving capacities of .000125, .00025 and .0005. .. .. **Price 17/6**

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ment of reaction, I have just been able to pick up every B.B.C. station, except Aberdeen, but not at readable strength, and only occasionally; last night I distinctly heard "God Save the King" played at the conclusion of the Newcastle programme.

The set giving such good results, will not Mr. Kendall confer a further favour on us and show us how to adapt the set for use with a stage of H.F. amplification? I feel sure that with such one could get all B.B.C. stations at comfortable strength; or perhaps it could be adapted for use as a dual circuit.

I am intensely interested in circuits for use without an outside aerial, and I am sure that many of your other readers are also; to many of us the putting up of an aerial is not convenient, and a set like this, that does not require even an indoor aerial or frame, and which one can take into any room of one's own or a friend's house, and be sure of getting, at any rate, fair reception by hitching on to the bell wire or water pipe, etc., is a great boon.

Perhaps Mr. Kendall would give us a further article on the set, showing us how to adapt it as above, and would also tell us how to modify the coil, so as to extend its wavelength range, so that one could get, say, Croydon on 900 metres, and perhaps also the Paris time signals.

I feel sure that the future of wireless, at any rate, as regards broadcasting, is verv much bound up with the abolition of the necessity for an outside aerial, and that without having to use more than one or two valves.—Yours faithfully,

J. PARKER FOWLER.

Thornton Heath,
Surrey.

FIXING IVORINE NAME PLATES

SIR,—After trying to fix neat Ivorine name plates on my panels with all sorts of adhesives without success, I had to resort to pinning them, with the tedious job of drilling and marking off.

A month ago I tried Dunlops' rubber solution, as follows:—First spread a thin coating of solution on the back of the name plate. Allow to stand for a few minutes to get "tacky." Lay the panel on the table and polish with a piece of silk. Press the name plates firmly in their respective places on the panel. Result, perfect cohesion between panel and name plate and a clean edge. No doubt many amateurs have experienced the above difficulty.—Yours faithfully,

"Ex-R.N.V.R., W.T."

Braunton Road,
Aigburth, Liverpool.

MISUSE OF CALL SIGNS

SIR,—My attention has been called to the article in your issue of even date regarding the above, page 672.

I have no intention of disguising my identity from Mr. Hay, but do not agree to the publication of my address, as is my privilege.

My licence was issued by H.M. Postmaster-General in December last, so you will appreciate that there is no misuse as suggested.—Yours faithfully,

GEO. K. FIELD, MAJOR.
Radio 2KG.

P.S.—Mr. Hay can have my address privately and in confidence.—G. K. F.

BEWARE OF WORTHLESS IMITATIONS, SEE THE TRADE MARK WatMel ON EVERY GRID LEAK.

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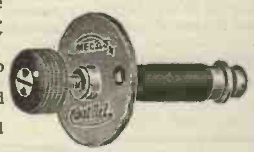

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ANODE RESISTANCE
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Messrs. Economic Electric, Ld.,

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(Prov Patent No 23937/23)

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"The Crystal Detector should be of a good pattern, and the latest Burndept Crystal Detector is the type used on original omni receiver itself. "This detector has a beautiful control and is one of the best types on the market to-day."

Fix it on your Crystal Set and note the difference.

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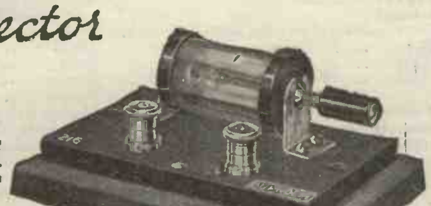

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Tuning Coils
and How to Wind Them.
By G. P. Kendall, B.Sc.

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Turn numbers
The choice of wire
Taking tappings
Damp proofing
Single layer coils
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Wireless Weekly

and the Wireless Constructor.

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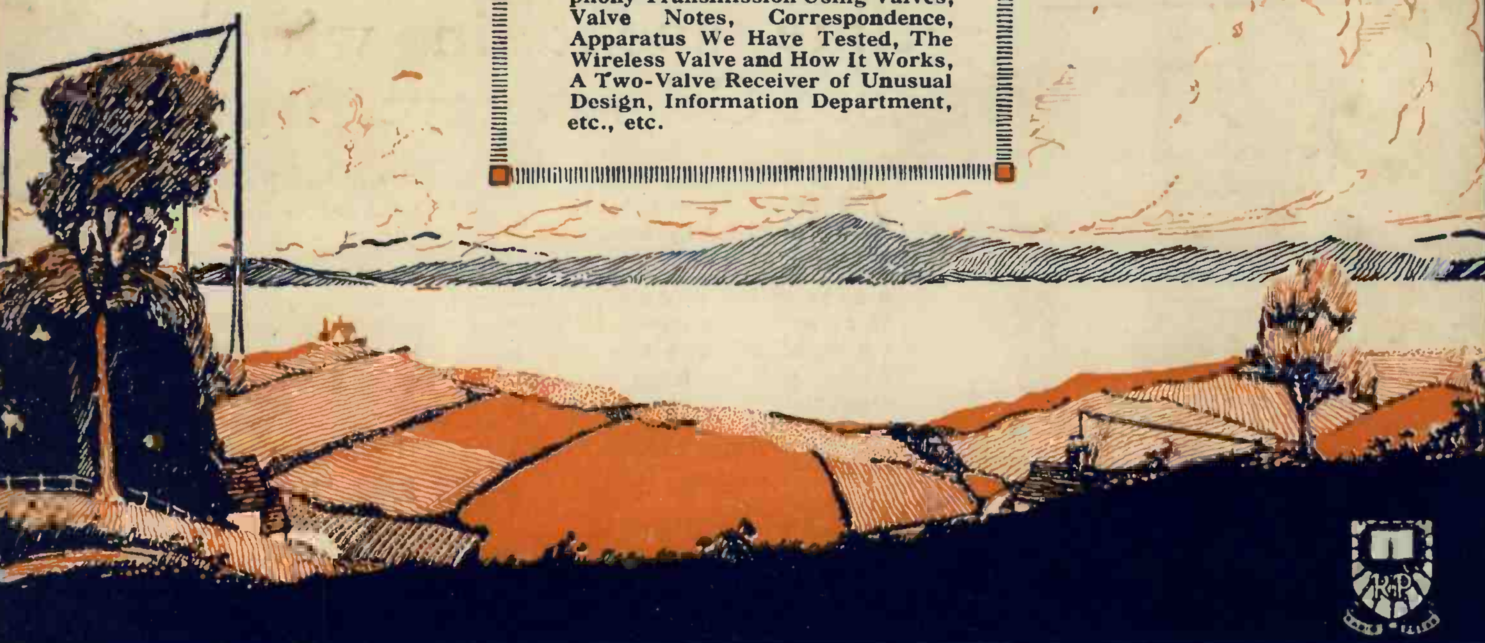
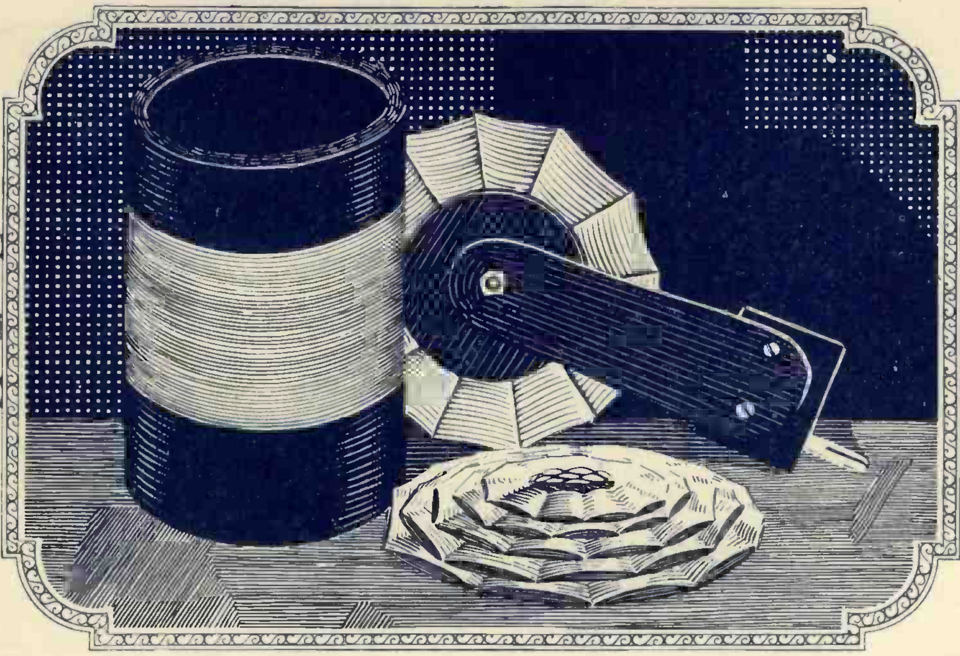


Aperiodic Aerial Coils

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



Tuning Coils
and How to Wind Them.
By G.P. Kendall, B.Sc.

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- How Circuits are tuned
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- Honeycomb and duo-lateral coils
- Mounting coils
- Aperiodic Aerial coils

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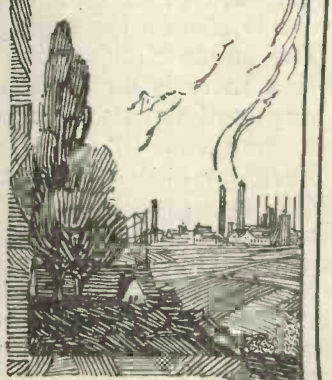

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Eliminating the High-Tension Battery

GREAT publicity has been given in the Press to the interesting experiments of G. V. Dowding and K. D. Rogers.

The matter is one of such general interest that a few remarks on the problem will not be out of place. We are sure that the gentlemen concerned will forgive us if we point out that the elimination of the high-tension battery is not new in itself. They state "The point we wish again to stress is that although innumerable attempts have been made to reduce H.T. to a minimum, no one, previously to ourselves, seems to have endeavoured to eliminate the H.T. battery altogether." A reference to page 114 of a book entitled "Thermionic Tubes in Radio Telegraphy and Telephony" gives an illustration which was reproduced in our last week's issue. There is also on the same page a statement: "The anode circuit includes the telephones T, but there is no anode battery," and that "very loud signals have been obtained with this arrangement."

There are also several other publications which have given circuits producing good effects without the use of any high-tension battery. This fact, however, does not detract in any way from any meritorious arrangement that may have been devised; it merely indicates that both the problem and the solution are not new.

Some force is absolutely necessary to drive the electrons from the filament of a valve to the anode, and this is supplied by a positive potential on the anode. If the anode is connected to the positive terminal of the filament accumulator, it is given a positive potential of, say, +6 volts if a 6-volt accumulator is used. This voltage is relative to the negative end of the filament and the voltage with respect to other portions of the filament falls off; consequently, the use of a filament operating off a low voltage would be highly desirable. For example, a dull emitter capable of working off 1 volt and operating off a 6-volt accumulator through a large rheostat would enable the anode voltage to be about 5 volts with respect to the filament. This would be quite a substantial anode voltage, but, though there is no separate anode battery, the L.T. battery is acting as such.

It is, therefore, a matter of opinion as to what constitutes a high-tension voltage, and the question resolves itself into one of degree, and the problem of eliminating the high-tension battery is identically the same problem as reducing its value. We have before us as we write a pamphlet of a French valve manufacturer in which circuits are given in which the anode voltage is reduced to a minimum and consists of only 2 or 3 volts. A valve with two grids is employed, and we propose to publish the circuits next week.

With these valves the manufacturers state that, at 300 kilometres from Paris, all the French broadcasting stations and also many of the British ones may be received with remarkable clearness on one valve.

Phillips, the Dutch valve manufacturers, also produce a double-grid valve for achieving the same purpose, and Dutch experimenters use them to a great extent, to enable the high-tension battery to be eliminated or to be reduced to extremely small dimensions.

The general interest in the subject is such that we are pleased to publish in this issue a very interesting article by Mr. Cowper. At the time of going to press we have not had an opportunity of seeing the circuit of the Dowding-Rogers' arrangement, but the results obtained with Mr. Cowper's circuits are undoubtedly very promising, and to those who have not carried out experiments in such directions, quite remarkable.

Although the results obtained with a minimum of high-tension voltage, or the complete absence of a high-tension battery, may be surprisingly good, yet the set with a reasonable amount of high-tension voltage will always give a greater power output. Nevertheless, any attempt to focus attention upon the disadvantages of the large high-tension battery is of great value.

Proportionate Aperiodic Aerial Coils

By E. H. CHAPMAN, D.Sc.

An article of great importance and interest to all experimenters.

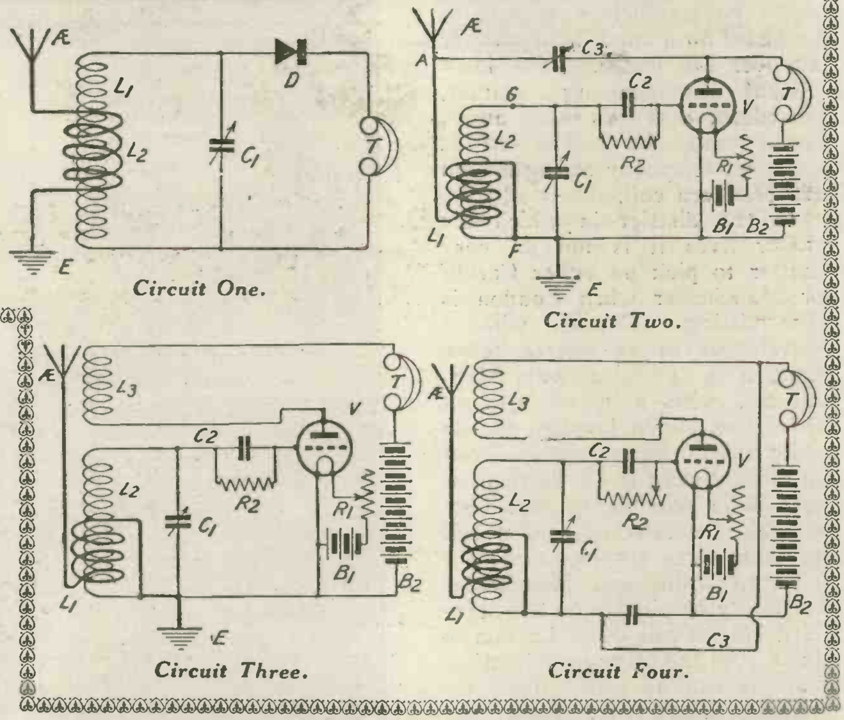


Fig. 1.—Four circuits in which the proportionate aperiodic aerial coil can be used.

THE proportionate aperiodic aerial coil which has been developed almost exclusively in this country by members of the editorial staff of *Modern Wireless* and *Wireless Weekly* forms the basis of a great deal of interesting experimental work. A large number of wireless experimenters hesitate to attempt experiments with a special type of coil, because of the prevailing idea that a specially-designed coil can only be put to one particular use and cannot be utilised in a variety of circuits, as is the case with the two-plug standard coil. Although this idea may be true with regard to certain types of coil, it is by no means true with regard to the proportionate aperiodic aerial coil, since such a coil can be used in (i) the very efficient crystal circuit due to Mr. P. W. Harris (Circuit 1, Fig. 1); (ii) the modified Reinartz circuit (Circuit 2, Fig. 1); (iii) the modified Haynes circuit (Circuit 3, Fig. 1); and (iv) the modified Flewelling circuit (Circuit 4, Fig. 1).

Tighter Coupling Possible

The proportionate aperiodic aerial coil is apparently an advance on other aperiodic aerial coils, because it gives tighter coupling between the aerial coil proper and the secondary or grid coil to which it is coupled. This tight coupling is obtained by winding the aerial turns simultaneously with the secondary or grid turns at some point of the winding, usually at the beginning. In the earlier type of this kind of coil, the secondary winding is first wound on the former and the aerial winding is then wound *over* the secondary winding.

The most interesting thing about the new proportionate aperiodic aerial coil is that the proportion of aerial turns to secondary or grid turns can be varied in order to obtain different results. Thus, in the proportionate aperiodic aerial coil made on the Harris former, and used with such success in the modified Reinartz receiver, the proportion of aerial turns to grid turns is 1 to 1 for 15 turns of each winding, after which the grid coil is continued alone for another 30 or 35 turns. In a new coil the writer has recently made, the proportion of aerial turns to grid turns is 1 to 2 until 15 turns of the aerial coil and 30 turns of the grid coil have been wound, the grid winding then being continued alone for another 20 turns.

Different Shape Formers

Not only can the proportion of turns in the proportionate aperiodic coil be varied, but such coils may be wound on cylindrical formers, on cardboard discs with radial slits, on basket-coil winding machines, on the Harris former, or on modified forms of the Harris former described later in the present article.

The writer has recently been carrying out a series of tests with various kinds of proportionate aperiodic coils, using a 2-valve Chapman - Reinartz receiver specially built for the purpose. At the back of the cabinet containing the receiver, a short strip of ebonite was mounted. This strip of ebonite carried three telephone terminals corresponding to the three points A, F and G of Circuit 2, Fig. 1. These terminals projected horizontally from the back of the cabinet, and it was an easy matter to connect the wires from a coil to the terminals without going to the trouble of mounting the coil in any way. When connected to the receiver, the coil in use was placed flat on the table behind the receiver.

In order to judge of the merits of any particular coil, a coil wound on a Harris former was used as a standard of comparison. This coil, referred to in the present article as Coil 1, was always used immediately before a new coil was tried, so that each new coil was made comparable with the one standard coil.

Coil 1 Standard

The standard coil wound on a Harris former consisted of 18 turns of "aerial" winding wound with 18 turns "grid" winding, the proportion being 1:1, the grid winding afterwards being continued for another 20 turns alone, all the wire being No. 22 d.c.c. With this standard coil connected to the

2-valve receiver, London, 14 miles away, gave sufficient strength to be heard on a small loud-speaker all over the house. The most distant broadcasting station, Aberdeen, over 400 miles away, could easily be picked up at excellent telephony strength with the standard coil.

In the district in which the writer lives it is not an easy matter to pick up either Cardiff or Manchester when London is transmitting. Cardiff, with a wavelength of 15 metres below London, is 140 miles away. Manchester, with a wavelength of 10 metres above London, is 180 miles away. Since London is but 14 miles distant it will be realised that it is possible to test very severely the selectivity of a coil on these three stations alone.

Both Cardiff and Manchester are easily obtainable on the standard Harris coil when London is quiet. All the other broadcasting stations can be heard distinctly without interference from one another with this coil. Newcastle 400 metres, Brussels 410 metres, and Glasgow 420 metres, could easily be picked up without interference from one another, when the Harris coil was in use, but since these three stations are respectively 250, 200 and 350 miles away, they do not give as severe a test for selectivity as London, Cardiff, and Manchester give.

Coil 2. Frame Aerial

Interesting tests were made using the frame aerial shown in Fig. 3 as the proportionate aperiodic aerial coil. The winding on

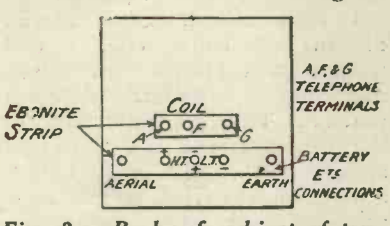


Fig. 2.—Back of cabinet of two-valve receiver used in the test.

the frame consisted of five turns of aerial coil with five of grid coil wound in the same slots on the frame, the grid winding then being continued alone for another five turns. The resultant square of wire was roughly of 2 ft. side, the spacing of the turns being ½ in., the wire No. 22 D.C.C.

London came in very strongly using the frame aerial and no reaction. Manchester could be

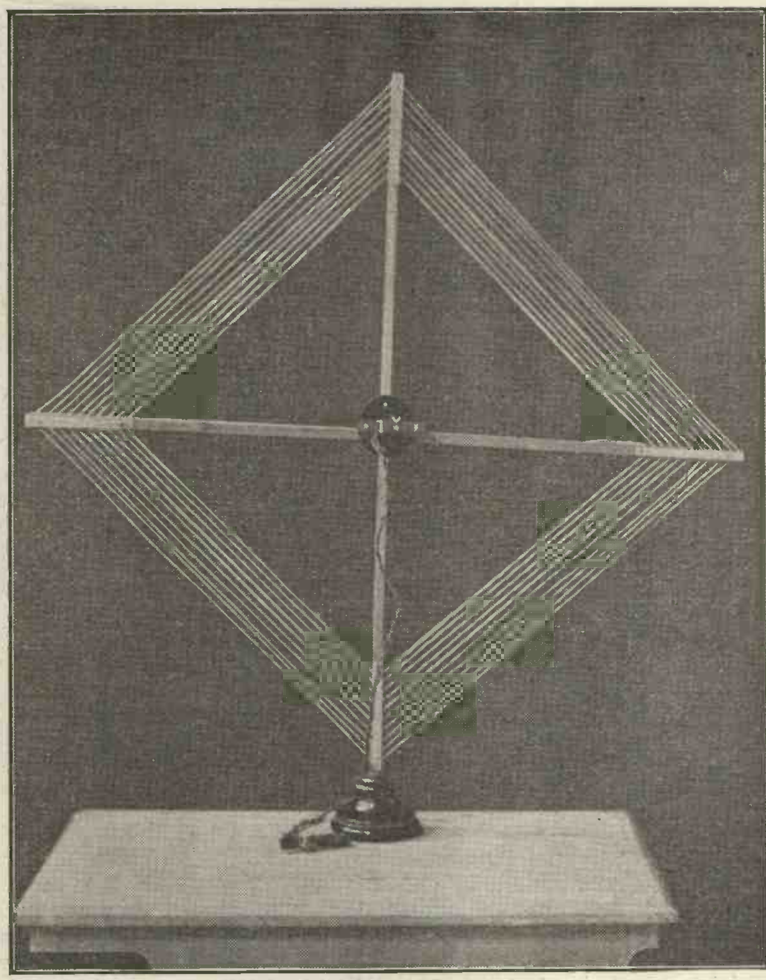


Fig. 3.—A proportionate aperiodic aerial coil in the form of a frame aerial.

tuned in, but London was audible most of the time. When Manchester was transmitting music and London speech, London could only be heard faintly, but when the opposite was the case, the Manchester speech was only audible now and then. Bournemouth came in well at fair loud-speaker strength on the frame aerial coil. The other broadcasting stations were also heard, although Aberdeen was somewhat faint using this coil.

(To be continued.)

A Triple Unit

Referring to the article which appeared in Vol. 3, No. 21, the author omitted to state that when using the unit for reflexing, a connection should be made between the earth terminal of the crystal set and the top telephone terminal of the unit.

In cases where the crystal receiver is tuned either by variometer or slider it may be found that the inductance of such sets is not sufficient for use as a tuned anode, in which case a fixed condenser of 0.0003 μF capacity should be connected across the aerial and earth terminals of the crystal set.

As there are now a number of concert coils of slightly different sizes for the reception of the lower waveband of the B.B.C. stations, the best sizes of coil should be found by experiment.

RADIO PRESS BOOKS AT WEMBLEY

Visitors to the British Empire Exhibition at Wembley can purchase copies of all Radio Press publications from the stand of Messrs. S. Rentell & Co., Ltd., Bay 14, Avenue 15, in the Electrical and Allied Section.

So Simple

I ALWAYS want to meet one of the fellows whose facile pens course over the paper to tell you how absolutely simple and easy wireless is. If we are to believe them, rolling off logs is a most difficult feat in comparison. I have never tried rolling off logs, and I cannot say that I have any wish to do so; but I have tried wireless, and I do not think that I fully endorse all these light-hearted opinions about its utter simplicity. What we very seldom take account of is that there appears to be a kind of substitute for character in even the most mechanical things. You can turn out two motor bicycles whose engine dimensions and so on do not differ from one another by a fraction of a hair's breadth.

Funny But True

To all outward seeming, and by every measurement that it is possible to make, the pair are identical. But will they perform in precisely the same way when you fill up their tanks and try them out? It is a thousand to one that they will not. One will be a gay, cheerful fellow always ready to start off when you want him to, and seeming to prefer going up hill to puttering along on the flat. You feel at once, when you ride this bicycle, that it is good tempered and full of high spirits. Its counterpart, on the other hand, may be a bad starter and a jibber when it comes to doing anything like heavy work. This is rather a sulky fellow with an almost human dislike for toil. And it is very much the same with wireless sets. Some are so highly strung that they scream at you instantly if you try to urge them on to make greater efforts. Others are of a calm and placid nature, and these you can ginger up almost to the bursting point without their making any fuss about it.

Theory and Practice

The only thing which is easy about wireless is to draw circuits. All you want is a piece of paper, a pencil, and a pair of compasses (or, failing that, a coin of the realm to act as a template for valves), and there you are. You simply join this to that in an irresponsible way, putting in coils and condensers where needed, and there is a beautiful circuit which quite obviously must work.

Zig-Zag Arrows

This valve cannot oscillate because its grid potential is carefully rationed by that zig-zag plus arrow which represents a potentiometer. The next one must give perfect rectification, for here is its .0003 μF condenser, and there its gridleak. The third will give you powerful and undistorted low-frequency amplification, for have you not shunted one of the squigglywigs representing the primary of its transformer with a pair of parallel lines, and the other one, the secondary, with a neat zig-zag?

A Little Variety

Everything in fact is precisely and exactly as it should be, and you have not a single shadow of doubt about it in your mind. You make it up. You try it out. V_1 smiles quietly and oscillates to beat the band. V_2, positively disliking its gridleak, does ditto, whilst V_3, as a strong believer in a little variety, proceeds to deliver a hideous mass of distorted sound which makes your ear drums rattle. Undismayed you rewire the whole show, and change the position of everything. This time V_3 feels called upon to distinguish itself by setting up a gentle crooning song which is far from hushing you to sleep. Faint but pursuing you make a further attempt. V_2 now seems to be the chief offender. You shoot an arrow through its zig-zag, or in plain words you instal a variable gridleak. Now we shall see something. You begin your reception with the resistance at its maximum. Not very good. Just wait a second, we shall soon find the correct value, and then all will be well. Very slowly you turn the knob, and by the time that it is screwed right home you find that results are just as they were. V_2 appears to dislike half a megohm just as much as five.

Generosity

There are painstaking and persevering souls who, when this point is reached, simply say, "Oh, well," and then go on to make a further attempt. I would that I were such as they. Alas, I am not. To me there are but two alternatives. Either I smash the thing with a coke hammer and then feel much better, or I run over the list of my acquaintances until I discover the one whom I like least. Then I make it my business to meet him and to be very jovial and friendly. I go to his house. I see his set which, of course, works badly in my presence. "My dear fellow," I say, "I have just made a real topper in the way of sets. Do let me give it to you. I have made so many that I don't know what to do with them." He pretends at first that he could not possibly let me do it, but eventually he gives in and I plant my dud in soil where it is likely to bear the richest fruit. When he comes bleating round a little later to tell me that the thing does not work well I explain quite gently that in my house it was perfection. I do not actually say that want of skill is responsible for its bad performances, but I let him gather that is what I am thinking.

Satisfaction

Now if there is one thing that a wireless man cannot stand it is that another should regard him as not very highly skilled. The recipient of my bounty therefore goes away feeling that it is up to him to let me see what the set really can do. I imagine him pulling it to bits, putting it together, then dismembering it again and again reassembling it.

Yards of Solder

I picture him using yards of solder and sweltering on the hottest days beside the gas ring which heats his iron. I enjoy the vision of him sitting with puckered brow and aching head endeavouring to solve the mystery. I know that he is drawing little diagrams with a piece of paper, a pencil, and a pair of compasses (or a coin of the realm to serve as a valve template). I can see him checking everything over for the hundredth time just to make quite sure that he has not attached the whatyoumaycallit to the thingmejig instead of the whatsitsname. I know that his otherwise sluggish brain is now having real exercise, and I am happy in the thought. At least, I would be happy, quite happy, if it were not that I was engaged in making my newest set, in drawing diagrams with a piece of paper, a pencil, and a pair of compasses (or a coin of the realm to serve as a template for valves), moving this to there and that to here, verifying my wiring connections, and finally wondering who there is left among those that I particularly dislike to whom I can present the latest child of my brain. This last is becoming a real difficulty, for I have now provided so many of my pet aversions with wireless sets that I am coming to the end of my resources. If things go on like this I shall have to resort to sending them anonymously to people whom I do not know, but yet dislike cordially. This would be rather a neat adaptation of the poison by post system to suit the needs of the present day. If any of you know any really suitable candidates I shall be happy to add them to my waiting list.

The First Coil Expert.

It was, if I remember rightly, a Trojan of old, one Laocoon, the earliest expert in coils, who was the first to question the truth of the old proverb about not looking a gift horse in the mouth. He counselled those who received gifts to be a little doubtful of the intentions of the giver. Now I am rather wondering whether my own splendid scheme of planting presents has not recoiled upon my own head. Quite recently a friend presented me with a very beautiful slide rule. "It will save you," quoth he, "any amount of trouble. Suppose, for example, you want to find the square root of 437962 you need not work it out; you just do this." With that he pulled a thing out and pushed a kind of little sliding window across its surface, "And here you see the answer." He did all manner of things with that slide rule. He multiplied appalling rows of figures by others that were even worse; in a matter of seconds he worked out the capacity of a hypothetical condenser. Then he departed leaving the thing with me. And now, when I want to find the wavelength of a circuit, I cannot use pencil and paper as of old. I feel that having a short cut lying in my drawer I must needs avail myself of it. I take out that slide rule and pull and push it in what I believe to be the correct manner. Then I run the little window across; and do I get the answer? I do not. It merely says 32 or something of that kind which is obviously not the square root of .0003. Then I realise that I made a slight mistake and read from the wrong scale. So I begin once more to pull and push and slide in the most approved manner. This time the answer appears to be 46 on one scale and 59½ on the other. After about a couple of hours I replace the short cut to calculations in its drawer and set to work in the ordinary way, only to find that by this time my brain is far too addled to permit of even the simplest arithmetical operation. That slide rule has worn me to a shadow. I am no longer the man I was, and grey patches are appearing above my ears. I am not quite sure, however, whether these last are due to the slide rule or to the fact that I was badly bitten some months ago by a pair of rat-trap 'phones lent to me by another ex-friend. Anyhow, I shall have to set to work seriously and get the hang of that slide rule, for it must be awfully jolly to have by you a thing that will do all the donkey work if you just pull and push it as it should be pulled and pushed, and slide the little window as it should be slid.

WIRELESS WAYFARER.

A reader's single valve reflex receiver incorporating a dull emitter valve and dry cells complete.

WHAT HAPPENED:
The Story of an Aerial Struck by Lightning

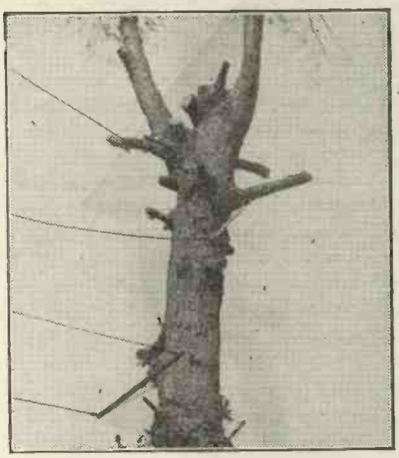
"Wireless Weekly" readers will be interested in our investigation of the case given below.

Mr. Will Hayson, whose set was damaged.

"WHAT would happen if my aerial were struck by lightning?" Thousands of newcomers to wireless have asked this question. We are therefore happy to be able to present to *Wireless Weekly* readers the result of an investigation into an actual case.

On Saturday afternoon, May 3, Mr. Will Hayson, a Mitcham resident, was sitting at tea with his family, the wireless set being unattended in the corner by the window. A violent storm was in progress, when suddenly a vivid lightning flash struck the aerial. Simultaneously there was a violent report as the set exploded, the component parts being flung across the room in all directions. The window frame was charred, and the room filled with fumes, but the amazed occupants were fortunate in escaping without personal injuries.

As soon as the storm was over Mr. Hayson set to work to collect the fragments of his single-valve reaction set. The ebonite panel had been hurled across the room with such force that it had chipped the opposite wall. The basket coils were scorched, the cabinet splintered, and several pieces of wire fused, but in the main the set was damaged

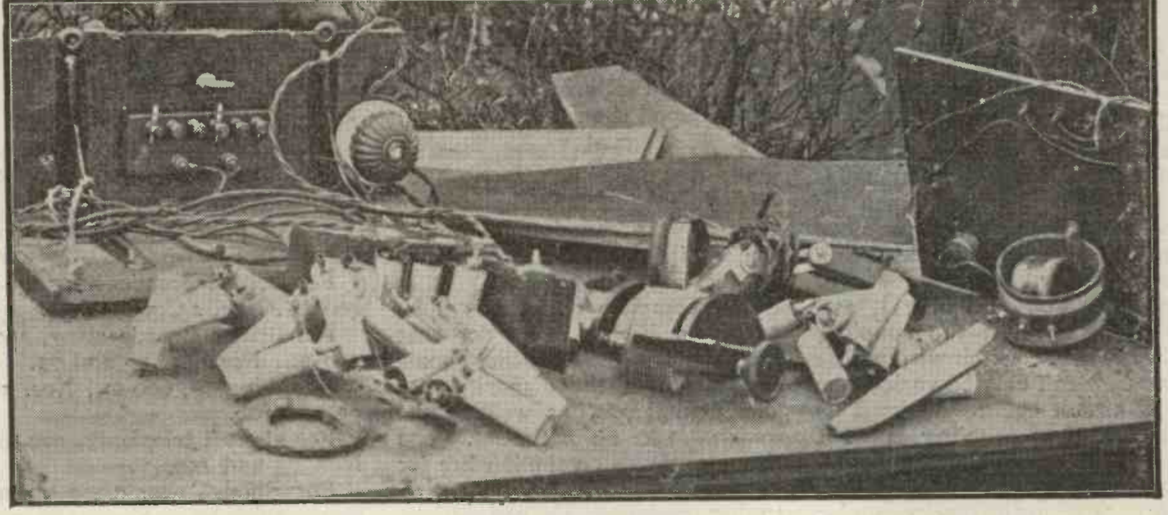


The upper of the two aerials was struck. The lower went to another house.

through being thrown about, rather than by burning. The real trouble seems to have arisen from the violent explosion of the high-tension battery, which, as the photograph shows, was completely disintegrated. Strangely enough, the valve (of Dutch manufacture) was not burnt out, the filament lighting afterwards as well as ever! Two pairs of telephones, connected in series, were joined to the set. One ear-piece only was burnt out.

Outside the aerial wire (twin) was found intact. It would appear that the lightning had jumped the insulators, as these were somewhat charred in parts. The spreader bridle wire was burnt through, causing the aerial to collapse. The tree itself is about sixty feet high, the point of suspension being about half-way up.

Earth connection had been made to a waterpipe, and the wire to this was blackened in parts. Although the set was fitted with an earthing switch, it was open at the time, and therefore out of action. It is highly probable that had the switch been closed the current would have preferred this path to that through the set, and no damage would have been done. It should also be pointed out that had the earth connection been made to a gaspipe (a procedure against which we have often warned our readers) a serious fire might have been caused.



All that remained! The high tension battery was certainly abolished here!

A Loose Coupled Crystal Receiver

By STANLEY G. RATTEE, M.Inst.Rad.E., Staff Editor.

An easily constructed receiver which caters for the coast dweller and others who suffer from interference.

Fig. 1.—The general appearance of the receiver.

OF all the various forms of eliminating interference, one of the most successful, in so far as crystal reception is concerned, is that in which the aerial circuit is indirectly coupled to a secondary or closed circuit.

The methods available of making the indirect coupling between two separate receiving coils take two definite forms, (a) that in which the aerial circuit consists of relatively few turns of wire, wound directly upon the secondary winding and untuned (such a crystal receiver being described by Mr. Percy W. Harris in Vol. 3, No. 11), and (b) that in which the coupling between the aerial circuit and the secondary coil may be varied, the aerial circuit being tuned. This latter form of coupling is what is commonly known as loose-coupling, and is the arrangement incorporated in the receiver under description.

General Considerations

In order that a variety of wavelengths may be obtained with the receiver, plug-in coils are employed instead of the usual arrangement of one coil sliding within the other—this latter limiting the possible wavelength range to the number of turns wound upon the formers.

A three-terminal arrangement, which will not be new to *Wireless Weekly* readers, enables one to connect the condenser tuning the aerial circuit either in a parallel or series position.

The complete receiver is illustrated in Fig. 1, in order that constructors may gather some conception of the disposition of the components, as well as the general make-up of the set. The three terminals on the left are for varying the position of the aerial-tuning condenser, the connections of which will be described later, while the four terminals on the right are for the telephones.

The condenser to the left of the set is for aerial tuning, whilst that on the right is for tuning the secondary or closed circuit.

Components and Materials

The materials and components embodied in the receiver, as seen in Fig. 1, are as given herewith, and though readers may vary in their choice of manufacture, it is essential that values of coils and condensers be adhered to:—

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

One 0.001 μF variable condenser (that illustrated is an A.C.H. type).

One 0.0005 μF variable condenser (Woodhall).

One two-coil holder (Burne Jones).

One crystal detector (Radio Instruments, Ltd.).

Seven brass terminals.

One fixed condenser of 0.002 μF (Dubilier).

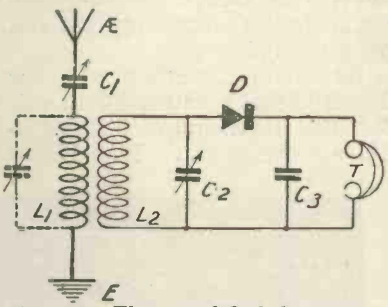


Fig. 2.—The simplified theoretical circuit.

One containing box, to the dimensions given in Fig. 7.

Set of plug-in coils, as given below:—

For British Broadcasting, 300/400 m., Nos. 25, 35 and 50.

For British Broadcasting, 400/500 m., Nos. 35, 50 and 75.

For shipping, 600 m., Nos. 50, 75 and 100.

For aircraft telephony, 900 m., Nos. 75 and 150.

For Eiffel Tower (time signals only), 2,600 m., Nos. 250 and 400.

One pair of 2,000- or 4,000-ohms telephones of good make.

The Circuit

A theoretical form of the circuit is shown in Fig. 2, the aerial tuning condenser C_1 being shown in black for the series position and in dotted lines for the parallel arrangement. Fig. 3 gives the actual circuit of the receiver, the

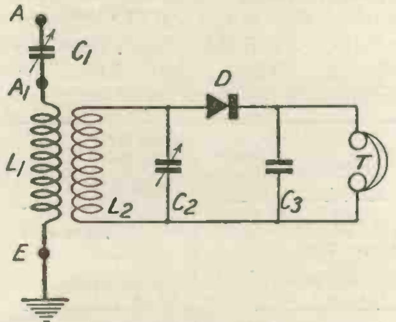


Fig. 3.—The circuit of the receiver.

three terminals permitting variation in the position of C_1, being lettered A, A_1, and E. A little studying of this latter figure will make it clear that if we connect the aerial to A and the earth to E, the condenser C_1 will be in series, or as shown in black in Fig. 2. On the other hand, if we connect the aerial to A_1, the earth to E, and E to A, we place C_1 in parallel or, in other words, in the position indicated by the dotted lines in Fig. 2, across the

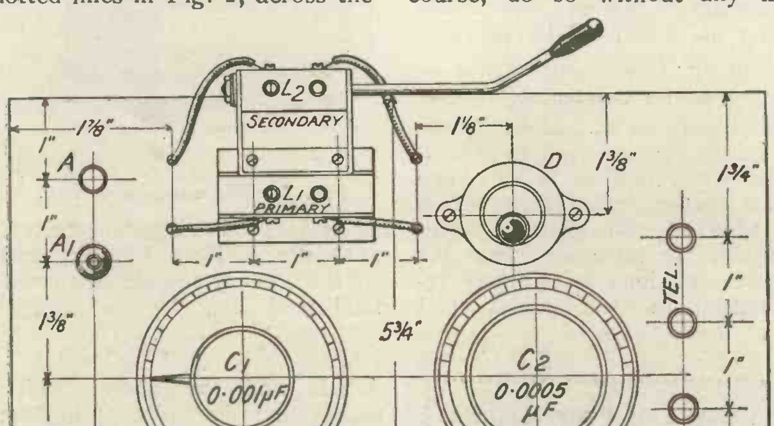


Fig. 4.—The panel lay-out.

aerial inductance L_1. The secondary or closed circuit is indicated by the secondary coil L_2, the variable condenser C_2, the crystal detector D, telephones T, and telephone condenser C_3 are also indicated.

Wiring the Receiver

The wiring of the receiver, together with the lay-out of the components, may be seen from the second photograph, which shows an underneath of panel view, whilst a practical wiring diagram is given in Fig. 5. The actual connections are made with stiff wire, though those readers who prefer to use soft wire and

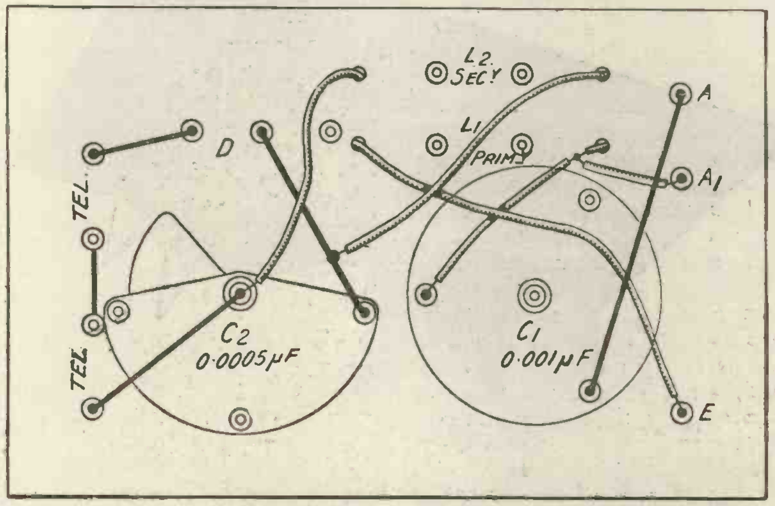


Fig. 5.—Practical wiring diagram.

insulating sleeving may, of course, do so without any ill-effects. In the receiver illustrated the telephone condenser C_3, of 0.002 μF, is omitted, as no improvement could be found with its inclusion. Should readers care to incorporate this condenser, however, it should be connected across the telephone terminals, as indicated in Fig. 3.

In accordance with the usual policy of this journal, blue-prints of Fig. 5 are now being prepared, and those readers who prefer to work from full-size drawings should apply to the office of Radio Press, Ltd., quoting blue-print No. 40, enclosing 1s. 6d.

Operating the Receiver

It may be taken that the maximum receiving range, for comfort, of this or any other crystal receiver is approximately 20 miles for British Broadcasting, the distance being chiefly decided by the power of the transmitting station it is desired to receive. A good outdoor aerial and a careful adjustment of the cat-whisker upon a sensitive point of the crystal are the main qualifications for long-distance reception, apart from the skill of the operator in handling his coils and condensers.

In the days before the valve became such a common form of detection, really remarkable distances were obtained by amateurs using simple crystal receivers, distances which present-day crystal users would find hard to believe. Patience and careful tuning are the secret of success in all long-distance wireless reception, particularly so in the case of crystal reception.

Choice of Coils

Using the aerial tuning condenser in parallel, readers wishing to receive the B.B.C. Station within their range should first ascertain whether the desired station's wavelength lies between 300 and 400 metres or between 400 and 500 metres. In the case of the 300/400-metre waveband a No. 25 or 35 honeycomb coil should be inserted in the aerial socket and a No. 50 coil in the secondary socket, after which, the two coils should be brought together and the desired station tuned by means of the two variable condensers. Small aerials may require a No. 35 in the aerial.

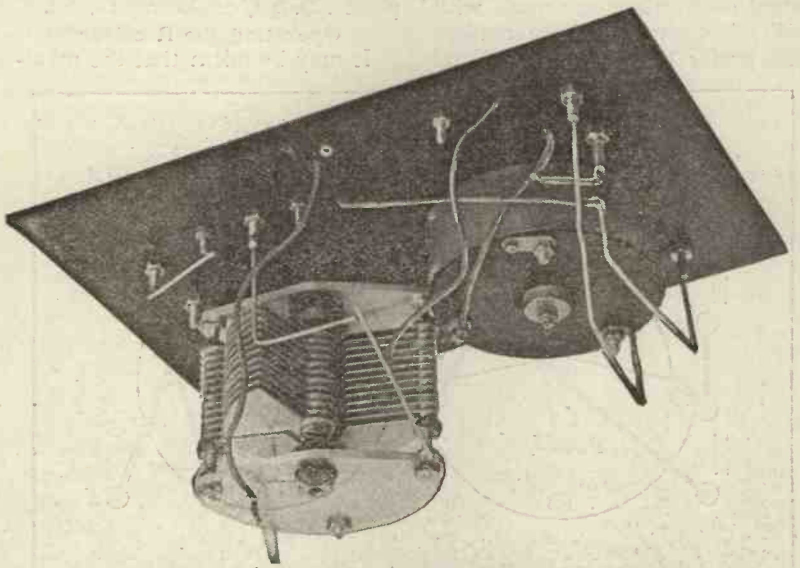


Fig. 6.—A photograph showing the internal wiring.

If interference is experienced during the tuning of the wanted station, adjust the condensers to give the best results, after which, slowly turn the secondary coil away from the aerial coil until the least interference is obtained without losing the wanted signal, when again re-adjust the two condensers. If the strength of signal will permit, once more move the secondary coil away from the aerial coil until the interference is either eliminated or lessened (still without losing the desired signal), when again tune with the two condensers. Proceed in this manner, alternately loosening the coupling and tuning the condensers until you are firmly convinced that the very best results are being obtained.

If the desired station is using a wavelength between 400 and 500 metres, then a No. 35 or 50 coil should be inserted in the aerial socket and a No. 75 in the secondary, further operations being as stated in the previous paragraph.

Series Condenser

The purpose of allowing the aerial tuning condenser to be used in series if desired is to enable those readers with large aerials to tune to the shorter wavelengths. In all cases where the B.B.C. stations are being received both the series and parallel positions should be tried, using for the lower waveband with series condenser coil No. 50 in the aerial and No. 50 in the secondary, whilst for the higher wavelengths coils No. 50 or 75 should be used in the aerial with No. 75 in the secondary.

Wavelengths Other than B.B.C.

For stations with wavelengths outside those referred to and within the range of the crystal receiver, suitable coils may be chosen from the following table:—

Station.	Wave-length.	Aerial Coil (condenser C_1 in parallel).	Secondary Coil.
Shipping ...	600 m.	50 or 75	100
Aircraft ...	900 m.	75	150 or 200
Paris Time Signals ...	2600 m.	250	400
Proposed New Station ...	1600 m.	150	250

Results

Using the receiver as illustrated, with an averagely good outdoor aerial in S.E. London, the writer was able to tune in with good volume, Croydon, 2LO, GNF, several ships, Paris Time Signals, and local amateur transmitters. With two ordinary note magnifiers following the receiver, 2LO, Paris Time Signals, and GNF are easily audible on a small loud-speaker.

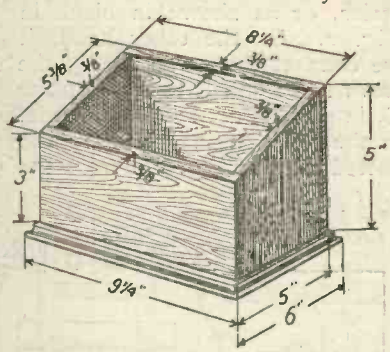


Fig. 7.—The containing box.

□

A Cause of Poor Results

When one is asked to look at a crystal set the owner of which is not satisfied with its performances, it is found in some cases that its inefficiency is due to the use of wire of too small a gauge for the lead-in or the earth lead. High-frequency currents flow entirely upon the surface of conductors. Hence a wire of small diameter has only a limited surface area, and therefore offers a considerable resistance.

Signal strength is dependent upon the amount of the potential difference across the A.T.I. To make the most of any set we must have the point of highest potential at the aerial end of the A.T.I., whilst its earth end must be as nearly as possible at zero potential. If the lead-in does not offer a very free path to oscillating currents, it acts as a resistance between the top of the A.T.I. and the aerial, which means that the point of highest potential, instead of being at the top of the A.T.I., is on the joint between the aerial wire and the down lead.

Similarly if the earth wire is of small gauge, the potential drop across the inductance will be reduced. Should both be of a wire that is too thin, the set will be very inefficient indeed. In valve sets, of course, much of the aerial loss can be made up by reaction. R. W. H.

Valve Notes

By

JOHN SCOTT-TAGGART,

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

Preventing Low-Frequency Reaction in Dual Circuits

THE great trouble, of course, in dual amplification circuits is the prevention of low-frequency reaction. This may be caused in several ways, and its elimination is, unfortunately, usually only obtainable by the use of further apparatus in the circuit.

Fig. 1 shows a circuit in which a pair of telephones T are connected in the best technical position and how the low-frequency reaction effect is overcome in another manner. This method was brought to my notice by Mr. A. D. Cowper.

It will be seen that the telephones T are connected between

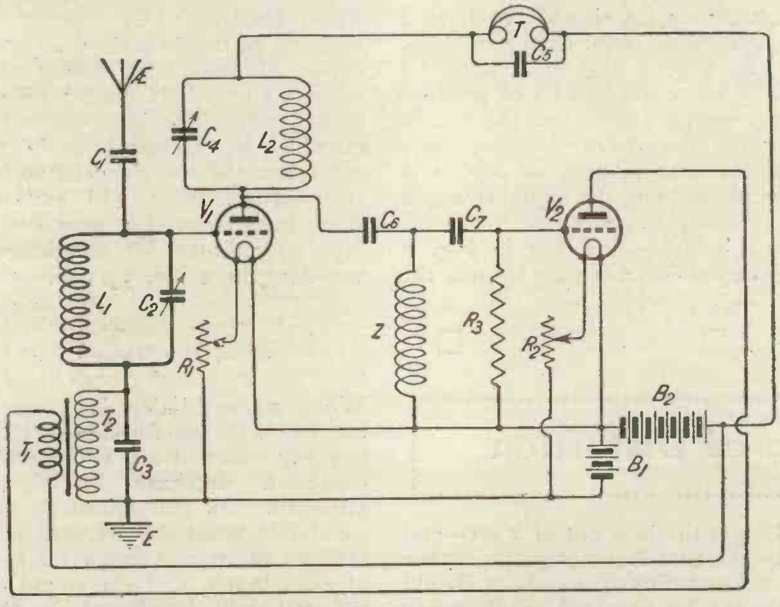


Fig. 1.—A dual circuit employing an effective method of overcoming low frequency reaction.

In last week's "Valve Notes" we discussed the troubles in the ST75 and ST76 circuits, due to the telephones, or the primary of an intervalve transformer, next to the anode of the high-frequency amplifying valve. The reason for placing the phones, or primary, in this position was to avoid low-frequency reaction. We can, however, place the phones, or primary of the intervalve transformer, in the more rational position on the anode battery side of the oscillatory circuit in the anode circuit of the high-frequency amplifying valve.

the tuned anode circuit L2 C4 and the positive terminal of the high-tension battery B2. The anode of the first valve is connected through a condenser C6, the capacity of which is not very important, and the condenser C7, which has a value of about 0.0003 μF, to the grid of the second valve V2. The usual gridleak R3 is connected between the grid of this valve and the positive terminal of the filament accumulator. The middle point between the condenser C6 and C7 is connected through an air-core choke coil Z to the filaments. This choke coil, for the broadcast waveband, may have a value of about 200 turns wound on a 3-in. tube. A No. 200 plug-in coil will work satisfactorily.

The Action of the Circuit

The first valve, of course, acts as a high-frequency amplifier in the ordinary manner, while the second valve acts as a detector, the rectified currents passing through the primary T1 of the step-up intervalve transformer T1 T2. The secondary T2 is connected in the aerial circuit in accordance with my usual practice. The first valve now proceeds to amplify the low-frequency currents, which pass through the telephones T. In passing through the telephones, varying low-frequency potential differences are set up across them, and these would, in the ordinary case of events, be communicated to the grid of the second valve through the inductance L2 and the grid condenser. They would then be again amplified by the second valve and re-amplified by the first, and so on. This would produce a reaction effect which would set up low-frequency howling.

How the Howl is Stopped

To overcome this trouble, we short-circuit the low-frequency potentials by adding the air-core choke coil Z, which has a negligible resistance and a negligible impedance to low-frequency currents. Any low-frequency impulses which pass through the condenser C6 cannot get any further, because the coil Z acts as a short circuit and acts in practically the same manner as an ordinary wire connection from the right-hand side of C6 to the filament. The condenser C6 may have a capacity of 0.0003 μF, or even a higher value, and the effect of its particular position is equivalent to it being shunted across the telephones T, in addition to the condenser C5, which acts as a by-path for the high-frequency currents in the anode circuit of the first valve. The condenser C6 does not, therefore, make any material difference to the strength of the signals in the telephones T.

The Action of the Choke Coil

The choke coil Z, although acting as a short-circuit for the low-frequency currents, chokes back any tendency of high-frequency currents to pass through it, these high-frequency currents being therefore communicated from the anode of the first valve, through the condenser C6, through C7 to the grid of the second valve. The gridleak, R3, is connected in the position shown for the usual purpose.

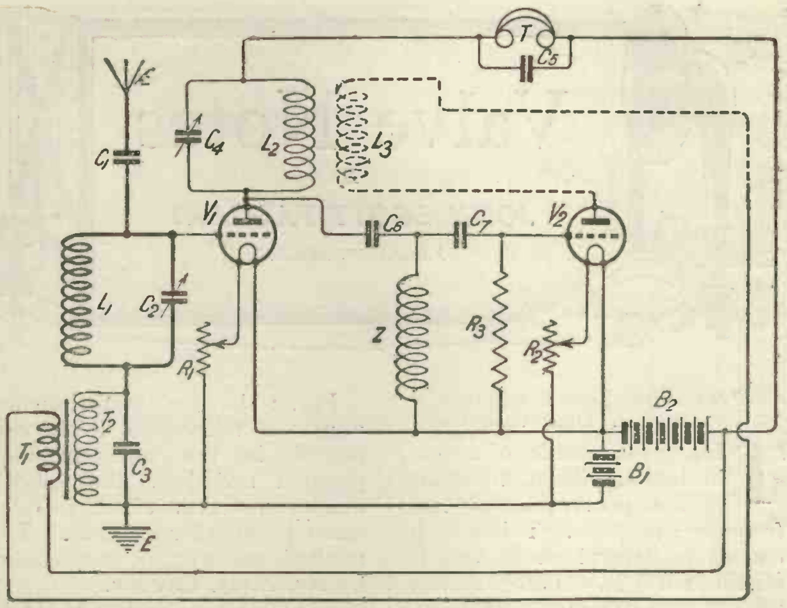


Fig. 2.—Introducing reaction, without the risk of causing interference.

Adding Reaction

Fig. 2 shows how the circuit of Fig. 1 may be modified to introduce reaction into the tuned anode circuit L2 C4. It will not usually be necessary to connect a by-path condenser across the primary T1 of the intervalve transformer, although this may be tried. In both circuits the condenser C3 should not have a capacity of more than 0.001 μF.

In Fig. 1 the inductance L2 may be coupled to L1 to produce a reaction effect, but the circuit is less likely to cause interference if the arrangement of Fig. 2 is employed, and the signal strength is usually as good.

It will be seen that in Fig. 1 constant aerial tuning is used, the fixed condenser C1 having a capacity of 0.0001 μF. The condenser C2 may be a 0.0005 μF, while C4 may be a 0.0003 μF or 0.0005 μF. The inductance L1 may be a No. 50 coil, or a No. 75 coil when the wavelengths to be received are over 420 metres. The inductance L2 may be a No. 50 coil, or for the longer wavelengths a No. 75 coil.

□ □ □

A Common Cause of Distortion

MOST of us have at least one friend who is immensely proud of his signal strength. When you go round to hear what his set can do you find that, using a minimum of valves, he is able to work a loud-speaker for the reception of a transmission which other people cannot get beyond good 'phone strength with the same outfit. You must admit at once that the signal strength is remarkable; but what of the quality of the reception? In nearly every case you will find that it is throaty, that speech is not easy to understand, and that there is a considerable undercurrent of mush. The reason is that the set, though not actually oscillating, is being worked far too close to the oscillation point.

To get the best out of a set—and by the best is meant quality rather than quantity of sound—it should always be operated well away from the oscillation point. You can always tell when tuning when you are approaching a condition of oscillation, for the signs are unmistakable. If the set gives normally a silent background it begins to be slightly noisy as the tuning is sharpened. A rustling or rushing sound, which may be very faint at first, is heard in the receivers, and mush from big stations, though usually inaudible, now makes its presence felt. If the high tension battery is at all noisy "atmospherics" are also heard. But the most reliable sign perhaps is to tap the grid leg of the first valve with the forefinger as tuning is done. When no oscillation is present, the touch of the forefinger, if it has any effect at all, will merely cause a decrease in signal strength. As you approach the oscillation point the decrease will become more and more marked at each touch, and the sound of the tap will be heard in the receivers. When the set is in oscillation tapping in this way will produce a response in the receivers in the form of loud sharp "plocks." R. W. H.

□ □ □

THE 2LO MICROPHONE

In connection with Captain Round's letter in our issue of May 7, and the article which appeared in our issue of April 30, it is interesting to note that *Popular Wireless* on February 16 published an outline of the principles of the Sykes microphone which Captain Round has developed for broadcasting.

A Crystal and Two Note Magnifier Circuit on the Omni Receiver

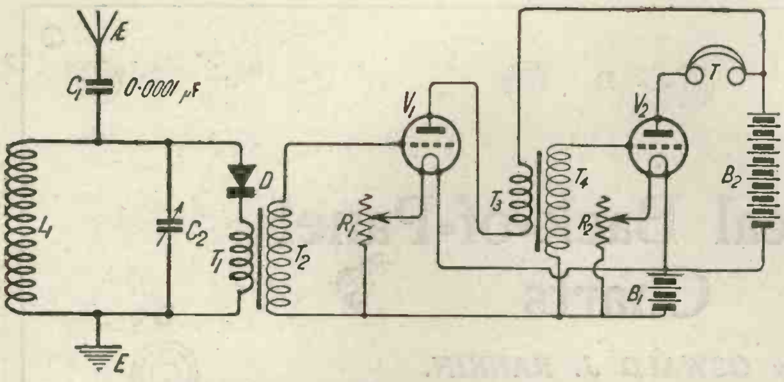


Fig. 1.—A crystal detector with two stages of note magnification, which may be wired up on the Omni Receiver.

FOR simplicity of operation it is very difficult to beat a detector and two-note magnifiers for broadcast reception when near to a broadcasting station, say, within ten miles. Such a circuit is illustrated in Fig. 1.

In this figure constant aerial tuning is shown, the condenser C1 having a capacity of 0.0001 μF. The inductance L1 may be a No. 50 coil, or a No. 75 plug-in coil if the wavelength to be received is over 420 metres. The condenser C2 is of 0.0005 μF. The crystal detector D is of the usual galena and cat's-whisker type; talite or the McMichael crystal give good results.

There are no special features with regard to the two low-frequency amplifiers. Signals will not usually be sufficiently strong to necessitate a negative base line potential to be applied to the grids of the valves.

Connections

Using the *Wireless Weekly* Omni receiver, the connections required are as follows:—

51—11
3—50
50—42
34—49
34—52
3—20
28—21
22—52
30—14
29—48
6— 7
15—24
56—16
55—48
8—23
31—24
32—40

Operating the Set

The only adjustment in this set is the tuning of the condenser C2. It is therefore as simple a circuit to operate as anyone could wish.

The inductance L1 is plugged into the left-hand front coil holder on the front of the panel.

Experiments to try with the Circuit

The first experiment to try with this circuit, after signals have been received, is to try series tuning instead of constant aerial tuning. The following alterations are necessary:—

Disconnect the lead between 51 and 11; disconnect the links between 49 and 34 and between 34 and 52. Join 51 and 34. The terminal 49 is connected to 52 direct.

If it is desired to use parallel tuning to receive, for example, the Eiffel Tower time signals on 2,600 metres, the original master key will do, but short-circuit the terminals 11 and 3, and substitute a suitable-sized coil for L1.

It is usually desirable to connect the negative of the filament accumulator to earth, and this may be tried out by connecting the terminal 52 to 48.

As some transformers give best results a certain way round, a reversal of the leads to 21 and 22 and a reversal of the leads to 7 and 15 may be tried out.

If you desire to carry out tests on the pure reproduction of speech and music, try connecting a condenser having a value of from 0.0005 μF to 0.002 μF across the anode of the first valve and grid of the second valve. To do this, join 18 to 6 and 26 to 16. The variable condenser 18-26 is now across the anode of the first valve and grid of the second valve. If you now desire to increase the capacity to see the effect, join 10 to 18 and 2 to 26; this brings in a second condenser 2-10, and a total capacity of 0.001 μF may now be tried. If it is desired to try a 0.002 μF, disconnect the leads going to 2-10 and 18-26, and join 6 to 39 and 47 to 16.

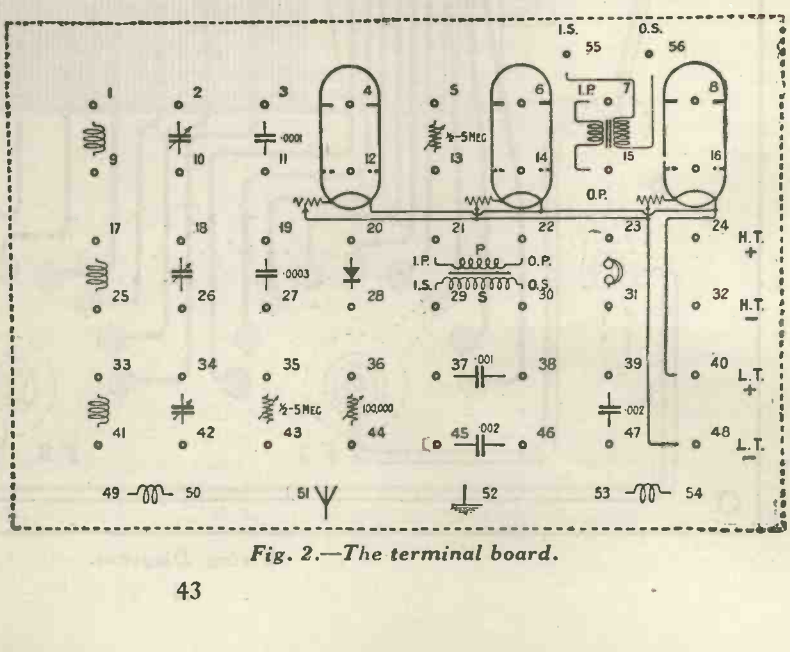
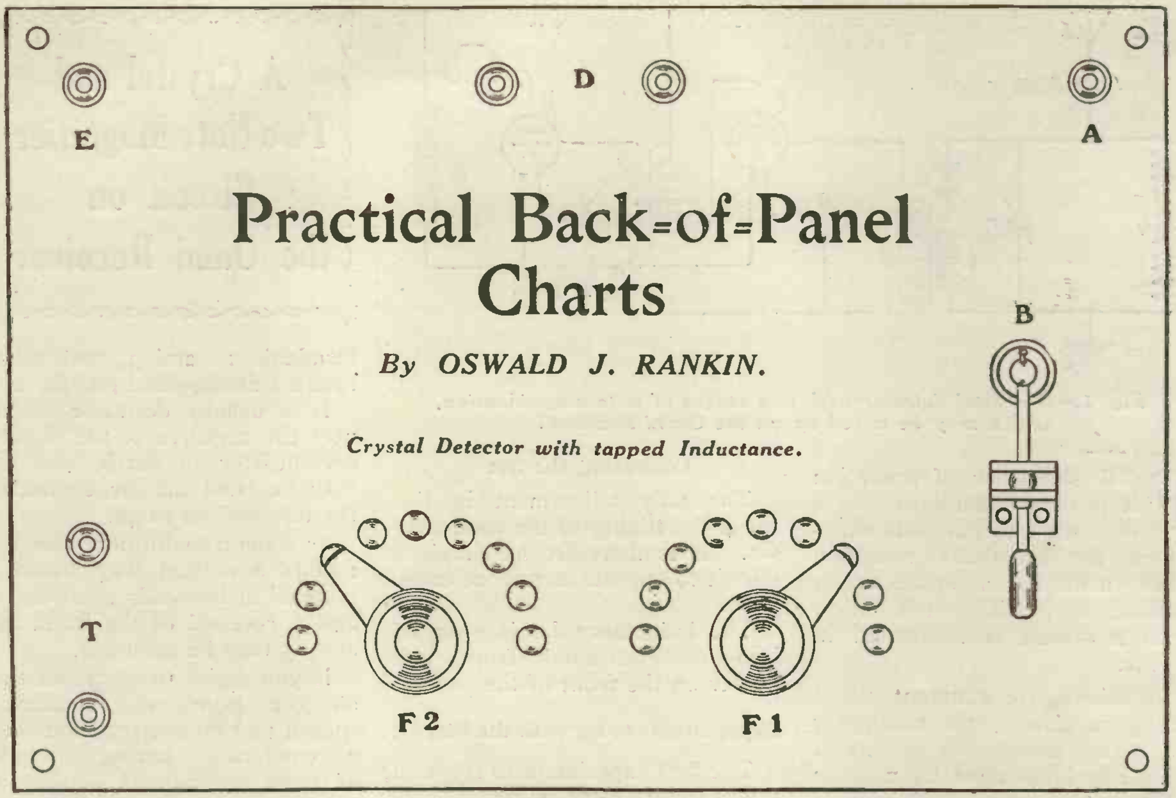


Fig. 2.—The terminal board.

Practical Back=of=Panel Charts

By OSWALD J. RANKIN.

Crystal Detector with tapped Inductance.

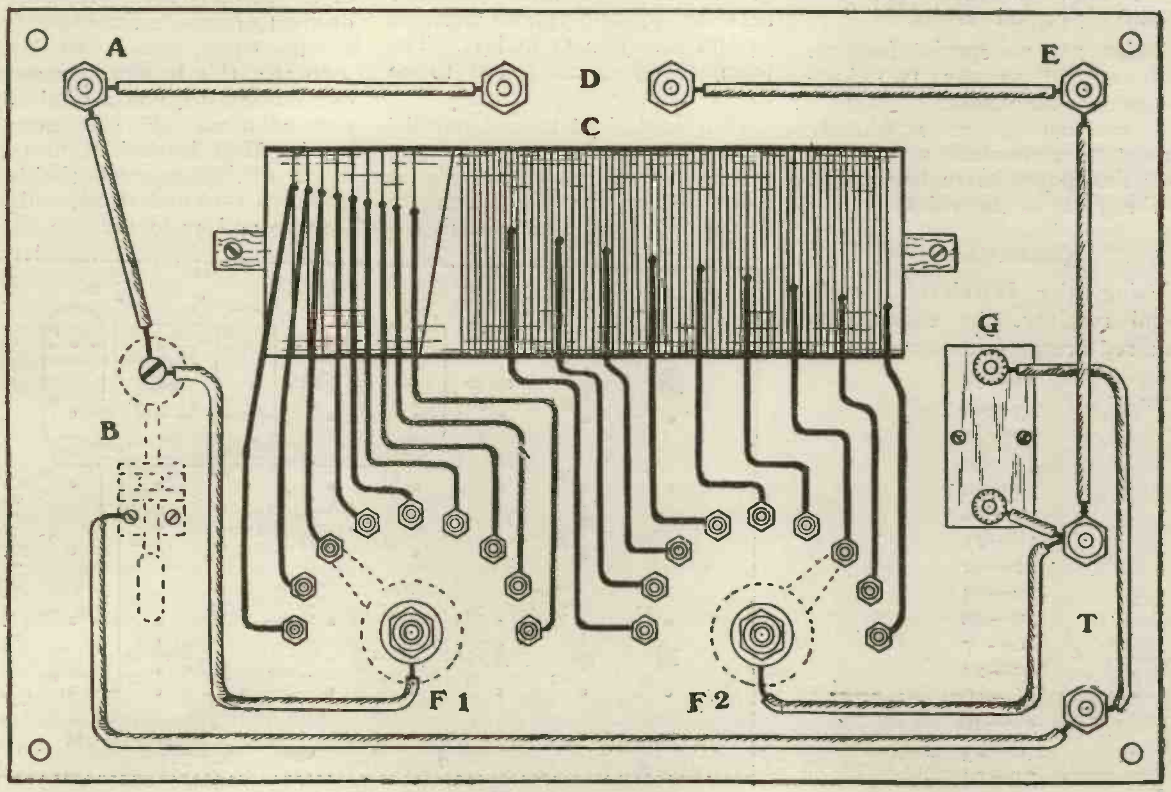


The Panel Layout.

The coil C may be 3" in diameter wound with No. 24 d.c.c. copper wire and tapped off as follows: From left to right, as shown, nine single turn tappings, then ten turns between each of the other tappings, the beginning and end of the winding counting as the first and last tapping respectively.

This arrangement will cover the most interesting band of wavelengths.

Two terminals D are connected to the aerial and earth terminals to permit the use of a variable condenser which, when thus connected, increases the wavelength range. B is the detector, and G the telephone condenser.



Wiring Diagram.

A Detector with Novel Points

THE perfect crystal detector has yet to be produced. There is hardly any existing design which has not a great deal in its favour, but most of them at the same time suffer very considerable drawbacks. Those which are small and neat are often too flimsy to be of much use. In some it is not possible to search more than a small portion of the crystal's surface; others do not allow a sufficiently delicate adjustment of the contact pressure, whilst others again cannot be locked once the correct setting has been found, often after considerable labour. It is not claimed for the little device to be described here that it reaches perfection, but it does embody a very great many good points together with very few bad ones. It is compact, measuring only 3 in. by 1½ in. over all: it allows most delicate adjustment of the contact to be made; much more of the crystal can be searched than is possible with any other type, and it can be locked tightly in position once it has been properly adjusted.

Fig. 1 gives a view of the finished instrument. It will be seen that the contact pillar on the right is double-jointed; hence the wire contact point can be moved both up and down as well as in a straight line horizontally. Adjustment of this part of the

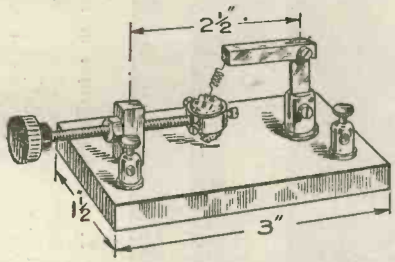


Fig. 1.—Appearance of the finished detector.

instrument is made, not by means of a screw but by hand, which is found to answer better, for the human hand is capable of exceedingly delicate movements. The "cup" is not strictly speaking a cup at all, being actually a brass ring provided with three setscrews for securing the crystal in position. It is fixed to a length of studding which passes through the pillar on the left and has an ebonite knob at its far end. By means of this screwed rod the cup can be moved at right angles to the movement of the wire contact point; hence, as two motions at right angles to each other are provided the entire surface of the crystal can be searched. Further, the crystal holder mav be turned right over, thus exposing a fresh surface of the crystal which is also available for use.

In Fig. 2 are seen the details of the double-jointed contact arm. The pillar can be made quite easily from a telephone terminal in which a hacksaw cut is made. The upright arm is a ¾ in. length of sheet brass of rather stout

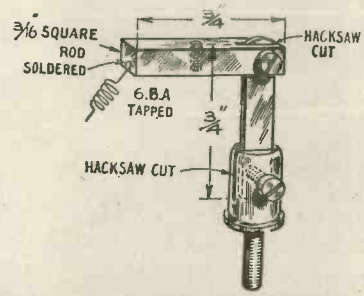


Fig. 2.—Details of the contact arm.

gauge, about ⅝ in. in width. At its lower end is drilled a 4 B.A. clearance hole for the bolt which secures it to the split terminal, and at the other a 6 B.A. clearance hole to take the bolt which passes through it and the horizontal arm. It is important that the cut made in the terminal should be a fairly tight fit for the strip. Should there be any wobble it can be taken up by packing with a few small pieces of copper foil.

The horizontal arm is made from a ¾-in. length of 3/16 in. square brass rod. A second hacksaw cut is made at one end of it and a 6 B.A. clearance hole is drilled at right angles to this. This cut again must be a tight fit for the brass strip. In the middle of the arm, as shown in the drawing, is a 6 B.A. tapped hole to take the screw securing the small ebonite knob. This last may be made very well from a piece of ½-in. round ebonite rod. The catwhisker is soldered to the far end of the horizontal arm. Both the 4 B.A. and 6 B.A. bolts are provided with securing nuts, preferably of the wing type, though if these are not available, circular nuts with milled

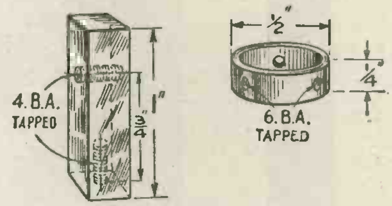


Fig. 3.—Dimensions of crystal holder and shaft support.

edges will answer very well. By means of these any play can be taken up and the arm can be tightly locked when set. These nuts should be so adjusted normally that the movement of the arm is fairly stiff without being jerky. Once the horizontal arm has been drilled and split with the hacksaw it should be trimmed down in order to lighten it.

Fig. 3 gives the details of the crystal holder and of the pillar which supports its screwed rod. The former is made from a small piece of brass tubing ½ in. in diameter. This should be about ¼ in. in depth. Three 6 B.A. holes, equally spaced, are drilled and tapped in its edge for the milled headed screws which hold the crystal fixed. The cup is soldered to one end of a 2-in. length of 4 B.A. studding. The pillar is a 1-in. length of ¼-in. square brass rod. Two 4 B.A. tapped holes are made in this, as shown in the drawing, one ¾ in. from the bottom for the studding which supports the crystal cup, and the other in the bottom to take the screw which attaches the pillar to the small ebonite panel on which the detector is mounted. This panel should be made from ¼-in. ebonite, its dimensions being 3 in. in length and 1½ in. in width. The two pillars are mounted 2½ in. apart upon it, and there are two terminals connected to the pillars by means of brass strips, which should be upon the underside of the ebonite.

The rod supporting the cup is provided with a milled, circular nut and with a 4 B.A. knob.

R. W. H.

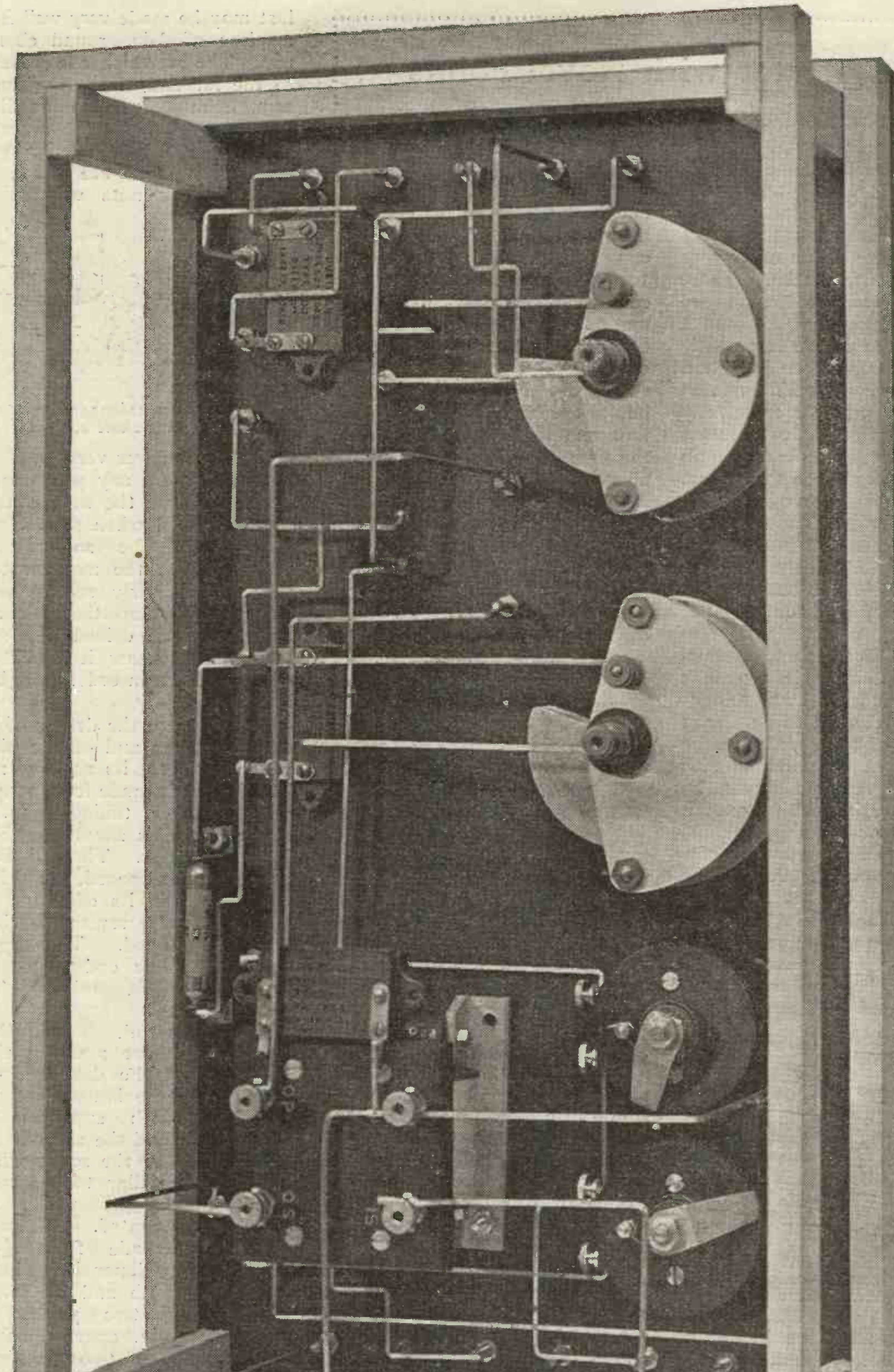


Fig. 7.—A photograph of the loose-coupled receiver, looking from underneath, with the framework in position. The wiring of the receiver can be easily followed.

A Two-Valve Receiver of Unusual Design

Type W6

By HERBERT K. SIMPSON

(Concluded from Vol. 4 No. 1, page 24)

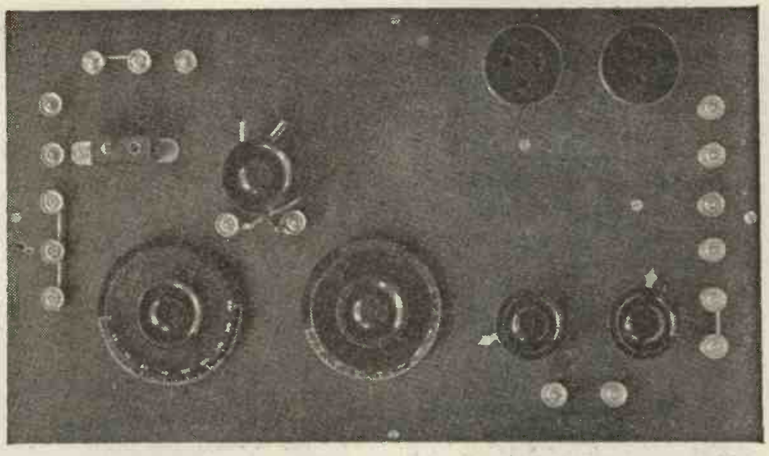


Fig. 8.—A bird's-eye view of the top of the panel, showing layout.

Constant Aerial Tuning with the Loose-coupled Circuit

To use constant aerial tuning with the loose-coupled circuit, the following connections, in addition to batteries and telephones, are made:—Aerial to terminal A, leaving A1 free; connect X to W, leaving Y free; join C, D, and E together, and connect the earth lead to terminal E. L1 is now the aerial coil, L2 the secondary circuit inductance, and L3 the reaction coil. Tuning is effected by means of the variable condensers C1 and C2, while reaction is obtained by coupling the coil L3 to the coil L2. The aerial circuit inductance L1 is that plugged into the socket on the left of the panel, L2 is the fixed coil in the two-coil holder, while the movable coil is the reaction coil L3.

If constant aerial tuning is not required, the aerial lead is moved to terminal A1, leaving A free, and the other connections remaining as before.

Series aerial tuning is obtained by joining the aerial lead to terminal D, the earth to E, connecting C and E together, and leaving all other terminals in the aerial circuit free.

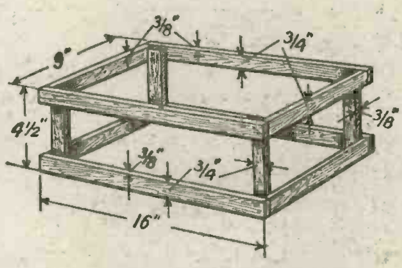


Fig. 9.—Details of the framework.

Table of Connections

Method of coupling	Method of Tuning.	Aerial.	Earth.	Other connections	Aerial coil.	Secondary.
Loose Coupling	Constant Aerial Tuning.	A	E	C to D and D to E. W to X.	L_1	L_2
	Parallel Tuning, No C. A. T.	A_1	E	C to D and D to E. W to X.	L_1	L_2
	Series Tuning	D	E	C to E	L_1	L_2
Direct Coupling	Constant Aerial Tuning.	A	E	X to Y	L_2	—
	Parallel Tuning, No C. A. T.	A_1	E	X to Y	L_2	—
	Series Tuning.	D	E	W to Y	L_2 L_1 is pulled out of its socket, and C_2 is set at zero degrees	—

Direct Coupling

A simple direct-coupled circuit may be obtained by joining the aerial to A, bringing in the constant aerial tuning system, the earth to E, and connecting X to Y, leaving terminals A1, W, C, and D free. The coil L2 now becomes the aerial tuning inductance, L3 remaining the reaction coil, as before. Tuning is now carried out on the variable condenser C2, the coil L1 and the condenser C1 not being in use. Constant aerial tuning may be omitted, and parallel tuning substituted, by moving the aerial lead to terminal A1, leaving the other connections as before.

Series Tuning

With this circuit, series tuning may be applied by joining the aerial lead to terminal D, earth to E, and joining W to Y. Terminals A, A1, X, and C are left free, and the coil L1 should be removed from its socket, while C2 should be set at zero. Tuning is now carried out on the variable condenser C1, reaction being obtained by coupling L3 to L2.

Mounting the Parts

When all the necessary holes have been drilled, the components may be mounted upon the panel. Commence with the smallest parts, such as terminals, filament resistances, and so on, leaving the heavier parts, for example, the transformer and variable condensers, until the last. By this means the set does not become so cumbersome to handle in the early stages of construction.

Some constructors may prefer to construct the frame next, in order that the set may be rested upon it, to facilitate wiring up.

The construction of the frame may be gathered from the photographs, and should present no difficulty whatever.

Wiring Up

The frame-type of containing box renders neat wiring an absolute necessity, and therefore square section bus-bar wiring has ordinary wire, and the following notes may be of use. A length of wire, judged to be nearly correct to join two given points, is bent so as to fit exactly between these points. The ends of this wire, as well as the points which saves much time in the end, is to tin all the terminals, etc., to which wires have to be joined, before commencing work with the wire itself. A wiring

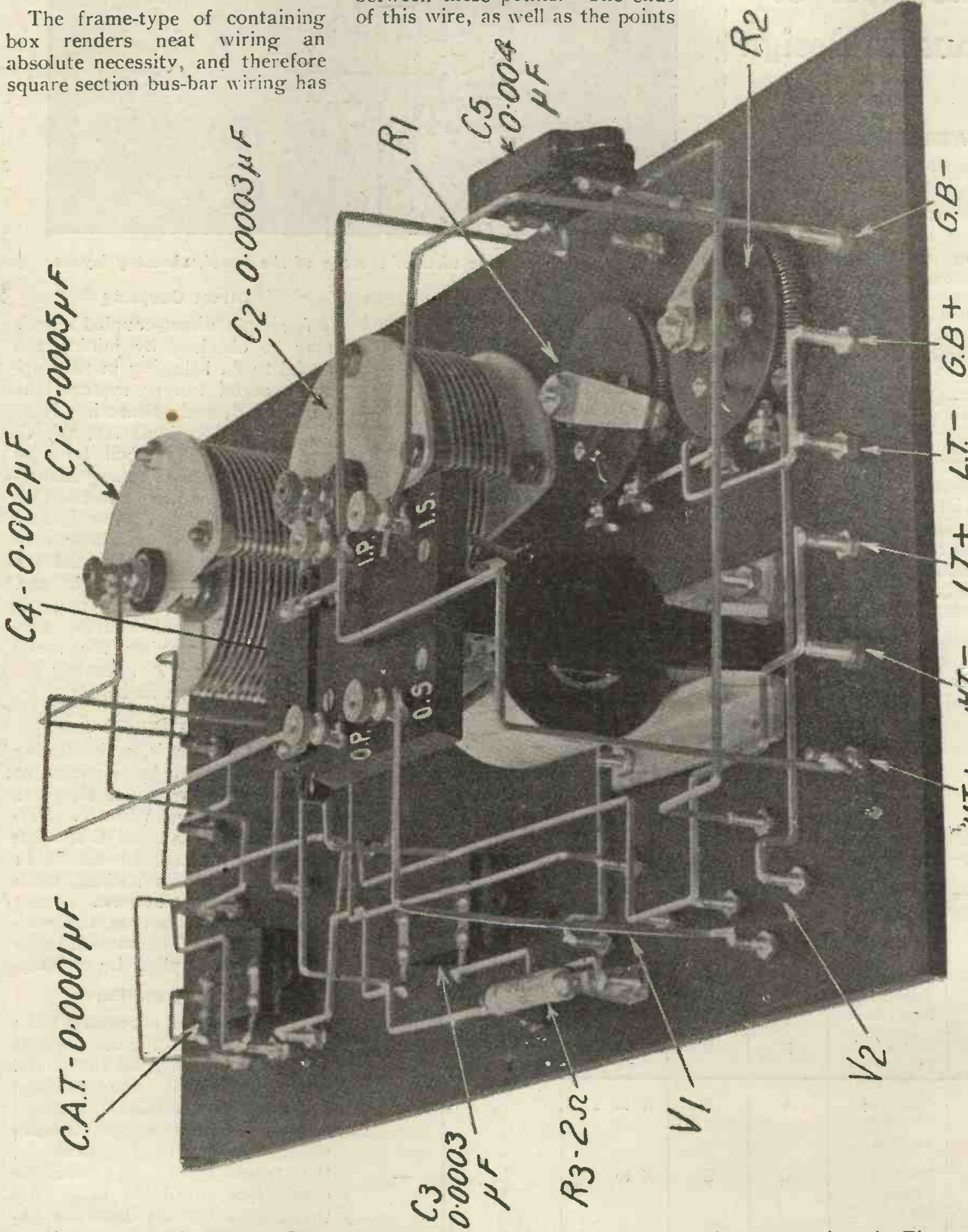


Fig. 10.—An endwise view of the underneath of the panel, with the majority of the components and terminals labelled for the sake of clearness.

been incorporated in this set. The wire used is "Radiohm Bus Bar" wire, sold by Messrs. Sparks Radio Supplies, Ltd. This type of wire must be handled in a manner somewhat different from between which it is to fit, should be well tinned, even though the wire is already tinned. Using as little solder as possible, consistent with safety, join the wire up in its place. A good plan, diagram is given in Fig. 11, and when this is used in conjunction with the photographs of the back of the panel, no trouble should arise from the wiring-up of the receiver.

The Framework

A sketch of the framework is given in Fig. 9, from which the construction should be perfectly clear. The wood measures $\frac{3}{4}$ in. by $\frac{3}{8}$ in., and four pieces are required to each of the following lengths:—16 in., 9 in., and $4\frac{1}{2}$ in.

Two rectangles are made with two of each of the 16 in. and 9-in. lengths, with the longer pieces overlapping the shorter. The pieces are fixed together by means of small brads, and then the two large rectangles are fastened together by means of the shorter ($4\frac{1}{2}$ in.) lengths of wood, which are fitted inside the rectangles, one at each corner.

The panel is fastened to the framework by four wood screws, one in the middle of each side.

Coils and Valves

Using the constant aerial tuning arrangement with the loose-coupled circuit, for broadcast wavelengths up to 420 metres, a number 50 coil may be used in the aerial socket. This is the socket on the left of the two-coil holder. Above 420 metres, a 75 coil may be used in this position. The secondary circuit coil L2 should be a number 75, while the reaction coil L3, the movable one in the two-coil holder, may be a 50. Any good make of coil may be used, such as Igranic, Burndept, or Lissen. With the direct-coupled arrangement, using constant aerial tuning, the coil L2 may be a 50 for broadcast wavelengths up to 420 metres, and a 75 coil should be used above that wavelength. The reaction coil may be a number 50. When using series aerial tuning the aerial coil may be a 75.

Any good make of valve may be used with this receiver, and possibly the constructor may already possess two, which will work quite satisfactorily. As previously mentioned, owing to their shortened pins, care must be taken, when using Ediswan valves, to ensure good contact being made with the socket.

Testing the Set

To test the set, it is advisable to start with the direct-coupled circuit, and test this first. Connect up the batteries and telephones to the terminals indicated in Fig. 3, and, if no grid bias battery is used, the terminals GB+ and GB− must be connected together by a piece of wire.

Join the aerial to A, earth to E, and join X to Y. Insert a number 50 coil in each socket of the two-coil holder, leaving the other coil socket on the panel, with no coil in it. Insert the valves, and turn on the filaments. Tune the set by means of the condenser C2 (the right-hand one), and when the local station is heard, bring the reaction coil up to the aerial coil. If this does not result in an increase of signal strength, reverse the leads from the coil socket to the two terminals upon the panel. Bringing the coils closer together should now result in an increase of signal strength; care must, however, be taken that the coils are not brought sufficiently near together to cause the set to oscillate, or interference will be caused to nearby listeners.

The Loose-coupled Arrangement

The loose-coupled circuit may now be tried. Leave the aerial on terminal A and the earth on E, but take out the link between X and Y, and join W to X; C, D, and E must also be joined together. Insert a 50 coil in the socket on the panel, and put a 75 into the lowest socket of the two-coil holder, leaving the 50 reaction coil as before. Tuning is now carried out on both variable condensers, and reaction is obtained by coupling the coils L2 and L3 as before. Using this circuit, it is not expected that signals will be as strong as with the direct coupling, but interfering stations will be more easily eliminated.

Blue Prints

For the convenience of those readers who prefer working to full-size drawings, blue prints of the panel layout, No. 39a, and of the wiring diagram, No. 39b, are obtainable, price 1s. 6d. each, post free.

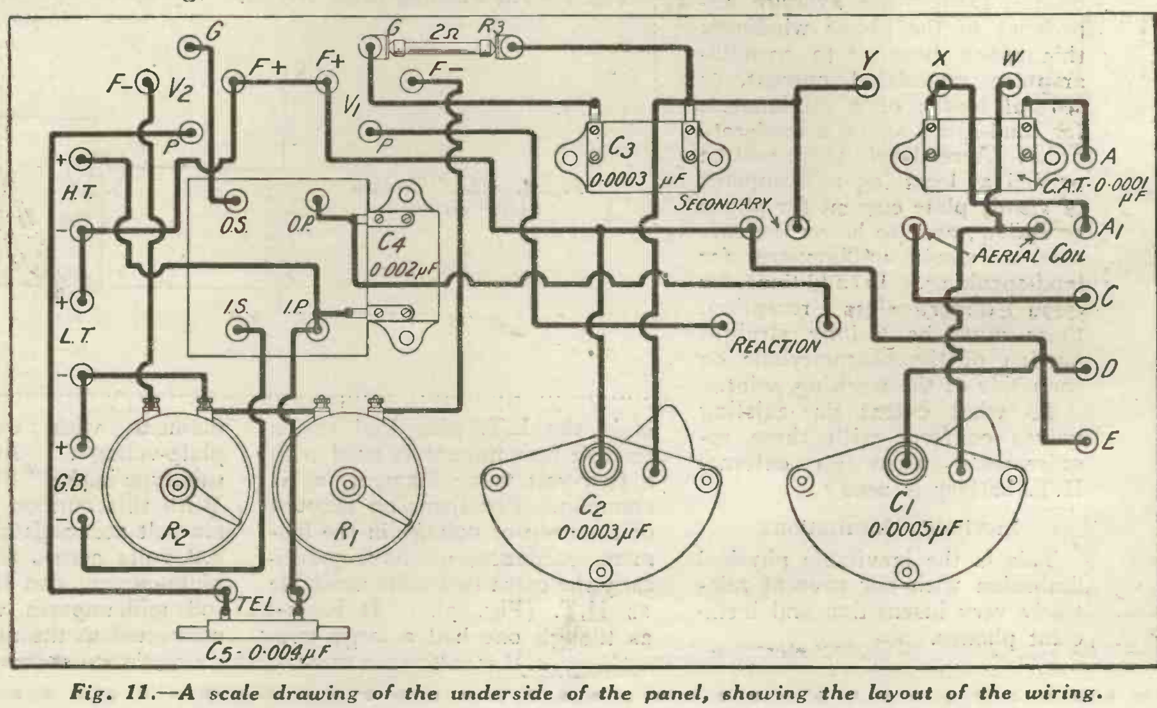


Fig. 11.—A scale drawing of the underside of the panel, showing the layout of the wiring.

Eliminating
Tension

By A. D. COWPER,

In this article Mr. Cowper, wh
already famous, has thoroughly
of eliminating the High Tension
are all tried and tested and c
Several employ ordina

It might appear that considerable simplification of valve receiving sets could be achieved if some or all of the high-tension battery could be dispensed with. It would then be of interest to consider the possibilities of eliminating the H.T. battery as a separate unit with the types of valves available at the present time.

What are the requirements in the way of plate-current for satisfactory reception (*a*) in headphones, (*b*) on the loud-speaker, under average conditions? Apart from the question of distortion, there must be a certain amount of steady current flowing in the plate circuit. Then the modulation of this current by the radio impulses received on the aerial will give an audio-frequency A.C. current which will in turn perform the work of setting the diaphragms in phones or L.S. into vibrations of sufficient amplitude.

Measurements

Actual measurement shows that with ordinary 4,000-ohm phones the signal-voltage required *across* the phones is around 0.2 volts for moderate, comfortable head-phone strength, to 0.4 volts for loud signals, and 2 volts upwards for real loud-speaking. (All R.M.S. values of the audio-frequency A.C. voltage). Taking the average impedance of the phone windings, this means about .01 to .03 milliamperes modulated current, or several tenths of a milliampere for loud-speaking of a moderate order. Accordingly there will be needed at least .05 milliamperes of *steady* plate current for phone reception; and (to be on the safe side) a whole milliampere for loud-speaking. In addition, for good distortionless reception, there must be a long straight portion of the characteristic on each side of the working point.

To what extent do existing valves conform with these requirements when no external H.T. battery is used?

Inevitable Limitations

This is the inevitable physical limitation with our present relatively very insensitive and inefficient phones.

The original Fleming valve is the historical example of the H.T.-less valve; here the natural electron emission of the hot filament gave sufficient " plate current " to provide for reasonable phone signals. Every experimenter of experience is familiar with the fact that feeble signals can be obtained with any ordinary type of three-electrode valve, with a hot filament but with the H.T. leads removed from the battery and connected together. The plate - current when measured is found to be minute; but suffices, when modulated by the action of the grid as usual, to give audible signals. The effect is more marked when the H.T. minus lead is connected with the L.T. plus; and particularly when the filament-resistance

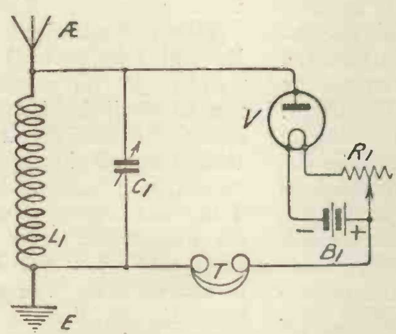


Fig. 1.—The Fleming valve circuit.

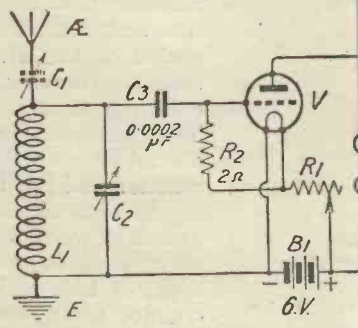


Fig. 2.—A simple circuit usin a six volt accumulator.

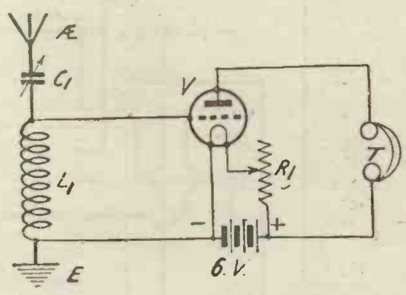


Fig. 4.—The " Sodion valve circuit.

is in the L.T. plus lead and a six-volt accumulator is used with a four-volt valve filament, as is common. For then, on account of the drop of voltage in the filament-resistance, we have practically the extra two volts available as H.T. (Fig. 3). It is just as though one had a large two-volt accumulator in place of the usual H.T. battery—a rather expensive and wasteful expedient.

Certain types of valves show a fairly liberal emission from the filament with extremely low plate-voltage. An example of this type is the " Sodion " valve. With this curious valve, with a six-volt accumulator and actually 3.8 volts across the filament, a plate-current can be obtained of .08 milliamperes with the grid connected to the negative end of

; the High Battery

3.Sc. (London), M.Sc.

iose experimental articles are investigated the possibilities Battery. The circuits he gives be put together very simply. hree-electrode valves.

the filament. As the characteristic has a very sharp bend about this point, excellent rectification is obtained under these circumstances without the use of grid-condenser and leak; and the plate-current suffices for fairly loud (and exceedingly clear) head-phone reception without any more H.T. than is obtained by connecting the phones to the L.T. plus (Fig. 4). Of course, considerable improvement in signal-strength results with every addition of (external) H.T. up to the maximum at which the valve is rated (22 volts); but this valve can be used quite successfully without an external H.T. battery.

With a "liberal" R valve of standard type—*e.g.*, a good specimen of the "Metal" French R valve—a plate-current of about .03 milliamperes results in a normal rectifying circuit with the phones connected to the L.T. plus, using a six-volt accumulator (Fig. 2). Quite good phone reception can be obtained in this way, with an efficient aerial and tuner, of local broadcasting; but effective reaction cannot be obtained, so that distant reception is out of the question. Actually, with four volts external H.T. (one fourpenny flash-lamp battery) and tuned plate reaction the circuit can be got to oscillate on a full-size outside aerial, the plate-current then being about .05 milliamperes.

With the circuit in Fig. 5, which amateur transmitters will recognise as bearing a close resemblance to some of their transmitting circuits, some reaction can be brought to bear even with extremely low plate-voltage. With a .00025 μF series condenser in the aerial-circuit as shown, London came in at 13 miles very well in the phones with no external H.T.; with 8 volts Bournemouth and Manchester were read, and with 12 volts Newcastle, all in a London suburb on a good, but not high, double aerial. With a larger inductance the higher stations would come in better. Substituting a small power-valve for the French R, considerably better signals were obtained, as might be expected.

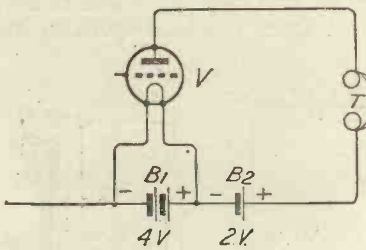


Fig. 3.—How the additional two volts of a six volt accumulator act as "High Tension."

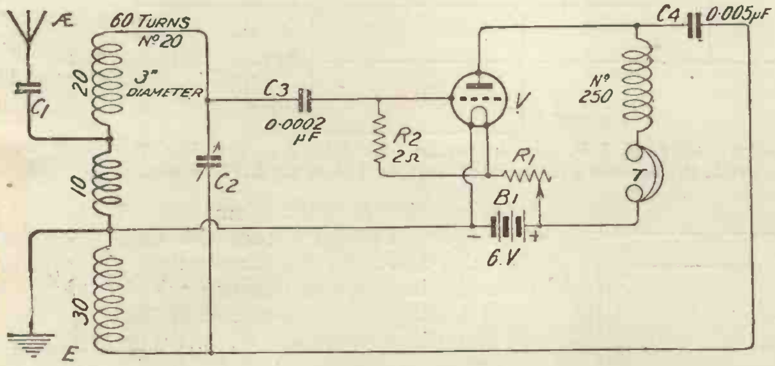


Fig. 5.—An interesting R valve circuit which gave good results at 13 miles.

On the Loud Speaker

With two valves, arranged as in Fig. 6, the first, an R valve, and the second the Ediswan P.V.3 power-amplifier valve, with a Pye No. 1 L.F. transformer and Ultra loud-speaker, 2LO was clearly audible in the L.S. at a short distance; with 4 volts H.T. in addition and 1.3 volts negative grid-bias on the second valve what may be described as "moderate" loud-speaking resulted. With 8 volts extra H.T. beyond the L.T. plus, Cardiff was clearly audible in London on the L.S.

Several experimenters had shown that different types of "super" circuits can be operated with extremely low H.T. value. Thus the writer (W.W. Vol. 2, No. 19, Nov. 21, 1923, p. 666) noticed that 2LO could be clearly heard on a two-foot frame-aerial, without any H.T. battery, at 13 miles in the head-phones; on the loud-speaker he was readable in a quiet room with 4 volts H.T.

Space Charge Effects

The real limitation in all these experiments is the choking effect of the "space-charge" or cloud of free electrons which surround the filament when there is no highly-charged plate to attract them away; and which repel (according to the ordinary laws of electricity) other electrons which are striving to leave the filament. This space-charge is controlled by the grid in the ordinary three-electrode valve; and this electrostatic control being very sensitive when the grid is finely meshed and close to the filament, a small variation of grid-voltage controls a comparatively large variation of the plate-

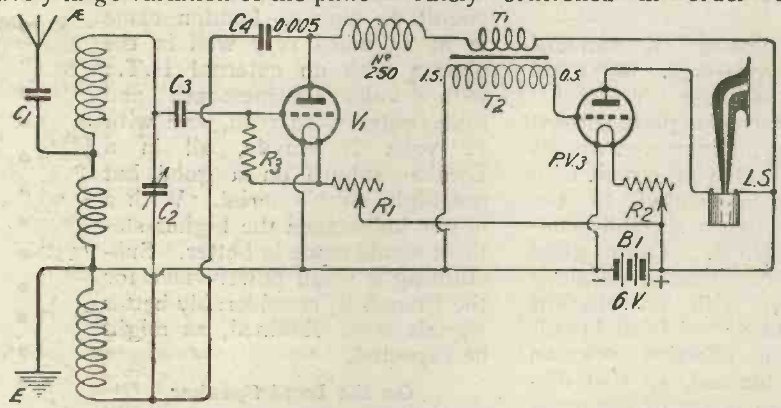


Fig. 6.—With this circuit a loud speaker was operated without H.T. C1 has a value of ·00025 μF.

current in the familiar way. If a second grid were immersed in this space-charge and made positive with respect to the filament, this entangling of the electrons projected from the hot filament in a fog of hostile electrons would be diminished, while at the same time a small variation of the electrical potential of this second grid would have a great effect on the plate-current.

This expedient has been exploited in the curious receiving circuit, using a four-electrode valve (*i.e.*, one with *two* concentric grids) of the Phillips type, in use for some time by the Dutch amateurs. An account of this was published in an esteemed contemporary in November,

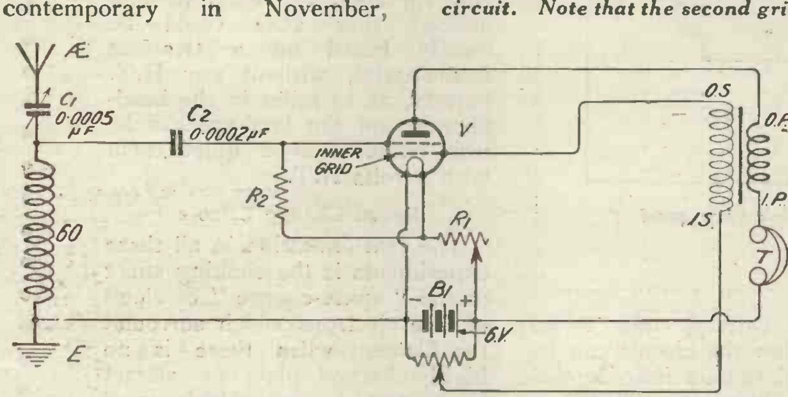


Fig. 7.—A circuit using a Dutch four-electrode valve. A re-action coil may be connected in the anode circuit of the valve.

1923. (Compare W.W., Vol. 4, No. 1, p. 25.) The second, inner grid is simply connected to a tapping-point in the small H.T. battery of 8-10 volts only; it is also impressed with a H.F. voltage. Four-electrode valves have been developed by the Marconi Company for use in certain complex dual-amplification circuits in which a second grid is separately controlled in order to superimpose oscillations of different frequency.

It is an obvious development to utilise the principles of diminishing the space-charge effect (so as to get more available plate-current for strong signals), and to use the well-established dual-amplification methods in common use in commercial wireless communication with the Marconi four-electrode valve, in an endeavour to get better signal-strength without an external H.T. battery. Thus with the circuit in Fig. 7, which is the Dutch amateurs' circuit with a six-volt battery only, and audio-frequency feed-back after the established dual methods, the average potential of the second inner grid being controlled by a potentiometer so as to be fairly positive with respect to the filament (and thereby repress to some extent the embarrassing space-charge), excellent phone reception of local broadcasting can be obtained with commercially available types of four-electrode valves, as good as any ordinary listener might wish who is content with head-phones. The plate-current is about .1 milliampere under these circumstances. Actually London at 13 miles was clearly audible at some feet from the loud-speaker, and

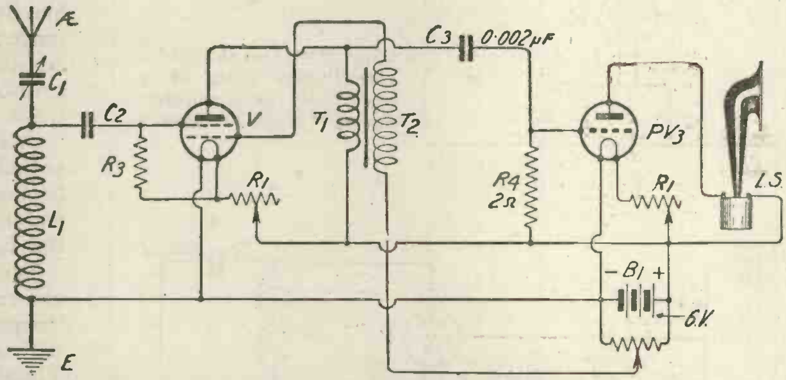
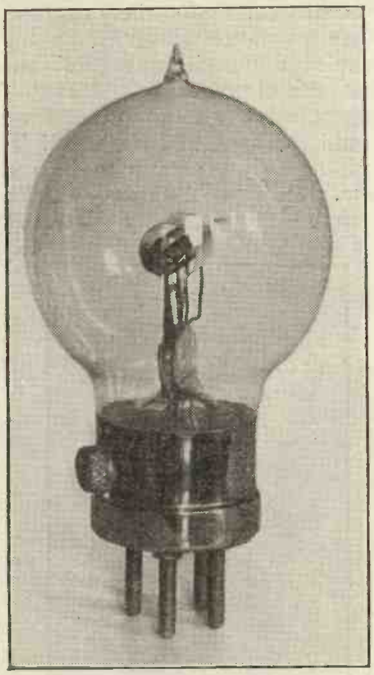


Fig. 8.—How a stage of L.F. amplification was added to the Fig. 7 circuit. Note that the second grid leak cannot be taken to L.T. minus.

faintly in the next room, with a single Phillips' four-electrode valve and a six-volt accumulator, and with efficient tuning devices.

Adding a L.F. stage as in the last diagram (Fig. 8), with reactance capacity coupling to the last valve, with Phillips' four-electrode and Ediswan P.V.3 valves and a R.I. transformer arranged as shown, a fair measure of loud-speaking resulted for a small room, but left much to be desired in the matter of distortion. The filament adjustment of the first four-electrode valve was fairly critical. Of course, every volt of real H.T. added improved both strength and clarity of reception, excellent results being obtained on the L.S. with less external H.T. than would normally be considered necessary for a detector-valve.

While much amusement and interest—and occasionally fairly good reception—can be obtained in such experiments with three and four-electrode valves with minimum or no external H.T., they are far from solving the real problem: the provision of an ample and closely-controlled plate-current, with real power behind it to give energetic signals, with minimum *total* battery equipment. A large expensive 2-volt accumulator cell for H.T. masquerading as an (unused) portion of the L.T. battery, of heavy cost and depreciation, is no solution of this. With small H.T. cells at 1d. a volt, which will last for months with a single-valve set in daily reception of broadcasting, and which will give no trouble at all if they are regularly weeded out and ruthlessly discarded when below 1 volt per cell, the direction of attack should be rather against the



The Phillips' four-electrode valve used in these experiments.

wasteful and extravagant L.T. battery. This implies the development of a new type of valve, which will give a generous filament emission with even less expenditure of energy than the .06 valves. This will only ensue from painstaking, quantitative scientific research of the type which produced the Fleming valve.

THE LATE MR. J. ST. VINCENT PLETTS

A recent portrait.

Mr. J. St. Vincent Pletts, who, at the comparatively early age of 44, died at his home at Surbiton after a short illness on Saturday, April 26, was a very familiar figure at Marconi House, having been connected with the Marconi Company for 25 years. Formerly, he constructed wireless stations for this company in Hawaii, Labrador, the Congo, Russia, and the Far East; and was the head of the Marconi Company's Patent Department. Later, in his capacity of Consulting Engineer, he figured as the Marconi Company's expert in all legal cases on Patents relating to Wireless Telegraphy, including the famous 7777 case and the recent Mullard Valve Case. He was a member of various technical societies and a writer of technical articles, as well as being the inventor of a Slide Rule, known as the "Davis-Pletts" Slide Rule; and a Cryptograph machine. During the War he acted as Expert in Cryptography at the War Office. Possessed of a shrewd and accurate judgment, he was an indefatigable worker and a very clear thinker. He also was a very reserved man and, though holding a prominent position, very unostentatious and considerate of those who worked for him.

Two Useful Fittings for the Brace

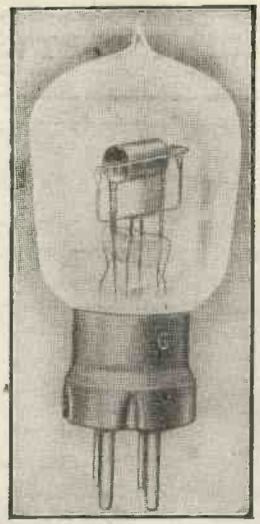
ONE of the most useful tools that the wireless man can add to his workshop outfit is what is known as a D-bit. This is half round in section with a square shank to fit the jaws of a brace, and its length is about 8 inches. It tapers gradually from the shoulder, where the width of the flat part is about ¼ inch, to quite a small point. Its use is to enlarge holes which are just not big enough to serve their purposes. Though really a woodworker's tool, it cuts ebonite cleanly and well. Its usefulness will be obvious. Suppose, for example, that you have made a slight mistake in drilling the holes for the fixing screws of a rheostat. A 5/16 inch hole has been bored for the spindle. This should be large enough, but since the rheostat is slightly out of place the spindle binds in its hole. It is a difficult job to get a larger twist drill through since it is apt to seize in the hole. With a D-bit, however, the hole can be slightly enlarged until it just serves its purpose. Another useful fitting for the brace is the expanding bit, which is made with a movable cutting jaw retained in place by a single screw. By loosening this screw the cutter can be moved nearer to or further from the centre, so that any size of hole within the full limits of the bit can be made. Usually these bits are sold with one large and one small cutter, and with the pair holes can be made from ½ inch to 1½ inches in diameter. The expanding bit is, of course, entirely a woodwork tool. It is very useful where wood panels with ebonite insulating pieces are used.

R. W. H.

THE WIRELESS VALVE AND HOW IT WORKS

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

The second of a series of new and exclusive articles by a world-famous expert



The Marconi R4C Valve.

What "Evaporation" is

We all know that such substances as water or gasoline will evaporate in an open dish. Just what is evaporation from the viewpoint so far presented? Perhaps you have seen a swarm of bees hanging in a cluster from the limb of a tree; the writer has often cut off such a limb, carried the swarm to the front of a new hive, and shaken the bees off on the ground. They will roll over the ground in a layer perhaps 100 bees thick, almost like thick treacle, and will gradually move into the entrance to the new hive; but if the queen has been lost, they will start to fly back into the air. So we have on the ground a mass of bees, perhaps half a bushel, corresponding to a liquid in their motion, and, leaving the surface of this mass, are the individual bees taking wing. We may say that the bees are "evaporating" as they leave the crawling mass on the ground and fly up into the air.

High Speed Atoms

This is a fairly good picture of what happens at the surface of a liquid. Most of the atoms of the liquid stay in the mass but some of those at the surface, having sufficiently high velocity, will fly away from the liquid altogether, in spite of the effect that the rest of the atoms of the liquid try to hold them in. The high speed atoms at the surface break away and become free individual atoms of the substance floating about among the air atoms at the surface of the liquid, gradually bumping their way through the air atoms and so away from the liquid. It is these individual atoms that break away from the surface of the liquid and cause it to evaporate.

As with Liquids

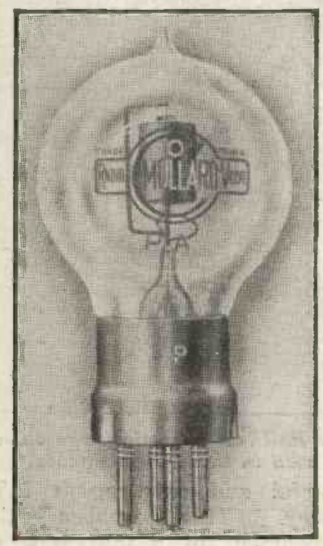
It is evident that those atoms at the surface with the highest velocity are the most likely to break away from the pull of their companion atoms, and such is always the case. In evaporation it is the fast ones that get away. It follows, therefore, that as the high speed atoms get away, those left behind will have on the average a lower velocity than before evaporation began to take place; but lower average velocity of the atoms means a lower temperature, and we know that this is just what occurs when a liquid evaporates. Alcohol allowed to evaporate from the hand will cool several degrees; liquid air left free to evaporate will so cool down that what is left behind actually freezes.

Effect of Temperature on Evaporation

The higher the speed of the atoms the more likely are they to break away from the attraction of their companions and so evaporate; thus hot water evaporates much more rapidly than cold water. Metals evaporate very slowly at ordinary temperatures, but as they are heated the rate of evaporation increases. If the metal is surrounded by air it will generally oxidise before reaching a temperature at which appreciable evaporation takes place; but if the metal is in a vacuum it will actually evaporate or boil away just as do liquids. In the ordinary electric lamp the tungsten is so hot that appreciable evaporation takes place; the metallic vapour condenses when it reaches the comparatively cold walls of the glass bulb. This is the black deposit of tungsten visible in the bulb of any tungsten lamp which has run a thousand hours or more.

Evaporation of Electrons

About 20 years ago it was predicted by Richardson that if a metal were sufficiently heated, not only would it evaporate, but *electrons might be made to evaporate from the metal* also. Moreover, it was evident that the electrons would be the same in kind, no matter what metal was heated. As the electrons move so much faster than the heavier atoms it was predicted that the electrons would evaporate at a lower temperature than would the atoms of the metal itself, and such proves to be the case. In a good vacuum (space from which practically all air or gas has been pumped out) a glowing piece of tungsten, platinum or similar metal may be maintained at a white heat for thousands of hours without appreciable evaporation of the



A Mullard Power Valve.

metal itself; yet in one hour the number of free electrons evaporated is several times as great as the total number of free electrons in the piece of metal. Of course as the free electrons evaporate, others must be supplied to take their place, as will be explained later.

Effect of Gas Evaporation

In order to get appreciable electron evaporation it is necessary that the space surrounding the hot metal, from which the electrons are being emitted, be very well evacuated, not only to prevent the metal from oxidising, but because of the effect of the gas on the electrons that are trying to leave the hot surface. The mass of the electron is so extremely small that if it collides with an atom of any kind it bounds backwards at about the same velocity with which it was rushing forward. This action is the same as when a tennis ball collides with a cannon ball going in the opposite direction; the path of the cannon ball is scarcely disturbed by the collision, but the tennis ball bounds back in about the same way it would have done had it struck a rigid wall. Thus if there are any atoms of gas surrounding the hot metal, the electron bounding out of the surface of the metal strikes against these atoms and so bounds right back into the hot metal from which it has escaped. The gas thus acts as a screen surrounding the hot metal, pushing the electrons back into the metal as fast as they escape.

Effect of Surface Condition

We know that if the surface of water is covered with a layer of oil the water is effectually prevented from evaporating. A similar effect is often noticed when studying electron evaporation, other things taking the place of the oil layer. Thus, if some certain gas sticks to the surface of the hot metal (such gas is said to be "absorbed"), it may practically stop the electron evaporation, whereas certain other gases have no effect at all. Langmuir and his co-workers in research have done most thorough work in investigating these effects of different gases in a vacuum tube; those especially interested should consult the scientific journals where such work is reported.

(To be continued.)

The keyboard of the Bourneville carillon, the music from which was recently transmitted from the Birmingham Broadcasting Station.

An Aid to Stability

VALVE sets with double circuit tuners are sometimes found to be rather unstable. There may be a tendency to oscillation on the high-frequency side whilst the note-magnifiers are prone to howl, unless their grid potentials are very carefully adjusted. Where this state of affairs exists it will usually be found that the batteries and, in fact, all the components of the set, are, so to speak, "up in the air"—that is, they are not earthed. The simplest way out of the difficulty is to connect the low-tension negative terminal to the earth terminal of the set.

R. W. H.

IMPORTANT ANNOUNCEMENT

In view of the evident interest aroused by articles on high-tensionless receivers, we propose to continue the highly important articles by Mr. A. D. Cowper, who has been working independently on this problem. The results he has obtained with his own special circuits are second to none and the articles will be read with great interest. Full constructional details are also being given.

Mr. Cowper, it will be remembered, won the 1st prize in the Armstrong super competition organised by the Radio Society of Great Britain, and his high reputation as a sound and original investigator is too well known to readers of WIRELESS WEEKLY to need emphasis.

C.W. and Telephony Transmission Using Valves

No. XVII.

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

Use of Rectified A.C. for Wireless Telephony

JUST as we obtain high-tension currents from a rectifier unit for use in continuous wave transmitters, we can use similar rectifiers to give us the high voltage currents necessary for medium and high-power wireless telephone installations. Fig. 45 shows a wireless telephone transmitter in which the D.C. supply consists of a single-valve rectifier. The valve V1 is the power generator, the valve V2 acting as the modulator. The source of D.C. anode current consists of a rectifier unit comprising the two-electrode valve V3. Alternating current is used to heat the filaments of all the valves, and the step-up transformer T1 T2 provides the high voltage alternating current which is rectified by V3. The rectified current charges up the condenser C5, and the iron-core choke Z2 in conjunction with the condenser C4 acts as a ripple eliminator. The choke Z2 also acts as the low-frequency choke through which the current surges result in a varying voltage on A1 when speaking. An additional iron-core choke is, however, sometimes connected at the point Y. The grid G2 is given a normal negative potential by taking a tapping off the gridleak R1. In series with the leak R1 is an air-core choke Z3, which is intended to prevent high-frequency current flowing through the grid condenser C3 and through R1; such a flow of current would partially short-circuit the condenser C1. Pure C.W. signalling may be accomplished by connecting a tapping key in series with the winding T1, and the gridleak circuit is preferably opened at the same moment. This class of circuit may be varied in a large number of ways, and we can, moreover, use a full-wave rectifier instead of a single valve.

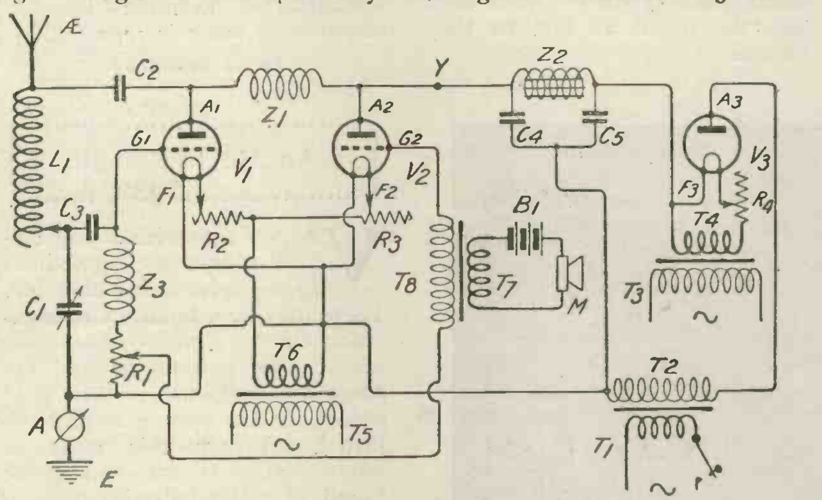


Fig. 45.—A choke control transmitter using rectified A.C. for H.T.

Use of Valves in Series

Another method of modulating the radio-frequency output of a valve oscillator is to vary the value of a resistance included in the high-tension supply circuit of the generating valve. A three-electrode valve is used in practice. This valve is connected in series with the first, so that the anode current first flows from filament to anode in one valve and then across the filament-to-anode path of the second valve; in order that an electron current should flow round the circuit it is essential that the filament of one valve should be connected to the anode of the other valve.

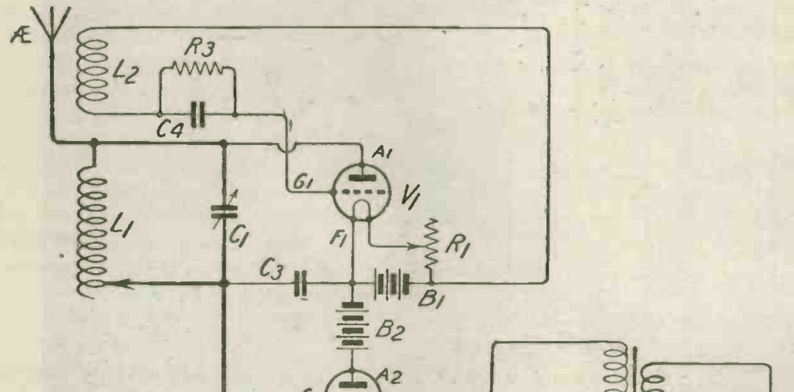


Fig. 46.—The microphone potentials vary the current in the anode circuit of V1 by varying the resistance of V2.

Fig. 46 shows a valve transmitter of a kind which has been previously described, but which has a second three-electrode valve V2 connected in the anode voltage supply circuit. The anode battery B2 has its negative side connected to the filament F1; the positive side of B2 is connected to the anode A2 of the valve V2; the filament F2 is connected through the inductance L1 to the anode A1 of the generator valve V1. The power developed by the valve V1 will depend upon the current flowing through the valve V1. By connecting the second valve V2 in series with V1, we can readily vary the output of V1 by altering the potential of the grid G2 of the second valve V2. The electron current through the two valves takes the path F1, A1, L1, F2, A2, F1; if we increase in a positive direction the potential on G2 we will increase the current through V2, and so increase the current flowing through V1; if, on the other hand, we lessen the potential of G2, we will decrease the current flowing through V1, and therefore decrease the aerial current. The condenser C3 is intended to act as a by-path for oscillatory current. The usual microphone transformer T1 T2 is provided, and it is preferable, though not essential, to give G2 a negative potential by means of a battery B4; this negative potential prevents distortion of the microphone potentials through the establishment of a grid current to G2.

Operation of this transmitter

We can operate such a transmitter so as to give a quiescent aerial effect by making the grid G2 sufficiently negative to cut down the anode current of V1 to a value approaching zero. Under these conditions the aerial current will be very small indeed; it could be made zero, but it is always desirable in such circuits to have the generating valve oscillating feebly. When speaking into the microphone M the grid G2 will vary above and below its normal negative value. The negative half-cycles of microphone potential will have practically no effect since the aerial current cannot be reduced below zero. The positive half-cycles, however, will allow a very much greater current to flow through V2 and the aerial current will rise to a high value.

Precautions to be taken

Circuits of this kind operate very effectively and may be recommended. There are, however, two disadvantages; one is that two separate filament batteries are needed, one of them requiring to be carefully insulated (B1 in our case), and the other is that since the valve V2 is always in series with the anode voltage supply, and is therefore equivalent to a high resistance inserted in the supply leads, the voltage of the high-tension generator requires to be greater than usual. It is to be noted that this particular method of modulation may be used in the case of any type of valve transmitter by simply connecting the extra three-electrode valve in the generator supply leads.

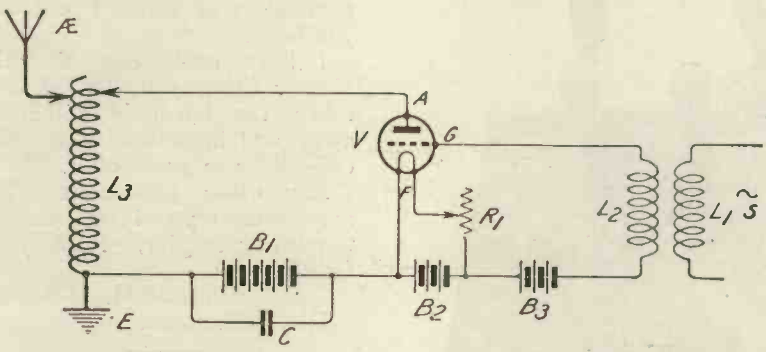


Fig. 47.—The oscillating currents are modulated by affecting the input side.

Systems Using Separately Excited Valves

We have indicated that an obvious use of the valve amplifier was to connect the anode circuit to the aerial system and to excite the grid circuit by a source of radio-frequency current which is then amplified by the valve.

Fig. 47 shows a typical circuit in which the radio-frequency input currents, which may be obtained from any suitable source S (usually a valve oscillator of some kind) are applied across grid and filament of a three-electrode valve V. The anode circuit is fed from a battery, generator or rectifier unit B1, which may be connected in any suitable position. The tuning arrangements on the output side of the amplifier valve V may also be varied in a number of ways. It is usual to operate such a valve either at a point near the middle of its anode current curve or near the lower bend. In the latter case, only the positive half-cycles of radio-frequency current produce the output from the valve; the output currents even under these conditions are of an alternating nature.

We may use such a circuit in various ways to act as a wireless telephone transmitter. We could, for example, arrange that the grid circuit (or input side, as it is often called) is excited by modulated radio-frequency currents. Another arrangement is to modulate the radio-frequency currents in the grid circuit of V. A further method is to modify the operating characteristics of the valve by altering the normal grid or anode potentials.

According to one system, we arrange a three-electrode valve across the inductance L2 so as to absorb energy from L2. By causing a microphone to vary the grid potential of such a modulator valve we can vary the radio-frequency potentials applied to the grid G. The radio-frequency current in the aerial circuit would be correspondingly varied.

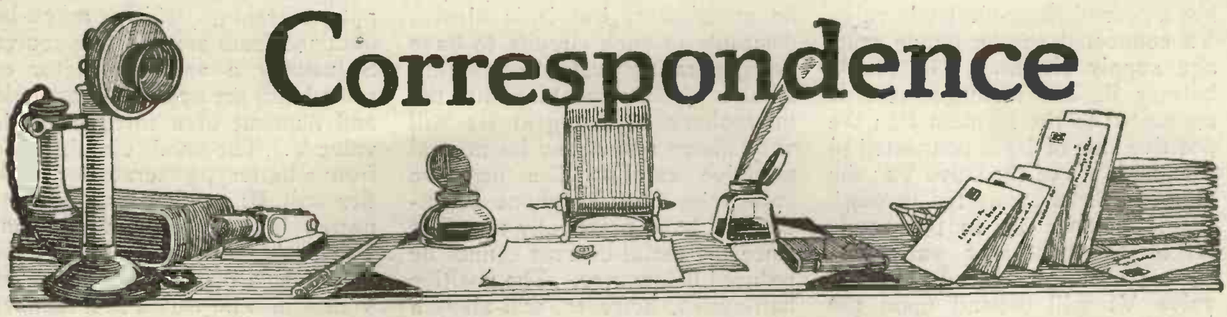
Oranges and Carrots as Grid Leaks

SIR,—I tried the experiment described by "Old Chap" in your issue of *Wireless Weekly* for April 23, and got it to work exceedingly well. I tried with an orange touching a carrot—one pin was stuck in the orange and the other in the carrot—on a one-valve set, home made. I received all B.B.C. stations except Glasgow and Aberdeen.—Yours faithfully,

B. U. A.

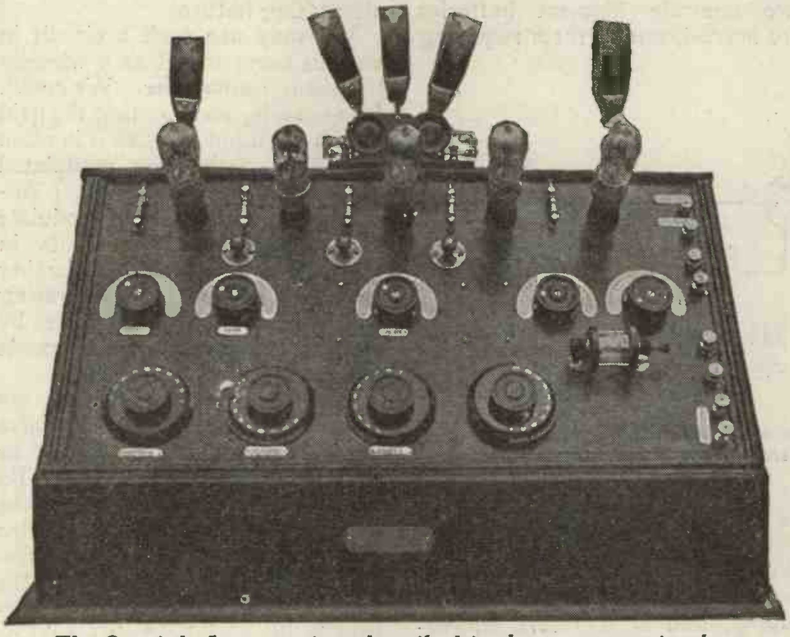
S. Loyes, Bedford.

Correspondence



AN "OMNI DE LUXE" RECEIVER

SIR,—I am taking the liberty of enclosing two photographs, back and front of my five-valve crystal set, built on the lines suggested by your excellent set appearing recently in *Modern Wireless*. Having departed somewhat from the original, I am unable to follow your key numbers, but to the real experimenter this is of little importance, as the theoretical diagrams are sufficient.



The Omni de Luxe receiver described in the accompanying letter.

When I wrote to you previously I had not long finished the set and had no opportunity of giving you many results obtained, but in the last fortnight I have tested out eleven different valve-circuits, including a three-valve reflex circuit, the ST100 circuit, a four-valve circuit by Mr. Oswald J. Rankin, and several other circuits illustrated in his book, "Pictorial Wireless Circuits." In every circuit adapted I have had no evil effects whatever from the crossing of various leads. The ST100 circuit brought in practically every broadcasting station, and Ecole Superior, as well as Eiffel Tower, the latter with changing coils. The three-valve reflex circuit brought in every broadcasting station and numerous Continental stations, with London and Glasgow, on loud-speaker strength.

The ST100 circuit was so remarkably good that since writing you last, three complete sets have been built by friends of mine who heard it on my Omni set, and in every case they have been highly satisfied.

My next circuit I hope to arrange to include all the valves, particulars of which I will send you later.

I have made one alteration since writing you, *i.e.*, I have taken the left-hand coil-holder away and introduced a two-way coil-holder in place of it.

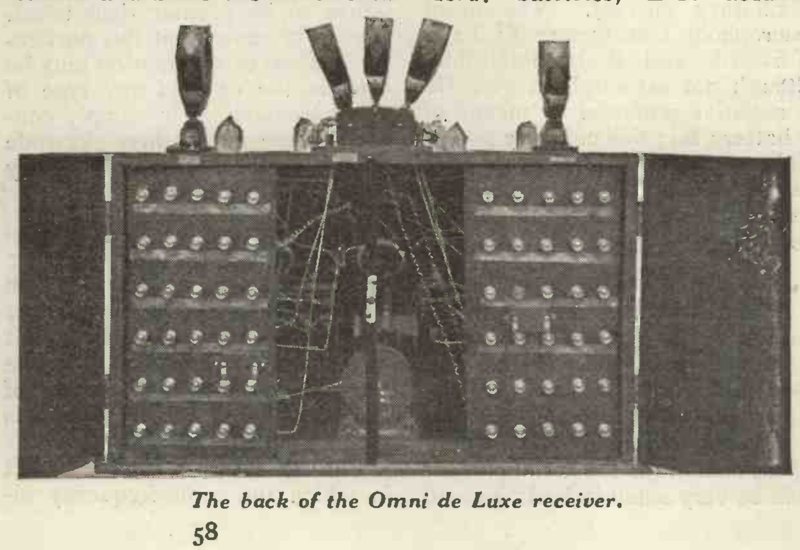
Any other particulars which may interest you I shall only be too happy to give.—I am, yours faithfully,

WILLIAM H. WILLIS.
Wolverhampton.

ELIMINATING THE H.T. BATTERY

SIR,—As the discarding of H.T. batteries appears to be an important advance, by some people, I should like to give your readers the benefit of one or two of my experiments.

I found it quite possible to work a one-valve set, without H.T. batteries, L.T. accumu-



The back of the Omni de Luxe receiver.

lators, gridleak or condenser, but using instead one pocket flash-lamp battery!! This last will perhaps sound like stretching a point too far, but with the following details and diagram of connections, any reader should be able to rig up this circuit in an evening and experiment for himself.

A variometer with a variable condenser of .0005 capacity in series, was used for tuning. This variometer is perhaps unique in construction. The design, I may state, was given to me by a friend.

The former is of strawboard, 5 in. long, 3 in. diameter, and has 64 turns of 28 S.W.G., s.c.c. wire (32 turns at each end of the tube). A rotor is placed inside one end of the tube, and has 40 turns of 28 S.W.G., s.c.c. wire. This rotor winding must be connected in series with the outer winding. The complete instrument now forms the aerial tuning inductance.

At the other end of the tube another rotor is fitted, which has 64 turns of 32 s.w.g. enamel wire. This rotor is to be used for reaction, and its winding must not be connected to the tuning coil in any way, but well insulated from it at all points.

The whole of the power to be used for the lighting of the valve and for the H.T. is drawn from a pocket flash-lamp dry battery.

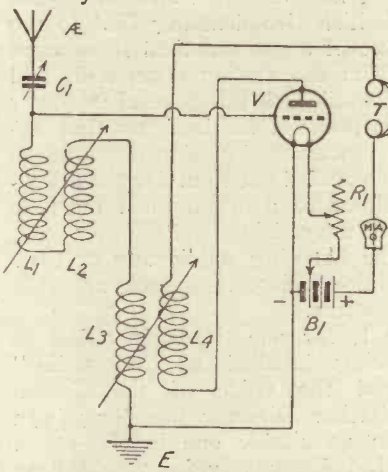


Fig. 1.—The full connections.

A good make of cell should be chosen, usually about 4.5 volts, and the pitch removed from the top to expose the three small cells and the wires connecting each.

A wire should be soldered to the negative pole (zinc) of the first cell and another wire to the positive (centre carbon) of the same cell. These two leads will give about 1.5 volts, and are to light the valve. A connection must also be taken from the positive of the third cell to supply the telephone and plate circuit. This will now give us a dry battery having three leads. Care, of course, must be taken to prevent the leads from touching each other.

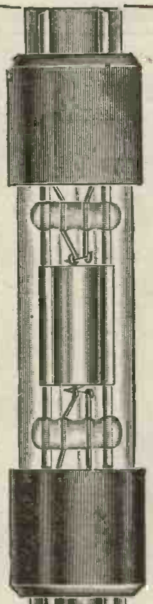
The valve used was an Ediswan dull emitter, and one of the latest type, consuming .06 amp., is the best to use.

Full connections are shown in Fig. 1. It was found that with the closest reaction howling was impossible.

It will be seen that no gridleak or condenser is used, it being found that with either fixed or variable gridleaks, signals were reduced anything from fifty per cent. to total extinction.

The milli-ammeter shown in the diagram was used solely for experimental work and, of course, is not necessary for reception of signals.

If greater signal strength is required, an extra dry cell can



Exact Size.

EXPEL VALVE DISTORTION

As one of the primary causes of distortion the valve frequently escapes censure. The responsibility of the valve for the greater part of distorted speech and music is readily recognised when proved by an actual demonstration of the distortionless MYERS valve.

That the filament of a valve will light is not all the care and deliberation of choice that should accompany your purchase. Take note of its construction—internal and external—and look for points of correct design, for correctness of design makes an astonishing and incredulous difference to reception.

The proximity of leads and the resultant capacity between them is the secret whereby the MYERS valve expels distortion from the valve. *The method of construction brings the lead from the grid out at the opposite end to that of the plate.* By this method of construction there are no bunched leads as in some valves to cause capacity effects—the direct origin of valve distortion.

In addition to their remarkable distortionless reception, the MYERS valve will produce louder signals. **Under favourable conditions it is possible to obtain a strength of signal with the MYERS which enables the saving of one valve! Lastly they are**

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Mounting Clips and drilling template supplied free with each valve, which is safely packed in special carton.

Insist on receiving the Myers at your dealers. If he is out of stock do not be disappointed, but send purchase price and be supplied post free.

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MANCHESTER - R. DAVIES & SONS, Victoria Bolt and Nut Works, Bilberry Street, Manchester.
NEWCASTLE - GORDON BAILEY & CO., Consett Chambers, Pilgrim Street, Newcastle.
LIVERPOOL - APEX ELECTRICAL SUPPLY CO., 59, Oldhall Street, Liverpool.
GLASGOW - MILLIGAN'S WIRELESS CO., 23-25, Renfrew Street, Glasgow.

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be put in circuit in place of the milliammeter, the positive pole being connected to the telephones. As the adding of this cell is equivalent to adding H.T. it was discouraged.

The value of the current used to work the 'phones (8,000 ohms), the plate circuit and the reaction, as shown by the milliammeter, was .05 milliamps. or .00005 amps., equal to about one six-thousandth part of the current necessary to light a pocket lamp bulb!! Yet this small current reproduces all the 2LO concerts, and the Savoy Bands, at comfortable strength.

No experiments were carried out to improve this circuit, though one attempt was made.
—Yours truly,

R. K. LLOYD.

London, S.W.

THE CARDIFF ANNOUNCER

SIR,—I had written a letter to you commending your excellent comments upon the Cardiff Station's methods and giving my views upon the unmannerly document you published over the signature "Comradio."

As I have now had the great pleasure and satisfaction of reading Mr. Wright's masterly statement of the case in your current issue, may I write a few lines to back him up in what he says?

I have objected already (to the British Broadcasting Co.) to the use of ungrammatical slang used from the station concerned, and I would ask the general manager to make it his business that announcers and station directors be instructed not to utilise the microphone as a propaganda machine for advertising and foisting upon the listening public any of their crazy whims of speech or other matters.

I, for one strongly object to being labelled a "comradio," and the voice of the Cardiff Station Director has long been an unsuitable one in the ether. Had I my way he would have been restrained months ago.

We have our English language and we do not require slang merchants from Cardiff, or any other station, thrusting their ideas down our throats.

I believe the person in question has now been taken on by 2LO, where I trust Mr. Reith will keep a heavy hand upon him.—Yours, etc.,

R. D. S. H. KENT.

P.S.—Stand to your guns as the leading English wireless editor.

[Unusually strong feelings have been aroused, and this and other letters have been heavily censored before publication. The new voice heard sometimes now at 2LO is being listened to with very mixed feelings. Already the introduction of the "familiar" method to 2LO—experienced, for example, in a subdued degree on St. George's night—has caused no small concern. Quite apart from the method of treating the lectures and music as "interludes" between the announcer's own "programme," the voice of this particular gentleman is quite unsuited, in our opinion, for the microphone. It is tremulous and suggestive (quite wrongly) of feeble age. No amount of literary versatility combined with familiar chats with members of the orchestra and other youthful sprightliness can disguise a voice undesirable in a lecturer but impossible in an announcer.—ED.]

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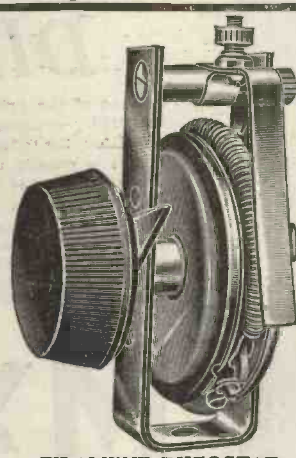

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Apparatus we have tested

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

"Galenel" Crystal

From N. Heywood come samples of the "Galenel" crystal, of the synthetic galena type. This is a coarsely-crystalline material. On test it showed a most satisfactory degree of sensitiveness, the good spots being extremely numerous. In reception good signal strength resulted in quantitative test comparing favourably with the customary standard for galenas. A fresh surface could be obtained by breaking open the crystal, which showed as satisfactory results.

Permion Detector

Messrs. Western Union Wireless Co. have submitted for test one of their "Permion" detectors, a substitute for the ordinary crystal detector, with permanent setting.

This takes the form of a small case, 2½ in. by 1½ in. by 1¼ in. high, with insulating top panel carrying two terminals; it is to be connected up as an ordinary crystal detector.

In this case, imbedded in a mass of plasticine and paraffin wax, is a galena cat's-whisker detector of ordinary type, but with the fine cat's-whisker permanently set by means of wax in a favourable "spot," so that the most severe mechanical vibration will not disturb it and spoil the setting. The galena, on test, proved to be of a sensitive variety, with many other available spots.

On practical test on 2LO's transmission the whole rectified wave gave 5 microamperes, as against 8 microamperes on that particular transmission at the moment with an excellent galena crystal set carefully by hand to give the optimum results—or about 63 per cent. of the available signal strength. Aural observation confirmed this result; and it was noticeable how convenient the fixed setting was in practice. Obviously the efficiency of the device depends on the quality of the first setting; and will survive only as long as that particular point or set of points continues effective.

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Where FALLON products are used there are no failures.

This is our NEW MODEL All Condenser—right up to FALLON standard and will appeal to thousands of constructors who prefer the following points which are included in same:

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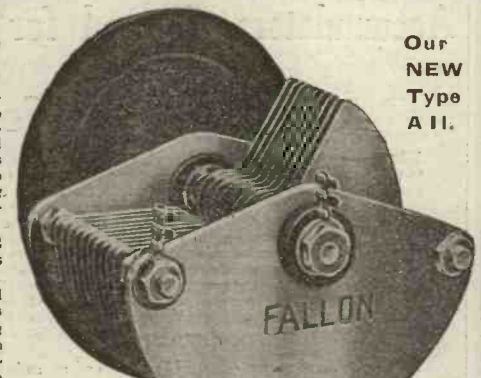
The Best and nothing but the best British material and workmanship are put into this New Fallon Condenser. Metal to Metal adjustable bearings.



Our NEW Type A II.

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.001	.. 57 Plates	Price	8/-	.00025	.. 15 Plates.	Price	5/-
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For those who prefer it, we still supply our well-known AII model, which is exactly the same as above, except that instead of having Aluminium ends, it has composition ends and is supplied with our special feature, the Aluminium Screening Disc, which Disc is also supplied with the model above illustrated. We have the courage of our convictions. We put our name "FALLON" on every Condenser we manufacture.

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The "DUANODE" CONDENSER
For tuning simultaneously 2 stages of H.F. amplification.

was the first popularly priced Twin Condenser placed on the market. There are many imitators but there are no superiors. Amateurs now receive America every night in the week with the "Duanode." In a recent article in "Modern Wireless" on the subject, Mr. Percy Harris gave very favourable reference to the "Duanode."

The "Duanode" consists of two matched condensers operated by one knob, thus by using matched COILS it is possible to tune BOTH circuits perfectly with one operation only. This Condenser can be used for other purposes. The two halves (each of .00025 mfd.) can be used in series or parallel, giving capacities of .000125, .00025 and .0005 .. .. **Price 17/6**

FIXED CONDENSERS

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For those who find difficulties in the daily setting of the crystal, this neat device will have some appeal.

Insulating Bushes for Board-Mounting

Insulating bushes for mounting radio apparatus on wooden panels, of No. 4 B.A. and No. 2 B.A. sizes have been sent us for inspection by Messrs. Leigh Bros.

These are discs of black composition, of ¾ in. diameter, with a shoulder and a lower portion ½ in. diameter to fit into a hole of that size in the panel. The thickness is ¼ in. A No. 4 B.A. and 2 B.A. clearing hole respectively are provided in the centre.

On trial, the insulation resistance proved to be satisfactory in a severe test with the "Meg" tester, and the bushes took terminals and screws of the corresponding sizes with the proper degree of fit.

"Belradio" Adaptor

Messrs. John Maclennan & Co. have submitted for inspection a simple little device by means of which town dwellers in the immediate neighbourhood of a broadcast station may utilise the "casual aerial" effect of the wiring of an electric bell system in a house, which can, it is well known, act as an aerial for powerful transmission at such short range, especially when valves are used.

This, the "Belradio" adaptor, consists of a push-button of the standard size common in house bell pushes, carrying a terminal to which the radio receiver aerial terminal can be connected. Contact is made by a nut at the back to the spring in the bell-push fitting, thereby connecting the corresponding bell wire to the set. Provided that the tuning range of the receiver is adequate to meet the new conditions—often a small series condenser would be advisable—good results should be obtained at a few miles in this way, though, of course, not comparable with those given by a good outside aerial.

A Two-Coil Holder with Fine Adjustment

A neat form of two-coil holder which allows of fine adjustment of coupling, and at the same time enables the coupling to be diminished to zero and reversed when needed without using a switch, is that submitted by Messrs. Leigh Bros.

In this device both coils can move; but while the one coil can be advanced or retired on a slide by means of a rack-and-pinion motion, the other coil simply rotates on its course on a vertical axis, a small handle being provided to control this.

On actual trial in reception satisfactory control over reaction-coupling was observed, and the mechanism worked well, without shake or back-lash. It was noticed that the small handle on the rotating holder was insecurely fastened; and it might with considerable advantage be made much longer to avoid hand-capacity effects when fine-tuning. The very small terminal screws, fitted in inaccessible places, where also the connecting wires showed a tendency to become entangled and to pull loose in use, might well be substituted by larger and more convenient terminals for experimental work.

The insulation when tested with the "Meg" proved unexceptionable; the workmanship being all that could be desired.

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PATENT TELEPHONE EXTENSION FLEX, 12 ft. long.
A speciality for the summer. Fitted with plug and sockets, to join up to the ordinary telephone flex, enables listeners-in to sit at any distance from their receiving sets, even out in their gardens if they like.
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CRYSTAL AMPLIFYING AND CLEANING POWDER.
A marvellous discovery to greatly increase sensitivity of crystals. Acts like an amplifier. **All Retailers, 1/-, or P.O. 1/2.**

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Testimonials say: "I consider your 'Special' Crystal and Multi-pointed Catwhisker a spendid combination. I get marvellous results."
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TELEPHONE STAND.
For hanging up headphones when not in use. Made with coloured mahogany wood base, and having an upright with four arms to receive any number of phones. Made of a new substance resembling red ivory. Base can be detached and upright screwed into set if desired. No capacity effects. A useful and ornamental adjunct to a Receiving Set.
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All above specialities and Patents are "Willesford" and only "Willesford's" have the right to make them, so BEWARE OF INFRINGEMENTS. Ask for :: WILLESFORD'S, and see that you get 'em. ::

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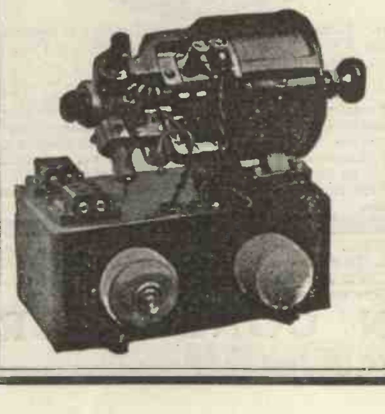
All machines are guaranteed for 12 months and we undertake to make good all defects clearly traceable to faulty manufacture or workmanship, provided such goods are returned to our works, carriage paid.



Send to-day for details of our home accumulator charging apparatus, general wireless accessories and the new valve which we shall shortly place upon the market.

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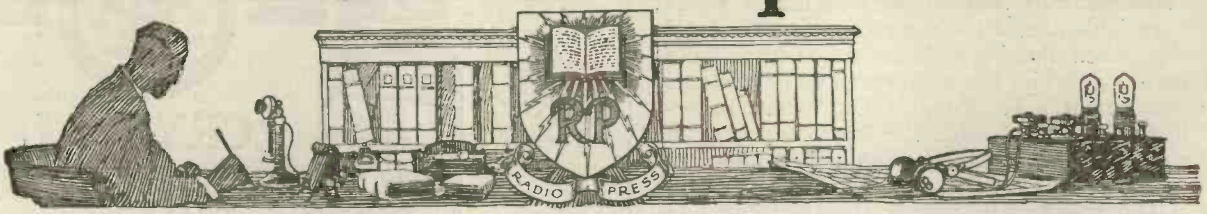
Information Department



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

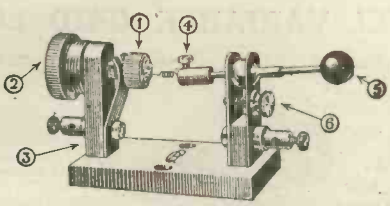
L. T. N. (LEICESTER) asks which is the best kind of flux to use with the ordinary soft solder recommended for wireless work.

It is most important that a non-corrosive flux be employed, and therefore the constructor should on no account use what is known as " killed spirit." Resin is quite safe, but is not very easy for the amateur to use, and probably the best expedient is to use one of the better-known proprietory articles, such as Fluxite.

The objection to the corrosive type of flux is that it is very difficult to make certain that one has wiped it all off when the work is finished, and if a trace is left upon a fine wire joint the wire is very speedily eaten away and a fault develops in the finished instrument.

D. B. Y. (GLOUCESTER) states that he has heard it said that the minimum value of a variable condenser can be reduced by means of an auxiliary fixed condenser connected into the same circuit, and asks for an explanation.

This can certainly be done by inserting a fixed condenser of suitable value in series with the variable one. The resultant total capacity in series will be always somewhat less than that of



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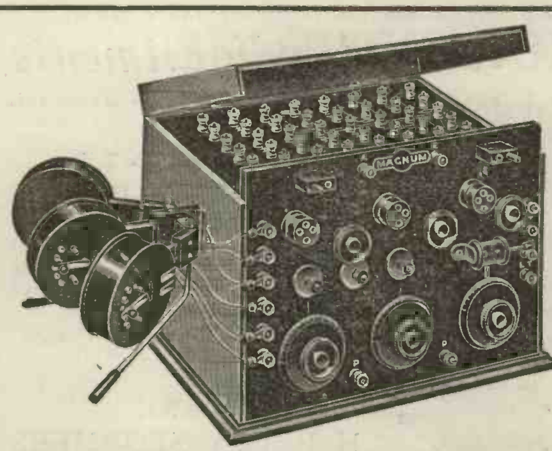

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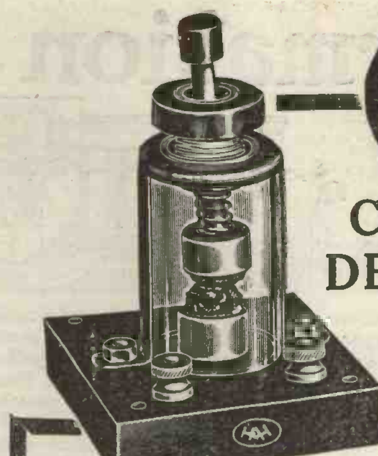
either of the two condensers, and thus it can be seen that the minimum value will be reduced considerably as will also the maximum. Thus, if a fixed condenser of .001 μF be inserted in series with a variable one of the same capacity, the total capacity when the variable is set at maximum will be .0005, while the minimum will be reduced to some extent. To obtain the greatest reduction in the minimum value the fixed condenser in series should be relatively small, but this, of course, will also limit the maximum value obtainable. The rule which governs the total capacity in series may be remembered from the relation that the reciprocal of the resultant capacity is equal to the sum of the reciprocals of the individual capacities.

T.J.R. (BOSCOMBE) asks if it is possible to receive continuous waves with a Crystal Set?

If the signals are transmitted with pure continuous waves it is not possible without some outside aid, such as the carrier wave of a broadcasting station. In many cases C.W. signals can be heard at short distances as a result of the fact that the waves carry a ripple of audible frequency which proceeds from the use of rectified alternating current for the H.T. supply of the transmitting valves. To enable C.W. to be properly received on a crystal, it is necessary to use either an oscillating valve circuit acting as a local heterodyne, or else some form of interruptor to break the waves up into groups of audible frequency.



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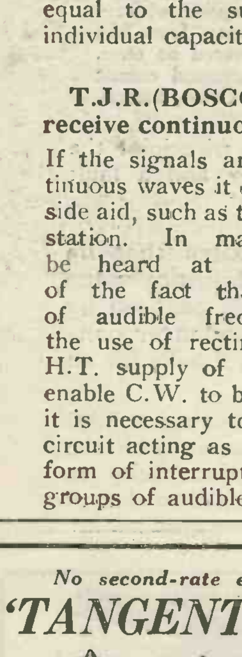

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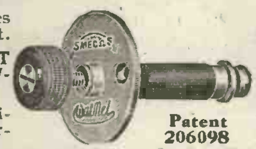

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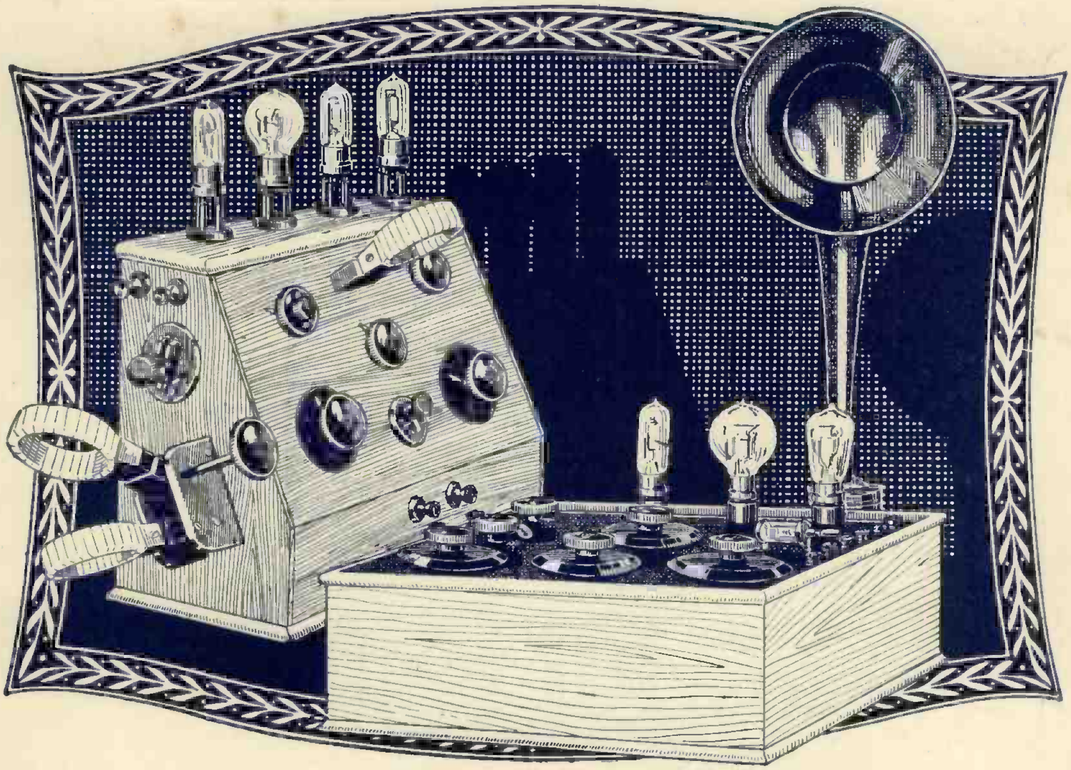

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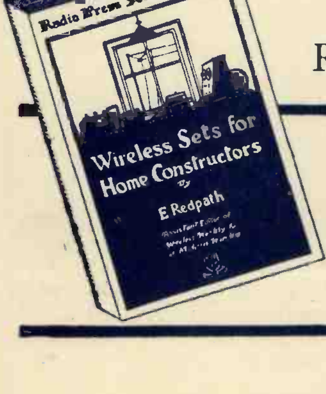

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Wireless Weekly

and the Wireless Constructor.

Vol. 4.
No. 3.

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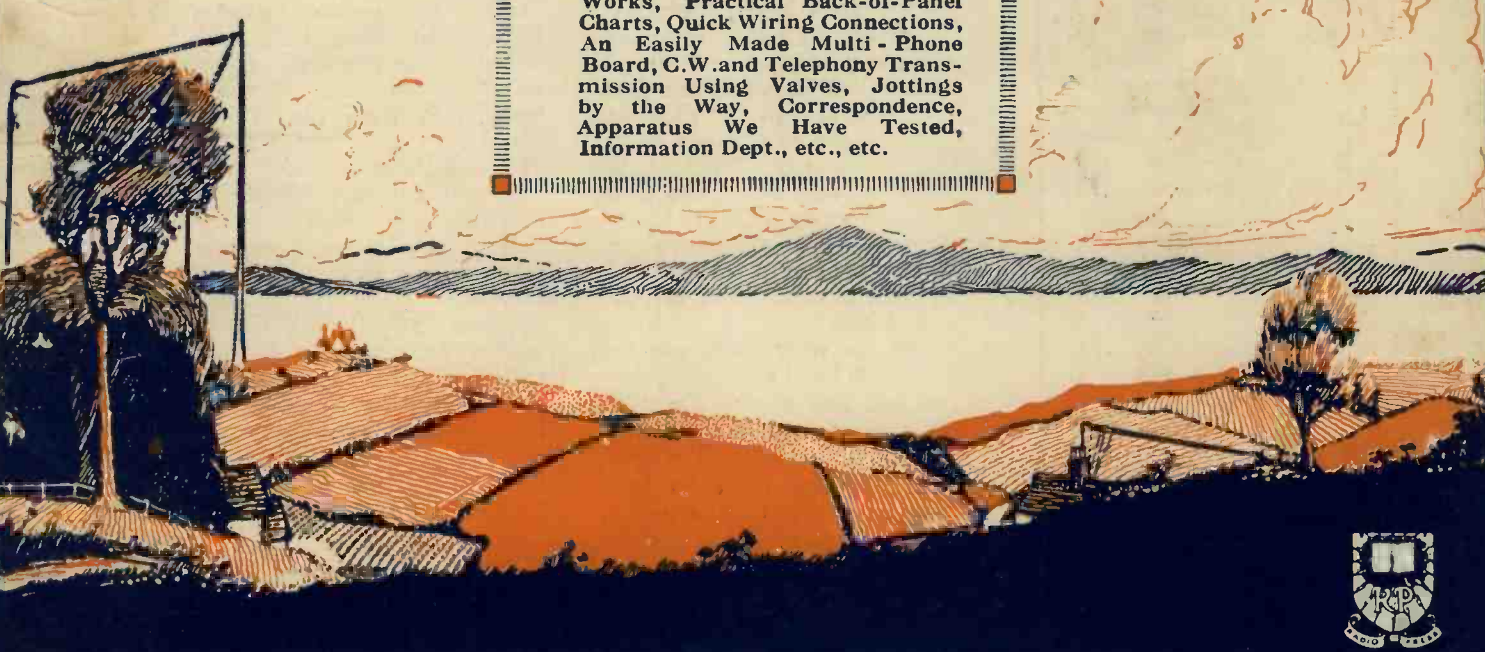

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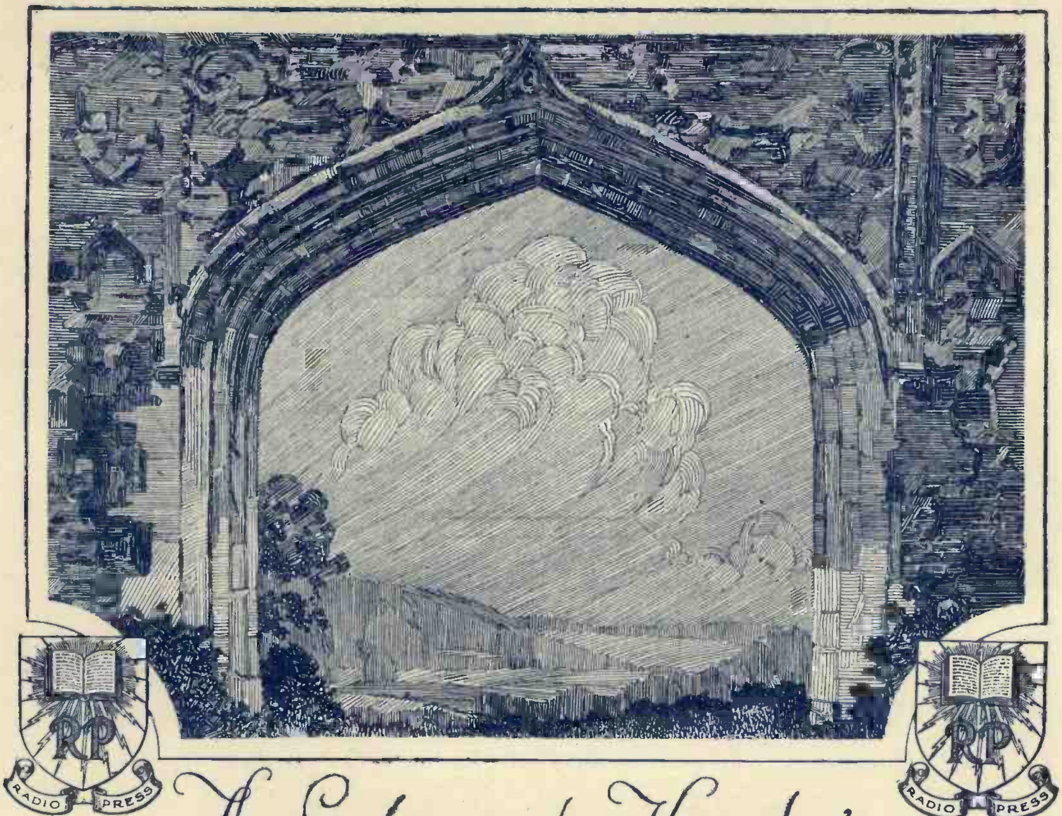
And How to Make It



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Wireless Weekly

Vol. 4, No. 3
May 21, 1924.

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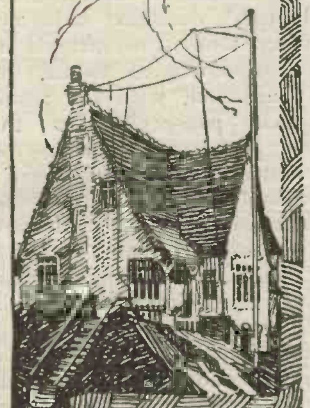

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All correspondence relating to contributions is to be addressed to the Editor of "Wireless Weekly."

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Broadcasting Publicity

As a nation we are very prone to take things as they are, assuming that everyone else thinks as we do, and can see advantages or disadvantages which appear obvious to us. The lack of publicity of the Wembley Exhibition in foreign countries has often been commented upon. Is not the British Broadcasting Company taking a somewhat similar attitude with regard to the whole art of broadcasting?

Is there not a danger of assuming that everyone is now fully acquainted with the advantages of possessing a broadcast receiver? Careful enquiries amongst those who do not yet indulge in wireless listening reveal the fact that the majority have quite erroneous ideas on the subject. Even the style and quality of the programmes are little understood. and the policy of issuing them in detail only in the *Radio Times* is not likely to attract new recruits, as obviously this journal is purchased only by those who already have sets. Almost invariably the new purchaser expresses delight in the quality of the programmes, and states that he had no idea they were so good. The British Broadcasting Company would do well to issue display advertisements in the general Press, the various items in the programmes being set out not in the present unimaginative way, but in an attractive fashion just as would be done with any other especially good concert it was desired to advertise.

Of recent years the use of co-operative advertising has grown. Take, for example, the admirable publicity conducted by the British Commercial Gas Association—a combine of all of the gas companies throughout the country for advertising purposes only. The delightfully homely pictures showing how gas fires may be used, the well-drawn illustrations of bathrooms fitted with gas geysers, and many other examples will occur immediately to the reader. Numerous excellent wireless sets are available on the market. A few of the larger firms are issuing good advertisements which tend to popularise wireless as distinct from individual sets. It is surely the function of the British Broadcasting Company, whose surplus funds are bound to be used for the good of the art rather than for the profit of the individual members, to acquaint the public by the aid of the best artists and the most powerful advertising media with such benefits as accrue to the user.

We have strongly advocated the extensive use of publicity by the B.B.C. in the past, and for a short span of time they did a little advertising in the general Press.

For some reason or another, however, this policy was only adopted in a half-hearted manner, and not carried out to any helpful degree.

It is upon the activities of the British Broadcasting Company that a great and growing industry in this country depends, and if the company can help listeners, the industry, and also themselves at the same time, they should surely do so. They appear already to have admitted that some such policy is desirable, and it is simply a question whether they propose to carry out the policy properly or not. Looking at the matter purely as a question of profit to the B.B.C., there is no doubt whatever that the publication of advertisements in the newspapers would result in a very large increase in the number of listeners, and the resulting increase in licence fees would show the B.B.C. a very handsome profit on their advertising expenditure. Even if the increased licence revenue only just covered the cost of the advertisements, the British wireless industry, employing tens of thousands of British workpeople. would be greatly assisted, with the result of added prosperity to the country.

As matters stand, it is purely by personal recommendation that newcomers join the fold. If trading corporations relied on the same method of extending their business, development would become very slow. and there is no reason why the B.B.C. should not be up-to-date in their methods of increasing their clientele. Good programmes and wide publicity should be their slogan. What wide publicity and a good article has done for innumerable trading concerns can be achieved by similar methods by the B.B.C.

With the erection of new stations. the present time is an ideal one to launch on a scheme of this nature.

IMPORTANT ANNOUNCEMENT

Readers of WIRELESS WEEKLY will no doubt be greatly interested to hear that Mr. Cowper, whose work on high-tensionless receivers is already known, has produced a new and highly-efficient single valve high-tensionless circuit using an ORDINARY valve. This circuit is unlike any yet published, and is particularly effective. Full details will be given next week.

French Double-Grid Valve Circuits

Some particulars regarding French Wireless Receiving Circuits in which the high-tension battery is reduced to a few volts or eliminated altogether.

THE general interest in so-called high-tensionless receivers, which are really receivers in which the filament accumulator supplies the high-tension voltage, makes appropriate the publication of some particulars regarding French circuits which have appeared in a catalogue issued by the firm called La Radiotechnique.

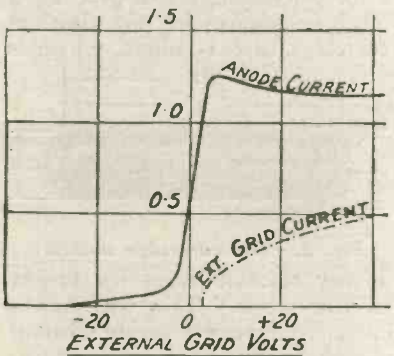


Fig. 1.—Characteristic curve of a double-grid valve.

In both Holland and France it has been usual to employ double-grid valves with the second inner grid connected to the positive terminal of the filament accumulator, or to the positive terminal of a very small high-tension battery of 2 or 3 volts, for the purpose of neutralising the space-charge in the valve and so enabling the voltage on the anode necessary for effective working to be very much smaller. The voltage, in fact, may simply be the voltage of the filament accumulator.

The valves do not seem to have had a sale in this country, due, no doubt, to the fact that they have not been advertised, and to the fact that British manufacturers have not produced any equivalent.

Fig. 1 shows the characteristic curve of such a valve, the anode voltage being about 8 volts. The grid potential shown along the horizontal axis is the E.M.F. applied to the external grid, *i.e.*, the one furthest away from the filament. The other grid is maintained at the same potential as the anode. The vertical axis represents milliamperes, and it will be seen that quite a substantial current is flowing in the anode circuit even with a low anode voltage. The grid current curve shows the currents flowing in the external grid circuit as the external grid is made more positive. There is, of course, also a current flowing to the inner grid, and in some circuits this current is utilised, whereas in others no advantage is taken of it, the grid simply acting, as in the Dowding-Rogers circuit and the circuits we ourselves have published, as a means of reducing the space-charge in a valve.

Fig. 2 shows the valve in use as a low-frequency amplifier, the inner grid, as well as the anode, being given a positive potential. The two batteries B1 and B2 may be compounded in the form of a filament accumulator of, say, 6 volts, and a rheostat connected in the positive lead to the filament.

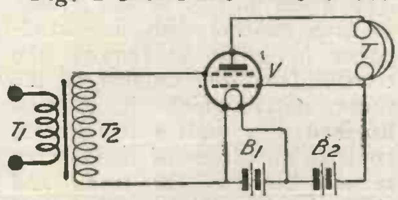


Fig. 2.—A double-grid valve used as a low-frequency amplifier.

Another interesting circuit is that illustrated in Fig. 3. We have now got a valve in which both grids actually take part in the operation of the circuit, apart from merely lessening the space-charge in the valve. The inner grid, this time, which is given a positive potential of small magnitude, introduces the high-frequency current; the external grid now acts as the anode for the purpose of introducing reaction into the circuit L2 C2, and also to act as the main anode circuit in which the telephones T are included. We should, ourselves, recommend the connecting of a condenser of about 0.002 μF capacity across the telephones T, but this is not specified in the catalogue. The plate proper of the valve is simply connected to one side of the battery B2, and acts in the same way as the inner grid of Fig. 2—that is to say, it lessens the space-charge effect in the valve. Although it is further away from the filament than the external grid, its large surface has a considerable space-charge reducing effect.

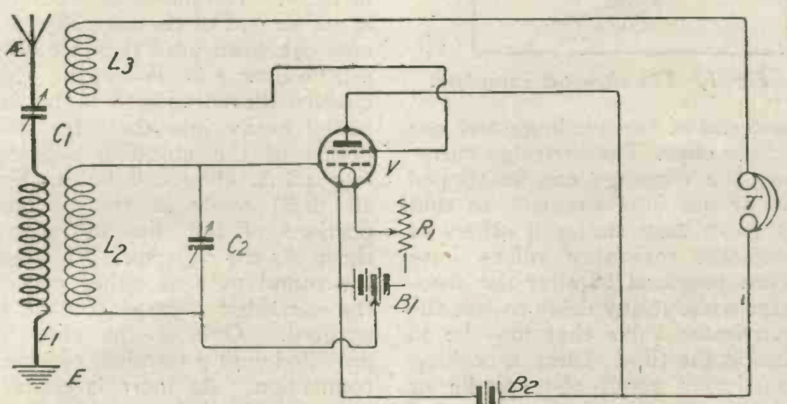


Fig. 3.—A double-grid valve arranged in such a manner that both grids take active part in the operation of the circuit, in addition to lessening the space charge.

A Rheostat with Interchangeable Cartridge Coils

THE widely-different requirements of the various kinds of dull and bright emitter valves now upon the market make things rather difficult for the man who wishes to be able to use any type at will upon the set. The standard 4- or 5-ohm rheostat is of no use at all for dull emitters of the "06" type, and it is not possible to use only a small portion of a 50-ohm rheostat for controlling bright emitters, since the fine wire of the windings will not carry the necessary current. Further, a rheostat with a high resistance per turn, even if it can carry the current, is not a good thing to work with when one is using bright emitters, since it does not allow the filament potential to be adjusted finely. Extra resistances in series with the main rheostat have their points, but they take up a good deal of room upon the set.

A very neat little device can be made by the adoption of the "cartridge" principle for the formers of the windings. Fig. 1 gives a general view of the device as seen from below. It will be noticed that the contact arm moves over the surface of a cylinder wound with resistance wire which is held between two clips. Contact is made between

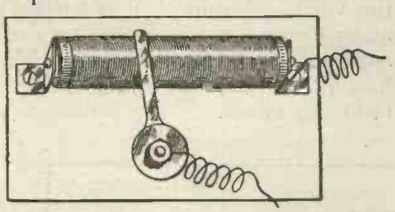


Fig. 1.—The rheostat complete.

one end of the windings and one of the clips. The cartridge carrying the windings can be slipped in or out in a moment, so that it is an easy matter if others of different resistance values have been prepared to alter the rheostat without any delay to suit the particular valve that may be in use at the time. There is nothing particular about the spindle or the contact arm; in fact, those of a discarded rheostat of ordinary pattern can be adapted, as a rule, without difficulty. The arm should, however, be filed until it is rather narrow, so that it shall not make contact with many turns at a time.

The cartridges (Fig. 2) are wound upon $2\frac{1}{4}$-in. lengths of ebonite rod, $\frac{1}{2}$ in. in diameter, in either end of which a 4B.A. tapped hole has been made. A short length of studding is inserted into each of these holes and a small round nut is screwed down upon it. Enamelled wire is used for the windings. The first process is to bare the end of the wire and to solder it to the round nut mentioned. It is then taken through a hacksaw cut in the edge of the rod, and the windings begin $\frac{1}{8}$ in. from the end. It is carried on until it is within $\frac{1}{8}$ in. of the other end, when it is taken through a second hacksaw cut and its far end is soldered to the round nut at the other end. After this, the windings are given a good coating of shellac or enamel which is allowed to dry hard. The whole surface of the bobbin is then rubbed with fine sandpaper in order to remove the enamel from the outside of the turns, after which it is well brushed over with a stiff brush, so that no pieces of metal may remain between the turns and short-circuit them. The two clips are made from springy sheet metal. They are mounted $2\frac{1}{2}$ in. apart upon the panel in such a position that the arm of the rheostat will travel over the surface of the cartridge when it is fixed in them. The pieces of studding at either end of the cartridge are now cut down until they are only a little over $\frac{1}{8}$ in. in length. This enables the cartridges to be inserted easily into the clips, the points of the studding slipping into 4B.A. clearance holes (No. 26 drill) made in the upright portions of the clips to receive them. As the clips spring against the round nuts at either end of the cartridge a good contact is ensured. One of the clips is provided with a terminal or other connection. As there is contact at both ends of the cartridge, and as the whole surface has been cleaned, it does not matter in the least how it is put into the clips.

So much for general description. We now come to the problem of working out the most suitable gauge of wire for our various interchangeable cartridges. Since the diameter of the ebonite rod is $\frac{1}{2}$ in. the length of wire required to make each turn will be approximately $1\frac{1}{2}$ in., that is to say, 24 turns will contain one yard of wire. No. 24 enamelled wire makes 40 turns to the inch; hence, 2 in. of windings will allow us 80 turns or $3\frac{1}{3}$ yards. As the resistance of Eureka wire of this gauge is approximately 1.9 ohms per yard, 2 in. of windings will give us a total resistance for the finished cartridge of 6.25 ohms, which is

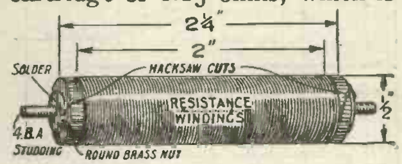


Fig. 2.—The cartridge details.

a very suitable value for bright emitter work. This wire has a current-carrying capacity without overheating of 1.5 amperes, so that a cartridge wound with No. 24 can be used for controlling even small power valves which take a good deal of current. Working in the same way, we find that No. 28 Eureka wire will give us a total resistance of 20 ohms, No. 30, 35 ohms, and No. 32, 50 ohms. A set of four cartridges wound with these wires will enable the rheostat to be used with any class of valve, from the smallest dull emitter to the power valve drawing a comparatively heavy current.

R. W. H.

OTHER LIGHTNING STORIES

We are given to understand that during a thunderstorm which passed over Buntingford (Herts) recently, a boy named Robert Wallingham, who was listening on his crystal set, had the unpleasant experience of being hurled across the room as a result of a particularly bright lightning flash. A tablecloth and newspaper were set on fire, whilst the set after trial was found to be useless.

At Little Court, a valve receiver was also destroyed as a result of lightning striking the tree to which the aerial of the set was anchored.

I WAS vastly interested in a note from a correspondent which appeared recently in *Wireless Weekly* upon the subject of vegetable gridleaks. My friend Professor Goop, after whose name appear most of the letters of the alphabet arranged in various ways, has, as a matter of fact, been engaged upon the subject for many months. He hopes before long to give to the world in book form the results of his experiments in the direction of what he terms radio botany.

Radio Botany

But he is going far beyond a simple gridleak. Though I must not give away prematurely his closely guarded secrets, I think I can tell you that the professor's latest receiver would fairly astonish you if you could see it. After an extensive inquiry into the inductance value of the common runner bean, the professor has been able to grow a beautiful set of coils covering all wavelengths. By means of a very special fertiliser he is able to tune without the use of any condenser. He decreases the wavelength merely by using a pair of scissors, whilst if he desires to soar to greater heights the application of his fertiliser from a watering pot makes his coils grow like mad with a consequent satisfactory increase in the microhenries.

Acacia Leaf Rheostats

There is, too, his automatic self-regulating acacia leaf rheostat which solves all the problems of the beginner at valve work. By properly educating his leaves, the professor is able to train them to carry without wincing precisely the right amount of current. Should an overload come along the leaf at once curls up, offering enormous resistance, and remains in this condition until the battery has decided to behave itself. The catwhisker, he assures me, will very soon become a thing of the past, for it will be succeeded by his new pea-tendril contact, which, in conjunction with a rectifying parsnip, performs all the duties of a detector. The professor's work would have been made public some time ago but for a rather unfortunate mishap. His little radio garden, as he calls it, had been performing excellently until a spell of warm weather caused his inductances and other parts of the set to burst into blossom. The resulting fragrance attracted large numbers of bees of every kind, and the professor was very badly stung upon the nose and hands whilst he was investigating a short circuit, which was eventually traced to the presence of a caterpillar in the second high frequency rheostat. However, I expect that before long you will know all about it, for Professor Goop is smiling through his bandages, and there is a hopeful twinkle in the one eye which is still open.

Going through it

I had a terrible time at Easter, for I had been rash enough to make a set as a present for some friends, and during the holiday I took it down and handed it over. I need hardly say that before doing so I had given the thing a thorough trial at my own house for a fortnight, and it worked perfectly. There was, therefore, every reason in theory why it should do just as well when it reached its destination. But if you know anything of wireless, as no doubt you do, you will realise that I was simply asking for it. And so you can picture the scene on the first evening vividly. There was I struggling with wires, and pliers, and batteries, and milliammeters, and things. There were my host and hostess striving politely to repress their smiles. And there was their small son asking every thirty seconds, " When are we going to hear some wireless? "

An Obliging Friend

I am fond of children, and I like that child in the ordinary way, but just then I had no affection for him whatever. What happened was this. These people, having no aerial, had been round and borrowed a frame from a man who they thought was their friend. I hitched the thing up; I switched on, and, like George Robey, I stopped, and I looked, and I listened. I tuned first carefully and then with growing frenzy. Not a syllable, not a note, not a dot, not a dash from the set, but plenty of unuttered things far worse than dashes from me. One cannot talk properly to a recalcitrant set in the presence of women and children.

A Thing of Beauty

That is the time when strong men should be left alone. When I had thoroughly examined the set, which meant disembowelling it and pushing it together again twice, when I had littered the floor with bits of wire, blobs of solder, B.A. nuts and salt tears, it suddenly occurred to me to have a look at that frame. Outwardly it was a beautiful thing, swinging at the slightest touch in any direction upon ball bearings or something equally ambitious. There were lots of silver plating about it, and its double silk-covered wires were tightly stretched and spaced to perfection. Seldom, in fact, has it fallen to my lot to behold anything more beautiful in the way of frames. But, remembering that beauty is only skin deep, I applied to its ends a flashlamp battery and a voltmeter, reading nought, nil, zero, nix. Was the battery run down? It was not. Was the frame dis? It was. Somewhere in its interior economy was a dear little arrangement of brushing contacts which permitted it to be rotated. Unfortunately one of the contacts did not brush, and there we were. A little later when a wire had been slung across the room all was well. Had the owner of the frame not been away I could have told him what I thought of him, but as it was I was denied even that satisfaction.

Getting Ready

The place to which I had taken my offering was, so they told me, almost untouched by wireless. As soon as I got that set working I realised that dozens of new receivers were being tried out. They were getting ready for the King's Speech, and to judge by the assortment of squeals and squeaks they were getting off their chests the local welkin was having a pretty rough introduction to wireless. I hope they managed to work it off before the great day; I was not there to hear. A curious thing was to see, as one walked about, the numbers of aerial wires that had been stretched in all sorts of queer places. In the little shop in the high street which dealt in wireless parts there was a queue clamouring for insulators, aerial wire, pulleys and all kinds of things. Such was the run that they were completely cleared out of every bit of wireless gear they had in stock.

That Nightingale

I am disgusted to hear that we are to have broadcast this summer the song of that vastly-overrated fowl, the nightingale. Time was when I, then a young man living in the far-distant north where the nightingale never sings, read my poets and longed to hear its full-throated notes. And then, having attained maturer years, I settled down for a time, after the strife of the Great War, in a village of the county known as Beechy Bucks. One of the main attractions of the place, so the house agent told me, was that there were nightingales. Entranced by the prospect I fell at once and seized upon the desirable residence which he had to offer me. As the summer drew on, my better half and I would walk into the woods of an evening in the hope of hearing that wonderful melody. And then, at length, the sweet singer came, and we listened enraptured to his song.

The Breaking Point

It would have been all right, so long as he had come alone, or at any rate, if there had only been a pair of them. But every blessed nightingale that ever was seemed to have pitched upon this as the one ideal spot for house building, and all night long they gurgled and trilled and jug-jug-jugged about their achievements of the daytime. For a little while we did not mind, and then we came to realise that of all the maddening noises ever invented there is absolutely nothing on this earth to beat the infernal din kicked up by a colony of nightingales. In the evening you could not read because of the noise that they made. Later, you retired to bed, you could not sleep. You get that wretched sound on the brain; until they depart later in the year to warmer climes you know no peace. If Captain Eckersley, or whoever it is, that is going to hunt nightingales with a microphone, wants to know where to find them, I shall be only too happy to tell him. He may even have my late house cheap, if he wants it, for I left the following spring for a spot that is less nightingale ridden.

Going One Better

If I was running that sort of show I would omit the nightingale altogether and would go in for something really interesting. I feel sure that you would be charmed if I could transmit you as I would the crooning cadences of the earth worm's love song or the plaintive cry of the young stag beetle that has lost its mamma. I would give you the battle song of the common whelk straight from the seashore—this, by the way, in case you did not know it, is the noisy noise that annoys an oyster most. You should even hear the wailing of the whale and the eerie shriek of the captured shrimp as a plaice snaffles him in his lair. These things, I am certain, would make broadcasting really interesting, and would provide just that stimulus that is required during the summer months.

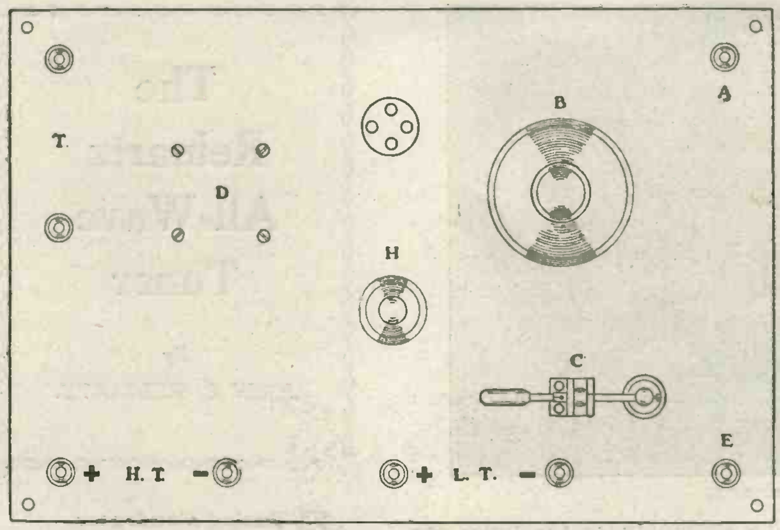
Those Little Improvements

I have just finished improving my set. It was working very well indeed, thank you, but the wiring of certain parts was rather of the rough-and-ready kind, also one of the condensers was not of the best. I spent a whole afternoon with soldering-iron and pliers making things as tidy as you like, and fitting a new condenser above reproach.

And now the wretched thing howls at me, a thing that it has never done before. It has lost its beautiful stability; it does all sorts of things that it has no right to. Take my tip, and if your reception is good let well alone.

WIRELESS WAYFARER.

The ingenious testing machine at the Brandes factory, referred to recently in "Random Technicalities."



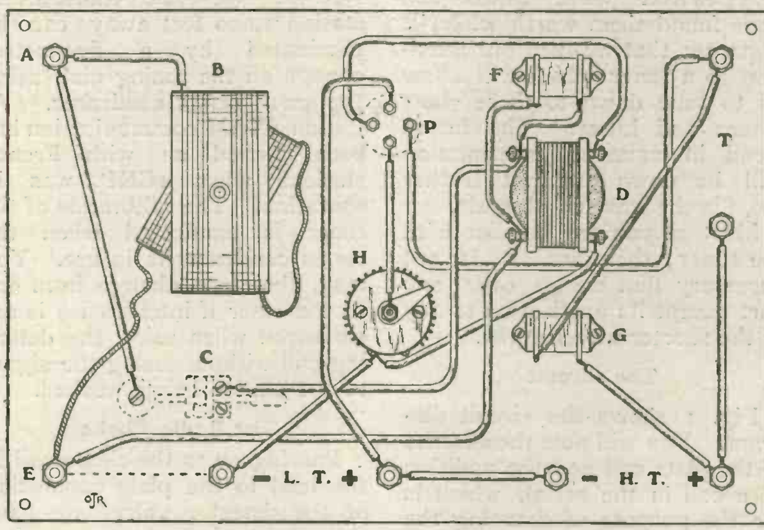
The lay-out of the panel.

Practical Back-of-Panel Charts

By
OSWALD J. RANKIN

Crystal Receiver with one stage of L.F. amplification.

A receiver similar to the one shown in Fig. 1, page 10, in the May 7 issue, with the addition of a note magnifier. P indicates the plate socket of the valve as in all other diagrams, B is the variometer, C the crystal detector, D the L.F. intervalve transformer, the primary side of which is shunted with a 0.001 μF fixed condenser F, G is the telephone condenser, and H the filament rheostat. It is sometimes necessary to earth the L.T. negative terminal, as shown by the dotted line. Reversal of the direction of flow of the current through the transformer windings should be tried.

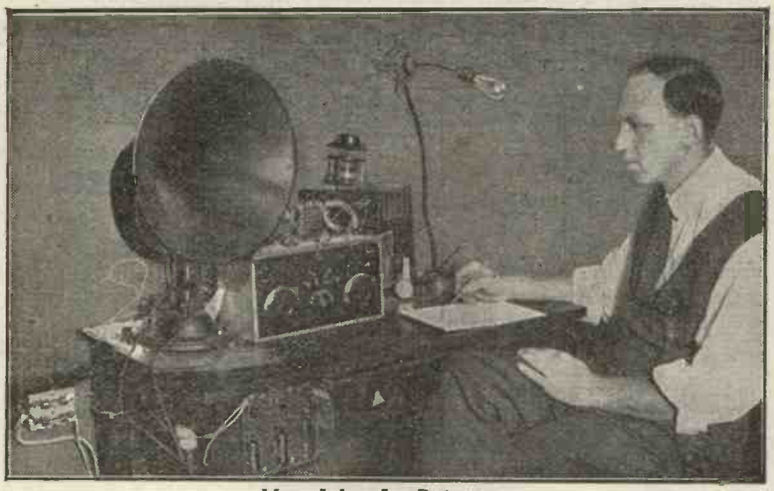


The wiring of the receiver.

Testing the High Tension Battery

IT is very important that the high-tension battery should be tested out from time to time, for it sometimes happens that one cell peters out and causes an enormous resistance which cuts down its potential to something quite small. It must be remembered that owing to the action of the depolariser with which they are provided all dry cells pick up considerably when they are given a rest. It is therefore of no value whatever to test out the high-tension battery *before* it is used on the set. If we do so we shall probably find that every cell of even a decrepit battery shows quite a respectable reading. The correct method is to work the battery under full load for a time and then to test it out with a small voltmeter. The battery will usually be tapped, so that the proper potential between sockets is 3, 4½ or 6 volts. Go over it carefully, and mark any pair of sockets between which the potential has dropped to 60 per cent. or less of what it should be. That is to say, if the battery is tapped at every three volts no pair of sockets that shows less than 2 should be passed. For 4½-volt tappings the minimum will be 3 volts and for 6-volt tappings 4 volts. Any pair of sockets which is not up to the mark should be short circuited by means of a piece of wire and a pair of valve pins. There is one small point about high tension batteries which may be worth mentioning. Some of them have their tops covered with pitch, which is a hygroscopic substance, though quite a good insulator when dry. The combination of moisture and dust which collects upon the pitch covering may allow leakages to take place between sockets, and so impair the efficiency of the battery. A good method of dealing with a battery of this kind is to brush over the surface with melted wax, a supply of which may be obtained from a worn-out high tension battery.

R. W. H.



Mr. John L. Reinartz.

The Reinartz All-Wave Tuner

By

JOHN L. REINARTZ.

NOW that we have become used to transmitting on the shorter wave bands and have found them worth while, it is proper that we turn our attention to a tuner which will allow us to tune down to these short waves and lower. The future trend in amateur transmission will be down and yet further down in the wavelength scale.

Most of you are familiar with the tuner; therefore, it is not necessary that we go over any part except its application to any of the shorter wavelengths.

The Circuit

Fig. 1 shows the circuit diagram. You will note the absence of the plate coil and the addition of a coil in the aerial, which is for the purpose of detuning the aerial circuit so that its effect on the tuning will be zero. Through this means the tuner can be calibrated before being connected to the aerial and its calibration will remain constant regardless of the size or type of aerial to which it may be connected. The greatest use of any tuner is not only to react to a signal, but also to be capable of calibration so that the signal may be found at a point corresponding to the calibration at the transmitter. A distinct advantage of this detuning coil is that it cuts receiver radiation to zero. This alone should bring it into favour.

The Aerial Coil

The aerial coil is connected to one point of a two-contact switch. The second point of the switch connects to a small fixed series condenser. This allows either the coil or condenser to be used. The selectivity of the tuner can be judged from the fact that a 1-K.W. 500-cycle transmitting station 1,000 feet away can be eliminated by a five-metres change on the tuning dial, using the small series condenser. At station 1XAM communication has been carried on with French stations when 1CKP was in operation. The calibration of the tuner is unaffected when the series condenser is in use. You may, therefore, change from one to the other if interference is experienced when using the detuning coil without losing the signal of the station being worked.

The Radio Choke

Passing on to the choke coil in the lead to the plate connection of the detector valve, we have come to an important necessity. This choke is to prevent any radio frequency current from traversing that circuit which is part of the audio frequency connection and is there for the same reason that you place a radio frequency choke coil in your plate connection in a transmitting circuit. The main coil of the circuit has four taps; the start of the coil is the aerial connection, the first tap is the ground connection, the next tap goes to the tuning condenser and the end is connected to the grid condenser. It is apparent that if we provide four binding posts we can change our coil as often as we wish, which will disclose the reason for the term, "All-Wave Tuner." There is no reasonable limit to which you can tune without any other trouble than to change the coil to the one desired for the wavelength range.

Tuning Condenser

This brings us to the tuning condenser. One should bear in mind that this must be a real condenser for good results. There are a number of good condensers on the market. Always connect the rotary plates to the grounded part of the circuit, and if the condenser used has insulating end plates, use a shield. This is not needed with some of the late types of condensers, as the end plates are a part of the rotating element and are in the ground part of the circuit, thereby eliminating capacity effects entirely. The variable condenser in the plate circuit must be a good one as far as its resistance is concerned, since it has the plate battery potential across it as applied to the detector valve. If hard valves are used, this may amount to 60 volts or more; a bad condenser will, therefore, allow a current flow which in time will run down your H.T. batteries. Its size is also 11 plates, although you may deviate from this size if you have a larger one on hand, but do not use one with more than 11 plates for tuning purposes.

The Plate Choke Coil

Not all of us have the tools needed to make a really neat coil. In most cases good looks do not add to the result value of a coil, therefore take an ordinary sized drinking glass, which should be smooth of surface so the coil may be slipped off. One that is about 2½ inches in diameter will do. Wind this with 75 turns of No. 24 d.c.c. wire in jumble fashion. Slip off and wind a few turns of thread around the coil turns so

It is with a great deal of pleasure that we present to our readers a special article by Mr. Reinartz himself on the latest development in receiving circuits. He gives detailed information in this article on the construction and operation of the set.

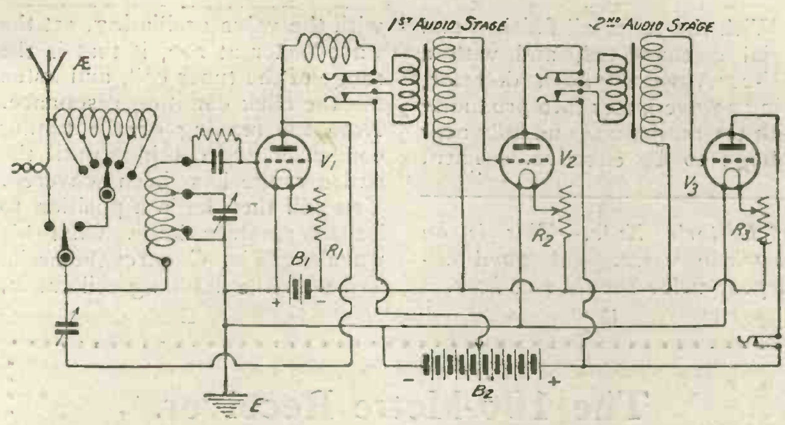


Fig. 2.—Two stages of audio-frequency amplification added to the Fig. 1 circuit.

that it will stay whole. If you must have a neater coil, wind it to the equivalent of the one described. Connect it as close to the plate connection on the socket as you can, consistent with good mounting practice. This coil should not be mounted near any of the other coils.

The Detuning Coil

Around the same drinking glass wind, with the same size wire, 50 turns, with a loop at every 10 turns for a tap. Again in this case, make the coil in any fashion you desire, as long as it remains the equivalent of the one described. This coil is mounted on the tuner panel near the aerial connection. It is connected to a switch lever with five switch points, the lever being connected to the aerial connection of the

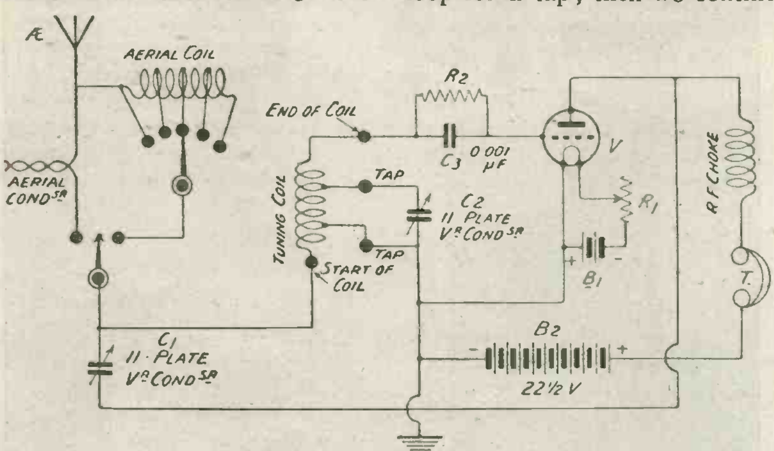


Fig. 1.—The single valve circuit diagram. The fixed aerial condenser is made of flex wire.

tuning coil. The aerial wire is connected to the beginning of the detuning coil, which is connected to the first switch point.

For Eliminating Interference

Take two feet of lamp cord and connect one end to the switch point and aerial as shown in the diagram of Fig. 1, leaving the other end open. This may take the form of two pieces of insulated magnet wire rolled up into as small a coil as desired. If selectivity is too great, add to the length of wire used. It must be remembered that the signal strength is reduced if this condenser is made too small.

The Tuning Coils

First we will assume that the required range for tuning is to be 150 to 220 metres, so around the same drinking glass we will wind, with No. 16 double cotton covered wire in jumble fashion five turns, making a three-inch loop for a tap; then we continue with 15 turns, making another loop for a tap; then five more turns and the coil is finished. Slip the coil off the glass and wind a few turns of thread around it and connect the starting end of the coil to terminal No. 1 on the front of the panel; connect the first tap to No. 2, the second to No. 3 and the end of the coil to No. 4. You will notice that there is a 4 to 1 turn ratio of aerial to ground and grid to ground. Maintain this in any other coil you may make. Also notice that the tuning range is approximately 150 to 200 meters, and that if you add a cypher to the 15 turns that are shunted with the tuning condenser, you will have 150, and that if you add a cypher to the total number of secondary turns, which is 20, you will have 200, meaning that the approximate range of any coil made with the turn ratio as above, may be determined beforehand. Again, as before, make this coil in any manner desired, but maintain its electrical equivalent.

Shorting Turns

Another means to lower the wave-length of a tuning coil is to short circuit some of its turns. The natural period of the coil then drops to the first even harmonic of the number of turns not short circuited. This can also be applied to the transmitter described by the author a few months ago, through which it was possible to tune down to 10 metres for transmission using an aerial having a natural period of 100 metres. Active work along this line is now in progress and after building the tuner described you may tune down to 30 metres and listen to the signals of 1XAM with 500 watts input at that wave.

With the tuner all finished and aerial disconnected, and with a UV-201A valve* as a detector, bring a wave meter into proximity with the tuning coil and only near enough to be effective. Then, with the valve oscillating, set the wave meter at 200, if that is the range of the tuner coil, and listen for the click denoting resonance. Note the reading of the tuning condenser and continue until the entire range has been covered. You will then be in a position to let an amateur know what his wavelength is. Connect the aerial and with the detuning coil cut in, set the switch lever controlling these turns until the tuner oscillates readily over the entire tuning range. This may then be left without change for the coil in use. If considerable interference is noted from nearby amateurs, cut out the detuning coil and switch in the series condenser. You will then have the "sharpest tuner ever."

** Editor's Note.—This is an American valve. A good all-purpose valve should suit here.*

The 100-Metre Receiver.

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

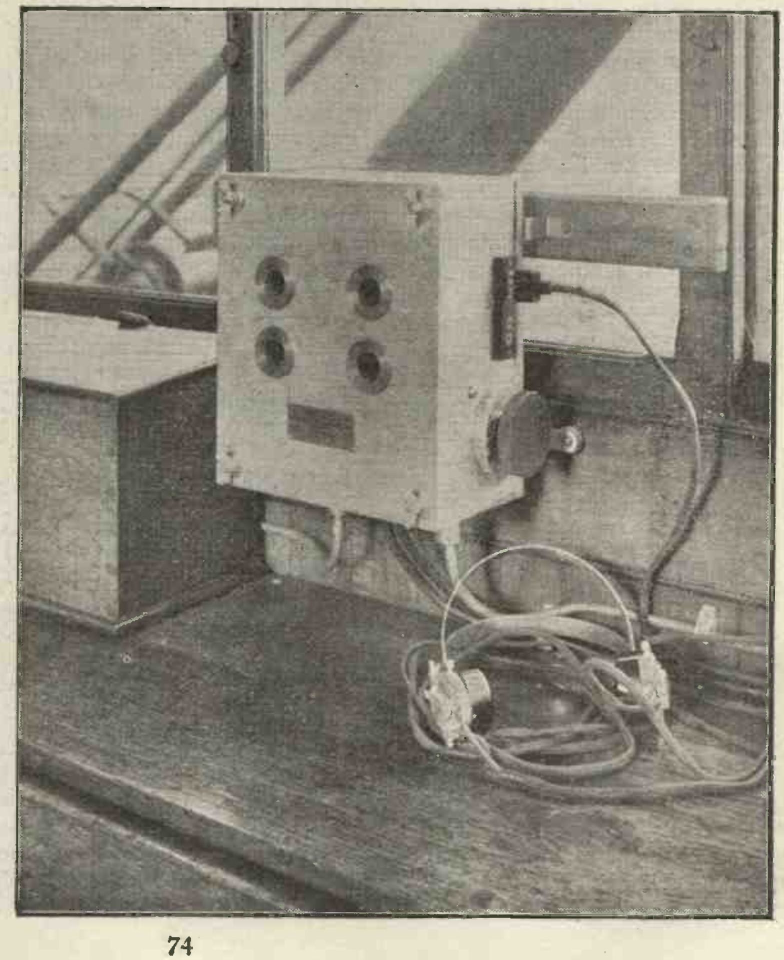
W. W., Vol. 3, No. 15.

SOME readers appear to be experiencing trouble in getting down to 100 metres with the inductances, as described in the article appearing in Vol. 3, No. 15, on account of high casual capacities and high minimum capacities in the tuning condensers. The variable condensers and valve-panel used in testing the tuning-unit had perhaps an unusually low minimum. It may be found, *e.g.*, that 125 metres is the lowest limit with some commercial variable condensers.

The obvious remedy is to remove a few turns of wire from the inductances, particularly from the first grid inductance, at the top. But this does not wholly meet the difficulty, as on account of its close coupling to a relatively large reaction-coil, the removal of ten turns from the grid inductance may not suffice. The solution is to remove, *e.g.*, 7 turns from the reaction-coil, and only 5 from the grid-coil; leaving a total of 33 turns of wire, viz.: 13 turns reaction; five turns double between earth and aerial-tap; and 15 turns extra grid coil. By inserting a small variable condenser in the aerial, set at a low figure, there should now be no difficulty in getting down below 100 metres if desired, on a P.M.G. aerial, and with ordinary apparatus. The tuned-anode coil will rarely need touching.

An obscure cause of persistent oscillation on a much longer wavelength has come to light: where the two radio-chokes are so nearly alike that they tune grid and plate of the second valve sufficiently alike to produce this effect. The remedy is obvious: to make these chokes of widely different value, but each of high enough value, *e.g.*, 150 and 250 turns respectively, and to keep them well apart.

If a low-reading wave-meter be not available, a useful check on the wavelength range can be made by picking up the local broadcast station on their strong third harmonic, which is quite easy to do, though not very attractive as far as quality of reception is concerned.



The "Marconi "beam" receiver mounted on the bridge of a ship. This receiver operates an ultra-short wavelength in the neighbourhood of thirty metres.

Valve Notes

By

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

A 2 H.F. Circuit

THOSE who are working on the problem of providing two stages of high-frequency amplification which really produce the desired results will be interested in the accompanying circuit which is similar to one which has been employed on one of the sets made by the Western Electric Company.

The results obtained with the set were certainly good, and there are one or two points of design which are sure to interest the experimenter.

Loose Coupling

In the first place it will be noted that series tuning is employed for the aerial circuit, which is separate from, but coupled to, the closed receiving circuit L_2 C_2. The coils L_1 and L_2 are honeycomb coils, which are placed in the relative positions shown in the drawing, the secondary coil being at right angles to the aerial coil, and slightly out of centre. The coupling, therefore, between the two circuits is loose, and this will obviously tend towards greater selectivity, although, incidentally, the reduction of damping of the secondary circuit tends to decrease the stability of the first valve.

The Anode Circuit

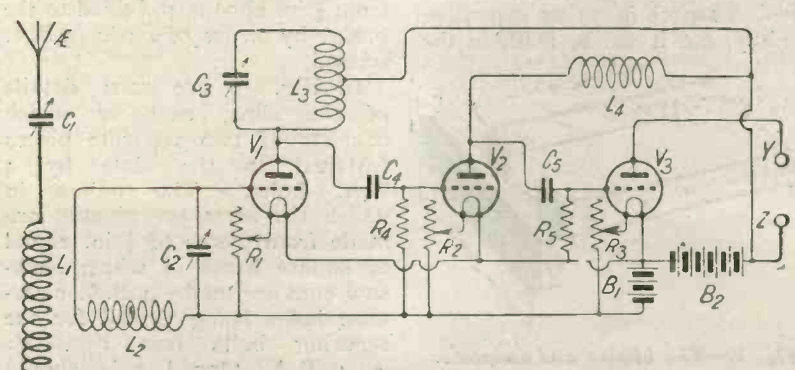
The anode circuit of the first valve is coupled to the grid circuit of the second by means of the oscillatory circuit L_3 C_3, which is wound on a tube about 3 in. in diameter. A tapping is taken from the middle of the coil L_3 instead of from the top end, and this is done, apparently, to secure a stable operation of the first valve which, in view of this coupling between L_1 and L_2, and to the fact that there is no positive potential on the grid of the first valve, would otherwise certainly oscillate readily.

The second valve acts as a high-frequency amplifier, and in the anode circuit is a coil L_4, which is not tuned. The coil L_4 appears to be in the nature of a slab coil about 1 in. diameter, the wire being apparently run into a deep groove in an ebonite disc.

The third valve acts as a detector, and two output terminals Y Z are provided, these being connected to a low-frequency amplifier.

Oscillation

The set may be made to oscillate, and the way to prevent this is to detune the grid or anode circuit or to dim the filaments.



The circuit of the Western Electric 2 H.F. receiver.

The low-frequency amplifier, in the case of the Western Electric equipment, is certainly a work of art, or, rather, a work of science, from the point of view of efficiency and purity of reproduction.

Dull emitter valves of special type are employed, and the transformers are also designed to operate with great efficiency.

A Selling Policy

The Western Electric Company commenced with the definite intention of not selling their equipment piecemeal—the loud speaker could only be bought with the amplifier, and no parts of the amplifier were sold separately.

In the intial stages this was, no doubt, a wise plan, because the Western Electric amplifier and somebody else's loud speaker might quite probably not be the ideal combination because the discriminating listener and experimenter knows that valves, transformer and loud speaker have all to be suitably matched, and that one combination may not work as well as another.

A Wise Decision

We are happy to note, however, that the Western Electric loud speaker is now sold separately, and we hope that when the Western Electric Company turns its attention to components they will be prepared to supply the transformers used in their amplifier. There is a huge market for intervalve transformers, and we believe that the sale of the transformer, separately, will in no way interfere with the sale of the complete amplifier unit.

A Sound Earthing Switch

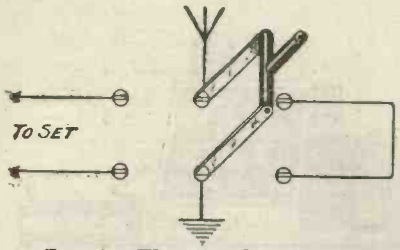


Fig. 1.—The switch wiring.

THE coming of the longer days and the fact that atmospherics are becoming more noticeable upon many evenings warns us to make preparations for the safety of our sets during the thundery weather which is bound to occur in summer time.

It is of little use to provide a path to earth which is merely shunted across the aerial and earth leads, for this kind of arrangement does not fully protect the set from the risk of injury. What is required is an arrangement such as that shown in Fig. 1, which entirely cuts out the set and provides a straight through path from aerial to earth.

Perhaps the best way of accomplishing the desired end is to use a large and well-insulated double-pole double-throw switch, which should be placed outside the house and not in the wireless room. Such a switch is rather expensive to buy, but it can be made in the

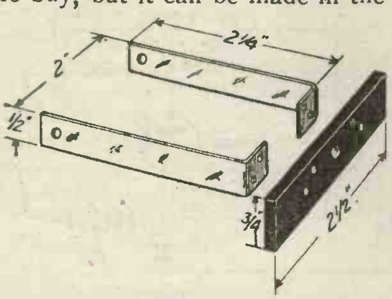


Fig. 2.—The blades and endpiece.

workshop at small cost. It is important that when it is not in use as a cut out there should not be sufficient capacity between the arms and the contact clips to cause a weakening in signal strength. The switch to be described is therefore on the large side, the distance between these arms being 2 ins. With a switch of this type capacity effects are very small indeed. The base upon which it is mounted may be made very well from a slab of slate ½ in. thick and 5 ins. in length by 3½ ins. in width. Slate can be drilled without difficulty with ordinary drills, the lubricant being water. Though good slate is an excellent insulator one sometimes comes across a piece which contains metallic veins. When these are present the insulating properties of the material may be so low that it is quite useless for wireless purposes. It is as well, therefore, when the slate selected has been drilled, to insert terminals temporarily into the holes and to have it tested with a megger. Any good working electrician should have one of these instruments, and he will make the test for a small charge. Fig. 2 shows the way in which a double switch arm is made up from strips of sheet brass ½ in. wide. The ends of these are bent round and fastened

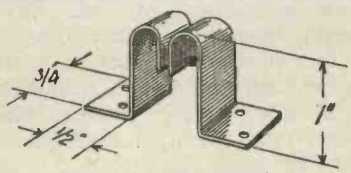


Fig. 3.—Clip details.

to the ebonite bridge by small screws. The knob can be made from ½ in. ebonite rod fixed to the bridge by means of a 1-in. 4 B.A. screw.

In Fig. 3 are seen details of the clips, each of which consists of two separate pieces fastened to the slate by 4 B.A. bolts. The pillars in which the arms are pivoted are made from pieces of ½ in. round or square brass in which hacksaw cuts are made, 4 B.A. clearance holes being drilled for the securing bolts (see Fig. 4). A 4 B.A. tapped hole should be made in the base of each pillar. A 1-in. countersunk screw is then driven upwards from the base into each to hold it in position. All of the bolts used for mounting the clips should be countersunk and passed upwards from below. Holes should be drilled lastly near each corner of the slate to take wood screws, which will secure the switch. It may be fixed very neatly to the wall by means of Rawlplugs. As it is outside and therefore in an exposed position, it is as well to box the switch in with a wooden case in order to keep out the damp. This case may be provided with a hinged front and a small padlock so that the switch cannot be tampered

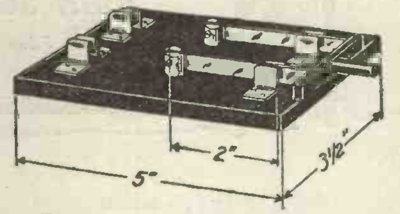


Fig. 4.—The complete switch.

with. Of course, the wires where they enter the box should be well insulated from the wood.

R. W. H.

Soldering Condensers in Place

THERE are many constructors nowadays who make use of those excellent little fixed condensers which are made to fit into clips. These consist of copper plates separated by a dielectric of mica and the condensers are fixed into hollow metal endpieces which make contact with the slips when they are pushed home. The clip mounting is most convenient when the condensers are on the top of the panel, for it enables them to be interchanged at will as different capacities are required. It is not, however, the best thing for condensers which are below the panel, and therefore out of sight, for there is always the chance that a mysterious breakdown in the set may result from one of them having become jarred out of its clips. Wishing to use some recently below the panels of a set the writer tried the experiment of soldering them into position. It was feared that the application of the necessary heat might be detrimental to them, but it appears to have had no ill-effects at all. The method is this. One-half of each clip is cut away and the metal is thoroughly cleaned with a file. Its surface is then tinned. One side of each of the endpieces is treated in the same way, and when all is ready the condenser is firmly attached by a brief application of a really hot soldering iron.

R. W. H.

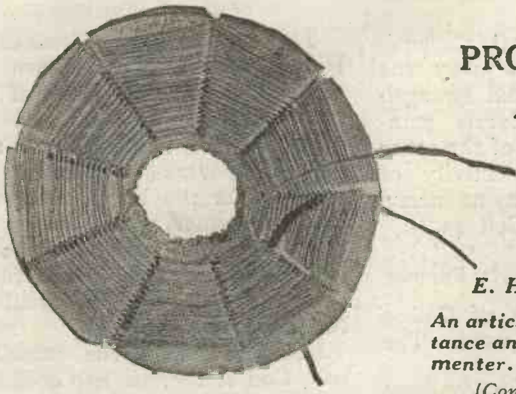


Fig. 4.—The double disc basket coil.

PROPORTIONATE APERIODIC AERIAL COILS

By

E. H. CHAPMAN, D.Sc.

An article of considerable importance and interest to the experimenter.

(*Continued from page* 34.)

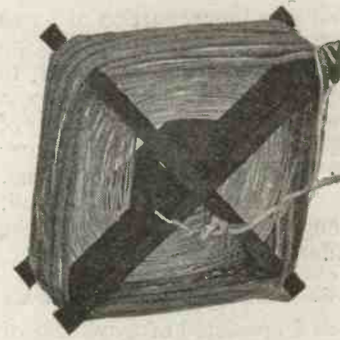


Fig. 7.—Coil wound upon first type of modified Harris former.

Coil 3. Double Disc Basket Type

The third coil used in the tests was of the basket type with double cardboard disc. This particular type of coil was first described by the writer in *Modern Wireless*, Vol. II, No. 7, page 622. The proportion of aerial turns to grid turns in the coil used in these tests was 1 : 2 until 15 turns of aerial and 30 turns of grid had been wound, after which another 20 turns of grid were wound alone. The aerial winding, No. 22 d.c.c., was wound between the two discs, the grid winding, No. 28 d.c.c. was wound under-over in the usual way. (See Fig. 4.)

London came in very strongly on this coil, quite as strongly as on the standard Harris coil. Manchester came in extremely well when London was not transmitting. When the Royal Air Force Band was playing from London, and Manchester was re-transmitting the music of the Savoy Band, the two bands were heard with almost the same strength, the tuning being very carefully set on Manchester. On another occasion speech from Manchester was perfectly audible in spite of the fact that London was transmitting opera at the time.

A curious effect was noticed when this coil was being tested. Bournemouth was re-transmitting the music of the Savoy Band. At the same time London was transmitting the music of the Royal Air Force Band. When the tuning was set on Bournemouth the only thing which could be heard of the Air Force Band was the striking of some instrument which gave a note like the tinkle of a bell.

With Coil 3, all the other broadcasting stations were easily obtainable, Birmingham and Aberdeen being picked up at weak loud-speaker strength.

Coil 4. Single Disc Basket Type

Since the 1 : 2 proportion of Coil 3 seemed very promising, coils were constructed having this proportion right through. Coil 4A had 19 turns of aerial winding and 38 turns of grid winding on a single basket disc of the usual type. Each turn of the aerial winding was followed by two turns of grid winding.

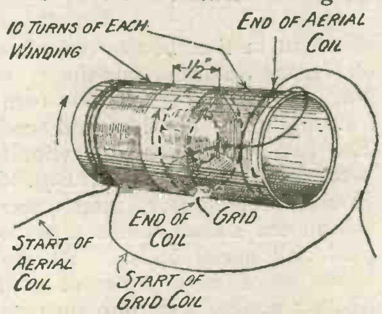


Fig. 5.—The cylindrical coil with flat disc coil inside.

With Coil 4A London came in at good loud-speaker strength at about the middle setting of the tuning condenser. Cardiff and Manchester were both easily picked up with sufficient strength to be perfectly audible through interference from London. Coil 4A was far and away the best coil the writer has tried for selectivity between the London, Cardiff and Manchester stations. Whether this excellent selectivity is due to the proportion of 1 : 2 adopted or whether it is due to the higher settings on the tuning condenser which gave a greater difference between the tuning positions of the three stations, it is difficult to say. A second coil having the same proportion 1 : 2 but having more turns, 23 of aerial and 46 of grid, gave good loud-speaker telephony from Birmingham. This coil, named Coil 4B, also gave very distinct loud-speaker speech from the Brussels station.

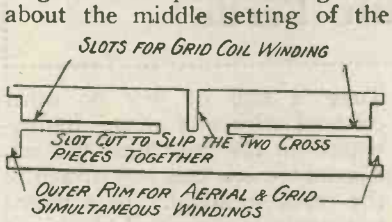


Fig. 6.—One of the cross pieces for first type of modified Harris former.

The writer looks upon Coils 4A and 4B not only as interesting because of the excellent selectivity they give, but also because coils with the same proportion, 1 : 2, could be made to cover much higher wavelengths.

Coil 5. Double Disc Basket Type

The fifth type of coil to be used in the tests had a proportion of turns of 1 : 5. The coil was wound on a double disc basket former. There were in all 12 turns of aerial and 60 turns of grid. Each turn of the aerial winding was followed by 5 turns of grid winding. London gave good signal strength with this coil, but the coil was not as selective with regard to Manchester and London as was Coil 4A. The distant stations were also rather weaker with this coil, possibly because of the low number of turns in the aerial winding.

Coil 6. Single Basket Type

Coil 6 had a proportion of 1 : 7, there being eight turns of aerial winding and 56 of grid. Results were poor with this coil, the proportion evidently being too high.

Coil 7. Single Basket Type

Coil 7 had a proportion of 1 : 10 for five turns of aerial and 50 turns of grid, but in order to bring the aerial turns up to a higher number, seven turns of aerial were wound on the former after the proportionate turns. The results with this coil, although good, were not up to the standard of the Harris coil.

Coil 8. Flat Disc Inside Cylinder

Coil 8 consisted of a cylinder of diameter of 3½ ins. inside, which was a flat disc. This disc was made from two circles of cardboard of the same size, each having nine radial slits. The two circles of cardboard were clamped together with a paper fastener and 50 turns of No. 28 d.c.c. were wound on the double disc. On the outside of

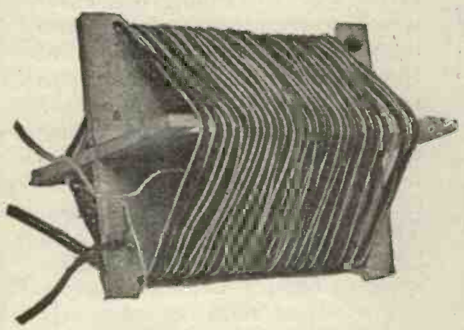


Fig. 8.—Complete coil wound upon second type of modified Harris former, the former being made of wood.

the cylinder there were 20 turns of aerial winding wound alternately with 20 turns of grid winding. The aerial winding was of flex and the grid of No. 22 d.c.c. The continuation of the grid coil was the flat disc winding inside the cylinder.

With Coil 8 signal strength from London 14 miles away was greater than the signal strength obtained with the Harris standard coil or with any of the other coils tried. The selectivity of Coil 8, however, was by no means as good as that of Coil 4A.

Coil 9. Modified Harris Former

In the construction of Coil 9 a Harris former was used. The

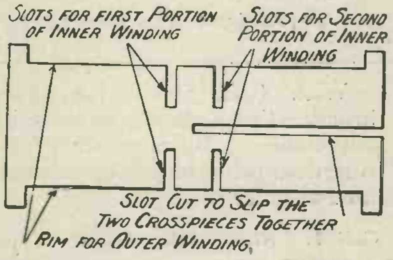


Fig. 9.—One of the two cross pieces for the second type of modified Harris former.

slots cut in the ebonite contained 60 turns single windings of No. 22 d.s.c., these 60 turns forming part of the grid coil. The two cross pieces of ebonite were cut, as shown in Fig. 6. Round the outer rims were wound the simultaneous turns of grid and aerial coils. At first there were nine turns of grid, No. 22 d.s.c., and nine turns of aerial, flex, wound together round the rim. These turns were afterwards increased to 15 of each winding wound pile fashion.

This modified form of the Harris coil gave very promising results, and it is a type of coil worth developing.

Coil 10. A Second Modified Form of Harris Former

The second type of modified Harris coil is well shown by Figs. 8, 9 and 10. Each of the two inside slots contained 25 turns of grid winding. These two windings were connected in series. On the long, outer rim of the former, there were 25 turns of aerial and 25 turns of grid winding, the aerial turns being of flex and the grid of No. 22 d.c.c.

Compared with the standard coil, Coil 1, the last two coils described, Coils 9 and 10, gave excellent signal strength from the broadcasting stations. Further experiments with these coils should result in improved selectivity, and it is highly probable that Coil 10 will prove a suitable type for coils to be used over higher wavelength bands than those in use for British broadcasting.

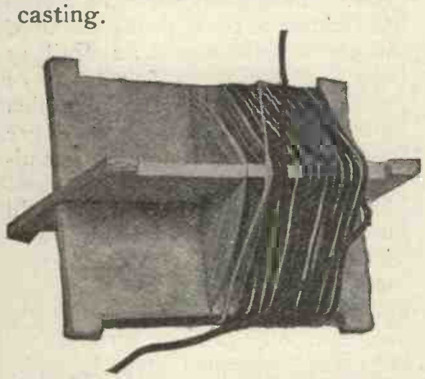


Fig. 10.—The coil shown in Fig. 8 with greater part of outer winding removed to show inner coils.

Throughout the tests described two Ediswan A.R.D.E. valves were used with a 2-volt accumulator and a high-tension battery giving 50 volts.

□

A Makeshift Earth

IT happens sometimes when one is testing out a set away from home that though there is no great difficulty in rigging up an aerial a suitable earth cannot be found. After all, any piece of wire suspended almost anywhere will make an aerial, so long as it is pretty well insulated from its supports, but unless there is a handy water pipe the earth is not quite so easy. Here is a tip which the writer has found most useful on occasions. Take a coil of flex or other covered wire and throw it anywhere on the floor near the set. Then bare one end and attach to the earth terminal. In a recent test made in a reputed blind spot in the west country, there was very little to choose between the coil of wire and a roughly-made earth, made by burying a large sheet of metal, which was rigged up a day or two later. The coil of wire acts probably in much the same way as a counterpoise forming the second plate of a condenser of which the aerial is the first.

R. W. H.

SOME USEFUL WIRELESS FIGURES

With reference to Table 3 in the above article (p. 16, *W.W.*, May 7), by a printer's error the decimal point was obviously displaced in column 2 (ohms per lb.). Thus Gauge 16 is correct, but the following gauges require the decimal point to be moved two places. Thus 0.17 should read 17.00 and so on to bottom of column.

The Wireless Valve and How it Works

By JOHN H. MORECROFT,

Professor in Electrical Engineering, Columbia University, New York City.

The third of a series of new and exclusive articles by a world-famous expert.

Effect of Oxides

As noted above, certain impurities on the surface of a hot metal prevent electron evaporation, yet Wehnelt discovered that certain oxides, spread over the surface of the hot metal, very much increased the rate of emission. Van der Bijl and his associates have developed this phase of the question and have produced an oxide-coated platinum filament that gives profuse

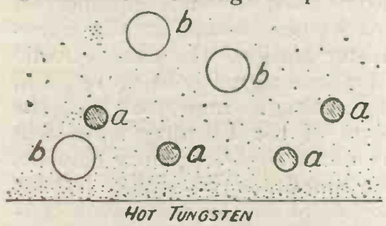


Fig. 1.—Illustrating the evaporation of electrons from a hot surface. The small dots representing the electrons, with the large circles representing tungsten atoms which have evaporated with the electrons.

electron emission at temperatures much lower than required for pure platinum or tungsten filaments. To get much emission from pure tungsten the metal must be at a dazzling white heat, whereas a properly coated oxide filament will give the same amount of emission at a dull red heat. An oxide-coated filament should never be raised to a temperature hotter than that which gives a dull yellow colour; otherwise the oxide coating will be spoiled.

Electron Atmosphere

The evaporation of electrons from a hot surface is pictured in Fig. 1, the small dots representing electrons, the larger circles *a, a, a,* representing some gas atoms, and the still larger circles *b, b, b,* representing some tungsten atoms which have evaporated with the electrons. It must, of course, be remembered that no matter how well the containing vessel has been pumped there will always be many gas atoms left in the vessel, around the filament. If there is no action pulling the electrons away from the hot surface from which they have come, the height of the electron atmosphere represented in Fig. 1 will be only a few hundredths of an inch. Unless the metal is above a dazzling white temperature, but few electrons get more than five hundredths of an inch from the surface before they slow down and then fall back into the hot metal.

The Strange Discovery that Edison Made

The first observer of the effect of electron evaporation was Thomas A. Edison. In the early days of incandescent lamp manufacture he noticed a peculiar action that could not be satisfactorily explained at the time. In an ordinary incandescent lamp bulb he introduced an extra plate, having a connecting wire to the outside of the bulb, as shown in Fig. 2. Edison noticed, when the filament was incandescent, that if this plate were connected through a galvanometer to the negative side of the battery heat-

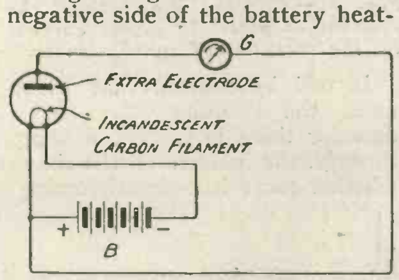


Fig. 2.—The circuit used by Thomas A. Edison for his first observations of the effect of electron evaporation.

ing the filament, no current flowed through the galvanometer, but that if the wire were connected to the positive side of the battery, the galvanometer showed that a current was flowing. This current stopped as soon as the filament cooled down, showing that it was an effect depending upon the temperature of the filament. Although the phenomenon could not be explained at that time we know that it was due to the electrons evaporated from the carbon filament. When the plate was connected to the negative end of the battery it offered no attraction to the electrons coming off the filament, but when made positive by being connected to the positive end of the filament it did attract the electrons, and so caused current to flow.

It is to be noticed that this current is due to the electrons evaporating from the filament, streaming across the vacuous

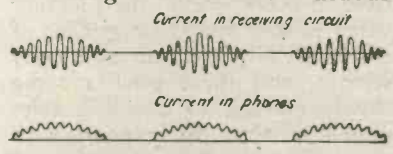


Fig. 3.—Curves illustrating spark signals before and after rectification.

space between the filament and plate, entering the plate, then drifting along through the wire and galvanometer, back into the filament, and so re-evaporating and starting on their course once more. The same electrons will evaporate many times if the filament is kept heated long enough.

For 20 years the " Edison effect " was known, but not used until Dr. Fleming, working with Senatoré Marconi in his early radio experiments, got the idea of using it in place of the coherer. as a detector, or rather a rectifier, of the high frequency signals.

How Fleming Applied Edison's Discovery in Radio

In the upper part of Fig. 3 are shown three groups of high-frequency waves such as would be sent out by three spark discharges at a transmitting station sending out spark-wave telegraph signals. The frequency, or number of reversals per second, of the current set up in the transmitting aerial, and the corresponding current set up in the receiving aerial, might be 1,000,000 cycles per second and the number of these groups per second perhaps 1,000. As the ear cannot hear 1,000,000 vibrations per second, but can hear 1,000 vibrations per second, it is necessary to use in the receiving circuit some apparatus which will give one impulse to the telephone diaphragm for one group of waves. If in series with the telephones there is some device which permits current to flow only in one direction (a device called a "rectifier") the current in the telephone will look as shown in the lower curve of Fig. 3. Each of these current pulses consists of a rectified (and smoothed out) group of waves of the upper part of the figure. Each of these current pulses will give one pull to the telephone diaphragm, and so the groups of high-frequency waves, through the rectifier, do give in the telephone an audible tone of 1,000 vibrations, which is a musical note of that frequency for which the ear is most sensitive. In other words, the Fleming valve passed spurts or gushes of electricity instead of a steady stream, and these gushes came slowly enough to enable a telephone receiver to respond with an audible musical note.

Action of the Fleming Valve

Fleming used the Edison effect to detect radio signals in the manner shown in Fig. 4. The filament *F*, was heated by battery *A*, the extra electrode which we shall call the "plate," was held at positive voltage, or potential, by battery *B*. Whatever electrons flowed to the plate returned to the filament by going through the telephones *D*. When a signal (high-frequency wave-train as in upper part of Fig. 3) came in, the voltage between the plate and *F* was alternately raised and lowered about the average value maintained by battery *B*.

The plate current (amount of current from filament to plate caused by electron evaporation from *F*) varies with the plate voltage about as shown in the full line curve of Fig. 5; the signal voltage is shown below and the corresponding plate current shown to the right. It will be noticed that while the plate voltage increases and decreases symmetrically about its average value, which is the voltage of battery *B*, the plate current variation is not symmetrical about its normal value, owing to the curvature of the plate-current curve. The average plate-current, which flows through the 'phones, is indicated by the dotted line and shows an increase during the time the wave train lasts. From this it follows that if a series of wave trains similar to those shown in Fig. 3 is impressed on the aerial circuit of

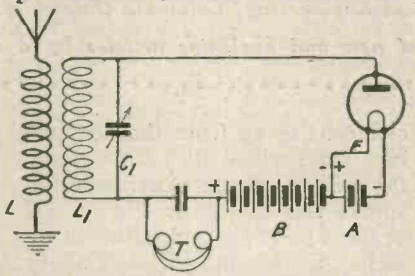


Fig. 4.—The circuit used by Dr. Fleming employing the two electrode valve.

Fig. 4 the 'phone current will show a "hump" for every wave train; hence 1,000 humps per second, and this will give a note of 1,000 vibrations per second in the 'phones.

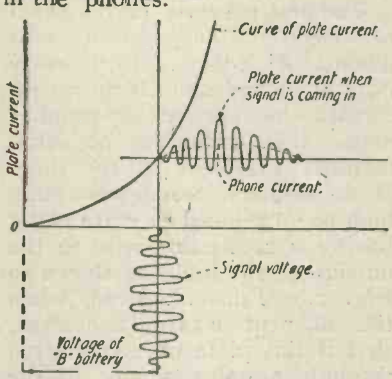


Fig. 5.—Curves illustrating the relation of plate to phone current in the reception of spark signals.

It will be noticed that when using the Fleming valve for a detector there is current flowing through the 'phones all the time, whether there is a signal coming

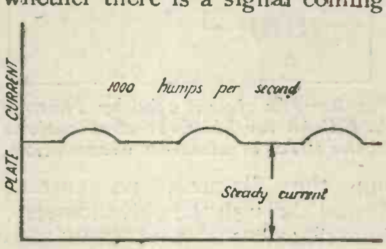


Fig. 6.—Illustrating phone current in the case of telephony reception; the humps instead of being smooth, however, will vary in shape and frequency with the pitch and quality of the voice.

in or not. But if a steady current flows through a telephone receiver no noise is sent off from the diaphragm at all; it is the changes of current only that cause the diaphragm to vibrate and sound.

When using a crystal detector no current at all flows through the 'phones until a signal is coming in, so the current will be about as shown in the humps of Fig. 3. When using the Fleming valve the 'phone current looks as shown in Fig. 6. There is always a large current flowing, and on the top of this are the humps of current caused by the signal. The noise given off by the 'phone will be just the same, however, as it is for the current shown in the lower part of Fig. 3.

The foregoing analysis has been made on the assumption that the telegraph signal received was sent out by a spark transmitter, and we have shown that a musical note is heard in the receiving telephones which has a pitch fixed by the number of sparks per second at the transmitter station. In case a radio telephone signal is being received the voltage impressed on the plate of the Fleming valve will be a very high-frequency current, the amplitude of which follows the shape of the voice-wave acting at the transmitting station. In such a case the current through the 'phones will be somewhat as shown in Fig. 6, but the humps in the current will not be regular and smooth but of a frequency and shape fixed by the pitch and quality of the voice.

(To be continued.)

Telephone Condensers

Sir,—In reference to the short article in April 30 issue of *Wireless Weekly* on telephone condensers, I have been experimenting in this direction for some time and have made what might be called a fixed variable condenser; it is made of four Mansbridge condensers of the following values: .01, .025, .05, .075, and are connected with Clix terminals. As low resistance telephones are employed, the condensers are put across the high resistance of the telephone transformer. As a rule, the .01 is sufficient, but if the reception is strong and very noisy, the .075 is useful.

I am building a set and shall incorporate this attachment.—Yours faithfully,

Percy W. Turner.

Birkdale, Lancs.

More Ideas for Inventors

By
OSWALD J. RANKIN.

In a previous issue the author gave several suggestions to would-be inventors. Here are many more.

In our April 20 issue there appeared, under the above title, a selection of suggestive ideas of a more or less simple nature on which the inventor or would-be inventor was urged to direct his efforts.

In the present issue the subject is extended to apparatus and devices of a more complex nature.

Before proceeding further it may be well again to emphasise the fact that demand, practicability, and competitive costs are features which invariably outweigh the actual ingenuity of an invention, and that it is a mistaken policy to overlook the small and apparently insignificant things, for after all, it is the little things that count, as the Germans proved when they almost captured the world's trade before the war. It is a regrettable fact that the majority of British inventors are strongly inclined to skip over the little things and strike out on almost impossible ideas which, to their way of thinking, should "revolutionise" everything and render obsolete a hundred and one of the smaller things *en masse*. This sort of thing is perhaps quite in order when a real "discovery" is made, but such instances are rare, and if we get down to solid every-day facts and cultivate the habit of improving things in easy stages, then one's chances are considerably improved by overcoming that swelled head feeling and by centring efforts on a really practical proposition which might bring in a fairly comfortable income. To understand this better we will take a little instance from the world of wireless With the advent of broadcasting it was intended that the non-technical man in the street should enjoy the pleasures of listening-in without acquiring any special technical knowledge. He was (somehow) to be placed on an equal footing with the "old timer"—all in five minutes! and although many inventors were, for a time, sufficiently interested to simplify the design, construction and use of receiving apparatus, they eventually ignored this supposedly unimportant problem and delved into television, power transmission, etc.

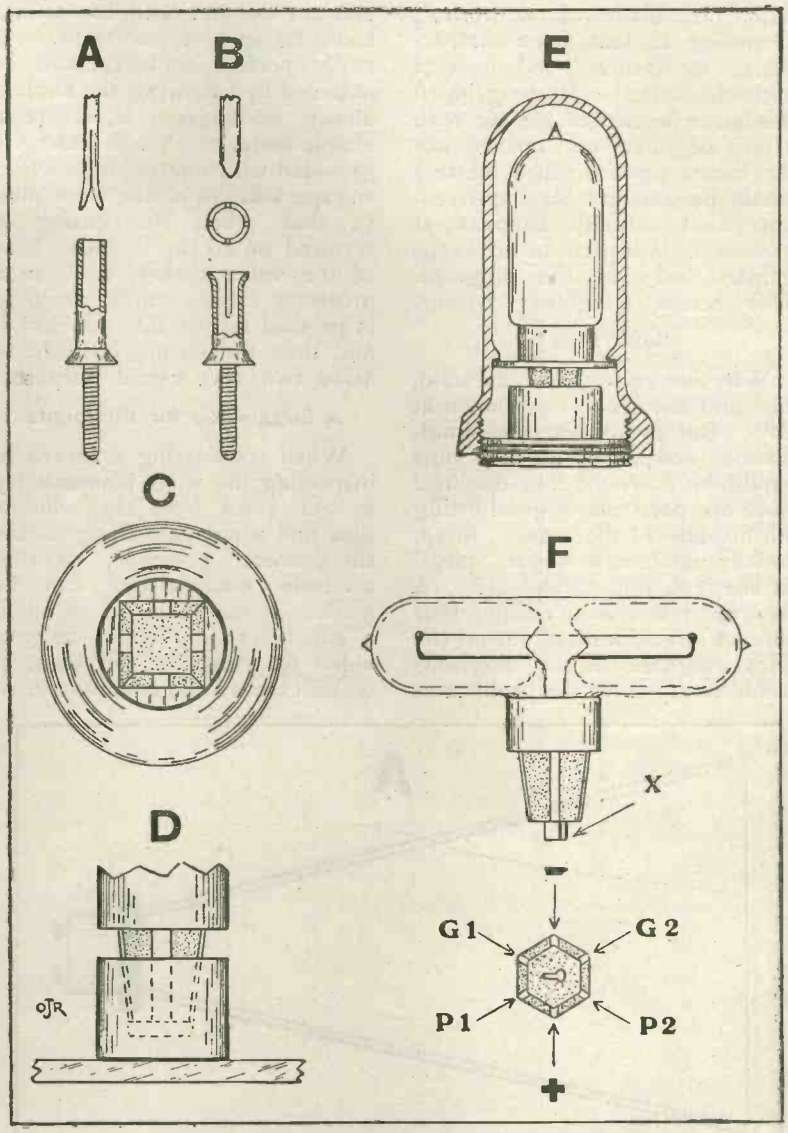


Fig. 1.—Some miscellaneous valve ideas.

A Question

Where is the uni-controlled receiver for the man in the street, and where are the many little improvements which would make present-day reception really perfect? The answer is: "held over" on account of the "skipping" tendencies of our inventors.

It is a mistake to be over ambitious. How can television and the more wonderful things be possible when we have not yet solved such comparatively simple problems as interference and jamming? Surely we must come back to earth and first perfect the foundations and walls of our building before we can fix the roof.

Those who would not be embarrassed at the suggestion of improving a mere valve leg, might be interested in the simple ideas outlined in diagrams A and B (Fig. 1). In diagram A we see the present type of valve leg after it has been "opened out with the blade of a knife," according to text book instructions, to assure good contact with the socket. If we gripped the lower portion of the leg with a pair of pliers and opened out the centre portion, then matters would be considerably improved, but what actually happens at present is indicated in an exaggerated way in the diagram. This seems altogether wrong.

Solid Pins?

Why not make the pins solid, and split the sockets as shown at B? But even then the simultaneous contact of all four pins would be more or less doubtful since one particularly good fitting might affect the other three, so why not have a single "pin" as suggested at C and D? A tapered plug, containing four contact strips, worked out on the lines indicated in the diagrams would easily solve the problem of efficient contact and the socket could be split if necessary. A really perfect contact could be obtained by following the method shown in diagram E, where a simple metal or ebonite casing is provided with internal lugs which engage a flange on the valve plug so that when the casing is screwed on to the threaded base of the valve socket, to form a protector for the valve, the plug is pressed tightly into the socket and thus the casing is made to serve two very useful purposes.

A Suggestion for Filaments

When considering a means of inspecting the valve filaments try to get away from the window idea and adopt something on the thermometer principle, so that accurate comparisons can be made. If the casing is of metal a small terminal could be provided for shielding purposes, in which case we should have a combined valve protector, contact sheath, and shielding device.

Diagram F depicts a simple idea which might have an interesting sequel if given a little attention. The idea is to have only one filament for two or more valves. Here the simple plug socket might be of hexagonal shape with the contacts attached to each corner, as indicated in the lower diagram. A simple key, X, would assure the correct position of the plug in the socket.

Insulation

Let us now consider the question of insulated wire as used for winding coils. Silk- or cotton-covered wires must usually be impregnated before they are damp-proof, and enamelled wires are so thinly covered that the turns lay too close together and thus the internal capacity of the coil is increased, as is also the case with silk- or cotton-covered wires after impregnation.

Damp-Proofing

In the book *Tuning Coils* (Radio Press Series, No. 18) the author in dealing with the subject of damp-proofing coil windings refers to it as "a vexed question" and rightly says "The whole question (to impregnate or not to impregnate) is one of considerable difficulty . . . . . we lack sufficient experimental data to come to a definite decision."

This means that one really does not know whether to shellac or wax a coil winding or not, since if the cotton or silk covering is left untouched it absorbs moisture from the atmosphere and increases internal capacity through impartial insulation, and if it is impregnated then the shellac or wax will also have the same detrimental effect. Inventors have sadly neglected this all important problem and it is high time someone produced a really perfect *piece of wire*—something quite different from what we are using to-day. Give the matter a little thought and tackle the problem in the following order: (1) Non-porous insulation, thick enough to avoid capacity effects and thin enough to permit compactness; (2) low resistance and consequent high conductivity; and (3) flexibility, general sim-

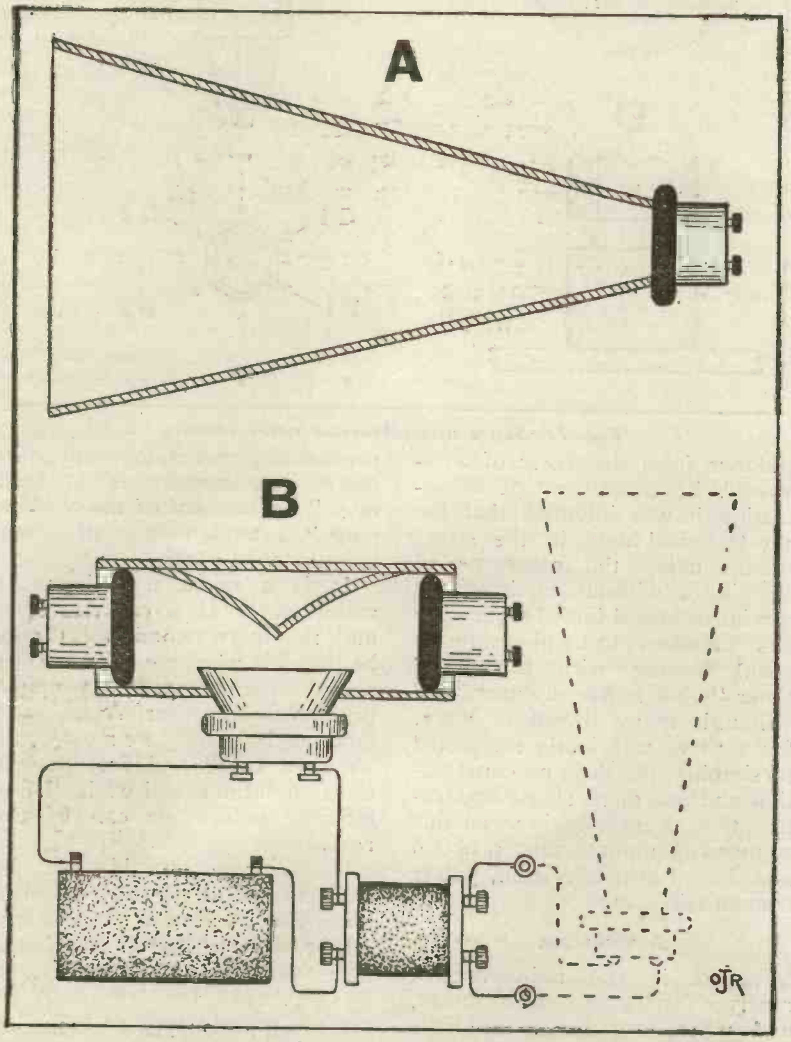


Fig. 2.—Loud-speaker ideas and comparisons.

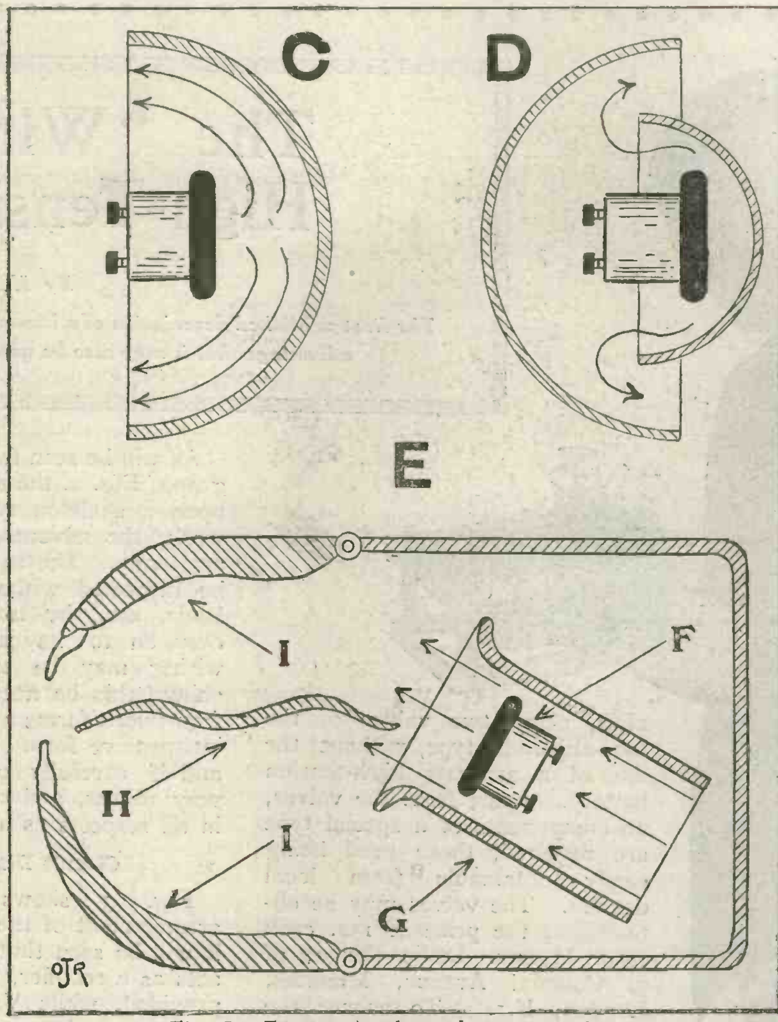


Fig. 3.—Further loud-speaker suggestions.

plicity and cheapness. Bear in mind that high-frequency currents flow over the surface of a conductor and not through it, and always adhere to the surface area idea when considering conductive properties.

Loud-Speaker Defects

The majority of present-day loud-speakers consist of nothing more than an elaborate horn attached to an ordinary receiver as shown at A (Fig. 2). This horn *concentrates* or *directs* the sound and thus fools our ears into believing that we have a *loud* speaker. This is a fact, I think, which cannot be denied. The microphone amplifier shown at B certainly amplifies the signals in the receiver, but here again we rather spoil things by using an ordinary receiver which is not specially designed to work from the amplifier, and make no effort to break away from the ultimate horn and spout idea. Interesting experiments have been carried out with glass or thin china bowls as indicated at C and D, but unfortunately the idea has apparently been dropped in favour of something less efficient but more attractive in commercial appearance.

No doubt crystal rectification will eventually do much to help solve the problem, for we must have a distortionless rectifier, a distortionless amplifier, and a perfect receiver before we can hope to improve the present state of affairs. As for the loud-speaker itself, why not consider the human mouth, tongue and teeth, and work out the idea on these lines? Let F (diagram E) represent the sound, G the throat, carrying air currents of varying pressure, H the tongue (flexible diaphragm) and I the inner walls of the sound box. Carefully study the construction of the human mouth, of what effect the teeth have on sound, and many other little points which, so far, have been overlooked. After all the mouth is the only perfect loud-speaker.

Attaching Leads to Terminals

THERE is a right and a wrong way of attaching a wire to a terminal. If you hook the end of the wire round the shank of the terminal in an anti-clockwise directions and then turn down the milled headed nut, which is, of course, moved clockwise to tighten it, you will find that it tends to push the wire out. Reverse the process—that is to say take a clockwise turn with the wire round the shank—and the nut will pull it in as it goes down. This may seem a pretty obvious hint, but it is surprising how many people either do not know it or disregard it. When making connections with flex always twist the strands of wire tightly together with the fingers as a preliminary. If this is done all the strands are held by the terminal, but if it is neglected a good many of them make no contact at all. Where two or three leads have to be connected to one terminal it is sometimes difficult to get them all satisfactorily gripped. It will generally happen that one or more of the leads are fairly permanent connections, whilst the others are frequently connected and disconnected. In this case it pays to put an extra nut—an ordinary thin 4B.A. nut—upon the shank of the terminal and to fix the permanent wires by means of it. The rest are gripped between the milled-headed nut and the extra one. When making several flex connections to a terminal it is best to twist them all together before placing them in the terminal. Where plain wire is used efficient connections will be ensured if a loop is made at the end of each lead with a pair of round-nosed pliers.

R. W. H.

An Ordinary General Meeting of the Radio Society of Great Britain will be held at the Institution of Electrical Engineers, Savoy Place, W.C.2, at 6.0 p.m., on Wednesday, 28th May, 1924, at which Major H. P. T. Lefroy will deliver a lecture upon "Wireless in British Military Aircraft up to August, 1914."

The "Wireless High-Tensionless

Type W 7.

By HERBERT K. SIMPS

The first published description of a loud-speaker high-tension ... advantage that it may also be used with ordinary valv

Fig. 1.—The author holding the set.

THE problem of eliminating the high-tension battery is one which has engaged the attention of many serious experimenters for some time, and although several circuits have been devised in which no separate source of high-tension supply is used, only a limited number have met with any degree of success.

Most experimenters know that weak signals may be obtained by removing the high-tension battery, and shorting the terminals of the set to which the battery is normally joined, but the question assumes much greater proportions when one turns to consider loud-speaker working.

Good loud-speaker signals are obtainable with the present set at a distance of ten miles from 2LO, using two valves of the four-electrode type, without the use of a separate high-tension battery. Apart from the valves, no components of a special type are required, those used being easily obtainable from local dealers. The valves may be obtained at the price of 15s. each from Messrs. Leslie Dixon, of 9, Colonial Avenue, Minories, London, E.1. To ensure the correct type, reference may be conveniently made to this article.

As will be seen from the photograph, Fig. 2, the set is mounted upon a skeleton type of framework, the advantages of which are many. The underneath may be inspected without disturbing leads, etc., by turning the set over on to its side, and the wiring may be easily checked should this be necessary. The framework forms a very neat and inexpensive form of mounting, and if carefully constructed, is very robust, and can be treated in all respects as a box.

Circuit Diagram

Fig. 3 shows the circuit arrangement of the receiver, and it will be seen that the valve V1 acts as a rectifier, reaction being provided, while V2, which may or may not be used, as desired, is a low-frequency amplifier.

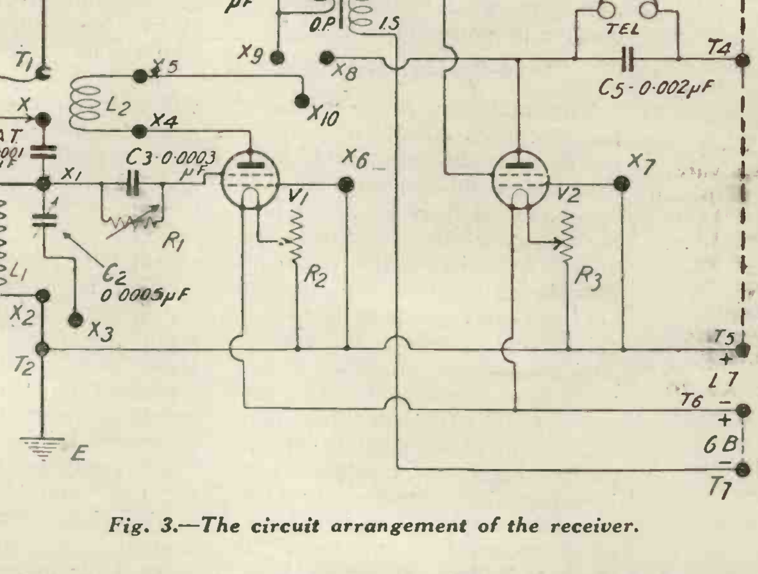


Fig. 3.—The circuit arrangement of the receiver.

Weekly”
Receiver

ON.

less receiver. The set has the unique
es and a high-tension battery.

The three principal forms of aerial tuning may be employed at will, namely, constant aerial, series, or parallel tuning.

It will be noticed that certain points are labelled X, X1, etc. These indicate that “Clix” sockets are used at these points, and the correct sockets are joined by means of “Clix” joined with rubber-covered flexible wire.

Constant Aerial Tuning

Constant aerial tuning may be applied by joining the aerial to T1, earth to T2, and connecting the flexible lead from T1, which terminates with a “Clix” plug, to the “Clix” socket X. The two sockets X2 and X3 are joined together in the same manner, the socket X1 being left free. Tuning is now carried out on the variable condenser C2, which is of 0.0005 μF capacity, and reaction is obtained by coupling the coil L2 to the coil L1. Provision is made for reversing the reaction coil by means of rubber-covered flexible leads, which terminate in “Clix” plugs, the latter plugging into the sockets X4 and X5 on the panel. Fig. 4 shows the circuit arrangement when using constant aerial tuning on two valves.

Parallel Tuning

When it is not desired to use the constant aerial tuning system, parallel tuning may be substituted, and the following connections are made: Aerial to T1, flexible lead to X1, leaving X free; X2 to X3, earth to T2. Tuning is carried out on the variable condenser C2, which is in parallel with the coil L1, and reaction is obtained by coupling L2 to L1.

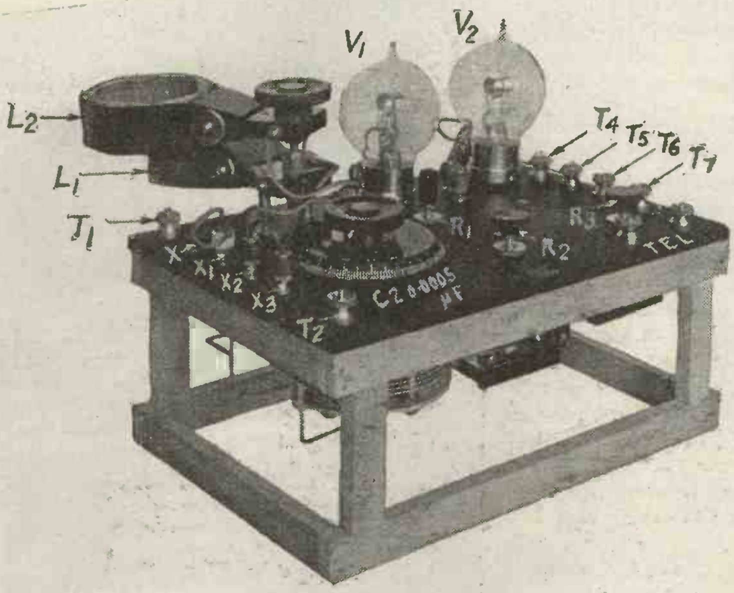


Fig. 2.—The general appearance of the set.

Series Tuning

The aerial tuning condenser may be placed in series with the aerial tuning inductance by making the following connections, starting with all terminals and sockets in the aerial circuit free: Aerial to T1, flexible lead to X3, leaving X, X1, and X2 free; earth to T2.

The inner grids of the valves, which are connected to a small terminal upon the cap of the valve, are connected externally to two “Clix” sockets upon the panel, these being situated behind the valve-holders. The remaining three electrodes are joined to the usual four-pin cap, the usual socket thus being used.

One or Two Valves

The second or note-magnifying valve may be cut out by joining X10 to X8 by means of two “Clix” plugs, joined by a piece of flexible wire, the filament of the second valve then being

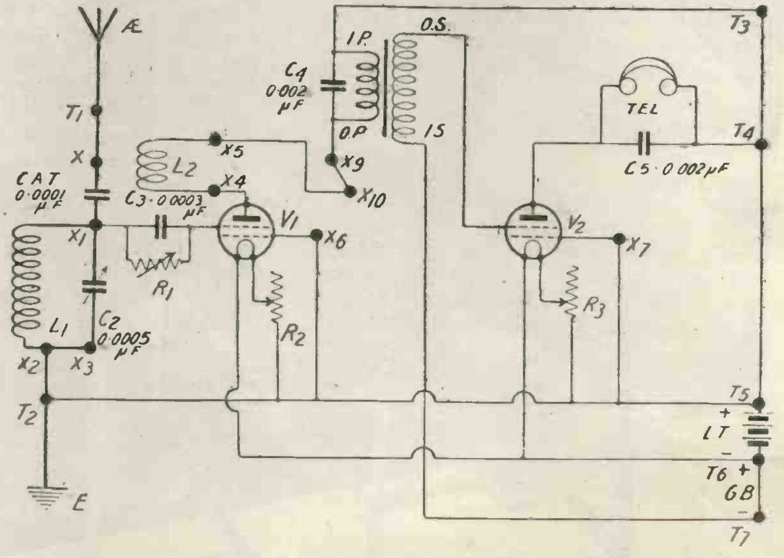


Fig. 4.—Showing the high-tensionless circuit using two valves. Constant aerial tuning is employed.

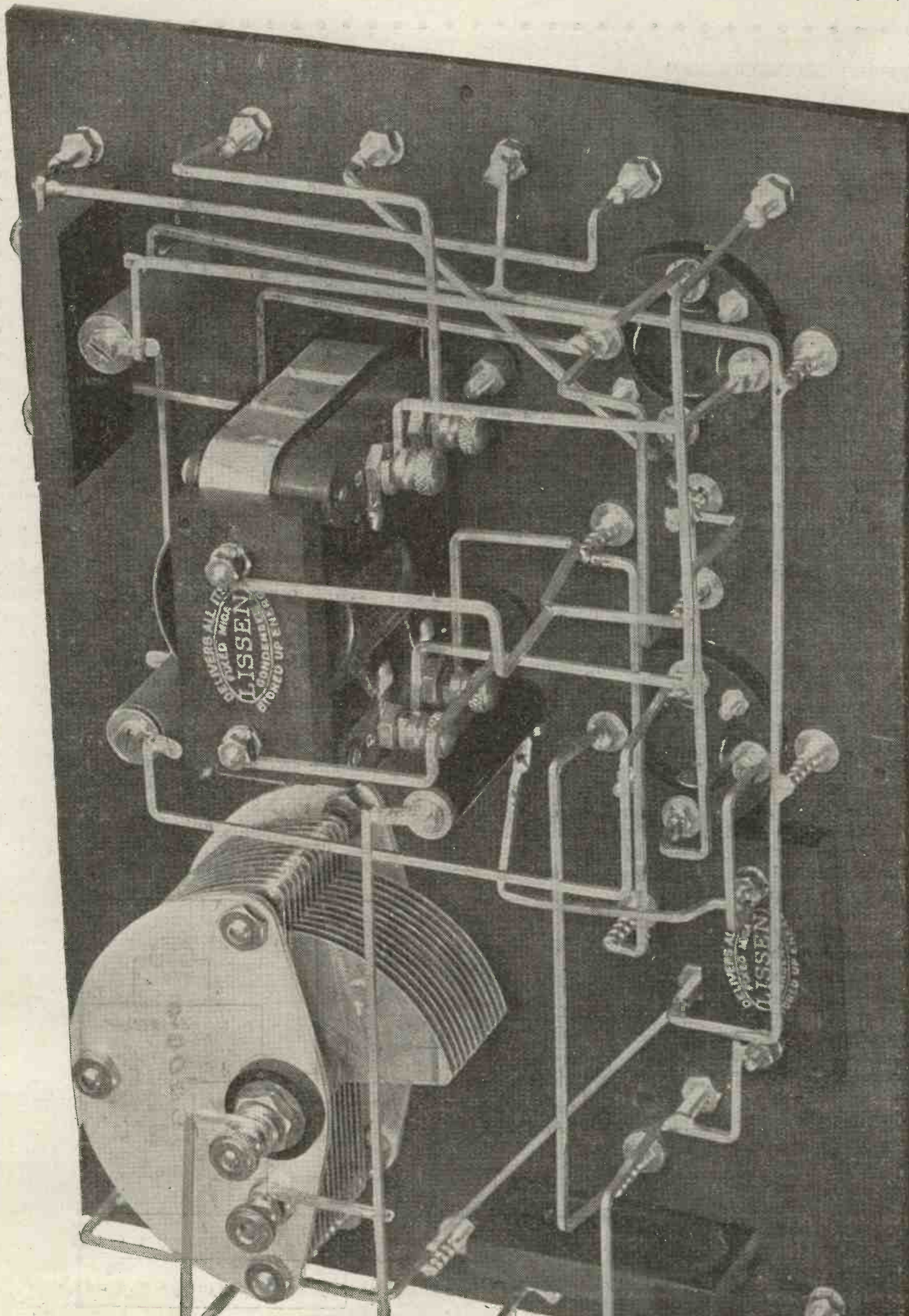


Fig. 5.—A photograph of the back of the panel showing the layout of the parts and wiring.

switched off. The receiver now acts as a single-valve detector with reaction. To switch the second valve into circuit, the "Clix" plug in the socket X8 is moved to X9, leaving the other plug in X10, and the filament of V2 is turned on. The receiver now functions as a single-valve detector with reaction, with the addition of one stage of low-frequency amplification. A terminal T7 is provided, by means of which grid bias may be applied, and when no grid bias is used, T7 must be shorted to T6 by an external short link.

Omitting the H.T. Battery

When the set is to be used with no high-tension battery, the terminals T3, T4, and T5 are joined together by a piece of wire, thus completing the circuit from the anodes of the valves to the positive of the low-tension accumulator. The inner grids of the valves must be connected to the sockets on the panel, these sockets being connected to L.T. positive.

Using the Set with High Tension

The set may be used as an ordinary two-valve receiver, with the usual high-tension battery without altering the existing wiring in any way. All that is necessary is to take out the link between T3, T4, and T5, and join T3 and T4 to points on the high-tension battery, the negative of the latter being connected to T5, as also is the positive of the low-tension battery. Ordinary valves must be used when the set is used in this manner, and the sockets for the extra grids are left open.

Components and Cost

The component parts required are of quite ordinary make, no special parts, apart from the valves, being required. The constructor is advised to adhere as closely as possible to the specification given, but he may use such parts as he may have to hand, provided they are of good make.

The H.T.C. valve holders, type C, which are used on this receiver are of a very neat and compact design, being mounted below the panel, the valve plugging into the usual four holes, which are drilled in the panel itself. Contact is made to the legs of the valves by means of pieces of springy brass which press firmly against the valve legs. A drilling template is supplied with each valve holder. These valve holders possess the great advantage of extremely low capacity, combined with the fact that it is impossible to short the filament of the valve across the high-tension supply when inserting into the socket, as no metal parts are exposed.

Components.	£	s.	d.
Panel, 10 in. by 7 in. by ¼ in (Paragon Rubber Co.)	0	5	0
Wood for framework, 7 ft. at 2d. per foot ...	0	1	2
1 0.0005 Variable Condenser (K. Raymond, New type, with dial) ...	0	5	7
1 Two-coil holder (Goswell Eng. Co., Ltd., Type V)	0	7	6
9 4 B.A. W.O. type Terminals at 2d.	0	1	6
7 Clix, complete with Insulator and Locknut at 4d. (Autoveyors) ...	0	2	4
11 Clix, with Locknut only at 3½d. (Autoveyors)...	0	3	2½
2 Lissenstat Minor Filament Resistances (Lissen, Ltd.)	0	7	0
1 Lissen Variable Grid Leak (Lissen, Ltd.) ...	0	2	6
2 H.T.C. Valve Holders, Type C (H.T.C. Electrical Co.)	0	3	0
1 Royal L. F. Transformer (R. A. Rothermel, Ltd.)	1	0	0
1 Lissen 0.0001 fixed condenser (Lissen, Ltd.).	0	2	0
1 Lissen 0.0003 fixed condenser (Lissen, Ltd.)	0	2	0
2 Lissen 0.002 fixed condensers (Lissen, Ltd.)	0	5	0
18 ft. Tinned Bus Bar Wire (Sparks Radio Supplies)	0	1	8
Screws, Leads, etc. ...	0	0	6½
2 4-electrode valves (Leslie Dixon & Co.)	1	10	0
Total	£5	0	0

(*Continued on page 89.*)

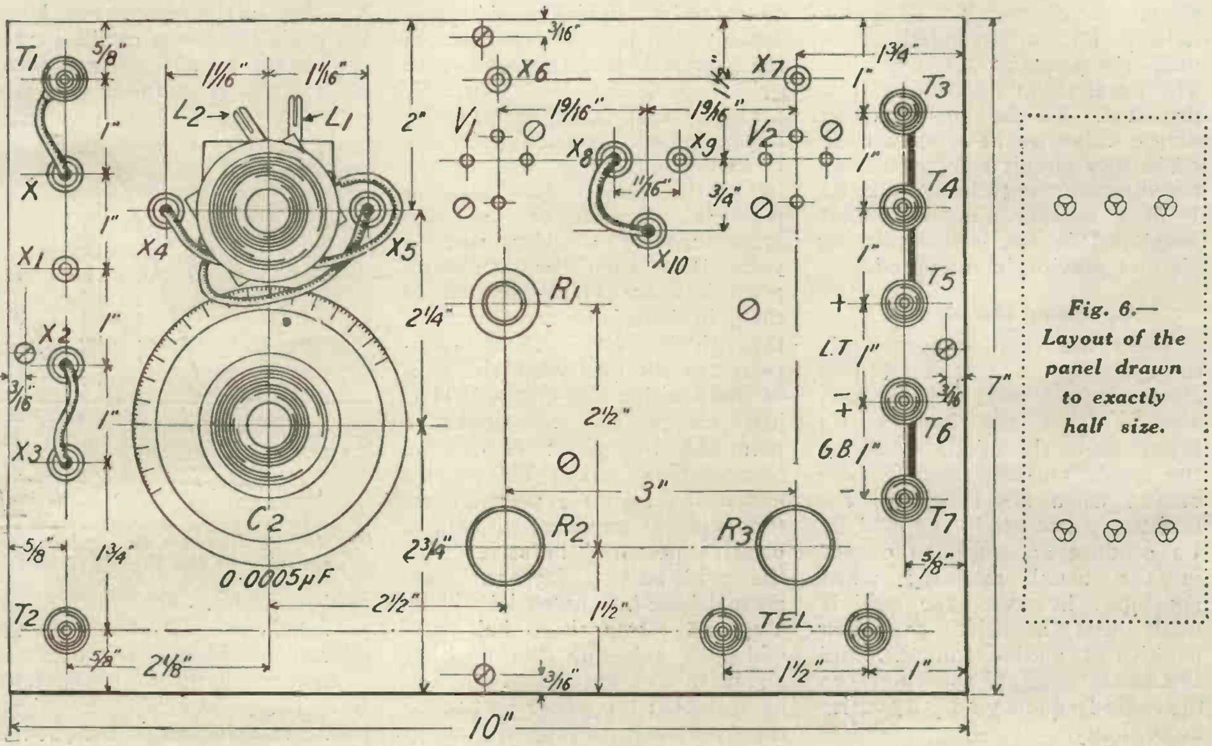


Fig. 6.—Layout of the panel drawn to exactly half size.

C.W. and Telephony Transmission Using Valves

No. XVIII.

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

ANOTHER circuit using a separately excited amplifier valve is shown in Fig. 48. Here we apply the radio-frequency currents to the grid through a transformer L1 L2, the coupling between the coils being preferably variable; we also connect in the grid circuit the secondary T2 of a microphone transformer T1 T2 and a battery B3, so arranged as to make the potential of G negative. The usual shunt condenser C1 is provided. In the anode circuit of the valve we have shown the oscillatory circuit separated from the direct-current circuit A Z B2 F in a manner similar to that employed in the self-oscillating circuits previously discussed.

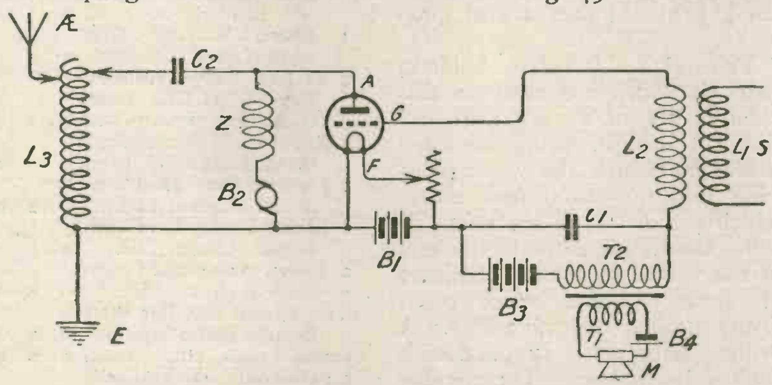


Fig. 48.—The high frequency output of the valve is varied by altering the grid potential by means of the microphone.

Operating the Circuit

There are two chief methods of operating a circuit of this character; we may, for example, arrange that the battery B3 brings us to the middle point on the anode current characteristic curve; when not speaking, the oscillatory potentials supplied by L2 produce an amplified output in the usual manner; when speaking, however, the grid is made first negative and then positive at audio-frequency, and the anode current, and therefore the radio-frequency output, varies accordingly.

Another Method

The other method of operation involves the use of a high negative potential, which is more than that required to cut down the normal anode current of the valve to zero. Fig. 49 will show more clearly how the circuit operates. The curve A B C D represents the grid-potential-anode-current, characteristic which should preferably lie just to the left of the vertical line through zero grid voltage. We normally arrange that the battery B3 brings us to a point V1 on the characteristic curve well to the left of the bend B. This negative potential should be adjusted approximately to just such a value that when the oscillatory potentials are being applied to the grid there is no anode current through the valve. These conditions are obtained when the peak of the positive half-cycles P H C just brings the representative point to the point B on the characteristic curve. If, now, we lessen the negative potential on the grid by connecting, say, a positive potential in series with the grid battery B3, our new normal base-line potential will be V2, and the positive half-cycle will now take up the position shown by the dotted line. It will be seen that the upper portion of the positive half-cycle will sweep along a portion of the characteristic curve, and the length of the curve over which the positive half-cycle sweeps will simply depend upon the extent to which the negative potential V1 has been decreased.

The Negative Half-cycles

In the Fig. 48 arrangement the positive half-cycles which lessen the normal negative potential on the grid are provided by the secondary T2 of the microphone transformer; the negative half-cycles move the base-line potential further to the left, but since the high-frequency output of the amplifier valve cannot be reduced below zero, these negative half-cycles do not enter into the operation of the circuit.

A Practical Circuit

This method of modulation gives such good results that a practical form of the circuit is reproduced in Fig. 50. A valve V2 acts as the master oscillator, the radio-frequency oscillations in the circuit L3 C3 being induced by a variable coupling into the grid coil L2. The microphone potentials are obtained from the microphone M which is operated from the filament accumulator B1. The secondary of the microphone transformer is included in

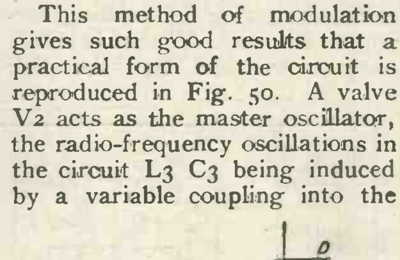


Fig 49.—A diagram to explain the operation of the Fig. 48 circuit.

the grid circuit of the amplifier valve V1. The negative grid potential which is necessary to make the apparatus function in the manner described is obtained, not from a battery which is usually inconvenient, but the gridleak R4 of the oscillating

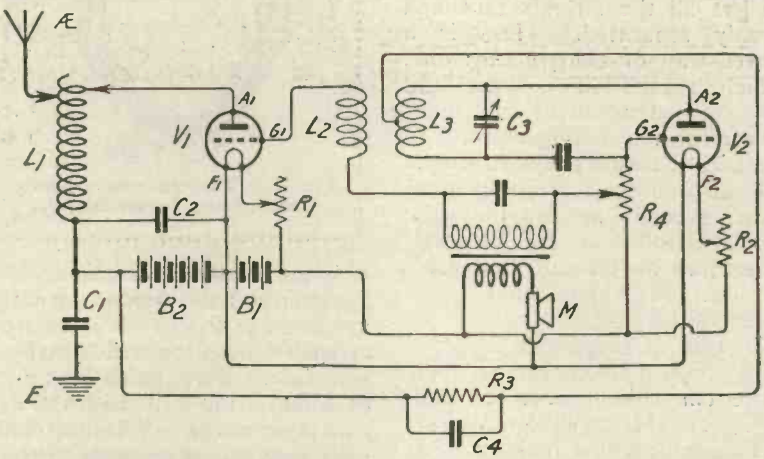


Fig. 50.—A telephone transmitter using a power valve V1 and a master oscillator V2.

valve V2. There is a steady drop of potential across this leak, and by taking a suitable tapping from the resistance we can give G1 the required negative potential. If the negative potential thus obtained is not high enough, we may connect a battery in series.

Practical Notes

The only additional feature of the circuit which is of interest is that we employ a single source B2 of anode voltage for both valves. If the voltage of B2 is too high for the oscillating valve V2 which, of course, is not required to develop much power, we can either take a tapping off B2 or, when a motor-generator is used, we may connect a suitable resistance R3 in series with the anode A2. This resistance R3 is preferably shunted by a fixed condenser C4. Two filament rheostats R1 and R2 are provided, as in all transmitting circuits it is desirable to provide for separate filament current regulation in each valve.

Varying Anode Voltage of Separately Excited Valve

Another method of obtaining a modulated output from a separately excited valve is to cause the microphone potentials to vary the anode voltage of the amplifying valve. It is found that the radio-frequency output of such an amplifying arrangement is approximately proportional to the voltage on the anode; by arranging that the microphone potentials vary this voltage, we can therefore vary the aerial current.

Controlling the Anode Supply by means of the Microphone

Fig. 51 shows a theoretical arrangement in which the microphone supplies, by means of the microphone transformer T1 T2, the required potentials for operating the anode circuit of the valve V. It is possible to dispense with a steady anode voltage, but it is usually desirable to arrange a battery B2 and to superimpose the microphone potentials on this steady anode voltage. By dispensing with B2, or arranging that its value will be small, we can obtain a quiescent aerial effect. It will usually be necessary to amplify the microphone potentials by one or more stages of low-frequency amplification before applying them to the anode circuit of the amplifier valve V.

A Similar Arrangement

Another rather similar arrangement involves the use of a second three-electrode valve in series with V for the purpose of varying the output from the aerial. This arrangement is analogous to that employed in Fig. 46.

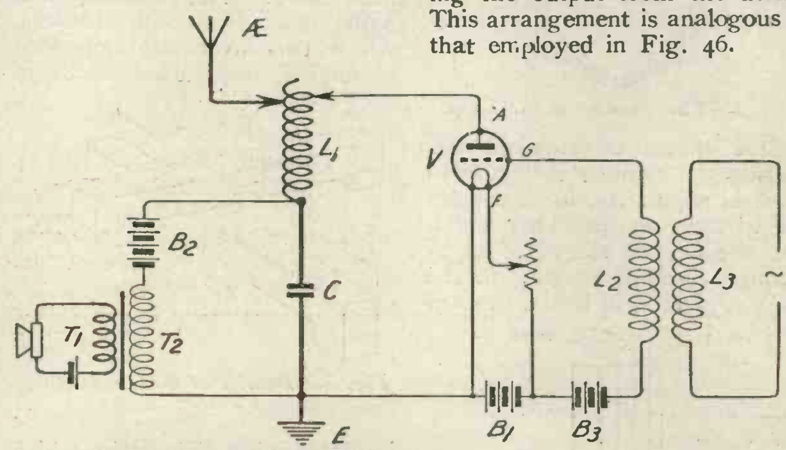


Fig. 51.—A theoretical arrangement in which the output of the valve is varied by altering its anode voltage.

THE W.W. HIGH TENSIONLESS RECEIVER

(Continued from page 87.)

Panel Layout

A half-size drawing of the layout of the parts on the panel is given in Fig. 6, and all the necessary dimensions for drilling the holes are given. In accordance with a practice frequently advocated in this journal, the holes for the bolts which secure the transformer to the panel are not dimensioned, as it is realised that these distances vary not only with the make of transformer used, but also with the particular model of any make. A drilling template for the valve holders is issued with each holder, thus ensuring accurate drilling of the holes for these parts.

Mark out the positions of the holes with some sharp-pointed instrument, but on no account should a pencil be used, as it will be remembered that some grid leaks consist of pencil lines. R1 is the Lissen variable grid leak, and R2 and R3 are the Lissenstat minor filament resistances, the former of which requires a ½-in. hole to be drilled for it, while ⅜-in. holes are necessary for the latter.

A Novel Frame Aerial

IN these days of really efficient receiving sets the frame or loop aerial is coming more and more into general use. It is extremely handy, it takes up little room, its marked directional properties make for great selectivity, and it is much less susceptible than is the open aerial

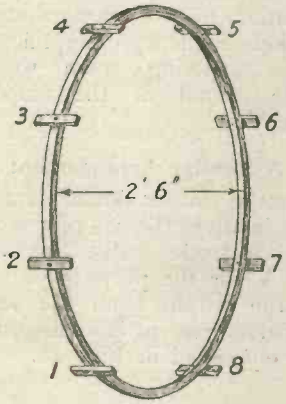


Fig. 1.—The details of the hoop.

to the effects of atmospherics. During the summer it is sure to grow in popularity, for it enables the wireless set, provided that it has one or two stages of high-frequency amplification, to be used at picnics, in boats, or even

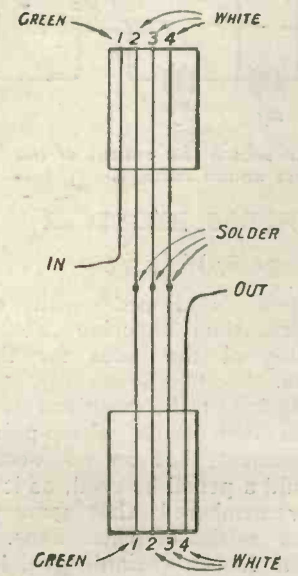


Fig. 2.—Showing how the joints are made.

in motor cars. Frames are rather expensive to buy, costing, as a rule, from thirty shillings to a couple of pounds, and if they are made at home by the usual methods it is not an easy business to get all the strands taut and evenly separated. Here is a novel way of constructing one, which results in a neat and efficient instrument at the trifling cost of only a shilling or so. The method of making it is so simple that anyone can turn it out in an hour, even if he has only the simplest tools at his disposal. There are no ebonite "combs" to cut out and winding is ridiculously easy.

Instead of single flex or d.c.c. wire we will make use of a far more convenient form of winding. The Metropolitan Vickers Company are now making what is known as the Cosmos Inductance Strip. This consists of a paper tape, ¾ in. wide, between whose two layers are embedded a number of parallel strands of

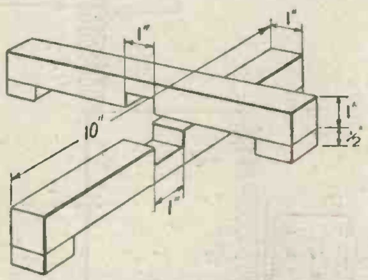


Fig. 3.—Details of the supporting stand.

insulated wires. The strip, which is very cheap to buy, is made in three sizes, containing three, four and seven strands of wire respectively. In the first the spacing between leads is 3/16 in., in the second ⅛ in., and in the third rather less than 1/16 in. The four-wire strip, with its ⅛ in. separation of leads, is ideal for short wave frame aerial winding. It costs 4d. per dozen feet, and for a frame to cover the broadcast wavelengths one and a half dozen feet will be ample.

The frame itself is made from a wooden hoop, obtainable at any toy shop, 2½ feet in diameter. Eight or twelve pieces of ½-in. hard wood, each 2 in. long by 1 in. wide, are cut out. These are fastened by screws to the circumference of the hoop, as shown in Fig. 1. The paper

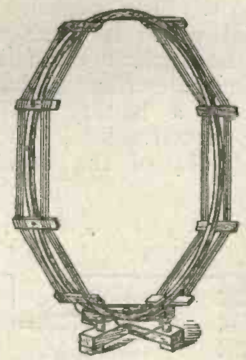


Fig. 4.—The general appearance of the frame aerial.

strip is now wound on clockwise, beginning at the supporting strip marked 1 in Fig. 1. It is secured at each crosspiece with a dab of seccotine. Care must be taken to wind on the strip with the flat side downwards. When a complete turn has been made on one side of the hoop the strip is taken across to the other and a second is wound on.

The strip is now cut, and the paper is pulled away from the wires at both ends. Fig. 2 shows how the necessary joints are made. One of the outside wires in the strips has a green covering; the remainder are white. Make the green wire the "in" end of the windings and the outside white wire the "out" end. Solder the green-covered wire to the first white one, and so on. Nothing now remains but to mount the frame on a suitable stand. This may be in the form of an X made from two pieces of 1-in. wood, 10 in. in length and 1 in. wide. These are "halved" together, as shown in Fig. 3. Terminals, fixed in insulating panel bushes, are mounted to two of the ends of the cross. The hoop is then secured to its stand by a couple of screws. Fig. 4 shows the finished aerial.

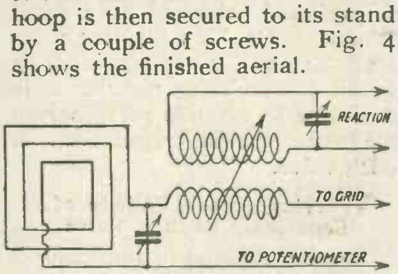


Fig. 5.—Showing one method of introducing reaction.

Those who have had no previous experience of frames must not expect too much. They are, as a rule, "one valve worse" than open aerials. That is to say, if you wish to obtain the same strength from a given transmission with the frame, as upon the open aerial, an extra high-frequency valve must be added. But reception can be strengthened greatly by making full use of reaction, as shown in Fig. 5. One need have no qualms about using reaction with a frame, for owing to its feeble radiating qualities it is not likely to cause interference with others. The reaction coil is coupled to a small inductance in series with the frame. To allow the frame to be used with an inductance of suitable size it is as well to take tappings from the sixth and seventh turns of the strip windings. This is very easily done, for the wire can be removed from the paper for an inch or two by prising it up with the points of a pair of scissors. The insulation is then scraped away and leads are soldered on at the tapping points. These leads may be brought to another pair of terminals mounted upon the stand.

R. W. H.

Quick Wiring Connections

It is often desirable with any type of set to be able to make or unmake certain connections quickly and without the bother of having to fiddle with screw terminals. Here is a very simple way of making connecting links of a most convenient type at small cost. It is necessary, in the first place, to secure some valve legs with 4B.A. shanks. 4B.A. *should* be the standard size, but for some unknown reason a certain number of makers prefer to make them either 5 or 6B.A., which certainly does not add to the convenience of amateur constructors. Having obtained these, rub down the threads with emery paper until the shanks will just fit into the sockets of other valve legs. Then, with a fine-bladed saw, split the shank after the manner of a valve pin. A little of the thread should be left near the top of the shank in order to allow for a nut to fix leads. The drawing shows how the converted legs are used. One great

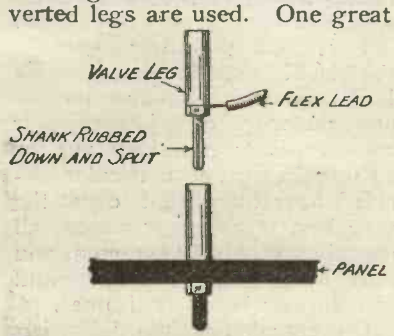


Fig. 1.—A quick method of connecting by means of valve legs.

advantage of the method is that any number of connections may be made at one point, the valve legs simply being fitted into one another. This method is most convenient for experimental panels, such as the Omni-Circuit Receiver, since it allows any kind of circuit to be wired up in the shortest possible time. For use with this receiver a selection of leads from 2 to 12 inches in length should be prepared, each fitted with converted valve legs. On the panel itself valve legs may be used to replace the terminals, or the method shown in Fig. 2 may be employed. Remove the nuts from those terminals which it is desired to prepare for quick connections. Take an equal number of valve legs and

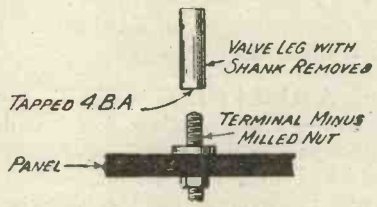


Fig. 2.—Another method, using valve legs and terminals.

cut their shanks off close. Place them one by one in a vice with the hole uppermost, and run a No. 35 drill right through them. Then tap the lower end of each 4B.A. Valve legs so treated can be used to replace the milled-headed nuts of the terminals, and when this is done the quick connection method described becomes at once possible. One advantage of this method of making quick connections is that it is exceedingly cheap, since quite good valve legs are obtainable at about 1od. per dozen.

R. W. H.

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An Easily Made Multi-Phone Board

One often wants to be able to attach an extra pair of 'phones, or perhaps several, when friends come round to listen to the wireless set, if it is not sufficiently powerful to work a loud-speaker. It is not satisfactory simply to attach the various pairs of 'phones to one set of terminals, for it is very difficult indeed in this way to obtain a proper connection. A simple little board for use at such times with several pairs of 'phones is shown in the drawing. It consists of a small panel made of ¼-in. ebonite, upon the upper side of which are two rows of terminals. On the underside are brass strips connecting all the members of one row together. By means of this little device, each pair of 'phones has its own terminals and good connections are assured. It is not always realised that even a crystal set, if signals are fairly loud, will operate more than one

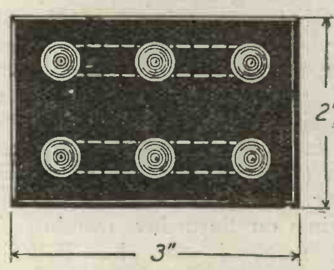
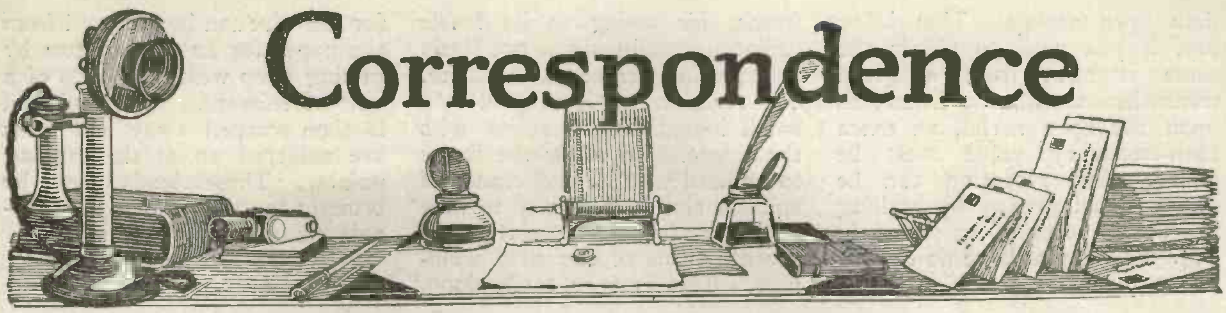


Fig. 1.—The connections.

pair of 'phones quite satisfactorily. If, however, only one pair is available, and two people desire to listen to some item of particular interest at the same time, it is quite possible for them to do so by the simple expedient of removing the headband and taking one receiver apiece.

R. W. H.



A DOUBLE REACTION RECEIVER

SIR,—Please allow me to congratulate you on the design of many of your circuits, which are, in my opinion, just " it."

My first real construction of a set was from *Modern Wireless*, of June, 1923, " A Broadcast Set Employing Reaction," by G. P. Kendall, which turned out a huge success, all the B.B.C. stations being received on it. My next was the 3-Valve All-Concert Receiver, from issue of *M.W.*, of September, 1923. This set brought in the distant stations more clearly, but, on the other hand, I was still dissatisfied with the results from the Continental stations, so I tried another of Mr. Percy W. Harris's circuits, given in the issue of February, 1924: " Some Experiments in H.F. Amplification," this being the " Grebe " circuit as described by him with one stage of L.F.

I found particular interest in this circuit owing to my being unable to make it stable; however, the results obtained were beyond all others obtained by me at that time.

On May 3 I completed the receiver described in the issue of *Wireless Weekly* for April 16, 1924, but with the addition of an L.F. stage, and to my surprise this circuit has given me more satisfaction than any I have yet built (" A Double Reaction Receiver," by S. G. Rattee). Before retiring on Saturday evening I had received all the B.B.C. stations, most of them on the loud speaker, " Ethovox " (Sen.), School of Posts and Telegraphs (loud speaker), and another French station which I have yet to locate (working on about Cardiff's wavelength). It may interest you to know the various components used on this set, so I herewith give a list :—

Aerial condenser .00075 μF.

C2 condenser .0005 μF.

L1 Igranic 50 with 15 turns removed.

L2 Burndept 75.

L3 Burndept 4.

3 M.O. valves with 75 volts on the plates.

I found it unnecessary to use the .002 μF fixed condenser across the 'phones, perhaps being due to my using the L.F. amplifier.

In concluding, I may say that up to the present this is the best all-round receiver I have yet handled.

Wishing your valuable papers long life and further prosperity,

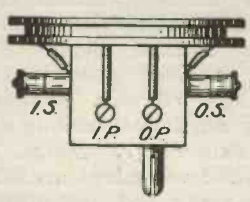
I am, yours faithfully,

D. CAMPBELL.

Kilmarnock.

A USEFUL GADGET

SIR,—The following sketch will perhaps explain an accessory which I find very successful for use in connection with the " Omni." In the course of various experiments with a number of circuits the necessity to use a tuned anode H.F. coupling is rather a handicap, especially when using two stages of H.F.; with the aid of this " gadget," however, circuits like the ST124 are obtained as easily as any. One or both coil-sockets on the front panel are called into use for this component, which consists of an ordinary H.F. aperiodic transformer wound to the required wavelength. This is screwed to the top of a plug-in coil socket, the inside and outside primary being taken to the two screws provided. Two small terminals are fitted to the sides of the plug to receive the inside and outside secondary. Unless the experimenter cares to insert permanently two more pairs of terminals on the panel in the same manner as the A. and E. terminals, the thin rubber-covered leads for I.S and OS can be allowed to project from under the lid during the trial of circuits, using aperiodic H.F. coupling. Where large valves, such as " R " type, are in use, the " former " may be oval in shape to clear the valves.



The arrangement referred to by Mr. Geo. F. Rose.

Trusting this " gadget " may be of some service to other users, and thanking you for the excellent " Omni."—I am, Dear Sir, yours faithfully,

GEO. F. ROSE.

Wealdstone.

IP AND OP

SIR,—Your article on page 631 of April 16 has raised a subject over which there have been many heated arguments.

Transformers are frequently placed in a circuit without the circuit having been studied if it is suitable for any particular make of transformer. This point is frequently overlooked, but it makes a very considerable difference *how* the circuit is arranged.

It is usual practice to connect the H.T. negative to positive L.T.; this has an effect on the performance of intervalvular action. After experimenting for 12 months on one particular circuit I have found that to get the very best transformer action, all negatives should be common, and also connected to earth, and transformer boxes or frames.

On actual test the following results were noticeable. IP to plate, OP to battery gave a greater amplification, but was more resonant and nasal, but this could be overcome to a fair degree by shunting a large condenser across the 'phones. Connecting OP to plate and IP to battery gave very good amplification, perhaps not so strong, but clear, the note was also slightly deeper, no shunting condenser was needed. In all these experiments .001 condensers were across the primaries.

Give me OP to plate and IP to battery every time, and the arrangement of wiring as described above; with due care better reception is experienced, with greater amplification owing to this arrangement, and no great tendency to self-oscillation.

In these particular experiments Fuller transformers were used, in conjunction with power valves, using 300 volts H.T. and 10 volts grid bias.—Yours faithfully,

J. P. J. Chapman.

Bournemouth.

TYPE W4 RECEIVER

Sir,—Having constructed the 3-valve set, Type W4, described in your very valuable paper, *Wireless Weekly*, I thought perhaps you would like to know the results obtained. After reading the report of the editorial test of the above set, I obtained the necessary extras for converting my ST100, and referring to the wiring diagram given in the following issue, I wired up the set and tried it out the same Wednesday evening.

I am situated some 26 miles from London, and 2LO came in with such volume on a loud-speaker, consisting of an Amplion attachment to a wooden-horned cabinet gramophone, as to cause a headache, unless very much detuned. Bournemouth came in as loudly as did 2LO on the ST100, which was of considerable volume. Manchester was easily separated from 2LO, and gave sufficient volume to fill a medium-sized room and be heard along a passage 15 ft. long. Aberdeen was also heard quite intelligibly, though not so loud as the others, of course.

I am using the following components:—Polar .005 variable condenser. Raymond vernier (which I found invaluable). Cossor valves. Dubilier fixed condensers. Watmel variable gridleaks. Lissenstats. One Igranic transformer. One transformer, supplied by the Polar-Blok firm, with an average aerial and earth.

The tone and volume obtained from the above set left nothing to be desired, and being a complete novice, my success was solely due to the very explicit instructions furnished in your helpful paper. (I wouldn't be without it if it cost twice as much.)

Thanking you, and wishing your papers the success they so richly deserve.—Yours faithfully,

Wm. L. Green, M.P.S.

Woking.

THE CARDIFF ANNOUNCER

Sir,—I read the letter from "A Comradio" *re* Cardiff's announcer with a feeling of disgust. We in this part of the world look on Cardiff as our provincial station, as it is not only the nearest but comes in best. Notwithstanding this, not only myself, but my friends also, were extremely delighted when your editorial appeared containing your opinion of this announcer. It expressed our views to a "T," and I have not found anyone yet who disagreed with it. London has the advantage of having within reach a great deal of

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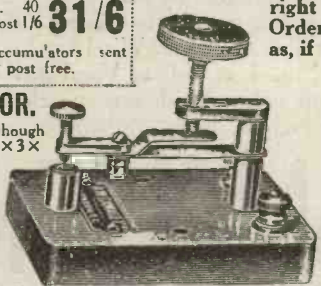

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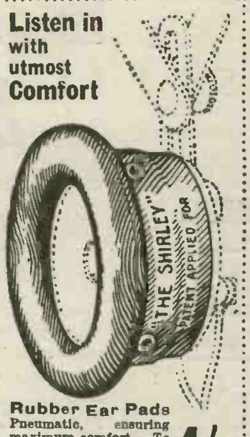

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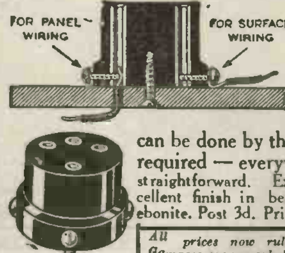

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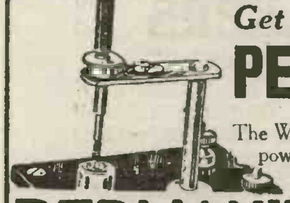

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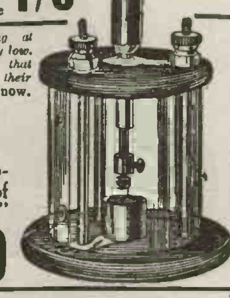

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talent which provincial stations cannot get, so that friendly criticisms from this quarter are always welcome.

Round here, too, as at Taunton, the word "Comradio" is heartily disliked, and the Cardiff station would be more in favour if it dropped it.—Yours faithfully,

H. WARE.

Woodbury.

THE OMNI RECEIVER

SIR,—I expect there are many wireless enthusiasts who, like myself, have built the Omni Receiver, but have made slight alterations to suit their particular needs and tastes.

The original receiver has only five fixed condensers, each of which is taken to a pair of terminals on the panel in the same manner as the rest of the components. These few condensers cover a rather limited range, as many values frequently needed are not included.

On my set I have used condensers of the type sold by Messrs. McMichael. Each of these is sold with a pair of clips to hold it. At the rear of the terminal panel of my receiver I have mounted four pairs of these clips, each fixed on by a terminal, which thus serves a double purpose. Then in order to try out the effect of different values of fixed condensers, all that is necessary is to join a pair of clips by means of the terminals in the positions of the circuit needed, and then clip in various values until the best is found. It is hardly necessary to have more than four or five pairs of clips, as it is not often that more than these are required in any particular circuit.

This method I consider much better than continually changing over the leads to different positions on the panel to try different condensers, but its great advantage is that one is not limited to four or five values only, as any number of condensers can be kept on hand to plug-in as required. If all these were mounted under the panel, as in the original receiver, it would obviously take up a very large amount of ebonite.

I have made another alteration in the matter of transformers. I have for some time used and obtained very satisfactory results with two transformers of a very cheap, but very popular, pattern. They are of the type which has the four terminals mounted on an ebonite base. I mounted these transformers direct on to the terminal panel of the receiver. This was done by removing the small ebonite base of each one and using this as a template, drilling six holes on the panel. Two of these were to take screws to fix the transformer on the panel and four for the IP OP IS OS terminals. These transformers can easily be mounted in this manner, but care must be taken that none of the leads are broken, as, of course, they are very fragile. This method of mounting not only saves room, but also lessens the amount of wiring in the receiver—a not inconsiderate item in a set of this nature. For obvious reasons the two transformers should be mounted at right angles, if it is possible.—Yours faithfully,

A. H. GLOVER.

Highbury Hill, N.4.

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W63

Apparatus we have tested

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

Electron Aerial Wire

Messrs. New London Electron Works, Ltd., have submitted samples of their insulated cable for test as a substitute for the customary stranded copper wire used for aerials. We have already put this cable to extensive trial as halliards and rigging for wireless masts, etc., and for loud-speaker and 'phone extension-leads.

It will be recalled that this cable is made up of seven fine steel wires, tinned and insulated somewhat heavily on the outside. In order to make a precise quantitative test of this in comparison with ordinary 7/22's stranded (bright) copper cable, two special test aerials were erected, so arranged that either the stranded copper or the Electron cable could be hoisted rapidly into exactly the same position, with similar insulators and length of lead-in, etc. The signal-strength was then measured on the local broadcasting in three ways: directly on the crystal by rectification of the whole carrier wave; in valve reception measuring the signal-voltage by the method of the Moullin voltmeter; and after a constant efficient stage of L.F. amplification the average audio-frequency voltage across the 4,000 ohm phones was measured directly, for a fairly uniform transmission of speech. The change was made from one aerial back to the other as rapidly as possible, the one not in use being lowered right out of the way meanwhile; and all measurements were repeated on the standard 7/22's cable, before and after those on the Electron cable. Only in this way can results of any relevance be obtained, casual observations at different times being quite illusive.

The aerial was an average kind of suburban aerial: 70 feet long of single cable, and average height 17 feet, over grass lawn; and was, as usual, rather screened. The lead-in was just over 10 feet in length, straight through the window of a low first-floor to the receiver. The earth was of unusually low resist-

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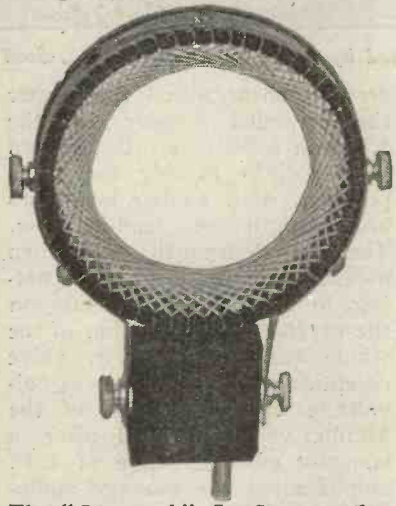
ance, directly down outside the house to a large lead water-pipe. The tuning arrangements were of considerably less resistance than is customary, and in the case of the valve-reception were arranged to give the maximum signal-voltage by the use of a small series condenser and critical, finely-controlled reaction. Accordingly, quite small differences in efficiency of the aerials should have been noticeable. With common types of inefficient receiving apparatus small differences might have been overlooked.

At 13 miles, the standard low-resistance variometer gave 11 microamperes with both Electron and 7/22's cable, rectifying with a good galena crystal as usual. In comparison, the higher twin 40 foot aerial near-by has given an average of 18 microamperes daily for some months, occasionally falling to 15 microamperes.

With .0002 μF series fixed condenser, and low-resistance variometer, 40 volts H.T. on a good French R valve and 1 ma. initial plate-current, 2LO's wave gave with critical reaction (with speech, etc., still clear) a signal-voltage of 1.6 volts with each cable, repeatedly.

With a real stage of L.F. amplification beyond, there resulted across the phones a signal-voltage swinging between 1 volt and 1.7 to 2 volts on fairly uniform speech (address by the Chief Scout from 2LO)—any advantage being slightly in the favour of the 7/22's cable. This gave on an efficient loud-speaker undistorted speech with every word audible the length of a large garden. Accordingly, with ordinary types of apparatus such an aerial should give a fair measure of loud-speaking for, *e.g.*, a small room, with this cable.

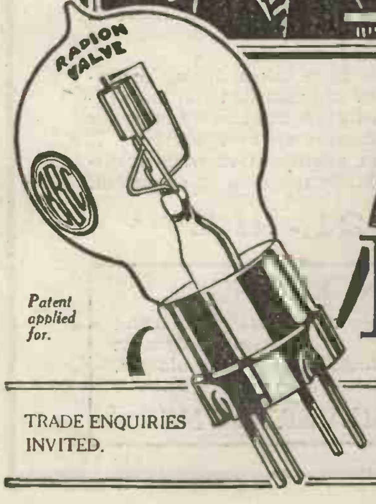


The "Diamond" Sunflower coil, a new type of tuning inductance.

So as to estimate roughly to what extent the heavy dielectric and the use of steel wire had increased the H.F. resistance, the reaction-requirements to bring a direct-coupled aerial (without small series condenser) just beyond the oscillating point were compared.

It was found that these were identical when a fine-wire non-inductively wound resistance whose D.C. value was 12 ohms was put in series in the 7/22's aerial, indicating a correspondingly greater resistance in the Electron wire, on around 365 metres. The capacity of the two aerials was practically identical: .00021 μF for the Electron, and .000205 μF for the other aerial.

Accordingly, the Electron cable is for ordinary reception purposes interchangeable with the standard 7/22's; but for transmitting aerials it would not be advisable to use it in the form of a single strand only.



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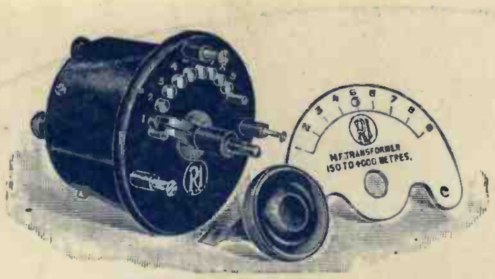

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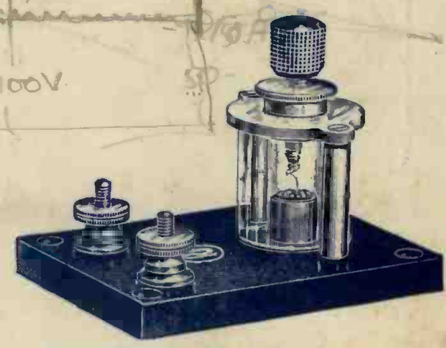

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The set referred to above was used by Mr. Cecil White and was bought from Messrs. Young & Co., Southampton.

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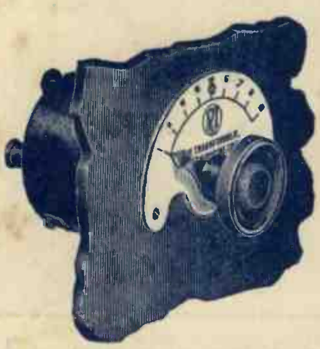

H.F. Transformer and H.F. Reactance showing panel mounting. 150-2,000 metres.

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Wireless Weekly, 6d. Net. Wednesday. May 28th, 1924.

Wireless Weekly

and the Wireless Constructor.

Vol. 4.
No. 4.

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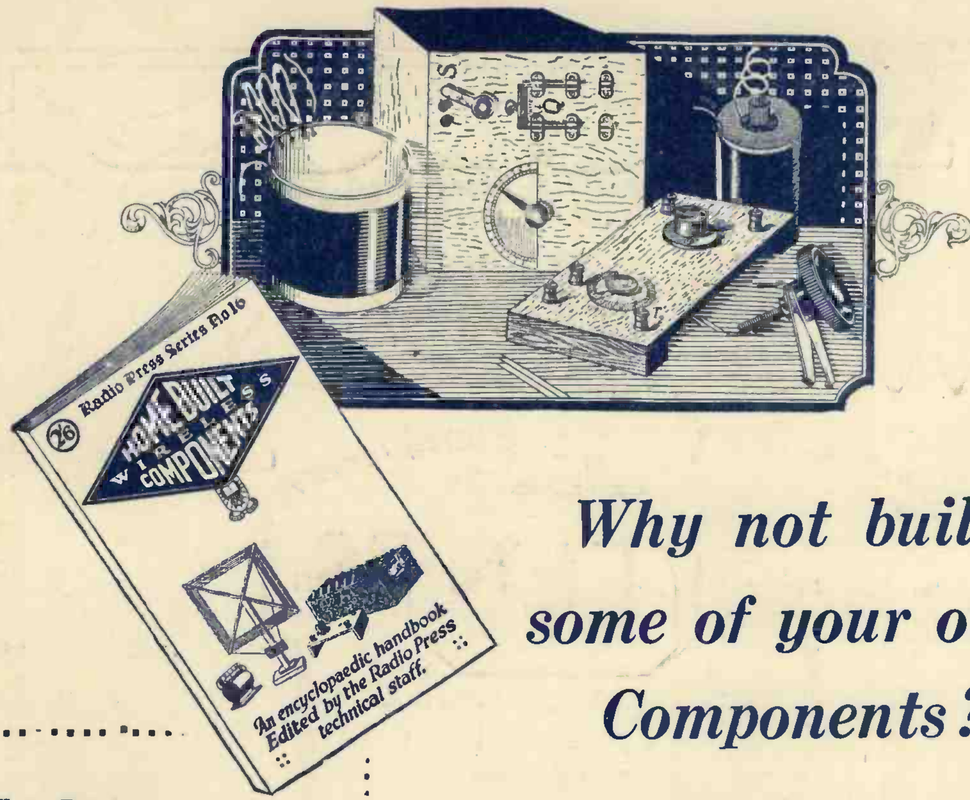
Our New Circuit

No High Tension
Ordinary Valves.



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Homebuilt Wireless Components

Radio Press Series No 16.

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Wireless Weekly

Vol. 4, No. 4
May 28, 1924.

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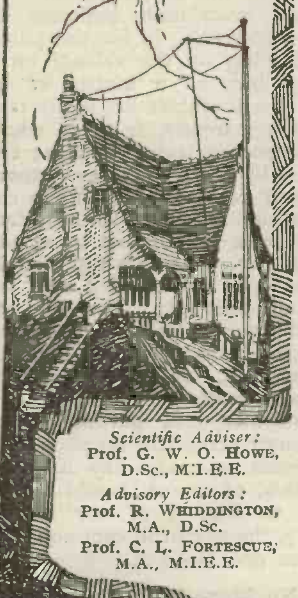

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All correspondence relating to contributions is to be addressed to the Editor of "Wireless Weekly."

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High-tensionless Circuits

WE had not proposed to deal further in a critical manner with the question of high-tensionless circuits, but since our remarks seem to have been taken considerably to heart in a journal publishing the description of the Dowding-Rogers arrangement, it might be as well to amplify a few of our comments, since extracts have been published, apart from their context, and given to assume a special meaning.

For example, the following extract has been made use of: " . . . it is a theoretical and practical impossibility to work a set without a H.T. battery." What we actually said was: " To state that a receiving set operates without a high-tension battery may sound a little sensational, and in a sense it is a theoretical and practical impossibility to work a set without a high-tension battery. What is actually meant is that instead of having two batteries, the filament battery and high-tension battery carry out both functions." A wilful misquotation of this character requires no further comment from us.

A Question of Degree

The next extract identifiable as emanating from this journal relates to two " apparently contradictory " remarks, one of which is to the effect that without a high-tension battery no appreciable signal strength has been obtained, and the other that very loud signals were obtained with the 1918 Army circuit. The words " very loud " in connection with a high-tensionless receiver were actually published three years ago, clear evidence of past success in this field. This does not in any way affect our opinion that the standard was not up to the high-tension battery standard, but nothing has transpired to change our views that, while relatively loud signals are obtainable with certain high-tensionless circuits, yet results are not equal to those obtainable with a high-tension battery. It needs little delving into the works of Einstein to appreciate that signal strength is an elusive matter and that, when dealing with a certain class of circuit, it is possible to call the signals loud, whereas when dealing with another type of circuit the results are not appreciable. Signals from a crystal receiver may be said to be very loud, whereas signals a hundred times as strong, if delivered to the Wembley Stadium, would be regarded as substantially inaudible.

Where Credit is Due

We have no desire whatever to try and minimise the credit claimed by our friends in being the first journal in the world definitely to announce the fact that there was an amazing invention about to be disclosed which would result in the complete abolition of the high-tension battery.

It is *now* recognised that the high-tensionless receiver idea is not new in itself, and that any merit must lie in the particular circuit employed.

It is *now* stated that " the inventors have already tested every known arrangement for dispensing with H.T. supply." Again, later: " Quite true it is that the idea of elimination of the H.T. battery is not new in itself, many have attempted it, many have secured quite good, promising results, but the Unidyne has passed the experimental stage."

How could Messrs. Dowding and Rogers have carried out tests with all previous high-tensionless circuits when they state in their article: " The point we wish again to stress is that, although innumerable attempts have been made to reduce H.T. to a minimum, no one, previously to ourselves, seems to have endeavoured to eliminate the H.T. battery altogether "?

Where We Agree

A further statement appeared to the effect that results equal to sets employing H.T. have not previously been produced, and that they " challenge refutation " on this point. This is one of the few definite statements made with which we thoroughly agree. In the past no high-tensionless receiver has given as good results as one using a high-tension battery, and we have no reason to believe that the position has in any way changed, however interesting high-tensionless circuits may be.

The minor point about our opinion of Mr. Cowper's results as being second to none, given before the actual publication of the Dowding circuit, was apparently raised without remarking that demonstrations of results were given before the publication of the circuit. Mr. Cowper, of course, now makes a distinct further advance by using an *ordinary* valve.

The articles in question describe the use of a transformer which has both primary and secondary connected to the anode circuit. The general description indicates that this, apparently, is for the purpose of stepping up the voltage on the anode, but, as a matter of fact, what the inventors are really trying to do, apparently, is to do what is equivalent to trying to hoist one's self up by one's bootlaces. Another classical example of trying to carry out a similar object is the attempt to propel a sailing boat by standing on the deck and blowing wind into the sails by means of a very large pair of bellows. The use of a transformer to step-up voltages in one circuit and to apply them into another is, of course, a very different matter. Cutting out the transformer and putting a fixed condenser across the telephones does not seem to make any difference, and this, of course, would bring us back to Fig. 3 of our issue of May 7, the circuit in common use in France and Holland.

No More H.T. Circuits?

Since it has been emphatically stated that there is to be " no more H.T.," we are, no doubt, right in assuming that circuits showing high-tension batteries will immediately and permanently disappear from the publication in question. A Gilbertian situation will otherwise arise, which no amount of explanation would render less amusing.

(Continued on page 120.)

A High-tensionless Circuit using Ordinary Valves

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

Details of a new high-tensionless circuit using an ordinary type of valve and employing audio-frequency reaction.

THE problem of applying audio-frequency reaction in order to increase the signal-strength still further, on the analogy of the ordinary radio-frequency reaction which is so effective in this way, has fascinated many experimenters. But the difficulty of controlling low-frequency reaction in any ordinary circuit, and the facility with which, on the other hand, an audio-frequency oscillation of "howl" of a pitch and character determined by the constants of the particular circuit (rather than by received signals) is set up, have largely baffled them up to the present. Only by using two separate valves, or a valve and a crystal, and thus dissociating the detecting or rectifying function from an audio-amplification (as in ordinary dual circuits), has the principle of audio-reflex been successful in circuits which use ordinary valves and high-tension supply. In some two-valve luals, as, for example, in some versions of the S T 100 circuit, there is undoubtedly a limited and controllable audio-reflex action in addition to the regular feed-back via the crystal and L.F. transformer; but whenever this is present in practice the very greatest care is necessary to avoid howling, and that kind of distortion which is due to incipient howling or oscillations of super-audio frequencies. Two-valve duals without a separate crystal rectifier are particularly prone to this kind of trouble.

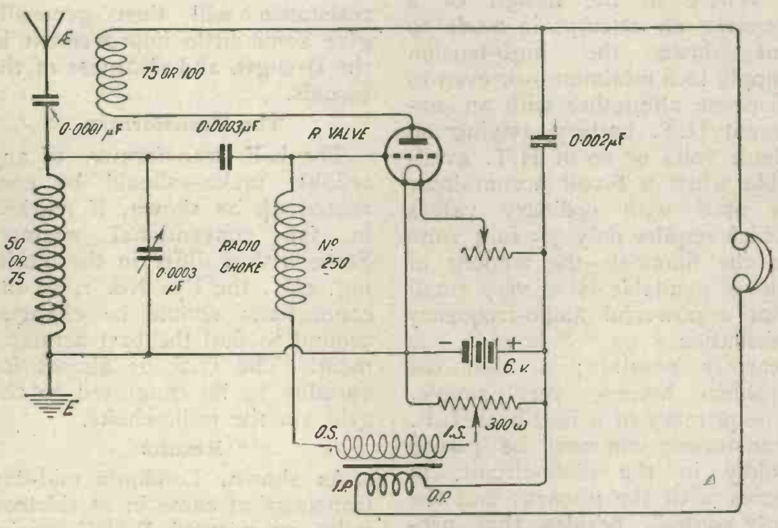

Fig. 1.—The new circuit. It will work just as well with a .06 dull emitter as with an R valve.

In order to produce an audio-frequency howl there is necessary a certain amount of available energy, which is derived from the usual high-tension battery. In H.F. reaction it is possible to obtain a crude control over self-oscillation by tapping the H.T. battery. If in addition the degree of damping in the grid-circuit can be varied by controlling the amount of positive bias on it by means of the conventional potentiometer (of, say, 300 ohms resistance) connected across the L.T. battery, quite fine control of self-oscillation is possible; this expedient is, of course, commonly used in many-stage H.F. amplifiers.

How Control is Simplified

If, now, a very low value of H.T. be used, or actually no external H.T. battery at all, merely the 2-volts or thereabouts) drop of potential in the filament resistance (if this be placed on the positive side of the filament) and a 6-volt accumulator be used with a 4-volt valve, as is common, then there is very little power available to maintain an audio-frequency oscillation, and control becomes a much simpler problem.

It is surprising how little audio-reaction is needed to produce a powerful howl with

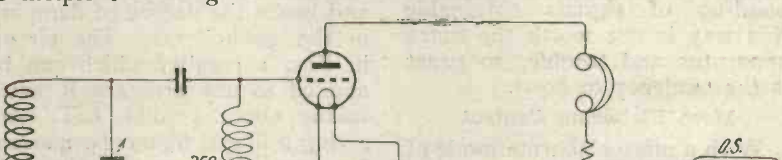

Fig. 2.—The potentiometer method of applying audio-frequency reaction.

ordinary circuits which have ample H.T. By using a potentiometer method of applying a slight audio-frequency reaction, as shown in Fig. 2, this can readily be tested. A variable resistance of, say, 10,000 ohms, made, for example, by smearing a paste of black-lead and indian ink on a long strip of stout paper, with a sliding contact on it (a paper-clip), is placed in series with the phones in an ordinary circuit, and the primary of an ordinary L.F. transformer is connected across the part of the resistance included in the circuit. The secondary of the transformer is connected to the L.T. negative—or, better, to a potentiometer as in Fig. 3 across the L.T. battery—and through a radio-choke (to avoid H.F. short-circuits) to the grid of the rectifying valve. When connected up the right way, there does not need to be much of the high resistance connected across the transformer primary to develop a powerful howl by audio-reaction. Actually the amount of safe build-up of signals obtainable this way is not worth the extra apparatus and trouble, so great is the tendency to howl.

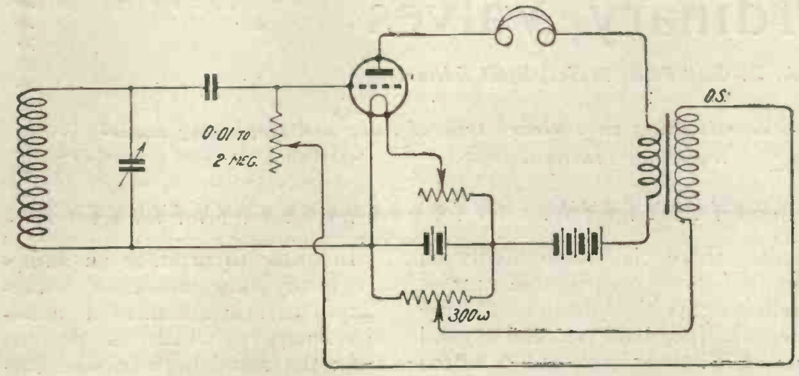

Fig. 3.—A more elaborate method of control.

More Elaborate Control

With a more elaborate mode of control, as in Fig. 3, a little useful increase of signals can be obtained by very careful adjustments, controlling both the grid-damping—by varying the potential of the point to which the grid-leak is taken by means of the potentiometer across the L.T. battery—and the efficiency of the feed-back by means of the high series resistance (a variable grid-leak of large range, such as the large Lissen). Quite low value of H.T. will be necessary, if reasonable ease of control is aimed at. It is questionable again, though, if the comparatively small gain is worth the extra complication.

The Problem Simplified.

Where in the design of a receiver an attempt is made to cut down the high-tension supply to a minimum—or even to dispense altogether with an external H.T. battery, relying on the 2 volts or so of H.T. available when a 6-volt accumulator is used with ordinary valves which require only 3.5 to 4 volts in the filament—the amount of power available is so very small that a powerful audio-frequency oscillation or "howl" is scarcely possible; so that the problem become very simple. The primary of a feed-back L.F. transformer can now be placed boldly in the plate-circuit, in series with the phones; and the only control, besides that provided by the filament-resistance, is a potentiometer across the L.T. battery, which will control the amount of average grid-bias and hence the degree of damping in the grid-circuit. The circuit in Fig. 1 results, which can be applied to any ordinary R valve taking about 4 volts L.T. and giving a liberal filament-emission. No expensive special valves or apparatus are needed; and the control of the L.F. reaction is simplicity itself by means of the potentiometer.

The Grid Circuit

For successful reception with these low values of H.T. (2 volts or less from the "L.T." battery) it is necessary to have an extremely lightly coupled grid-circuit. In the circuit illustrated this is achieved by using Mr. Scott-Taggart's constant-aerial-tuning device of a *small* fixed series aerial condenser combined with a *small* parallel tuning variable condenser across the inductance. Suitable values are indicated for the broadcast belt and a P.M.G. aerial. The radio-choke on the grid must be a fairly good one, e.g., a plug-in coil of 250 turns; if of much lower value, the circuit will not respond much to reaction. The reaction-coil is brought very near to the A.T.I.

To adjust the circuit, the reaction-coil is swung right up, and the filament made fairly bright. Then the potentiometer is adjusted so that the howl just vanishes. Then H.F. reaction is somewhat loosened, and the station tuned in by the A.T.C. Small adjustments of reaction-coil, potentiometer, and filament resistance will then generally give some little improvement in the strength and clearness of the signals.

The Transformer

The L.F. transformer—of any reliable make—should be connected up as shown, if marked in the conventional manner. Some makes differ in the marking, e.g., the Pye No. 1, so the connections should be changed around to find the best arrangement. The O.S. is almost invariably to be connected to the grid via the radio-choke.

Results

As shown, London's mid-day transmission came in at thirteen miles on a good P.M.G. aerial at a strength which made the performance of the Wireless Trio clearly audible in the next room on an "Ultra" loud-speaker, with a liberal French Metal R valve and the six-volt L.T. accumulator alone. On the 70-ft. single low aerial the reception was also excellent. In each case distortion was conspicuous by its absence. With a four-volt accumulator alone, and suitable readjustment of the potentiometer and reaction, London was audible with the 'phones hung on a nail on the wall, and came up to the same moderate loud-speaker strength with a single fourpenny flashlamp battery as H.T. supply. Any reasonably good valve appeared to work in this circuit. Penton R, Radion, soft Dutch, etc., were tried. An L.S.3 also gave good results.

Curiously enough, it was noticed that the circuit seemed to oscillate more easily with this audio-reflex in action than with the radio-choke, etc., substituted by the customary grid-leak to L.T. plus (or to the potentiometer). Thus C.W. Morse around 500 metres came in clearly with six volts, heterodyned by the oscillating circuit; whilst in ordinary single-valve reception with the identical equipment only, a noisy station could be heard, i.e., H.F. oscillation was scarcely possible, unless a very small series condenser was used.

It is extremely doubtful whether, except as an interesting experiment, this kind of low-power circuit has any permanent practical value. There is no reserve of power, and the small H.T. which is available is obtained very extravagantly at the expense of a needlessly large L.T. accumulator battery.

Jumpy Rheostats

THE performances of many a set are ruined by the unevenness of its rheostats, the contact arms going round the turns of resistance wire, not with a smooth, quiet motion, but in a series of jumps from turn to turn. The result is that when one uses the rheostat to adjust the filament potential a rattling noise occurs in the receivers as the knob is moved. This is particularly annoying when one is using in a single valve set a valve whose filament potential is critical, for it makes it exceedingly difficult to find just the right adjustment. Jumpiness in a rheostat may result from several causes. It may happen that the coil is wound with wire of rather large gauge and that the turns are placed some way apart. If this is the case, it is best to remove the coil and to replace it with one that is more suitable. Ready-made coils, with a value of 5 ohms, can be purchased for 6d. apiece from advertisers in *Wireless Weekly*.

Or the cause may be that the arm is made of metal which is not sufficiently pliable. If the contact is not springy there is bound to be a certain amount of jumping as it passes from turn to turn. Here, the remedy is to make a new arm from springy sheet copper or German silver. In a rheostat a very hard contact is unnecessary, for both the point of the arm and its path round the turns of the resistance coil are automatically kept clean by use. Another fault which will give rise to jumpiness is a looseness of the spindle in its bush. To see whether this is at the root of the trouble, turn on the valve and then press the rheostat knob gently from side to side with the fingers. Should there be undue play, a noise will be heard in the receivers as the knob is moved. When buying a rheostat one is often rather in a quandary. The smooth, velvety contact is obtained when the resistance coil is not wound upon a former, for then the turns of wire themselves provide the necessary springiness. Rheostats so wound, however, are liable to be short lived, since the coil is very easily damaged. The former wound rheostat is far stronger, but unless its arm is very well designed it may be inclined to be jumpy.

R. W. H.

Books for the Constructor

How to Make Your Own Broadcast Receiver 1/6
John Scott-Taggart, F.Inst.P., A.M.I.E.E.

How to Erect Your Wireless Aerial 1/-
B. Mittell, A.M.I.E.E.

The Construction of Wireless Receiving Apparatus 1/6
P. D. Tyers.

How to Make a "Unit" Wireless Receiver 2/6
E. Redpath.

Twelve Tested Wireless Sets 2/6
P. W. Harris.

Home-Built Wireless Components 2/6

The Construction of Crystal Receivers .. 1/6
Alan L. M. Douglas.

Wireless Sets for Home Constructors .. 2/6
E. Redpath.

Tuning Coils and How to Wind Them .. 1/6
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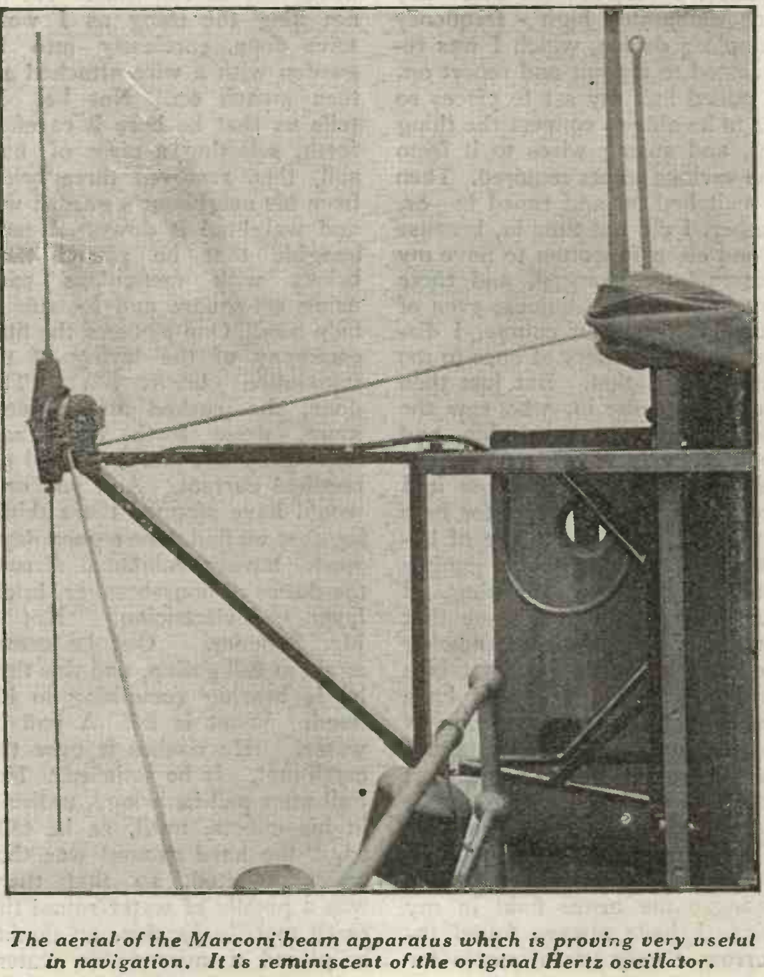
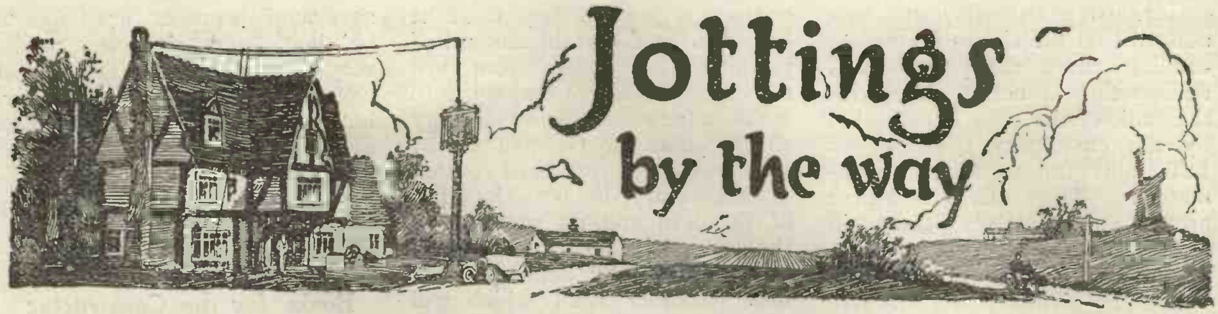


The aerial of the Marconi beam apparatus which is proving very useful in navigation. It is reminiscent of the original Hertz oscillator.



How We Do It

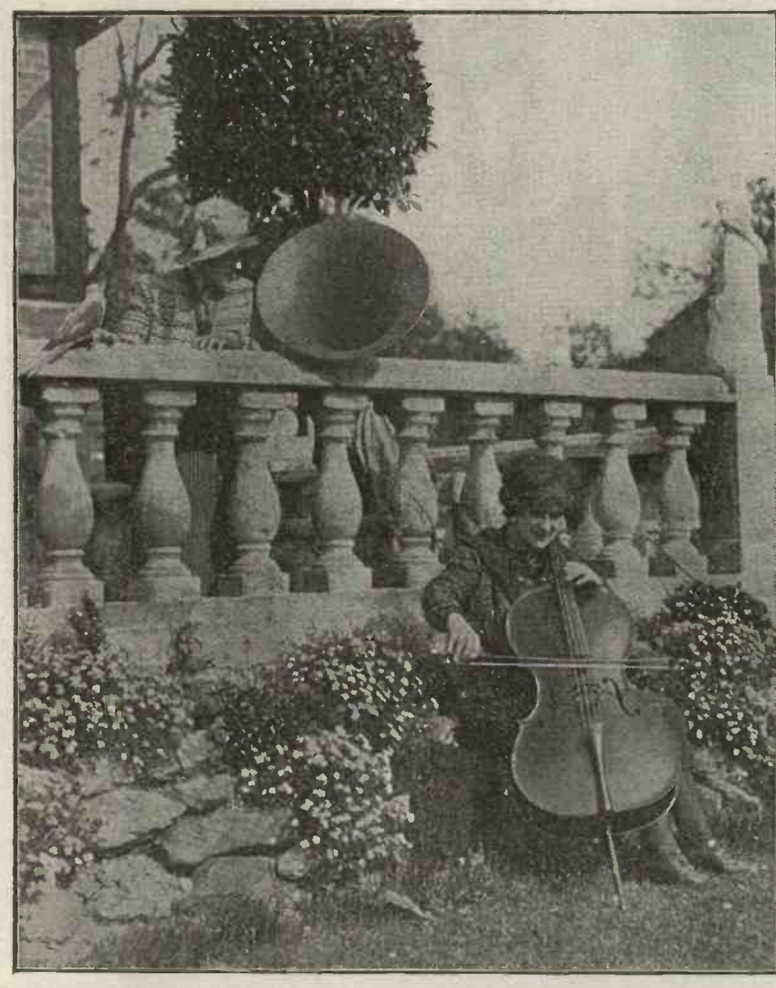
I trust that you always read with the greatest attention the tests of apparatus which are described in *Wireless Weekly* by my colleague, Mr. A. D. Snooper. Now, if they send *me* down a variometer or a pair of telephones to test I usually say to myself, "Oh, yes, I will do that to-morrow." Then, with the best intentions in the world, I place them upon a shelf, where, to my utter surprise, I find them again a year later, having, no doubt, benefited greatly by their rest. Sometimes, however, I really do get to work. For instance, I received the other day an elaborate high - frequency coupling device, which I was requested to try out and report on. I pulled half my set to pieces so as to be able to connect the thing up, and strung wires to it from the various points required. Then I switched on and tuned in—or, rather, I did not tune in, because I had clean forgotten to have my accumulator charged, and there are limits to the dullness even of dull emitters. Of course, I dispatched the battery at once to the charging station. But just then Poddleby came in, who saw the new device upon my table, and took a fancy to it. When he asked if he might borrow it I consented with alacrity, for here was a heaven-sent chance of letting someone else do the donkey work in the way of testing. I fear that I shall never see that wondrous gadget again, knowing Poddleby as I do, but that is a small matter. You will have gathered that I am not one of those conscientious, painstaking souls who will spend the best part of a week in getting at the real qualities of a gridleak. Though, so far as I know, not a drop of Spanish blood flows amongst the azure fluid in my veins, I have always found to-morrow a very useful motto for the tester, and if I am driven by force of circumstances to do some work, my methods may be described as rather of the slap-dash or even crash-damn order.

Lost in Admiration

This does not prevent me from appreciating sterling qualities in others. When I read recently of Mr. Snooper's manful wrestling with an earth mat (whose name I do not remember exactly, but which we will call the Whosafradio) I was moved to tears of admiration, which with true economy I shed upon the ground above my own earth, the weather being dry at the time. He did not fling the thing as I would have done, carelessly into his garden with a wire attached and then switch on. Not he. He tells us that he bore it carefully forth, selecting a piece of hard soil, then removed three bricks from his neighbour's garden wall and weighted it down. I quite imagine that he placed those bricks with meticulous care, using set-square and footrule to help him. One pictures the little ceremony of the laying of the foundation brick. . . . This done, he rushed within once more, drew forth his trusty microammeter, and measured the rectified current. And you or I would have stopped there thinking that we had done a good day's work, having combined already the duties of housebreaker, bricklayer and electrician. Not so Mr. Snooper. Out he comes again at full gallop, and this time he is bearing something in his hand. What is it? A pail of water. He dashes it over the earth mat. Is he satisfied? No. Pail after pail he brings, untiring in his efforts, until, as he tells us, "the hard ground was thoroughly wetted, so that there was a puddle of water round the earth mat." In this, no doubt, he placed a micrometer water-gauge, dashing for a fresh bucket whenever the level dropped by .0000001 millimetre. Again he pranced in to use the microammeter. Again he dashed out to do still more good work.

A Good Man and True

And now we see that he is a real genuine wireless man, for he lets us infer that he concurs whole-heartedly with the views upon the gardening nuisance which I expressed a week or two ago, and with which I am sure all true enthusiasts are in thorough agreement. What are gardens for? Obviously to provide resting-places for aerials and earths. To Mr. Snooper they are also convenient testing-places for earth mats. Here in his own words is how *he* treats *his* flower-beds: "When the earth mat was thoroughly tramped down on a soft flower-bed and weighted with three bricks, with enough water (I would have been tired after carrying all that water) poured on it to make a puddle, the current rose to eight microamperes." Even then the man was not ready to cry "Hold, enough." He gives us yet another example of his devotion to wireless. If such as we happen quite accidentally to upset our accumulators on the drawing-room carpet or to melt a little fluxite into the table-cloth, or even in an absent-minded moment to lay a hot soldering iron upon the seat of a leather-covered chair, we hear quite a lot about it—at any rate, if we are married. Few of us can claim that our absorption in wireless is such that we do not receive an occasional prick from conscience when these things happen. But Mr. Snooper has reached a stage far beyond all this. He seizes the earth mat, all dripping from its puddle in the flower bed, and, still wearing the boots that did the trampling, bears it through the French windows into the drawing-room, out of the drawing-room into the hall, across the hall into the kitchen, through the kitchen into the scullery, and then, deaf to the screams of the scandalised cook, places it in the sink for further experiments. To make assurance doubly sure he moves once more into the kitchen, where he grabs the heaviest weight from the scales, and, returning to the scullery, plonks it down on top of his earth mat. Then trailing a muddy wire behind him he makes once more for his wireless and hooks up.



Broadcasting the song of the nightingale. Our photograph shows Miss Beatrice Harrison at her 'cello.

Whetting the Appetite

The true art of really great writing is always to leave your reader asking for more. In a serial story you take your hero and heroine for a stroll along the cliffs, and just as they turn to admire the sunset, and begin to indulge in their sloppiest passages, the villain pops up from a rabbit hole or from the cover of a sheltering foxglove, and rushes upon the hero with a shout like the challenge of an infuriated bull mastodon. The hero turns just in time. They embrace, not in friendship but in anger. The edge of the cliff gives way; they hurtle into space and . . . .

(*To be continued in our next.*)

Or, if you are writing a novel, you must leave the reader wondering at the end of it. Why did not Angelina go straight home to her mother? Why was Edwin such an utter ass as not to tell her the truth right away? What, anyhow, will happen now that they have made it up on the last page? Such a pair of blithering idiots as they are would be perfectly sure to go and make a mess of things all over again in the next chapter if only there was one. You see the idea. Now, Mr. Snooper understands as few men do the art of whetting his reader's appetite. He does not tell us how he got the earth mat out of the sink or what was the sequel to his display of enthusiasm. He merely records the measurements which he made. Sound and conscientious fellow, Snooper.

Sympathy and Help

Even the Editor, stony-hearted though all editors are, gave a little choking sob when he read of Mr. Snooper's labours. The thought of him trampling into a pulp a priceless collection of rare daffodils, so that the earth mat might be thoroughly tested on a flower-bed, is one that can leave few eyes quite dry. It was obvious that Mr. Snooper must have assistance, for there were dozens more earth mats awaiting test lying in the office, and he would certainly reduce himself to a shadow if he were turned loose upon them alone. A parade of staff editors was therefore held to discover who, if anyone, had feet of the right size for dealing properly with flower beds. The results were unfortunately most disappointing, for staff editors run to brains and not to feet, and no one wears anything larger than number twelves. What was to be done? The problem was pressing, and there appeared to be no solution. Mr. G. P. Bendall, who, having joined the ranks of the married, finds his coil-winding activities curtailed, and is no longer allowed to leave bits of wire all over the place, was loud in his expressions of sympathy, but these were of no avail, since he could not produce the "goods" in the shape of a real pair of flower-crushing extremities. Mr. Hercy Parris offered a few random technicalities, whilst Mr. Wallows volunteered to write a constructional note on the subject of bed tramplers. For some days an air of gloom hung over the whole office. But this was finally dispelled by the appointment to the staff of ex-P.C. Bottlesworth, who has recently retired from the Little Puddleton Police Force.

WIRELESS WAYFARER.

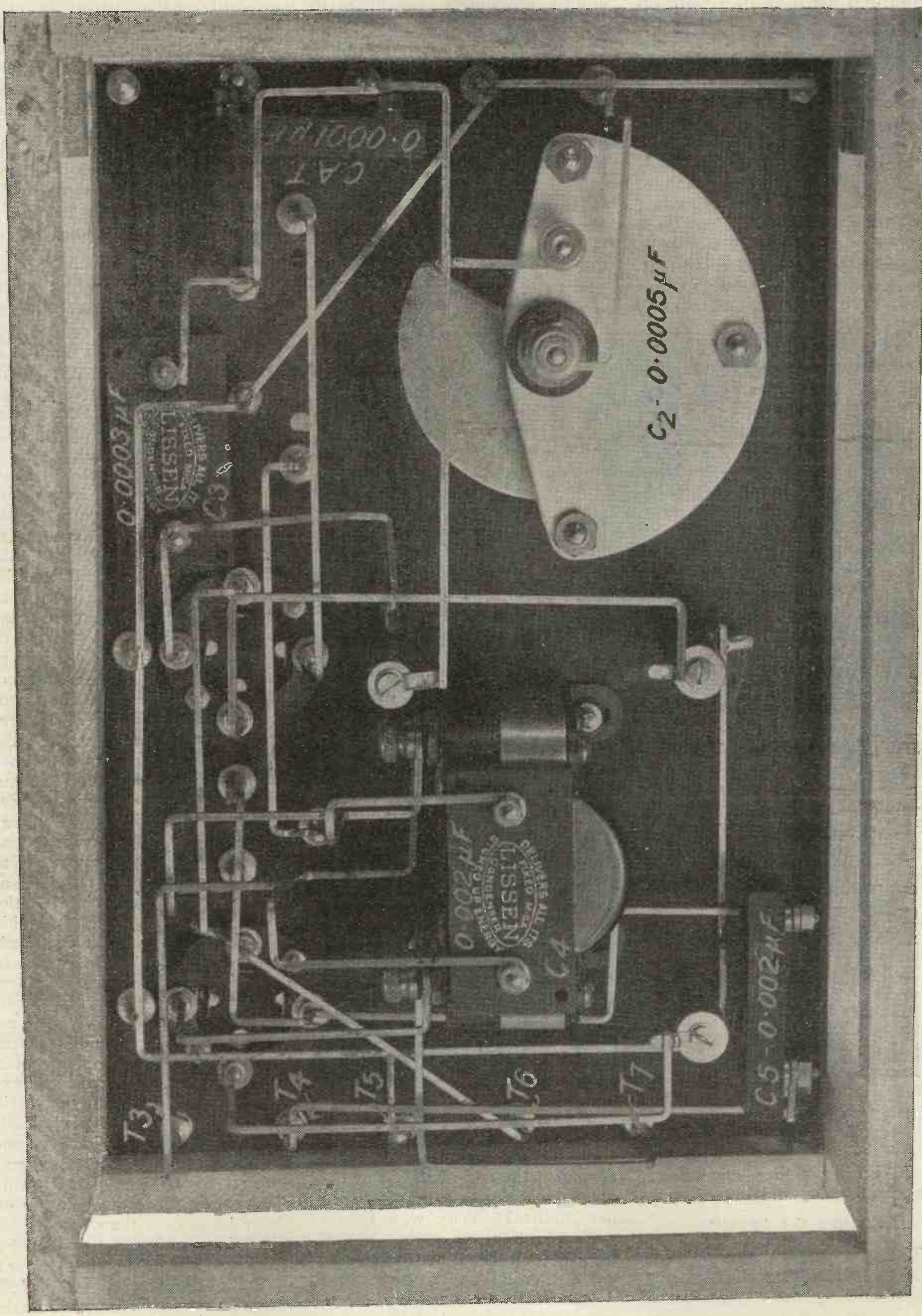


Fig. 7.—A view of the set looking from the underneath, with the framework in position.

The "Wireless Weekly" High-Tensionless Receiver

Type W 7.

By HERBERT K. SIMPSON.

Full constructional details following the theory of last week.

DRILLING having been finished, and all the parts being at hand, the constructor may proceed to mount the components upon the panel. It will be found easiest to commence with the smaller parts, such as terminals and Clix sockets, proceeding to the more bulky parts in order, leaving the variable condenser and transformer until the last. A 3-16 in. clearance hole should be drilled for the Clix sockets, these being passed through the panel from the top, and secured on the underside by means of the locknuts. It is to be noted that no insulator is used in this case, the Clix with insulators and locknuts being used for making connections above the panel.

Wiring up

Wiring is carried out with square bus bar wire, obtainable from Messrs. Sparks Radio Supplies, and, if carefully carried out, presents a neat and workmanlike appearance. The wire must be bent exactly to shape, to fit between any two or more terminals, and should be carefully soldered on to each point. In this connection it may be pointed out that it is advisable to tin all points, such as terminal shanks, to which a wire has to be soldered, before commencing the process of wiring up. A detailed diagram showing the layout of the wiring is given in Fig. 8, and should clear up any points of difficulty which may arise. Large photographs of the back of the panel also give an idea of the arrangements on the back.

The Framework

The framework is made from ¾ in. by ⅜ in. strip wood, about 7 ft. being required. Cut four pieces 10 in. long, four 6¼ in. long, and four 2½ in. long. These dimensions are given in the sketch, Fig. 10, which shows exactly how the pieces of wood

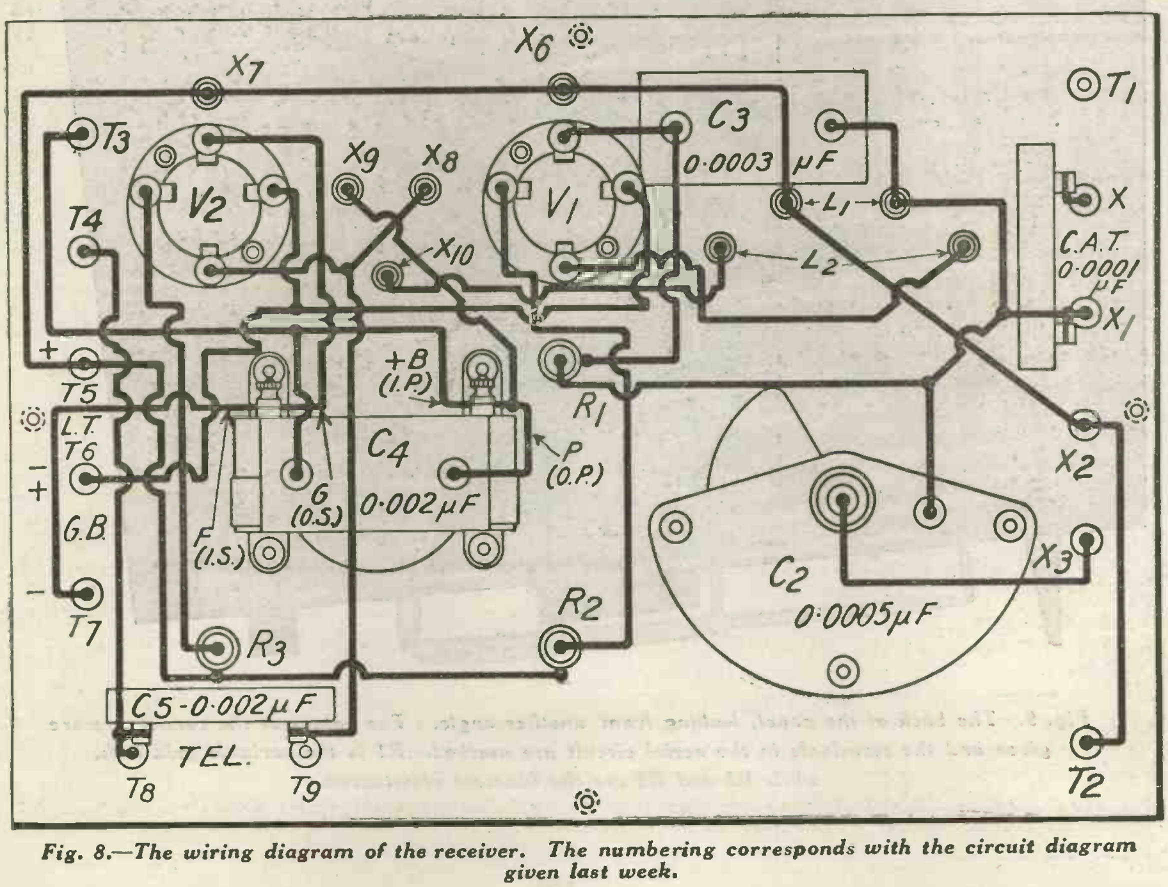


Fig. 8.—The wiring diagram of the receiver. The numbering corresponds with the circuit diagram given last week.

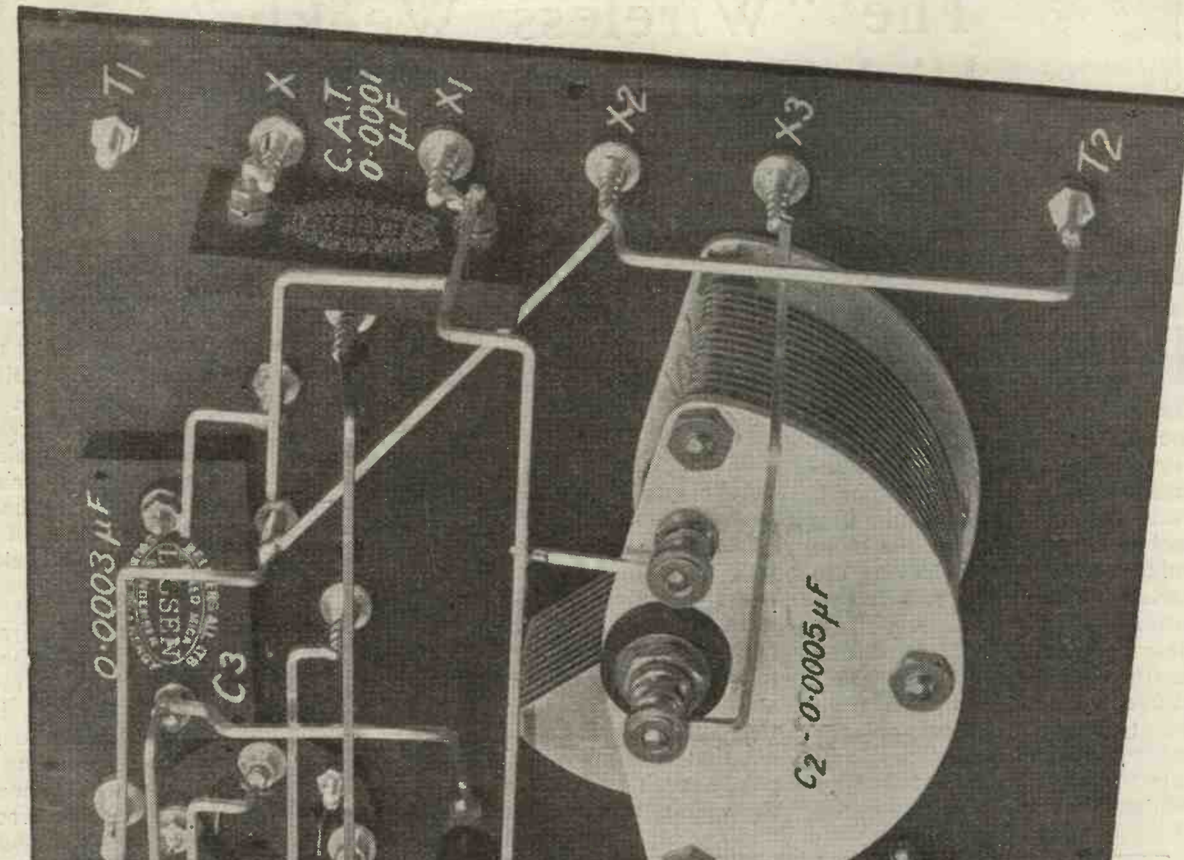


Fig. 9.—The back of the panel, looking from another angle. The values of the condensers are given and the terminals in the aerial circuit are marked. R1 is the variable grid leak, while R2 and R3 are the filament resistances.

are fastened together, with the longer sides overlapping the shorter, giving an overall size of 10 in. by 7 in. for the panel to rest upon.

The panel is secured to the framework by means of four countersunk head brass wood-screws, one being situated at the middle point of each side of the panel.

Coils to Use

For broadcast wavelengths up to 420 metres, a No. 50 coil will be required in the aerial socket L1 when using constant aerial tuning, and the reaction coil L2 may be a 75. Above 420 metres the aerial coil may be a 75 for broadcast reception, while L2 may be a 100.

Testing the Receiver

When complete, the receiver may be joined up to an aerial and tested. Owing to the ease with which the local station may be tuned in, it is best to commence testing using the constant aerial tuning system. Join the aerial lead to T1, and plug the flexible lead into the socket X. Join X2 and X3 by means of a rubber lead ending in two Clix plugs, and join the earth lead to T2. Join T3, T4, and T5 together, L.T.+ to T5, L.T.– to T6, and connect T6 and T7 together.

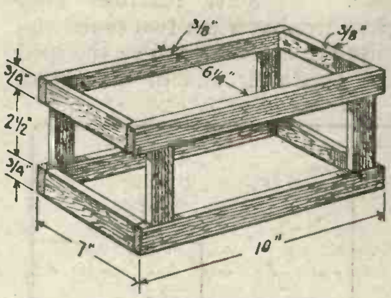


Fig. 10.—A dimensioned view of the framework.

The telephones or loud-speaker are connected to the terminals T8 and T9 in the front of the panel. By means of two Clix plugs, joined by a piece of rubber-covered flex, connect the socket X10 to the socket X9, thus completing the circuit for two valves. Insert a 50- and a 75-coil in L1 and L2 respectively, provided the wavelength to be received is not above 420 metres, as explained above, and turn on the filaments of the valves, having made sure that the fourth electrodes are connected to the sockets upon the panel. Tune on the variable condenser C2, keeping the coil L2 well away from the aerial coil L1. When signals are heard, the coil L2 may be brought closer to L1, the condenser C2 being readjusted for the best results. If this does not result in an increase of signal strength, the leads from the reaction coil L2 to the two sockets X1, X2 upon the panel should be reversed, and the procedure repeated.

Results Obtainable

On a reasonably efficient aerial, audible loud-speaker signals will be obtained at about twelve or so miles from a broadcasting station. On telephones very good signals are obtainable, even on a small aerial.

As previously stated, the set may be used with ordinary valves and a high-tension battery, with no alteration to the wiring. All that is necessary is to take out the link between terminals T3, T4, and T5, and to join T3 and T4 to points on the high-tension battery, the negative of the latter being connected to T5, as also is the L.T.+. The negative of the low-tension battery is connected to T6, and if no extra grid bias is used, T7 must be shorted to T6.

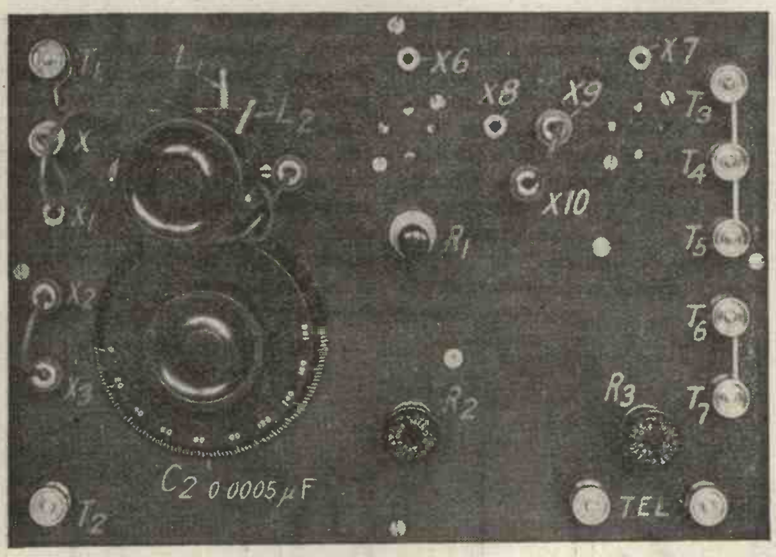


Fig. 11.—A plan photograph of the top of the panel, with the various parts lettered. This lettering corresponds with that in the other figures.

□ □ □

What is the best kind of wire to use for winding Tuning Coils: cotton-covered, silk-covered or enamelled ?

A great deal depends upon the type of coil which is to be constructed, and the method for varying the number of turns in circuit. Enamel-covered wire is most suitable for coils to which a slider is to be fitted. Double cotton-covered or double silk-covered wire are about equally suitable for winding tapped inductances, the cotton-covered wire having perhaps a slight preference because the thicker covering ensures a greater spacing between the actual wires of adjacent turns. Incidentally the cotton-covered wire is much cheaper. For honeycomb, basket, or duolateral coils double cotton-covered wire is most suitable. The silk covering frequently becomes damaged during the winding, especially upon the removal of the steel rods of the former or "spider." Single silk-covered wire is not recommended for use on any type of wireless receiving coil.

Valve Notes

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

High-Frequency Coupling

THE tuned anode method of coupling two valves has had such a vogue that other methods frequently do not receive the full attention that they deserve. This is the case with the type of circuit which Mr. Harris recently brought into prominence, entitling it "A Modification of the Grebe 13 Circuit."

Fig. 1 shows a modification of the circuit previously given, using the same method of coupling. It will be seen that constant aerial tuning is employed, and that two plug-in coils L2 and L3 are coupled together variably. The first valve acts as a high-frequency amplifier, the high-frequency currents passing through the inductance L2 being induced into the inductance L3. The circuit L3 C3 is tuned to the same wavelength as the incoming signals, and considerable selectivity is thereby obtained. The second valve V2 acts as a detector in the ordinary way, telephone receivers being included in the anode circuit of the valve. It will be noticed that a variable tapping is taken from the high-tension battery to the anode of V2 to enable that valve to operate in the most successful way as a detector.

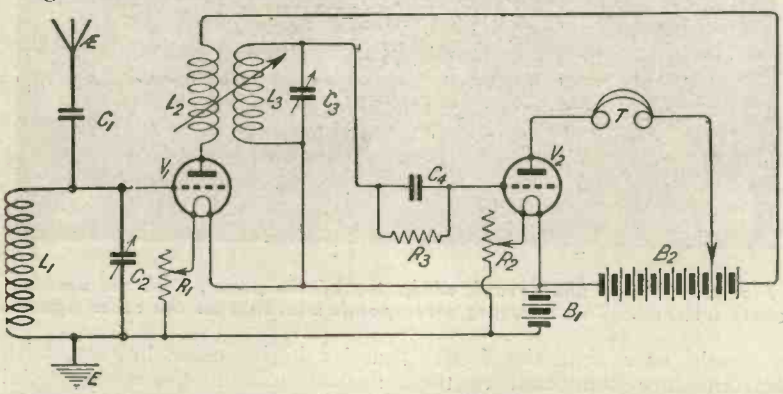


Fig. 1.—A circuit employing two valves, in which a method of high frequency coupling seldom employed is incorporated.

Capacity Reaction

The circuit as it appears, seems perfectly simple, but the doubtful element which is always present in wireless receivers, namely, capacity reaction through the valve, is distinctly present, but fortunately it may be readily controlled with a circuit of this kind, whereas when using a tuned anode circuit much more difficulty is experienced.

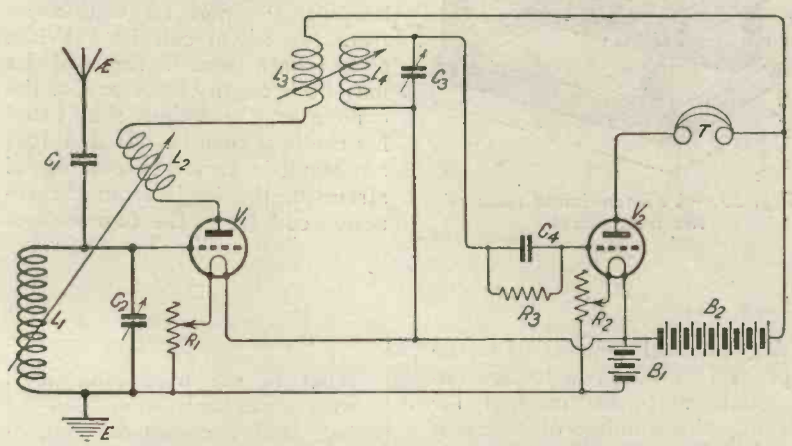


Fig. 2.—Showing how to introduce reaction into the aerial circuit.

Personally, I never like introducing reaction from one tuned circuit into another by coupling the respective inductances of the two oscillation circuits. My experience is that a much finer control of reaction is possible when one of the circuits is aperiodic, or substantially so. As a matter of fact, when coupling two tuned circuits together, such as a grid circuit and a tuned anode circuit, the chances are that a reaction effect will be obtained, whichever way round the leads to the reaction coil may be connected. The whole question of coupling two tuned oscillation circuits has been discussed at length in these columns, and it is only desired to point out here how a very good control of reaction is obtainable.

Controlling the Circuit

If, in Fig. 1, we loosen the coupling between L2 and L3, the coil L2 acts substantially as an aperiodic anode coil, and the first valve V1 does not tend to oscillate. The valve V2, of course, would not tend to oscillate in any case. Capacity reaction only gives trouble when two tuned circuits are associated with the grid and anode circuits of the valve, and if a tuned circuit associated with the anode circuit is actually directly in that circuit, then trouble is very likely to arise. The use of an aperiodic coil, however, as in Fig. 1, makes it possible to keep the circuit absolutely under control, because when L2 and L3 are loosely coupled there is practically no reaction introduced into either the tuned circuit L1 C2 or the circuit L3 C3. On the other hand, of course, the amount of energy passed on from the anode circuit of the first valve to the grid circuit of the second is much smaller. In other words, the valve V1 is not amplifying the high-frequency currents to the same extent. Nevertheless, greater stability and greater selectivity are obtained by this arrangement than with most forms of coupling.

Effect of Tightening the Coupling

If, now, we tighten the coupling between L2 and L3 we will increase the energy passed on, and consequently signal strength will increase. The circuit L3 C3 will, however, now begin to influence the anode circuit as well, and L2 L3 C3 will act in much the same way as a tuned anode circuit; the closer the coupling between L2 and L3 the more like a tuned anode circuit will Fig. 1 act.

Constant Aerial Tuning

The result is that the first valve will tend to oscillate through the condenser action between the grid and anode in the first valve, producing a capacity coupling. A reaction effect is therefore introduced, and the condensers C2 and C3 should be readjusted to take advantage of the extra reaction effect. It may be that if L2 and L3 are sufficiently tightly coupled the first valve will oscillate, particularly when constant aerial tuning is employed, because this method of tuning, really only intended to enable the experimenter to get good results on any aerial without trouble about choosing the coils, decreases the damping of the grid circuit, thereby making the valve more prone to self-oscillation. If the valve V1 therefore oscillates, the obvious remedy is to decrease the coupling between L2 and L3. Such a simple remedy is not possible in the case of a troublesome tuned anode circuit which tends to oscillate. Unfortunately, loosening the coupling between L2 and L3 will also weaken signals somewhat, and the experimenter may prefer to connect the connection from the bottom of L1 and C2 to the positive terminal of the filament accumulator B1, instead of to the negative terminal as shown, using a tighter coupling between L2 and L3. Alternatively, it may be connected to a point on the potentiometer shunted across B1. A further modification would be to connect a 100,000 ohms variable resistance across C2. I have not, however, found that with the average type of valve used nowadays that this self-oscillation effect is likely to give much trouble with this circuit.

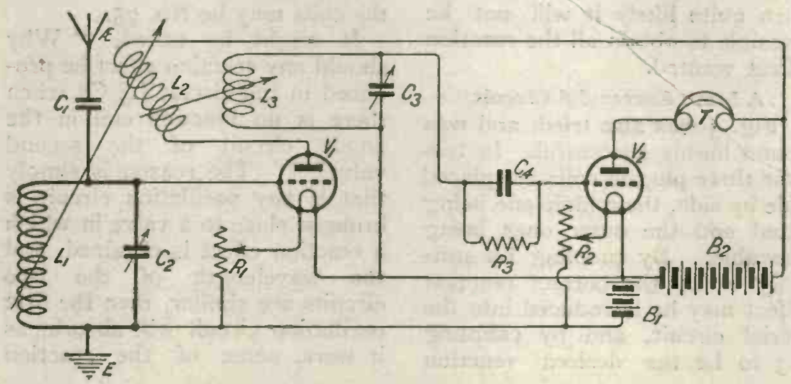


Fig. 3.—A further modification of the circuit, using a three-coil holder, which was found to be highly successful.

Connections to the Coil L2

A point I would like to emphasise, however, is that the connections to the coil L2 are important. If the connections are made in a certain direction the circuit will oscillate much more readily than otherwise when the coils L2 and L3 are closely coupled; a reversal of the leads to L2 will overcome this effect. This point does not seem to have been mentioned by anyone who has worked with these circuits, or even with transformers, although the effect is prevalent in both cases. The moral is: Always try varying the connections to the primary of an intervalve high-frequency transformer or to the primary of an arrangement as the Fig. 1 type.

Adding Intentional Reaction

The circuit of Fig. 1 is frequently so stable that not sufficient reaction is obtained through the natural coupling of the valve. If this is so, the experimenter should feel pleased with himself, because I am not a believer in trying to vary unintentional reaction; I am always much happier when I have a reaction coil with which I can adjust the degree of reaction required. Unintentional reaction is elusive, and varies with the different types of valves used, and while one experimenter might get the results desired, another one would probably get no reaction effect at all. It need hardly be emphasised again that the method of tuning the aerial circuit considerably varies the reaction effect in the aerial circuit. A parallel condenser tuning arrangement is the hardest method of tuning to introduce reaction into, whereas constant aerial tuning is probably the easiest.

Fig. 2 seems the obvious method of introducing the reaction into the aerial circuit. In this circuit the anode circuit of the first valve contains a reaction coil L2 coupled to L1, and the primary L3 which serves to induce the amplified high-frequency currents into L4.

Disadvantages of Fig. 2

The trouble about this circuit is that there is a tendency for the inductances L2 and L3 to form an oscillation circuit by the aid of their own self-capacities and the capacity between filament and anode of the first valve. This tuned circuit will approximately be tuned to the same wavelength as the incoming signal, and self-oscillation of the first valve, without effective control, is likely to take place. If, on the other hand, we have the inductances smaller, we get one of two effects. If the inductance L3 is made smaller and the reaction coil L2 is made sufficiently large to get a proper reaction effect, the coupling between L3 and L4 is not sufficiently strong to give good high-frequency amplification. If, on the other hand, we keep L3 sufficiently large for the coupling effect, the reaction coil L2 must be kept small, and then quite likely it will not be possible to obtain all the reaction effect wanted.

A More Successful Circuit

Fig. 3 was also tried, and was found highly successful. In this case three plug-in coils are placed side by side, the middle one being fixed and the outer ones being movable. By coupling L2 suitably to L1 the correct reaction effect may be introduced into the aerial circuit, and by coupling L3 to L2 the desired reaction effect may be introduced into the circuit L3 C3.

Coils for Broadcasting

For broadcasting, the coil L1 may be a No. 50, while L2 is a No. 75, L3 being a No. 50. For wavelengths over 420 metres all the coils may be No. 75.

It might be asked, "Why should any reaction effect be produced in the circuit L3 C3 when there is no reaction coil in the anode circuit of the second valve?" The reason is simply that if any oscillation circuit is brought close to a valve in which a reaction effect is obtained, and the wavelength of the two circuits are similar, then the first oscillation circuit will absorb, as it were, some of the reaction effect of the valve. In the present case the valve V1 is producing a reaction effect which is introduced into its circuits. By bringing the inductance L3 near to these circuits the circuit L3 C3, being tuned to the same frequency as the aerial circuit, will absorb some of the reaction effect, with the result that the tuning of the circuit L3 C3 will be sharper and the signal strength will be increased.

Obviously, however, L2 and L3 should not be so loosely coupled as to weaken to too great an extent the passing on of the amplified currents to the grid circuit of the second valve. It is much better to loosen the coupling between L2 and L1 if the reaction effect is too great.

TUNED ANODE EFFICIENCY

MANY people find it rather difficult to decide upon the most suitable capacity for the variable condensers used in connection with tuned anode high-frequency coupling. A very small condenser such as one with a maximum of .0001 μF is delightful from one point of view since it allows very fine tuning to be done. On the other hand, it cuts down the waveband which the inductance will cover to very small limits, which means that one must always be changing coils if the set is worked upon transmission on different wavelengths. Conversely, the larger condenser eliminates the trouble of constant coil changing, but makes the circuit very difficult indeed to tune when the critical adjustments called for by weak and distant transmissions have to be made. The writer has used the tuned anode method of high-frequency amplification exclusively for some time now, and after trying condensers of many sizes, has come to the conclusion that .00025 μF is the ideal size. With this capacity the same inductance will cover easily all the broadcast wavelengths between 300 and 500 metres. It is small enough to allow fine tuning to be done even on the very short waves when one is searching round for America and other 100-metre stations. Two points, however, are important. The inductance used must be of an efficient type, otherwise its wavelength limits may be small. Secondly, the condenser must have a small minimum capacity, and you must be sure that its maximum *is* .00025 μF. Some of the low-priced condensers upon the market have minimum capacities that are far too high for wireless use, and there are many whose actual maximum capacity is little more than half of that stated.

R. W. H.

A REAL MULTI-VALVE SET

The reader who built this receiver was obviously anxious to have everything to hand. Note the built-in loud speaker. There are twelve valves in sight!

A Variable Gridleak for the Experimenter

THOUGH the infinitely variable gridleak, if well made, is a very handy thing to have upon one's bench when trying out new circuits, it has one great drawback, which is that the value of the resistance cannot be ascertained unless one is provided with some kind of expensive measuring instrument. Thus one may spend quite a long time in discovering the optimum adjustment of the leak for some particular rectifying or amplifying valve without being able at the end of it to ascertain what value of fixed leak may be used to replace the variable one.

The little apparatus to be described is without this disadvantage, and as it provides for variations by half megohm steps from .5 to 3.5 megohms it will do all that is usually needed in a variable gridleak. To use it one simply finds the best value by experiment, and then places in the circuit a leak of the resistance shown.

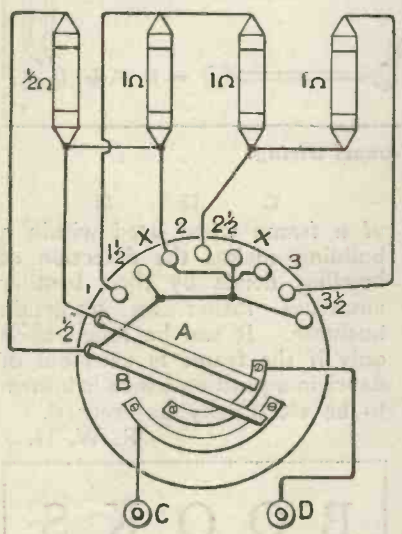


Fig. 1.—The wiring diagram.

To make it up is neither a difficult nor expensive matter, though it is essential that the four gridleaks used should be of the best quality, and that they should be guaranteed accurate to within a small percentage. The writer has found both Mullard and Dubilier gridleaks perfectly satisfactory.

Fig. 1 shows the wiring diagram of the apparatus. The brass arms A and B travel with one end of each resting upon a brass segment and the other making contact with brass studs. It will be seen that if they are placed as shown in the drawing

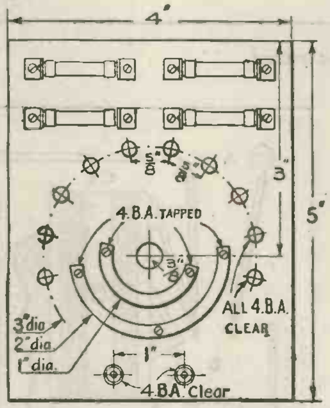


Fig. 2.—Panel details.

the resistance across the terminals C D is .5 megohm since from C current travels through a larger segment, and the arm B to the half megohm leak, whence it passes back *viâ* the arm A and the smaller segment to the terminal D. If the arms are moved so that they rest upon studs 2 and 3 the resistance becomes 1 megohm. Studs 3 and 4 give 1.5 megohms, 4 and 5 give the same value, the next pair 2 megohms, and so on. The only useless spaces are those between 4 and 5 and 7 and 8, both marked X.

Fig. 2 shows the drilling layout of the panel, which is a piece of ¼-inch ebonite measuring 4 ins. by 5. The ten studs are arranged with their centres ⅝ in. apart on the circumference of a 3-in. circle. The larger brass segment lies on the circumference of a 2-in. circle, the smaller on that of a 1-in. circle. As the studs are so far apart it is better, in order to ensure smooth working of the switch, to mount them in the way shown for the variable grid biasing battery, which was described on page 662 of *Wireless Weekly*, Vol. 2, No. 19. Two pieces of ebonite are used, the upper ¼ in. and the lower ⅛ in. thick, the studs being sunk into the former so that their tops are flush with its surface.

The segments are cut from thin sheet brass and are secured to the ebonite in the way described in the article previously referred to. The switch is quite easily made from a spindle of 2 B.A. studding, an ordinary knob and two discs of ebonite, the details of which are given in Fig. 3. These discs are of ¼ in. ebonite 1¼ ins. in diameter. Each has a 2 B.A. clearance hole drilled through its centre. In the lower one are cut two grooves ¼ in. wide and 1/16 in. deep. The upper one is left plain.

The arms are made from three strips of thin springy sheet metal. The shorter is 2 ins. in length to the bend, the longer 2½ ins. The arms are placed in the grooves of the lower disc and sandwiched between it and the upper one, the two discs being clamped firmly in place by means of the nut seen in Fig. 3, which is screwed down as tightly as possible. Care must be taken to bend the ends of the arms well down so that they make firm contact with both strips and studs.

The four gridleaks, one with a resistance of half a megohm, and the others of 1 megohm apiece, can be conveniently mounted in

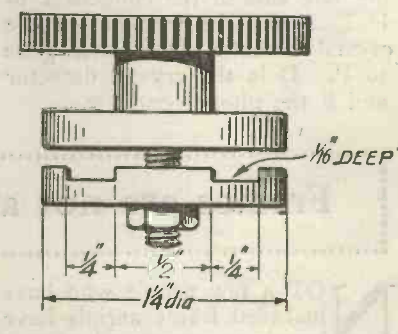


Fig. 3.—Details of the switch knob.

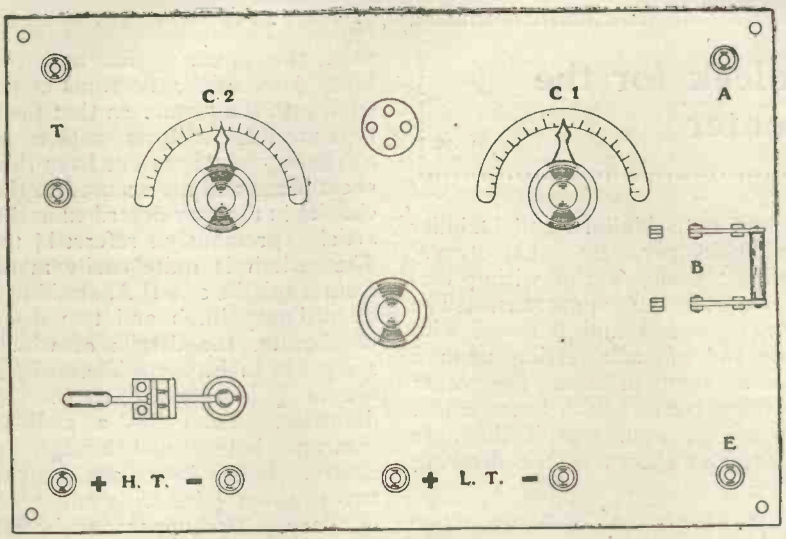
their clips, as shown in Fig. 2. In the case of the holes for the screws which hold these clips, distances are not given in Fig. 2, since they will naturally vary according to the type of leak that is used. In some cases it may save space if the arms of the gridleak clips are turned inwards instead of outwards.

R. W. H.

Practical Back-of-Panel Wiring Charts

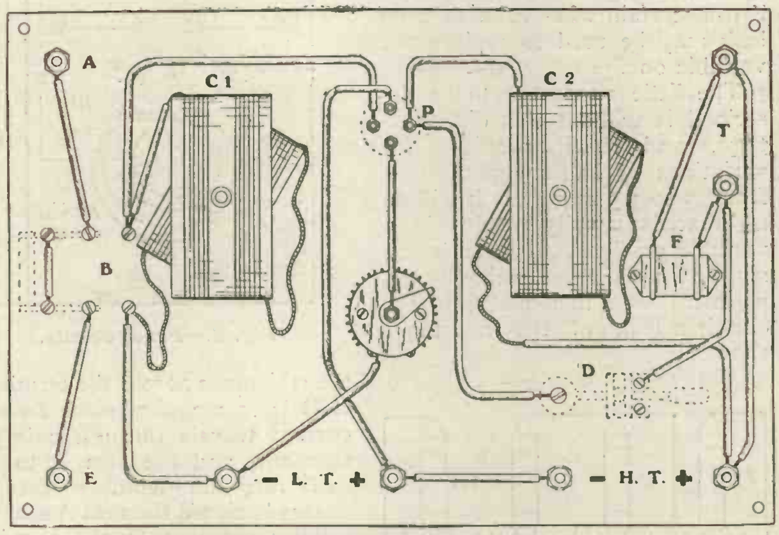
By
OSWALD J. RANKIN

A Crystal Receiver with one stage of H.F. amplification.



The lay-out of the panel.

This introduces the Double-Pole-Double-Throw knife switch as an efficient aerial to earth change-over device. The H.F. valve is coupled to the rectifying circuit by means of the variometer C2, which is wound with a greater number of turns than the variometer C1 in order to balance the capacity of the aerial circuit. Variometers especially wound for the plate circuit may be purchased. If both variometers are identical, C2 should be shunted with a 0.0003 μF. fixed condenser by connecting one side of the condenser to H.T. + and the terminal of the crystal detector D, which goes to P. D is the crystal detector and F the phone condenser.



The back-of-panel wiring.

Frames are not always Directional

NOT a few people who have installed frame aerials have begun to wonder whether it is really true that this form of "wavecatcher" is as strongly directional as it is said to be in most text books. You are led to believe by them that you will obtain full signal strength *only* when the frame is pointing directly towards or away from a particular station; but often a compass will tell you that you get the best signals when it is not pointing in such a line. The frame, as a matter of fact, is strongly directional, but owing to the peculiar effects of refraction which take place within buildings the path of the waves from any station may be deflected somewhat during their passage through the house. When this happens they reach the frame from a direction quite different from that which was originally theirs, and all the rules about pointing towards the station go by the board. When used out in the open the frame will be found to conform to the rules unless it is placed near some absorbing or reflecting element, such as underground metal pipes, streams of water, metallic veins, slag heaps, and so on. The curious behaviour of a frame when used within a building makes the detection of howling fiends by their brother amateurs rather an uncertain business. It can be relied upon only if the frame is used out of doors in a position which is known to be electrically unscreened.

R. W. H.

BOOKS

From the number of queries we receive from readers it would seem that it is not known how adequately do Radio Press Books deal with the subject of Wireless. A full list of our publications may be obtained post free on application.

The Wireless Valve and How it Works

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

The fourth of a new and exclusive series of articles by this world-famous expert dealing with the basis of valve-working in an interesting and unique manner.

De Forest Introduces the Grid

Probably the greatest single step in the advance of radio communication was due to De Forest. He conceived the idea of introducing into the Fleming valve an extra electrode in the form of a lattice or grid, this grid being so placed that electrons on their way over from the filament to the plate had to pass through it. Other names for this "three electrode valve," in more or less common use, are the *audion* (De Forest's original name) *oscillion, radiotron, pliotron* and *triode*.

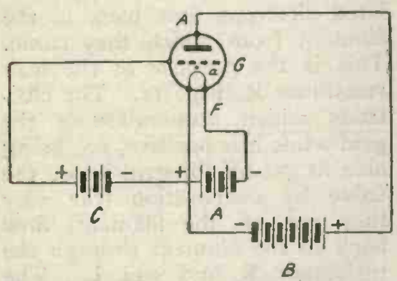


Fig. 7.—Showing the connections of the three electrodes of the triode.

The last named seems to be the most applicable of the lot.

The Fundamental Law of Electric Charges

In reading the following explanation of the action of the triode the fundamental law of electric charges must be remembered: *Negative* electricity is repelled by a *negatively* charged body and is *attracted* by one which is *positively* charged. The general arrangement of a triode is shown in Fig. 7; the grid here shown as a dotted piece of wire was as originally used by De Forest, a zigzag piece of wire. An

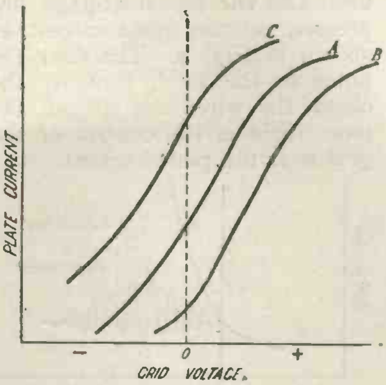


Fig. 8.—Illustrating the relation of grid voltage to plate current with various H.T. and grid potentials.

electron *a*, having evaporated from the filament is attracted by the plate, which is maintained at a positive potential by the battery *B*. The electron, however, in getting to the plate must pass between the grid wires, and these grid wires may be charged either positively or negatively by the battery *C*. If the grid is charged positively the electrons are attracted and therefore helped on their way over to the plate, but a few of them will go to the grid itself on their way through the spaces of the grid.

Saturation Current

Thus, making the grid increasingly positive gives greater and greater flow of electrons over to the plate. This increase in plate current with increasing grid voltage, will continue as long as there are plenty of electrons evaporating from the filament. After a certain positive grid potential is reached, however, all the electrons being evaporated are drawn over to the plate or grid, and so no further increase in grid voltage can increase the plate current. This amount of plate current is said to be *saturation current* for the tube; evidently the value of this saturation current will depend entirely upon the temperature of the filament, that is, upon the filament current.

Now, if the grid is made negative the electrons can get to the plate only by passing through this *negatively* charged grid and this negative grid *repels* the electrons. What will the electrons do? Many of them will be hurled back into the filament from which they have just evaporated and some will sneak through, keeping as far away from the negative wires as possible. Once through they will travel over to the plate with even greater velocity than they would have if the grid were not there. For once they have passed through the grid and so enter into the space between the grid and plate they are not only attracted towards the plate by its positive potential but are also pushed towards the plate by the negative grid behind them.

One must imagine then, the tremendous crowd of electrons having evaporated from the hot

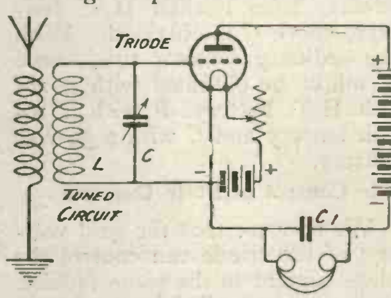


Fig. 9.—A simple receiver using the triode.

filament, pausing on their way over to the plate because of the repelling influence of this negative grid; some of them, being near the centre of the holes in the grid, and perhaps being pushed by some of their companions from behind, do dash through and reach their goal, the positively charged plate, but many of them, apparently less daring or fortunate, cannot run the gauntlet and so fall back into the filament. The more negative the grid the more formidable an obstacle it becomes to the electrons endeavouring to get to the plate, and in the ordinary valve used in radio receiving sets it takes only a few volts negative on the grid to stop practically all electron flow to the plate.

The Grid as a Shutter

One may also imagine the grid as a lattice shutter, such as were used on house windows a few years ago, or such as are sometimes used in front of the radiator of an automobile. A positive grid corresponds to a wide open shutter that lets all the electrons through, and as the grid becomes more negative we must imagine the shutter more and more tightly closed.

If the plate voltage (determined by the H.T. battery of Fig. 7) is held constant and the voltage of the grid battery is changed in gradual steps, both positive and negative, the variation of plate current with grid voltage will be as shown in Fig. 8, curve *A*. With increasing grid potential the plate current continually increases until saturation current is obtained, and then further increase in grid potential can produce no further increase in plate current. If the same changes in grid voltage are carried but with a lower voltage in the H.T. battery, curve *B* of Fig. 8 is obtained, and, if for greater than normal H.T. battery, curve *C* is obtained. With the ordinary detector tube curve *A* might be obtained with a 20-volt H.T. battery, *B* with a 10-volt battery and *C* with a 30-volt battery.

Control of Plate Current

We now see that the grid voltage of the triode can control the plate current in the same fashion as it was controlled in the Fleming valve by the plate voltage. Moreover, with a construction of grids as ordinarily used *a variation of grid voltage of one volt will produce from five to 100 times as much change in plate current as would a change of one volt in the plate voltage.* That is, the grid gives us a very sensitive control over the flow of electrons to the plate, acting as a valve in the plate current circuit. Comparatively weak radio signals impressed on the grid so as to vary its voltage may produce changes in the plate current perhaps 25 times as great as would be produced if a Fleming valve were used and the signal voltage impressed on the plate circuit as shown in Fig. 4. The finer the holes in the grid, that is, the closer the wires are spaced, the more rigid is the control of the grid over the plate current.

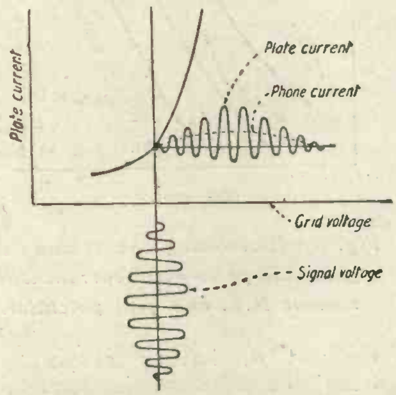


Fig. 10.—Illustrating the relation of plate current and grid voltage to phone current.

These gas valves are much used as detectors in the United States, but it must be remembered that to give the best results with such valves the plate voltage must be regulated to just the right amount, and this can only be found out by trial after the set is connected and put in operation.

Action of Valve with Grid Condenser

The average triode is a somewhat better detector if it is used with a suitable condenser in series with the grid instead of being connected as in Fig. 9. In this case the connection is made as in Fig. 11; it will be noticed that the connection of the valve is nearly the same as before, but the grid is connected to the tuned circuit through a condenser C_2, which is itself shunted by a resistance R, called the "gridleak resistance."

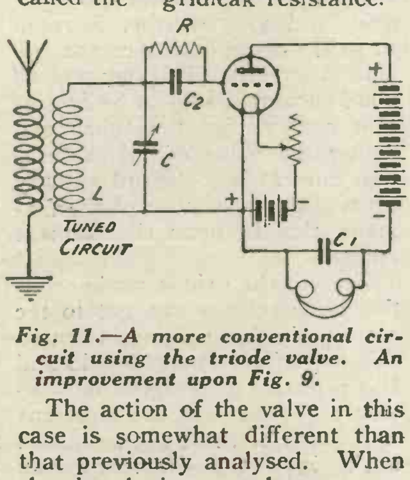


Fig. 11.—A more conventional circuit using the triode valve. An improvement upon Fig. 9.

The action of the valve in this case is somewhat different than that previously analysed. When the signal gives a voltage across condenser C (Fig. 11), the grid is made to go up and down in potential, almost the same as if condenser C_2 were not in the circuit. Now when the grid goes positive it attracts to itself some of the electrons which are flowing through its spaces on their way over to the plate; when the grid goes negative the electrons cannot leave the grid inside the valve, as electrons cannot evaporate from a cold metal. When the grid again goes positive at the beginning of the next cycle, electrons are again attracted to the grid and thus as long as the signal is coming in the grid accumulates electrons, and the number it accumulates depends upon how positive the signal causes the grid to become. A strong signal will make the grid swing positive by a large amount, while a weak signal will force it less positive and so accumulate fewer electrons on the grid than will the strong signals.

The Grid-Leak

The accumulation of electrons on the grid would soon make it so negative that the plate current would stay permanently low, and the detecting action of the valve would be very poor if means were not provided to let these accumulated electrons flow back to the filament from which they came. This is the purpose of the leak resistance R, Fig. 11. The electrons which accumulate on the grid while it is positive, not being able to get off the grid inside the valve by evaporation (the way they got off the filament) flow back to the filament through the resistance R and coil L. The values of C_2 and R must be properly chosen to make the valve operate at its best; for the average British valve about 300 micro-microfarads (.0003 mfd.) of capacity and a leak resistance of two million ohms (2 megohms) seem best.

How the Vacuum Tube Detects Telegraph Signals

When the triode is used as a detector in a radio receiving set it is connected to the circuit as shown in Fig. 9. The signal current, coming in the aerial, induces a corresponding current in the tuned circuit, the inductance and capacity of which have been properly chosen for the wavelength of the signal being received. The grid of the valve will then be affected by the signal, and as the voltage of the grid goes up and down, the plate current must correspondingly go up and down according to the shape of the curves given in Fig. 8. A part of curve B of Fig. 8 given in Fig. 10, drawn downwards, is the form of the voltage impressed on the grid of the triode when one wave train comes in the aerial. For any grid voltage the plate current may be found from the curve of plate current; these values have been picked off the curve and are drawn to the right in Fig. 10.

Telephone Current.

Due to the curvature of the plate current curve the plate current has more of an increase when the grid goes positive than it has decrease when the grid goes equally negative, and this results in an increase in the average plate current while the wave train is acting on the grid. The high frequency fluctuation in the plate current, which is of the same frequency as the voltage acting on the grid, passes through the condenser C_1 in Fig. 9, but the average increase shown by the dotted line in Fig. 10 goes through the telephone. So we see that one wave train impressed on the grid of the tube will give a hump in the current through the telephones, just as it did in the Fleming valve. The size of the hump, however, will be much greater in the case of the triode than in the case of the two-element valve. This fact is expressed by saying that the triode is a "more sensitive" detector than is the Fleming valve.

Valve with Gas or Soft Valve.

A valve which has been evacuated as well as modern methods will permit, and therefore has a very high vacuum, is said to be a "hard" valve; on the other hand, some gas is actually introduced into the valve in special cases, so that the vacuum is not as good as it is possible to make it, and such valves are said to be "soft" valves. If an appreciable amount of gas has been put into the valve the plate current-grid potential curve is not the smooth curve shown in Fig. 8, but has a small kink in it, where the curvature is much greater than is the case with the hard valve. If the plate voltage is adjusted to just the right value the plate-current, with no signal coming in, will be on the kink in the curve. Now as the curvature is greatest at the kink, and as the size of the hump in the 'phone current of Fig. 10 depends directly upon the curvature of the plate-current curve it is evident that the valve with gas may be made a better detector than one without gas.

From the foregoing it is therefore seen that as a signal of varying amplitude is coming into the tuned circuit the grid accumulates more or less electrons, which gradually leak off through *R;* with a strong signal many electrons are caught by the grid, and with a weak signal but few are captured. Now, as electrons are *negative* electricity it follows that the average grid potential, due to this accumulated charge of electrons, will be lowered the stronger the signal. Thus the signal voltage might be of the form shown in curve *a* of Fig. 12, which is part of a word spoken at a radiophone transmitting station.

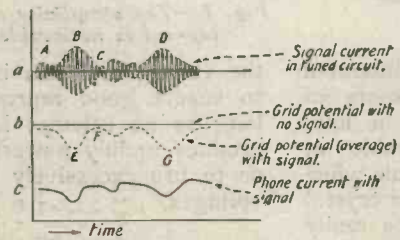


Fig. 12.—Showing relation of signal current, grid potential and telephone current.

When the high-frequency current in the tuned circuit is of low amplitude, as at *A*, the electrons are accumulated by the grid at a slow rate and so the average potential of the grid is about the same as when no signal is coming in. But when the signal current increases in intensity, as at *B*, the electrons accumulate more rapidly on the grid, and so its average potential falls, as shown at *E* of curve *b* in Fig. 12. At *c* the signal voltage is again low, and so the average grid potential again approaches its normal value at *F*. In fact the average potential of the grid will follow quite closely the envelope (dotted line through the peaks of the waves of the high-frequency current) of the voltage in *a*, and if the radio transmitting set is working properly this envelope will correspond with the form of the voice wave at the transmitter.

Now as the plate current of the triode, which flows through the 'phones, must go up and down as the average grid potential goes up and down, it follows that there will be humps and hollows in the form of the plate current which will have the form of the voice sound as indicated in curve *c* of Fig. 12. But the telephone receivers give off a noise which corresponds to the form of the current flowing through them, and so the sound given off by the receivers will resemble the sound uttered at the transmitter station.

High Frequency Oscillations

In the foregoing paragraphs the action of the three electrode tube has been outlined as a rectifier and detector of high-frequency waves, which we now summarise. Sent off from the aerial of the transmitting station are high-frequency waves the amplitude of which varies. In the case of a radiophone transmitter the variation is such that the amplitude of the waves sent off closely resembles the form of the sound wave of the voice. When these waves strike the receiving aerial they set up currents in it and also in the local tuned circuit. These currents make the grid potential vary with high-frequency fluctuations, the amount of this fluctuation varying as does the high-frequency current in the aerial of the transmitting station. The variation of grid potential causes corresponding changes in the amount of plate current, which is the current flowing through the telephone receivers. As the sound given off by the 'phones is fixed by the shape of the current flowing through them, it follows that the sound given off by the receiving 'phones will resemble that at the transmitting station.

"Modern Wireless"

FOR JUNE.

"How to Construct an ST100 with Two Stages of H.F."

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A Simple Tw
Magn

By G. P. KENDALL,

Success in adding low-frequency often depends upon the use of well-spac

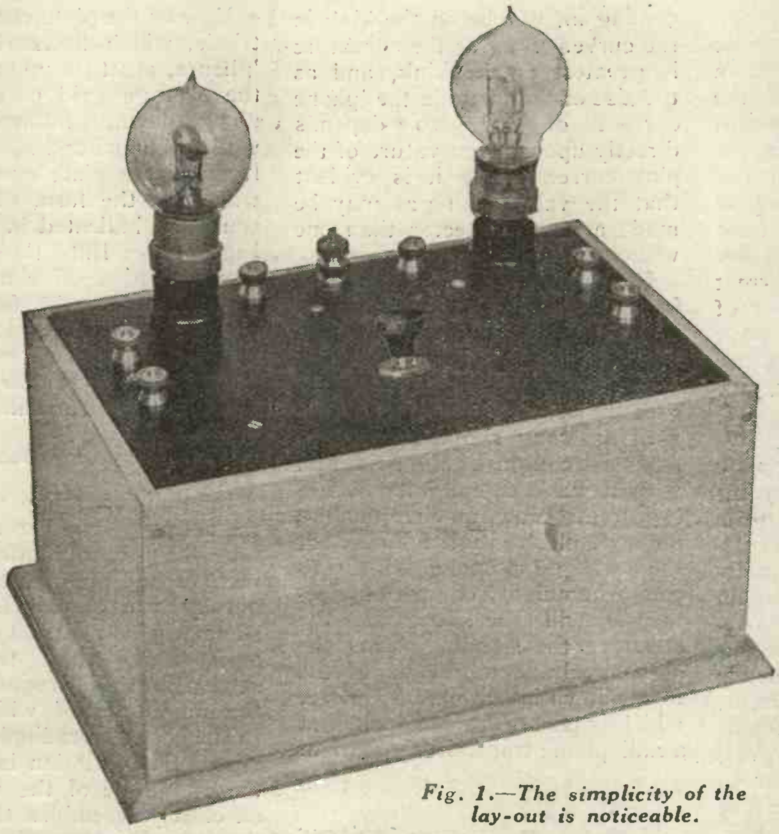


Fig. 1.—The simplicity of the lay-out is noticeable.

THE instrument illustrated on this page represents an attempt to design a low-frequency amplifier capable of giving really strong signals when connected to any valve or crystal set, and which should be really simple to make and easy to operate. Further, it is intended to use either high temperature valves or dull emitters without any modification, and to possess only *one* adjustment, namely, that of the filament current. No provision is made for the use of grid cells, since the magnifier is not intended to be regarded as a power amplifier, but is designed to use ordinary receiving valves with an anode potential of 60-80 volts. Under these conditions an ample volume of sound for a room of normal size can be obtained, and the only "grid bias" needed can be got from the drop of about two volts across the filament resistance. The connections of the secondary windings of the transformers are such that this voltage drop is used to apply a negative bias of about two volts to the grids of the valves, and this is sufficient to ensure good reproduction so long as no attempt is made to produce unduly powerful signals or to use excessively high plate voltages.

Modifications

If it is desired to modify the design so that it can be used as a power amplifier, the lead which joins the O.S. terminal of the transformer seen on the left in the wiring diagram to the filament resistance should be broken and taken to an extra terminal, instead of to the Lissenstat. To this new terminal the negative terminal of a grid bias battery should be joined, the positive being connected to L.T.—.

Considerable care was taken to lay out the amplifier so that its construction shall be as easy as possible, and the wiring simple and efficiently arranged. This latter point is most important, of course, since it affects the stability and efficiency of the finished amplifier, and the photograph of the underside of the panel will show that the wiring is actually extremely direct and well spaced. The instrument is very stable and well behaved in its action, and shows no tendency whatever towards howling, which is partly to be attributed to the simplicity

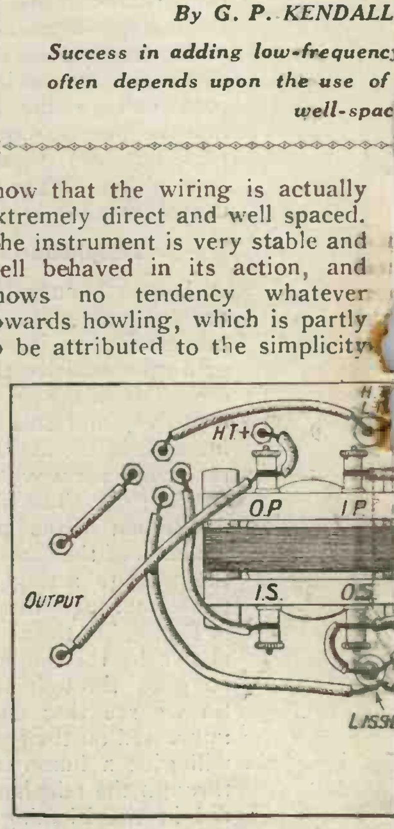


Fig. 3.—The exact arrangement

of the wiring and partly to the placing of the transformers.

It will be observed that no

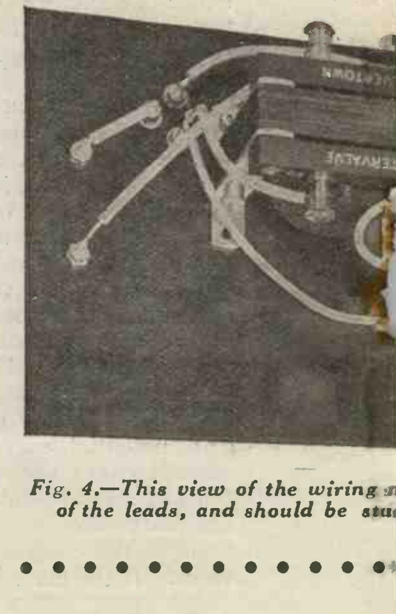


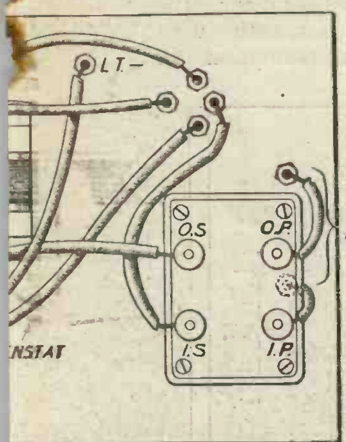
Fig. 4.—This view of the wiring of the leads, and should be stud

o-Valve Note
ıifier

, B.Sc., Staff Editor.

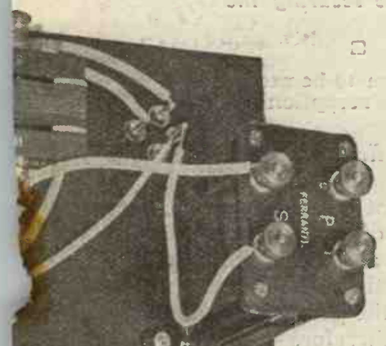
valves to an existing receiver an amplifier with simple and ed wiring

switches are incorporated for bringing the valves in and out of circuit, and I would most earnestly entreat the reader not to attempt to add them for himself. To do so would involve re-designing the amplifier on a larger



of this wiring should be copied.

panel, finding fresh positions for the transformers, and spending a considerable amount of thought



akes clear the precise disposition lied in conjunction with Fig. 3.

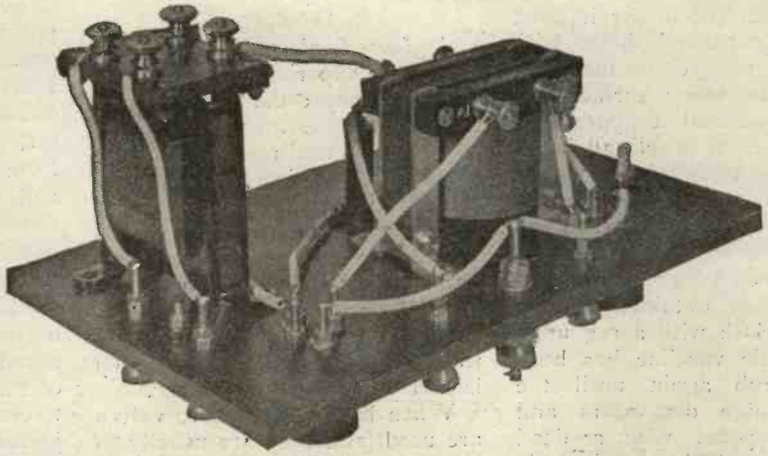


Fig. 2.—Note that the transformers are arranged at right angles.

on the simplification of the new wiring, and therefore if the reader feels that he must have an amplifier with switches he is urged to wait until he sees a design incorporating them, and *not* to try to so modify the present instrument as to include them.

Transformers

The amplifier as it stands gives very good results, both as regards freedom from howling and other undesirable noises and the purity of the reproduction which it gives when used to operate a loud-speaker, this latter good point being attributable to the fact that the transformers are of good and *different* makes. It is well known that low-frequency transformers of even the best type have usually a tendency to respond to certain frequencies more strongly than to others, thus producing uneven amplification over the range of audible frequencies. Some transformers, for example, produce undue prominence of the high notes, whereas others cause the lower notes to be amplified more strongly.

It is possible to take advantage of this fact and spread out the amplification more evenly over the musical scale by using two transformers of different make which may be expected to possess differing characteristics, and this expedient was adopted, as has been stated, in the amplifier being described. The first transformer is of Ferranti make (commonly known as the "H.D."), and the second is a Silvertown. These two transformers do not perceptibly emphasise any particular frequency when used alone, yet when they are used together the compensating effect seems to be present, since the reproduction is noticeably good. Any good makes could, of course, be employed.

Components

The actual construction of the amplifier is extremely simple. First obtain the following parts and materials :—

1 ebonite panel, 10 by 6 by ¼ in.

1 wooden box to carry the above panel, and 5 ins. deep.

2 L.F. transformers of good make.

1 filament resistance (preferably of the carbon compression type, for reasons to be given later).

1 double terminal of the Army pattern (desirable but not essential).

6 single terminals.

2 ebonite valve holders for panel mounting.

4 ¾-in. 3 B.A. brass screws with countersunk heads for attaching the L.F. transformers to the panel.

4 brass nuts, 3 B.A. size.

1 yard of Systoflex tubing.

1 yard of No. 20 S.W.G. tinned copper wire for connections.

The Panel

The first operation is concerned with the preparation of the ebonite panel for use. If this has a polished surface when received from the dealer it must be carefully rubbed down with very fine emery cloth until the whole of the shiny surface has been removed and it appears to be a dead matt black all over. The best way to do this is to wrap the piece of emery cloth round a small block of wood and then rub with a gentle pressure and a circular motion. When a matt surface has been obtained replace the emery cloth with a rag upon which a little vaseline has been put and rub again until the brownish tinge disappears and leaves the panel with a dead black finish. This treatment is to be applied to *both* sides of the panel, since its purpose is to ensure that the surface insulation of the ebonite shall be good.

Drilling

The panel being ready for use, we proceed to mark it out for drilling, by means of the drilling plan. Note that the positions of the holes A, B, C and D are only approximately given, since they are for the screws which fasten the transformers to the panel, and as the holes in the feet of these instruments may vary in different specimens it would be well to buy the transformers and check these dimensions before drilling the panel. After drilling the various parts are to be attached in the positions shown by the photographs and the wiring diagram, and we are ready for the wiring-up operation. This is very easily done with so simple a lay-out of the parts, and it is recommended that all the joints should be soldered, since the slightest imperfection of contact anywhere in a low-frequency amplifier is liable to show up as a crackling or fizzling noise in the 'phones.

Filament Control

It was mentioned in the list of components that a carbon compression type of filament resistance was advised, and it should now be explained that this is to enable dull-emitter valves to be used from either dry cells or an accumulator. These rheostats (such as the Microstat and Lissenstat) have a very wide range of resistance variation, and hence enable widely differing types of valves to be tried without the use of any kind of external or auxiliary resistance.

Howling

A few final points: if any trouble is experienced with howling (this may occur if a different make of transformer is employed, or if the internal resistance of the H.T. battery is high) simply reverse the two connections to the secondary of the first transformer (i.e., the one whose primary is connected to the input terminals), and connect a Mansbridge condenser of 2 μF across the H.T. battery. This latter step is rarely necessary, however.

When high temperature valves are used (and they are usually to be preferred for this purpose) it should be made a rule that a six-volt accumulator should be employed in order to produce the previously-mentioned two-volt drop across the filament resistance.

Operation

To put the amplifier into operation for the first time the procedure should be as follows: First tune in the signals in the ordinary way upon the receiving set, then remove the 'phones from their customary terminals and connect them to the output terminals of the amplifier. Connect the telephone terminals of the receiving set to the input terminals of the amplifier, join the batteries to their appropriate terminals, noting that the positive of the accumulator and the negative of the H.T. battery are both joined to the centre (double) terminal, and insert two valves in the sockets. Turn on the filament current by means of the rheostat and adjust for the greatest signal strength with the minimum consumption of current.

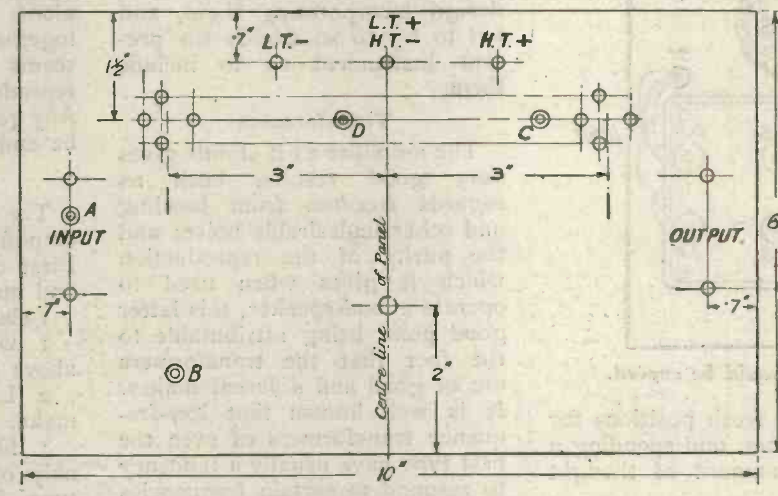


Fig. 5.—Drilling guide. The points A, B, C, and D, are intended to mark the approximate position of the screws securing the transformers to the panel.

Two Important Questions

How should a reaction set be adjusted if the loudest reception of telephony is desired ?

Gradually increase the reaction, making any necessary slight readjustments of the tuning as you do so, until the set is *almost, but not quite,* oscillating. If the conditions under which the valves are working are correct, the receiver will be quite stable in this state, and will maintain the adjustment indefinitely.

How is reaction to be used to give the clearest reception of telephony ?

Since the effect of reaction is to check damping, it interferes with the extent and form of the modulation of the received carrier wave, and therefore may produce distortion. The stronger the reaction, the greater the distortion, and therefore it is best to use as little as is consistent with good signal strength. If quality is desired it pays to add a high-frequency valve and reduce the reaction, rather than to achieve strong signals with a few valves and reaction pushed up to the limit.

Flush Fitting Plugs and Sockets

THE set is very greatly improved if plugs and sockets for mounting plug-in coils, such as those used as anode inductances, are fixed so that their shoulders are flush with the surface of the panel. A very simple way of doing this is shown in Fig. 1. It will be seen that

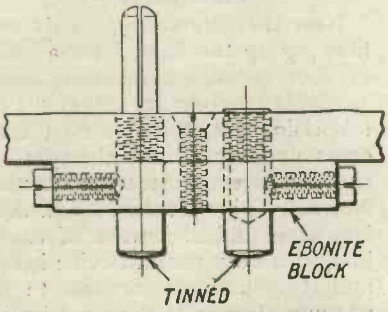


Fig. 1.—A suggested method of mounting coil sockets.

the plug and socket are first mounted upon a small block of ebonite into which they are secured by means of a pair of 4 B.A. screws driven through the ebonite into the brass. The block is then fixed to the underside of the panel by means of a ½ in. 4 B.A. countersunk screw, the plug and socket passing through holes so that their shoulders are flush with the surface. Fig. 2 shows how the block is laid out and drilled. It consists of a piece of ¼ in. or ⅜ in. ebonite 1½ ins.

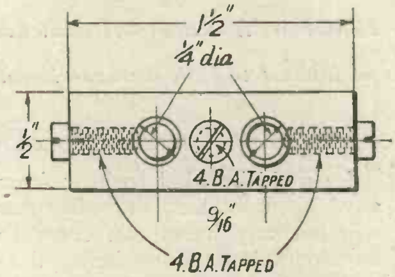


Fig. 2.—Constructional details.

long and ½ in. wide. In this are made two ¼-in. holes 9/16 in. apart, into which the plug and socket will be found to be a driving fit. Tin the base of each first of all, and then insert them so that their shoulders are exactly ½ in. above the top of the ebonite. Next drill into them from the ends of the block and insert a 4 B.A. screw to hold them firmly. The hole between the plug and socket in the block may be made of either clearance or of tapping size. If the former, a ¾-in. screw will be required, and the block will be secured to the panel by turning down a nut. The panel is drilled in the same way as the top of the block, except that in any case the hole for the screw is made clearance. Those for the plug and socket should be slightly larger than ¼ in. so as to allow them to slip through without difficulty. If a 9/32 drill is avail-

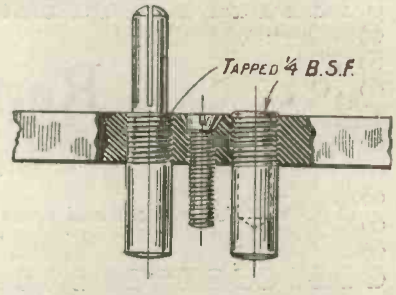


Fig. 3.—An alternative suggestion for mounting coil sockets flush with the panel.

able it should be used, but if not the holes may be slightly enlarged with a round file.

A still neater way of mounting plugs and sockets flush which will appeal to those who use taps and dies is shown in Fig. 3. The plug and socket are first of all run through a ¼-in. die—¼-in. B.S.F. (British standard fine) is a very suitable thread. It may be found that the shanks are slightly oversize, in which case they should be rubbed down with emery paper before screwing is done. The holes in the panel are drilled with a No. 3 drill. No. 7 is the size given in the tables, but No. 3 makes for easier work, and takes quite a full thread—and tapped. The plug and socket can then be screwed in, a nut being placed upon each below the panel if necessary to lock it tightly. The base of each should be tinned before they are screwed home so as to avoid heating up the panel.

R. W. H.

□ □ □

Marking Out Holes for Valve Legs

EVERYONE who has tried to mark out valve leg holes has found that it is a much more difficult business than might be thought. No matter how much care one takes one can seldom make them a good fit for valves if marking out is done by means of measurements. The best way of all is to use a template of some kind. Two sorts are now available for amateur use. One is a metal plate containing four correctly-spaced holes through which centre-punching can be done with great accuracy. The other is a small disc of steel on the lower side of which are four centre-punch points. A central hole in the disc allows it to be correctly centred up. It is placed upon the panel and given one tap with a medium hammer which suffices to punch all four holes at once.

Should no template be handy one can be made fairly accurately if a valve with correctly-spaced pins is available. Place a small piece of white paper upon a folded newspaper and press the valve hard down upon it The legs will make indentations in the paper at each of which a pencil dot may be made. With the help of such a paper template one can dispense with marking out and feel sure that the legs will fit pretty well. It is as well to make the holes for the valve legs rather large so that they allow a little play for the nuts to tighten up. Place a valve in them whilst they are still loose and screw up the nuts without removing it. This will automatically ensure that the legs are properly spaced.

R. W. H.

OUR NEXT ISSUE

Full constructional details of how to make a practical H.T-less Receiver, employing the new circuit given on page 99. A further circuit on the Omni Receiver will also appear.

Random Technicalities

By PERCY W. HARRIS, Assistant Editor.

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

A Froth Cure

AMONG my collection of accumulators there is one which suffered badly from frothiness. I do not wonder, considering the bad treatment it has had in the past (not, be it said, from me, but from a friend to whom it was lent for about a year), and, although the acid had been changed frequently, the cell washed out thoroughly, and steady charges and discharges given to it, it seemed incurable. Naturally when I heard the other day of a rather strange cure for such a trouble, I thought I would risk it and see what happened. Nothing venture, nothing have—in wireless as in everything else!

The alleged "cure" was to place a tiny pinch of Hudson's soap in each cell! It does sound silly—putting something which easily froths into an existing froth, but nevertheless I tried it. Judge of my surprise when I saw the froth disappear as if by magic. Previously the froth had appeared after a few hours' charging at a slow rate (I always charge my accumulators at two amperes from a Tungar rectifier), and had poured out of the vent-holes like a shampoo advertisement. After the treatment it was possible to continue the charge until all cells were gassing freely without any trace of frothing.

I should be glad to hear from any accumulator manufacturer whether any harm can come to an accumulator from the application of the soap compound. Until receiving such information I do not intend to introduce such foreign matter into the cells of an otherwise good accumulator. If readers have cells which seem incurable they may care to try the trick, but, of course, I cannot yet guarantee that harm will not eventually come to the battery.

Templates

Possibly, owing to the frequent demand in the columns of this journal for the provision of templates with wireless components, there has recently been a considerable increase in the number of these useful articles. Several makers of filament resistances now supply them in the carton, as do some of the variable condenser manufacturers. Every variable condenser should be provided with a paper template for panel drilling, and all "one-hole" mounting components should have marked on the carton the size of drill required to make the hole. Not a single four-pin valve manufacturer supplies a template for drilling the holes for the separate valve pins, although it is frequently advisable to use the separate pins rather than the composition-sheathed sockets.

Condensers

Now that the spring winds are blowing up the dust, have a look at your variable condensers, and see whether they are clean. It is surprising how much dust can creep unobserved into the narrow space between condenser vanes. A woolly pipe-cleaner, on which has been rubbed a trace of vaseline, is a very useful device here, and if you have access to a vacuum cleaner of the electrically driven type, put on the blower attachment and use this for cleaning them.

Dust in condensers is often the cause of parasitic sounds put down to "atmospherics" or "battery noises."

Aerial Connections

Another point requiring attention at this time of the year is the outside aerial connection when this is made by a nut or terminal on the brass rod of a lead-in tube. The combined effect of rain and heat may have set up slight corrosion with the development of a high-resistance joint—not enough to cut off signals, but still enough to weaken them. Take off the lead-in wire, clean its end and the nut or screw, and reassemble. You may get a pleasant surprise. The same treatment should be accorded to the earth connection.

Editorial
High-Tensionless Circuits

(*Concluded from page* 98)

It is only the great amount of publicity which has been given in the general Press to very startling statements that has prompted us to provide our readers with sufficient data for them to soothe any tendency to unjustifiable hysteria in the mind of the general public. We are not concerned with the domestic policy of another journal and we would not ordinarily dream of interfering in any way. A large section of the new wireless public is still susceptible to shocks, especially when some apparently unusual proposition is put before them.

We ourselves have thoroughly explored the high-tensionless problem, and our published accounts show what can be done. This, however, does not prevent a sane appreciation of the limitations of such circuits which we believe will simply go to swell the already innumerable arrangements that may be tried. They will not "revolutionise" any more than "supers" have revolutionised. We will continue to use high-tension batteries, just as we will continue to use aerials, earths, telephones and other adjuncts which have been abolished in the past.

C.W. and Telephony Transmission Using Valves

No. XIX.

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

VARIOUS methods of modulating radio-frequency currents using a rectifier, preferably a two-electrode valve, have been devised. A two-electrode valve with a negative potential on its anode is usually employed.

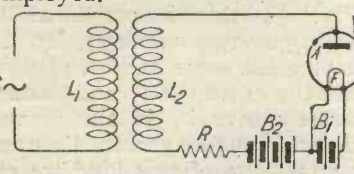


Fig. 52.—Explaining the use of a two-electrode valve in telephone transmitter circuits.

Fig. 52 will help to explain how such a valve may be used. An ordinary two-electrode valve has connected in its anode circuit a battery B2, a source L2 of radio-frequency current, and an output circuit R. The radio-frequency current may be supplied from the source S through the transformer L1 L2. If the maximum positive half-cycle of oscillating current supplied by L2 is just equal to the negative potential supplied to the anode A by B2, no current will flow through the valve V. If we decrease the steady negative potential on the anode A, the positive half-cycles supplied by L2 will overcome the negative potential supplied by B2 and cause the anode A to rise to a positive value above zero volts. A flow of current immediately takes place, and this current passes through an output circuit R, which may be an inductance or resistance, or may take other forms. By varying the potential of B2 we will be able to vary the high-frequency pulsating output current in R, and in wireless telephone circuits we can cause the microphone potentials to act in series with B2.

Another Application of the Two-Electrode Valve

Another application of the two-electrode valve is in dissipating absorbed current. We have seen how the three-electrode valve may be shunted across an aerial circuit, for example, and how, by varying the grid potential, we may vary the amount of current absorbed by the three-electrode valve. An analogous effect may be obtained by a two-electrode valve, and looking at Fig. 52, we might assume that the inductance L2 is an aerial circuit and that we absorb current from that circuit by varying microphonically the value of the negative potential on the anode. When the negative potential is sufficiently small to allow the positive half-cycles to rise above zero volts the valve V absorbs current from the aerial circuit. All these arrangements may be adapted to employ two valves, each of which conducts half a cycle of oscillating current.

A Recently Developed Circuit

Fig. 53 shows a very recently developed wireless telephone transmitter, which probably gives the most remarkably pure articulation that has, as yet, been obtained. The principle is briefly as follows :—

In an ordinary oscillating valve circuit, the oscillating potentials on the grid build up until the representative point sweeps over the whole of the anode current curve. In the Fig. 53 arrangement, the representative point only sweeps over a portion of the characteristic curve, the size of the portion depending upon the magnitude of the microphone potentials. This effect is obtained by introducing back-electromotive forces into the grid circuit of the oscillating valve the moment the grid potentials rise above a certain value. This effect is obtained by connecting a two-electrode valve with a negative potential on its anode across the grid coil; when the potentials across this coil exceed a predetermined value the negative potential on the anode of the two-electrode valve is more than neutralised, and the resulting current through the valve is made to pass through a high ohmic resistance in such a direction that back-electromotive forces are set up which oppose the normal electromotive forces applied by the grid coil to the grid. In this way the potentials supplied by the grid coil cannot exceed a given value (because after this value has been reached, there is

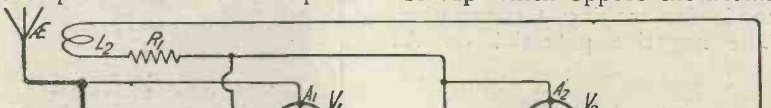


Fig. 53.—The amplitude of the oscillating potentials on the grid of V1 is limited by the valve V2, which acts as a two-electrode valve.

a tendency to produce back-electromotive forces which prevent further increase), and this value may be varied by causing the microphone to alter the negative potential on the anode.

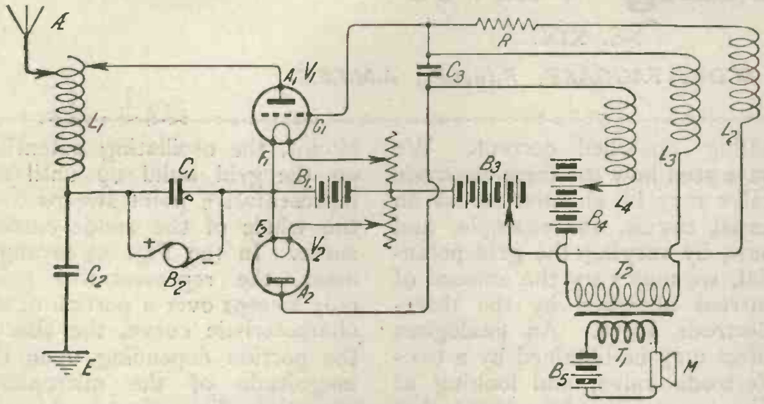


Fig. 54.—Another form of the Fig. 53 circuit; in which a single source of filament current is used.

In Fig. 53, the grid coil has in series with it a resistance R1 of, say, 100,000 ohms. Across the grid and filament of the valve V1 is connected a two-electrode valve V2, which may be an ordinary three-electrode valve with the anode and grid connected together. Between the filament F2 and the filament F1 is a battery B3 so arranged as to make the anode A2 of the two-electrode valve negative. The microphone transformer secondary T2 is connected also so as to influence the voltage of A2, but not that of G1. In the arrangement shown, provision is made for making G1 negative. The negative potential on A2 may be normally so high that the oscillating potentials across the grid coil L2 produce no current through V2. There is, therefore, no drop of potential across R1 due to a current flowing through V2. If, now, we speak into the microphone M the positive half-cycles in T2 will reduce the negative potential on A2; the radio-frequency potentials applied to A2 by L2 will now cause the potential on A2 to rise above zero, and the resulting current flowing through V2 will flow through R1 from right to left, thus making the grid G1 negative with respect to the left-hand side of R1. The momentary potentials across R1 will consequently act in opposition to those across L2, and the potentials applied to the grid will be unable to rise above a certain value. In this manner the aerial output current will depend upon the microphone potentials which limit the maximum grid potentials supplied by the grid coil.

A Practical Form of Circuit

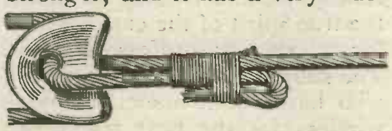
The arrangement of Fig. 53 is not a very practical one, as two filament batteries are required. In Fig. 54 we reproduce the circuit in such a manner that a single-filament accumulator may be used. Two filament batteries were necessary in Fig. 53 to prevent batteries being at a high-frequency potential to earth. In Fig. 54 this is prevented by arranging two windings, L3, L4, having the same number of turns as the grid coil and wound directly over it, in the manner shown in the diagram. By using a stratagem of this kind we can overcome the difficulty of having batteries at a radio-frequency potential to earth.

In the arrangement of Fig. 54 the grid coil is, of course, magnetically coupled to the anode circuit coil L1. The batteries B3 and B4 may generally be omitted. The valve V2 may be of the ordinary receiving type, even when V1 is rated at 1 kw.

Our photograph shows the McLachlan Recorder a practical commercial form of the instrument described in our first volume on page 184. The McLachlan Recorder is now operated in the Marconi long distance services.

Attaching Cabled Wire

CABLED wire, whether made of steel or galvanised iron strands, is coming more and more into favour with wireless folk, either for making the stays of masts or for forming the halliards which suspend the aerial wires themselves. Its advantages over ordinary rope are very great. It does not slacken and tighten in varying atmospheric conditions, it is much stronger, and it has a very much



A method of attaching steel wire to any insulator.

longer life. The difficulty of many people is to find a suitable way of securing its ends. To make a really good job these should, of course, be spliced, but the splicing of steel cable is a job which comparatively few "landlubbers" can tackle without making an unholy mess of it and puncturing themselves pretty severely in the process. The drawing shows a method very simple to carry out which makes everything perfectly secure. Let us suppose that we are attaching a supporting wire to one of the aerial insulators. Pass the wire through the eye of the insulator and pull through about 4 in. Lay the short end against the standing part of the wire and bind tightly either with copper wire or with the soft galvanised iron wire sold by ironmongers for use in the garden. When about a dozen turns have been put on, bend back the end of the cable, as shown in the drawing, and bind it down tightly with a dozen or so more turns. Then twist the ends of the binding wire together with a pair of pliers and cut off. A fastening made in this way will stand a pull equal to the breaking strain of the cabled wire itself.

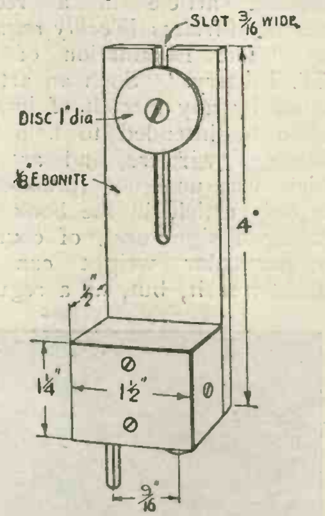
R. W. H.

Countersinking Screws

TO make a neat job of things we often require to countersink screws upon the panel of the set. These may either be the wood screws which hold it down to the case or they may be B.A. screws which fix transformers, condensers and so on to the underside of the panel. The most usual method amongst amateur constructors is to use a larger drill than that employed for the clearance holes, so as to make a hollow into which the heads of the screws will sink. The great disadvantage of using this method is that it is most difficult to countersink all screws to the same depth. The big drill has a way of running rather easily into ebonite, so that before we know where we are we may find that we have made a hollow which allows the screw to sink some way below the surface. By far the handiest tool for the purpose is the metal countersink which can be bought from any toolshop. What the constructor requires for B.A. screws is the 90 degrees countersink with a ¼-inch round shank. This will fit into the breast drill, and with its help the countersinking is easy. One has only to find the number of turns of the crank required for making a suitable hollow for one screw and then to give the same number at each hole. Some screws have heads with a rather steeper slope, and for this a 60 degrees countersink may be more suitable. These are quite inexpensive tools, and the purchase of a pair—one 90 degrees and one 60 degrees—is not a formidable expense. It is certainly very well worth while, for with their help any amount of trouble is saved and much neater work can be done. R. W. H.

Mounts for Basket Coils

IT often happens that one wishes to use ordinary basket coils in the holder with plug and socket mounting. A very simple adaptor can be made in the way to be described. Small blocks of ebonite provided with one plug and one socket are obtainable at about 10d. apiece from advertisers, and one of these may be used as the foundation of the holder. If, however, the constructor prefers to make the block himself he will find the dimensions given in the drawing. To this block is attached a strip of ⅛-in. ebonite, 1½ in. wide and 4 in. in length, in which is cut with a hacksaw a slot 3/16 in. wide, extending to about 2½ in. from the top.



The basket coil mounting.

Either a disc of an inch diameter or a square with 1-in. sides of ⅛-in. ebonite is now cut out, a 4B.A. clearance hole being drilled in the middle of it. Through this is passed a ⅝-in. 4B.A. bolt. The bolt serves to secure the disc in the slot and allows it to be adjusted to any height. A basket coil is mounted simply by passing the bolt through it and screwing up the nut at the back. By means of the up-and-down adjustment, the coil can be mounted so that it is concentric with others of any size. The holder will thus take all baskets from the smallest up to those with a diameter of 5½ in.

Corrections to Advertisements.

With reference to the advertisement of the H.T.C. Electrical Co. which appeared in May 7th issue, we understand that the valve holder for below panel mounting should read "Type C."

We are also asked to point out that in the advertisement of Quality Products which appeared in May 14th issue the prices of the "Kapee" Crystal Detector should read:—Type "A," 7/6; "B," 7/-; "C," 6/6; "D," 6/-.

Correspondence

SOUR GRAPES

SIR,—It was with great surprise that I read your rather scathing article in a recent issue of *Wireless Weekly* regarding "The Elimination of the H.T. Battery." Such an article cannot by any stretch of imagination be intended to help the science of wireless, and as the article was unsigned (practically the only article in the book not bearing a signature), of course, no particular weight can be attached to it, but, as a regular reader of *Wireless Weekly*, I must confess it strikes me as being much below the standard set up by the staff of *Wireless Weekly*, as being fair and impartial and only seeking the advancement of the science.

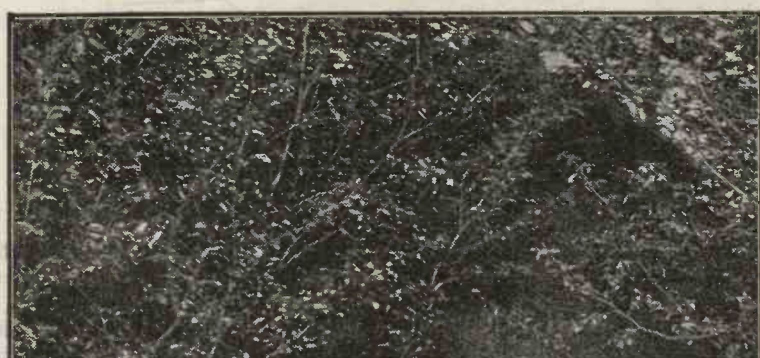
Surely this is a case of "Sour Grapes," and it has caused considerable adverse criticism amongst many local enthusiasts with whom I have come in contact, one of whom politely described it as "low down mud slinging." In any case, it hardly appears to be "playing the game."

Again, your editorial the following week on the same subject is, to my mind, narrow in conception and tending to hinder the true spirit of the experimenter for whom you profess to cater. The subject is not new, as we all, who have been associated with wireless for the past few years, are aware, but a more open-minded attitude towards a competitive journal would be appreciated by a reader of both.—Yours faithfully,

CYRIL J. MORLEY.

Ward End, Birmingham.

P.S.—It is only fair to state I have no connection, business or otherwise, with *Popular Wireless*.



Our photograph shows some of the apparatus used for the broadcasting of the nightingale. The set was placed in a convenient summer house.

A 100-METRE RECEIVER FOR KDKA

SIR,—You may be interested to know that I recently made up the "100-metre Receiver for KDKA," described in *Wireless Weekly* for March 19. I am greatly pleased with results obtained. I have received KDKA without difficulty on each of the three occasions I have tried, for periods of from 1 to 1¾ hours, and yesterday I listened from 1.50 a.m. to 3.20 a.m. to WGY's programme on 100 metres. Addresses, the coming week's programme, piano and violin solos, and soprano and tenor solos were remarkably clear, and at times quite strong, although there is a certain amount of distortion at times which seems difficult to eliminate entirely.

All component parts, except valves and a Watmel variable gridleak, are home-made. I use a Cossor P2 valve for H.F. and a Marconi Osram R. for detector, with 48 volts H.T. On the last occasion I added a 1 valve L.F. amplifier (Ediswan A.R.).

C.W. and Morse stations come in very strongly. Atmospherics are not very troublesome. Tuning is very sharp and selective.

My aerial is 33 ft. high, 35 ft. long, triple L-shaped, on 9 ft. spreaders, in an open district. By using a smaller variable condenser in series with the aerial London amateurs on about 200 metres are clearly received.

I propose to overhaul the valve panel and remove all superfluous nuts and the insulating sleeving to the wiring, as recently suggested in *Modern Wireless* and *Wireless Weekly*.

My only regret is that this was not published last autumn, as I should have "burned the midnight oil" on many occasions during the past winter.

Wishing both your journals every success. I have not missed an issue of either since No. 1 of both.—Yours faithfully,

EDW. M. KNIGHT.

Wandsworth Common.

ALL CONCERT RECEIVER

SIR,—As a regular reader of both your *Modern Wireless* and *Wireless Weekly*, I feel I must write and acquaint you with the wonderful results I am having with the "All Concert" receiver, which I constructed at Christmas. I have made a few alterations which I think are more convenient; for instance, I have built the second L.F. into the same cabinet, using a selector switch to cut off the first and second stage L.F. as required. I have also inserted a series-parallel switch, and have built the valves in a straight row, and find the set is just as strong. With 1 H.F., D., 1 L.F. I can tune in all B.B.C. stations, Birmingham being the weakest, yet the strangest thing about this station is that it is the only one that I can tune in, with the exception of Cardiff and Bournemouth, during the afternoon transmissions. With the second stage L.F. added I can tune in all B.B.C. stations, and most of the Continental on the L.S., which is clearly heard by the villagers who live a mile away. I might add that this place is a wee hamlet four miles from Teignmouth, and on quiet nights one can walk up on the Haldon Moors, 1½ miles, and hear clearly the concerts from Cardiff, Bournemouth, Manchester, and Newcasle, and especially the Savoy Bands. I think you will agree with me that these results are splendid. There are a few sets near me, and they are mostly sets built by a firm of great repute and expensive, and the owners themselves flatter me with the remarks that their sets cannot be compared with mine, so you will readily understand how very grateful I am to Mr. Percy W. Harris for his truly wonderful circuit. I might add also that I have tuned in several times the popular American Station, viz., WGY. In conclusion, I am sailing to America in June, where I shall interest myself in the American circuits, and when I return later will write to you again. Please excuse such a long letter, but I am afraid it would be impossible to give the wonderful results of the "All Concert" receiver in a briefer missive.

Wishing your publications still greater success.—I am, Sir, yours faithfully,

W. H. SYMES.

South Devon.

ST100

SIR,—Since this famous circuit was first published, I have constructed, or assisted friends to

49 separate tests are part of our scrupulous manufacturing process

Myers Valves

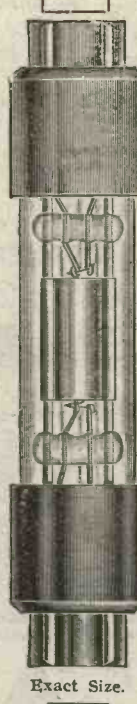
PRACTICALLY UNBREAKABLE

Universal, **12/6** - 4 volts ·6 amps.
Dry Battery, **21/-** - 2½ volts ·25 amps.
Plate voltage, 2 volts—300 volts.

With the exception of the MYERS you must add to the cost of the valve the price of the valve-holder. Thus, when you fit MYERS, besides receiving a better valve you also save the additional cost of a holder. **With the MYERS mounting clips and drilling template are supplied free.**

CUNNINGHAM & MORRISON

49, Warwick Road, Earls Court, LONDON - - S.W.5



Exact Size.

Before any one MYERS Valve is delivered from the works it is scheduled to pass through forty-nine separate and individual tests. The scope and rigour of these tests is of such intensity that any valve which may contain any manufacturing fault of the minutest description is discovered.
Those valves failing to survive one single test are scrapped.
This scrupulous care after an equally careful manufacturing process ensures beyond doubt that the MYERS *you* buy is perfect.
But this is not all. The MYERS is actually tested for reception.

The same ambition which is typical of the testing room is found in the design of the MYERS. Its overwhelming superiority as a receiving valve is the remarkable reward of scientific research.

The secret of the success enjoyed by the MYERS is due to the elimination of a useless internal capacity present in valves whose electrode leads are bunched together. Distortion and valve inefficiency generally is the responsibility of that useless capacity.
By its construction—the grid and anode leads being brought out at opposite ends—the MYERS is rendered free of valve noises. Detection therefore, is pure, and amplification remarkably truthful over the whole scale of musical and speech frequency.

Choose MYERS therefore. If your dealer cannot supply, write to the nearest selling agent or direct to the Sole Distributors.

LONDON: The Dull Emitter Valve Co., 83, Pelham Street, South Kensington, S.W. 7 ('Phone—Kensington 3331). MANCHESTER: R. Davies & Sons, Victoria Bolt and Nut Works, Bilberry Street, Manchester. NEWCASTLE: Gordon Bailey & Co., Consett Chambers, Pilgrim Street, Newcastle. LIVERPOOL: Apex Electrical Supply Co., 59, Old Hall Street, Liverpool. GLASGOW: Milligan's Wireless Co., 23-25, Renfrew Street, Glasgow. YORKSHIRE: H. Wadsworth Sellers, Standard Buildings, Leeds. SOUTHERN COUNTIES: D.E.D.A., 4, Tennis Road, Hove.

construct, many ST100's, invariably with the same excellent results.

I recently removed from Wembley to Wallasey in Cheshire, some 40 miles from the nearest broadcasting station. The sceptics may think I am a very imaginative person when I say that I obtain loud-speaker results from Manchester (40 miles away) almost indistinguishable from those obtained at Wembley, 7 or 8 miles from 2LO—that is to say, it can easily be heard out in the street.

Recently, I also tuned-in on the loud - speaker L'Ecole Supérieure des Postes, Paris, and a German station almost on the same wavelength, at a strength that could easily be heard two or three rooms away. This, from Wallasey. Single aerial, about 65 feet long and 35 feet high.

After dusk (and often before) all the B.B.C. stations are received at genuine loud-speaker strength.

Interference from electric-light mains is completely eliminated by using "D" terminal as the earth, instead of E (see your blue-print); this involves a very slight loss in stability, which is, however, completely overcome by slightly re-tuning.

I am a keen amateur, who has tried and listened on many kinds of circuits, and have yet to be convinced that any other circuit using the same number of valves, and even more, gives anything like the same results.—Yours faithfully,

G. I. PETTY.

Wallasey.

ST100 CONVERTED AS A ONE-VALVE DUAL

SIR,—As a ST100 enthusiast it has occurred to me that others of your readers may like to adapt their ST100 sets so that if desired the first valve may be used separately as a "one-valve dual." I obtained very good results in this manner, receiving the Paris concerts on the one valve at good 'phone strength with coils loosely coupled. This result is achieved by providing an extra terminal to which a lead is taken to that side of the plate coil connected to O.P. of the first transformer. By switching off the filament of the second valve and using the extra terminal for one 'phone lead, and that which goes to H.T. + of the ST100 for the other, an efficient one valve dual circuit is obtained. It sometimes happens that the enormous volume of the two valves is not required, and it is interesting to know that ST100 is so easily adapted in this way.—Yours faithfully,

N. B. REEVE.

Mile End, E.1.

ENVELOPE No. 2

SIR,—You may be interested to know the results I have obtained with your "Four-Valve Family Receiver."

The first night I tried the set I received Birmingham and Aberdeen, using only an indoor aerial. The local station came through with such power that it was quite loud enough to fill a medium-sized hall.

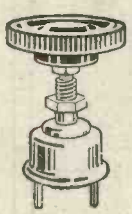
The quality and tone of the results of the set are quite remarkable, exceeding all the results obtained from other circuits. I think this is very good, considering that only an indoor aerial is used.—Yours faithfully,

ERNEST TOPPER.

Mile End, E.

VERNIER CONDENSER. Both knobs deeply fluted, ensuring easy control. Vernier indicator shows position and makes the finest tuning simple. Their high overall efficiency enables hitherto impossible stations to be tuned in readily.

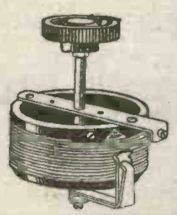
	Best Quality. With Vernier.	Best Quality. Without Vernier.	Cheaper Quality. Without Vernier.
·001	13/-	8/6	7/-
·006	12/-	7/-	5/9
·003	11/-	6/-	5/-

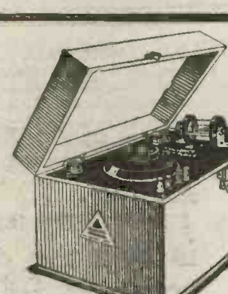


"RADIOSTAT." Suitable for ordinary or D.E. Valves. Price 2/9

Wholesale Agents for Igranic Coils.

FILAMENT RESISTANCES. Vernier Type, 3/6. Igranic Vernier, 7/-. Igranic Plain, 4/6. Standard Type, 1/10

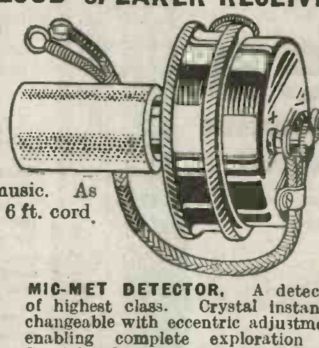




20 to 50% more power.

THE CHALLENGE SUPER-POWER CRYSTAL SET, Giving exceptionally loud and clear reception. Its detector is enclosed, has micrometer adjustment and will retain its setting for days or even weeks, without variation. Crystal can be changed instantly if desired. All enclosed in polished mahogany cabinet.

THE HERALD LOUD SPEAKER RECEIVER for building a loud speaker in any form. Adaptable to any horn or gramophone. Instantly attached. Adjustable diaphragm. Perfect tone on speech and music. As illustrated, but with 6 ft. cord. Price 29/-



CONDENSERS (Mansbridge). For H.T. Batteries, etc. ·5 mfd. 4/- 1·0 mfd. 4/6 2·0 mfd. 5/6

MIC-MET DETECTOR. A detector of highest class. Crystal instantly changeable with eccentric adjustment enabling complete exploration of Crystal and micrometer setting giving delicate yet permanent contact. 6/-

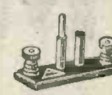
RADIAX LTD. 50, Radio House, Percy Street, Tottenham Court Rd., London, W.1. Museum 490. 3 minutes from Tottenham Court Road or Goodge Street Tube Stations.

RADIAX WE SATISFY YOU

RADIAX S.S. HEADPHONES. Really super-sensitive and will almost double the strength of reception, having adjustable diaphragms and are absolutely unbeatable. 4,000 ohms - - Price 19/6

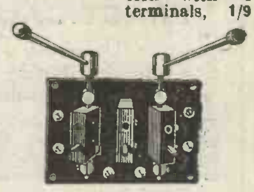
DRY CELLS. Use Radiax Super Cells for D.E. Valves. 2/3 each. Postage on 2, 9d.; 4, 1/-; 6, 1/3. Larger sizes for Multi-Valve Sets 4/-, Postage 9d. 6/- and 8/-, Postage 1/- each.

BASKET COIL MOUNT, 1/6



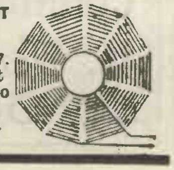
STANDARD COIL SOCKET, 1/6 Improved pattern with 4 terminals, 1/9

COIL HOLDERS. No. 277. 2-way 3/8. No. 274. With Vernier adjustment, 9/-. No. 272. 3-way 7/6. All with long handles.



CRYSTAL DETECTOR. Vertical enclosed. Pat. 1/10. Horizontal pat. heavy, enclosed 2/6. Open type on ebonite base, strong, 1/9. Set of same parts, 10½d.

BASKET COILS, Set of 7. Largest tunes to 2,600 metres. 3/6



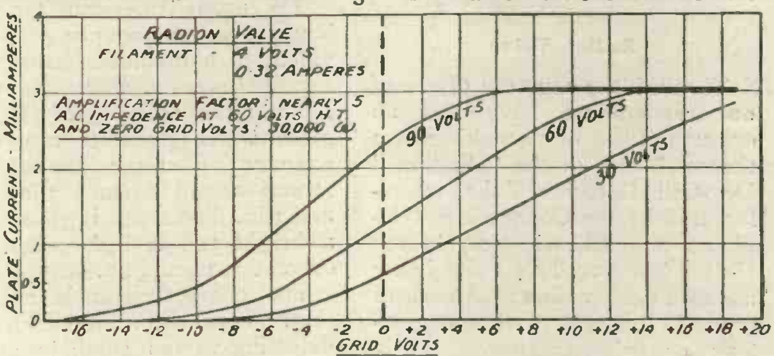
Apparatus we have tested

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

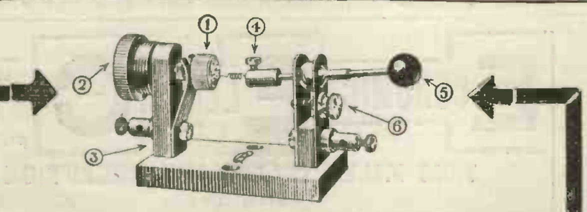
Radion Valves

Messrs. Radions, Ltd., have submitted for test a couple of their " Radion " valves, the containers of which were marked Types A2 and D4 respectively. Both valves had bulbs of a yellow-brown colour, one being of a lighter tint than the other : otherwise there was no distinguishing mark, and both were rated at the same figures. In appearance they resemble the ordinary bulbous type of R valve, but with vertical filament and rather open spiral grid.

On 3.8 volts the filament emission was on the low side : saturation being reached below 1.5 milliamperes plate-current. The current required at 3.8 volts was .29 and .28 ampere respectively in the two valves. With 4 volts on the filament (which implies the use of a 6-volt accumulator and filament-resistance of the right value) the saturation current reached 3 milliamperes. The characteristic curves for the one valve are shown for these conditions, and the plate voltages quoted by the makers. It will be noticed that the desirable long straight portion is obtained on each curve. The



Characteristic curves of the Radion Valve.



THERE IS NO COMPARISON

between other and inferior detectors and the

"KUPEE" CRYSTAL DETECTOR.

It is the IDEAL detector for the novice and the experimenter. Perfect results from Crystal Sets assured. To the experimenter it will prove a revelation. Any combination *instantly* available. Perikon or catswhisker detector at will. Micrometer pressure adjustment gives EXACT results. It is especially suitable for board mounting in making up experimental and reflex circuits for which it is ideal.

Get one to-day. Satisfaction or your money back.

FEATURES OF THE "KUPEE" DETECTOR

1. Crystal cup interchangeable with contact.
2. Rigid micrometer adjustment for pressure.
3. Rigid mounting
4. Contact holder interchangeable with crystal cup.
5. Smooth ball adjustment for searching.
6. Clamp screw for pressure on ball joint.

All metal parts are heavily nickel plated giving it a very handsome appearance.

PRICES—POST FREE,

Type A. Mounted on base, and complete with Mounted Orgelite Crystal, 2 spare cups, 3 contact holders and tube of 5 cat's whiskers	7/6
Type B. As above, but without base, for panel mounting	7/-
Type C. Mounted on base and complete with 3 crystal cups and 3 contact holders	6/6
Type D. As above, but without base, for panel mounting	6/-

QUALITY PRODUCTS

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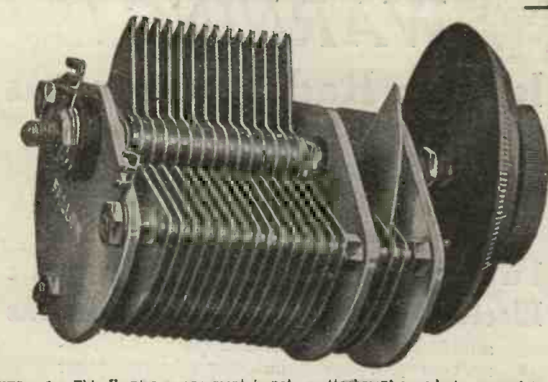
New FALLON CONDENSER with Combined Vernier



POINTS: 1. This Vernier arrangement is not an attachment or gadget supposed to effect a Vernier adjustment, but is a proper Vernier Condenser as clearly shown in illustration. 2. Main Condenser and Vernier adjusted by one knob only. Push knob down to operate Main Condenser. Pull knob up to operate Vernier Condenser. 3. Main Condenser cannot possibly move while Vernier is being adjusted, thus eliminating the constant trouble experienced where two knobs are used. 4. Setting of Main Condenser and Vernier are both read from one dial.

This condenser can be had in both styles of our All Model, with either moulded or Aluminium ends.

PRICES: ·001, 10/6 ; ·00075, 9/6 ; ·0005, 8/6 : ·0003, 8/- : ·00025, 7/6 : ·0002 7/-

Foreign and Colonial Agencies: AUSTRALIA.—The Westralian Farmers, Ltd., Perth, W.A. SOUTH AFRICA.—G. D. Henderson & Co., 15, Timber Street, Maritzburg, Natal ; Stuttaford & Co., Ltd., Johannesburg and Cape Town. SWEDEN.—Graham Bros., Stockholm. HOLLAND.—De Witt Sadee & Co., 182, De Carpentier-Straat, THE HAGUE.
Scottish Depot—120, Wellington Street, Glasgow.

Write direct for Trade Terms :

FALLON CONDENSER Co. Ltd.

The Condenser People. *Tottenham* 1932.

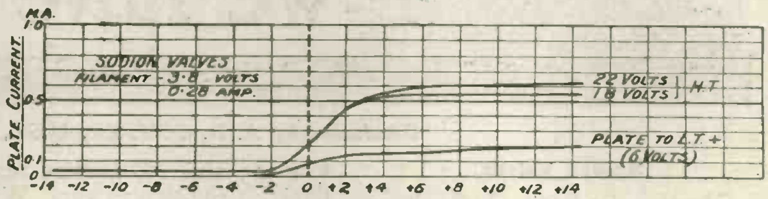
White Ribbon Works, Broad Lane, N.15.

results for the fellow valve were not markedly different. The amplification-factor is not high: just below 5.

Tested in various circuits, both valves functioned well, with but little to choose in comparison with a standard R-valve. Only in L.F. amplification the lower amplification-factor showed up: thus on a certain constant test-transmission the signal-voltage across the 4,000-ohm phones, in a detector-note-magnifier circuit, amounted to 1.5 volts with the Radion valve as L.F. amplifier, as against 1.7 volts with a standard French R, and 2.25 volts with an L.S.3, using 85 volts and optimum grid-bias in each case.

Sodion Valve

Through the courtesy of one of our readers we have had an opportunity of making a thorough test of the "Sodion" Dry-Cell Detector Tube, manufactured by the Connecticut Telephone and Electric Co., in the United States. This valve is for use as a detector in the American type of circuit, *i.e.*, without grid-leak or grid-condenser. It is rated at 3.8 volts and .24 amperes filament current; the sample submitted took .28 amperes when 3.8 volts were applied, but would operate at a somewhat lower voltage quite well. It will be seen that the valve is more suitable for running off a small 4-volt accumulator than for use with a dry-cell battery.



Characteristic curves of the Sodion Valve.

The usual American type of bayonet-fitting mounting is provided, in a moulded base with terminal screws, about 2⅝ in. by 1⅝ in.; the bulb is of frosted glass which prevents any close examination of the internal construction, and is nearly 3 in. high and 1 in. diameter. It glows with a bright yellow light when the current is turned on.

The characteristic is as one might expect for an exclusively detecting-valve: small in amplitude, but with a sharp bend close to zero grid volts. The saturation current is very small: only just over .6 milliamperes.

On actual trial in reception, very fine qualities indeed were disclosed as a detector. With the phones connected to the L.T. plus only, and using a 6-volt accumulator with the filament-resistance in the positive lead, good signal-strength resulted on local broadcasting without any H.T. and without grid-condenser leak; and with H.T. up to the rated maximum of 22 volts this improved in strength up to a very satisfactory quantity. The clarity of reception was quite surprisingly good. Perhaps the best results were with 18 volts H.T. No appreciable reaction-effects could be obtained; and tests as L.F. amplifier were emphatically negative in their results. It was noticed that the tuning was unusually flat with this valve.

WARNING!

Igranic Radio Apparatus

In an action in the Chancery Division of the High Court of Justice at the instance of Igranic Electric Company, Ltd., the London Variometer Company on the 7th of May, 1924, submitted to a perpetual injunction restraining them from

Infringing the Igranic Electric Company's Trade Marks

and from selling electrical apparatus in connection with any circular or advertisement containing the word "IVANIC" or any other colourable imitation of the word "IGRANIC" and from supplying in response to orders for "IGRANIC" goods, any apparatus not of the Igranic Company's Manufacture, and submitting to deliver up to the Igranic Electric Company all labels, invoices and articles the use of which would be a breach of the injunction.

RADIO IGRANIC ELECTRIC Co. Ltd. DEVICES

149, Queen Victoria Street, LONDON.

Works: Elstone Road, BEDFORD.

ECONOMIC ELECTRIC LD.

40 Page RADIO LIST post free 4d.

7,000 MILES TELEPHONY RECEPTION WITH ONE "XTRAUDION" VALVE!

Unsolicited Testimonial from Messrs. Dowson & Dobson, Ltd., Johannesburg, South Africa. *March 26, 1924.*

Messrs. Economic Electric, Ld.,

"DEAR SIRS,—For your information we would like to add that Mr. Pleese, " a local amateur has had 7 of your 'XTRAUDION' valves in constant use for " 18 months and has heard Bournemouth's programme *on one valve only. This " is absolute fact, not fiction.*"

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Other Resistances to suit any circuit.

ARE THE BEST FOR THE FOLLOWING REASONS:

Continously Variable. Silent in operation. Constant in any temperature. Dust and Damp proof. Each tested and guaranteed. Neat and well-made. *Send P.C. for descriptive folder.*

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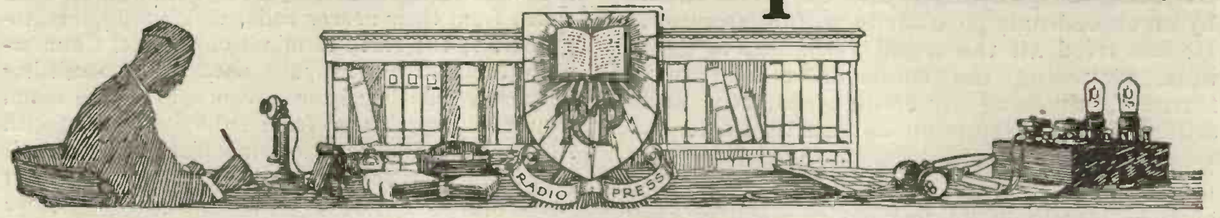
Information Department



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. C. (HORNSEY) asks what are the advantages, if any, of a matt surface upon ebonite as compared with a polished one.

It is very dubious whether a matt surface has any real advantage over a polished one, except from the point of view of appearance, since it does not show every slight scratch and trace of dust. The real object of matting the surface is to remove the original skin which is often a very imperfect insulator, since it commonly contains a certain amount of tin sulphide which results from one of the processes of manufacture.

I. T. L. (BRADFORD) says that he has been informed that he cannot employ reaction in his variometer tuned single-valve receiver, and asks our advice as to what modifications are needed to enable him to do this.

Reaction can certainly be employed in a quite efficient manner in a variometer tuned receiver, simply by placing a second variometer in the plate circuit of the valve, between the telephones and the plate, shunting the telephones with a condenser of 0.002 μF, and placing the two variometers side by side. If the set will not oscillate upon varying the new variometer between zero and maximum reverse the two connections which lead to it. It will then be found that this variometer provides a very critical control of reaction, this circuit being of American origin.

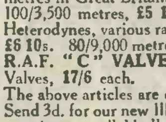
Electradix Radio Bargains

We have the largest stock of High Grade Apparatus ever offered. Prices—a fraction of cost. Delivery to any part of the World from our Huge Stock. Catalogue Goods are listed and illustrated in our 3d. April Catalogue which should be on every experimenter's table.

RECEIVERS. One, two, three and five-valve sets. Hundreds in stock. We specialise in Portable Sets for all seasons and have purchased the remaining stock of the famous R.A.F. No. 10 Aircraft Telephony Receivers, 5-valve 200/600 metres, 2 H.F., 3 L.F. Cost £50 and sold by others at £10. Complete with diagram, instructions and test sheet at the bargain price of **£5 5s.** Less valves. An unparalleled Opportunity which should be seized at once.

TUNERS. We have a large stock of the beautifully made Army 60 *w* Tuners. Those who know this fine set will remember the two variable air .0015 mfd. Condensers in dust-proof cover, similar to those in Paul Wavemetres, which are fitted in the ebonite panel of this Tuner. The variable reaction, slow motion coil movement, is the most admirable mechanism ever seen in Radio apparatus, and is most accurately made, giving very fine tuning-coupling to either of the two coils. Having a large number of these we offer them at the cut figure of **£4** each.

For those making their own sets we can offer quantities of the famous **Short Wave Tuner Coils.** Wound stranded Litz wire on 3½ in. ebonite tubes, at **4/-** each.



RECORDERS. For recording Morse Wireless Signals. Enable high speed signals to be received and read at leisure. Magnificent British instrument work, cost £40. R.A.F. surplus, guaranteed working, **£6 10s.**

MEG. GENERATORS. Hand Generators, 1,000 volts, **£13** 1,000/1,200, **£11.** M.G. 12/1,200 at 75 m/a, **£20.** 1 K.W. 200 volts, M.G. to 2,000 volts at 500 m/a, **£28.**

ALTERNATORS. Newton 200 watt 500 cycles, self-exciting Generators, wonderful machines, **£3 10s.**, or with step-up Transformers for 1,000 to 5,000 volts, 500 watt type **£8 10s.** All sizes up to 2 K.W.

WAVEMETRES. The Largest and Finest Stock of Selected and Tested W.D. Wavemetres in Great Britain. L.R. Townsend, 120/4,000 metres, **£6.** Paul's Wave-Testers 100/3,500 metres, **£5 10s.** Station Testers, 120/1,400, **£5.** Townsend Broadcast **£3,** Heterodynes, various ranges, 200 metres up, from **£4 10s. 0d.** Forward, 80/3,000 metres. **£6 10s.** 80/9,000 metres, **£7 10s.**

R.A.F. "C" VALVES. 5 v., 6 amp., British Made, **6/6** each. Four Electrode "R" Valves, **17/6** each.

The above articles are only a few of our huge selection of Radio and Electrical apparatus Send 3d. for our new Illustrated Catalogue and Price List, again enlarged for April. If you can give us a call, kindly note that Colonial Avenue is the first turning on the left in Minories from Aldgete.

LESLIE DIXON & CO.

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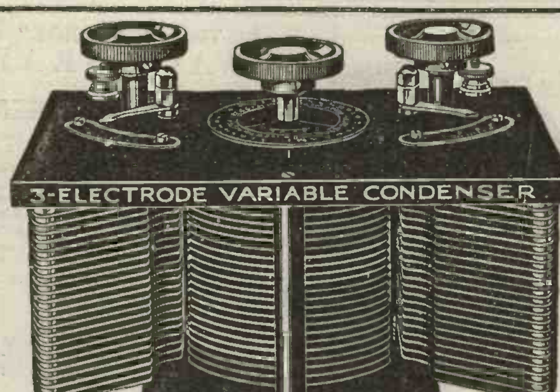
Telephone: Avenue 4166. Aldgate Station Met. Rly. *Telegrams:* "Electradix, Ald." Buses pass entrance.



INTERFERENCE CAN BE ELIMINATED

Perfect reception is possible only when your receiving set rejects *all* signals except those coming from the particular transmitting station to which your receiver is tuned.

The 3-E.V.C.

IS THE ONLY PROVED REJECTOR.

The "Bridge of Radio Science" eliminates troublesome local stations, minimises atmospherics and selects the particular broadcast programme desired. Its addition will make *your* set 100 per cent. more *selective* and *sensitive*.

Send 3d. in stamps for our new instruction booklet.

Prices: .001 mfd. panel mounting ... 47/6
.001 ,, cabinet mounted ... 55/-

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AUTOVEYORS, LTD. *Radio Engineers and Contractors,*
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'Phone: Vic. 309. 'Grams: "Autoveyor, Sowest, London".

C. A. F. (BRISTOL) states that he possesses a receiver employing two stages of low-frequency amplification, and he is troubled by an exceedingly peculiar form of distortion. He has tried all the usual remedies of grid bias, reversing the connections to transformers, shunting by condensers, etc., and still finds the distortion as bad as ever.

Since all the usual expedients have been tried, we are led to think that a somewhat unusual fault must be present in this set, which we have observed before, namely, that the two ebonite valve sockets which are used are of inferior composition with a very poor factor of insulation. You should certainly try the experiment of replacing both the valve sockets with others whose quality you are confident of. Probably the safest method is to use separate brass legs, mounted directly upon your panel.

T. H. O. (WIDNES) asks exactly what is meant by a counterpoise earth, and whether he would find it of any use with his crystal set.

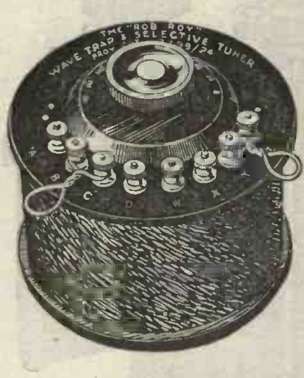
A counterpoise, or balancing capacity, as it is sometimes called, is used instead of a direct connection to earth, and consists of some insulated capacity, such as a sort of dummy aerial suspended a few feet above the ground immediately beneath, for preference, the main aerial. An efficient counterpoise can be made by the use of a pair of 10-foot spreaders, between which are stretched four equally-spaced wires, insulated at the ends in the same manner as that employed with an ordinary aerial. The wire should be of large diameter, preferably the standard wire used for aerials, and a really robust lead should be taken from their nearer ends, which are joined together, to the earth terminal of the set. Counterpoise earths are principally used for transmitting purposes, but they have advantages where much trouble is experienced from induction effects with A.C. mains, and electrical machinery in general, and further for the reception of exceedingly short wavelengths. With a crystal set, however, we can see very little use for a counterpoise.

F. R. C. (ROTHERHAM) enquires how he can distinguish the positive and negative terminal upon an accumulator which is not marked in any way.

If the accumulator is contained in a celluloid case, it can be done by noticing which terminal is connected to which plate inside the battery. The dark-coloured plates are the positive, and the light grey lead-coloured plates are the negative. You will also find that the negative plates will be greater in number than the positive.

W. I. C. (BERMONDSEY) asks up to what length the earth lead may be uninsulated, since he has seen it said that long earth leads should always be composed of insulated wire.

In the case of a receiving set it seems to make very little difference up to about 15 feet whether the earth lead is insulated or not, but beyond that length insulation is usually desirable.



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SELECTIVE TUNER
Prov. Pat. 7798/24.
The most efficient Wave Trap yet produced. Will positively enable you to receive distant stations without interference from your local station, and *without any appreciable reduction of signal strength.* Very effectively eliminates Morse. An efficient and *selective* tuner for either crystal or valve receiver. No extra condensers or coils are required.
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Patentees & Manufacturers.
Trade enquiries invited.

Useful Advice!
Unless a Leak of the proper resistance is placed across the grid condenser the valve will either choke or the effect of the Condenser be destroyed. The value depends on both the characteristics of the valve and the circuit, and can only be obtained through using the "BRETWOOD," ***the only accurate variab e grid leak*** of watch-like precision and scientific design. PRICE 3/-
The only Grid Leak with which it is possible to supply a reliable Chart giving 25 different readings covering from 100,000 ohms to 10 megohms. This Chart is supplied for use with the "Bretwood" Grid Leak only, at a cost of 1/3.
Send yours to be calibrated and chart supplied.
IMPOSSIBLE to short circuit valve when using the BRETWOOD valve holder which acts as its own jig and valve fits flush to panel. Valve legs are held yielding by ball bearing spring device, thus always assuring perfect contact. One screw fixing only. PRICE 1/9.

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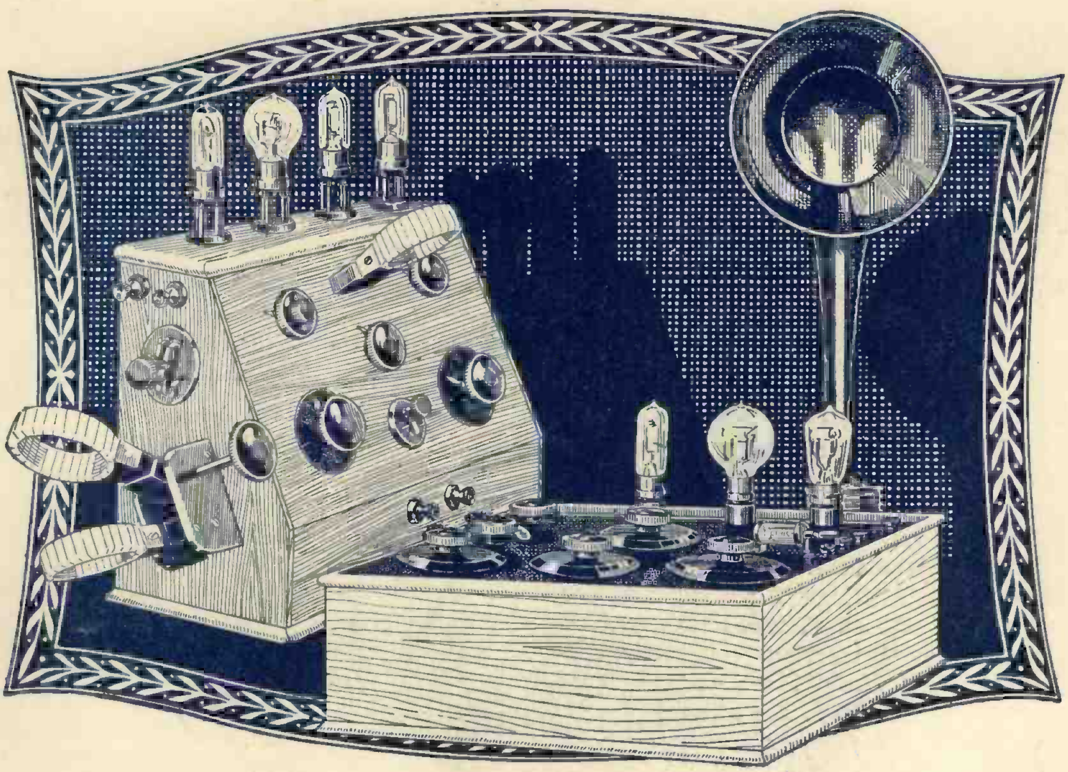

No previous Radio experience needed.

EVERY Receiving Set described in this Book has been actually built by the Author and its performance thoroughly tested under various conditions.

The result is that any man wishing to make up a Set can read through the Book, study his local conditions, gauge his anticipated expenditure and make his choice. And when he gets down to the actual building he will find every item fully described just as if he were working side-by-side with the Author himself.

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- A four-valve Universal Receiver.

Together with information as to the testing and operation of Receiving Sets.

RADIO PRESS LTD., DEVEREUX CT., STRAND, W.C.2

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Wireless Sets for Home Constructors

By E. Redpath.

Radio Press Series No 17.

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Ask your dealer to demonstrate the Sterling "Threeflex"

Here are the descriptive facts and prices: The "Threeflex" is designed for use with D.E.3 Valves. It is simple to control, very selective and ready at a minute's notice to receive British broadcasting. It will operate a loud Speaker with ample volume for average requirements at a reasonable distance from a transmitting station. If the valves are inadvertently left on, they will be automatically switched off when the instrument is closed. Complete with high and low tension dry batteries in base of instrument, one pair of Sterling Headphones and Folding "Loop"

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Extras:—Three D.E.3 Valves at 30/- each

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B.B.C. Tariff 16/- net

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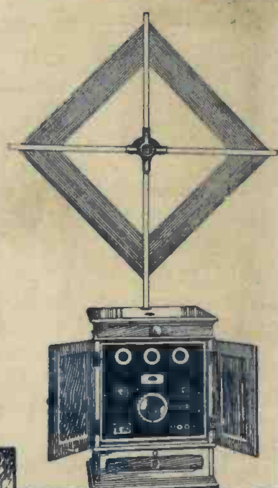

The "Threeflex" Loop Folded

Sterling "Audivox" Loud Speaker

STERLING THREEFLEX RADIO RECEIVING SET

No Earth · No Aerial · No Accumulator

Visit the Sterling Exhibit, Palace of Engineering, Avenue 15, British Empire Exhibition.

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