POPULAR WIRELESS WEEKLY, APRIL 7th, 1923. REGISTERED AT THE G.P.O. AS A NEWSPAPER

WAVE-LENGTH TABLES FOR TUNING COILS.

Popular Wireless

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Canada's Largest Broadcasting Station at Montreal. The Studio at "C K A C."

FEATURES IN THIS ISSUE.

POPULAR WIRELESS

April 7th, 1923. SCIENTIFIC ADVISER, SIR OLIVER LODGE, F.R.S. D.Sc. [Every Friday.

TOPICAL NOTES AND NEWS.

Coming Attractions.

THE Editor tells me that he has some nice surprises up his sleeve in the way of "scoops" for POPULAR WIRELESS, and readers will be well advised to order their copies in advance. I must not anticipate these surprises too much, but I have spotted the names of De Forest and Squier under the titles of extremely interesting articles. There are others, too, but of these more anon.

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A Mysterious Jammer.

EVERY evening between 6.15 and 7.30, from some point in the region of Paris, says the "Morning Post," a series of wireless signals are being sent out simultaneously with the usual broadcasting service from the Eiffel Tower. Every evening during the past fortnight this mysterious wireless station, whose whereabouts nobody has yet been able to discover, has been sending out musical selections and other communications, which have been clearly heard by thousands of wireless receiving sets within a radius of 200 miles of the capital.

The signals from this mysterious wireless station are extremely clear and strong. Its power appears to equal that of the Eiffel Tower itself, which is at present what is described technically as equivalent to five kilowatts in the antennæ. It has not yet been possible to ascertain whether the unknown station is using the same wave-length as the Eiffel Tower or its harmonics. The longest of these harmonics would be about 1,300 metres, and the next 700 metres.

* * *

F L's Rival.

INQUIRIES in official and other technical quarters have failed to elicit any clue to the mystery. A scheme was recently broached by a group of French constructors for the organisation of a huge commercial plant to send out wireless concerts on a subscription basis. But this scheme still exists only on paper. The mysterious station must have necessitated a large expenditure of money for such powerful plant, and no application for permission to set up a station of such magnitude has been received by the authorities. While all the signals sent out by other French stations are indicated by a code name, such as F 4 for Brest or F 2 for Cherbourg, the mysterious emissions in question are absolutely anonymous.

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The Silent North.

CAPTAIN LEWIS, that genial soul known to the London area as "Uncle Caractacus," is at present up in Newcastle in temporary command of the Broadcasting Station, pending the appointment of another director to replace Mr. Payne, who recently tendered his resignation. Captain Lewis tells me that although he has a large and appreciative "audience" in the Newcastle area, it is a curiously silent one. He believes that it is due to the fact that the Northerner is naturally less inclined to enthuse. He goes on to say that he finds this very particularly with the children, and that only one will write to him where dozens would in London.

* * *

Newcastle "Lecturettes."

CAPTAIN LEWIS, following on the successful reception of the series of lectures that he arranged on Art, Printing, and Psychology, given by Professors of the Armstrong College of the University of Durham, and broadcast from the Newcastle station, tells me that he is going to arrange a further series with the Natural History Museum.

* * *

"Where's Uncle Cactus"?

A VERY commendable effort on the part of "Uncle Caractacus" is the way in which he is organising these Newcastle programmes, so that the public will have some indication beforehand as to the type of music to be expected on certain evenings during the week. For instance, he has arranged for the Wireless Orchestra to play four nights a week on the same days as that of the London Station, while Tuesdays and Fridays are to be classical evenings. Taking everything into consideration, Captain Lewis seems to be bringing the standard of the Newcastle Station well into line with that of London. The London kiddies, however, refuse to sympathise with his motives, and I have heard many tearful inquiries for "Uncle Cactus" by the little listeners-in to 2 L O.

* * *

The Clergy Broadcast.

DID you listen-in to the Bishop of London last Saturday? His short speech on behalf of the Waifs and Strays was another example of an excellent Radio voice. It was a different matter with the Rev. S. Kennedy, M.C., who gave an address on Sunday. "Woodbine Willie"—as he was affectionately called by the Army—has not a Radio voice of a particularly happy brand, and I only heard a few words at all clearly.

Drawing Tungsten Wire in the new G.E.C. Laboratories, Wembley.

Dear! dear!

THE following is from the "Manchester Guardian," and it sums up a big question in a few words. Read it, ye experts! "The only things we really understand are some of the posters. Here is a cosy room, discreetly lit, and a young man and woman in evening clothes listening rapt to sounds which we must presume to be coming through the 'loud speaker.' A grey-haired and wise parent is stealing quietly through the door, looking back over his shoulder with an expression which clearly says: 'I've done my bit. I've got 'em together. The loud speakers will do the rest.' And then we left the exhibition in a final doubt whether we understood even that, for there are moments when one does not wish to compete with a 'loud speaker.'

(*Continued on next page.*)

NOTES AND NEWS.

(*Continued from previous page*).

Unless the wise parent was going to turn the loud speaker off? But can one turn off a loud speaker? Dear, dear! How little we know about it all!

* * *

The Gramophone and Radio.

THE gramophone companies have thrown down the gage to the B.B.C. The other day it was announced in the Press that the gramophone people had warned all artistes under contract with them that they would not be allowed, under the terms of their agreement, to broadcast by wireless.

I hear that some attempt to compromise is to be made, but I regard the action of the gramophone people as one of weakness. Much better to have faced the inevitable, and compromised to the extent of getting a good advertisement out of Radio.

* * *

The "Jammer" Found.

"POSTE ZERO," says "The Times," which has so long disturbed the "listeners-in" in Paris, has at last been discovered. The mysterious operator turns out to be a manufacturer of wireless apparatus who has been testing his installations over wave-lengths equal to those of the Eiffel Tower. He has been warned to experiment on shorter wave-lengths, and it is hoped that "listeners-in" will not again be troubled.

* * *

A Brave Lad.

BROADCASTING: Wanted, expert with direction-finder to detect experimenter probably near Hyde Park, continually interfering; others troubled also.—A "Personal" in "The Times" the other day.

"The message did not come from us," an "Evening News" representative was told at the London Station of the British Broadcasting Company. "We are delighted, however, that some member of the public is so enthusiastic as to take the step.

* * *

The Editor's Broadcast Chat.

THE Editor tells me that while broadcasting his short chat on wireless the other evening, the most curious sensation he felt was complete loss of sense of time.

He had calculated to speak for ten minutes, but found he had run dry after speaking for only six minutes—much to the annoyance of Uncle Jeff (who was in charge of the station that night) and to the Editor's surprise.

* * *

The Modern Bogeyman.

OUR radio "uncles" must not be employed in the manner of the "Bogeyman" of other ages. The other day I heard a lady informing her little son that "Uncle ——" was in the cupboard, and would be "after him" if he was naughty. It seems that little Johnny, in the definite way of an intelligent little chap solving a problem, had come to the conclusion that the broadcasting performers were concealed in the cupboard. I have lately and surreptitiously been giving little Johnny his first lessons in radio, and soon the day will come when he will openly defy the "Uncle in the cupboard" when employed for corrective terrorism.

The B.B.C.'s New Home.

THE British Broadcasting Company is now in its new home at 2, Savoy Hill, Strand, W.C.2, to which all communications should be sent. I looked over the offices the other afternoon, and was especially impressed with the elaborate arrangements made for dealing with letters from listeners-in. It is evident that the B.B.C. means to spare no trouble in keeping very closely in touch with its listeners-in.

As Uncle Arthur announced the other evening, moving to the new home has resulted in a little delay in answering some letters to the children, but arrears will soon be cleared up.

* * *

The New Disease.

SOME people would credit every individual receiving set with the frailties of the broadcasting artiste—and most of them acknowledge to some form or other of "microphonitis" when first they perform into and before that bland, implacable piece of mechanism, the microphone. The other evening I observed an elderly lady looking quite alarmed when my set (using three valves) commenced to "crashingly" reproduce "Finlandia," as broadcast from the London station. I believe she wanted me to soothe my "vibrating" valves in the tender manner of a motorist "pumping through" a little oil.

Curiously enough, after but a few bars 2 L O broke down—the lady's eyes reproachfully told me her thoughts. "There you are—I knew it." Five minutes later 2 L O confirmed her thoughts, for my set broadcast to the room, "Sorry, but have broken a valve——"

* * *

Mr. Burrow's Latest.

MR. BURROWS' innovation of reading notes on the week's chief anniversaries is a good one, and I hope he will keep it up. A good deal of really interesting and concise information can be "got over" in this way in just a few moments. The little "poem" he finished up with last Sunday brought tears to my eyes.

* * *

Alone I Did It.

BY the way, several readers of POPULAR WIRELESS have written to the Editor asking if he made up the jokes about the Broad-cast eyes and the two-step amplifier himself.

Strictly *entre-nous*, he didn't: I made 'em up for him!

ARIEL.

Broadcasting Programmes

What you can hear every evening of the week on your set.

TELEPHONY AND MUSIC TRANSMISSIONS

Station.	Call sign.	Wave-length in metres.	Remarks.
London Broadcasting Station, Strand ..	2 L O ..	369 ..	11.30 to 12.30 every morning and usually every evening, 5 to 5.45 p.m.; 7 and 9.30, News; 7.15, Orchestra; 8.25 to 10.30, Music. Sundays from 8.30 p.m.
Newcastle Broadcasting Station	5 N O ..	400 ..	As a rule from 7 to 10 p.m.
Manchester Broadcasting Station	2 Z Y ..	385 ..	Every evening, usually from 4.30 to 10 p.m.
Birmingham (Witton) Broadcasting Station	5 I T ..	425 ..	Every evening, usually from 6.30 to 10 p.m. (News, Concerts, etc.).
Glasgow Broadcasting Station	5 S C ..	415 ..	5 to 10 p.m.
Cardiff Broadcasting Station	5 W A ..	353 ..	5 to 10.30 p.m.
Croydon	G E D ..	900 ..	Throughout day to aeroplanes.
Paris	F L ..	2,600 ..	11.15 a.m., Weather Report; 6.20 to 7 p.m., Weather Report and Concert; 10.10, Concert.
Königswusterhausen ..	L P ..	2,800 ..	4 to 6.30 p.m
The Hague	P C G G ..	1,085 ..	Sundays, 3 to 5 p.m. (Concert).
Haren	O P V H	1,100 ..	12 noon and 4.50 p.m. Telephony.
Radio-Electrique, Paris	—— ..	1,565 ..	5.5 p.m., News Items; 5.15 to 6.10, Concert; 8.45 p.m., News Items; 9 to 10 p.m., Concert.
School of Posts and Telegraphs Paris ..	—— ..	450 ..	Every Tuesday and Thursday, 7.45 to 10 p.m. Saturdays, 4.30 to 7.30 p.m.

Note.—See announcements in daily Press for last minute alterations in times of Broadcasting Programmes. No Broadcasting during hours of public worship on Sundays.

NOTE.—The Bar Lightship, Liverpool, sends telephony at 7 a.m., 9 a.m., 11 a.m., 12 noon, 1 p.m., and every two hours until 9 p.m. Calls "Dock Office" Liverpool answers "Bar Ship."

In addition to the regular transmissions carried on between the British amateur stations, much telephone conversation may be heard from St. Inglevert (A M), Le Bourget (Z M), and Brussels (B A V). These stations are quite powerful, but they call for a little extra care in tuning. Wave-length, 900 metres.

All times given at G.M.T.

SOME WIRELESS OBSERVATIONS.

By SIR OLIVER LODGE, F.R.S., D.Sc., M.I.E.E. (Scientific Adviser to "Popular Wireless.")

PART 6.—ON SELF-INDUCTION AND ITS MAXIMUM VALUE.

THE first idea of Self-Induction originated with Faraday, long ago, but he was quite vague about it, and called it "the electrotonic state of a conductor." It puzzled him a good deal, and he treated it almost as if it were some chemical property of the metal, acquired under electrical influence. He named it "electrotonic state" in November, 1831, during his great discoveries in electromagnetic induction generally.

The idea became rather more definite in the hands of Sir William Thomson (Lord Kelvin), who in 1853 gave the mathematical theory of electric oscillations. He perceived a sort of analogy between Faraday's electrotonic state and electrostatic capacity—only kinetic instead of static—and he therefore called it "the electrodynamic capacity of a discharger"; in other words, he perceived that it was a constant belonging to all the wire circuit through which a Leyden jar discharged. Thus in an oscillating circuit there were the two things, both essential to oscillation: First, the electrostatic capacity of the terminal charged areas; second, the electrodynamic capacity of the connecting wire or discharging rod. Resistance came in subordinately, as a damper out of oscillation, in a comparatively simple way which he thoroughly understood.

Derivation of Inductance.

Then, later on, it was realised that just as two wires lying alongside of each other had a mutual coefficient of induction, so that the one induced currents in the other (as discovered by Faraday), each being susceptible to the rate of variation of the current in the other—so it might be said that every filament or longitudinal part of a single wire reacted on the other parts of the same wire; or, in other words, that the wire was itself susceptible to the rate of variation of the current in itself. Hence it was possible to speak of not only the mutual induction of two parallel conductors, but of the self-induction of one. And so Clerk Maxwell introduced the term "self-induction," and made it quite definite and calculable. Later, Heaviside styled it "inductance," to correspond with "resistance."

There are two ways of calculating this quantity, now commonly denoted by the letter L. One is to reckon the number of magnetic lines of force which effectively surround a wire carrying a current—the momentum, so to speak, of its magnetic field—and to call that momentum L I, where I is the strength of the current. The other is to treat the wire as if stranded, and to reckon the mutual induction of the strands on each other. This can be done by taking it as equal to the mutual induction of two parallel wires at what is called the "geometric mean distance apart"—that is to say, at a distance determined by the shape and size of the cross section of the single wire—a distance which can be reckoned as the average distance of the points in such a section from each other. It is all worked out in Clerk Maxwell's great treatise, published in 1873; and he gives an expression for this geometric mean distance for different shapes of section. It is important, because it applies not only to a single wire, but to the cross section of the wound channel in a coil. That cross section may be square, or oblong, or round—as when the coil is shaped like a curtain-ring.

The Most Compact Section.

In practice the section is usually oblong or square. It may be oblong broadways, as when one or a few layers are wound cylindrically on a tube; or oblong depthways, as when short layers are wound so as to be piled on top of each other, making a sort of disc. For a coil with one narrow dimension—that is to say, for a winding whose section is a thin oblong, whether the coil is wound horizontally or vertically—the geometric mean distance asunder of its parts is ·223, or, say, a quarter, of its larger sectional breadth. For a square section, the value is ·45 times the length of one of the sides, that is, about half the side of the square. For a circular section it is ·78 or say, three-quarters of the radius. For an oblong section in general the accurate expression is decidedly complicated, involving logarithms and tangents, but it may be taken as approximately a quarter of the width and depth of the section added together. More accurately $\frac{b+d}{\sqrt{(20)}}$ which is very nearly right. The complete formulæ will be found in Maxwell, or quoted in Professor Fleming's comprehensive treatise, and I need not attend further to it now, because I want to concentrate on the most compact section—either a circle or a square. For it is this compactness which gives the maximum self-induction.

Effect of Linear Dimensions.

That, however, is not all that is necessary to be known, by any means. That only determines the shape of the channel in which the wire is wound. We must know the average size of the channel in relation to the circle of wire so formed; that is to say, we must know the external and internal diameters of the coil, in terms of its sectional dimensions. Clerk Maxwell calculates that, too, though he says it was first worked out by the mighty mathematician Gauss, in 1867, though under what circumstances and for what reason Gauss can have calculated it, I do not know. It will be instructive to some of my readers if I indicate the manner of calculation, though those who like may skip the algebra, which I will defer for the immediate present. Anyhow, the *result* is clear and definite and simple enough. The width and depth of the channel's cross section must be approximately three-fourteenths of the external diameter of the coil, or three-eighths of the internal diameter, the external diameter being $\frac{14}{8}$ or $1\frac{3}{4}$ times the internal. That determines completely the shape of the best coil, whatever its size may be. Every coil that we now proceed to speak of is to be of this shape; they will differ only in size, one will be like another magnified. But the wire which is wound on the coils will not be magnified. If it were, the number of turns would remain the same, and the inductance would increase very slowly with the additional size. It would, in fact, in that case simply increase with the linear dimensions, or, what is the same thing, it would be proportional to the length of wire used.

But if the wire is maintained of constant thickness, whatever the size of bobbin on which it is wound, the inductance increases very fast as the dimensions increase. It increases not only because of the greater length of each turn of wire, but also in proportion to the square of the number of turns. If the linear dimensions are doubled, the number of turns are quadrupled, and therefore the length of wire is quadrupled. The inductance depends on the square of the number of turns, and therefore is quadrupled twice over, making 16-fold, and the linear dimensions being doubled makes it altogether 32-fold. That is to say, increasing the size of the coil, for a given thickness of wire, increases the self-induction as the fifth power of the size. In other words, doubling all the linear dimensions multiples the inductance by 32.

The formula connecting the three things—outside diameter of coil (D), thickness of covered wire (T), and maximum self-induction (L), is as follows:

$$\frac{D}{T^5} = 66.6L.$$

Here the D, T, and L must all be expressed in the same units, no matter what those units are, and for convenience L should, therefore, in such cases, always be expressed as a length, not in such units as henries or secohms, though these are useful for other purposes.

Simplified Calculation.

So also it is best for wireless apparatus to express capacity as length, and not in farads or microfarads or micromicrofarads. It is much better to express it in metres, because one usually wants to employ it to calculate the wave-length. The wave-length is 2π times the geometric mean of the inductance length and the capacity length, that is, about 6 times the square root of their product. Thus suppose L is 10 kilometres, and C is 1 metre, the wave-length would be 600 metres. If L is 1 kilometre, and C is 10 metres, the wave-length is the same. If L is 16 millihenries, or 16 by 10^5 centimetres, and C is 100 centimetres, the wave-length will be 240,000 centimetres, or about $2\frac{1}{2}$ kilometres.

By thus working in length units, the calculation is quite simple, and can be done in one's head, and slips of extensive magnitude can be avoided, because there is a commonsense feeling about the size of the quantities dealt with, all the time, which prevents their being accidently taken hundreds or thousands of times too big or too small, as may easily happen when hastily dealing with meaningless units of quite unsuitable size. To measure things in farads and henries when we want the dimensions of a coil in inches, or a wave-length in metres, is not practically convenient.

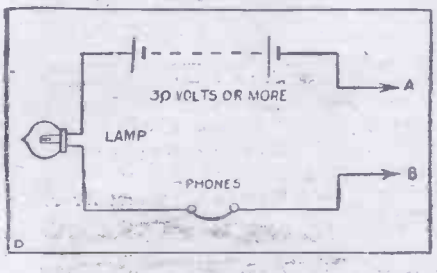
AMATEUR "STATICS" AND THEIR REMEDY.

By A. E. D. KENNARD, A.C.G.I.

HOW often do even some of the best of us excuse unwanted noises when our friends are listening-in as "statics?" However readily this excuse may be swallowed, it should be our aim to eliminate all set noises, and ensure quiet working, which *can* be done during most of the winter with the one exception of those awful spark stations and the reactionary fiends! For the benefit of beginners I propose to set down a few of the common causes of unwanted noises.

Ebonite Surface Leakage.

One of the most frequent causes and one very difficult to locate is leakage between the legs of valve sockets and across the surface of ebonite having a bad surface insulation. Highly polished ebonite should be looked upon with grave suspicion unless it has been tested in the way I will show presently. I once had a case of a miniature thunderstorm caused by H.T. leakage across a piece of well-polished and clean ebonite. The under side of all panels should be well sandpapered, and also the spaces between



the valve legs of the valve socket *before* fixing socket in panel; anyone who does this will be surprised at the result.

The tops of the accumulators should be kept scrupulously clean and free from acid, particularly when the H.T. negative is connected to the L.T. positive, as is often the case, making the L.T. battery part of the H.T. circuit. As proof of this I can receive Paris time using only 4 volts H.T. with the H.T. positive plug *lying on the celluloid case* of the accumulator, even when apparently quite dry.

More Obscure Points.

A telephone with a portion of one of its coils broken down will cause most annoying noises, and is difficult to locate unless it is so badly damaged as to cause a serious falling off of signal strength. The same thing happens if the metal head-band comes in contact with one of the telephone terminals. Stray strands of the fine leads will do this if not properly soldered.

In towns stranded aerials become corroded, and chemical and small electrical actions are set up to the detriment of the set. This remark applies to all outside soldered joints. Even in the country I have noticed a great improvement in occasionally renewing the aerial, since wire is cheap. Enamelled wire may be used, but many people prefer the plain variety.

All valve legs should be bright and clean, and their sockets cleaned with a rag on a bradawl dipped in methylated spirit.

Perhaps the worst noise of all is the rushing sound due to the use of too much reaction. Signals may be much stronger, but are horrible to listen to, and upset everyone else for miles around, besides giving 2 L O a sore throat warning people every evening.

Condenser noises are obvious, and usually only occur when rotating same, though particles of dust between finely spaced condenser vanes will often give rise to obscure trouble.

An Insulation Test.

Low-frequency amplification noises are in a class by themselves, and present a more difficult problem, and only first-class transformers should be employed, well screened from each other, and all connections carefully insulated, especially that of the grid.

Lastly, keep all high potential wires away from low potential ones, and if possible have sufficient space beneath the panel to keep *all* wires well separated and as non-parallel as possible.

A good test for the insulation of ebonite is as follows: Connect up a pair of high resistance telephones, flash lamp bulb, and a battery of about 30 volts, as shown in the diagram, taking great care that the ends A and B do not touch—the lamp will act as a fuse, and break the circuit should this accidentally occur, but it will not improve the phones.

Lay the wire A on the piece of ebonite to be tested, then touch the wire B on the ebonite a short distance away. There should not be more than the very faintest click in the telephones, due probably to capacity effects, or a loud click denotes poor surface insulation which can be remedied by sandpaper.

This method can also be applied between the legs of valve sockets. Finally disconnect the battery when finished—don't leave the wires A and B lying about on the table.

COMBINED SELF-CAPACITY SHIELD AND DIAL INDICATOR.

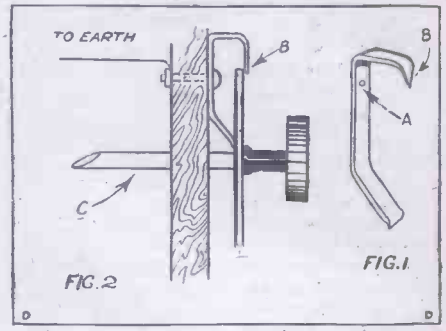
EVERY amateur who uses valve apparatus combined with up-to-date circuits has experienced at some time or other the annoyance caused by the action of self-capacity upon his set when endeavouring to obtain a very critical adjustment. A position which is apparently the correct one for obtaining the required results is often found during tuning, but as soon as the operator releases his hand from the condenser knob, or other control by means of which the tuning is being effected, the signals weaken or become distorted and a further adjustment has to be found.

This false tuning is always more prevalent when metal dials are used, and much of the annoyance can be obviated by employing the simple device shown in the diagrams.

A strip of brass should be obtained, care being taken to see that it is not too thick to prevent it, when bent to the shape shown in Fig 1, from acting as a spring. A small hole for mounting the springy brass strip to the panel should be drilled as indicated at A. This strip, mounted in its correct position on the panel is also shown in Fig. 2, and it will be seen that the lower part is sufficiently bent to make contact with the rear of the dial.

Direct Earth Connection.

The screw by which the brass strip is connected to the panel is firmly fixed by means of a lock nut; but before tightening the nut in question a lead which is taken to earth, is inserted between this nut and the panel, as shown. The dial on the front of the instrument should have an enlarged centre to prevent it from making contact with the shaft C, and that part of the dial with which the brass strip makes contact should be sandpapered to ensure smoothness in operation. If necessary, the brass strip should also be smoothed down at this end.



It will be observed that the top of the strip is bent at right angles to the front of the panel above the indicator dial, and is then again slightly bent downwards to form the indicator point. The action of the device is self-explanatory, as it will be easily seen that any capacity from the body which is communicated to the control knob is passed directly to earth, and if the centre of the dial is enlarged as stated above no capacity effects will be conveyed from the hand to the apparatus by means of the shaft.

BRIGHT IDEAS

Are welcome. Send along the results of your experiments. We pay well for copy accepted for publication.

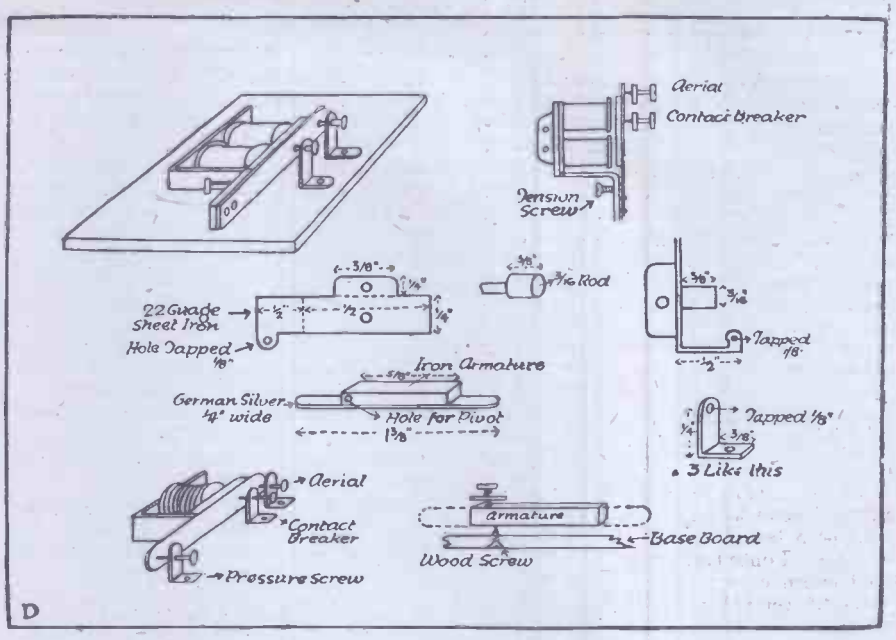
HOW TO RECEIVE C.W. ON A CRYSTAL SET.

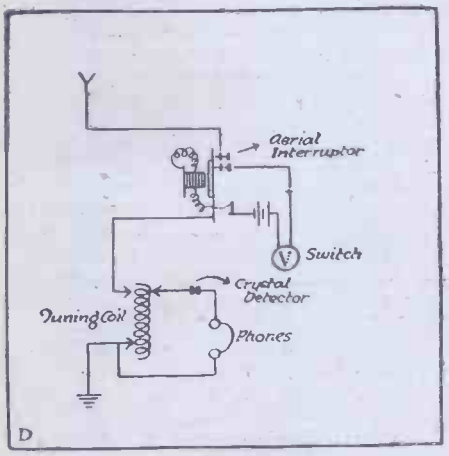
By A. W. DRANSFIELD.

IN selecting a buzzer for this work it is necessary to get one that provides a very high note and also has an adjusting screw that will permit the note to be altered at will. The alterations necessary will be seen clearly in the drawing and consists of an extra contact screw which controls a break in the aerial circuit.

Constructing the Buzzer.

It is proposed to describe a buzzer that will have all the requirements necessary, and at the same time easy and inexpensive to make. The main portion is made from a scrap of sheet iron. This should be cut to the size and shape shown in the diagram and bent at the dotted lines. File a shoulder on the pole-piece and rivet it in its place. Make a paper and cardboard bobbin and wind it with 36 or 38 G. D.S.C. wire, dip the whole in molten wax, and whilst warm slip it on the pole piece, and the wax will hold it in its place.





The two small holes in the armature are for the points of the pivots that it has to work on, and if the spring is made of German silver it will allow the contact screws to be mounted in any position. If steel spring is used it will be necessary to fix two small contacts on the steel for the points of the contact screws to engage.

The contact screws are made out of $\frac{1}{8}$ in. brass screws, small holes drilled in the ends with small pieces of wire soldered in. The brackets to take these screws should be made of fairly stiff sheet brass. $\frac{1}{16}$ in. thick will do.

In Operation.

The whole buzzer should now be assembled on a small piece of ebonite. The pivot for the under-side of the armature should be screwed up from underneath, having a point first filed on the screw.

The other details can be seen in the diagrams. Keep the buzzer as far as convenient from the tuning coil and introduce a switch in the buzzer circuit. To receive it is only necessary to switch the buzzer on and then alter the note up and down until clear signals are heard.

Another view of the modern telephony transmitter at the Glasgow Broadcasting Station.

IN ODD CORNERS.

By C. G. G.

NOTHING deserves a warmer welcome than that which tends to promote camaraderie and good fellowship, and in this respect, it is safe to assert that the great and growing public interest in "wireless" is forging a link of friendship between many. At lunch, in train, 'bus or tram, one hears many interesting conversations of things attempted, successes achieved, "gadgets" devised, and hosts of other little anecdotes typical of the radio game; reserve is broken down and the discussion becomes general, and closes with cordial invitations to "Call in and look over my set." Among the amateurs of the pre-broadcasting period there are many who have acquired the status of general adviser to a host of friends, fired with a keen enthusiasm, and glad to seek assistance on the finer points of "wireless" from a source that has several years' experience to back it.

"Amateurish" Efforts.

Personally speaking, I have found this new venue a very happy one, full of interesting, and not a few humorous, incidents. I was quick to learn that in dealing with some newcomers one had to be very tolerant. In many instances they were trying to run before learning to walk, and disseminated copious views on capacity earths, dual amplification and the like, generally the reiteration of a particular chapter from an advanced text-book which had come their way. The logical method, a study of a sound elementary treatise on radio, seemed very remote in their minds. The opposite type, of course, is the man who asks advice on the "set" suited to his particular circumstances, professing his lack of knowledge of radio, and his desire to learn.

My first "case" was in the former class. Introduced by a friend, he arrived at the moment when I had just succeeded in getting some excellent results with a twenty-feet-long indoor aerial. With a cursory glance at the wire stretched between two picture hooks, he remarked, "Frightfully amateurish, isn't it!" I hastened to assure him that it was. "Just an amateur's efforts," said I. "But do 'listen in' on it." "Oh, but you don't get results with that," said the cynic. A demonstration, however, convinced him that "amateurish" arrangements will work. Diplomatically, I "lost" him.

A Strange Experience.

My travelling companion was indeed a hard nut to crack, and I felt that I was "up against it." A mutual glimpse of a "radio" family in a lower room of a house alongside the track had prompted, from myself, the remark, "Looks happy, doesn't it?" "Certainly, but this broadcasting business has been lauded too much. It's worse than a cheap gramophone, much worse." This put me on my mettle, and on inquiry I learned that it was to the trumpetings of a "loud-speaker" that this gentleman had lent his ear. To judge from his emphatic condemnation of broadcasting I was convinced that his initiation must indeed have been a bad one.

I quoted instances of excellent results obtained with various "sets," the remarkable clarity of music and speech, but my hearer remained obdurate. "You have mentioned your experience. That is the asset which the layman cannot command to assist him in getting a decent return for his money." I countered that argument, but knew that a practical demonstration was the only solution to this problem, and at the moment it was beyond me. Succour came from the third party in the carriage. "Pardon me," he said, "but I have been an interested listener to your conversation, and if this gentleman lives in the Birmingham district, perhaps he will call on me, and I think I can convince him that he is under a very wrong impression." Their respective homes were about three miles apart, and when I bade "Good-night" at New Street, I felt assured that, ere long, radio would count still another recruit.

My visit to the Midlands was in no way connected with "wireless," but it seemed just a natural sequence of things to be wearing a pair of 'phones within a few hours of arriving. I was "listening-in" on a beautifully-constructed three-valve receiver, the interior wiring reflecting much credit on the builder. It was a strange experience to listen-in to 2 L O, distant a hundred-odd miles. Accustomed to his mighty bellow at 3 miles, the quiet, though clear, voice of 2 L O's announcer seemed somehow wrong, and it was several minutes before I could quite reconcile myself to it.

Exploring Street Markets.

5 I T, just five miles away, was, as expected, simply deafening. I was particularly cautious in regard to a "loud-speaker" which stood in front of the "set," still mindful of my experience on the journey from London. My fears, however, were quite allayed when a switch cut out the 'phones and put the "loud-speaker" in action. Distortion was conspicuously absent, and closer inspection of the instrument revealed it as home-made, and a veritable triumph.

During my stay, I had the pleasure and privilege of making a tour of a coal mine in the locality. At the Baggaridge Colliery, Willenhall, many hundred yards in the bowels of the earth, dust-begrimed, hot, and, except for a safety lamp, looking anything but a miner, I was told, with not a little pride, that it was this mine in which wireless experiments had been carried out to determine the value of radio telephony as a factor in saving life in colliery disasters, and of the results achieved, surpassing the expectations of those conducting the tests. Here was a vivid illustration of wireless in the rôle of life saver, and glancing towards the dense blackness of the tunnel I fully realised what radio would mean to men entombed in a pit, and able to furnish their would-be rescuers with verbal details of their position of peril.

It is worth the while of any keen experimenter to stroll among the street markets of London, where, since the boom in radio, considerable quantities of Disposal Board wireless and signalling apparatus have found ready purchasers. In a central London district, famed for its street markets, I saw the most heterogeneous collection of "gear" one could imagine. One stall, commanded by three perspiring salesmen, was heaped high with ex-army field telephone cases, dispatch cases, webbing equipments, lead-in wire, insulators, and a brand new MK 3 tuner.

A few yards away was a display of apparatus obviously causing much attention. Here, to the discerning eye, bargains were many. Vario-meters and vario-couplers, in excellent condition and needing but suitable mountings, stood alongside new 80-watt field transmitters. Seeming quite out of its element, a case of army water-testing poisons stood surrounded with field telephone receivers. Masts complete with guys, and in many instances a fair covering of dry mud, were receiving close attention. Valves of various types, including Dutch and German products, were being eyed with some apprehension. A selling price of 8s. each seemed to cast a doubt on their reliability.

Where Crystals Score.

The assortment of component parts was truly remarkable and of quite excellent quality. Walking away from this locality, with a last glance at the numerous bargain-hunters, a thought crossed my mind—"Are *all* those people experimenters?"—and the necessity for a speedy decision in regard to the home-made set seemed greater than I had considered it before.

As an ardent advocate of sets employing crystal detectors, I am always gratified to know of instances where good results have been obtained. In a recent letter from Dudley, Worcs., I read of some excellent broadcasting received on a crystal set, described in the letter as "simply wonderful." Such testimony makes good reading in view of the craze for valve outfits. The crystal has much to commend itself. Its simplicity of operation and comparative cheapness brings it within the reach of all. It has its limitations where a greater volume of sound is required, when it must give place to the superior functions of the valve. I am a keen admirer of sets employing a combination of crystal detectors and one or more L.F. amplifying valves. The resultant signals have great clarity, and in the London area, with just one stage of amplification, the strength is excellent.

While visiting a friend's home in Tottenham, and watching his grandmother, aged 89, "listening-in," there was aptly illustrated the awe and wonderment with which this latest advance of science, is regarded by the older generation. A note magnifier had just been added to the set, and glancing towards the valve, this lady remarked: "Lights! whatever are you boys doing." The voice of 2 L O's announcer was so powerful that it caused her to wince at each remark, and after several minutes she turned to her nephew, saying, "Take me away, I am frightened." We, of the younger generation, schooled in an age of scientific development, are less impressed by these happenings; not that we are unappreciative, but because of the environment of this period of the century.

To-day we are happy in our broadcasting; it has established a new and helpful feature in home life; it is but in its infancy, we are told. Where will progress have carried us ten years hence? Who knows?

DRY CELLS FOR LARGE CURRENTS.

By S. E. WALKER, M.I.E.E.

IT is very often convenient to employ a battery of dry cells, even at comparatively high cost, rather than have the trouble of charging accumulators. A few years ago the present writer would have advised any experimenter on no account to employ dry cells for large currents; but during recent years they have been enormously improved, and it is now quite safe to use them when other reasons, such as convenience, dictate.

Dry cells may be taken to have a pressure of 1·5 volts per cell; but this is the total pressure furnished by each cell, and is subject to the effects of a charge for the current that the cell is furnishing at any time. The charge is found from the formula $E = C R$; where E is the charge in volts, the pressure that has to be subtracted from the total pressure furnished by the cells, C is the current flowing through the cells and R is the resistance of the cells. If, for instance, there are 4 cells connected in series, and the internal resistance of each cell is 0·15 ohm, the total internal resistance of the cells will be 0·6 ohm, and a current of 1 ampere flowing through the cells will make a charge of 0·6 volts, leaving only a pressure of 5·4 volts for use in the external circuit. If two such sets of cells are connected in parallel the internal resistance will be halved, making it only 0·3 ohm, and the charge for the passage of 1 ampere flowing through them will only be 0·3 volt. If three such sets are connected in parallel, the combined resistance of the three sets will be 0·2 ohm, and the charge on the pressure for each ampere flowing through them will be only 0·2 volt.

Gauging Available Current.

Current applies because the lower the resistance of the cells the larger they are, and the larger the current they will carry without breaking down too quickly. As pointed out in an article in POPULAR WIRELESS some time since, each size of dry cell has a limiting current which it will supply for a certain time continuously. If that current is exceeded, the cell runs down very much more quickly than it should do; if that current is not worked up to, the cell will go on furnishing current for a longer time; and, if the cell is given a good deal of rest between times of furnishing current, it will go on for a much longer time than if the current is taken from it continuously.

This is the secret of the comparative success of some flash lamps compared with others. If they are only switched on occasionally and for only a short time, and are given long periods of rest between, they will last a very much longer time than if they are used continuously. This also applies to batteries furnishing large currents. Make the cells as large as possible in the first instance, and give them plenty of rest between the times they are furnishing current, and they will do good service.

If one cell will furnish, say, $\frac{1}{4}$ ampere safely without running down quickly, two cells in parallel will furnish $\frac{1}{2}$ ampere, 3 cells $\frac{3}{4}$ ampere, and so on.

When cells are connected in series their pressures are added together; when they are connected in parallel their possible currents, the currents they will furnish, are added together. Thus if a cell of a given size will furnish 1·5 volts, 4 such cells will furnish 6 volts, and, as mentioned above, if one set of such cells will furnish $\frac{1}{4}$ ampere, it is only a question of the multiplication-table to find how many such sets will be required to furnish the necessary current. Two sets will furnish $\frac{1}{2}$ ampere, 3 sets $\frac{3}{4}$ ampere, etc.

Each size of dry cell has its own current that it will supply continuously. If it is made to furnish a larger current the time will be shorter, and the greater the increase in the strength of the current the shorter will be the time it will furnish it. Doubling the current will more than halve the time, and the ratio goes up very rapidly as the strength of the current increases. On the other hand, lessening the current increases the time during which it will be furnished; but the time does not increase so rapidly with decreased current as it decreases with increased current for similar increase and decrease.

The gramophone as a loud speaker! (Sent in by Mr. G. Hay, of Hoylake, Cheshire.)

Series—Parallel Grouping.

Cells are arranged in series, it will be remembered, by connecting the positive terminal of each cell of the series to the negative terminal of the cell in front of it in the series, and the negative terminal of each cell to the positive of the cell behind it in the series, leaving out a positive terminal at one end of the series and a negative terminal at the other end. Cells are connected together in parallel by arranging wires leading to all the positive terminals, and other wires leading to all the negative terminals. The wire connected to all the positive terminals becomes the positive terminal of the group, and the wire connected to all the negative terminals becomes the negative terminal of the group.

Cells are connected in series parallel, or parallel series, by looking on a group of cells arranged in parallel as a single cell, so far as connection with other cells is concerned. The positive wire of a parallel group is practically the positive terminal, and the negative wire of the parallel is the negative terminal of the group.

A Few Examples.

Suppose, for instance, we have 10 cells in two groups of 5 each, and it is desired to connect them in series parallel, the positive wire of one parallel is connected to the negative wire of the parallel in front of it in the series, just as the positive wire of a single cell is; and the negative wire of the group is connected to the positive wire of the group in front of it, just as the negative terminal of a single cell would be. The pressure furnished by the whole of the cells, when they are connected in a series parallel, will be that of a single parallel; in this case, supposing the cells to have a pressure of 1·5 volts per cell, 7·5 volts.

This again is the total pressure furnished by the group, and the nett pressure available for work outside the battery will be this pressure less the charge for the passage of the current through the cells. Suppose, again, the internal resistance of each cell to be 0·15 ohm, the total internal resistance of the 5 cells in series will be 0·75 ohm; the resistance of two parallels of the cells will be 0·375 ohm, of three parallels 0·25 ohm, and so on. And the charge upon the initial pressure will be 0·75 volt for each ampere of current for a single series, 0·375 for each ampere with two parallels, 0·25 for each ampere with three parallels, and so on.

To use dry cells, therefore, for large currents, obtain from the makers the largest current that each size of cell will stand for the time required without breaking down, and arrange as many groups of cells in parallel as will make up the required current, each group consisting of the number of cells required to give the required pressure.

The Use of Resistance.

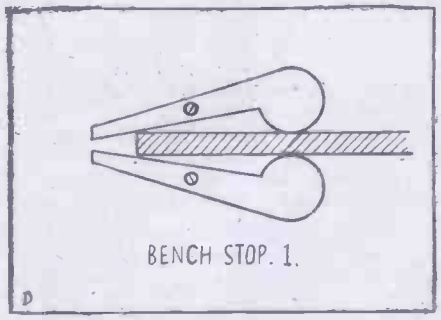
There is a point that should be mentioned here. It will usually be difficult to arrange for a definite number of cells to furnish the required pressure, owing to the charge passing through the internal resistance of the cells. The remedy is to employ a larger number of cells in series than would be required if it were not for the internal resistance, and place an adjustable resistance in the circuit to use up the surplus pressure. The adjustable resistance will be useful in another way. Dry cells work down as current is taken from them, and it is, therefore, necessary, if the pressure is to be maintained at a constant value, to increase the initial pressure furnished by the battery as a whole, as the individual cells work down. This is done very conveniently by the aid of the adjustable resistance.

HINTS ON WOODWORKING.

TO give a complete course on the art of "wood-working" would take many pages of this paper, but it is hoped that the following will give an insight of how to "get at" many of the little jobs that will help to complete a "set."

Let us assume, for instance, that a panel has been made up, and that it requires a box base, and that the dimensions are 9 ins. by 6 ins. by 3 ins.; the panel is to lay on top with all the connecting wires, condenser, etc. inside.

The first thing to consider will be the kind of wood to use. This will be a matter of taste, and of financial ability to gratify it, although a middle alternative will be to make it of American whitewood. This wood is easy to work and easy to stain, and is at the same time very strong.



Get enough for the work in hand and a little to spare in case of errors in measuring. What will actually be wanted will be 30 ins. by 3 ins., and one piece 10 ins. by 7 ins., but it will be easier perhaps to get an odd piece that will cut to this amount. For instance, 15 ins. by 6 ins. will do equally well for the strip sides. This wood would be quite thick enough if a $\frac{1}{4}$ in. was used, but if starting this kind of work it would be better to procure a little thicker wood—say $\frac{3}{8}$ in.

Bench Stops and Tools.

Before going on with the construction it will be as well to consider the tools, etc., that will be required. In the first place a bench of some sort is very desirable, and this difficulty may be overcome by getting a decent plank of deal that is long enough to go along the edge of the kitchen table when it is held on by two fretwork clamps.

This board should be fitted up with bench stops. Fig. 1 shows one that will be found quite a good thing, as it is easy to make, and will do away with the necessity for a bench vice for small jobs similar to the one with which we are dealing. It will be seen that as the wood to be planed is pressed towards the wedge aperture, the tighter becomes the grip. This stop should be made out of $\frac{1}{2}$ in. wood, or even thicker timber.

Another kind of stop is shown in Fig. 2. This will allow of a very firm hold being taken on the wood that has to be cut. Make the saw cut with the same saw that will be used on the work, and before making the cut, mark it out quite square.

The stop required for planing flat wood will be just an ordinary piece of slightly thinner wood tacked on, with the heads of the nails punched in a little way to prevent the plane from getting foul of them.

Fig. 4 shows a sand-papering block that will permit any strength of paper being quickly placed in position.

Tools are quite another matter, and it is necessary to have a few wood-working tools for work of this kind. The quality and quantity must be left to the worker, but for the work which we propose to deal with it will be necessary to have a small plane; an iron Stanley plane is quite the thing. If a small drill is not accessible, then use a fine bradawl (a chisel about $\frac{3}{8}$ in. will do, the kind known in the trade as a "firmer chisel" is the kind we want), a small screwdriver, a small tenon-saw or small brass-backed saw, a mallet that can be easily made, and a marking gauge and square will complete all we require at the moment. The marking gauge could also be made, and after all is not a very difficult proposition.

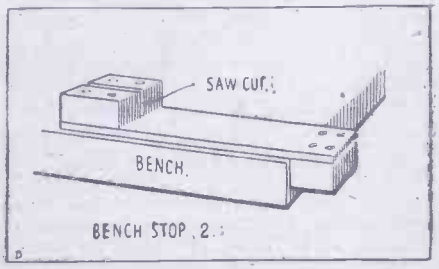
After fixing up the board, we are ready to make a start, and the first thing will be to get the wood cut up into the desired lengths and widths.

Marking Out.

One of the first things to really matter is the marking out; it must be borne in mind that the pencil mark cut out or left in makes all the difference, so make allowances accordingly, and in this case mark the wood so that all pencil marks are the exact size. Then, when cutting the wood up, we must so cut it that the marks are just "in." This will leave a little room for planing, and to get the edges quite true. We require two pieces 9 ins. by 3 ins., and two pieces $5\frac{3}{4}$ ins. by 3 ins. Mark these out carefully and cut the ends (across grain) on stop, Fig. 2.

Place the mark in line with the saw-cut, and cut off any surplus that you have allowed. If you have cut the first 9 ins. by 3 ins., lay it on top of the next piece and use it as a pattern; this will give you two exactly alike, and the same process applies to the other two pieces.

To dovetail these ends together may prove a little too difficult for the amateur unless he is good at wood-working, so we will use a far easier "corner." On the ends



of the 9 ins. by 3 ins. pieces, with the marking gauge mark the exact thickness of the two ends that are to be fitted in, then set the gauge to $\frac{1}{16}$ in. and mark the outside ends. Mark all four ends on the two pieces and cut them out with the saw; this will give the sides and ends a strong joint if glued together. The base is larger than the box. This is arranged to enable us to put $\frac{1}{2}$ in. bevel for the sake of good "appearance." The bevelling must be done carefully when going across the grain, and a good plan is to hold the plane in a slanting direction when doing this. If preferred, a rounded edge may be used, and may be done by sand-papering, which is a little simpler.

Our box will now only require a coat of stain and polish, or a very fine varnish will do if polishing is considered too difficult. To stain the wood a deep mahogany red, obtain a small quantity of Bismark brown crystals; dissolve these in methylated spirit, and after a couple of coats the wood will be a very deep soft red; this should be sand-papered down very smoothly with a very fine paper, and if we propose to polish the box, we shall require a small quantity of French polish. A good plan is to do an odd end of wood first until you get the knack of it. The method of putting on the polish will be to get a clean piece of calico and place inside a pad of cotton wool. Drop a few drops of the polish on to the wool, and squeeze the calico into

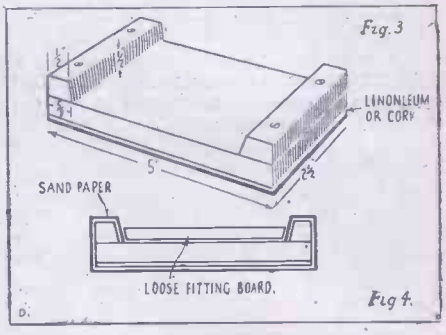


Fig. 3

Fig 4.

a pad so that a little of the polish will ooze out when the pad is pressed on to the wood.

French Polishing.

Then commence to polish by moving the pad round and round in a circular motion until all the wood has been so treated. As the polish dries very quickly, the best way is to start at one end of the wood and carry on until you get to the other end; by that time the end first treated will be ready for its next coat. Rub very lightly, and it will soon become apparent that a polish is being obtained; do this over and over again until a good finish is formed, and by that time the cloth will be rather sticky and liable to drag off some of the polish. To overcome this, a little linseed oil dabbed on the face of the pad with the finger will be found to obviate the desire of the cloth to stick. A little polish must be put inside the pad of the cloth occasionally when the desired finish is obtained; make another pad and put just a little methylated spirit inside, taking care that it only just moistens the cloth; then very lightly move the pad just as in polishing. This will clean off the oil, and the polish will soon get quite hard. In any case, it is advisable to prepare a few odd pieces of wood and practice polishing before doing the box. It will be much safer, and a little practice is necessary to get the "knack."

THE WAVE-LENGTH OF TUNING COILS.

By C. E. FIELD, B.Sc.

Specially prepared for "Popular Wireless," these tables should prove invaluable to amateur experimenters.

MANY wireless amateurs experience considerable difficulty in estimating the maximum wave-lengths of their tuning coils, or in adjusting their coils to receive any particular signals. The accompanying table gives the wave-lengths of single-layer coils, and will be found to cover a sufficiently wide range for most ordinary purposes. The figures given in the table are calculated for use with a normal P.M.G. aerial, but the effect of a tuning condenser has not been taken into account. If the condenser is connected in parallel with the A.T.I., the wave-length of any coil or part of a coil will be longer than that given in the table; if the two are connected in series it will be shorter.

One or two examples will make clear the method of using the table. Suppose we are contemplating the construction of a coil consisting of 380 turns of No. 24 S.W.G. wire, wound upon a 5-inch diameter cardboard tube, and we wish to find out whether we shall be able to receive telephony from Paris (F L).

Locating Slider Positions.

Towards the end of the end of the first column of the table, we find the number 380. Opposite to this in the second column are the numbers 20, 22, 24, 26, 28, and 30, representing different gauges of wire. Our coil is to be wound with No. 24, so we follow along from the figure 24, until we come to the column headed "5-inch diam." Here we find the number 2440, which is the maximum wave-length to which the coil will tune. This coil would, therefore, scarcely suffice for the reception of Paris telephony, which is transmitted on a wave-length of 2,600 metres.

Again, suppose we have a coil consisting of 500 turns of No. 22 wire, wound on a 3½-inch diameter former, fitted with a slider, and we wish to know approximately where to put the slider to receive the Dutch concerts. These concerts are transmitted on a wave-length of 1,085 metres. Looking down the column headed "3½-inch diam." at those figures which are in line with the numbers 22 in the second column, we come to 1090, which is the nearest figure to the wave-length we require. In line with this figure, in the third column (headed "Length of winding in inches"), is the value 5·6, so that if we put the slider of our coil about 5½ inches from the end which is connected to the aerial, we should be able to tune in The Hague by adjusting a parallel condenser. If the condenser were in series with the A.T.I., it would be better to place the slider a little farther along, say, 6 inches from the end of the coil.

For Honeycomb Coils.

Approximate values can be obtained in the same way for the secondary coil of a loose coupler, but in this case rather more turns will be required for any particular wave-length than is indicated by the table, on account of the absence of the inductance and capacity possessed by the aerial.

(*Continued on next page.*)

TABLE GIVING WAVE-LENGTHS OF SINGLE-LAYER TUNING COILS WOUND WITH ENAMELLED WIRE.

MAXIMUM WAVE-LENGTH OF COIL IN METRES.

Number Turns	Size of Wire S.W.G.	Length winding in ins.	2-inch diam.	2½-inch diam.	3-inch diam.	3½-inch diam.	4-inch diam.	4½-inch diam.	5-inch diam.	5½-inch diam.	6-inch diam.
20	20	0.75	165	185	205	225	240	255	270	285	295
	22	0.56	175	195	210	230	245	260	275	290	300
	24	0.44	180	200	215	235	250	265	280	295	305
	26	0.36	185	205	220	240	255	270	285	300	310
	28	0.3	190	210	225	245	260	275	290	305	315
	30	0.25	195	215	230	250	265	280	295	310	320
30	20	1.1	205	235	265	290	315	340	365	390	410
	22	0.84	215	245	275	305	330	355	375	400	425
	24	0.66	230	260	290	320	345	370	390	415	440
	26	0.54	240	270	295	325	350	380	405	425	450
	28	0.45	245	280	305	335	360	390	415	435	455
	30	0.37	260	290	325	350	370	395	420	435	455
40	20	1.5	240	280	320	355	390	420	450	480	510
	22	1.1	255	295	335	370	405	440	475	505	535
	24	0.88	270	310	355	395	430	465	495	525	555
	26	0.72	285	330	370	405	440	475	500	535	565
	28	0.6	300	345	385	420	455	490	525	560	590
	30	0.5	305	350	390	430	465	505	540	570	595
50	20	1.8	275	325	365	410	450	490	530	570	605
	22	1.4	295	345	390	435	475	520	560	600	640
	24	1.1	315	360	410	455	505	550	590	630	660
	26	0.9	335	385	435	480	530	570	610	650	680
	28	0.75	345	395	450	495	545	585	625	665	700
	30	0.62	360	415	470	515	565	605	645	685	725
60	20	2.2	310	355	410	460	515	555	600	645	690
	22	1.7	335	385	440	495	550	595	635	690	735
	24	1.3	355	410	470	525	580	630	675	725	770
	26	1.1	370	430	495	555	610	660	705	755	800
	28	0.9	390	455	520	580	635	685	730	780	825
	30	0.75	405	475	540	600	655	705	750	800	840
70	20	2.5	335	395	455	515	575	620	670	720	770
	22	2.0	365	425	490	550	605	660	720	770	820
	24	1.5	390	455	520	585	645	705	765	820	875
	26	1.25	415	480	550	615	680	745	800	855	910
	28	1.0	435	510	580	650	715	775	830	885	940
	30	0.87	455	530	605	675	740	800	855	910	965
80	20	2.9	365	425	495	565	630	680	740	795	850
	22	2.2	395	465	540	605	665	725	790	845	905
	24	1.8	430	500	575	645	710	775	840	905	965
	26	1.5	450	525	605	680	750	815	885	950	1010
	28	1.2	475	555	640	720	790	860	925	985	1045
	30	1.0	500	580	665	745	815	885	950	1010	1070
90	20	3.2	390	455	535	605	680	740	805	865	925
	22	2.5	425	500	580	655	730	790	855	925	985
	24	2.0	465	540	620	700	775	845	915	985	1050
	26	1.6	490	575	655	745	820	895	965	1035	1105
	28	1.3	520	605	695	785	865	940	1015	1085	1155
	30	1.1	540	630	720	810	895	970	1045	1115	1185
100	20	3.6	415	485	575	650	730	795	865	935	995
	22	2.8	450	530	620	700	680	855	925	995	1065
	24	2.2	490	575	670	750	835	915	990	1060	1140
	26	1.8	525	615	710	795	885	965	1040	1120	1200
	28	1.5	560	650	750	840	930	1015	1100	1175	1250
	30	1.25	585	685	785	880	970	1055	1140	1215	1290
120	20	4.3	460	540	640	735	825	905	980	1060	1140
	22	3.4	500	595	695	790	880	965	1055	1135	1220
	24	2.7	555	655	760	860	950	1040	1130	1210	1300
	26	2.2	590	700	805	905	1000	1095	1195	1275	1370
	28	1.8	630	745	855	960	1060	1155	1255	1345	1440
	30	1.5	660	775	895	1000	1110	1215	1315	1405	1500
140	20	5.0	495	590	705	805	910	995	1085	1175	1260
	22	3.9	550	655	770	875	980	1080	1170	1260	1350
	24	3.1	605	720	840	955	1060	1160	1260	1360	1450
	26	2.5	650	770	895	1010	1125	1230	1335	1435	1530
	28	2.1	695	825	955	1070	1185	1295	1405	1510	1615
	30	1.75	740	870	1000	1125	1245	1360	1470	1580	1690
160	20	5.8	535	640	760	870	985	1080	1180	1280	1380
	22	4.5	595	715	835	955	1070	1180	1290	1390	1490
	24	3.5	655	785	915	1040	1155	1280	1390	1490	1600
	26	2.9	705	840	970	1110	1225	1350	1460	1570	1685
	28	2.4	755	905	1050	1190	1305	1430	1545	1665	1780
	30	2.0	800	955	1100	1245	1370	1500	1625	1745	1860
180	20	6.5	575	680	810	935	1060	1160	1280	1385	1490
	22	5.0	635	745	895	1025	1150	1270	1400	1505	1620
	24	4.0	700	835	985	1120	1255	1385	1515	1625	1740
	26	3.2	755	905	1060	1200	1340	1470	1600	1715	1830
	28	2.7	820	980	1140	1280	1420	1560	1690	1810	1935
	30	2.25	870	1030	1190	1350	1490	1640	1770	1910	2040

(*Continued on next page.*)

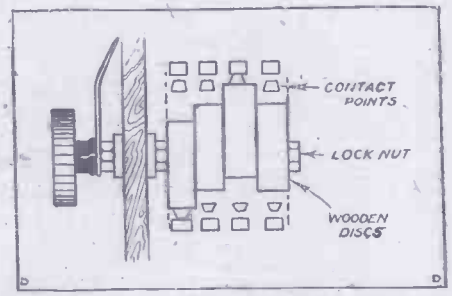
AN EASILY MADE PANEL SWITCH.

AN easily made panel switch, which can be constructed to take the place of more complicated and expensive jacks, is illustrated in the accompanying diagram. The mechanical action is performed principally by the aid of circular wooden blocks, about an inch or so in diameter, and approximately ¼ in. thick. A short length of broomstick sawn into sections of the required width and smoothed down with sandpaper, will answer the purpose admirably.

Having fashioned the wooden discs, a small hole should be drilled through each piece, about ¼ in. from the centre of the disc. The number of pieces required will, of course, depend upon the type of circuit which the switch is desired to operate. The contact strips acted upon by the switch can be made of any springy material, which will give sufficient "play" to allow of their proper operation.

An Easy Adjustmnt

A rod is then threaded for an inch or so on both ends, and lock nuts placed in position to prevent the cams from turning. By loosening one of the nuts the cams may be easily adjusted to meet the demands of various circuits. In order to mount the switch a hole is sunk in the panel through which the rod is taken, care being observed to see that a washer is placed over the rod on either side of the panel mounting.



Before fixing the control knob to the end of the shaft, a pointer might be fastened between the knob and the washer and lock nut on the outside of the panel if it is desired. The contact strips are then fastened to a base in such a position that the turning of the knob moves the cam until it presses the contact strip against the second strip which is necessary to make a good connection to complete the circuit.

WAVELENGTH OF TUNING COILS

(Continued from previous page.)

For short wave-lengths the table may serve as an indication of the number of turns required in a honeycomb coil, but the results will be very approximate, and will be quite unreliable if more than about 70 turns are called for.

Finally, it must be emphasised that the table is intended to serve as a rough guide only, and considerable latitude must be allowed to take account of variations in the dimensions of the aerial and the tuning condenser.

TABLE GIVING WAVE-LENGTHS OF SINGLE-LAYER TUNING COILS WOUND WITH ENAMELLED WIRE—*Continued from previous page.*

MAXIMUM WAVE-LENGTH OF COIL IN METRES.

Number of Turns.	Size of Wire S.W.G.	Length winding in ins.	2-inch diam.	2½-inch diam.	3-inch diam.	3½-inch diam.	4-inch diam.	4½-inch diam.	5-inch diam.	5½-inch diam.	6-inch diam.
200	20	7.2	605	725	865	995	1125	1240	1365	1480	1595
	22	5.6	670	810	955	1090	1230	1360	1490	1615	1740
	24	4.4	745	895	1050	1200	1350	1490	1620	1750	1880
	26	3.6	805	970	1130	1290	1440	1585	1715	1845	1975
	28	3.0	870	1050	1215	1380	1535	1685	1820	1955	2100
	30	2.5	925	1100	1285	1450	1610	1765	1915	2055	2200
220	20	7.9	635	760	915	1050	1190	1315	1445	1575	1700
	22	6.2	705	855	1010	1155	1300	1440	1590	1720	1850
	24	4.9	785	945	1110	1275	1430	1580	1730	1860	2000
	26	4.0	855	1025	1200	1370	1535	1690	1840	1980	2130
	28	3.3	925	1110	1310	1470	1640	1800	1955	2095	2245
	30	2.75	985	1175	1380	1555	1725	1885	2045	2200	2360
240	20	8.7	675	800	960	1105	1250	1385	1525	1660	1790
	22	6.7	740	895	1060	1210	1375	1525	1670	1810	1955
	24	5.3	825	995	1175	1345	1510	1670	1830	1985	2130
	26	4.3	895	1080	1270	1450	1625	1790	1955	2115	2260
	28	3.6	975	1170	1370	1560	1740	1910	2080	2240	2400
	30	3.0	1040	1240	1450	1650	1830	2010	2180	2340	2510
260	20	9.4	695	835	1000	1145	1310	1450	1595	1740	1880
	22	7.3	775	940	1110	1280	1445	1600	1760	1910	2060
	24	5.7	865	1040	1230	1415	1585	1760	1930	2085	2250
	26	4.7	940	1130	1330	1525	1710	1900	2070	2235	2400
	28	3.9	1020	1225	1440	1640	1835	2025	2200	2375	2540
	30	3.25	1090	1310	1530	1740	1935	2140	2315	2480	2660
280	20	10.0	725	870	1045	1210	1370	1515	1670	1820	1970
	22	7.8	810	980	1160	1330	1505	1670	1840	2000	2160
	24	6.2	900	1090	1285	1480	1660	1840	2020	2190	2360
	26	5.0	980	1180	1390	1595	1790	1980	2160	2340	2515
	28	4.2	1065	1280	1505	1720	1930	2130	2315	2500	2680
	30	3.5	1140	1370	1605	1820	2040	2240	2430	2620	2810
300	20	10.8	750	900	1080	1250	1430	1580	1740	1900	2055
	22	8.4	835	1015	1200	1390	1570	1740	1915	2090	2255
	24	6.6	935	1120	1340	1540	1735	1930	2110	2295	2470
	26	5.4	1020	1230	1450	1665	1870	2080	2275	2460	2640
	28	4.5	1110	1340	1570	1800	2015	2230	2435	2625	2820
	30	3.75	1190	1430	1680	1915	2135	2350	2560	2750	2950
320	20	11.5	775	935	1125	1300	1480	1640	1810	1970	2130
	22	9.0	865	1050	1250	1440	1630	1810	1990	2170	2345
	24	7.1	970	1175	1390	1595	1800	2005	2195	2380	2565
	26	5.8	1055	1275	1505	1730	1950	2160	2365	2560	2750
	28	4.8	1150	1390	1640	1880	2105	2325	2540	2750	2945
	30	4.0	1230	1485	1740	1990	2225	2460	2680	2890	3090
340	20	12.2	800	965	1160	1340	1530	1695	1870	2045	2210
	22	9.5	895	1090	1290	1485	1680	1880	2070	2250	2435
	24	7.5	1000	1215	1440	1655	1870	2080	2280	2480	2680
	26	6.1	1090	1325	1560	1790	2025	2250	2460	2670	2875
	28	5.0	1195	1440	1695	1930	2185	2420	2640	2855	3060
	30	4.25	1280	1540	1810	2070	2320	2570	2795	3010	3230
360	20	13.0	825	995	1200	1385	1580	1750	1935	2115	2290
	22	10.0	920	1120	1340	1540	1740	1940	2240	2330	2510
	24	7.9	1030	1255	1490	1710	1930	2155	2365	2565	2770
	26	6.5	1130	1365	1615	1860	2095	2325	2550	2760	2980
	28	5.3	1230	1490	1760	2010	2265	2510	2740	2970	3195
	30	4.5	1320	1595	1880	2145	2410	2660	2890	3130	3355
380	20	13.7	850	1020	1230	1430	1630	1810	1990	2185	2360
	22	10.6	950	1160	1375	1580	1790	2005	2210	2410	2600
	24	8.4	1060	1290	1530	1765	1995	2220	2440	2660	2865
	26	6.9	1160	1410	1670	1920	2160	2400	2640	2865	3090
	28	5.6	1270	1540	1810	2080	2345	2600	2845	3080	3320
	30	4.75	1365	1650	1950	2225	2500	2760	3010	3250	3500
400	20	14.5	875	1050	1270	1470	1675	1860	2055	2240	2440
	22	11.2	975	1190	1410	1630	1840	2070	2275	2480	2680
	24	8.8	1095	1330	1575	1820	2060	2290	2520	2740	2960
	26	7.2	1200	1455	1720	1980	2235	2480	2720	2950	3190
	28	5.9	1320	1590	1880	2160	2435	2700	2955	3195	3440
	30	5.0	1420	1700	2000	2290	2575	2860	3120	3365	3620
450	20	16.2	925	1115	1350	1570	1790	1990	2190	2400	2605
	22	12.6	1040	1270	1505	1740	1980	2210	2415	2660	2880
	24	9.9	1165	1420	1685	1950	2210	2460	2695	2945	3185
	26	8.1	1275	1550	1840	2120	2395	2670	2925	3180	3440
	28	6.7	1400	1695	2005	2300	2600	2880	3160	3430	3700
	30	5.6	1505	1840	2150	2465	2770	3080	3360	3640	3920
500	20	18.0	970	1200	1430	1655	1895	2100	2320	2550	2760
	22	14.0	1100	1340	1595	1845	2100	2340	2590	2820	3065
	24	11.1	1230	1505	1785	2065	2340	2620	2865	3140	3390
	26	9.0	1350	1640	1955	2250	2550	2840	3110	3400	3665
	28	7.4	1480	1795	2130	2455	2770	3075	3360	3660	3960
	30	6.2	1595	1940	2290	2630	2960	3280	3600	3900	4210

ETHER AND ETHER WAVES

An Article which describes in simple language the theory of wave formation.

PART I.

ONE of the most troublesome points to explain to a beginner in wireless concerns the actual manner or "mechanism" by means of which the signals travel across the open "space" between the sending station and the receiving aerial. According to modern science there is no such thing as "action at a distance." In other words, in every case where a "cause" of any kind gives rise to a corresponding "effect" at some distant point, these two events must necessarily be harnessed together, in some way or other, by a connecting link. In the case of the ordinary or "line" telephone we have reached the stage where familiarity breeds contempt. It is taken more or less for granted that the words spoken into the instrument at one place shall be faithfully and instantaneously repeated at another place miles away. We *know* that there is a conductor or line between the two points, and without going into further detail, this seems to be sufficient to strip the performance of most of its "mystery." There is a wire joining the "cause" and "effect," there is an electric current, and there you are!

The Connecting Link.

When, however, it comes to a question of sitting comfortably at home in the suburbs and hearing grand opera from Covent Garden without any apparent or visible connection whatever, the matter becomes more perplexing and calls for further explanation. For many years before the advent of "wireless," scientists had felt the need for the existence of some medium which would account for the passage of light and heat across the millions of miles of apparently empty "space" which separate the earth from the sun and stars. Both light and heat are forms of energy. The power reaching the earth from the sun in the form of radiant heat is sufficient to generate millions of horse-power if it could be properly applied, whilst that received in the form of light is not inconsiderable. Therefore, it was argued, there *must* exist between the earth, sun, and stars some continuous *medium* capable of carrying this energy from the start to finish of its journey. And the medium or "carrier" must be *continuous*, in the sense that if it could be cut across, inch by inch along its length, it should always be possible to follow the passage of the energy and the process of its transfer.

How It Conveys Energy.

Scientists are now convinced of the existence of an all-pervading substance or "fluid" which has been named "ether." The earth, and in fact the entire universe, is immersed in an illimitable "ocean" of this mysterious fluid, which not only occupies all known "space" but also penetrates and completely fills the interstices between the atoms of solid matter itself. Not only does the ether serve to bring us light and heat from the sun, but it also forms the "missing link" which joins the broadcasting station to the receiving aerial of each listener-in. Granted that the connecting link, although invisible, does in fact exist, we will next examine the manner in which it acts when conveying light, heat, or "wireless" energy.

The process or "mechanism" of transfer may be described briefly as the setting up of "strains and stresses" which travel through the ether in the form of "waves," spreading out in all directions and travelling at enormous speed. The subject of wave-motion, although apparently simple, is well worth a little closer examination.

In the first place, "wave-motion" can be set up in any substance which possesses two qualities, viz., elasticity and density. *Elasticity* is the property whereby a body tends to resist any change of *shape*. Rubber, which requires the application of force in order to stretch or compress it, is one example of an elastic body; whilst steel (say in the form of a spring or thin blade), which opposes any attempt to bend, twist, or otherwise deform it, is another. *Density* is an essential property of all matter. When, for instance, one end of a rope is fastened to a hook, and the other end is held in the hand and given a sudden jerk, a single wave or "hump" will be formed at the loose end and will apparently "travel" at some speed towards the fixed end. Here the *elasticity* is manifested in the resistance offered by the rope to the rapid "bending" of its substance caused by the hump. The *density* in the case of this example can be represented by the weight of the rope compared to its mass or, rather, length and thickness.

Energy Through Rope.

The first "hump" is lifted up against gravity, and accordingly tends to fall down again to the common level. The natural desire of the rope to remain straight and "undeformed" assists in the "restoring" effect. The combined pull, however, proves too strong, and instead of merely coming back to the "straight" the rope "overshoots" itself and creates a depression or trough. This again offends against the elasticity and tension of the rope, which tries to restore matters, but again acts with too much vigour. And so the process goes on until the "wave" strikes against the fixed support at the far end. If, instead of being fixed to a hook, the other end of the rope is held by a second person, the latter will experience a slight tug or jerk as the "hump" reaches him. In other words, the "energy" applied at one end has been carried through to the other by means of a "wave." Having considered the two qualities which it is necessary for any medium to possess before "waves" can be set up in it, we come to another point of importance, namely, the actual nature of the wave formation itself.

Two Types of Waves.

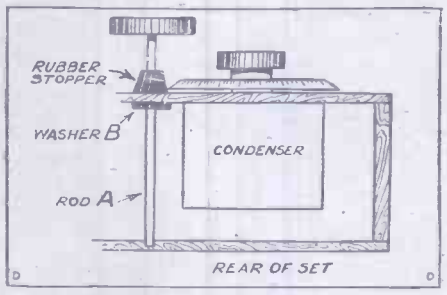
In the first place a little thought will make it clear, in the case of the "rope wave" just referred to, that although the "wave formation" actually moved forward from one end of the rope to the other, the motion of each particle of the rope itself was confined to a limited to-and-fro motion or "swing" about its normal position of rest. To put it in another way, although the wave form travelled *forward* bodily over a distance of several yards, no single particle of rope moved more than a distance of two or three feet, and this only in an up-and-down direction. But every single particle, in turn, makes this smaller or vibrating movement. It is the succession of these movements which gives rise to the wave form, and so creates the illusion that a part of the rope itself (namely, the "hump") has actually travelled from one end of the rope to the other. This distinction between the movement of the "wave" and that of the individual particle of the medium should be carefully noticed, as it forms a basis for the division of all waves into two broad types. In one type the particles themselves move to an fro in a direction *at right angles* to the direction in which the wave itself travels. In the second type they move to and fro along the *same line as the path of the wave*. The first class is called a "transverse" wave because the path of the particles cuts across the path of the wave (as in the case of the rope).

(To be Concluded.)

VERNIER ADJUSTMENT

A SIMPLE Vernier adjustment which can be adapted to act on the variable condenser of any existing apparatus is shown in the accompanying diagram. A rod A, of approximately ¼ in. diameter, is taken through a hole bored for the purpose in the front of the panel to the back of the set, where it is supported in a second hole sunk in the rear of the cabinet. A rubber stopper is then procured and a hole bored through the centre, this hole, of course, being of a diameter corresponding to that of the shaft over which it has to be fitted.

A rubber washer, B, is treated in a similar manner, and is fitted over the shaft in such



a way that it lays close to the rear of the front panel of the set as shown above.

A control knob is then fitted to the end of the rod, and the device is ready for operation. It is as well to mention that the rod should be of a sufficient length to allow it to stand out well clear from the front of the panel in order to avoid self-capacity effects.

The distance should be at least two or three inches if the best results are to be obtained. It is hardly necessary to mention that care should be taken to see that the rubber stopper acts smoothly on the edge of the condenser dial, as any error in adjustment will either render the action stiff, which is not conducive to good working, or will fail to operate the condenser at all, which is worse.

THE PIANO AND BROADCASTING

Miss Marion Snowden is one of the foremost teachers of the pianoforte in the country, besides being a very well-known concert artiste. In this interview with "Ariel" Miss Snowden gives her views on the broadcasting of music by wireless.

THE other evening I had the pleasure of demonstrating a Marconi six-valve portable receiver to Miss Marion Keighley Snowden, the talented pianist who recently broadcast a recital from 2 L O.

As usual, the portable set created a mild sensation. The lack of an outside aerial, and the fact that one could carry the set about, all contributed to Miss Snowden's surprise.

But 2 L O came through quite clearly, and, after "listening-in," Miss Snowden gave prompt judgment.

"The piano sounds a little 'tinny' at times," she said, "but on the whole I think the expression and the sense of individuality one obtains when listening to wireless music is far greater than that obtainable with even the best of gramophones.

"As far as I am able to judge, bright, crisp music is best for broadcasting purposes —music in which the pedal is least used. After I had played a Chopin Etude (Opus 25) at Marconi House recently I was told by friends that it had not come through very well on a loud speaker, the general effect being blurred. This is a work which must be played *smoothly*—for which reason I had to use the pedal as a sustaining link.

"But I am sure it is early yet to say anything definite, for each time I broadcast they have improved the transmission beyond belief. My brother, who knew all the music I had played on this last occasion, but has a very critical ear, affirmed that pianissimos in some Debussy pieces—which are as delicate as I can make them—came through as if I had been playing in the room where he listened-in. The conditions were favourable for him, and he was fairly near to Marconi House.

"Another who listened-in to this programme pleased me by saying that I made the piano 'sing.' One's friends are kind, of course, but I regard this less as a personal compliment than as a tribute to the Matthay system of piano touch and technique; I am sure it must be the most favourable for broadcasting."

"Strange and Isolated."

"And how did you enjoy broadcasting?" I asked Miss Snowden.

"It was not particularly enjoyable the first time," was the reply, "because the whole atmosphere of the studio at Marconi House seemed strange and isolated. I missed the audience terribly. I should have felt much the same, I think, if I had found the piano in a churchyard, with a pair of candles, on a dark, still night, and been asked to play to the ghosts! It isn't merely the applause one misses, but all sense of the company of and contact with the audience.

"It is very disconcerting to hear a whispered warning from the anxious expert while one is playing, such as, 'Not so loud, please,' or, 'Your pianissimos won't come through,' particularly in chamber music, when one has so many things to think about.

"But the knowledge that one is playing to a vast audience all over the country is very thrilling, and I find the terrors of my first experience greatly lessened now. The piano at the London Broadcasting Station has an exceedingly nice tone, and it is a real pleasure to play it.

"The applause comes to one by post next day! Here is a letter from a friend in Llandudno, full of exclamation marks—the thrills she experienced on hearing her favourite Spanish Dances of Granados; another comes from Yeadon, near Leeds, and the writer, who is a wireless enthusiast, says: 'Marconi House seems to have discovered the correct microphones for reproducing piano music, as their transmissions are always much better than the other broadcasting stations.'

Education of Public Taste.

"But the most wonderful to me is this postcard from a small cousin, who heard me in a little village away up on the Yorkshire moors, miles away from a railway station. 'I almost felt able to see you, dear,' she says."

"And do you think the musical programmes are good?" I asked Miss Snowden. "A number of people seem to be of the opinion that the musical standard adopted by the wireless orchestra might be better."

"Well," replied Miss Snowden, "when you come to consider the huge public the orchestra caters for, it must be very difficult indeed to provide music which will please everybody. From the programmes I see every day in the papers, I think, perhaps, that the standard might be raised a little. Why not devote, say, one evening a week to really first-class music? I am sure this innovation would appeal to a very large number of listeners-in, and in time those who, at the present, cannot appreciate a Beethoven Symphony, would gradually acquire a liking for the great masters. That is where the Broadcasting Company have an opportunity to do an incalculable amount of good in educating public taste. In time listeners-in would look forward to an evening's programme of really first class music instead of a *pot-pourri* programme of musical 'third raters.'

Necessary to Discriminate.

"But broadcasting is young yet," said Miss Snowden, "and it is hardly fair to criticise too closely. There is always room for improvement in anything, and from what I have seen and heard, I believe the Broadcasting Company are quite right in starting off with fairly ordinary musical programmes. They can always be improved as the public taste changes."

I asked Miss Snowden what music she thought best suited for pianoforte broadcasting.

"At present," she said, "it would be well to discriminate. Very heavy and very delicate works are not entirely successful just yet. I should think it quite possible, however, to choose suitably from all composers—classical and modern. Some of the old English virginal music of Byrd, Farnaby, Gibbons, Purcell, and Arne is very charming indeed, and some of it would come through perfectly. In this music one would not regret so much missing the resonance of the modern grand pianoforte."

Miss Marion Keighley Snowden at her piano. [*Photo Vandamm*

POPULAR WIRELESS Beginners' Supplement

PART XI. THE THERMIONIC VALVE.

By MICHAEL EGAN

IN the previous article we noted the different functions of the "accumulator" and "high tension" battery used in connection with valve receiving sets. The accumulator passes a fairly large *current* through the filament of the valve, and the high tension battery applies a fairly high *tension* or *pressure*, to the metal cylinder (usually referred to as the "plate") which surrounds the filament.

The object of passing this current through the filament is to raise the latter to a certain temperature. The Greek word *thermos* means "hot." This is why wireless valves are called "thermionic" valves; they are operated by making the filament *hot*. Of course, in heating the filament by passing an electric current through it, we also, accidentally, produce light. The valve lights up to a greater and greater brilliancy as the filament is made hotter and hotter.

An Accident.

But the light so produced is not an essential factor. In the case of an ordinary electric bulb, the whole object of passing an electric current through the filament of the bulb is to produce light. Yet this bulb accidentally produces *heat* at the same time. In the former case, heat is the essential thing, whilst light is an accidental by-product, as it were; in the latter case, light is the essential thing, and heat is produced accidentally. Nevertheless, since the light produced by a wireless valve increases as the heat of the filament increases, it serves as a useful guide for the operation of a valve in practice.

Now, the accumulator is connected to both ends of the filament wire, thus causing a current of electricity to flow from the former through the latter. But the high tension battery is connected in quite a different way. Only one wire is taken from this to the plate of the valve. The high tension battery, therefore, in the normal course, sends out no current. It merely exerts an electrical *pressure* on the plate of the valve.

One side of the high tension battery is connected to the plate of the valve, but the other side is connected to the filament. Of course, if the filament and the plate were touching one another inside the valve, a current would immediately flow from this battery, because there would then be a "complete circuit," viz., from one side of the battery to the plate, from the plate to the filament (these being in contact), and from the filament to the other side of the battery.

The plate and filament of a valve are not in contact, however; they are separated from each other by a distance of about a quarter of an inch. (Moreover, this is done for the express purpose of preventing any current from flowing direct from the plate to the filament, the reason for which will be seen presently.) Of course, if this gap could be made conductive at any moment a sudden gush of current would take place from the battery, and, on making the gap non-conductive again, the current would be shut off at once.

This is really the way in which the valve is operated. When the filament is heated to a suitable temperature, it shoots off little particles of electricity from its surface. These little particles are hurled across the valve from the filament to the plate, and their effect is to make the gap conductive. As soon as this happens, therefore, a stream of electricity pours from the high tension battery and flows across the valve. Incidentally, the telephones are connected in the same circuit, so that the current also flows through them.

So long as the temperature of the filament remains steady, this current remains steady, and, therefore, does not cause the diaphragms to vibrate. But should anything cause this current to vary in strength, the diaphragms of the telephones would then be affected. As was explained in a previous article, a steady current will not make telephone diaphragms vibrate, whilst an unsteady, or fluctuating, current will do so. Moreover, the diaphragms will vibrate at the same rate as the fluctuations that occur in the current flowing through the telephone coils.

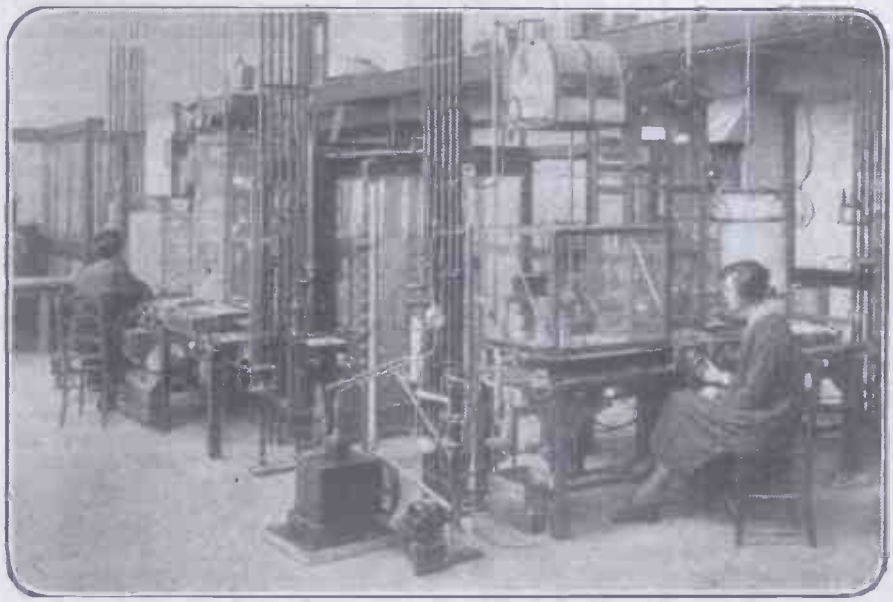
Positive and Negative.

When the valve is connected up, before any signals are picked up by the aerial, there is a steady flow of current across the valve, from the plate to the filament, and this current is conducted through the coils of the telephones, and as it is a steady current, the diaphragms are not vibrated and no sound is heard. Now, electric charges, like magnet poles, are of two kinds. Magnet poles are "North" and "South," and electric charges are said to be "positive" and "negative." And just as like poles repel and unlike poles attract, like electric charges also repel and unlike charges attract. Between the filament and plate of a valve, but not touching either, is a small spiral of thin wire. This wire is connected to the down lead of the aerial. When the waves from a transmitting station strike the aerial, therefore, they give rise to small electric currents which flow down on to this wire spiral, making it alternately positive and negative. As the spiral (usually called the grid) changes rapidly from positive to negative, the current flowing from the high tension battery is shut off and switched on at the same time.

The Meaning of a Name.

That is to say, at one moment the grid repels the current that tries to flow from the plate to the filament, and at the next moment attracts it and, as it were, encourages it to flow. The positive and negative currents that flow in an aerial when signals are picked up thus produce fluctuations in the current that previously flowed steadily through the coils of the telephones. These fluctuations occur in sympathy with the currents in the aerial, with the result that the diaphragms of the telephones vibrate at the same rate as the sound waves that strike the microphone at the transmitting station.

The reason why a valve is called a valve will now be obvious. The grid, when acted upon by the received aerial currents, alternately shuts off and releases the current which tends to flow from the plate to the filament. The grid is made in the form of a spiral, or mesh, so that a steady current can flow through it before signals arrive at the aerial. If the grid were also a metal cylinder, like the plate, no current could pass from the plate to the filament in the first instance. Being in the form of a spiral, this steady current can flow through it.



Testing Valves in the G.E.C. Laboratories, Wembley. The valve under test has a pressure of 5,000 volts D.C. on the plate.

QUESTIONS & ANSWERS FOR BEGINNERS.

NOTE.—On this page the beginner will find a selection of questions and answers which will concisely deal with many little problems met with in the erection of a wireless receiver. Readers are invited to send their queries to the Technical Dept., Room 138, The Fleetway House, Farringdon Street, London, E.C.4, where they will be carefully and promptly dealt with. Replies are sent by post free of any charge.

Q. Using a three-coil tuner I find that best results are obtained with the reaction coil away from the secondary. As I bring it nearer the signals die away. Should this be so?

A. Your experience points to the fact that you have your reaction coil wrongly connected. Try turning the coil round so that the impulses go round it in the opposite direction. As you have the coil now, these impulses will react upon the secondary coil in such a way as to oppose the currents flowing in that coil. This will naturally result in the signals becoming weaker the nearer you couple the reaction coil to the secondary. If your set is working properly, the nearer you bring the reaction coil to the secondary the louder should become the signals until at last the valve goes into oscillation with a sound like a loud "pop." When this occurs the reactance should be decreased until the signals are again heard clearly and free from distortion.

* * *

Q. What are the best contacts for galena, hertzite, permanite, silicon, carborundum.

A. The first three operate successfully with a copper "cat's-whisker" contact, though in many cases a silver one has been found to give better results. Silicon should have a gold point contact. Carborundum is used with a flat steel plate or strip pressing fairly firmly upon one of its sharp points. In this latter crystal a potentiometer and battery are needed.

* * *

Q. What size battery and potentiometer are needed for a carborundum crystal.

A. A 3-volt cell or two 1·5-volt dry batteries would be quite O.K. The potentiometer has a resistance of 200—300 ohms. A small current is always flowing through the potentiometer, so that when the set is not in use the batteries should be disconnected in order to prevent waste of their energy. The cells should last for several months if properly used.

* * *

Q. I have a 2-valve B.B.C. receiver using reaction. Is this quite legitimate?

A. Yes; the use of reaction is permitted by the P.M.G. in all receivers, including those stamped B.B.C., provided that it is so employed as to be incapable of causing the aerial to oscillate, and thereby giving rise to interference. You will probably find that the reaction coil of your set is coupled to the anode or plate circuit of the first valve.

* * *

Q. Would not two plates of lead in a solution of sulphuric acid be quite sufficient to form an accumulator?

A. No. They would undoubtedly form an accumulator, but a large number of charges and discharges would be necessary before any useful amount of energy could be stored. The plates would have to be "formed" before being of any real value. The charging and discharging would eventually do this, but it is more satisfactory and quicker to prepare the positive plates by filling holes in them with red lead. The negative plates are prepared with litharge coating. A few charges then converts the red lead into lead peroxide on the positive plate, while the negative plate is reduced to spongy lead.

* * *

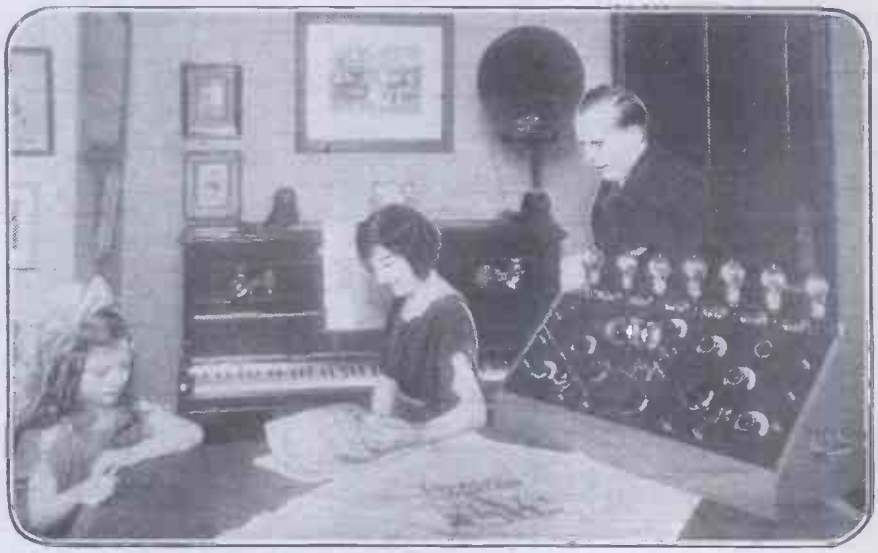
Q. How does a loose-coupler work? There does not seem to be any connection between the secondary and the aerial. Is that as it should be?

A. Yes, that is quite right. No metallic or electrical connection is necessary between the secondary coil and the primary or aerial. When a current flows through a coil it gives rise to a magnetic effect all round the coil, and this effect varies as the current varies in the conductor or wires. Now, as the currents flowing through the primary coil from the aerial are oscillatory—rushing up and down—so the magnetic lines of force or field round the primary will be constantly changing. The property that a current has of causing a magnetic field to rise round the conductor holds good for the converse, namely, that a magnetic field cutting a conductor will give rise to a current in that conductor. The secondary of the loose coupler is therefore so placed that it is cut by the lines of force from the primary. These lines are continually changing owing to the oscillatory current in the primary, and are in their turn giving rise to changing currents in the secondary. These currents are exact replicas of those in the primary, though their strength can be varied by varying the distance of the secondary from the primary coil. This variation of distance merely has the effect of varying the number of magnetic lines cutting the secondary, and hence the "induction" between the two coils, thus varying the strength of current flowing in the secondary coil.

* * *

Q. Can Wood's metal be used for soldering connection to terminals?

A. It can be used, but it is not likely to give a satisfactory joint as the solder is so soft. If you use Wood's metal for this purpose you run the risk of having a great deal of trouble over loose connections, as a slight jar will often be sufficient to release the grip of the solder on the wire or terminal. Where no strain occurs, as in crystal cups, this type of solder is quite efficient, but we would not advise its use for terminal connections.



Mr. James, director of the Holborn Radio Co., "listens-in" on one of his own sets.

Q. Which do you consider the better type of H.F. transformer, the plug-in type in preference to that covering all wave-lengths by means of tappings?

A. For low wave work it is advisable to use the plug-in type in preference to that covering all wave-lengths and using switches. The latter is not usually an efficient instrument as a great deal of dead end effect is bound to occur, and this makes the fine tuning of the H.F. circuit almost impossible.

* * *

Q. Can spider web coils be used as tuned anode coils?

A. Yes; they are fairly efficient in this respect, and also lend themselves to easy coupling with a reaction coil. The size of the coil varies with the wave-length required, but in every case a 1 in. centre and 7 slots will be found to be quite O.K. As the wave-length rises you can use finer wire instead of greatly increasing the size of the coils. A reaction coil of the same type will be found quite satisfactory.

A HISTORY OF WIRELESS TRANSMISSION.

By SEXTON O'CONNOR.

PART I.

THE idea of signalling across "space," *i.e.*, without the use of a wire connecting the sender and receiver, first arose shortly after Faraday's discovery of what is now called the "inductive" action of an electric current.

It is commonly said that a current flows "in" or "through" a wire. This is only a half-truth. The fact is that only a portion of the electric energy concerned is concentrated in the wire itself. The rest spreads or "leaks" outwards from the wire for a considerable distance, and sets up an invisible "field of induction" or "strain" on the surrounding ether.

Hertz's Experiment.

The truth of this is fully borne out by the well-known "cross-talk" or interference effect so frequently experienced when using the ordinary telephone, which is simply due to the "field" from one line spreading outwards and cutting across a neighbouring line. In other words the "interfering voices" are being *transmitted* from one line by "wireless," and are being *received* on the "aerial" formed by the second line.

It was soon found, however, that the "range" of such inductive effects was far too limited to be of any practical use for signalling purposes.

In those early days modern high-frequency currents were unknown, and this formed a fatal bar to success. With currents of a lower frequency than about 50,000 cycles per second, the electric "field" is, so to speak, "sticky" and will not spread far afield from the conducting wire.

About the middle of last century the famous scientist Clerk-Maxwell, first suggested, in effect, that if currents of very

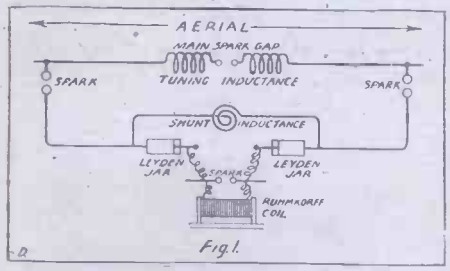


Fig. 1.

high frequency were employed, a considerable proportion of the energy seated in and around the conductor would actually detach itself from the wire and travel outwards through the ether in the form of "waves." By a process of mathematical reasoning he showed that such waves would be of the same general nature as those which carry light and heat to us across stellar space.

Twenty years later, in 1887, Heinrich Hertz proved this reasoning to be correct. By using the spark discharge from Leyden jars he obtained oscillatory currents of tremendous frequency, and shewed in fact, that such currents created "waves" which could be detected a considerable distance away.

The ranges obtained by Hertz were still, however, very limited. The difficulty at this stage was not a question of frequency. In fact, the frequencies used were far too high and the wave-lengths in consequence too small.

The next problem, therefore, was to find some means of diminishing the frequency so as to produce longer waves which would "carry" more energy and so travel farther.

Ten more years were to elapse before Marconi in 1897 solved the difficulty by the

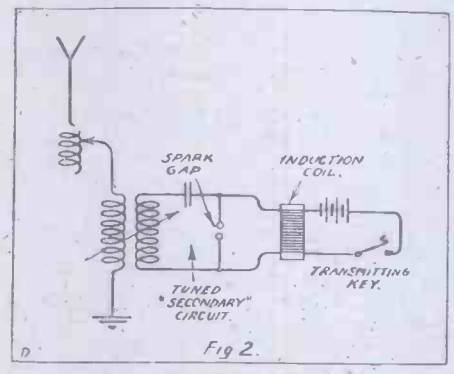


Fig 2.

apparently simple device of feeding the spark discharges from a Hertzian oscillator directly into a long upright or "elevated" aerial. Such an arrangement will radiate waves which, when measured in metres, are equal to four and a half times the length of the aerial in metres. He used a similar elevated aerial to "pick up" the waves at the receiving end.

It is interesting to note here that a Russian physicist named Popoff had actually used an elevated aerial for *receiving* electric oscillations before Marconi, but so long as only short wave-lengths could be radiated this, by itself, was of little use. Popoff apparently missed what now seems a rather obvious point, namely, that of fitting the *transmitting* station with an upright aerial.

Sir Oliver Lodge and "Tuning."

Once Marconi had taken this vital step forward, progress was rapid. Within a few years wireless signals were being successfully received over a range of several hundred miles.

It should be mentioned that a year after Marconi's pioneer invention, Sir Oliver Lodge made another important advance by inserting "inductance" in the otherwise plain aerial, thereby "loading" it so that it would radiate still longer wave-lengths. Lodge also appears to have been the first to realise the importance of "tuning" both the sending and receiving aerials to the same frequency. The original Lodge transmitting circuit is shown in Fig. 1. The arrangement of Leyden jars and various spark-balls looks rather quaint at the present day, but there is no doubt of the value of his introduction of the "aerial tuning inductance."

In 1900 Marconi evolved what still remains one of his most important contributions to the subject. This improved circuit arrangementis shown in Fig. 2, and was covered by the famous "four sevens" patent of which so much mention is made in wireless literature.

Instead of coupling the spark gap directly to the aerial, the oscillations are built-up or "concentrated" in a closed secondary circuit. This, in turn, is loosely coupled to the "open" or radiating circuit formed by the elevated aerial, both aerial and secondary circuits being tuned to the same frequency.

The combined circuits when used in transmission, give a greatly increased range and an output of practically constant wave-length. When applied to reception the closed secondary circuit acts as a kind of "filter," helping to shut out from the detector all signals which differ in frequency from that to which the circuits are tuned, and thus preventing interference or jamming by undesired signals.

At this stage of development, the "spark" system of wireless transmission may be said to have reached maturity. Further improvements were, however, made from time to time to increase its efficiency in detail, but most of these are outside the scope of the present article.

(To be concluded.)

CATALOGUES.

RADIO Instruments, Ltd., have just issued a new catalogue dealing with every conceivable kind of wireless set, from the 105 guinea cabinet to the crystal receiver complete for under £5. All the apparatus has been designed with a view to simplicity in use, and conforms with the regulations of the Broadcasting Licence in every way. A "Distortionless Loud Speaker" is also featured, claiming a fair volume of sound with a pure tone. As a matter of fact, a certain amount of "loudness" is sacrificed in order to obtain this clarity of reception.

* * *

A useful little booklet has been issued by the Marconi Scientific Instrument Co., Ltd., dealing with their special unit system. The booklet gives a full description of each unit, how and where it acts, and a complete wiring diagram of the set of three valves with tuning units and telephone transformer unit. Full instructions for tuning-in are also provided, and the amateur possessing one of these sets, or contemplating the purchase of one, will find the brochure of great assistance. Besides the unit set, the same company provide cabinet sets of one, two, three, and up to 6 or 7 valves.

* * *

A useful accessory has been brought out by the Sterling Telephone and Electric Co., Ltd. It consists of a long block containing a number of terminals for the connection of up to six pairs of telephone receivers. This telephone block is so arranged that the phones can be either connected in parallel or series-parallel.

WIRELESS ON TRAINS.

By G. H. DALY.

THE use of train wireless for the reception of broadcasting holds out decided possibilities of increasing the comfort of the travelling public. Also everyone knows how indispensable the ordinary telephone is to the business man, yet if this man finds it necessary to travel by rail to a town some distance away, he is cut off from the world for a number of valuable hours. A simple system of wireless telephony would obviate this and bring a large sum of money into the coffers of the railway companies.

With railways, unlike ships or aircraft, it is possible to utilise wired wireless, which has certain advantages over ordinary wireless.

Early Experiments.

The first railway in the world to make use of wireless was the American Lackawanna and Western Railroad. In November, 1913, this company fitted their "Lackawanna Limited" with a wireless telegraph installation, and constant communication was maintained between the train while travelling, and the wireless station at Ringhampton and other stations erected along the line.

The following December a sleet storm brought down the telegraph wires between Hoboken, N.J., and Scranton, Pa; this would have resulted in a three days' stoppage had it not been for the train wireless equipment which enables traffic to be dealt with as usual.

About this time the Union Pacific Railroad also began experimenting on train wireless at Omaha and fitted wireless installations in six of the towns on their system.

On the entry of America into the war the Lackawanna Company had to suspend further experiments, and it was not until March, 1922, that they restarted train wireless. In the meantime, wireless had made great strides forward, and it was possible to equip the historic "Lackawanna Limited" with wireless telephony instead of wireless telegraphy.

Broadcasting on Railways.

The wireless apparatus consisting of a 15-watt valve transmitter and a valve receiver was installed in a buffet car. An aerial of the cage (or sausage) type was carried on the roofs of two of the cars. Excellent results in receiving and sending were obtained over a distance of 25 miles, and no appreciable interruption of communication was experienced when passing through tunnels or when going over steel bridges or through cuttings.

Early this year the Chicago Elevated Railroad experimented with wireless telephony with the idea of providing concerts transmitted by wireless telephony to all suburban trains. The first test took place on a car of the Chicago, North Shore and Milwaukee train, when a successful concert was held while the train was in motion.

The Southern Pacific Railroad have also adopted a system for providing concerts to passengers on long distance journeys. The first concert was broadcast from Los Angeles of cinema fame. Other enterprising lines have installed a loud speaker in each car, while in some cases a loud speaker is attached to each seat. On many lines it is possible for passengers to telephone from the train and inform their friends verbally of when they are likely to arrive.

The first occasion on which wireless was applied to railways in this country was during the railway strike of September-October, 1919. For, owing to the possibility of ordinary telephonic communication being interrupted the Government decided to link up all railway centres by wireless telephony.

On the 3rd October operations were started on the Midland line, and by the 7th officials at St. Pancras—the London Terminus—were able to speak to Birmingham, Leicester, Durham, Rotherham, and Leeds, the last-named being 170 miles from St. Pancras. The sets used were Marconi 1/2 k w. Portable Y.C.1.

It was the intention of the Government to link up all other centres of our great railway systems, but on account of the termination of the strike this was never carried out.

Interesting Tests.

On October of 1919, a special wireless coach of the Great Western Railway was attached to the morning Paddington to Bristol train, and throughout the whole journey of 117 miles signals were received from the Woolwich Experimental Army Station which was transmitting on a wavelength of 150 metres. On the train a loop aerial was carried for reception. Signals, however fell off when going through tunnels and under bridges, although good signals were received under an iron roof at Paddington station.

The following month the same coach was fitted with a 120-watt valve transmitter and attached to the Irish mail from Paddington to Fishguard. The wave length this time was 1,370 metres, and signals transmitted from the train were received at Woolwich for the first 70 miles, but were then jammed by an R.A.F. station. According to the officials concerned these experiments proved that, with a loop aerial 2 feet square inside a compartment, and apparatus occupying a space of 4 feet 6 inches by 2 feet 6 inches, communication could be maintained between Woolwich and the train during the whole of the journey of 261 miles from Paddington to Fishguard.

In 1920 the Marconi Company carried out wireless telephony tests between Euston—the London and North Western Railway terminus—and Crewe, a distance of 158 miles. Results were extremely satisfactory, speech being clearer than by the ordinary wire telephony. Colonel Cortez Leigh, the divisional electrical engineer of the L. & N. W. Railway stated that the experiment was tried partly because, after their experiences of a severe storm, when most of the telephone wires came down, it was thought desirable to have a stand-by in case of a similar occurrence.

Soon it is hoped that all passenger trains will be fitted with wireless telephony so that travellers may relieve the monotony of the journey by listening to the latest news, music, or speeches.

The train wireless at present being experimented upon in France is to utilise the telegraph wires running alongside the railway lines as a means of guiding or carrying the wireless waves sent out by a central wireless station. This is somewhat similar to the wired wireless invented by General Squier some time ago.

Wired Wireless on Railways.

In Germany the well-known Hamburg-Berlin express is equipped with wireless telephony, and it is claimed that passengers can converse with telephone subscribers quite as easily as when in their offices.

The most interesting use of train wireless in Germany, however, is a wired wireless safety device for informing the driver of an engine when he is approaching a signal post.

At the railroad station of Angemünde a wireless installation has been fitted which radiates into the telegraph wires a never-ending stream of wireless waves. This wireless energy travels along all the telegraph wires of that particular section of the railway, and, as is the case with the French wired wireless system, this energy can be picked up by a wireless receiver for some hundreds of yards on either side of the wires.

Now the engines of all trains on the line are fitted with a special type of wireless receiver which picks up the waves from the telegraph wires. The energy passing through this receiver operates the needle of a very sensitive galvanometer in the engine cab. And as the energy is being constantly transmitted the wireless receivers on the engines are constantly receiving signals. Therefore the galvanometer needle is being constantly deflected by the unending stream of wireless signals from the telegraph wires.

Wireless Signalling System.

The face of the galvanometer is so arranged that when the energy is deflecting the needle, this needle is out of sight altogether, and therefore cannot be seen by the driver. When, however, no wireless signals are being received on the engine the galvo needle springs back to its zero position and *can be seen*.

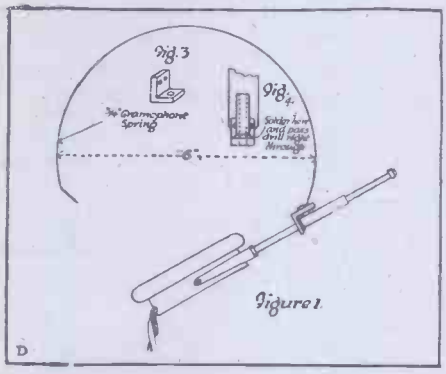
The idea is that no wireless energy will be received by the engine receiver at a certain place some hundreds of yards form the signal post. Thus the needle will be seen as the train passes this point and the driver will know that a signal is near.

The method adopted to prevent the train from receiving energy just before approaching a signal post is to surround the telegraph wires with a metal sheet or tunnel. This effectively stops the waves emanating from the telegraph wires, owing to the fact that any electrical conductor, such as a sheet of metal, reflects wireless waves striking against it and prevents them from travelling further in their original direction.

Therefore, when passing this metal screen no energy is received by the engine receiver and the galvanometer needle becomes visible.

HOW TO MAKE TELEPHONE HEADBANDS.

MANY excellent ex-Government ear-pieces are on the secondhand market. These are mostly sold without headbands, and the purchasers of such will find it necessary to obtain or improvise these necessary adjuncts. Now, nothing mars the enjoyment of a lengthy period of listening-



in more than uncomfortable and ill-fitting phones. To fit snugly but firmly to the ears each phone must have some sort of "universal motion" This is simply and effectively provided by what is known as the "stirrup and gymbal."

This article describes how the writer made such a headband for a pair of ex-Government ear-pieces at a cost of only one shilling and threepence for materials. The materials required are as follows:—11 inches of steel gramophone spring, ¾ in. wide (failing this a strip of springy brass would do); 2 brass detector brackets (Fig. 3); 1 piece of springy brass ribbon, ⅜ in. wide, 8 in. long; 1 piece of brass wire, No. 10 S.W.G., 6 in. long; 2 valve sockets; 8 screws and nuts, 2 B.A.

The diagrams clearly indicate the assembly of these parts.

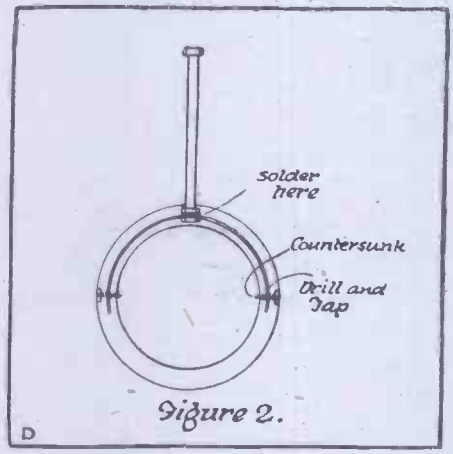
Fixing the Phones

The steel spring is bent to the arc of a circle of 6 in. diameter, as shown in Fig. 1. This can be done by coaxing with the fingers. About half an inch of each extremity is then heated in a Bunsen flame to a cherry-red and allowed to cool in the air. This softens the steel and allows of the four holes being punched or drilled therein to take the tiny screws and nuts which secure the brackets to the spring (see Figs. 1 and 4). It will be observed that the softened ends are also turned in at an angle, that shown in the sketch being about correct.

Having fastened the brackets to the spring, the two valve-sockets may now be fixed to the lower members of the brackets. The screwed shanks of the sockets are filed or sawn off and the bottoms filed level. Tin the bottom of each, and also the face of the brackets on which they are to rest. It is then only necessary to lay the sockets in place and heat in the Bunsen till the solder runs, and allow to cool to effect a neat and good union.

A twist drill must now be passed carefully through each socket and the base of each bracket, so that each forms a tube in which the 10 S.W.G. brass rod can slide freely.

Attention may now be turned to the stirrups for the ear-pieces. Fig. 2 gives a clear idea of this simple fitting. The brass rod is divided into two 3 in. lengths, each of which is threaded top and bottom to take nuts 4 B.A. The piece of ⅜ in. brass ribbon is also divided equally and drilled, each with three holes, one in the centre to take the rod, which is secured by a nut either side and soldered, and two smaller ones near the ends, which are tapped 2 B.A. for the little pivoting screws seen in Figs. 1 and 2. These little screws are the same as those used for the brackets and may be obtained with the detector brackets and valve-sockets from any wireless dealer. The cases of the ear-pieces are now drilled with a small countersunk hole in diametrically opposite positions, as clearly shown in Figs. 1 and 2. It is not necessary to drill right through into the interior of the cases, these being fairly thick. The brass strips, being now fixed to the rods, are to be bent into stirrup form, the screws being inserted and tightened up, and the ear-pieces slipped into place. The ends of the stirrups should, of course, be sprung inwards somewhat first so that it is necessary to



open them slightly to get the phones in between. This ensures a pincer-like grip of sufficient power to hold the phones securely in position.

This completes the job, except that one or two refinements, such as covering the band with leather, neatly rounding off all sharp edges from the metal parts, etc., may be indulged in at the option of the maker.

Very Convenient.

One great convenience of this form of headband is the instantaneous ease with which an ear-piece can be slipped out of its stirrup and used singly. A very useful dodge, where the phone capacity of a set is limited (as in a crystal or single-valve set) and it is desired to split the phones up amongst several people, is to make three or four of these headbands and fit one side of each with a dummy phone composed of a disc of wood, padded with a wash-leather pad. This forms a convenient and comfortable arrangement, enabling one to turn a "deaf ear" to extraneous noises. It will be greatly appreciated by anyone who has experienced the agony of holding a single ear-piece to one ear and plugging the other ear with a finger of the disengaged hand during a lengthy session of 2 L O.

GLASS PANELS.

AN ingenious experimenter who wishes to see the component parts of his apparatus in action has evolved the idea of dispensing with the ordinary ebonite panel facing and substituting glass, thus enabling him to see, to a certain extent, the internal parts of the set without the disadvantages which result from having the various parts exposed to dust or dirt. In constructing a panel of this character, it is probable that the greatest difficulty to be overcome is that of sinking holes through the glass face.

A simple way to make the required holes is to obtain some sand, and, after damping it, place about as much as can be contained in an ordinary teaspoon on the spot where it is desired to make the hole. A cast should then be made in the sand by means of a piece of cylindrical wood, the diameter of which should correspond to that of the desired hole. Some lead or solder should then be melted and poured into the cast, when it will be found that the glass will fall out, leaving a fine hole. If the glass is treated in this manner, a cheap and serviceable panel will result.

Photo] A Broadcast Concert in full swing at the Manchester Station. *[Metropolitan-Vickers*

FURTHER VALVE SET FAULTS

By G. V. DOWDING, Grad.I.E.E.

NEXT we come to another quite common annoyance, and that is "stumbling." This is more technically and correctly described as "intermittent fading." Signals are quite good for a little while and then they fade away suddenly or gradually, sometimes into absolute inaudibility and then suddenly or again gradually they resume their normal strength. This may be repeated at frequent or infrequent intervals, but is one of the most annoying of all the faults that may be experienced, because, with the perversity of all such happenings, the fading always seems to occur just at the critical moment, preventing the identification of a station or the hearing of an important announcement. Quite frequently the trouble can be located as existing in the H.T. battery or accumulator, and the previous remarks about these hold good in this case also, with the addition that in the case of the accumulator, the cells should be examined very particularly with regard to internal shorting of the plates.

Grid Leak Troubles.

This may be caused by the deposit of some foreign substance on the surface of the plates, or excessive "fanning" or splaying of the plates at the top or the bottom. Also "buckling" may have occurred. This latter, caused by the shorting of the accumulator terminals or any other form of excessive discharge of current or charging, is very visibly evidenced by the bending of the plates in a literal sense. However, should the "fading" be caused by the L.T. accumulator or any intermittent or bad contact or connection in the filament circuit, a close examination of the glowing filament of the valve will reveal an unequalness in its temperature by the slight variation in its colour.

The next point to be examined and tested is the H.T. battery, which, as previously mentioned, can possess faults that will cause varying symptoms. The internal local action can cause the resistance of a cell to intermittently rise very considerably and quite sufficiently to prevent reception altogether, although it must be added that such cases as this are indeed rare. Finally, probably the worst and most common cause of intermittent fading is the grid leak. Unfortunately this is situated in the interior of the set, and is not easily accesssible. If the set is of a sound, reliable make, however, it should not be very possible for the grid leak to cause trouble. There is one little thing that can be easily done as a last resort before referring to the makers or an expert. What mostly happens in the case of grid leak trouble is that possibly valves or one valve may be used that requires a grid leak of less resistance than the one supplied with the set. The result is that the electrons collecting on the grid are unable to get away quickly enough—in other words, the valve is accumulating more electrons on its grid than the particular grid leak will allow to pass through in the time allowed, and therefore the grid becoming choked, signals fade away until the grid becomes cleared again.

Quite a good scheme is to try the effect of drawing a pencil line from the grid leg of the detector valve, which is the leg that is opposite to the one that projects out of line to the others, across the panel to the aerial or earth terminal, or the L.T. minus or positive terminal, whichever is the nearest. This pencil line should be varied in thickness until results are at their best. Should such an operation result in the improvement of results it will be as well, if it is intended to employ similar valves in the future, to get the grid leak changed for one of more suitable value, seeing that the emergency pencil line additional leak is carefully removed. It might well be added that where a multi-valve set is employed the results of changing the position of the valves should be very carefully noted. As has often been pointed out in these columns, the individual characteristics of valves will vary to an alarming degree, even although they are of the same make and type. Therefore one of the first experiments with a valve set should be to change the position of the valves about.

Tests for "Howling"

Quite a common complaint one hears with regard to valve sets, and more commonly valve sets employing two or more valves, concerns what is commonly alluded to as "howling." Should the beginner have come into possession of a multi-valve set that tends to "howl" he will do well to obtain the advice and assistance of an expert rather than endeavour to deal with it himself, because all the time that he is "howling" it is quite possible that he is causing interference over a radius of as much as half a mile to all other listeners-in. "Howling" is more often than not the audible proof of what is known variously as "reacting," "re-radiating," "oscillating," etc. First of all, "re-radiation," I must point out, is not always evidenced in an audible "howling" in the phones of the owner of the interfering set. It can be practically inaudible to him, but by heterodyning with the carrier of the broadcasting station will cause a very audible and annoying interruption in the phones of all other listeners-in on the same wave length. The best test for re-radiation is to tap the aerial terminal of your set. A click should be noticed both when the finger touches the terminal and when it leaves, because it first of all stops the re-radiation by damping out the pulsating plate current, and then allows it to continue. This will cause the release and then the resumed attraction of the telephone diaphragms. Now to deal with the methods of avoiding "howling" and cutting it out, should it arise.

Explaining Heterodyning.

I take it for granted that you have a set that does not normally possess the necessary coil coupled to the A.T.I. for the purpose of artificially producing the state of reaction, because, although this is very desirable when properly used, it is also a source of trouble if misused. If you have that permissible intervalve reaction allowed by the P.M.G., then even with the reaction coil tightly coupled you will be unable to radiate more than very weakly, and will therefore not be causing appreciable interference.

However, one of the most common causes of "howling" and undesired self-oscillation which will, apart from anything else, cause the received music and speech to be distorted and not worth listening to, can lie in the capacity effect caused by twisted, bunched, and leads too closely arranged. Therefore, see that all connecting leads are kept well separated the one from the other, and are as short as possible and take the quickest, straightest route possible. If you are employing a set that is arranged on the unit system, for instance, do not use flex for wiring up the different panels. Keep the aerial lead well away from the earth lead and well separated from all the other leads employed on the set. Should persistent "howling" occur, it may unfortunately not be due to the set at all; it may be what is known as the "heterodyning" of two transmitting stations, which is roughly the effect caused by the carrier waves of two stations on slightly different wavelengths which combine at periods of a certain frequency and produce an audible note. Again, it might be due to another receiving station in the manner previously mentioned, which is of course "heterodyning" again. You can test whether the "howling" is due to such an outside source or a fault in the set by tapping the aerial terminal as previously mentioned.

"Soft" Valve Adjustments.

Now there is one quite common cause of "audible" howling, and this is to revert back—an unsuitable grid leak for the particular detecting valve employed. The action is this. The grid chokes up because the grid leak is of too great a resistance to allow it to easily clear, and this of course reduces the intensity of the plate current flow through the phones, but almost immediately the grid clears and the plate current increases, and where this happens at an audio-frequency the phones will of course be actuated with the same frequency which is evidenced in the form of the objectionable "howl."

This can almost be called "fading at audio frequency." The obvious remedy is to change either the grid leak or the valve. The latter expedient, although not always the most successful, being the most easily accomplished. Sometimes "howling" is caused by the unskilful handling of very "soft" valves. The adjustment of these is always very critical in point of both the plate and the filament current. As trouble from this source can be very easily dealt with after just a little experience has been obtained, it will be sufficient to just mention that either too much H.T. voltage or too bright a filament can cause "howling" where soft valves are employed.

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Lead-in Wire, Rubber Covered, per yard	3d. and 4d.
Detectors, Ball Joint, Galena Crystal	3/6
" Glass Covered, Best Quality	5/6
Aero Cord, 20-yard skeins	2/-
Spreader Cord, 20-yard skeins	1/6
Wiring-up Wire, 18g. Insulated, 12 yards	2/-
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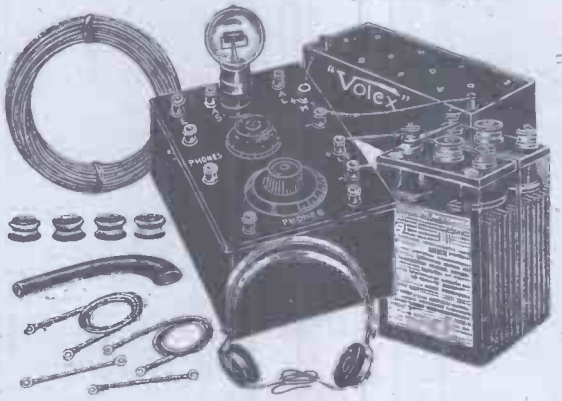

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Represents the finest value in Single Valve Sets ever offered.

EXPERIMENTAL STATION DESIGN.

By S. D. ISON.

IT is the writer's intention to very briefly describe the receiving apparatus at his own experimental station, for the help of any who have just started on the practical side, having obtained a technical knowledge from the various assortment of text books which abound at the present time. It should not be thought that this is by any means an "ideal" station, but the setting out of apparatus in the following manner has been found extremely useful for the quick changing of circuits, essentially an important feature of any experimental station.

Question of Accommodation.

It is almost essential that the experimenter should have plenty of room, a room to one's self being the ideal Unfortunately, many would-be experimenters are handicapped here, and there appears no way out of this difficulty, as to experiment, one must have a fairly large amount of apparatus. Some of this can be mounted vertically on walls, etc., but the majority should be kept horizontal. A long table being very useful.

In the writer's set (up to 5 valves) the three-coil holder and the standard honeycomb coils have been installed for induction, anode, etc. Of course, there are many other methods, solenoid, basket, slab, variometers, vario-couplers, etc., but the writer's chief experiments consist in valve-crystal circuits, dual amplification, and reaction, and as experiments at present do not cover the various methods of tuning, the honeycomb coils have been installed as standard. The reader is urged to confine his experiments to one or two particulars, and not to attempt to experiment with everything in general, otherwise I am afraid the work would prove fruitless.

How to Employ Reaction.

Firstly, all the apparatus for the work has been built or installed on the "unit" system. Each particular piece of apparatus being an entirely separate "unit," *i.e.*, condensers, fixed and variable, transformers, filament rheostats, valves, etc., etc. It would be impossible in this short space to describe fully each piece of apparatus, but a brief description of some of the more important would perhaps prove useful to any who are about to commence experimenting in valve and crystal circuits.

It will be found very useful to bring the aerial lead-in direct to a plug, sockets for the reception of same being placed in any convenient position, thus allowing a number of circuits to be tested comparatively. One of the sockets should be connected directly to earth. This will prove a useful earthing method for the aerial. Perhaps the first unit in the receiving set is the A.T.I. with the A.T.C., with a series-parallel switch. As (with the exception of very unusual circumstances) this will not be altered in any arrangement of circuit, it is well to connect this permanently. The apparatus consists of an ·001 variable condenser, ·00005 Vernier condenser, and a D.P.C.O. switch, preferably of the Dewar anti-capacity type, although other types are suitable. These should be mounted in one panel. The Vernier condenser is connected permanently in parallel with the ·001 A.T.C., and has been proved to be a very useful adjunct to fine tuning, the series-parallel switch being, of course, almost a necessity for reception of any quality over a large range of W/L.

Another useful addition for the experimenter is a D.P.C.O. switch in the reaction circuit, enabling reaction coil to be coupled either to the anode coil or transformer, in the case of H.F. amplification, or to the C.C.I. It is, as is well-known, essential that the reaction coil should not be coupled to the C.C.I. during broadcasting hours on W/L's. between 300 and 500 metres, otherwise interference might be caused should the coupling be too tight, but there is no reason why this valuable help should be discarded when listening to the broadcast programmes, as by switching over to the anode coil all P.M.G.'s restrictions are immediately complied with. Indeed, in a report of a certain wireless society a few weeks back, the writer noticed that it was claimed a full 20 per cent. increase in signal strength when using reaction coupled to the anode coil.

Use of Switches.

Another refinement, enabling greater ease in tuning, will be found in a D.P.C.O. switch in the closed circuit, giving a change over from the C.C.I. to A.T.I., generally known as a "tune standby" switch. The experimenter will find that a number of D.P.C.O. switches very useful, especially for cutting out valves, variety of circuit, etc. The writer has mounted six of these switches on an ebonite panel, each switch being complete with six terminals. This may seem to some a somewhat bulky piece of "gear," but its value and adaptability will be easily understood by all serious experimenters.

All variable condensers of like capacity are mounted together, with the exception of the A.T.C. before mentioned. A useful variety is as follows:

3, ·0005, 1 for C.C., and 2 for 2 stages of H.F., presuming transformer method of coupling be adopted.

2, ·0002 for 2 stages of H.F., presuming the tuned anode method of coupling be adopted.

1, ·00005 Vernier for fine tuning across reaction coil.

It will be found almost indispensable for the experimenter to have the choice of at least the two foregoing methods of H.F. coupling, resistance capacity coupling also being very useful on long waves.

To Avoid "Howling."

Fixed condensers are mounted on one panel, each being brought to two terminals, with the capacity marked on the ebonite. Two ·001, two ·002, and one ·005 will be found very useful. The grid leak and condenser is mounted in an entirely separate panel, with a three-way switch, enabling the grid leak to be placed in a variety of positions as required, and by this piece of apparatus comparative tests can easily be made with the grid leak in various positions, one side, of course, being permanently connected between the grid condenser and the grid of the detecting valve. Four filament rheostats are mounted on a panel, each being supplied with two terminals. The valve holders, five for valves and two for "plug-in" type transformers, are mounted on a long panel, each holder being supplied with four terminals. The majority of L.F. transformers can be mounted direct without enclosing in panel, but unless they are screened with an iron jacket it is advisable to place them a reasonable distance apart, otherwise a slight howling might be experienced.

By this brief description the reader will easily be able to follow the general idea of the station. Any variety of combinations, with any number of valves, providing there is sufficient apparatus, can be easily connected up. Ordinary bell wire, or 24 D.C.C., will be found quite suitable. Different colours being kept for certain circuits will prove helpful for locating faults, if any. Of course, it is essential that wires be kept as far from parallel as possible.

Some might think that the result of external wiring might be very unsightly, looking rather a "glorious muddle" and a maze of wires, but with careful working the result will be quite neat, and the advantage of the "unit" system, especially to the experimenter, will be very much appreciated.

Broadcasting—a boon to the hospitals and the deaf.

LOOKING AHEAD.

By C. L'ESTRANGE MALONE, F.R.Ae.S., etc.,
CHAIRMAN OF THE EXECUTIVE COMMITTEE OF THE RADIO ASSOCIATION.

WE live in an age of inventions and scientific development, of which part is detrimental and part is helpful to human progress. The advent of broadcasting is definitely one of those achievements which can be an asset to civilization, which will help to bring mankind together, and will have great influence in moulding the structure and the quality of our society. But in this country, at any rate, it is still in its infancy.

In America there are ten receiving sets where there is only one over here. There are no licences and there are no royalties. At least 73 newspaper offices alone have their own broadcasting stations. Large stores, business houses, hotels, and private companies also transmit.

Whilst England has been slow in starting, America has gone a little too fast; but the organisation is settling down. There is now less overlapping and jamming.

It is probable that in Great Britain, when the boom has passed, when all stunts have become commonplace—politics, business, sport, religion, education, etc.—when saturation point has been reached, and the curve of sales has flattened down, the monopoly will break up, and individual groups will apply for broadcasting transmitting licences.

The number of persons whose incomes exceed £500 a year in this country is 563,000. The number of persons whose incomes exceed £400 a year is 743,000. Here, then, is something definite to work on.

Adverts in Ether.

The managing director of the British Broadcasting Company should study the latest report of the Commissioners of Inland Revenue, together with the latest census of industry, and he will there find out where potential subscribers are to be found, and what their particular interest is. Outside enthusiasts should also be enlisted. I should like to see all the provincial radio societies conducting a "national radio week." Such a campaign would arouse widespread interest, and introduce radio into homes which otherwise may long have a vacant place for a receiving set.

The advertising question has also got to be considered. Artistically handled, it should produce a revenue for the B.B.C. without giving offence to the radio enthusiast. The advertising agent who can offer the maker of any household article five minutes "broadcast space" has got talking points galore, and can sell his "space" like hot cakes.

In a year or two there should be wonderful developments and applications, and much experience will be available. We are not far off the day when it should be possible, by a mere turn of the knob, to tune in the House of Commons, the Law Courts, or a football match.

For good or for evil, according to the scheme in the minds of those who are controlling our destinies (so far as broadcasting is concerned), Radio telephony is going to have a great effect on society. Politics, expressed through the radio instrument, will be one of the most important factors.

We have to rely, now, on the Press for reports of important speeches made by our great political leaders. Such reports, clipped, distorted and shaped according to the fancy of each newspaper, give but a mere travesty of the original.

The Mother of Parliaments, the House of Commons, is unknown to all save a few, a very few, of the electors who send men and women to represent them there. The public galleries are so hopelessly inadequate that there are invariably long queues waiting for admission. It should be possible to arrange that, when the House is sitting, important debates are broadcast—perhaps on a special wave-length. For the convenience of those who cannot keep continuous attention, but who wished to chip in and keep up the thread, an interjection, say every fifteen minutes, would be put in, giving the subject of the debate and the name of the speaker, thus: "Debate on Ireland, Mr. Lloyd George speaking." Broadcasting applied in this way to political life would do much to quicken the interest of our people in Parliament.

Radio Election Meetings.

Apart from actual parliamentary broadcasting, I hope that the foreign and home news which we get in the evening bulletin will be considerably amplified. The news bulletin is one of the vital factors of broadcasting.

Broadcasting will also play a very important part during a General Election. Anyone who has fought an election, knows the difficulty of getting round to address all the meetings that he should do.

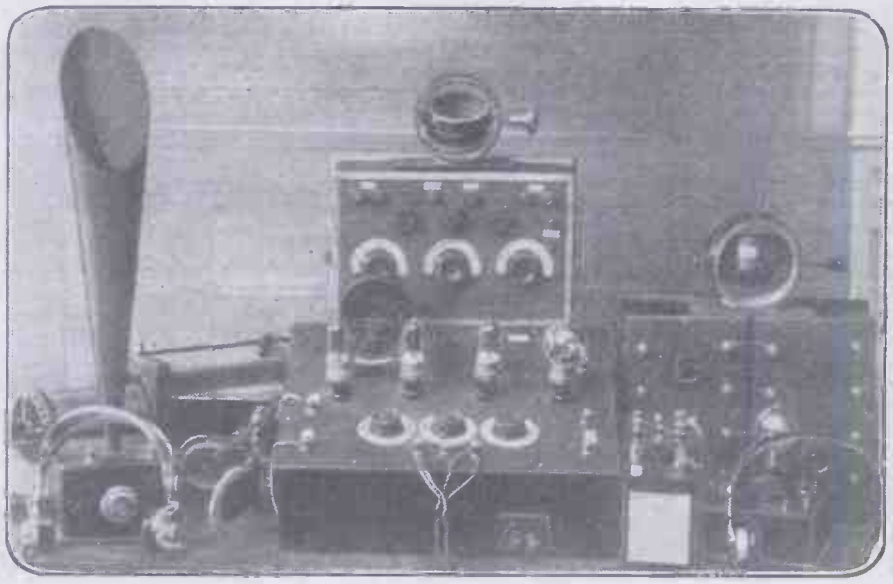
By broadcasting from his central committee rooms, not only can the candidate address meetings in every ward or parish by using "loud speakers" in suitable halls, or on motor-cars at street corners; but also individuals with their own receiving apparatus will be in direct touch with the candidate, and can form a considered judgment at their own fire-side.

Speeding Up Trade.

Again, every candidate hopes to get one of the "big guns" of his party to come down and speak in his constituency during the election fight. Of course, the "big gun" can only visit very few constituencies in the limited time; but, whilst they in person can only visit very few places, in future their voice can be heard appealing in every constituency.

. . . . . .

In all quarters of the commercial world, time and efficiency are the most important factors. Starting at the top, in the realms of high finance, the use of the telephone and telegraph are vital factors. The introduction of the ordinary telephone, operated by the old-fashioned land-line, and functioning through series of exchanges and relays, and through different countries where the exchange operators spoke different languages was nevertheless a revolution.

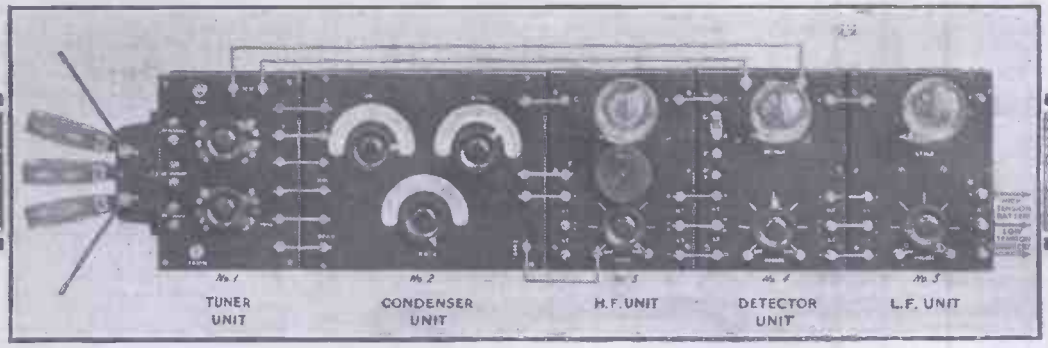


Home-made gear by a Stoke-on-Trent wireless amateur.

The office of a big city firm dealing in arbitrage, foreign exchanges, etc., is full of weird and wonderful machinery. Perhaps four operators are required. Imagine them sitting at a table. At each end are private telephone switchboards connecting up with other offices of the establishment, with other brokers' offices, and with the principal banks. Between two of the operators is an arbitrage calculating machine. Time is vital, and the telephone is used tremendously.

The application of the radio telephone will result in a still further acceleration of business. Market reports, the city column, the exchanges, will be available to all who require them over the country.

In more parochial business life, the radio weather reports are already of value to agriculturists. Also the dissemination of prices of different commodities has a levelling down effect, and tends to prevent profiteering.



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On these Units Experimenters can easily tune out their local broadcasting Station and pick up any other

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IT is quite easy for those who use Peto-Scott Standardised Radio Units to tune their Sets to a very fine degree of selectivity. This is due to the unique design of the Tuner.

This Tuner makes use of a loosely coupled Circuit—now recognised as the **only** Circuit for selective Tuning—but in order that Tuning can be performed easily, a rotary switch is incorporated which changes the Circuit automatically from a Double Circuit to a single one for broad tuning.

To use it, set the switch to the Single Circuit and when you have tuned in your Station, throw in the Secondary Circuit and **tune out** any unwanted Station.

Could anything be easier or more efficient?

In this Standardised Unit System—at a cost of but a few shillings—you can add a H.F. Amplifier which makes use of a choice of **three** different couplings without a single alteration of wiring No. Tuned Anode (probably the most efficient yet discovered) interchangable Transformer, or resistance capacity can be added at a moment's notice.

There are many other advantages but space here is too limited—certainly no other Valve Receiving Instruments allow such flexibility no matter how much you pay.

Send 6d. to-day for a copy of "Radio" showing how each Unit functions and how it can be built up at home.

PRICE LIST OF SETS OF PARTS.

No. 1.	Tuner Unit ..	27/6
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Mahogany Cabinets to fit Nos. 1, 3, 4 and 5, 3/6. To fit No. 2, 7/-

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WIRELESS CLUB REPORTS.

The Editor will be pleased to publish concise reports of meetings of Wireless clubs and associations, reserving the right to curtail the report if necessary. Hon. secretaries are reminded that reports should be sent in as soon after a meeting as possible. Reports sent in cannot appear in this paper in less than ten days after receipt of same. An Asterisk denotes affiliation with the Radio Society of Great Britain.

The Beckenham and District Radio Society.

The exhibition of members' and trade sets organised by the Beckenham society was a good success. Many good ideas were to be found by a careful perusal of the home-made variety. The trade apparatus, loaned by Messrs. Buchanan & Curwen, also had some very fine sets on view. During the evening a number of selections from the Broadcast programme was received on a four-valve set owned and constructed by one of the members. Members are reminded that the new headquarters is at the Hut, High Street, Beckenham.

Sec., Mr. J. F. Butterfield, 10, The Close Elmers End, Beckenham.

St. Albans and District Radio Society.

The St. Albans and District Radio Society was formed on February 27th, 1923, and will all those interested who reside in the district communicate with the hon. sec., J. H. Holderness, 8, Westview Road, St. Albans, Herts."

Exeter and District Wireless Society.

At a meeting of the above society at 31, Longbrook Street, Exeter, on February 19th, a very interesting lecture and demonstration on "Bridge and Megger Testing" was given by Mr. Parkhouse. After a brief description of the Wheatstone bridge and its uses, Mr. Parkhouse went on to describe the Megger with regards to the testing of insulation and conductivity. By means of the megger which Mr. Parkhouse brought with him, the insulation of the society's aerial was tested. Several members brought their grid leaks to be tested. Various questions were asked, and an interesting discussion followed.

Hon. sec., F. S. Valentine, 10, College Avenue, Exeter.

Paddington Wireless and Scientific Society.

The last general meeting of the above society was held in the Physics Theatre of the Paddington Technical Institute on the evening of February 1st, and the attendance exceeded that of any other meeting, inasmuch as forty-three out of a possible fifty were in attendance.

Dr. J. H. Vincent, M.A., D.Sc., M.I.E.E., was in the chair, our president, Mr. A. G. Cooke, M.A., A.M.I.E.E., being unable to attend.

Designs for the society's apparatus were submitted by Messrs. Beal and Turton, and volunteers were forthcoming to commence building.

A few words by the hon. sec. on what he had seen on his recent visit to Northolt Wireless Station brought to a close a very enjoyable evening.

Communications to hon. sec., L. Bland Flagg, 61, Burlington Road, Bayswater, W. 2.

St. Bride Radio and Experimental Society.

A very interesting and instructive evening was spent by members of the above society on Wednesday evening, 21st inst., when the president, Capt. H. Riall Sankey, C.B., C.B.E., R.E. (Ret.), M.Inst.C.E., occupied the chair. The proceedings opened with an admirable lecture by the president, in which he explained in non-technical language the rudiments of wireless telephony. The lecture was copiously illustrated by lantern slides and blackboard diagrams.

This was followed by a short demonstration and general meeting, when the Formation Committee gave an account of their stewardship; draft rules of the society were submitted to the meeting and approved; permanent committee and officials elected; and meeting nights arranged alternate Mondays at 7.30 p.m., commencing March 5th.

At the conclusion of business a hearty vote of thanks was accorded the president, followed by further selections from 2 L O and enrolment of new members, of which quite a number were received.

Visitors and prospective members will be cordially welcomed at any of the meetings of the society.

RADIOTORIAL

All Editorial Communications to be addressed The Editor, POPULAR WIRELESS, The Fleetway House, Farringdon Street, London, E.C.4.

It is very likely that a third class of licence for the amateur who wishes to make his own receiver will shortly be issued by the Post Office, as consultations have been held recently between officials of the British Broadcasting Co. and the General Post Office. Unofficially, I hear that this new class of licence will be issued to amateurs at the usual fee of 10/-.

It is expected that the B.B.C. will receive a royalty on the chief component parts sold by wireless dealers. Whether this plan will be eventually adhered to I cannot say, but on the face of it I can hardly credit it being accepted by any of the parties concerned.

If all component parts are to be stamped with the B.B.C. stamp and the purchaser to pay a royalty on them, then there will be considerable cavilling between manufacturers and the public as to what really constitutes a bona-fide wireless component part.

For instance, a rotary switch arm need not necessarily be for wireless gear. Neither need a resistance switch. Nor need a condenser, for that matter.

In fact, there are very few component parts in wireless apparatus which can be definitely classed for use in wireless and wireless alone.

It would seem to me that the best course is to charge a higher fee for the home-made set licence.

However, doubtless all these little points will be thoroughly cleared up when the new licence is issued.

In the meanwhile, I should like to draw the attention of my readers to some of the difficulties which lie in the way of the B.B.C., and of which, until a few days ago, I was ignorant.

I should like readers of POPULAR WIRELESS to know that the task of choosing selections for the programmes to be broadcast from the various B.B.C. stations is rendered all the more difficult by the worries of copyright fees, and publishers' rights.

Many readers have probably noticed in the press recently that the gramophone companies have warned artists who have contracts with them that they will not be allowed to broadcast by wireless, and that if they do so they will be sued for breach of contract.

This is, again, one of the many stumbling blocks that beset the path of the B.B.C., but it is hoped a compromise will shortly be effected.

That the B.B.C. will win out in the end I have not the slightest doubt. They represent a young and ever-increasing industry, which is an essential and integral part of the progressive age in which we live.

That there will be serious competition there can be no doubt. But without competition there is no incentive, and readers may rest assured that, from what I hear, nothing will stop the B.B.C. from ever striving to give their very best to listeners-in. So long as the listening-in public do their fair share, by paying the legitimate licence fees and royalties on their sets, which, after all, are absurdly small, there is no reason why the B.B.C. should not revolutionise modern amusements.

THE EDITOR.

Questions Answered

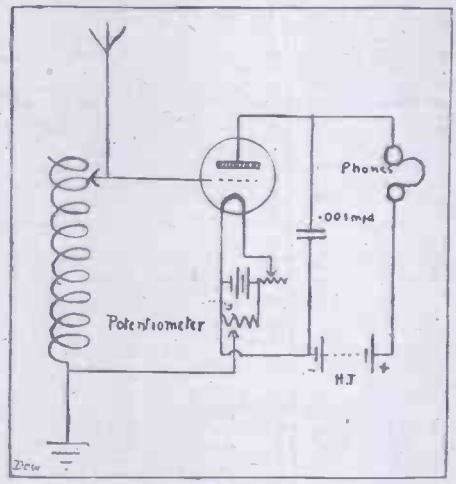
Owing to the enormous number of queries received daily from readers of POPULAR WIRELESS, I have temporarily decided to limit the number of questions sent in by one reader to three. Readers are asked to keep their questions as short and as concise as possible in order that the minimum of delay can be exercised in answering queries. Until further notice three questions from one reader will be the limit for one letter. All questions should be addressed to POPULAR WIRELESS Queries Department, Room 138, Fleetway House, Farringdon Street, London, E.C.4.

Readers are requested to send the necessary postage for reply..

The Editor desires to direct the attention of his readers to the fact that, as much of the information given in the columns of this paper is of a technical nature and concerns the most recent developments in the Radio world, some of the arrangements and specialities described may be the subject of Letters Patent, and the amateur and trader would be well advised to obtain permission of the patentees to use the patents before doing so.

T. N. (Bridlington).—How can I apply a grid control to my single valve set instead of a grid leak and condenser?

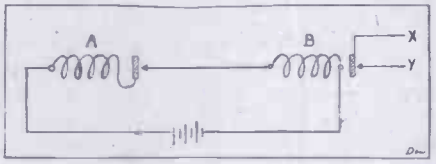
See the accompanying diagram. You will observe that the potentiometer is placed across the L.T. battery, and it will be as well to try the effect of reversing this latter until the best effects are noted. By doing this you will not need to alter the wiring of the panel—just change over the leads of the actual accumulator.



* * *

O. R. (Cardiff).—Can I arrange a crystal set so that I can receive C.W. signals without using the armature of a direct current breaking buzzer to break the circuit?

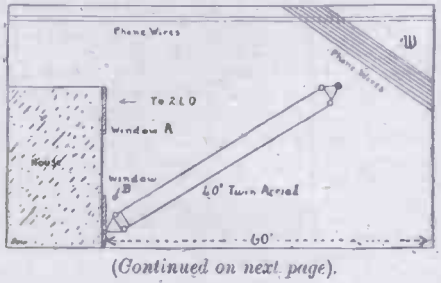
You can do so by inserting in series with a buzzer another magnetically operated make and break in the manner depicted in the accompanying diagram. A good plan is to place both buzzers in a casing of soft iron, with just the contact of the aerial circuit breaker projecting in order to minimise the direct effects of induction from the buzzers. In the accompanying diagram you will notice that the second buzzer must make and break the circuit across X and Y simultaneously with the make and break of the other buzzer, because this makes and breaks the circuit actuating the second buzzer, as the coil of this latter is placed in direct series in the circuit. X and Y are the breaking points of the aerial or receiving circuit.



* * *

H. C. (Leytonstone).—I enclose a rough diagram illustrating the unfortunate position in which I am placed with regard to telephone wires. Diagonally across the corner of my garden you will notice a large "bunch" of these wires, whilst along the side of the garden run two more; moreover along the front of the house there is the electric tramway. Where would be the best position to erect an aerial?

The best plan will be to erect the aerial diagonally, and to take the lead-in into the window marked B, although we would not like to guarantee that in the circumstances you will be free altogether from interference.



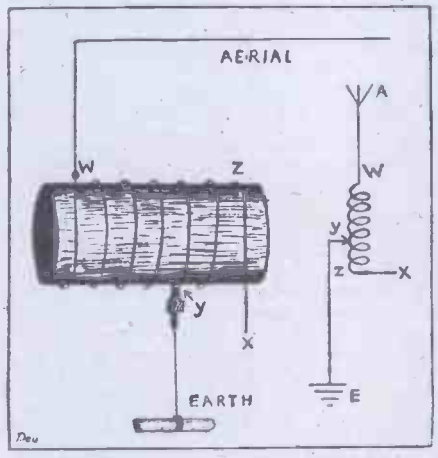
(Continued on next page).

RADIOTORIAL QUESTIONS AND ANSWERS.

(Continued from previous page.)

T. H. (Manchester).—What exactly is meant by "dead-end" effects, and how does it affect reception ?

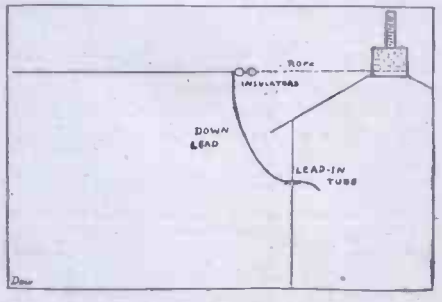
Dead-end effects are caused by the turns on an inductance coil that are not actually in use. These turns are electrically connected with those turns that are in use, and therefore cause an unwanted capacity effect. This can best be illustrated diagrammatically. Note in the accompanying diagram a simple aerial-coil-earth circuit is shown both pictorially and theoretically. It will be noticed that with the sliding contact in the position Y as shown the open aerial oscillatory circuit consists of the aerial, the coil from the points W to Y and the earth. At the same time the turns of wire from Y to the end of the coil marked X are electrically connected to those turns in use from W to Y, and therefore will have the effect of increasing the self capacity of the coil. This is, of course, an undesirable factor, and prevents one easily tuning or rather efficiently tuning down to the lower wave-lengths.



* * *

"BEGINNER" (Colchester).—I have fastened my aerial to the chimney on the top of the house, but in order to bring the lead-in into the house it is necessary to come over the edge of the roof. How should I arrange this ?

The best plan will be to make up that portion of the horizontal length between the edge of the roof and the chimney with rope, so that the down lead can be taken from the aerial right by the insulator down to the point of entry into the house, and so will clear the edge of the roof. Should this tend to considerably shorten the aerial so that the length of rope employed for this purpose approximates to the length of the horizontal wire, then it will be better to dispense with the rope, run the horizontal aerial wire right up to the insulator near to the chimney, and take the down lead from the centre of the aerial. This would make it a "T" aerial, which is very efficient where the two "arms" or lengths running each way from the point to where the down lead is connected are of exactly equal dimensions.



* * *

E. T. (Crouch End).—Is the resistance of a wire directly proportional to its length and thickness ?

Hardly, but take a conductor of uniform gauge, and, disregarding temperature effects, its resistance will be directly proportional to its length, but inversely proportional to its sectional area. In a nut-

(Continued on page 276.)

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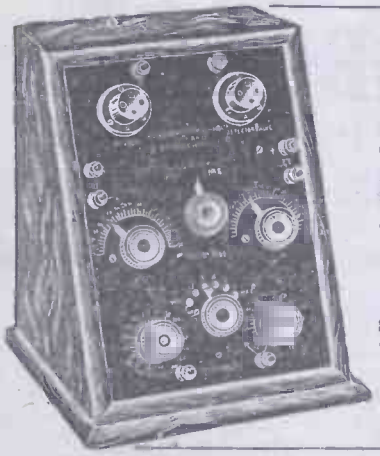

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RADIOTORIAL QUESTIONS & ANSWERS.

(Continued from page 274.)

shell its resistance will depend upon its dimensions, composition, and temperature, and the thinner and longer it is the greater will be its resistance.

Supposing I have a wire of a certain thickness, say 50 mils, and 5 yards in length, which on test gave the same figure of resistance as another wire, say, two yards long, would it be possible, mathematically, to work out the thickness of the shorter wire?

Quite possible—we will give the working of the example you quote, although it may be rather difficult to follow if you are not fairly well up in the mathematics of electricity. Take L to represent the length of the wire, D the diameter, and R the resistance, then $L1 : L2 :: R1 : R2$ and $(D2)^2 : (D1)^2 :: R1 : R2$, therefore $L1 \times (D2)^2 : L2 \times (D1)^2 :: R1 : R2$ since $R1 = R2$, then $L1 \times (D2)^2 = L2 \times (D1)^2$, that is $2 \times 50^2 = 5 \times (D1)^2$, and therefore

$$(D1)^2 = \frac{2 \times 50^2}{5} \text{ and } D1 = \sqrt{\frac{2 \times 50^2}{5}} \text{ i.e. } 31 \text{ mils approx.}$$

* * * *

F. B. (Leyton).—Some little time ago you gave me the formula

$$\frac{A \times K}{T} \times 000{,}000{,}224{,}6$$

for finding the capacity of condensers T being in inches. Can you tell me how the formula was derived, as I have been told that it is incorrect?

The formula was obtained as follows.

$$K \text{ (absolute electro static units) equals} = \frac{AK}{4\pi T}$$

I absolute electro-magnetic unit of capacity equals V^2 static units where V is numerically equal to the velocity of light, 300,000,000 metres per sec.

10^{15} mfd = 1 absolute electro-magnetic unit of capacity.

$$\therefore K \text{ in mfd} = \frac{AK \times 10^{15}}{T \times 4 \times 3{\cdot}1416 \times 3^2 \times 10^{20}}$$

$$= \frac{88{\cdot}42\,AK}{T \times 10^9} \text{ A and T being in cms.}$$

$$= \frac{88{\cdot}42 \times 2{\cdot}54^2 \times AK}{T + 2{\cdot}54 \times 10^9} \text{ where A and T are in inches.}$$

The rest is obvious.

* * *

P. T. D. (Basingstoke).—Is the resistance of a wire the same for direct current as it is for high-frequency alternating current?

No, the resistance varies according to the frequency of the alternating current. If we take R as the resistance of the wire to direct current, then its resistance to high-frequency currents will be found by

$$R_f = R\left(1 + \frac{1{\cdot}121}{10^5}n^2r^4 - \frac{1{\cdot}007}{10^{10}}n^4r^8\right)$$

Where r is the radius of the conductor in cms, and n is the frequency of the current, R being its resistance to ordinary direct current.

RECENT WIRELESS INVENTIONS.

The following abstracts are published by arrangement with our Patent Adviser, Harold J. C. Forrester, Chartered Patent Agent, of Jessel Chambers, 88-90, Chancery Lane, W.C.2.

Grant of the following Patents can be opposed, and printed copies of the full specifications, with drawings, can be purchased from the Patent Office, Chancery Lane, W.C. 2.

192,090.—WESTINGHOUSE ELECTRIC AND MANUFACTURING CO.—RECEIVING APPARATUS.—Relates to a receiving system having a back-coupled valve oscillated by received impulses and choked by negative charges accumulating on the grid. The choking is controlled according to the intensity of received impulses by causing them to apply a biassing voltage to the grid. The detecting valve may have its plate circuit reactively coupled and its grid circuit completed to the filament through an inductance adjustably coupled to the aerial circuit and a grid leak and condenser. Control is provided by an inductance, adjustably coupled with the aerial circuit, and connected in circuit with a rectifying valve and the grid leak.

In a modification, the two valves may be combined into one, by providing an additional grid, which acts similarly to the plate of the rectifying valve.

192,133. BRITISH THOMSON-HOUSTON CO.—DUPLEX TELEPHONY.—For receiving and transmitting simultaneously, the aerial is coupled to a closed oscillatory circuit, and made resonant to two different frequencies—one for transmission, and the other for reception by a tuned detector.

Transmission currents are further prevented from affecting the detector by a closed circuit, containing a variable transformer and phase adjuster, inductively coupled with the detector and transmitter circuits.

192,140.—H. ST. J. de A. DONISTHORPE.—VALVES.—The grid is helical, and a current is passed through it, which produces a magnetic field which counteracts mutual repulsion, and prevents spreading of the electrons.

192,272.—J. F. SUTTON.—INDUCTANCES.—Coils having spaced turns wound in layers, with the turns crossing at an angle to give a lattice formation, have the wires arranged to follow sine curves.

We have arranged for Patent Enquiries addressed to our Patent Adviser to be answered direct by post, any enquiries of general interest being also answered in our columns.

R/R

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Ewell. *J. L. S.*

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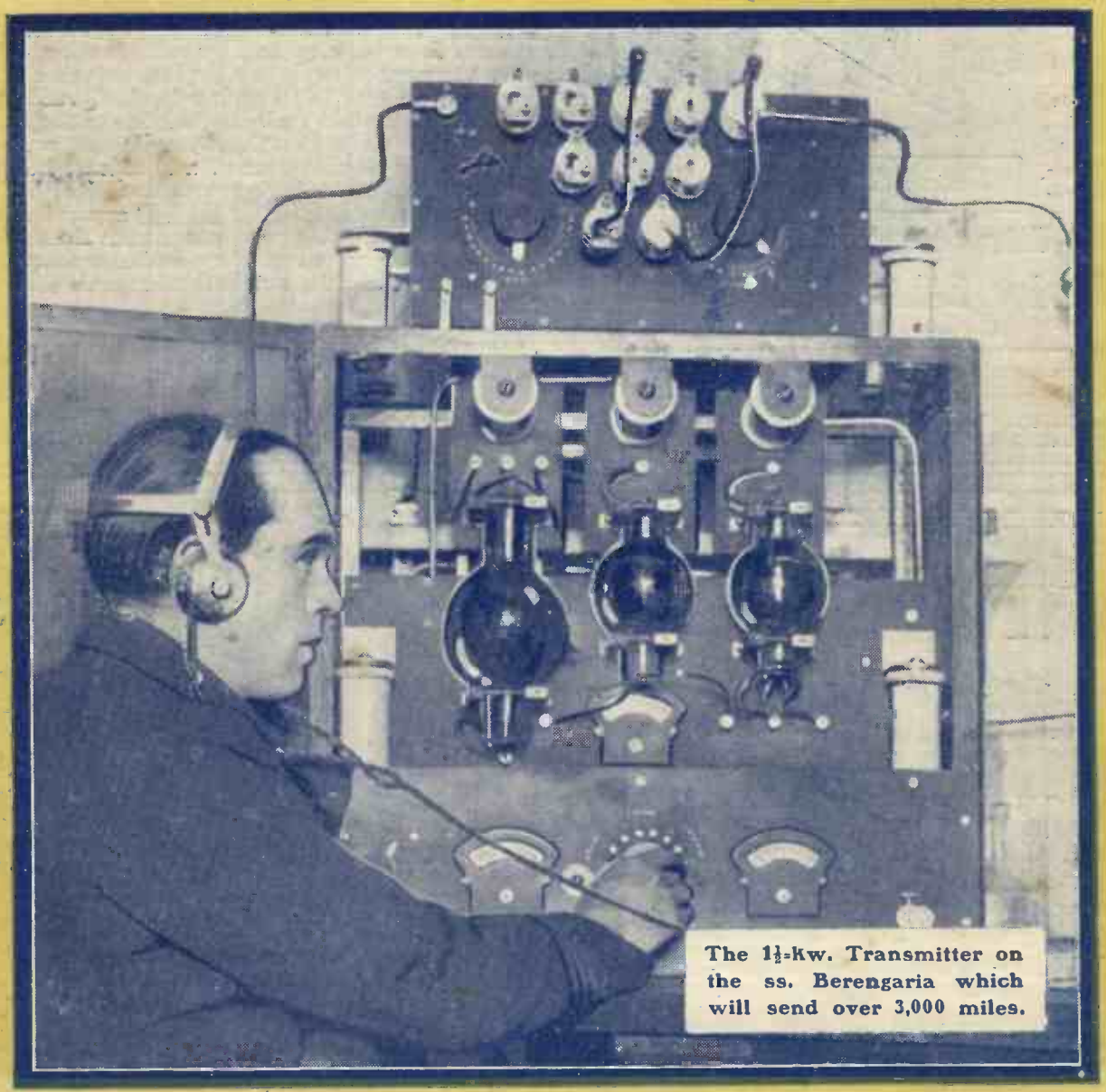
R/R

POPULAR WIRELESS WEEKLY, APRIL 14th, 1923. REGISTERED AT THE G.P.O. AS A NEWSPAPER.

DISTORTING INFLUENCES IN WIRELESS.

Popular Wireless

No. 46. Vol. III. PRICE THREEPENCE WEEKLY. April 14th, 1923.



The 1½-kw. Transmitter on the ss. Berengaria which will send over 3,000 miles.

FEATURES IN THIS ISSUE.

POPULAR WIRELESS

April 14th, 1923. SCIENTIFIC ADVISER, SIR OLIVER LODGE, F.R.S., D.Sc. [Every Friday

TOPICAL NOTES AND NEWS.

A First Night.

I HEAR that on April 16th, Act 2 of "Battling Butler" will be broadcast from 2 L O. The other evening the B.B.C. broadcast for the first time in history a "first night" performance, "Marriage by Instalments." The only drawback was the fact that we had the play, also, in instalments, but that's only a pathetic attempt to try to be funny. Seriously, though, the transmission was O.K. Let's have some more of a like ilk.

* * *

New Musical Director.

I HEAR that Mr. Stanton Jefferies has been appointed musical director of the B.B.C., and that in future he will be in charge of the musical items of all the B.B.C. stations. This does not mean, however, that provincial stations will not be allowed to exercise their own ideas in arranging the musical part of the programme. Mr. Jefferies is out to encourage initiative all he can, and I wish him the best of luck.

* * *

An Uncontrollable Factor.

A SCHEME has been evolved for the employment of the broadcasting stations at certain hours during the day for communicating with the moving motor vehicles belonging to the larger road transport companies. It is suggested that arrangements should be made with the Post Office so that telegrams addressed to motor vehicles could be handed in at any post-office and forwarded to the most convenient broadcasting station. On paper, the idea might seem quite workable, but there is one uncontrollable factor to be dealt with, and this is the time factor in the transmission of land line messages. Electricity might travel many thousands of miles per second, but I somehow am inclined to think that a motor vehicle—even a ten-ton lorry—would reach its destination before any special telegram. Anyway, neither the B.B.C. nor P.O. have yet been approached with regard to this scheme.

* * *

Centralising Broadcast Programmes.

NOT many listeners-in in the Manchester area are aware of the fact that at times they are listening to the London and Birmingham broadcasting stations' concerts which are received on a special receiving aerial and re-transmitted by the Manchester station. The success of such experiments, which have been conducted several times, indicates that there are great possibilities of the practicability of such a scheme whereby only one broadcasting station—say, at Birmingham—would be necessary, the other stations acting merely as relays. Thus the B.B.C. would be able to concentrate on such a centralised programme, and the best of the leading artists could be engaged. I need hardly dwell on the advantages of such an arrangement, as they are more than obvious.

* * *

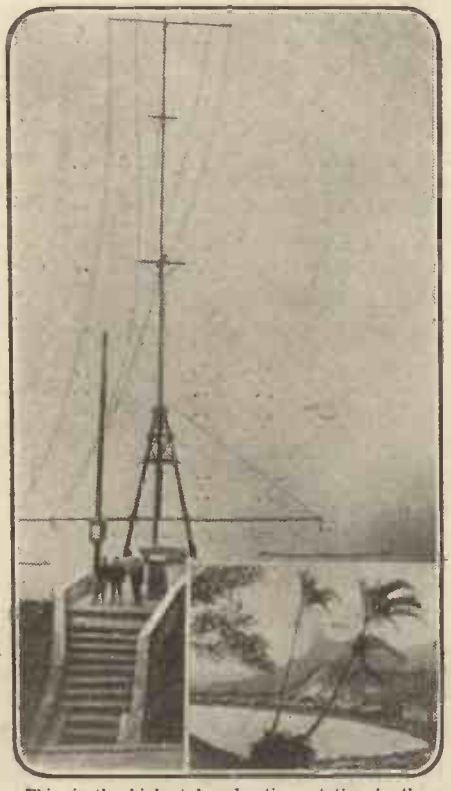
The Children's Hour.

I AM glad to learn from Captain Eckersley, who is now in charge of the children's hour from all the broadcasting stations, that he intends to thoroughly reorganise this part of the evening programmes. I understand that both the tiny tots and the older kiddies will be catered for, and that the items will be more varied in nature. The material for these will be distributed to the various stations in advance.

* * *

Controlling a Battleship.

THE possibilities of wireless control in naval warfare were strikingly shown in recent manœuvres of the United States fleet. The battleship Iowa, steaming full-speed without a soul on board, was made to simulate an enemy vessel attempting to escape the fire of the battleship Mississippi. The Iowa was steered by radio from the shore several thousand yards away, and was at all times perfectly under control.



This is the highest broadcasting station in the world, being 2,175 feet above Boteford Bay Station, which is now operated as a feature of the Brazilian Centennial by the Westinghouse Electric International Company, which broadcasts Grand Opera direct from Rio de Janeiro.

* * *

America's Silent Nights.

"SILENT NIGHTS," inaugurated in Chicago, when local wireless broadcasting stations forego the presentation of programmes, have resulted in many feats of long-distance reception.

A plan whereby "silent nights" would be adopted by broadcasting stations throughout America is being discussed. Under this plan stations in a certain district would not broadcast on Monday night, another district would not send on Tuesday night, and so on throughout the week. In this way the entire country would have a silent night once a week.

* * *

Aerials Across Streets.

FOUR applications were received by Newcastle Corporation Town Improvement Committee for permission to allow wireless aerials to cross public streets in different parts of the city, but they were all refused on the ground that, should the wires break, they might be a source of danger to the public.

* * *

Warning to Motorists.

THERE seems to be quite an epidemic of petty pilfering by people obviously wireless enthusiasts. Receivers and wire have disappeared in alarming quantities from public telephone call-boxes, and a motorist dare not leave an inch of copper wire exposed when he leaves his car momentarily unattended. I, personally, witnessed the lamentations of a holiday motor-cycle tourist who was stranded in a lonely Devonshire village with his motor-bike, minus all its H.T. cable and rear and headlight wiring, and this occurred during just a few moments' call at the village inn. Unfortunately, I could not help him, except with six inches of H.T. cable, by shortening my own. I left him stringing hairpins together and insulating the resultant "cable" with valve rubber, spare tyre patches, and perfectly good three-halfpenny stamps.

* * *

P.M.G. and "Home-made" Sets

POSSIBLY, by the time these words are read, Sir William Joynson-Hicks, the Postmaster-General, will have announced his decision in regard to that problem of the hour, the question of the home-made set. The other day he received a deputation representing 4,000 manufacturers of wireless apparatus.

(*Continued on next page.*)

NOTES AND NEWS.

(Continued from previous page.)

The Shysters.

AS a Business Nation—are we narrow-minded? Upon my soul, I am almost inclined to believe so when I hear all this talk about broadcasting doing the theatres harm. Where is the imagination of our theatrical magnates? Are they so despondent about the quality of shows they put on that they don't like the idea of them being broadcast? Read the following, which I clipped from the "Daily Mail" the other day:

"Opera companies and theatres give broadcasters every facility, as they also have profited immensely from the publicity accorded their performances by radio. The Manhattan Opera House (New York City), for instance, was playing to half-filled houses until the management permitted one of the large stations to broadcast 'Tristan and Isolde.' The very next evening the house was filled by owners of receiving sets and their friends."

* * *

Over There and——

IT is estimated that the "invisible audiences" of the United States number 20,000,000. Throughout the country more than 600 broadcasting stations are in operation. The authorities have licensed 25,000 owners of sending sets. The owners of receiving sets require no licence as in Great Britain; but it is known that they exceed in numbers the 14,000,000 people who subscribe to the telephone or 12,000,000 who possess motor-cars or lorries.—"Daily Mail."

* * *

Over Here.

ALTHOUGH it is estimated that there are about 200,000 listening-in sets in use in the country, less than half of these are licensed. If these figures are correct, the first year's loss to the Broadcasting Company is more than £60,000 and to the Government £25,000.—"Daily Mail."

* * *

Another Stunt.

THE "Daily Express" had a loud shout the other day about the Broadcasting monopoly. This paper wants the P.M.G. to select "ten firms of repute," etc., to run broadcasting, and offers to do the trick itself for nothing. If the latter suggestion was adopted, the "D. E." would simply be cutting its own throat as regards a monopoly. As for the poor news bulletin, the daily press are to blame for that. Their objections to a full broadcasting news service are well known.

The attitude of POPULAR WIRELESS in this attack on the B.B.C. is given on the Club Reports page.

* * *

Great Tenor at 2 L O.

ONE of the most enjoyable items that I have yet listened-in to was the recent broadcasting from the London station by Mr. Mischa-Leon, the great operatic tenor who has just returned from Prague. A wonderful voice most wonderfully suitable for wireless transmission was the opinion of everyone who listened-in on this occasion.

Marconi's Cruise.

SENATORE MARCONI will have probably set sail on his yacht Elettra for an extended cruise by the time these words are read. He intends carrying out a series of experiments connected with the problems of interference, and will doubtless have some interesting results to show when he returns.

* * *

Various Items.

DURING the concert at the Albert Hall to-morrow, Saturday, Madame Lily Payling will visit the London Station, broadcast a song which will be reproduced at the Albert Hall by means of loud speakers, and then return to conclude the concert in person.

* * *

The Yorkshire and District Electric Lamp Repairing Co., Ltd., ask me to point out that they are the actual repairers of broken valves. Their agents are Messrs. G. W. I., Ltd.

* * *

Will the amateur who wrote to the Editor saying he had heard V T C (Basra) on a crystal set come and have lunch with me one day. I do admire imagination.

To Assist Progress.

WITH a view to exploring the possibilities of developing wireless telephony over long distances, the Postmaster-General has appointed a Committee "to consider in the light of recent progress in wireless science the possibility from a technical standpoint of transatlantic wireless telephony of sufficient reliability for commercial use, and to advise what practical steps, if any, can at present be taken to develop this means of communication." The Committee will be constituted as follows:—

ADMIRAL of the FLEET SIR HENRY JACKSON, G.C.B., K.C.V.O., R.N. (chairman); MAJOR-GENERAL SIR F. H. SYKES, G.B.E., K.C.B., C.M.G., M.P.; Mr. R. A. DALZELL, C.B.E., Director of Telegraphs and Telephones, General Post Office; PROFESSOR W. H. ECCLES, D.Sc., F.R.S.; Mr. F. GILL, O.B.E., president of the Institution of Electrical Engineers; Mr. E. H. SHAUGHNESSY, O.B.E., Engineer in-Chief's Department, General Post Office; with MAJOR A. G. LEE, M.C., of the Engineer-in-Chief's Department, as secretary.

ARIEL.

Broadcasting Programmes

What you can hear every evening of the week on your set.

TELEPHONY AND MUSIC TRANSMISSIONS

Station.	Call sign.	Wave-length in metres.	Remarks.
London Broadcasting Station, Strand ..	2 L O ..	369 ..	11.30 to 12.30 every morning and usually every evening, 5 to 5.45 p.m.; 7 and 9.30, News; 7.15, Orchestra; 8.25 to 10.30, Music. Sundays from 8.30 p.m.
Newcastle Broadcasting Station	5 N O ..	400 ..	As a rule from 7 to 10 p.m.
Manchester Broadcasting Station	2 Z Y ..	385 ..	Every evening usually from 4.30 to 10 p.m.
Birmingham (Witton) Broadcasting Station	5 I T ..	425 ..	Every evening usually from 6.30 to 10 p.m. (News, Concerts, etc.).
Glasgow Broadcasting Station	5 S C ..	415 ..	5 to 10 p.m.
Cardiff Broadcasting Station	5 W A ..	353 ..	5 to 10.30 p.m.
Croydon	G E D ..	900 ..	Throughout day to aeroplanes
Paris	F L ..	2,600 ..	11.15 a.m., Weather Report; 6.20 to 7 p.m., Weather Report and Concert; 10.10, Concert.
Königswusterhausen ..	L P ..	2,800 ..	4 to 6.30 p.m.
The Hague	P C G G ..	1,085 ..	Sundays, 3 to 5 p.m. (Concert).
Haren	O P V H ..	1,100 ..	12 noon and 4.50 p.m. Telephony.
Radio-Electrique, Paris	—— ..	1,565 ..	5.5 p.m., News Items; 5.15 to 6.10, Concert; 8.45 p.m., News Items; 9 to 10 p.m., Concert.
School of Posts and Telegraphs Paris ..	—— ..	450 ..	Every Tuesday and Thursday, 7.45 to 10 p.m. Saturdays, 4.30 to 7.30 p.m.

Note.—See announcements in daily Press for last minute alterations in times of Broadcasting Programmes. No Broadcasting during hours of public worship on Sundays.

NOTE.—The Bar Lightship, Liverpool, sends telephony at 7 a.m., 9 a.m., 11a.m., 12 noon, 1 p.m., and every two hours until 9 p.m. Calls "Dock Office" Liverpool answers "Bar Ship."

In addition to the regular transmissions carried on between the British amateur stations, much telephone conversation may be heard from St. Inglevert (A M), Le Bourget (Z M), and Brussels (B A V). These stations are quite powerful, but they call for a little extra care in tuning. Wave-length, 900 metres.

All times given at G.M.T.

SOME DISTORTING INFLUENCES IN RADIO-BROADCASTING.

By Dr. N. W. McLACHLAN, M.I.E.E. (of the Marconi Research Works, Chelmsford).

Each week I hope to publish special articles for the advanced amateur and experimenter. Further articles by Sir Oliver Lodge, and contributions by Major-General Squier, Dr. Lee de Forest, and others, will shortly appear.—THE EDITOR.

THE object to be attained in the complete system of a broadcasting transmitter and receiver is a linear control. That is to say, if the musical sounds have a certain wave-form before broadcasting, the sounds issuing from the reproducing device at the receiver should have the same wave-form, but, in general, a different amplitude. Owing to the fact that the currents in the various parts of the system depend upon the frequency, the intensity of a sound in the receiver will vary according to its pitch, although in the concert-room all the notes sound equally loud. This means that if a curve is plotted showing the relation between frequency and output intensity for equal input intensity, it will take such a form that it will be evident that both the higher and lower musical tones are reduced considerably in comparison with those in the middle register.

Action of Diaphragms.

In speech and in music, it is the upper tones which determine the interpretation of the sounds, and are responsible for their discriminating properties. Thus a system whose complete characteristic is akin to that shown by such a curve will give distortion, and the sounds will be muffled owing to the dearth of higher harmonics.

Telephonic systems can be severely tested when reproducing the jingling of coins, the high notes of a violin or piano, the high hiss of the sibilants, drums and the clapping of hands. Some good test words are, "sink," "ships," "five," "thrive," "invaluable," "Mississippi," "thistle."

We will now indicate briefly the chief causes of this effect of selectivity. The first instrument in which this occurs is the microphone, and it is a property peculiar to all vibrating systems. In a microphone the vibrating member is usually a circular diaphragm. When reproducing the piano, the action on the diaphragm is a percussive or impulsive one, and in addition to reproducing particular pianoforte notes, the diaphragm superimposes a vibration of its own. The frequency of this vibration depends upon the diameter, thickness, and material of the diaphragm, and is known as the resonant or free note of the diaphragm. For example, in a telephone receiver, this resonant point occurs at about 800 cycles per second.

Superimposed Frequencies.

Usually iron-cored transformers are employed between the microphone and transmitter to step up the voltage of the microphonic currents. The windings of these transformers have both inductance and capacity, and will exhibit the same phenomenon of resonance as a telephone diaphragm at a certain frequency. This will again introduce the problem of selectivity, and, in order to obtain approximately uniform transforming action over the audio-frequency range, a damping or high-resistance rod should be connected across high-inductance windings.

In the transmitter itself, the main oscillator is usually coupled to the aerial, and it is well known that since any wireless circuit can be tuned, it exhibits the phenomenon of resonance to which we have just alluded. Now, when the carrier wave is modulated by the currents induced in the microphone system, there are two additional high-frequency oscillations created for each audio-frequency component of the sound. If the carrier wave has a frequency of 750,000 cycles per second, and one of the audio components has a frequency of 10,000 cycles, the frequencies of the two additional vibrations will be 750,000 – 10,000 and 750,000 + 10,000. There are thus three high-frequency oscillations associated with each tone in a musical sound. If the tuning of the transmitter is very sharp, there will be a reduction in the intensities of the two side frequencies, and the degree of reduction will increase with increase in the frequency of the musical sound. The ideal selectivity curve of the transmitter will clearly cause no reduction in intensity; that is, the musical scale will be uniform. The selectivity or resonance curve should, therefore, have a flat top over the range 740,000 to 760,000—that is, a compass of 20,000 cycles.

Distortion due to Rectification.

In the receiver there is also a series of tuned circuits, and these circuits should, therefore, not be too selective. Much has been written on the subject of reaction, and we are now in a position to examine why it causes distortion in radio-telephony. The chief object of using reaction is to receive signals with the least number of valves. When reaction is not employed, more valves are required, owing to the comparatively large resistance of the receiving circuit. The effect of reaction is to reduce the resistance and therefore the damping of the receiving circuit, so that currents due to the feeble influence of the electromotive forces in the aerial are comparatively large. When the resistance of an oscillatory circuit is reduced considerably, as is the case when reaction is employed in a high degree, the resonance or selectivity curve of the circuit becomes very peaked, and the top of the curve is far from being flat. Bearing in mind that we ought to be able to receive equally well a band of frequencies from 740,000 to 760,000, it is clear that with a highly selective circuit this is impossible, and the higher audio frequencies in speech and music which are responsible for their interpretational qualities are reduced to such an extent that the sound is muffled and hollow.

In all receivers there is incorporated a rectifier. Let us see what distortion may arise from the operation of rectification. We have already shown that a musical sound in radio-telephony consists of a very large number of high-frequency vibrations on each side of the carrier wave. During rectification, the heterodyning effect which takes place between these frequencies themselves, and between them and the carrier wave, creates, in addition to the original musical frequencies, a whole host of others. These others represent double the frequencies of the components of the musical sounds and their sums and differences. The proportion of these alien frequencies to those from which they are produced depends upon the degree of control applied to the oscillation valves of the transmitter—*i.e.*, the depth of modulation. If this exceeds a certain amount, the sounds produced in the telephones or loud speaker are particularly distressing.

Moderation of Signal Intensity.

Passing from the rectifier to the speech magnifiers, there may be distortion caused by iron-cored transformers due to resonance effects in the windings, but the remedy for this disease has already been cited. A further source of distortion may be due to the use of unsuitable valves, and the variation of voltage on the grid of the valve may be such that it reaches its rectification and saturation boundaries. A valve should always be worked on the sensibly straight portion of its characteristic curve. Valves used for speech amplifiers should, therefore, be capable of dealing with a comparatively large voltage variation on the grid without rectifying or saturating.

In either H.F. or L.F. amplifying valves it is eminently desirable to avoid a current from the grid to the filament during operation. When this occurs, the valve acts partially as a rectifier, and the wave form of the incoming oscillations is altered. To obviate "grid current," as it is termed, the H.T. voltage should be increased, and a suitable negative potential applied to the grid of the valve.

The final source of distortion to which we will refer is inherent in the telephones or loud speaker. In treating microphones and tuned circuits, we have already shown that the response or amplitude of the vibration depends upon the frequency. This is also the case in all the usual forms of telephones and loud speaker. With almost all varieties of loud speaker, the best quality is obtained when the intensity is moderate. When the sounds are very loud, the effect is to introduce in the loud speaker, owing to the large movement of the vibrating system, tones which are not present in the incoming radiation.

Regarding Linear Control.

In a loud speaker there are other sources of distortion due to the horn and to the influence of the room where the reproducer is situated. In conclusion, considering the question of distortionless reproduction, *i.e.*, linear control, it is essential to distort the input at the transmitter in such a manner that the selective influences which operate throughout the complete system apply the necessary degree of correction. At the moment there is no system which will give perfect linear control—*i.e.*, there is no perfect system—but the timbre in the telephone or loud speaker, although somewhat different to that at the input, can be made comparatively pleasing, and the pleasure is enhanced if the issuing music is taken at its absolute value, and the hearer is not absorbed in making mental comparisons between it and the original.

A NEW USE FOR FOUNTAIN PENS.

If you have any old parts of fountain pens, this article will tell you how they can be made to serve several useful purposes in your wireless set.

ONE can nearly always find an old decrepit fountain-pen "knocking around" at home, and it can be used for many pieces of wireless apparatus, where insulation is required, fountain-pens being made of a highly insulating material. Here are a few suggestions.

An excellent lead-in tube may be constructed from the barrel of a fountain-pen,

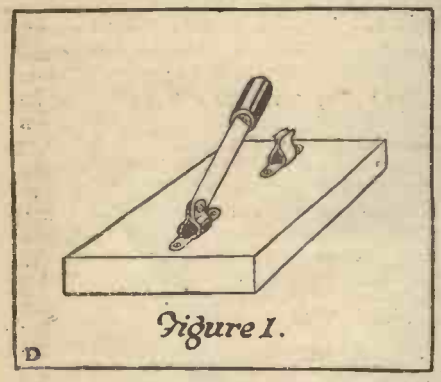


Figure 1.

when the closed end has been either cut off or drilled through.

Switch Handles.

Fig. 1 shows a simple home-made knife switch, the handle of which is the cap of a fountain-pen. The method employed to fix on the handle is to make a plug of soft wood to fit inside the cap; then split the

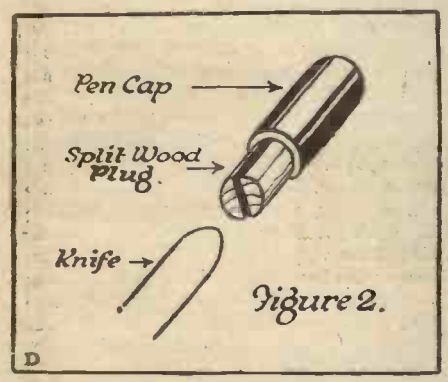


Figure 2.

plug of wood longitudinally and push in the knife of the switch between the two halves of the plug. Fig. 2 shows the way this is done, quite clearly. If necessary, shellac or seccotine can be used to keep the plug firmly fixed.

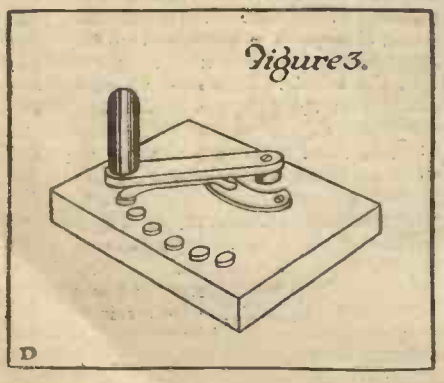


Figure 3.

Fig. 3 shows a stud switch, of the simple form described in No. 12 of POPULAR WIRELESS. The base is of ebonite, and so the arm may be of hard wood. The handle of this is a fountain-pen cap, plugged with soft wood, and is fixed to the arm by a slender brass screw passing up through the arm and into the plugged cap. The screw expands the wooden plug slightly, and in consequence, the pen cap is gripped perfectly rigidly in its place. The whole of the construction of this switch may be clearly seen from Figs. 3 and 4.

Contact Sliders.

Fig. 5 shows a fountain-pen cap made into a contact slider for a cylindrical inductance coil or resistance. For this a good fat solid fountain-pen cap is necessary, with a

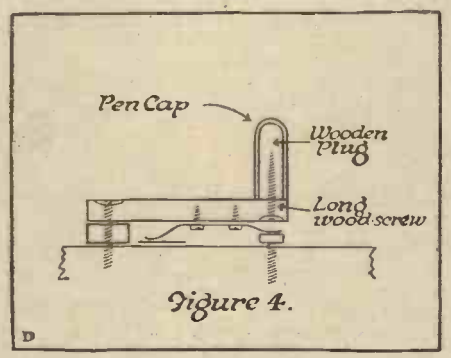


Figure 4.

diameter of not less than ½ inch, if the slider rod to be employed is of a ¼ inch square section. If a large-enough cap is unprocurable, a thinner rod may be employed, say $\frac{3}{16}$ inch square section. The square hole through which the rod passes is made by drilling two holes in the pen cap directly opposite each other; then gradually widening them with a file into the requisite square shape. The plunger is a piece of circular brass rod of suitable size to slide easily within the pen cap, the end with which contact is to be made being fashioned slightly convex.

The assembly is shown sectionally in Fig. 6. The plunger makes contact with

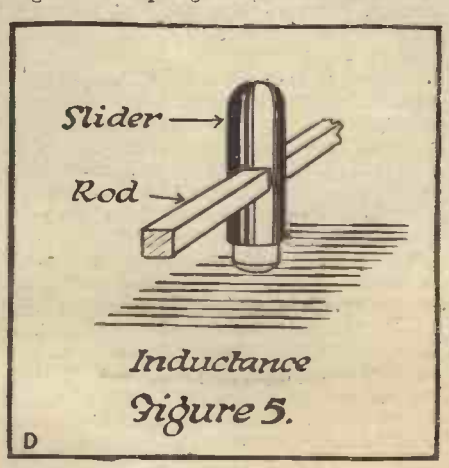


Figure 5.

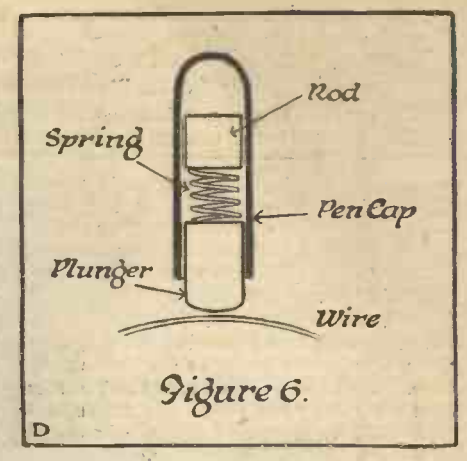


Figure 6.

the wire on the inductance; the plunger is kept pressed on to the wire by a strong spring, which makes contact with the plunger and the rod going through the slider. No fixed dimensions are given, these being determined by the amateur to suit his own apparatus or fancy. This remark also applies to the other apparatus here described.

Extended Controls.

Fig. 7 shows a very effective and easily made extension handle, for the accurate control of condensers, slab-coil inductances used in holders, etc. The drawing is self explanatory and needs no further comment.

In manipulating the vulcanite, a sharp knife or a file may be used for trimming, and a hack-saw for cutting. Great care is necessary, as the vulcanite is very liable to crack.

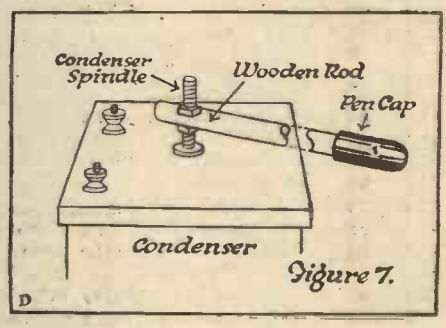


Figure 7.

Writing for "P.W."

If you contemplate writing articles for "Popular Wireless," make sure that your themes are bright, generally useful, and as original as possible.

Short constructional articles and details of interesting experiments are well paid for if accepted for publication; good, clear photos, the larger the better, are also welcome, and will be paid for at the rate of 10s. 6d. if published in "Popular Wireless."

Diagrams accompanying articles may be drawn in rough in pencil; our draughtsman will do the rest.

If articles are not typed, only ONE SIDE of the paper used should be written on.

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A UNIT BROADCAST RECEIVER.

By H. G. HERSEY (Member of the Wireless and Experimental Association).

Further comprehensive details are given in this article for the construction of a complete Broadcast Receiver. All the apparatus described by Mr. Hersey has actually been made and tested before being described in these articles.

Part II.—THE DETECTOR PANEL AND TELEPHONE TRANSFORMER.

FOLLOWING on from the last article, in which details were given for the construction of a broadcast tuner, I am now about to describe a single-valve detecting panel for use with the tuner. This panel will be a simple detector built upon standard lines, and to be used at the present stage without reaction, although reaction terminals are provided in order

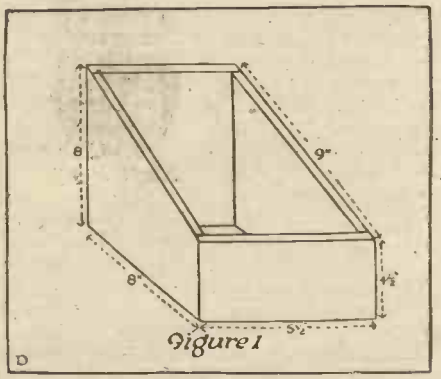


Figure 1

that we may make use of it a little later on, when a high-frequency valve is placed before the detecting valve; also, it will be useful should the panel be used for the reception of long waves where reaction is allowed directly coupled to the aerial circuit. When used as a detector only, without reaction, the reader is advised to use a fairly soft valve.

The Filament Resistance.

In order to match the tuner and present a neat appearance, the panel cabinet should be built upon similar lines, although it is admitted a considerable amount of space will be left beneath the ebonite front. This is, however, unavoidable in order to bring the panels upon the same level, and the space will be required when dealing with the high-frequency panel. The cabinet should be built up in accordance with Fig. 1 from some suitable wood, and then well papered and polished or stained, etc.

A piece of ebonite 5½″ by 9″ by ¼″ is next purchased, and marked out as in Fig. 2. The panel should be drilled around the edges for the ten terminals, the holes drilled being in size according to the type of terminal used by the reader. In the position "A" four holes should be drilled to take the pins from the valve holder, the latter being secured to the panel by the nuts provided upon the pins. If the type of holder with a flange be purchased, it should be secured to the panel by three screws and nuts passed through the flange and the panel. A filament resistance, skeleton form for panel mounting, is next required. This should be mounted in the position "B."

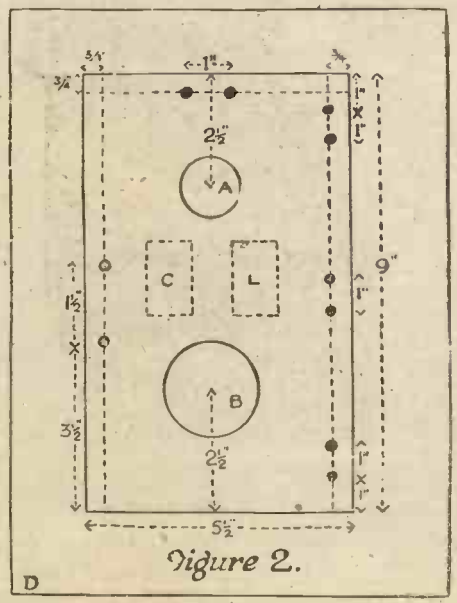


Figure 2.

Mounting Incidental Parts.

The most convenient type available consists of the usual circular spiral resistance in an ebonite groove, the spindle from the contact arm being passed through the panel in order to mount the same. The ebonite knob and pointer should first be unscrewed. The spindle is now passed through a hole drilled in the panel. The ebonite of the resistance is now screwed permanently to the panel by two screws provided for the purpose, passed through the panel from the front. The knob and pointer may now be replaced upon the spindle, and, should the reader so desire, a scale may be fitted.

The grid leak and grid condenser call next for consideration. For the former the reader may purchase a leak and two brass clips, or he may construct the leak according to instructions given in previous articles in POPULAR WIRELESS. If the leak be purchased, the reader may either mount it upon the top side of the panel to come midway between the valve holder and the filament resistance, or under the panel in the position "L." When mounted above the panel, between clips, the reader has the option of trying various leaks with different valves. Should the leak be made up upon slate pencil, it should be clamped against the under-side of panel by a strip of fibre and two screws.

Grid Condenser.

The grid condenser is the next component for mounting. The condenser, about ·0002 mfd., may be purchased in a neat ebonite mould ready for mounting, or it may be made up upon the lines described recently in POPULAR WIRELESS. When ready, the condenser should be mounted under the panel in the position "C." The ten terminals should now be screwed to the panel in the positions shown in Fig. 2.

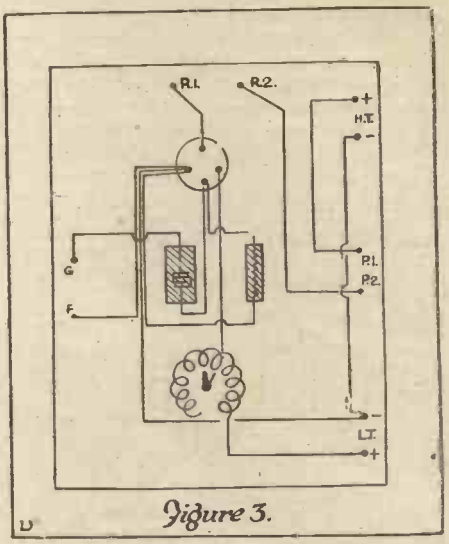


Figure 3.

The panel is now ready for wiring. The wire used should be about 22 or 24 S.W.G. copper wire, and if covered with coloured systoflex will present a very neat appearance, and the insulation be the best. The low tension side should be wired first.

From LT solder a lead to filament resistance. From resistance spindle to right-hand filament leg of valve holder. From LT to left-hand filament leg. Place a valve in position and connect up LT terminals to accumulator. All being well, the valve should light up and be adjustable by the resistance. HT—and LT—should now be connected together.

Continuing the Wiring.

From the plate leg of valve holder a lead is taken to terminal R1. From R2 take a lead to P2, and from P1 to HT, completing the HT supply circuits. From the grid leg take two leads, one to the grid condenser and the other to the grid leak. From the other side of condenser take a lead to terminal "G." From the other side of leak take a lead to the negative filament leg. The grid leak, you will

(*Continued on next page.*)

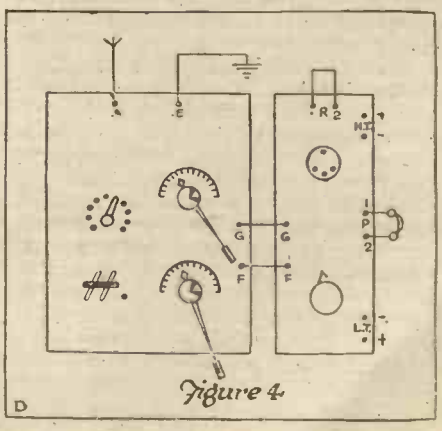


Figure 4.

A UNIT BROADCAST RECEIVER.

(Continued from previous page.)

observe, is placed between the grid and the filament direct, and not across the grid condenser, as is usual. This is because, in a later article, a high-frequency tuned rejector circuit is to be employed, and the HT through the rejector coil would place a high positive potential direct through the leak on the detecting valve grid.

This panel, used as a simple detector, should have the terminals R1 and R2 shorted by a piece of wire. They are

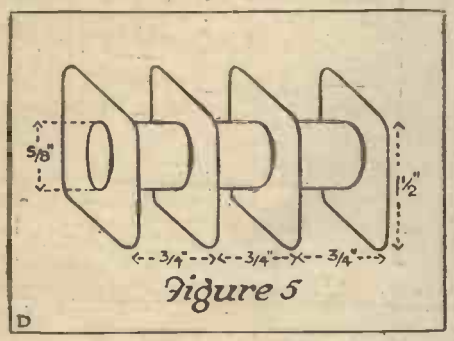


Figure 5

provided for reaction to be introduced at a later stage. The panel, now completely wired, should be screwed to the cabinet by counter-sunk screws around the edge. The panel should be connected to the tuner as per Fig. 4. This detector, being standard as regards connections, may be used in any circuit where a detector is required.

Telephone Transformer Construction.

With the telephones connected direct in the HT circuit, certain disadvantages appear; more so should your phones have faulty insulation, for you may experience nasty shocks when touching terminals. Capacity effect is most pronounced, also, when you place your hands or body nearer the instruments. Again, a steady plate current, although small, passing through the telephones, will, if connected the wrong way round for polarity, tend to decrease the strength of the magnets, thereby decreasing the efficiency of the phones.

Where valves are used, I always advocate the use of a telephone transformer. This may be of various ratios, according to the resistance of the phones in use. For all-round purposes, I have found a telephone transformer constructed upon the lines of the ex-service transformers most useful, the ratio being 2-1 step down. Readers unable to obtain one of these from the various disposals stores may make the transformer up in the following manner.

A former in which to wind the wires should be made up according to Fig. 5. There are three sections, the centre to be secondary and the two outside to be the primary. The former should be made of cardboard, the flanges which form the partitions being glued and the whole waxed with paraffin wax. The reader should next purchase a small quantity of No. 42 S.W.G. D.S.C. wire. A short length of rubber-covered flex should be soldered to the fine wire for the inside connection, and placed in the centre of the first section, leaving several inches to spare. The end may now be bent over the flange out of the way of winding.

Now wind on as near as possible in layers the wire until the section is almost full, and solder a length of flex, binding the latter to the coil and leaving a few inches protruding for connection. Continue in the same manner to wind the centre section and the other outer section, winding each section in the same direction and noting the inside from the outside ends of each winding. The two outside sections should now be connected together in series by connecting the outside end of the first section to the inside end of the last section, or vice-versa. The connection should be soldered and well-insulated with tape. The two centre coil ends should now be marked in some way to denote them from the other pair.

A quantity of soft iron wire, about 28 to 30 gauge, should be purchased and cut into 4½ inch lengths. These are placed through the centre of the coils, the coils being first well-bound with waxed tape. The ends are now bent over as the inter-valve transformer described in POPULAR WIRELESS, page 813, No. 35. The transformer may now be bound with tape and mounted in a suitable cabinet with ebonite top and four terminals. The approximate resistance of this transformer is primary 2,000 ohms, secondary 1,000 ohms.

FRAME AERIALS.

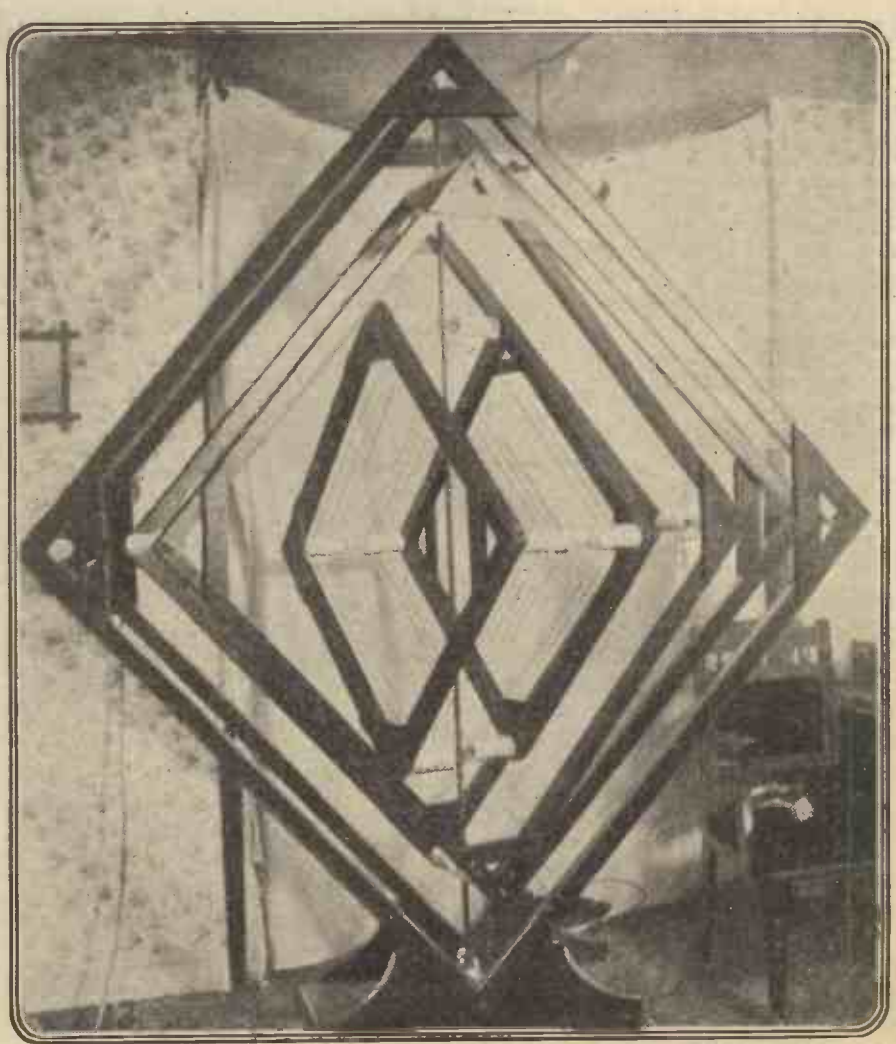
By C. ERIC EXLEY.

WITH this frame aerial, and using only three Marconi panels, Nos. 3, 4, and 5—that is, one H.F., one detector, and one L.F., I have been able, in Hull, to receive telephony broadcasted from London, Manchester, Birmingham, and Cardiff.

The large outer frame is mounted on a base board 2 ft. square, and revolves on casters; the two smaller inner frames are seated on pins and washers, attached to a central iron rod. By this means each frame rotates independently of the other, and the two inner frames can be completely taken out in less than one minute.

On the large outer frame there are four turns of wire, and on the two inner frames eight turns. The outer frame is coupled to the primary circuit, and the other two to the secondary and reaction. Height of frames over all, 7 ft. 9 in.; width, 6 ft. 6 in.; length of sides of outer frame, 5 ft.; the two inner ones, 3 ft. 10 in. and 2 ft. 6 in. respectively.

If any readers would care to communicate with me at Sunny Bank, Hull, I should be pleased to hear and receive their comments on this frame and the results which I have received.



The frame aerial constructed by Mr. Exley and described in the article above.

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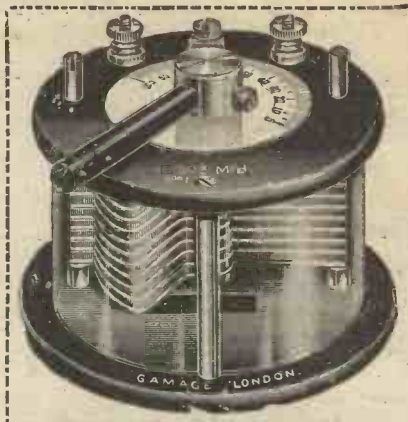

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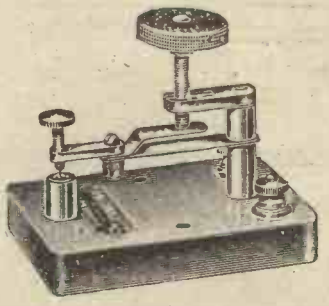

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Low-frequency intervalve transformer is for use when signals require amplifying by a valve. The primary is connected in the plate circuit of a rectifying valve, and the secondary across the grid and filament of a valve used as an amplifier. It may be used as the initial transformer, or between the valves in a low-frequency amplifier. A two-valve low-frequency amplifier would require two of these transformers in the ordinary way, or one only if the valve receiver used in conjunction is provided with an amplifying valve. The windings and general manufacture are the outcome of much experimental work, and their efficiency cannot be improved upon.

Mounted in polished mahogany container, filled with best paraffin wax thereby insuring perfect insulation. Core of best quality stalloy iron. This type is specially recommended. Size 3½ by 2½ by 3 ins. Price **25/-**

ROTARY POTENTIOMETER

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FIRST IN 1908 **GAMAGES, HOLBORN, LONDON, E.C.1.** FOREMOST TO-DAY

LOOKING AHEAD

THE QUESTION OF RELIGION AND BROADCASTING

By C. L'ESTRANGE MALONE, F.R.Aë.S., etc.
(Chairman of the Executive Committee of the Radio Association).

THE question of religion and broadcasting is most engrossing, its possibilities are so numerous, its scope is so wide.

There are certain material reasons which account for the fact that such a large proportion of people never go near a church. There is the trouble of getting to and from church, the trouble of getting up and dressing on Sunday morning—a morning often set apart for a licenced "lie in"; many might wish to hear a sermon, but do not like to sit through a service in that particular church or chapel, or there are others who do not care for the preacher in the only church of their denomination within reach.

So the Sunday broadcast sermon will fill a great gap, it can reach every home. It can be heard by everyone who for whatever cause, cannot get to church. But as the "broadcast congregation" will include members of almost every known creed, the utmost care must be taken as to what is broadcasted.

Detecting the presence of dirt by using wireless valves and telephones

Christianity Without Sectarianism.

There is a great move amongst the different churches for a reunion. The broadcast pulpit can well be arranged so that the sermons preached and the doctrines propounded are purely Christian, and of as undenominational and non-sectarian nature as possible. The director of programmes of the B.B.C. should get into touch with the leaders of the wonderful movement which is known as the Christian Conference, which is presided over by the Bishop of Manchester.

The churches might say that broadcasting will keep the congregations from coming to church. It will not. It will reach a far wider field, a field untouched at present; it will reach people who do not dream of going to church to-day. There is too much in the ritual. in the building, in the atmosphere which cannot be transmitted by radio, and therefore radio is an addition and not a substitute to the churches.

Loud speakers ought to be fitted in every church and chapel so that congregations can listen to preachers of renown who are so sought after that they cannot possibly undertake all the engagements they are invited to. The bishop of the diocese, or even the archbishop, can be brought into closer touch with the people. If this is done, so far from depleting the churches, broadcasting will provide new life and vigour.

The advent of radio telephony is one of the greatest developments reached in the cause of humanity and real Christianity.

Broadcasting and the Press.

One of the biggest developments in the future is along educational lines. Broadcasting has now reached a point of reliability that there need be no hesitation in scheduling lectures to be given by radio. I expect that before very long it will be possible to make some arrangements whereby universities and colleges will find it their duty to broadcast extension courses which will encourage home study.

Broadcasting is the most serious challenge to the power of the Press that our present day newspaper magnates have ever experienced.

Man requires to know what is going on in the world around him. This information is collected by the reporter, telegraphed or posted to the newspaper office, passed by the staff, sub-editor and editor. Then comes a long and expensive mechanical process before the news item reaches your breakfast table in a presentable form.

Meanwhile the news is getting stale.

All this mechanical process, this expense and delay is rendered unnecessary by broadcasting the news.

Fresh from the reporter, checked and censored by the editorial staff, the news can go at once into the ether.

Much of broadcasting work is essentially journalism pure and simple. Broadcasting can only be a success by making use of the years of experience which has raised modern journalism to its present position.

The Press organisations can only retain their influence by adapting themselves to modern inventions. Worked in conjunction with each other both will enlarge their scope.

As I have already said, it is very unlikely that the present arrangements whereby the whole monopoly for broadcasting rests in the hands of a single group will continue for very long. Sooner or later the important London dailies will have their own transmitting arrangements. In the United States of America at least seventy-three journals have their own stations.

An efficient news agency or newspaper needs to have built up behind it a world-wide organisation. Will the B.B.C. attempt to build up such an organisation?

I doubt that any page in a modern newspaper in this country is more widely read than the sporting page. Much of this interest is due to what is termed the Englishman's love of sport, much is due to "economic" considerations. Broadcasting will never appeal to certain sections of the community unless the world of sport is fully dealt with.

Radio Sporting News.

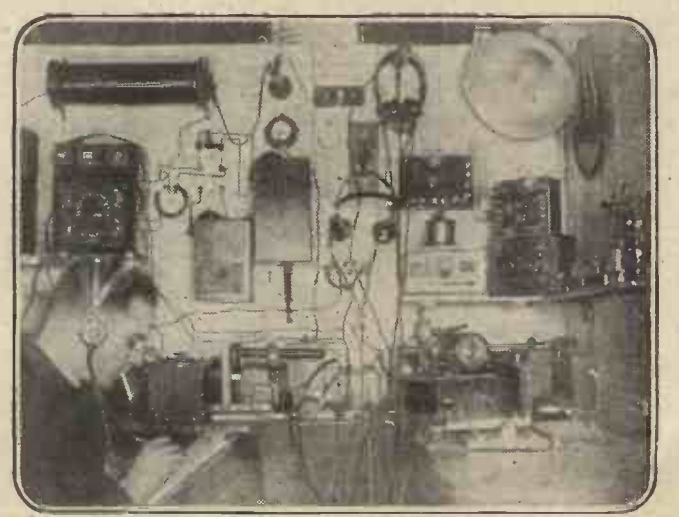
I look to the time when all important sporting results will be "put into the ether."

It is not the bare results, or even the half-time scores, which will be given, but a whole match or race can be followed and so much local colour given that you will be almost compensated if you lose.

A microphone will be connected by land-line to the nearest transmitting station. A master of ceremonies will be near the touch-line with the microphone.

He will tell us when the team come on to the field, who they are, why someone is not there, who the substitute is, and where he has played before. He will describe the kick-off, he will let us follow the ball closely, he will describe a brilliant run up by Jones, who was unfortunately tackled and brought down by the famous back, Brown, of the other side; we shall actually hear the whistle of the referee, we shall hear some shouts against the referee's decision, we can almost imagine that we see the trys obtained and the goals scored. Special microphones placed round the stadium will enable the master of the ceremonies to switch on when necessary the roars of the vast cup-tie crowd, and finally perhaps we shall hear the speech of the Prince of Wales when he presents the cup.

Again, if we cannot get down to the Derby, let us hope that a representative of the director of programmes will be there. Here, too, he can send us a very vivid picture of the scenes from the Downs leading up to his first bulletin from Tattenham Corner.



Mr. W. Scott Hay's experimental station, Barrhead Road, Renfrewshire, Scotland

A HISTORY OF WIRELESS TRANSMISSION.

BY SEXTON O'CONNOR.

PART 2 (Conclusion).

BEFORE leaving the spark systems mention must be made of the "quenched" gap, or "singing" spark system so called because of the peculiarly penetrating quality of the emitted note as heard in the receiving phones.

The chief object in "quenching" is to make each spark last for as short a time as possible. In the first place this allows a greater number of discharges to be fed

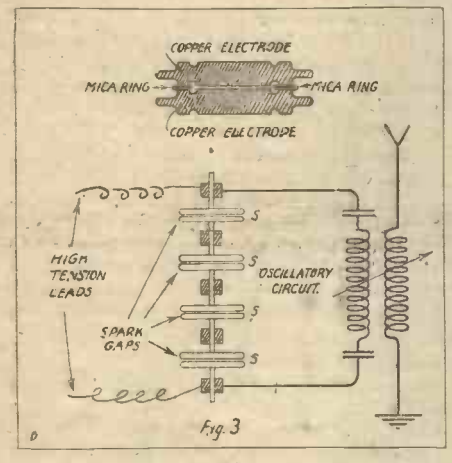


Fig. 3

into the aerial in each second, which naturally increases the output of signalling energy into the ether.

In the second place a serious loss of power is avoided by preventing what is called "back transfer" of energy from the aerial to the closed circuit during the persistence of the spark.

The quenched spark system invented by Wien in 1906, and adopted by the Telefunken Company is shown diagrammatically in Fig. 3. It consists essentially in the use of a number of separate spark gaps placed in series, each spark electrode being separated by less than a millimetre from its fellow. The main spark is thereby split up into a large number of small discharges, which are very rapidly quenched or extinguished, owing largely to the cooling action of the massive plate-electrodes.

Much the same effect is assured by the Marconi rotary spark-gap shown in Fig. 4. Here a series of projecting lugs C are mounted on a rapidly rotating wheel B, and the sparks pass between these and two slowly rotating discs AA placed at right-angles.

Owing to the speed of the wheel B, the sparks occur in very rapid succession, and each is automatically quenched by the widening of the gap as the projecting lugs C move away from the discs B. This is sometimes called "mechanical" quenching.

About 1900 Professor Duddell discovered that it was possible to create high frequency oscillations by shunting a tuned circuit across the electrodes of an ordinary arc lamp. In 1906 Poulsen developed this idea into the system of continuous wave transmission bearing his name. His arrangement is shown diagrammatically in Fig. 5.

The Arc System.

The arc electrodes, of copper and carbon, are contained in a water-cooled chamber filled with hydrogen gas, and are connected to the high tension mains. In addition a pair of electromagnets (not shown) provide a transverse magnetic field which serves to steady the arc. A parallel circuit containing inductance and capacity is connected across the arc.

The varying voltages set up across the arc give rise to continuous high-frequency oscillations in the tuned Duddell circuit.

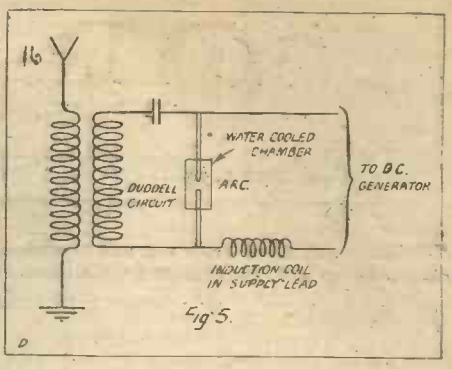


Fig. 5.

These are transferred to the aerial and are thence radiated outwards as an unending stream of ether waves.

As soon as the problem of emitting such a stream of continuous waves from the aerial had been solved, the wireless transmission of speech and music became possible.

In addition to the Poulsen or arc system, the use of high-frequency alternators has also been suggested for the same purpose, i.e. to radiate an unbroken stream of ether waves upon which speech variations could be imposed.

High-Frequency Alternators.

As early as 1890, Elihu Thomson and Nikola Tesla had designed such machines. Alexanderson, and later Goldschmidt (1907) and Fessenden (1908) actually succeeded in constructing alternators capable of supplying continuous oscillations direct to the aerial at a frequency varying between 100,000 and 1,000,000 per second.

All previous methods of radio transmission will, however, probably be replaced in the near future by the discovery made in 1913 of the capabilities of the thermionic valve as a generator of high-frequency energy.

By linking together the input or grid circuit with the output or plate circuit, the valve can be caused to produce continuous oscillations of practically any frequency, with a constancy and efficiency far superior to any other means at present known.

It is capable at present of giving an output varying from a few watts to some hundreds of kilowatts, and the limit of its possibilities in this direction remains still to be seen.

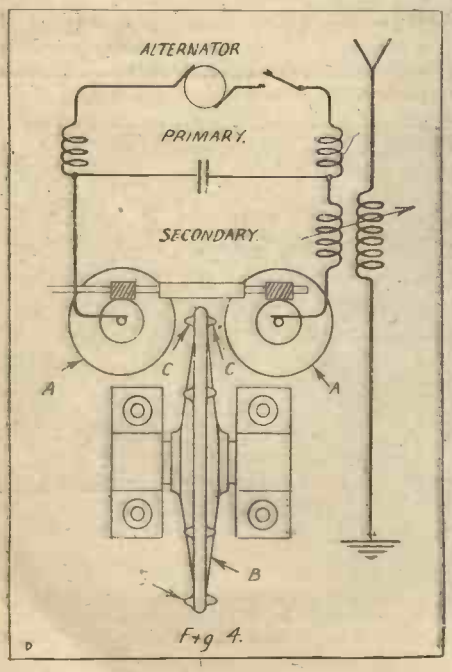


Fig 4.


The Battery Supply Department for Radio use on an American Express Train.

GEARY DISCOVERS AMERICA.

By HIGHAM BURLAC.

Another Geary Adventure which cannot fail to bring a smile to the face of the most perfervid of experimenters.

THE biggest mistake Geary every made, in a life consistently devoted to error, was his trip to America. No, gentle American reader, this is no unpleasant insinuation directed against that fair land of yours which, I am credibly informed, "licks creation." Geary went to America because the ship went there, and he could not leave the ship except for a supreme feat of natation for which he has not the proper specific gravity.

The Potent Draught.

Geary's employer sent him to Liverpool with an important document to deliver into the hands of Hiram P. Buckeye, of Boomville, Pa., who was returning to New York by the s.s. Berengaric; but long before Geary arrived at Prince's Pier, Hiram was well bedded down in the Berengaric's bar, beginning his long farewell to cocktails. Geary felt confused after ten minutes aboard. He thought a ship consisted chiefly of a bosun's mate, a binnacle, and a cabin, and began to lose his bearings after he had plodded along a mile of alleyways, through three palm gardens, and two swimming pools. Somewhere between the fourth-class squash racquets saloon and the third-class gymnasium he was hopelessly lost, and wandered about till he came to anchor in the steerage knife-and-boot-cleaning hole, and was run in by a quarter master as a stowaway.

Learning that Geary knew something of wireless, the skipper handed him over to the Marconi operators, who were kind to him, and permitted him to sort out the contents of the tool chest. After three days he was rescued by Hiram, who on receiving the precious document took Geary to the bar, and poured into him four fluid ounces of devilment called "Angel's Kick." That was the beginning of Geary's metamorphosis.

So Geary came back from America wider in soul but clad in unfamiliar raiment, conspicuous by the absence of a waistcoat, with his watch poked down the front of his trousers, and fifteen of his teeth patched with golden plates. I found him chewing gum meditatively at the foot of his wireless mast, and clapped him on the back with a hearty:

Matter of Opinion.

"What ho, old chap!"

He turned round upon me with a startled air and said:

"Aw, nix on the gumshoe work, Kelly!"

"Beg pardon?" I gasped.

"I said, cut out the 'mits up' dope, and come across with some of the home burg glad news. How's the folks?"

"Er—very well, thanks."

"That's the shout. How's *raddio?*"

"Oh, wireless is booming here just now."

"Bueno! Say, what's the load now in this half-acre lot?"

"Say it again—slowly."

"Stiffen it! I said, how many watts of Wattville do you boys shake into the wires hereabouts?"

"Ah! I gather dimly—by the way, do you speak like that to Mrs. Geary?—that you wish to know the aerial input affected by wireless amateurs in this country?"

"Yep!"

"Well, I don't know. Since you took up *raddio* I've rediscovered my affection for stamp collecting and the intensive culture of white mice."

"Say bo, *you don't say!* I was just dinging to pass you the latest guff about *toobes* and ground wires, and here you backstep like a third-storey, honest-to-goodness,

Miss Cecil Dixon, "Aunt Sophie" of 2 L O

dyed-in-the-wool bootlegger, when he feels the bottle break in his pants. Have a heart, old timer!"

"Sorry! What's that about boots and wool?"

"You pass! Say—what about that son-of-a-gun of a Broidcasting Company? It don't amount to a hill of beans s'far's N'Yark's concerned."

"Ah, we think it's the—pardon me—the whole cheese—not being concerned with what hill of beans New York is concerned with. The London station gets over the Atlantic, anyhow."

A "Super" Needed.

"Sure thing! We took it for static at *fyist*, till old man Armstrong hooked up his go-getter circuit, and piped what your game was. Believe me or believe me not, stranger, there warn't a *toobe* 'n N'Jersey but didn't register pained surprise when li'l ole 2 L O lit out for the tall grass, I'll tell the woild."

"Well, now you are back where you belong, you have jolly well got to toe the line, and sub up to the B.B.C., and listen-in like the rest of us. By the way, did you like Ellis Island?"

Radio from the Cradle.

"Nope! But I'm a fly guy, and I passed the buck to the President of the *Raddio* Rioters who spilled the beans by Special Expedited Relay *Raddiogram* on Eli K. van Hucklebaumerblitzen, Vice-President of the *Fyist* National Group of *Raddio Toobe* Twisters. Eli no sooner lamped this S.O.S. than he switched his Heaviside-scraper on to Judge Schwarzenheimer at Washington, D.C., and jammed him good and fine till he had gotten a check for my egress. Some boy!"

"Who's a boy? Huckle, etc, or the judge, or the president of the thingummy-bob?"

"You don't get me. Use your harkers! I said he was the goods with an upper-case G, and then some."

"Quite so. I must have missed that. Well, so you got away from Ellis Island by *raddio* influence. Have a good time?"

"Bully! Strength ten. I was the little bit of hog in the hull can of beans. *Raddio?* My good sirree, we Briddishers are the last hair in the broncho's rudder in *toobe* work. We are—why, in Amurrca the babes yowl for "B" batteries in their cradles; at the age of three they can repeat Richardson's emission formula, and at eight are getting through to the next but one State on *toobes* saved from candy money. Talk about a good time—they handed me the joy clutch. Do much listening-in? Nary listen. You don't listen, you hear! You push the button in N.J., and read off every *raddio* riot's far's the Panhandle. It's laid on to every apartment, son, like the card of rules in a dime dosshouse. Man I met on Forty-first told me he could mow his tennis-court with *Chaykoffski's* "1812," and I believe um. Yessir!"

A Sudden Return.

"Very interesting indeed. Anything else? I asked.

"Man I met on Twenty-third allowed he could strip off wallpaper by spraying it with *Vargner's* Overture to *Tanhorser*, as played in Schenectady, and toast bread by holding it against a Magnavox while Mrs. Walla Bella Silcox recites her Bedside Stories. Say, what about two spots of snake-juice?"

I was just opening my mouth to accept this strange invitation, when Mrs. Geary called from the house:

"Aloysius, come in at once. Catching your death of cold!"

"Yes, my dear, certainly. I'll come at once," replied Columbus the Second.

"Thank goodness!" I muttered, as Geary steered towards the house. "English at last!"

THE TELEGRAPHONE

By SEXTON O'CONNOR

THE principle of the phonograph is familiar to most people. It can be described as a machine for "storing-up" the human voice in permanent form ready for reproduction as desired. The "dictaphone" is a somewhat elaborate form adapted for the business man so that he can dictate at his leisure to a machine which will presently repeat his accents to the willing typist.

One of the difficulties experienced in providing a thoroughly representative Broadcast programme is to persuade the right people to come to the microphone "torture chamber" at the radiating station. In certain cases "Mahomet has gone to the mountain," and special cables have been laid down in order to connect the Broadcasting depot with the centre of attraction. This has been done recently in the case of Covent Garden, the Hippodrome, and other theatres, but the process is troublesome and expensive.

An Instrument with Possibilities.

It may be asked why not use the phonograph recorder as a convenient method of bringing a wider circle of prominent—but somewhat inaccessible—artistes and other notable personalities into touch with the growing army of listeners-in?

Whatever may be the objections to this course in practice, the suggestion seems worthy of full consideration. With the perfected type of recording and reproducing instruments now available, there should be little difficulty in ensuring good results in the quality of speech or song so transmitted.

As an alternative to the use of the phonograph for this purpose, there is available a most ingenious form of speech recorder, which, though not so well-known, has certain decided features of advantage and is capable of development to a high level of efficiency.

The instrument referred to is called the "telegraphone" and is an invention of Valdemar Poulsen of "Poulsen Arc" fame. It is free from many of the obvious objections that might be urged against the use of the phonograph for Broadcasting. There is no necessity, for instance, to make a permanent "record" involving delicate questions of copyright, and correspondingly high fees. Further there is practically no limit to the length of the speech or other entertainment that can be stored up. At the same time the "record" can be retained for several months, if necessary, unimpaired in quality.

A Magnetic Impression.

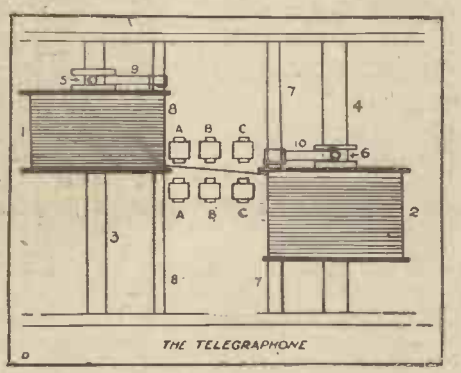
The telegraphone may perhaps be best described as a magnetic phonograph. It depends for its action upon the peculiar properties of a magnetised wire.

Those familiar with the action of the Marconi magnetic detector will remember that when a strip of wire is passed near two reversed magnets, a "delicate" magnetic condition is set up which is amazingly sensitive to the impact of wireless signals.

Poulsen found that when a strip of unmagnetised wire is passed near to the poles of an electromagnet, which is wound with coils forming part of a local microphone circuit, a peculiar magnetic "condition" results. This magnetic condition is confined to the part of the wire in close proximity with the poles of the magnet, but it is of a more complex nature than in the case of the Marconi detector. Instead of being subjected to a uniform magnetic field, the wire is also influenced by the varying voice currents flowing in the windings that form part of the microphone circuit.

The result is that the wire receives a magnetic impression which faithfully "reflects" the voice at the microphone.

Not only does it store up the spoken



word, but it does so in a semi-permanent form. That is to say, the magnetic record will remain available until it is deliberately effaced, which, however, can readily be done by passing the wire across the poles of a second magnet. Once it has been so "cleaned," the wire is ready to receive another "impression" which, in turn, can be destroyed, and so on, the same piece of wire being used as often as desired.

How Signals are Recorded.

Once a wire has been impressed with "magnetic" speech in this way, all that is necessary to "repeat" the record is to pass the prepared wire in front of the poles of a second magnet, in which, this time, the windings are in series with a telephone receiver.

The lines of magnetic force from the wire then induce currents in the receiver which vary in strength precisely in the same way as the original magnetising currents, and therefore repeat in the telephones the words originally spoken into the microphone.

A simple diagram of the apparatus is shown in the Figure. The wire strip is slowly unwound from a spool, 1, and is taken up by a second spool, 2. Both spools are mounted on pillars 3, 4 respectively, and are arranged to be slowly moved in opposite directions along the pillars by means of screw shafts 7, 8, which carry arms, 9, 10, engaging collars, 5, 6, secured to the spools.

This ensures that the uncoiled straight strip of wire lies always in a straight line, passing between the electromagnets A B C. Only the electromagnet B is actually used for recording or repeating. If, for example, the apparatus is being used for recording, the microphone circuit is connected to the electro-magnet B, and impresses the speech magnetically upon it in the manner previously described.

Reproduction of Signals.

If the wire is travelling in the direction from the spool 1 to the spool 2, the electromagnet A is used simply to obliterate any traces of former impressions that may remain, so that the wire is presented to the recording magnet in a "clean" condition ready to receive the new impressions. The third magnet C is in this case idle.

If on the other hand it is desired to reproduce speech from a prepared record, a telephone transmitter is connected across the magnet B. The first magnet A is in this case inoperative, and has no effect upon the strip.

The second magnet is affected by the varying lines of force springing from the magnetised wire, and speech currents are accordingly produced in the attached telephones. The third magnet may, if desired, be strongly excited so as to wipe out the magnetic "traces" from the wire, thereby destroying the message and rendering the wire ready for use again for a subsequent message.

Useful in the Home.

It is obvious that this feature of automatically obliterating the record as soon as it has been transmitted may appeal to a certain class of artiste. They may be prepared to offer their services for a single performance or a "one use" record at a figure much below that which they would expect to receive for work which is multiplied, as in the case of a phonograph record and sold to hundreds of thousands. At the same time, the performance could be given wherever they might chance to be, thus avoiding personal attendance at the Broadcasting station and the unaccustomed ordeal of facing the microphone, where nervousness or an involuntary mistake may spoil the effect as heard by the listener-in.

With the facilities afforded by an instrument like the telegraphone, it should be possible to increase very considerably both the scope and variety of the somewhat restricted Broadcasting service at present available.

From another point of view the telegraphone could easily be adapted to serve the convenience of individual Broadcast receivers. It is not always possible to be "on guard" at the phones, or even at home, when an especially interesting item is being transmitted.

How convenient it would be in such circumstances to have an inexpensive automatic "recorder" hitched on to the receiving set, from which one could extract, at leisure, say next morning, the entire programme of the night before.

THE CONSTRUCTION OF PLUGS AND JACKS

ORDINARY telephone jacks and plugs often prove to be very useful fitments to the wireless experimenter. The operation of inserting or withdrawing the plug forms a very easy method of connecting or disconnecting various pieces of wireless

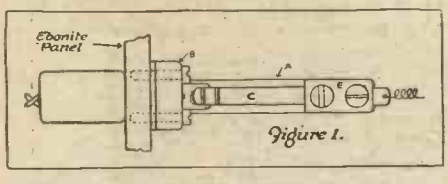


Figure 1.

apparatus; it is far easier than having to screw up or unscrew a whole collection of terminals which, if often necessary, becomes very troublesome.

In addition to being useful, a well-made jack and plug fitted to a set enhances its appearance to no little extent. The jack to be described, while somewhat different to the usual type, is not difficult to construct and, providing it is carefully made, works quite as well as the orthodox article. This jack should appeal to those amateurs who wish to make as much of their own apparatus as possible.

Fig. 1 is a plan of the jack with the plug inserted; Fig. 2 a side elevation with plug inserted—the plug is in section to show the method of construction; Fig. 3, side elevation with plug out.

The construction is as follows: The piece marked A, which carries the contacts, is cut out of sheet brass $\frac{1}{16}$ in. thick to the shape shown in Fig. 4. A $\frac{5}{8}$ in. diameter hole is

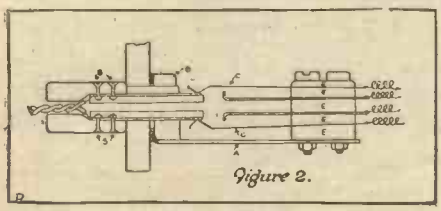


Figure 2.

cut through the large end, as shown, so that when in position the plug will not make connection with the brass. The six other holes are drilled to take $\frac{1}{8}$ in. Whitworth (or an equivalent B.A. size) brass screws. B is a piece of ebonite $\frac{3}{8}$ in. thick and 1 in. square. A $\frac{3}{8}$ in. diameter hole is drilled through the ebonite panel of the set on which it is intended to mount the jack; four $\frac{1}{8}$ in. diameter holes must be drilled and tapped to take the four screws which hold the jack in position. The contacts CC and DD are cut to the shape shown in Fig. 5. They are held in place by two $\frac{1}{8}$ in. diameter bolts; strips of ebonite (E) are interposed between the brass strips in order to separate them the correct distance, and to insulate the one from the other; $\frac{1}{4}$ in. diameter holes should be drilled through the contacts CC and DD where the bolts pass through so that they do not touch the bolts.

Careful Insulation Required.

When assembling, care must be taken that the contacts do not touch the bolts; if ebonite washers $\frac{1}{4}$ in. diameter and the same thickness as the contacts are inserted, all risk of "shorts" is avoided. The contacts CC are made of spring brass $\frac{1}{64}$ in., or slightly more, thick; DD are made of $\frac{1}{32}$ in. thick sheet brass. An insulated connecting lead should be soldered to each contact-piece where it projects from the ebonite strips as indicated in the figures.

To Prevent "Shorts."

The plug is made from a piece of brass tube $\frac{3}{8}$ in. diameter and $1\frac{3}{4}$ in. long. The handle is a piece of $\frac{3}{4}$ in. diameter ebonite rod $1\frac{1}{4}$ in. long. A $\frac{3}{8}$ in. diameter hole is drilled half-way through the ebonite, and the tube inserted in it. Four $\frac{1}{16}$ in. diameter countersunk screws (S in Fig. 2) are then fitted in the positions shown in Fig. 2. The tube is removed and split

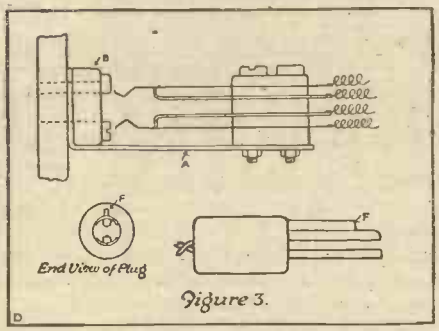


Figure 3.

along its centre with a hacksaw; each half should then be filed until both pieces of tube, when in position in the handle, are separated by a gap of about $\frac{1}{8}$ in.

The nuts of the countersunk bolts are then soldered in their correct positions on the inside of each piece of tube which now form the plug contacts. At the same time must be soldered the "feather" (F in Fig. 3), which is a strip of brass $\frac{1}{16}$ in. thick, and $\frac{1}{8}$ in. wide. A slot or "keyway" must be cut out of the panel and out of the piece B to accommodate the feather. The object of the feather is to ensure that the plug is inserted with the right side up, otherwise it might inadvertently be plugged in upside down, thus reversing the connections with perhaps disastrous results.

The slot or "keyway" can be cut to the required depth with a piece of broken hacksaw blade, and trimmed with a thin file. A length of twin flexible wire is inserted through a hole drilled in the plug handle,

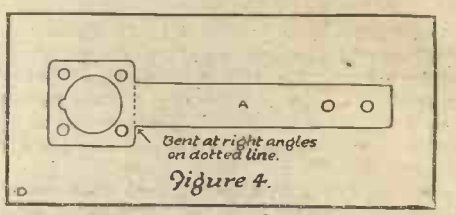


Figure 4.

one wire of which is soldered to one piece of the tube and the other wire to the other piece of tube; it will probably be easiest to do all the soldering at the same time.

Application to Valve Circuits.

The whole should then be carefully assembled, due care being taken to prevent short circuits; liberal use of shellac will probably improve the insulation. All sharp edges and corners should be neatly rounded off. The contacts can then be adjusted to make proper contact; when the plug is in position the contacts CC should be well separated from DD; when the plug is withdrawn, then CC should make contact with DD, but CC must, of course, not touch each other. A good plan is to solder small pieces of platinum wire where the contacts are made and broken, as if any sparking takes place a coating of oxide is apt to form and so impair good connection. The contacts from an old electric bell would do excellently for this purpose.

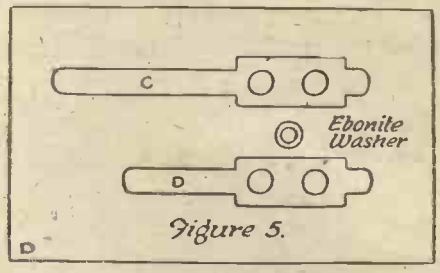


Figure 5.

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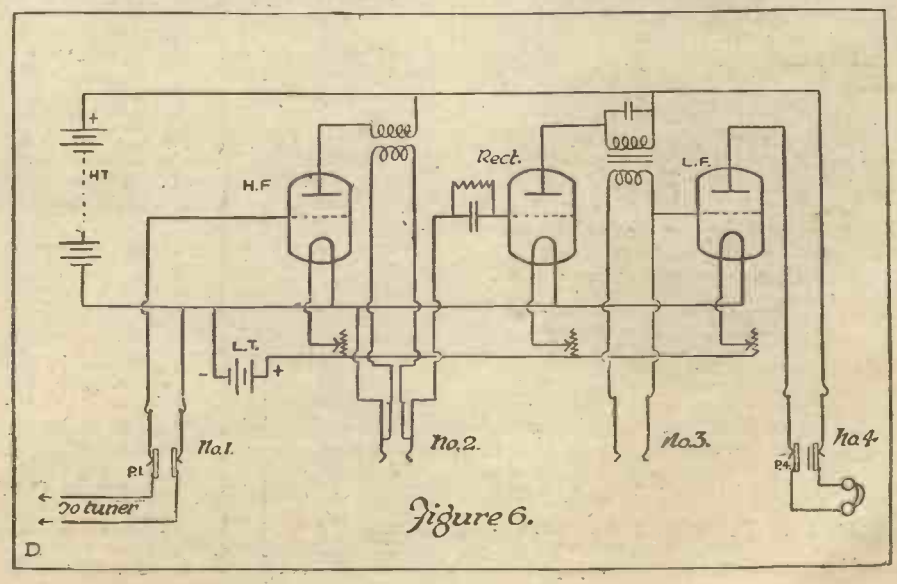

Figure 6.

2 K O

A VISIT TO A WELL-KNOWN MIDLAND STATION

ONE of the pleasures of the present stage of radio-telephony is to meet a veteran, or, in other words, an amateur whose licence to experiment has not been renewed just once or twice, but many times. Usually the call-sign concerned is something of a classic, and when the station itself is visited there are found all the traces of careful building up and of happy ideas which have led to fruitful results.

In any district it will be found that the best-known call-signs still indicate the "old guard," and to them wireless owes much. For example, among the well-known call-signs of the Birmingham area are 2 N V, 2 O X, 2 L G, 2 K O, 2 R G, 2 F H, 2 I Y, to mention those that occur to mind.

Broadcasting a Charity Appeal.

Among the foregoing a station that is particularly prominent for reasons of its excellent transmissions is 2 K O, which, for example, became well-known last October when it provided the Lord Mayor of Birmingham with the opportunity of being the first Lord Mayor to broadcast an appeal on behalf of charities. On this occasion the wireless amateurs and their invited friends who listened-in were appealed to on behalf of the Birmingham hospitals, and the latter benefited considerably as a result. For that occasion, Mr. C. S. Baynton, the man behind 2 K O, was granted a special broadcast licence by the Post Office authorities.

An early interest in microphones—an interest which still survives and which accounts for a good deal of the remarkable excellence of 2 K O's transmissions together, of course, with an interest in telephones and electro-magnetism, led to wireless telephony, and when the removal of the war-time ban gave wireless experimenters a real chance of getting going again, 2 K O came into being.

The first set installed was a valve set, of which every part was made at home, and it is suggestive to note that telephony was the only concern. For the first three months Mr. Baynton and his son—Mr. Gerald Baynton—tested and listened-in, built anew, tested and listened-in again, and then they picked up their first message.

Profiting by Experience.

"I made every mistake that it was possible to make," Mr. Baynton told a POPULAR WIRELESS representative, "but we stuck it out. We worked together a good deal with 2 F H and 2 L G transmitting and receiving. The ether was very free in those days—we had it all to ourselves."

"In 1919," he continued, "the stations in Birmingham were less than half a dozen in number.

"Every kind of coil imaginable was made even to the winding of 'pancake' coils, two feet in diameter, as well as others twenty times smaller."

So 2 K O grew up until it is certainly one of the best equipped of amateur transmitting stations. For wireless work, Mr. Baynton's house is ideally situated. Four hundred and fifty feet up above the sea-level in the first place, and plus the height of the masts, there is stretched the maximum span of a single strand aerial leading into the instrument room on the first floor. From this room connections seem to run to all parts of the house, so that it

Making Tuning Coils in one of the new Radio Factories.

is possible to have a loud speaker anywhere. It is not unusual for three to be in use at the same time, and when Birmingham is being received two valves suffice for this purpose, while London or Manchester can be picked up on three valves when Birmingham is in full blast. The Hague on a loud speaker is heard on two valves without amplification.

Ingenious Arrangement of Microphones.

Apart from the transmitting and receiving panels, 2 K O contains various "gadgets" mention of which cannot be other than interesting. The microphones for music transmissions, for example, are unique. Three separate microphones—each ball-socketed to give the ideal angle for successful picking up of the sound waves—on arms which slide up and down on a centre piece, are used outstretched for piano items. The left microphone takes in the lower octaves, the centre the middle, and the right the higher octaves. Thus there is no possibility of any difference in the collecting of the sounds.

If, however, a vocal item with accompaniment is being broadcast, one arm is dropped into the piano and the singer directs the voice between the other two which are brought together. This reference to transmission draws attention to an effective means employed to gauge the flow of the current into the aerial. This is an ammeter fixed on the transmission panel in series with the microphone current. The broadcaster who marks the regular beat of the needle is thus assured that he is transmitting efficiently.

One other striking point must be mentioned and that is in regard to the change over. In this matter 2 K O can almost be said to have solved the problem of an effective duplex system, for conversational telephony can be carried on with ease so simple are the arrangements for the change over. One movement of the switch arm is all that is necessary. Worked on three relays this lights the filaments, switches on the microphone current, puts on excitation current, and starts the generator.

CONSTRUCTION OF PLUGS AND JACKS

(*Continued from previous page.*)

Before putting the jack into use, the insulation should be tested with a dry cell and a pocket galvanometer. It should be made sure that CC and DD are thoroughly insulated from each other, and that no "shorts" exist.

If the experimenter intends building a multi-valve set, then the jack comes in very useful. He can at will disconnect any valve with very little trouble. Fig. 6 shows the connections for a 3-valve set, H.F., rectifying, and L.F. In this case four jacks are required; three of them need not have the inner contacts, since only the outer ones are made use of. The diagram shows all three valves in circuit. If now the plug P1 is inserted into jack No. 2 the H.F. valve is cut out of circuit. Similarly the L.F. valve may be disconnected, or both L.F. and H.F. can be cut out. Only two plugs are needed for the above arrangement.

Fig. 7 illustrates how the jack can be used to earth the aerial when the set is not in use; in this case three contacts are used, two being connected together. When the plug, to which the set is attached, is withdrawn, the aerial is automatically earthed. It should be mentioned that in this case the insulation should be very good, and the connecting wires should preferably be composed of high-tension cable.

There are many ways in which this accessory can be used, but it is left to the individual reader to think out additional applications to suit his own particular case.

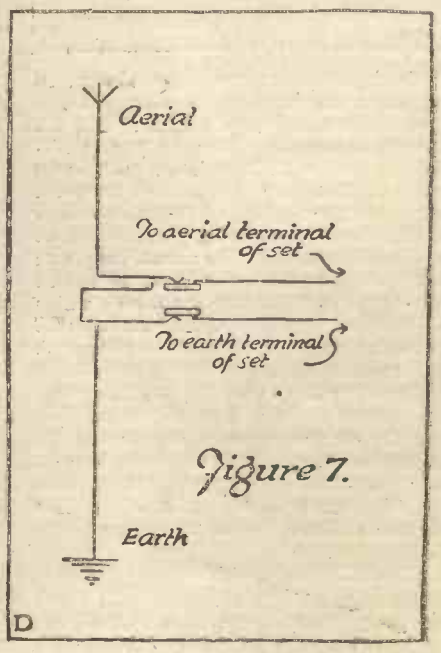

Figure 7.

BROADCASTING RECEPTION SETS

OF EVERY DESCRIPTION

and everything for wireless at everybody's price

SEND FOR CATALOGUE

All Instruments Passed for Broadcasting Licence, G.P.O.

THE "ALDERSGATE"

Single-Valve Set, complete with all Accessories, including Phones, Accumulators, H.T. Battery Valve—

£7 10 0

B.B.C. Royalty, £1 0 0

If Aerial Wire and Insulator required, 5s. extra.

Hundreds of Testimonials for Efficient Working.

Large Variety of Crystal Sets. Send for List

THE "PERFECTO"

2-VALVE SET.

Comprises one L.F. and one D.T. Functions alternatively to the Duo, this Set giving Volume where the other gives Range

A Powerful Set for local Broadcasting. Complete Phones, Batteries, Accumulator, Valves, for—

£10 15 0

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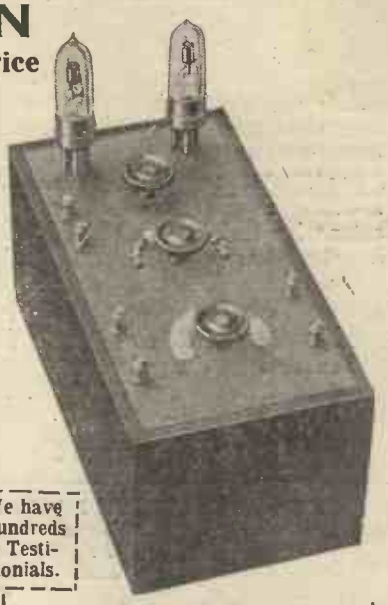
If Aerial Wire and Insulators required, extra 5s.



We have Hundreds of Testimonials.

THE "DUO"

2-VALVE RECEIVING SET.

Designed for Broadcasting only.

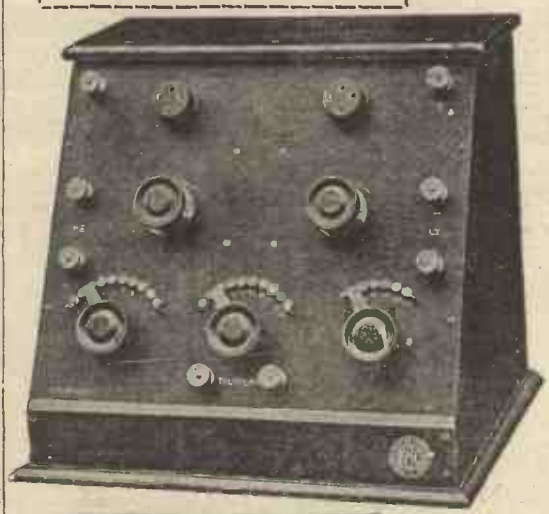
This Set has a patent coupling, and will not radiate The High Tension Battery is enclosed, and there are only six external terminals, aerial, earth, phones, and low tension.

We claim that this Set is the easiest 2-Valve Set to manipulate on the market.

Price complete, all accessories for working, including Phones, Batteries, H.T. and L.T., Aerial Wire, Insulators, and Valves,

Total £10 15 0

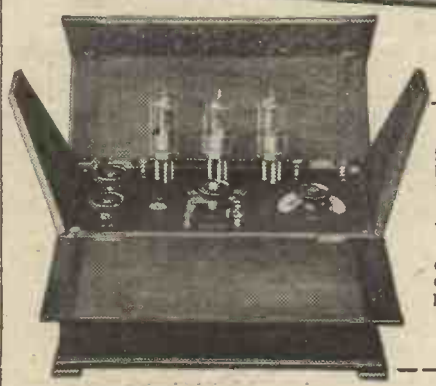
B.B.C. Royalty stamp, £1 15 0 extra.



A TWO-VALVE SET WITH REACTION APPROVED BY POSTMASTER-GENERAL FOR BROADCASTING. No. 0236. Comprises one D.T. Valve and one L.F. Valve mounted in a handsome slope back Cabinet. Separate filament control for each valve, wave-length range, 200-4,000 metres. Price, complete with phones, battery, accumulator, and valves, aerial wire, and insulator—

£13 13s. 0d.

Size of Cabinet, 2 ft. by 1 ft. by 7 ins.



Highly efficient 3-Valve Broadcasting Receiver. Will tune in all the broadcasting stations and the low-wave French telephony.

The H.T. battery is enclosed, and is varied by a switch.

Tuning is accomplished by condenser only, thus making it the easiest 3-valve set to work at the price of

£20, with all accessories.

The "UNIQUE" 3-VALVE RECEIVING SET.

As can be seen by the photograph, this set has a unique design and a high finish.

The valves are behind the panel and are out of the way, and can be seen by 3 peep holes.

The batteries fit into the cupboard on the left, thus making it a set that is absolutely self-contained. Has a High-Frequency Transformer with one D.T. and one L.F. A Tapped Inductance is on the right-hand side of the set, with 2 terminals for coils for higher wave-lengths.

£25, complete with phones, accumulators, batteries, aerial, and 2 insulators.

There is no doubt that this is the finest piece of workmanship which can be had at this price.

B.B.C. Royalty Stamp, £2 5 0 extra.

WIRELESS INSTALLATIONS LIMITED

(DEPT. A.), 81, TURNMILL STREET, LONDON, E.C.1.

Telephone: CLERKENWELL 5434.

(Nearly opposite Farringdon Street Station, Metropolitan Railway.)

PATENT RIGHTS AND THE VALVE

SOME REMARKS ON THE MARCONI-MULLARD CASE

By A BARRISTER-AT-LAW

THE recent litigation between the Marconi Company and the makers of the Mullard valve has been followed with great interest by the wireless public. The question of patent rights in the thermionic valve—probably the most important appliance in the whole industry—has for some time been an outstanding bone of contention, and the present action, which is in the nature of a test case, will, it is hoped, throw some much-needed light upon the whole situation.

The importance of the questions at issue may be judged by the determination shown by both sides to fight the matter out to a finish. The result of the first action in the High Court went in favour of the Mullard Company so far as it decided that they had not infringed the Marconi patents, whilst at the same time the Marconi Company secured a judicial certificate to the effect that their patents were valid—so far as they went.

The Marconi Company appealed against this decision. They allege that the Mullard valve infringes two of their patents, viz., one granted to Captain Round in 1913; and another granted to two Frenchmen named Peri and Biguet, which dates from 1915.

In the first, Captain Round claims "a vacuum tube containing a hot filament, a grid *formed as a closed cylinder completely surrounding* the filament, and a third electrode (plate) in the form of a cylinder *surrounding* the grid."

Capt. Round's Invention.

Most of the legal arguments concerning this patent centred around the precise meaning to be given to the italicised words. On behalf of the Marconi Company it was argued that, before Captain Round's invention, there were no three-electrode valves known in which the grid was made to *surround* the filament, nor in which a cylindrical plate was used to enclose both the filament and grid.

It was pointed out that in the De Forest or Audion type of valve, the grid was made in the form of a *flat* sieve or mesh placed between the filament and a *flat* plate or anode.

At the time in question, i.e. 1913, the modern type of "hard" valve, in which the air pressure in the tube is reduced to the neighbourhood of one-millionth of a millimetre, was unknown. All the valves then in use contained a comparatively large amount of residual gas, the presence of which affected the "steadiness" of the valve in operation.

This trouble arises from the following causes: (1) A certain proportion of the electron stream from the filament fails to strike directly upon the plate, which, being flat, only covers a comparatively small area. The electrons missed by the plate find their way to the inside surface of the glass vessel and lodge there, with the result that the glass surface becomes negatively charged and thereby effects the normal potential on the grid. (2) In addition, some of the electrons, as they shoot outwards from the filament, collide with the free molecules of gas. The impact is sufficient to disintegrate the gaseous molecule, knocking away some of its associated electrons, and leaving a positively charged "ion" free to wander about inside the tube.

These vagrant "ions" are inimical to the proper working of the valve for two reasons. In the first place, they are apt to "bombard" the filament with such force as finally to break it, and so shorten the working "life" of the valve. In the second place, some of them are from time to time drawn into the negatively charged walls of the tube. Each positive ion, as it strikes against the glass surface, naturally diminishes the degree of negative electrification, and therefore upsets the normal grid potential. This action is intermittent and, in consequence, the working of the valve becomes erratic. The only remedy is a constant readjustment of the valve of the grid potential by means of an external potentiometer circuit.

The Main Points at Issue.

By using a cylindrical plate instead of a flat one, Captain Round sought to trap the *entire* stream of electrons. If none of the electrons can escape from the attraction of the plate, there will be no negative charge set up on the inside walls of the tube to interfere with its steady working.

A "cylindrical" grid was employed in order to secure a uniform "control" of the electron stream on all sides of the filament. It was obviously the most suitable form to use in conjunction with the cylindrical plate.

Mr. Hunter Gray, for Messrs. Marconi, pleaded that the improvement made by Captain Round was of the first importance. He claimed that any three-electrode valve containing a cylindrical plate and a "closed" grid was an infringement of the Marconi patent rights. It was immaterial whether the improvements were applied to a "hard" or to a "soft" valve. The "greater included the less," and as Captain Round had solved the more difficult problem of controlling the working of the "soft" valve he ought not to be robbed of the fruits of his invention merely because his improvements were subsequently applied to the more easily controlled "hard" valve. He asked the court not to follow the wording of the patent claim too literally, but to say that the words which described the grid as "completely surrounding the filament" meant that the filament was "*electrically* closed or surrounded" by the grid. It was obvious that the words in question could not mean that the grid must "physically" surround the filament on all sides so as literally to encase or box it up. Such a construction was impossible in practice.

Sir Duncan Kerley, for Messrs. Mullard, urged that, whatever were the merits of Captain Round's invention, it did not cover the valves made by his clients. The Round patent applied only to the particular difficulties met with in "soft" valves. The Mullard valve was a "hard" or highly exhausted tube. There were no positive ions to be contended with. Surface electrification of the glass walls of the valve was present, in actual fact, both in hard and in soft valves. In the case of hard valves, such as the Mullard type, this charge did not affect the steadiness of the instrument in operation. It was counterbalanced by the initial adjustment of the grid potential, and did not thereafter have any injurious effect upon the working of the valve.

How Judgment was Delivered.

Whatever was the nature of the invention which Captain Round intended to protect, he asked the court to confine it to the arrangement actually described in his patent specification, which laid down that the grid must "completely surround" the filament. His client's grid was in the form of an open spiral of wire, which could not in any way be said to fall within the words of Captain Round's claim.

The second Marconi patent which it was alleged had been infringed by the Mullard Company related to the well-known "French" valve, in which all the electrodes are carried by leading-in wires supported from a common base at the bottom of the valve casing. The defendants maintained that this particular patent covered only a precise arrangement or combination of well-known parts, and that there were sufficient differences in the actual construction of the Mullard valve to take the latter outside the scope of the Marconi patent.

Judgment in the Appeal was delivered on March 23rd by the Master of the Rolls and Lord Justices Warrington and Younger. The court held that the invention protected by the Round patent applied only to a valve in which the grid was formed as a cylinder closed in the "physical" or geometrical sense, i.e. having ends. The grid in the Mullard valve did not fall within this definition, and there was consequently no infringement. Further, the Mullard valve did not infringe the narrow construction covered by the Peri and Biguet patent (i.e. the French valve).

The question as to the validity of the Marconi patents remains as it was left by the court below. In other words, they are valid for the construction of valves which they actually describe.

BOOK REVIEW

Your Broadcast Receiver and How to Work It. A want long felt by those who have just taken up wireless has been supplied by Percy W. Harris, Editor of "Conquest," in his book entitled "Your Broadcast Receiver and How to Work It." (Wireless Press Ltd.).

Containing eleven chapters, this little book deals very conclusively with all the problems that beset the beginner, taking the various parts of the instrument separately and thoroughly, explaining their construction and manipulation. A useful chapter deals with the care and management of accumulators; while a final chapter discusses concisely the question of reaction, its use and abuse. Amateurs with B.B.C. sets should certainly get this book.

CORRESPONDENCE.

The Editor, POPULAR WIRELESS.

Dear Sir,—I think that the following extract from my log book might be of some interest to your readers.

Monday, March 13th, 1923, I was listening to 5 S C (Glasgow) on a crystal set to-night, and was getting it very well. During a two-minute interval I was surprised to hear a woman singing very faintly; I immediately tried to tune in better, and in doing so, tuned in another station in time to hear the "wireless orchestra will now play," followed by distinct though faint music. The time was about 19.30, and the wave-length and items pointed out that the two stations were Newcastle and Birmingham respectively. Feeling rather pleased and very optimistic, I tried lower down, and was rewarded by hearing a man speaking; this I took to be Manchester. I then tried for London, but by this time 5 S C was on again.

At 21.30 I again tried the crystal set and heard chimes, but before they were finished a man commenced talking. I am quite sure that the man talking was at Manchester, but whether the chimes came from there or 2 L O I cannot say.

For the benefit of your readers I may state that my distances from the stations mentioned are as follows: 5 S C, 30 miles; 5 N O, 150 miles; 2 Z Y, 200 miles; 5 I T, 280 miles; and 2 L O. 380 miles. My aerial is a single wire, 40 ft. high and 60 ft. long, and pointing in an easterly direction.

To those who would suggest re-radiation as the cause of this, I would mention the fact that there is no wireless experimenter within a five-mile radius, though there is a "broad-catcher" about a quarter of a mile away. Also, there is the fact that at present most people are listening to Glasgow, as it is impossible to tune it out in this district. There is also the fact that I heard several different stations to disprove this theory.

Trusting that the above may be of interest, and wishing your paper every success.

I am, yours truly,

ALEX. A. M. TURNBULL.

Ruberslaw, Innellan.

The Editor, POPULAR WIRELESS.

Dear Sir,—In a recent issue, in the article by A. H. Daly, he states that Leafield, Oxon, can be heard clearly in Melbourne, Victoria, the distance being 11,000 miles.

Leafield can be heard there, but it is not 11,000 miles in distance.

I am a professional operator on the Australian run, and regularly receive Leafield up to 9,500 miles, which is a point around the coast between Melbourne and Sydney, passing through the Bass Straits.

The question of reflection can be doubted to some extent by the fact that the signals from Leafield remain a constant strength from Port Said to Sydney, N.S.W. I speak of the 8 p.m. press transmission.

With the same single valve set, Annapolis, U.S.A., has been received up to 10,500 miles, the farthest point possible on the route.

This will make amateurs wonder a little, but it is perfectly true.

To those who grumble of Leafield's harmonics, let them remember that the press being sent out is being received half the world over, and by ships who otherwise are isolated from the outside world.

Leafield is a station to be proud of, and our government has surely achieved something when it is possible to transmit to Australia, our farthest dominion of the Empire, whenever it chooses to do so.

Thinking this little correction is necessary, and a little sidelight to the amateur of many valves, of what the professionals do with only one, and no reaction.

Yours truly,

G. E. BAKER.

The Editor, POPULAR WIRELESS.

Dear Sir,—I am heartily in accord with the views expressed by Mr. C. A. Sheldrick in your issue dated March 3rd, wherein he thinks that the trouble he is experiencing in obtaining a licence is shared by scores of other "unfortunates."

At the present time 2,000 applications for experimental licences are received daily by the G.P.O., and, to my mind, this fact alone should convince the B.B.C. that there are thousands of people willing to pay their share towards the cost of the excellent entertainments that are broadcasted nightly.

Moreover, seeing that the B.B.C. receive 50 per cent. of the licence revenue, are they not "robbing" themselves of £500 daily by refusing to grant permits to these amateurs, myself included, who are at present forced to forgo the pleasure of listening-in owing to their inability to purchase expensive apparatus whereon the royalties imposed are already paid?

It certainly behoves the B.B.C., in conjunction with the G.P.O., to issue a permit that will cover the amateur who has made his own set, and I think, by so doing, the revenue of which they seem to be sorely in need will be forthcoming to an extent that will exceed their expectations.

Yours faithfully,

F. C. L.

Thornton Heath, Surrey.

The Editor, POPULAR WIRELESS.

Dear Sir,—In reading some of your articles, I see that in the Old Country the experimenter has been putting up some records in low-power transmission, and perhaps that your readers would be interested in some of the doings of amateurs in far-away Australia.

Up till a month ago experimenting in Australia was not all milk and honey for amateurs, but now we have a new set of regulations which are pretty liberal. The licence fees are £1 for receiving and transmitting, and 10s. for receiving only.

Power of from 5 watts to 250 watts is allowed, according to distance from a Government station, and there is no restriction on the size of aerials.

Two young American amateurs with their home-made sets. Note the American type of gear

The biggest slug out here now is the high price of apparatus. For instance, the "Ora" valve costs 30s., and is the cheapest obtainable. I have to content myself with a crystal set, but intend to build a valve set as soon as finances will allow.

With my loose coupler set I have had good results, getting land and ship stations up to 2,000 miles on a three-wire aerial, 110 ft. long and 45 ft. high, the spreaders being 12 ft. long. I also get the concerts which the Amalgamated Wireless Co. send out now and then. It is their intention to start a proper broadcasting service at an early date.

I might add that I have been a reader of POPULAR WIRELESS ever since No. 1, and I think we have had 23 copies so far. We have two publications, printed in Sydney, devoted solely to amateur wireless, the "Wireless Weekly" and the "Australian Wireless Review," published monthly

I am, yours faithfully,

JOHN E. JUNG.

"Newport," George Street,
Gladesville, Sydney, Aus.

Quality Components at Keen Prices

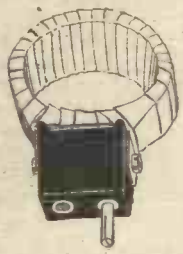
THIS COLUMN IS DEVOTED TO SPECIAL RADIO BARGAINS.

In accordance with the established policy of this Firm, we are offering below a few new items (not yet listed in our Catalogue) at particularly keen prices. All are sold on our guarantee of complete satisfaction or money willingly refunded in full.

Aerial Masts.

Best quality steel tubing, light yet immensely strong, in three sections. Makes a permanent aerial. Painted grey. As illustrated. **50/-**

As above but complete with stay wires, strainers, pulley, etc. **65/-**



Atlas Coils.

Set of three Coils for all B.B.C. Wave-lengths from 180 metres to 1000 metres. The set of 3 as illustrated. **14/-**

French Phones.

Finest value ever offered.

Superior Phones, not to be compared with the rubbish often offered as French phones. Tortoise-shell headbands, plated phones, excellent finish, wonderfully light and comfortable in use. Complete with cords, 4,000 ohms per pair **21/-**

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Reproducer exactly as used in the well-known PETO-PAN but metal horn now replaced with moulded, unbreakable composition. Splendid acoustic effects. Gives true tone values without distortion. 4,000 ohms. Fitted with adjustable diaphragm to control pitch of note. **63/-**

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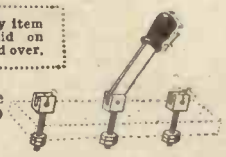
Superior nickel plated D.P.D.T., without bases ready with nuts for mounting on your own Panel. Extremely smart appearance. Take up little room. **2/6**

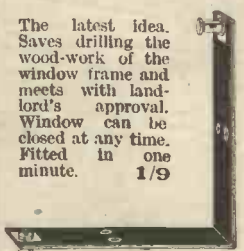
Postage on every item extra, but paid on orders of £2 and over.

Ditto, but single pole only **1/9**



Simplex Lead-in.

The latest idea. Saves drilling the wood-work of the window frame and meets with landlord's approval. Window can be closed at any time. Fitted in one minute. **1/9**



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4 leaf laminated. Complete with bush, nuts and washer 2/-

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Single pole, single throw. On ebonite base ... 2/3 each.

KNIFE SWITCH.
Double pole, single throw. 3/6

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Miniature size, each 5d.

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Small size and light weight, each 4d.

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7/22 stranded hard drawn Copper, per 100 ft. coil... 3/6
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18 SWG Silicon Bronze, per 150 ft. coil ... 3/-

16 SWG Enamelled Copper, per 150 ft. coil ... 2/-

REEL.
2 in. diameter, good quality, each 3d.

CIRCULAR IVORINE SCALE.
Very neat pattern, each 4d.

IVORINE SCALE
Engraved 0-180 each 1/-

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Superior pattern in solid Ebonite, each 2/-
American pattern. Engraved 0-180 each 2/6

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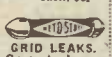
H.T. BATTERIES.
Very silent and thoroughly reliable. Fitted with two Wander Plugs

15 volts	...	5/-
36 "	...	7/6
60 "	...	14/-



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Brass clips free.

RESISTANCE UNIT.
50,000 ohms, 2/6
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Guaranteed accurate and mounted with clips.
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COIL WINDING WIRES. Prices per lb.

S.W.G.	S.C.C	D.C.C.
12 ...	1/10	1/11
16 ...	2/-	2/1
20 ...	2/2	2/3
24 ...	3/-	3/6
28 ...	4/4	4/7
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Bobbins Free. Postage Extra. Reels 3d. extra if under one pound of any size. For quantities less than ½ lb., add 10 per cent.

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Finest quality Intervalve Transformer. Fully guaranteed. Tested to 500 volts between windings. Very silent in action and free from all distortion ... each 21/-

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For H.F. Amplification on all wave lengths above 1000 metres. No. 1 for coupling between H.F. and Detector and No. 2 for use where more than one stage of H.F. Amplification is used.
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Permits the usual type of honeycomb coil to be used as a tuned anode coil with exceptionally good results. Simply plug in H.F. Holder and add suitable honeycomb coil. each 3/6

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L25 ...	5/-	L300 ...	9/5
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L75 ...	5/6	L600 ...	11/-
L100 ...	7/-	L750 ...	11/10
L150 ...	7/10	L1000 ...	12/8
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SLAB COIL PLUG.
To take Slab Coils. Solid ebonite throughout ... ... each 2/6

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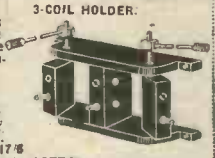
3-COIL HOLDER.
Best solid ebonite throughout. Fitted with either knobs or long handles. Price, 17/6



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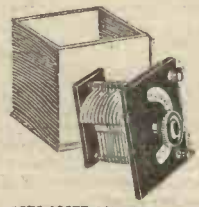

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For Panel mounting.

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Small size ... 2d.
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4 volts, 10 amp. hrs. continuous, 14/6
4 volts, 20 amp. hrs. continuous, 17/6
4 volts, 40 amp. hrs. continuous, 27/6
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All Accumulators add 1/- for packing.

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Totally enclosed and mounted on polished Ebonite and all fittings plated 5/6

EBONITE SLIDER.
As shown, each 5d.

BRASS TERMINALS.

MK III. pattern. Small, 2/3 doz. Large, 2/6 doz.
Divided pattern. Large, 3/6 per doz. Small, 2/- per doz
Telephone pattern. Small, 2/6 doz.

SWITCH STOPS.
Brass, fitted with two nuts.
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Brass, fitted with two nuts.
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Brass, fitted with two nuts ... ... each 1½d.
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THE "PETO-PAN," LOUD SPEAKER.
A superlative Loud Speaker. Fitted with adjustable diaphragm which controls pitch of note. Price 50/-
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CRYSTAL RECEIVER.
(De Luxe pattern).
Complete with best quality phones, aerial wire and insulators. Nothing more to buy.
Price, £6 6s. 0d.

WIRELESS CLUB REPORTS.

The Editor will be pleased to publish concise reports of meetings of Wireless clubs and associations, reserving the right to curtail the report if necessary. Hon. secretaries are reminded that reports should be sent in as soon after a meeting as possible. Reports sent in cannot appear in this paper in less than ten days after receipt of same. An Asterisk denotes affiliation with the Radio Society of Great Britain.

The Stratford-on-Avon and District Radio Society.

The fifteenth general meeting of the above society was held on Monday evening, February 19th, at the Rother Street headquarters. The report of previous meeting being read, the secretary explained the construction of a variometer and its use, various parts of the instrument being passed round for inspection. The next item consisted of the winding of "Honeycomb" inductances, both by hand and machine. A receiving set made by one of the members was brought along for inspection and test, and after a brief explanation of the apparatus it was coupled to the aerial and good results obtained.

Hon. sec., Mr. E. W. Knight, 17, Park Road, Stratford-on-Avon.

Isle of Man Radio Society.

A meeting was held on February 19th at the Secondary School, Douglas. Mr. H. Colebourne presided, and there was a good attendance. After the opening business the chairman called upon Mr. P. J. Johnson to address the meeting on "The Valve as a Detector." The speaker explained the action of the original two-electrode Flemming valve. Dealing with the three-electrode valve he showed the action of the grid as a controlling electrode, producing variations in the anode current which affected the telephones. Mr. Johnson illustrated his very capable address by a large number of very clear diagrams which reflected the thoroughness and excellence of his effort. Some discussion took place, and a vote of thanks to Mr. Johnson was proposed by Mr. Gillmore, seconded by Mr. Denny, and carried unanimously.

Joint hon. secs., Mr. J. S. Craine, 6, Belmont Terrace; Mr. J. P. Johnson, 16, Hildesley Road, Douglas.

Guildford and District Wireless Society.

On Monday, February 19th, the club assembled for the first regular meeting at their new premises (148, High Street) to hear a paper read by Mr. P. K. Turner on aerials and aerial circuits. Mr. Turner went considerably into detail on the matter, devoting the vast majority of the available time to considering the outside aerial only.

The Fulham and Putney Radio Society.*

The above society has been reorganised and a new committee formed, who intend to run the society on up-to-date lines and give the members something of interest at each meeting.

At a meeting held at headquarters on Friday, February 16th, amongst other business, R. H. Redmond, Esq., T. Hart Smith, Esq., and E. M. Wolfe, Esq., M.B.E., were elected vice-presidents.

A very interesting demonstration was given by Mr. Pincott with his four-valve set and loud speaker made by himself, and at 9.30 p.m. Mr. Hubbard, 2 X O, a member, transmitted speech and music from his station, which was rendered very loud and clear to the members through Mr. Pincott's loud speaker.

The membership has greatly increased, and now that the society is well established and bright, instructive meetings promised, the membership should still increase.

Hon. sec., J. Wright Dewhurst, 52, North End Road, West Kensington, London, W. 14.

The Hinckley and District Radio Society.

The Hinckley and District Radio Society, which was formed in December last, continues to make progress. The membership exceeds thirty, and includes several ladies. Messrs. Pickering & Sons, printers, have given the free use of a room in their premises, and an aerial has been erected by members of the society. Application has been made for a licence for reception, and in the meantime a sub-committee is undertaking the construction of a five-valve instrument. A Morse class has been formed with Mr. Elliot as instructor.

Sec., W. Bliss, The Haven, Cleveland Road, Hinckley.

South Shields Y.M.C.A. Wireless Society.

The above society gave a demonstration of wireless telephony on February 3rd at the Sunday evening concert held in the Y.M.C.A. Hall, and aroused considerable interest.

Hon. sec., Mr. G. G. Busbridge, 25, The Crescent, Cleadon Estate, South Shields.

THE ATTACK ON THE B.B.C.

As we go to press with this issue the "Daily Express" has created some interest in the Wireless World by a whole-hearted denunciation of the B.B.C. and the present broadcasting arrangements.

"Popular Wireless," at the moment of writing, will adopt an impartial attitude until the "Daily Express" give some indication that they have a practical alternative scheme for "running" a broadcasting service.

At the moment their criticisms are more destructive than constructive; they suggest their readiness to carry out a broadcasting service on their own—another monopoly, and one which would only set the rest of the Press in an uproar.

In their issue for April 6th the "Daily Express" says:

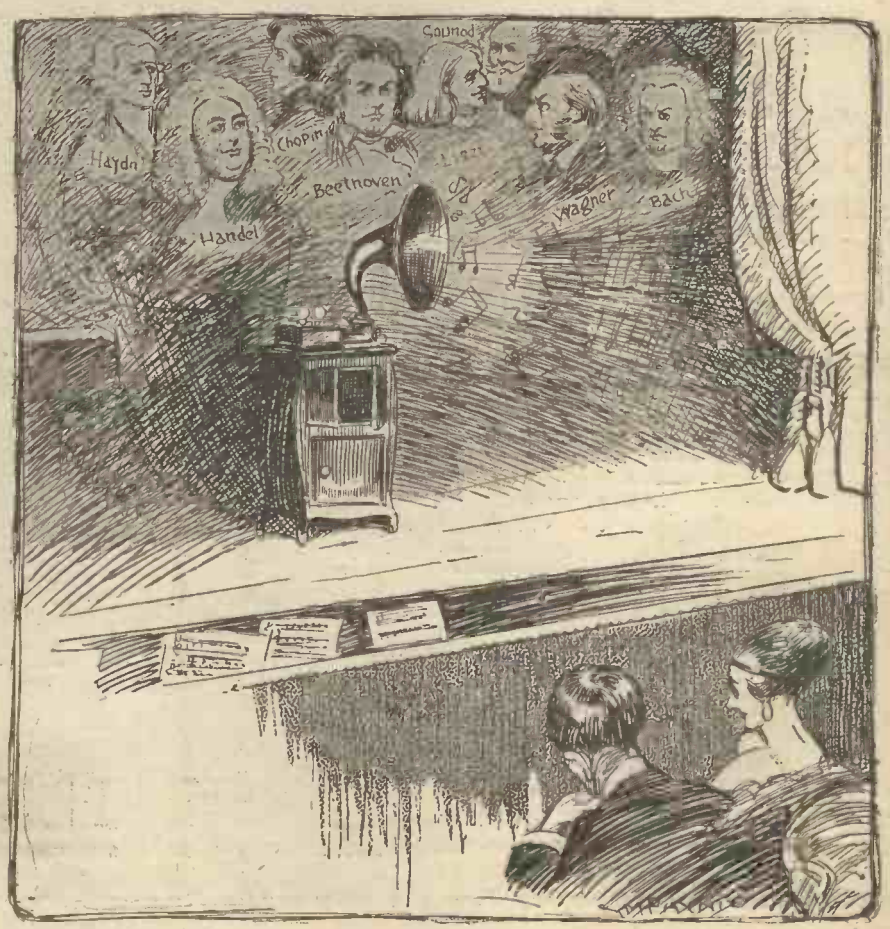
"Several firms are prepared to follow the lead of the 'Daily Express,' which has offered to begin broadcasting at once for nothing and provide programmes that will rescue listening-in from the boredom of the lustreless programmes sent out by the British Broadcasting Company.

This would, of course, be a very nice little scoop for the "Daily Express"—but there is not much chance of it coming off. On the other hand, the "Daily Express" has undoubtedly a very good case against the present broadcasting system. "Popular Wireless" agrees that the programmes are not as good as they might be, and that the exorbitant charges for receiving sets are a direct result of the present monopoly.

The Radio Association has cast in its lot wholeheartedly with the "Daily Express" — but although "Popular Wireless" is the official organ of that Association, its views are not necessarily the same as those expressed by the Radio Association.

"Popular Wireless" prefers to withhold a definite opinion until further details are forthcoming.

THE GHOSTS LISTEN IN.



RADIOTORIAL

All Editorial Communications to be addressed The Editor, POPULAR WIRELESS, The Fleetway House, Farringdon Street, London, E.C.4.

Readers have probably noticed how all the daily papers have just lately taken up the slogan, "Another class of licence is wanted." The "experts" employed by the various newspapers have at last realised the importance of encouraging the amateur to exercise his ingenuity in making his own apparatus, and although they have been a long time following the lead given by POPULAR WIRELESS, I am glad to see that a good deal of publicity is being given in the daily press to this important question. As I have said before, things move slowly in the official world, but no one doubts that the home-made set licence is now a foregone conclusion, and before long the thousands of P.W. readers who have been chafing under the narrow restrictions resulting from a hasty G.P.O., will have been relegated to the scrap heap, and amateur initiative will at last be able to work in the light without detriment to the revenue of the B.B.C.

But, as I have said before, even when this desirable state of things has come to pass, there will still remain a few "dodgers," gentlemen who feel a moral objection to paying even a yearly licence fee.

Every reader who loves fair play will agree with me when I say this type of dodger deserves no sympathy, and that if he is caught out he has only himself to blame if he gets severely dealt with.

THE EDITOR.

Questions Answered

Owing to the enormous number of queries received daily from readers of POPULAR WIRELESS, I have temporarily decided to limit the number of questions sent in by one reader to three. Readers are asked to keep their questions as short and as concise as possible in order that the minimum of delay can be exercised in answering queries. Until further notice three questions from one reader will be the limit for one letter. All questions should be addressed to POPULAR WIRELESS Queries Department, Room 138, Fleetway House, Farringdon Street, London, E.C.4.

Readers are requested to send the necessary postage for reply..

The Editor desires to direct the attention of his readers to the fact that, as much of the information given in the columns of this paper is of a technical nature and concerns the most recent developments in the Radio world, some of the arrangements and specialities described may be the subject of Letters Patent, and the amateur and trader would be well advised to obtain permission of the patentees to use the patents before doing so.

M. C. H. (Antwerp).—What are the millimetre dimensions of the most used gauges of copper wire ?

20 S.W.G. is ·9144 mm ; 22, ·7112 ; 24, ·5588 ; 26, ·4572 ; 28, ·3759 ; 32, ·2743 ; 36, ·1930 ; 38, ·1524 ; 40, ·1219 ; 44, ·0813 ; 46, ·0610 ; 48, ·04064.

* * *

D. E. R. (Harrow).—I am thinking of using dull emitter valves on my three-valve set, shall I need to alter the wiring at all ?

No, practically the same circuits will be quite suitable, but you may find that a grid leak of different value will be necessary for the best results. Your present filament resistance will be O.K. if you use dry cells or a 2 volt accumulator. It would be best to add a separate filament resistance for the detector valve, as a great deal depends upon the filament control, and it is not always convenient to have the detector and L.F. working off the same control.

* * *

A. T. C. P. (Catford).—I have been told that to decrease the wave-length of my aerial I must connect a small capacity condenser in series with it, but also that the smaller the condenser the more decrease in wave-length will be obtained. Is this correct ?

Yes, quite correct. You are probably familiar with the fact that a capacity in a series decreases the capacity of the aerial, and also that to add a condenser in series with another condenser will decrease the capacity of the circuit. This is easily shown, and the actual values obtained can be worked out by the formula $\frac{1}{K} = \frac{1}{K_1} + \frac{1}{K_2} + \frac{1}{K_3}$, etc., where K is the resultant capacity, and K1, K2, K3, etc., are the respective capacities of the various condensers connected in series. Suppose, for the sake of argument, that the capacity of your aerial is 2 mfd.—it is much less really—and that you are adding a capacity of 3 mfds. in series with it. The resultant K is found by the above formula; so we have $\frac{1}{K} = \frac{1}{2} + \frac{1}{3} = \frac{5}{6}$; therefore $K = \frac{6}{5} = 1\frac{1}{5}$ mfd., which is less than that of the original aerial. Now, if we add a *smaller* capacity to the aerial we shall find that the capacity of the aerial is still further reduced. Using a capacity of 1 mfd. we have $\frac{1}{K} = \frac{1}{2} + \frac{1}{1} = \frac{3}{2}$, so that $K = \frac{2}{3}$, which is much less than $1\frac{1}{5}$. Thus it is seen that the smaller the capacity in series with another capacity, the smaller is the resultant capacity. Now, if we decrease the capacity of an aerial we decrease its wave-length, so, therefore, by adding a small capacity we decrease the wave-length of the aerial by a larger amount than if we added a large capacity in series with the aerial.

* * *

"Spider-Web" (Northampton). I have wound some spider-web coils, using 9 spokes and 26 D.S.C. wire, but find it very difficult to keep the coils from falling to pieces when the spokes are removed. Can I soak them in paraffin wax ?

The coils may be soaked in paraffin wax, but on removal should be shaken so that all surplus wax is thrown off. Before removing the spokes tie each part of the coil where the wires cross with string. This will prevent the coil collapsing when the spokes are removed. Remember that not more paraffin wax should be used on the coils than is necessary to keep them fairly rigid, as the whole idea of the basket or spider-web coil is to avoid too much self capacity, and if you fill up the air spaces between the turns with paraffin wax you will increase the capacity of the coil.

* * *

M. A. M. (Torquay).—How does a hot-wire ammeter function ?

This type of ammeter is used when alternating or high frequency currents have to be measured. Owing to the fact that these currents are always rapidly changing in direction, the ordinary coil type of ammeter would not be able to register. In this case the hot-wire ammeter is used. A special platinum wire, which expands evenly is employed, and this is attached to the pointed and calibrated scale. The heat evolved by the current surging through the wire causes the wire to expand and sag, and this in turn operates a pointer controlled by a small spring. Thus it is the heating effect of the current which operates the instrument, and from this is registered the flow of current in amperes.

* * *

P. T. D. (Winchester).—Is there any fuse on the market which can be used to protect a valve from the H. T. battery ?

You will find that a 2·5 volt pocket-lamp bulb placed in series between the high-tension battery and the positive H.T. terminal of the set will protect the valve quite successfully against any wrong connection that may endanger the filament. Normally, only a few milliamps. will be flowing through the small bulb, so that it will not form any appreciable resistance in the plate circuit. Any sudden discharge of the battery will have to pass through the lamp, and will blow the filament before damage is done to the valve.

* * *

"Dull Emitter" (Plaistow).—Are there any dry cells that will successfully light a dull emitter valve for a fairly long period of time ?

Yes, the ordinary pocket-lamp cells will do it if a very low consumption valve is used, such as the ·11 amp. type. If the ·3 amp. valve (D.E.R.) is employed, you will find that the Hellesen batteries of large capacity will last a considerable time. Such types naturally cost rather more than the ordinary small cell, but will be worth the extra outlay in the end.

* * *

"Condenser" (Manchester).—What are the specific inductive capacities of plate-glass, paraffin wax, ebonite, mica, air, shellac?

(*Continued on next page.*)

RADIOTORIAL QUESTIONS & ANSWERS.

(Continued from previous page.)

The specific inductive capacities or dielectric constants are as follows: Plate-glass, 5.8 to 8.5; paraffin wax 1.9 to 2.3; ebonite, 2.2 to 3.2; mica, 5.0; air is taken as unity; shellac, 2.74 to 3.73.

* * *

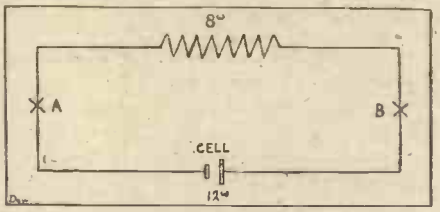
M. A. P. (Godalming) asks for a criticism of his four-valve set.

Firstly, your grid is wrongly connected. You are using I.H.F. valve and a L.F. with the detector between them, therefore the grid leak and grid condenser should be connected to the second, or detector, valve, not to the first valve, which is to act as an H.F. amplifier. Your H.T. battery should have a condenser connected across it, about ·02 will be O.K., and the phone transformer should be shunted by a ·001 mfd. condenser. Yes, we advise the tuned anode type of H.F. plate tuning for wave-lengths below 1,500 or 2,000 metres; but you should certainly use reaction. The reaction can be coupled with the tuned anode coil very easily, especially if you use basket of honeycomb coils for both.

* * *

F. L. (Teignmouth).—How can I measure the internal resistance of a battery?

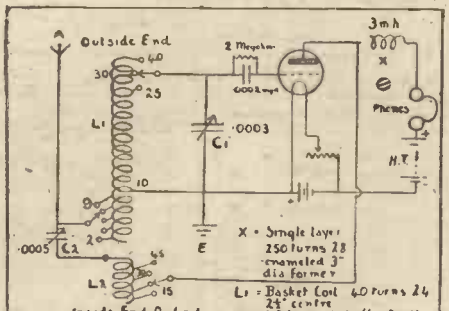
There are numerous methods, most of which call for the employment of a standard cell; but the possession of a voltmeter and a known resistance will suffice in the following case. From a knowledge of the voltage of a cell on open circuit, and the difference of potential across its terminals when connected up with a known resistance, the value of its internal resistance can readily be calculated. For instance, we will presume that the voltage registered across the cell terminals on open circuit is 2 volts, but when the circuit is closed through an 8-ohm resistance, as shown in the diagram, the difference of potential across points A and B drops to ·8 volts. Therefore it shows that 1·2 volts have been lost in the battery itself. Now the current flowing through the battery and the external resistance will be, naturally enough, the same, therefore it follows by Ohm's Law that ·8 is to 1·2 as 8 is to the internal resistance of the battery, which is obviously 12 ohms.



* * *

B. N. (London) and others ask for particulars of the Reinartz receiver.

The Reinartz receiver designed by Mr. J. L. Reinartz is the combination of inductive and capacity reaction, and is said to be one of the most suitable circuits for the reception of short-wave C.W. yet devised. It is not suitable for the reception of telephony. Most of the details are embraced by the accompanying diagram, with the exception of the coils L1 and L2. These are constructed in the following manner. On a former 2½ ins. in diameter with 9 spokes, 45 turns of 24 gauge wire is wound



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RADIOTORIAL QUESTIONS AND ANSWERS.

(Continued from previous page.)

leads being taken to studs at the first, fifteenth, thirtieth, and last turns. Above this coil on the same former is then wound a further 40 turns of the same wire, tappings being taken at the points shown in the diagram. This latter is L1, whilst the first coil of 45 turns is L2 in the diagram.

* * *

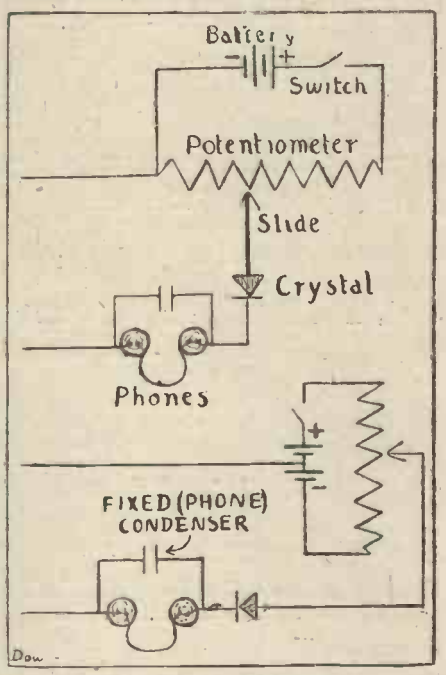
P. W. R. (Nottingham).—Is there any advantage in using an earth arrester?

Yes. It does away with the need for an earthing switch for protection against lightning and other heavy discharges. The earth arrester provides a by-pass for such heavy discharges, which will spark across the small gap in the arrester rather than take the path of high impedance through the coils and windings of the set.

* * *

"CARBO" (Glasgow).—How do I put a potentiometer and battery into circuit if I change my crystal for carborundum, which I believe must have such additions?

See the accompanying diagram. You will note that two methods are shown, the bottom one allowing for the varying of a potential through the detector circuit in either direction. Although an extra battery may be required, this latter arrangement is very advantageous, as it prevents the necessity of changing leads over arising. Don't forget to leave the switch open when the set is not in use, otherwise the battery will be slowly running down all the time. The potentiometer should have a resistance of some 400 ohms, the battery a pressure of 4 volts or so. A dry battery is all that is required, and the detector should be carborundum and steel.



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RADIOTORIAL QUESTIONS AND ANSWERS.

(Continued from previous page.)

F. E. (Peterboro').—Why is a short aerial advisable for broadcast reception? You tell me that a 60-ft. single aerial will be more suitable than one that is longer, and also a single 60 ft. will be better than a twin aerial 60 ft. long. Why is this?

In the first place, an aerial has fundamental wave-lengths, and to tune to stations sending on various W.L.'s, it is necessary mostly to loud inductance on to it in order to increase its wave-length and bring it to that value, where it will correspond or be in tune with that of the desired station. If the natural wave-length of the aerial system is above that of the transmitting station, then the capacity factor must be attacked and reduced by placing a condenser in series. The next point to consider is that of potential. A detector is a potential operated device, and therefore it is as well to tap the detector circuit off across points of greater difference possible. Therefore, the inclusion in the aerial circuit of a reasonably sized inductance is advantageous. Further, the introduction of capacity is, as is well known, disadvantageous, owing to the damping that results. Therefore, a moderate aerial with a fair amount of inductance in the set is necessary for obtaining efficient results on the shorter and broadcast wave-lengths. It must be added that height is *the* important factor in aerial efficiency.

* * *

"Amateur" (Broad Oak).—What are the most important points that determine the power of a wireless receiver?

The efficiency of the aerial and earth system, sharpness of tuning, sensitivity of the detector and telephone receivers, and degree and extent of amplification if employed. There are other points no less important, but will be efficient in standard design and construction of apparatus.

* * *

L. C. (Bristol).—I have a crystal set ranging from 300–600 metres, with two sockets for plug-in loading coil. What size coil should I need to increase the range to 2,600 metres?

Provided you do not wish to tune in stations between 600 and 2,000 metres or so; a 150-turn honeycomb coil would be quite suitable. Use 26 D.S.C. on a 2-in. former, about an inch to an inch and a half wide, with 15 spokes each side. Tappings could be taken from this coil to provide for wave-lengths between 600 and 2,000 metres, though for those lengths it would be more advisable to use various sized coils for plugging in. A set of honeycomb coils of 35, 50, 75, 100, and 150 would meet your requirements quite well.

* * *

"Enquirer" (Barnes).—How does one work out the inductance and capacity of an aerial?

The formula for working out the inductance of an aerial is as follows. In the case of a single wire:

$$L = \frac{2l}{1000}\left(2.3 \times \log. \frac{4l}{d} - 1\right) \text{ mhys.,}$$

and in the case of two parallel wires,

$$L = \frac{4l}{1000}\left(2.3 \times \log. \frac{D}{d}\right) \text{ mhys.}$$

For mathematically determining the capacity of an aerial:

$$C = \frac{1}{4605\left(\log. \frac{4h}{d}\right)^2 900{,}000} \text{ mfds.}$$

l = length of wire; D = distance between parallel wires; d = diameter of wire; h = height. All, as usual, in cms. Results will be approximate.

Another and simpler method, which will give results almost as accurate as the above is likely to be, is to multiply the length of the aerial in feet by 1·5, call the capacity factor ·0002 for a small aerial and ·0003 for a larger, and apply the formula

$$L = \left(\frac{1{\cdot}5 \times l}{1885}\right) \div {\cdot}0002 \text{ or } {\cdot}0003$$

in order to obtain the approximate inductance of the aerial in mhys.

* * *

E. E. P. (Axmins er).—I find difficulty in polishing ebonite. Can this be done successfully by an amateur?

Yes, but why polish it? In the case of panels, though a highly polished surface certainly gives the instrument a smart appearance, we prefer a matt surface when the insulating properties are taken into account. You will find that moisture is apt to condense on the surface of the polished panel, and thereby give rise to a certain amount of leakage. The necessary treatment of ebonite in order to get that fine polish is rather tedious, but if carefully carried out will be

(Continued on next page.)

RADIOTORIAL QUESTIONS AND ANSWERS.

(Continued from previous page.)

found to be quite effective. If a lathe is handy, the procedure will be considerably shortened, though just as fine a surface can be obtained by hand. First of all the ebonite is treated with water and finely powdered Bath brick until all the rough scratches and surfaces have disappeared. Then rub the surface carefully with a mixture of soft soap and rotten stone until the desired smoothness has been obtained. Rinse with petrol and polish with a dry chamois leather cloth. This latter can be greatly facilitated if a lather with a high-speed revolving buff is used.

* * *

F. H. T. (Pitsea).—What materials are used in lacquer, and how is it applied?

A very good lacquer can be made up from about 1½ lbs. of seed lac—as clean as you can possibly get it and free from all black specks—and a quart of rectified spirits. The two are shaken up together and kept warm until all the solid has dissolved. When lacquering see that the brass is perfectly clean and free from grease, and apply the solution with a fine camel-hair brush. It is usually found more effective if the lacquer is applied to the object when cold, instead of warming the brass, as is often recommended. When a fairly even coat has been put on warm the article gently until the lacquer melts. Remove the brass from the flame as soon as it becomes bright, when it will be seen that the lacquer has run slightly and formed an even coat over the surface of the metal. Needless to say, the portions of terminals, switches, etc., which have to make electrical contact with wires or one another should not be lacquered.

* * *

K. N. T. (Harringay).—Up to the last few days my set has been working quite well, but lately results have been very faint. Is my valve burning out?

No; the valve will keep up its efficiency to the last, though it may become a trifle soft. In all probability either the H.T. or L.T. batteries are at fault. See that the L.T. accumulator is not sulphated and is registering its correct voltage (1.8 or more per cell) while on discharge. Try a new H.T. battery. If this does not clear up the trouble, test the phones on someone else's set and see that they are O.K. Next have a look at all connections, especially the switches, and make sure that they are clean. A tiny coating of oxide will be quite sufficient to cause decreased signals or even complete failure. It will be just as well to clean all connections and terminals and thoroughly overhaul the set.

RECENT WIRELESS INVENTIONS.

The following abstracts are published by arrangement with our Patent Adviser, Harold J. C. Forrester, Chartered Patent Agent, of Jessel Chambers, 88-90, Chancery Lane, W.C.2.

Grant of the following Patents can be opposed, and printed copies of the full specifications, with drawings, can be purchased from the Patent Office, Chancery Lane, W.C. 2.

192,342.—NAAMLOOZE VENNOOTSCHAP PHILIPS' GLOEILAMPENFABRIEKEN.—RECTIFIERS.—A screen of mica is placed between the electrodes of a two electrode rectifier to prevent disintegration and deposits of one upon the other.

192,404. — SIGNAL GES. — TELEPHONES. —Diaphragms have radial and concentric corrugations or inclined slots to prevent buckling under temperature changes which would affect tuning and air gap.

192,429.—J. SCOTT-TAGGART & RADIO COMMUNICATION CO.—RECEIVING APPARATUS.—For receiving continuous waves a valve has its anode at zero, negative, or slightly positive potential, and a local current of audio frequency or a slightly different frequency from the received waves is impressed upon the anode of a two electrode valve or upon the grid of a three electrode valve. The anode potential prevents current flow in the anode circuit except when signals are received. In one arrangement, the grid of one valve receives the incoming oscillations, the plate and filament are bridged by the grid circuit of a generating valve, the oscillatory circuit of which may be tuned to give oscillation at nearly the incoming frequency. The telephones are inserted in the anode circuit of the second valve, and fluctuations of conductivity of the first valve cause variations in the current flow through the second.

192,460.—C. LORENZ AKT.-GES.—ALTERNATING CURRENTS.—For converting low to high frequency, the iron cone of a transformer in series with an alternator is arranged to be readily saturated, and the circuit tuned to the alternator frequency. The high frequency circuit comprises an aerial and inductance connected to earth through the transformer, and tuned to an odd multiple of the low frequency.

192,461.—C. LORENZ AKT.-GES.—ALTERNATING CURRENTS.—An oscillatory circuit tuned to a harmonic of a low frequency source is connected in parallel, and a large inductance in series with a transformer coil. An aerial may be directly or inductively connected to the transformer winding.

192,464. — W. R. BULLMORE. — VALVES. — The electrodes are made spherical or egg-shaped, and arranged one inside the other, the grid being wound about the filament upon a removable hollow mould, and the plate formed of two hemispherical stampings of sheet metal or fine gauze.

We have arranged for Patent Enquiries addressed to our Patent Adviser to be answered direct by post, any enquiries of general interest being also answered in our columns.

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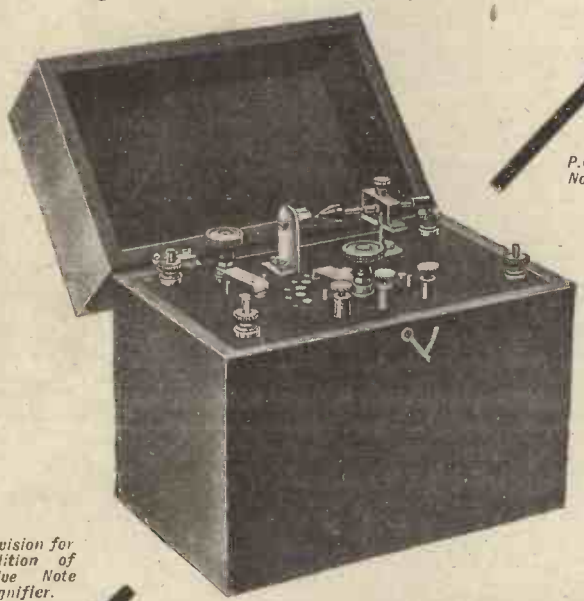

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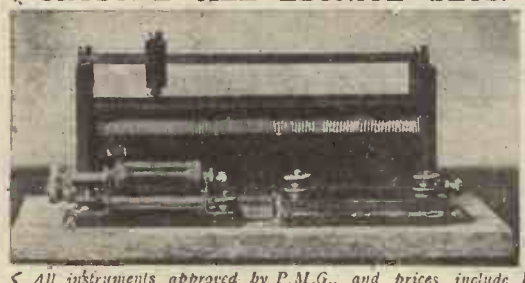

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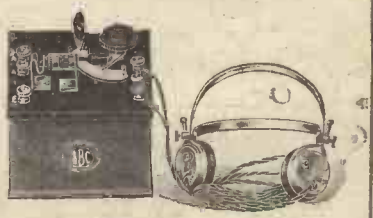

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R/R

POPULAR WIRELESS WEEKLY, April 21st, 1923. REGISTERED AT THE G.P.O. AS A NEWSPAPER.

THE LEADING WIRELESS WEEKLY.

Popular Wireless

PRICE 3d.

No. 47. Vol. III.

SCIENTIFIC ADVISER: SIR OLIVER LODGE, F.R.S., D.Sc.

April 21st, 1923.

Wireless on a Pullman car running between London and Dover. Sir Davidson Dalziel is seen listening to a concert.

FEATURES IN THIS ISSUE.

Tuned Anode Conversion.
A Novel Tuning Arrangement.
Notes on Accumulators.
Transformers for A.C. Charging.
Constructional Hints on Loud Speakers.
A Unit Broadcast Receiver.

And Articles by William Le Queux, M.I.R.E., E. Blake, A.M.I.E.E., and Captain H. Shaw, M.Sc., A.R.C.S., F.Inst.P.; and Special Report of Captain Eckersley's Lecture.

POPULAR WIRELESS

April 21st, 1923. SCIENTIFIC ADVISER, SIR OLIVER LODGE, F.R.S. D.Sc. [Every Friday.

TOPICAL NOTES AND NEWS.

A Big Scheme.

A SCHEME involving the expenditure of between £2,000,000 and £3,000,000 is to be carried out by the Marconi Company in order to provide a chain of powerful wireless stations.

In effect, a new wireless town is to be erected in England, consisting of six stations grouped together for the purpose of communicating with as many parts of the world, or, alternatively, being devoted to one point where for any reason there is a "rush" period. The minimum transmitting capacity for the combined stations is to be about 35,000 or 40,000 words per hour.

The site of the new stations has not yet been decided, but the probability is that Marlborough Downs, in Wiltshire, will be chosen.

* * *

Wireless Licences.

ABOUT 260 wireless manufacturing firms have become members of the British Broadcasting Company, stated Sir W. Joynson-Hicks recently. The number of types of broadcasting-receiving apparatus approved by the Post Office is 1,450. The number of wireless licences at present issued is, approximately, 115,000, of which about 80,000 are in respect of receiving sets bearing the trade mark of the British Broadcasting Company.

* * *

Charabanc Wireless.

MESSRS. Ward and Goldstone, Ltd., tell me that they recently equipped a Salon de Luxe charabanc, which made a trip from Mosseley (Lancs) to the Grand National race at Liverpool. The set was a "four valver," with loud speaker, and the passengers enjoyed concerts from 2 L O and 2 Z Y during the ride.

* * *

Radio Association Activity in the Midlands.

IT is proposed to form a Midland centre of the Radio Association with headquarters in Birmingham, where there has been already formed an active and enthusiastic branch. This step is being taken in order that members and branches in outlying districts may have the opportunity of attending some of the excellent lectures and demonstrations that are being arranged by the Birmingham branch, and also that proper co-operation of the Midland radio enthusiasts may be obtained for their mutual advantage and benefit. Will those interested in this movement who live within a 20 mile radius of Birmingham kindly write to Mr. C. H. Gardner, Hon. Midland Organiser, Amblecote House, Brierley Hill, Staffs.

Birmingham Notes.

THE largest hotel in Birmingham, the Queen's Hotel, has been licensed for broadcasting from 12.30 p.m. to 11 p.m. for six days of the week.

* * *

THE former Postmaster-General (Mr. Neville Chamberlain, now the Minister of Health) and Mrs. Chamberlain, recently entertaining their supporters in the Ladywood Division (Birmingham), included in the programme of entertainment a wireless concert from 5 I T, which by special arrangement also provided the dance music. A striking item was a spot dance. The music suddenly ceased, and when Mrs. Chamberlain reached the lucky spot the voice of the announcer was heard congratulating the winning dancers. The demonstration was arranged by a well-known Birmingham wireless enthusiast, Mr. C. S. Baynton, of 2 K O, and Burndept's Midland representative.

* * *

TO the Birmingham Broadcasting Station belongs the honour of being the first British broadcasting station to solve the mystery of a Boy Scout missing from his home in Birmingham.

In 5 I T's weekly talk to Boy Scouts a description of the missing lad was given. On that night members of the Bristol police were listening-in, and they took down the description of the boy, traced him, and he was returned to his home within twenty-four hours.

Wireless "Howlers."

MR. MEIKLEJOHN told by wireless recently some good schoolboy "howler" stories. I agree with the bright lad who, asked where Mary Queen of Scots was born, and how it came about that she was born there, said that she was born at Linlithgow, "because her mother happened to be staying there at the time."

* * *

Loud Speakers for Railways.

AN interesting experiment to travellers on the Brighton line was made recently in the booking-hall at Victoria Station. Two huge "loud speakers" were fixed high up in the roof, and news of the arriving and departing trains was broadcasted for the benefit of travellers and their friends. Railway officials were present to test the device, and no doubt if it is a success the company will take up the invention.

* * *

Admiral Sir Henry Jackson, the Naval Wireless Expert, with Lady Jackson, adjusting part of his experimental receiver.

Another Radio Giant.

THE big, high-power Radio station at Monte Grande, near Buenos Aires, the first South American station in the international commercial Radio system, is almost completed, and it is announced that service will begin in June or July.

It will place Argentine in direct Radio communication with the United States for the first time, as well as with Europe. Engineers say there are two strange, static "dead areas," one near the equator off Brazil, and one in the South Atlantic, which only a station equipped like that at Monte Grande can overcome.

(*Continued on next page.*)

NOTES AND NEWS.

(Continued from previous page.)

"That Freedom."

DID you hear the London station's broadcast play "That Freedom"? Quite an amusing skit, I thought—though the "Daily Express" was a bit snappy about it next morning. Captain Eckersley was, as usual, the life and soul of the whole affair, and I hope he will blossom out into a full-blown "Radio actor, author, and playwright" in the near future. Meanwhile, he has promised to write some articles for POPULAR WIRELESS, which is real good news.

Dr. N. W. McLachlan, of the Research Department, Marconi Works, Chelmsford, and inventor of the new magnetic power apparatus which will revolutionise high speed automatic radio transmission, will describe his invention in an early number of POPULAR WIRELESS. Dr. McLachlan will not describe this invention in any other wireless paper—in accordance with an agreement with the Editor—until his article in POPULAR WIRELESS has been published. This article will be exclusive, and will appeal to every reader.

* * *

Further articles by Sir Oliver Lodge will shortly commence in POPULAR WIRELESS.

An Editor's Regrets.

DID you hear Mr. W. Blackwood, the editor of *Answers*, broadcast last Friday? He is a Scotsman—and a Scotsman's voice seems "just right" for broadcasting. His remarks on an editor's life were remarkably true. If you don't believe me, write and ask the editor of POPULAR WIRELESS what he thinks!

* * *

Leafield and Cairo Expenses.

SIR R. BURTON CHADWICK, M.P., recently discussing an answer received from the Postmaster-General regarding the income and expenditure of the Post Office wireless stations at Leafield and Cairo, said a very disquieting state of things was revealed.

"It appears," he said, "from this statement that the Leafield station is costing £36,000 a year, and that the revenue for the nine months ending January is only £24,200.

"The figures for the Cairo station are even more extraordinary. The expenses are estimated by the Post Office at about £49,000 a year, whilst the revenue for the nine months ending January only amounted to £4,700. Bad as these figures are, it is by no means clear that they reveal the full extent of the loss on the working of these two stations."

* * *

Broadcasting and Theatres.

"THE theatrical industry is putting up a strong fight against the broadcasting of plays," Mr. Taylor Platt, secretary of the Theatrical Managers' Association, told the Press after a private meeting, representative of all sections of the profession, held to discuss the question.

"If plays are to be broadcast to people in their own homes," said Mr. Platt, "it will be difficult to get them to come to the theatres. That would be a very serious matter to those who are dependent upon the public support for their living, and must affect every branch of the industry."

Well, in my opinion, Mr. Platt has got hold of the wrong end of the stick. All records at present go to show that broadcasting *sends* people to the theatres rather than keep them away.

* * *

Only a Dream.

THERE'S quite a little flutter in wireless dovecotes nowadays as to whether the Wireless Telegraph Act of 1904 covers the present regulation whereby all wireless receiving sets must be licensed. One contemporary hints that amateurs may be able to demand their licence money back. This is interesting. Fancy a queue of amateurs outside the G.P.O. all waiting to get 10s. back for every year they've been amateurs! And just imagine the P.M.G. standing behind a counter ladling out ten-shilling notes.

Oh, it's too good to be true!

* * *

The Fly in the Ointment.

ALL the disgruntled critics who want to scrap the B.B.C. have lost sight of one big point. If the B.B.C. go smash no one else can carry on with broadcasting, simply because the Marconi Co. hold master patents which would put an end to the whole business should they choose to refrain from permitting their use for broadcasting. So the "Daily Express" need not have applied for a Broadcast Licence after all.

* * *

The Silver Lining.

BUT this outcry against the B.B.C. has done some little good. It has had the effect of improving the quality of the programmes, and Mr. Reith states that by May 1st every station's programme will be of much better quality. Contracts to broadcast the Grenadiers' band have already been fixed up.

* * *

Some Query!

OVER a hundred thousand people buy POPULAR WIRELESS every week, and judging from some of the letters received by the Technical Queries department which I saw the other day, a large majority are pretty hot stuff on wireless "technics." One modest lad wrote in the other day and asked for full details for the construction of a five-valve Armstrong Set introducing super-regeneration. The Technical Editor went out and had a cup of tea to think it over. I am surprised he ever came back.

ARIEL.

Broadcasting Programmes

What you can hear every evening of the week on your set.

TELEPHONY AND MUSIC TRANSMISSIONS

Station.	Call sign.	Wave-length in metres.	Remarks.
London Broadcasting Station, Strand ..	2LO ..	369 ..	11.30 to 12.30 every morning and usually every evening, 5.30–6.15 p.m.; 7 and 9.45 News; 7.30 Orchestra; 8.25 to 10.30, Music. Sundays from 8.30 p.m.
Newcastle Broadcasting Station	5NO ..	400 ..	As a rule from 7 to 10 p.m.
Manchester Broadcasting Station	2ZY ..	385 ..	11.30 to 12.30 every morning. Every evening usually from 5.30 to 10 p.m.
Birmingham (Witton) Broadcasting Station	5IT ..	425 ..	11.30 to 12.30 every morning. Every evening usually from 5.30 to 10 p.m. (News, Concerts, etc.).
Glasgow Broadcasting Station	5SC ..	415 ..	11.30 to 12.30 every morning. 5.30 to 10 p.m.
Cardiff Broadcasting Station	5WA ..	353 ..	11.30 to 12.30 every morning. 5.30 to 10.30 p.m.
Croydon	GED ..	900 ..	Throughout day to aeroplanes.
Paris	FL ..	2,600 ..	11.15 a.m., Weather Report; 6.20 to 7 p.m., Weather Report and Concert; 10.10, Concert.
Königswusterhausen ..	LP ..	2,800 ..	4 to 6.30 p.m.
The Hague	PCGG ..	1,085 ..	Sundays, 3 to 5.40 p.m., Concert. Thursdays, 8.40 to 9.40 p.m., Concert.
Haren	OPVH ..	1,100 ..	12 noon and 4.50 p.m. Telephony.
Radio-Electrique, Paris	—— ..	1,565 ..	5.5 p.m., News Items; 5.15 to 6.10, Concert; 8.45 p.m., News Items; 9 to 10 p.m., Concert. 2 to 3 p.m. Sat., Concert.
School of Posts and Telegraphs, Paris ..	—— ..	450 ..	Every Tuesday and Thursday, 7.45 to 10 p.m. Saturdays, 2.30 to 6 p.m.

Note.—See announcements in daily Press for last minute alterations in times of Broadcasting Programmes. No Broadcasting during hours of public worship on Sundays.

NOTE.—The Bar Lightship, Liverpool, sends telephony at 7 a.m., 9 a.m., 11 a.m., 12 noon, 1 p.m., and every two hours until 9 p.m. Calls "Dock Office" Liverpool answers "Bar Ship."

In addition to the regular transmissions carried on between the British amateur stations, much telephone conversation may be heard from St. Inglevert (A M), Le Bourget (Z M), and Brussels (B A V). These stations are quite powerful, but they call for a little extra care in tuning. Wave-length, 900 metres.

All times given at G.M.T.

"STOP THAT HOWLING."

A CHEERY CHAT BY CAPT. P. P. ECKERSLEY OF "TWO EMMA TOC" FAME.

A CHIME (?) of bells like someone stumbling over dozens of saucepans in the dark heralded the entry of Capt. P. P. Eckersley of 2 Emma Toc fame. "Hallo, C Q! hallo, C Q!" once more that cheery voice reminiscent of our radio "salad-days."

"I am now Chief Engineer of the B.B.C.," Captain Eckersley told us. "Engineer en Chef (that's French). To those old Writtle-ites who are now listening to me, I bow to them; I bow from the depths of my microphone. Now then, stop that howling, *stop it!* I say, I can see I shall have to teach you a bit about that. Now, I've come to the conclusion that heterodyning is due to three classes of people who use sets with adjustable reaction. First there is the ignorant, second the careless, and thirdly the malicious—ugh!—malicious.

The Cherry-stone Fable

"The ignorant are, I think, in the majority, please remember it might be *you*. I don't mean to say that you are ignorant. I don't know how to milk a cow, or to fill up an income-tax form because I haven't got a lot of money, but I do know a huge lot about wireless, and perhaps I can help you if you care to learn. 'Now what's that silly ass talking about?' you'll say. Well, it's about oscillating, howling, heterodyning, or what ever you like to call it (I won't say what I call it), and it's simply caused by maladjustment. Remember it might be you. You wouldn't, I know, you've got such a nice strong face, but just let me explain how you can tell if your set is oscillating. You know there is a handle on your set, which, if you turn it, makes the sounds get louder and louder until finally you get this"—with the faithfulness of long acquaintance, Capt. Eckersley voiced the protest of the oscillating set. "If you get that, *your set is oscillating*—stop it!"

"As regards the careless ones, I have a little story to tell them. There was once a very shy man who went to a dinner party. He'd already got through a good dinner when the cherry tart came along and this was exceedingly good. Now the difficulty was how to put out the stones. Some just spat them out, some took them out on their spoons, while others sort of blew them into their hands. This man, however, didn't like to do either of these so he kept them in the side of his mouth. Now, as I said, the tart was an exceedingly fine one, and our friend simply had to have another helping. After this he had two cheekfuls. But still, the tart was so fine he had a third helping. Then he was seized with a sneeze (that's difficult, 'seized with a sneeze,').

"Oh Heterodyne!"

Well, he 'snoze,' and later they were carrying out all his friends with shrapnel wounds. Needless to say he was never invited out again. You see it's one of those difficult situations like when somebody drops their false teeth and you simply have to laugh. You feel so ashamed of yourself. Similarly, when you find your set is oscillating, you should feel ashamed. Remember the story of the cherry stones. To the malicious I have nothing to say; I cannot understand anyone being of that state of mind. That's almost all I have to say to-night. To sum-up, let me say to the careless, if the note varies while you are tuning, you are oscillating. Stop it! To the careless, remember the story of the cherry stones. To the malicious, silence. An old Writtle-ite has written to me asking me to finish that little parody of mine, of Shakespeare's 'Mistress mine, where are you roaming?' This is it:

'Oh, heterodyne, why are you moaning?
Oh, how you spoil our telephoning
That we send out from 2 L O.'

"But no, let me sing it! Here, hold this, old man."

(What with falling over the piano, however, the words of the song were indistinguishable.

"Well, that's all, C Q. Good-night. Sor-r-r-r-r-ry you've been tr-r-r-r-r-oubled. Good-night, C Q. Good-night!"

Strange to say all through this cheery talk the moaning whistle of the "howler" was audible. Good advice in at both ears, but filtering out somehow.

Captain Eckersley, the Chief Engineer of the B.B.C.

NOTES ON THE RADIO ASSOCIATION.

BIRMINGHAM BRANCH.—At the branch meeting on Thursday, March 22nd, held in the Y.M.C.A., Dale End, Mr. C. H. Gardner, of Stourbridge, and late of London, gave an interesting lecture on his experiments in transmission from racing cars.

On Thursday, April 5th, Mr. Gardner gave a demonstration with a loud speaker.

BRIXTON BRANCH.—On Friday, March 23rd, at the Y.M.C.A., there was a good attendance of members to hear a paper read by the secretary, Mr. D. G. Fowler. After discussion, a vote of thanks was tendered him.

Professor P. M. Baker will attend the next meeting, giving one of his popular lectures.

BROCKLEY & DISTRICT BRANCH.—Professor P. M. Baker gave the second of his popular lectures at Gladstone Hall, March 23rd, which are thoroughly appreciated by members of the branch. Recent changes in personnel of the officers has resulted in the speeding up of branch business.

ABERYSTWYTH BRANCH.—A keen and determined branch of the parent organisation is now in being in this town. A large number of members were enrolled at the inaugural meeting, February 27th, and recruiting is steadily proceeding. Professor Gwilym Owen, D.Sc., M.A., Professor of Physics at University College of Wales, accepted the invitation to act as local president.

SOUTH NORWOOD BRANCH.—A strong and progressive committee is making this branch one of the foremost in the country, and their programme for the next few months is one to appeal to all wireless enthusiasts.

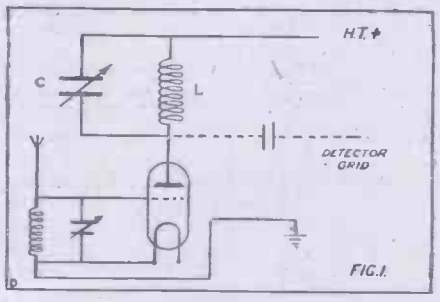
KENTISH TOWN AND DISTRICT BRANCH.—Though young, this branch is rapidly becoming a force in N.W. London. A very attractive programme has been formulated, and steps have been taken to deal with local "interference."

A UNIT BROADCAST RECEIVER.

By H. G. HERSEY (Member of the Wireless and Experimental Association).

PART 3.—THE H.F. PANEL.

THE panel I am about to describe is to be a Tuned Plate Rejector Circuit High-Frequency Panel. This instrument, when completed, is to be placed before the detector panel, its duty being to amplify the incoming signals at their own or radio frequency, passing the amplified signals to the grid of the detecting valve, where they are rectified and rendered audible in the headphones.



There are many forms of H.F. circuits, the most common in use being resistance capacity, transformer and tuned plate rejector. The first method is very efficient upon all long waves, i.e. above about 900 metres, and below this falls off in efficiency rapidly as the wave gets shorter, therefore this form cannot be considered of use to us at present for 400 metres and below. The second form, i.e. transformer coupled, is very efficient upon all waves from the highest to the lowest. The third form is also very efficient upon all wave-lengths, and only employs one winding or inductance. This method of amplification is to be recommended, although perhaps at first it will be found a little difficult to manage.

Principle of Tuned Anodes.

The circuits consist of an inductance. This may be of any variety (cylindrical, pile, basket, or honeycomb) that the reader may care to use. In order that my readers may understand clearly what actually happens in the rejector circuit a little space will be devoted to its description. Looking at Fig. I, it is seen that we have an ordinary valve circuit, except that an inductance is placed in the plate circuit. Now consider what will actually happen in this circuit; the incoming signals are fed upon the valve grid, causing a variation of plate current. This variation is of the same frequency as the incoming signal, and therefore not audible in the headphones should they be inserted. Now, if a small variable condenser, C, be placed across the inductance, L, Fig. I, the latter, if of a suitable value, may be tuned to the same wave-length as the incoming signals, the circuit so formed being known as a rejector circuit.

The effect of this circuit, L C, is that when it is in tune to the same wave-length as the incoming signals it offers an exceptionally high resistance or really impedance to frequencies of that wave-length, therefore they cannot pass through the circuit. With this state of affairs it will at once be recognised that a great P.D. (potential difference) will be set up across the coil, whilst the coil itself, having a comparatively low ohmic resistance, will readily pass the direct H.T. current from the H.T. battery to the plate of the valve.

If we now connect a small fixed capacity from the lower side of the inductance to the grid of the detecting valve, this condenser will pass the P.D.'s set up across the coil on to the detecting valve grid. In practice the coil should be of as low self-capacity as possible, in order to get the best results, and that it will work over a wide band of wave-length without undue loss of signal strength.

Grid Control.

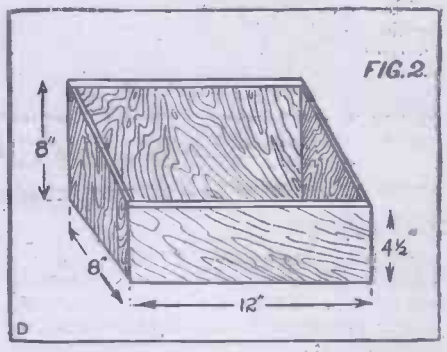
With a circuit so described above it is found that when the anode circuit is in tune with the aerial circuit the great impedance of the former causes the signals set up in it to be fed back into the valve, through the valve capacity itself. When this happens continuous oscillations are set up, and will heterodyne incoming signals, also break up or distort telephony. For the former it is most useful for C.W. reception, but for the latter a nuisance.

In order to obviate the setting up of local oscillations grid control is made use of. This means that provision is made that various potentials may be applied to the grid as required, and thereby render the set stable. This control may be utilised by connecting a suitable resistance across the valve filament, i.e. between the positive and negative legs. If we now have a slider or the resistance be tapped and a switch used, we are able to connect the grid at will (through the A.T.I.) either to the negative or positive leg, or any intermediate point where the set is maintained in a stable state.

Some instruments of this kind have the filament connection from A.T.I. connected direct to the positive leg of the valve filament, but this generally results in a loss, often considerable, of signal strength, the position upon a resistance in practice being found to be from one-third to half-way across the resistance from the negative side, and as the switch or slider be moved more to the positive side the amplification falls off.

Use of Reaction.

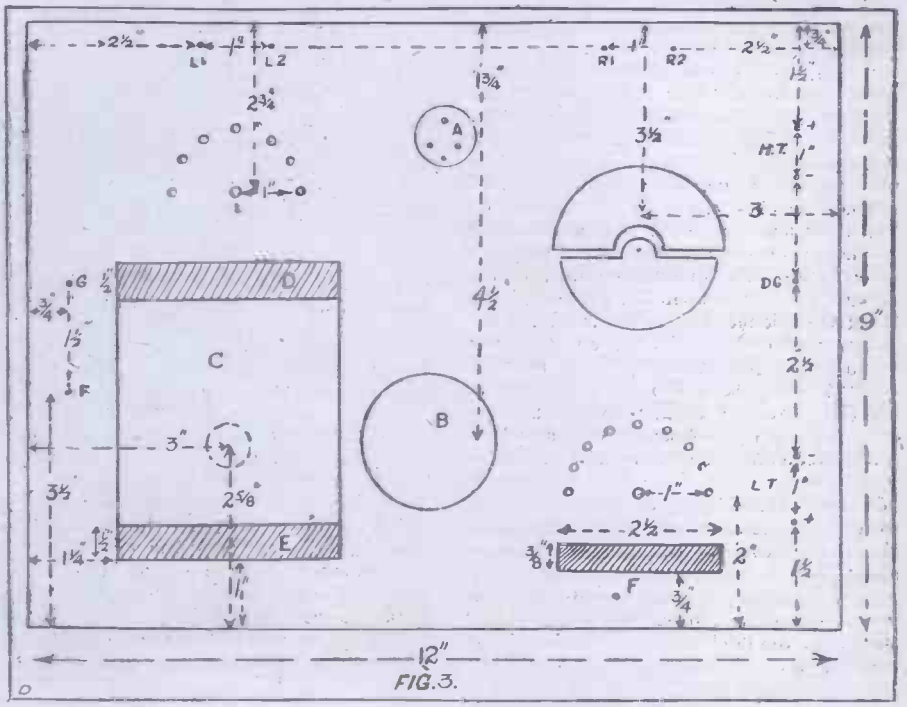
The actual construction of this instrument has called for considerable thought regarding design, in view of the fact that the reader might desire to use the H.F. panel for



longer wave-lengths than those at present in use for broadcasting in England, more so considering the excellent concerts that are broadcast from Paris and The Hague. The high-frequency anode coil used, therefore, will go considerably above the 400-metres wave, tappings taken, and the tuning between these effected by the variable condenser of ·0002 mfd. or smaller capacity.

The value of the anode coil condenser is most important, because when used upon short waves the slightest adjustment considerably alters the wave-length, thereby

(Continued on next page.)



A UNIT BROADCAST RECEIVER.

(Continued from previous page.)

making the instrument difficult to operate successfully. Coupled inside to the tuned anode coil is a reaction coil, consisting of a few turns wound upon a slotted ebonite disc basket style. This coil is intended to be used below 600 metres only, so as to cause no re-radiation in the aerial, while at the same time the benefit of reaction fed into the H.F. coil can be enjoyed. Upon the longer waves, however, where reaction is permitted directly on to the A.T.1 the small coil can be ignored and cut out, the connections from R.1 and R.2 being taken to a separate reaction coil coupled to the A.T.1. Having now considered the operation of the panel in theory, we can put the whole into practice.

Concerning the "Lay-out."

Seeing that our panel will have mounted upon it a valve, filament resistance, reaction control, a tapped anode coil, variable condenser, and grid control, it at once follows that much space is needed, for with H.F. work, all leads, etc., should be well spaced. The cabinet in design is the same as the previous ones, except longer, and should be constructed according to Fig. 2 from suitable wood, stained, etc., as previously.

A piece of ebonite is purchased 12 in. by 9 in. by ¼ in. This should be marked as per Fig. 3, the various lettered positions being as follows: A, the space for valve holder; B, the filament resistance; C is the space under which the anode coil is to be mounted by two strips of wood screwed to the panel in the spaces D E; a little below the centre of space C a hole is drilled to take the spindle upon which the reaction coil is to revolve.

Above the anode coil is the position for a radial switch arm and seven contact studs for tappings from the anode coil. Right of the valve holder is the small variable condenser for tuning between the tappings; below this condenser is another switch and nine studs. These connect to tappings upon a resistance coil and are the means of adjusting grid potential. In the space F a small resistance, wound upon a piece of wood, is to be screwed to the underside of panel.

Providing for Loading Coils.

The terminals are placed around the edges, the lettering being G F to grid, and filament from aerial, L.1 and L.2 are provided in order that an extra loading coil may be added to the existing anode coil for the purpose of longer wave reception. Normally, these are shorted externally. R.1 and R.2 are the terminals for the reaction coil, and O.G. the output terminal to the detecting valve grid. The small fixed condenser for passing the oscillations from the anode coil is already provided in the detector panel.

Insulation and avoidance of capacity effects are two of the most important points we will have to deal with in the construction of apparatus of this nature and care should be taken that details of construction are very carefully followed. However, this completes the description in general of the panel, and the next article will deal with the making up of the various components and the mounting of same.

TUNED ANODE CONVERSION.

A TUNED anode circuit can be arranged in place of an ordinary H.F. with plug-in transformers, by making use of the base of an old valve. Reaction, coupled to the anode coil, can also be used without causing trouble to other people.

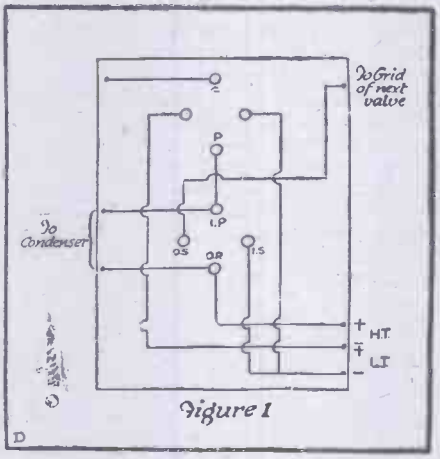


Figure 1

Fig. 1 shows the wiring of a typical high-frequency panel, the sockets at the top of the panel being for the valve and the lower ones for plug-in transformers. From this it will be seen that the plate of the valve is connected to one side of the primary of the transformer, the other side being connected to + high tension; across these two is a variable condenser.

Construction of the Plug.

The secondary sockets are connected to the – low tension and to the grid of the next valve respectively.

To use a tuned anode circuit in place of the plug-in transformer, no alteration in the above wiring is necessary, all that is required being the base of an old valve and a coil holder, which can be purchased quite cheaply or can be made with very little trouble.

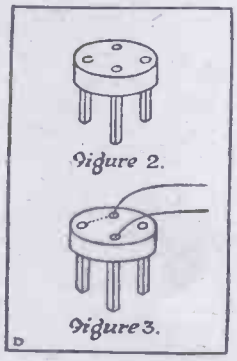


Figure 2.

Figure 3.

The valve base is shown in Fig. 2, and it will be found that holes are made through the ebonite and that a thin wire can pass down these and through the legs. Pass a wire down the top hole, opening the leg a little to allow it to come right through, give the wire a turn round the leg, and then carry it to the leg which goes in the socket that is connected to the grid of the next valve (in the present case this is the left leg—see Fig. 1), pass the wire down the slit in this leg, and turn round the leg.

Pass another wire down the bottom hole and turn round the leg; this wire is connected to the one leg only.

The appearance of the valve base will now be as in Fig. 3, the dotted line showing the wire underneath from the top leg to the left leg. It only remains to plug-in this piece of apparatus in place of the transformer and connect the wires to a suitable coil for the wave-length being received, and tune by means of the variable condenser.

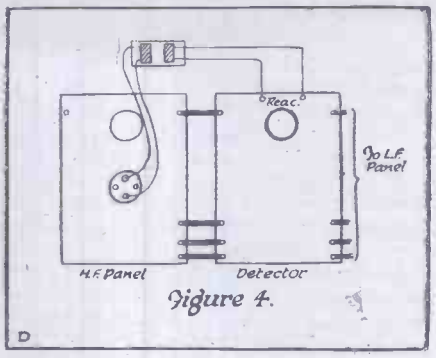


Figure 4.

The best way to connect is to use a two coil holder of the usual type for plug-in coils, the wires from the valve base being attached to the holder.

If it is desired to use reaction, this can be done by using a second coil in the holder, connected to the reaction terminals on the detector panel, the arrangement then being as in Fig. 4.

Simple Coil Holder.

A simple holder for the coils can be made should the reader not wish to go to the expense of the usual type until he has tested the arrangement. This consists of a wire reel off which one of the flanges has been sawn; this can then be screwed by the other flange to an upright support. The anode coil is placed on the reel, the wires from the valve base being connected to the coil by any suitable means. The reaction coil is then slipped on the reel and connected to the proper terminals, the coupling between the two coils being varied by moving them nearer or farther away from one another. See Fig. 5.

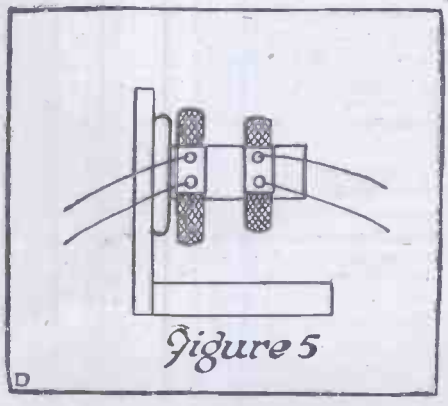


Figure 5

BRIGHT IDEAS

are welcome Send along the results of your experiments. We pay well for such copy if accepted.

CONSTRUCTIONAL HINTS ON LOUD SPEAKERS

THE saying that "The nearer the bone the sweeter the meat" might very well be applied to telephony, as "The nearer the phone the sweeter the music," for it is indeed a fact that the best reception of wireless signals is obtained by means of a pair of head telephones suitably adjusted.

The wearing of a pair of head telephones is never too comfortable, it restricts movement, forbids converse, is tiring, and a central method of distributing the sound waves over a comparatively large area is to be preferred. The trouble is, however, that in spite of all arguments to the contrary, a certain amount of distortion is bound to take place and that inevitable "tinney" sound associated with any trumpet distributing apparatus, renders the music, etc., which is being received, entirely inferior to that which is heard in the head telephones.

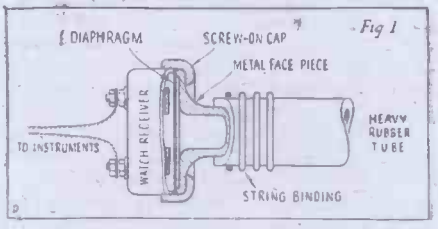


Fig 1

Necessity for Small Diaphragms.

Sooner or later in the amateur and experimentalist's progress a loud speaker will however, be required, and the best advice that can be given on that subject is, do not buy one at all until a good one can be afforded, and then only purchase the best. It is very much the cheapest in the long run. Be sure that it has been made by a well-known maker of good reputation, and that it is of solid construction with no loose parts or rough inside finish.

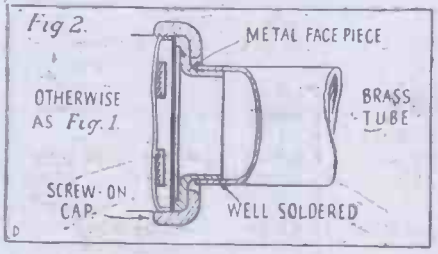


Fig 2.

It is quite possible that the experimenter will desire to construct this piece of apparatus, and there is no particular obstacle in the way of so doing; make sure, however, when starting that a good solid job is going to be made of it.

A loud speaker consists essentially of a watch receiver and a trumpet; magnification and distribution of the sound by means of a large type of receiver, employing a large diameter diaphragm, is at present impossible, as no means have yet been found of overcoming the natural frequency of a larger diaphragm than is at present used in telephone receivers, the larger diaphragm will not, therefore, respond to the frequencies imposed upon it from speech, music, etc.

It is not recommended that the watch receiver be constructed, as a much better one can be bought and adapted. Obtain such a receiver and mount it firmly on to a heavy piece of wood or metal so that it stands firmly and does not vibrate as a whole. See that all screws, etc., are tight to avoid the possibility of irritating "tinkley" noises caused by small loose parts vibrating in time with certain of the notes that will be received.

The ebonite face piece of the watch receiver should be removed and one constructed in metal substituted; this piece should be tuned up as shown in Fig. 1. Make it a good fit under the clamping ring and with a well-rounded inside root. The tubed-shaped portion should be left sufficiently long to allow of a piece of heavy section rubber hose pipe being slipped over it, which should be bound on tightly with string.

Simple Type Described.

For the trumpet a horn from one of the old-type of gramophones is excellent, especially if it is one of the large suspended type. Fix the horn up suitably so that it cannot jar or ring against anything, and attach the other end of the hose-pipe (four inches long, including clamping portions, is enough) firmly to the horn. An excellent loud speaker will then have been made.

A progressive step to such a sound distributor just described, is the use of two watch receivers. Obtain two good watch receivers and substitute the ebonite face pieces for metal ones turned as shown in Fig. 2. Next obtain a piece of brass tube about four inches long to exactly fit over the tuned tube portions of the metal face pieces and well and thoroughly solder the face pieces into the tube, cleaning from the inside of the tube any solder, etc., that may remain.

At the exact centre of the tube drill a hole and, turning out the edges of the hole, solder a piece of tube to this (Fig. 3). This small piece of tube is for the rubber hose connection to the trumpet as before. Assemble the face pieces, bind on the rubber hose and suitably and firmly mount the receivers to some solid baseboard. The assembled twin receiver loud speaker will appear, as in Fig. 4, and should give excellent results if properly made.

With the above described twin type, the two watch receivers must, of course, be connected together in series in a similar manner to a pair of ordinary head telephones, and it will be found that there is a "best way round" for each receiver. Try them out, and vary the connection until the best results are obtained.

A very neat method is to adapt a cabinet gramophone as a loud speaker. The trumpet being self-contained, is usually a solid non-vibrating structure, and admirably adapted for this purpose. Here again a watch receiver must be obtained, the ebonite face piece removed, and a metal piece turned up with the tube end made to fit the swan neck portion of the tone arm. By this means a simple substitution of either the gramophone sound box or the watch receiver enables the cabinet to give forth music from either a disc (record) or the other.

This latter method has much to recommend it, having a decidedly drawing-room aspect. The actual wireless receiving apparatus need not be in the room at all, a short length of well insulated twin wire being all that is necessary to connect the receiving instruments to the cabinet. A note magnifier should be used in conjunction with the receiving gear when employing this remote reproductive device.

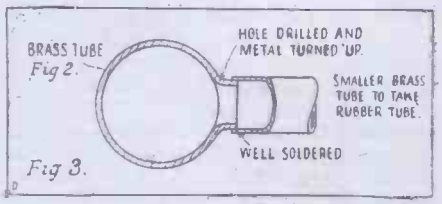


Fig 2.

Fig 3.

So many and varied are the means employed and employable to effect this principal of loud speaking that it would fill many pages to give even a brief description, but one new method due to two Danish engineers, Messrs. Johnson and Rahbek, deserves a description, although the making up of such a set involves rather more work than the average amateur is willing to give to an individual piece of apparatus.

The Agate Cylinder.

A cylinder of agate suitably mounted and coupled by direct (worm for preference) gearing to an electric motor (See Fig. 4) is set running at a uniform speed. A diaphragm and trumpet are fixed up on a suitable base-board and the diaphragm is directly coupled by a metal rod to a light metal shoe which has been made to be a nice, smooth, easy running fit over the agate cylinder.

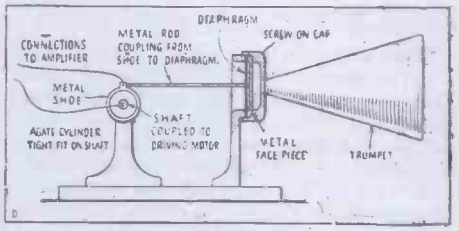


Fig. 4.

The amplified currents from the receiver are then connected one side to the agate cylinder and the other to the metal shoe. As impulses of current flow in this circuit from the receiver, the metal shoe sticks to the agate and *via* the metallic coupling vibrates the diaphragm each time it sticks, reproducing exactly and purely the music, speech, etc., which is being received.

TIME AND WIRELESS.

AN INTERLUDE.

By E. BLAKE, A.M.I.E.E.

The charm of this article lies not only in the delightful style of which Mr. Blake is a past master, but in the good-humoured satire he expresses against the radio fiend who can see no romance in his hobby beyond the height of his aerial and the depth of his earth plate. Read this article. It shows Mr. Blake in a new vein, which you will find wholly delightful.—THE EDITOR.

WIRELESS, like every other business, at times and seasons becomes a weariness to the mind, and at these periods one can loathe the subject, its jargon, its devotees and all its associations. It was under the stress of such a revulsion that I fled recently to the windy hills of Yorkshire, the county of bold skylines and tonic air. A miserable fellow with no ideas beyond the horizon of an Armstrong super-regenerative circuit importuned me at the moment of my departure, so I took him along. He proved to be the inevitable snag in what was, otherwise, good business.

We boarded the train, he—I will call him Armstrong—with a collection of radio publications, I with a "Tatler" and a highly artistic production full of pictures of pretty ladies. At Potter's Bar Armstrong spotted a 'plane up and tried to talk to me about the Bellini-Tosi D.F. business. At the moment I was wondering how they managed to pack haystacks so tightly, and answered him like a Cabinet Minister in a tight corner—vaguely. At Hatfield he told me his uncle had disproved the existence of the Heaviside Layer. I was talking to the steward about the lunch menu just then and mixed up Armstrong's uncle with that story about the boiled mutton and the charwoman's boots.

At Newark, Armstrong saw an aerial and drew diagrams to prove its inefficiency, and at Doncaster he began to describe how he would conduct the affairs of the Broadcasting Company. Whereupon, lacking an instrument with which to stun him, I went to sleep.

II.

This article does not deal with wireless time signals, or with time considered as duration artificially divided into seconds—or drinks; neither is it concerned with wireless according to Armstrong's notions. He disregards the time factor and is intrigued mostly with the problem of over how many square miles he can spread ten watts—like a clodhopper and his cartload of phosphates!

I went to Yorkshire feeling as though I had eaten one of those very heavy American radio textbooks and that the thing had broken out on my mind like a sort of rash. The cows and haystacks I saw *en route* were most soothing, but Armstrong was always there to prickle me up again. He is a fine fellow and in great demand amongst the Societies, but he suffers from ingrowing grids. The tungsten has entered his soul.

Between York and Scarborough lies Hutton's Ambo. I think it is a village, though it sounds like a patent medicine. Anyhow, there was a platform complete with oil-lamp and octogenarian porter, who may be Mr. Hutton or his friend Ambo. Armstrong was inclined to think that the place is the site of an ancient beacon or flambeau, which was tended by a man called Hutton. My own theory is that Hutton brought the Ambo from foreign parts and kept it in a cage at this spot, which, when the railroad came, was a natural stopping place on account of the local attraction. Be this as it may, what a name! What balm to a tired mind!

Hutton's Ambo presented us with a fellow passenger who had a squint. He squinted so badly that when he remarked to a man on his left that it was a fine day a girl to the right rear told him not to be so fresh. Armstrong, who is particularly keen on D.F., was intensely interested and speculated at some length as to whether the poor chap noticed any deviation when the train went under a steel bridge. In fact, I could hardly restrain him from asking the victim whether he had even observed any "night effect." It certainly was a bad case, and I know now what inspired Franklin to devise his "wireless beam."

III.

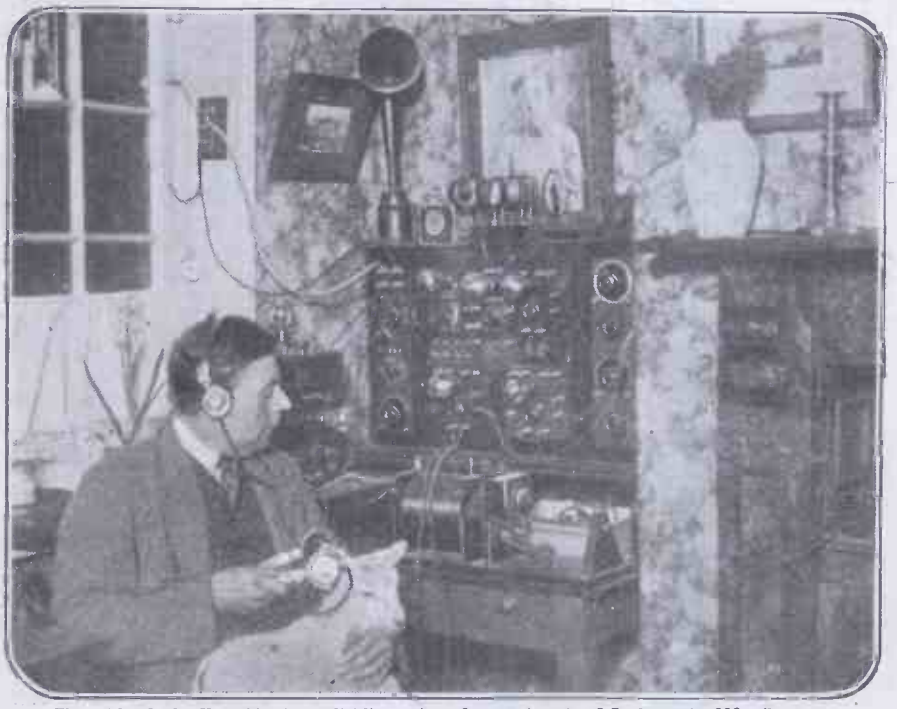
I introduced Hutton's Ambo because, in foisting upon me Phi, the man with the Angle of Lag, it reminded me of Einstein, the man with the theory which made so many of us feel as if our brains were gyroscopes. It is much more popular to be hazy on Einstein than to pretend (or attempt) to understand what he means. I gather from the various expositors of Einstein that the learned professor has said unorthodox things about Time, Space, and Motion. That, of course, is a common crime. Thinking of this sent me ballooning away into speculations similar to those which one makes just before the dentist's gas lets go of one's consciousness.

We are gradually reaching the wireless part, but it's a long way to Yorkshire.

Now, I think it far more likely that we can receive signals across Time than across the space which divides us from Mars; not necessarily by the Marconi system, which has so successfully conquered terrestrial space, but by a system unknown and undefined. The man with the two-way eyesight got out at a hamlet called Gristhorpe, and I wish it the joy of him.

Perhaps I had better explain. I defy anybody whose psychic circuit is not hopelessly "shorted" to stand in the dim, religious light of Westminster Abbey amidst the echoing tombs of the great English, or in the narrow aisles of some humble Saxon chapel, and not receive wireless messages across Time. Why do I choose ancient sacred buildings as exemplars of psychic receiving stations? Because they are peculiar in that they are, as it were, the nerve-centres of history, concentrating within their walls the passion, the pride, the piety, the hopes, griefs, joys of many generations of men. These old beams have vibrated to the voices of people, people like ourselves, of every reign for over a thousand

(*Continued on next page*).



The pet lamb of a Yorkshire journalist listens in and seems to enjoy 2 L o's music, 200 miles away.

THE B.B.C. AND THE PRESS.

AS far as we can gather, as a result of attending the meeting arranged by the B.B.C. to discuss with representatives from the press, questions relating to certain adverse criticisms lately levelled against this company, the B.B.C. intends to fully admit that they hold an absolute monopoly of broadcasting in this country in the accepted sense of the term, but suggest that it is a monopoly so arranged as to be advantageous to the community at large. In opening the discussion, Mr. Reith, the general manager, we are afraid, was inclined to adopt to too great an extent the attitude of the much caricatured paternal government official representing that "naughty public doesn't know what is good for them" form of control. In doing so, Mr. Reith made a great mistake. "John Bull" detests anything in the nature of control or anything that savours of a "ring," although it might quite possibly be beneficial. Mr. Reith also, we consider, tended to blow the B.B.C. trumpet too loudly in respect of the programmes being broadcast, although he admitted it difficult to satisfy the diversity of public tastes. Mr. Reith should remember that the B.B.C. have no criterion—he cannot drag America into this part of his argument—and no competition. We may be wrong, but we hold the view that a little healthy competition is conducive to progress.

Merely a Toy!

Mr. Godfrey Isaacs, one of the directors of the B.B.C., who amplified considerably on the views expressed by Mr. Reith, introduced the subject of the "Home-made" set. This, he considered, not worthy of being categorised as a receiving-set at all, but should be looked upon merely as a toy and something for the children to play with. Only well-established wireless firms can construct *receiving* sets, he declared. Comment on this point in POPULAR WIRELESS is quite unnecessary, we think.

Question of Publicity.

Asked why the normal profits of the wireless trade are not able to support the advertising medium through which they are obtaining vast publicity, i.e., broadcasting, he replied that it was by the formation of the B.B.C. that the wireless trade has boomed to such an extent. The statement of the B.B.C. itself, that before their formation over 20 companies had applied to the P.M.G. for leave to broadcast, would seem to nullify the aptness of his remarks concerning this point. He rightly declared that it was due to the activities of the B.B.C. that the wireless trade owed its present state of prosperity, but we must point out that, on the other hand, it is within the bounds of possibility that the same conditions would obtain in the case of broadcasting undertaken by individual and competitive firms. "If the B.B.C. fails," said Mr. Isaacs, "this new industry will collapse." It seems, however, that newspapers and large commercial firms would be quite willing to run broadcasting stations in order to reap the benefit of the publicity attained, but the B.B.C. consider that the normal profits of the wireless trade must not be dipped into in order to provide funds for publicity in its own interest. To sum up, it would appear to us that the B.B.C. forget that broadcasting as they control it is, after all, but the publicity campaign of the wireless trade, for which the listener-in pays; although in our opinion, no alternative scheme has been suggested by the critics that would tend to offer a better broadcasting service than that which we enjoy at present by this means. We do not think that the B.B.C. have put up a good defence; their arguments are not at all convincing and their statements seem to lack that "punch" which is essential when dealing with destructive criticism. But simply because the criticism that occasioned the friction between the B.B.C. and the press *was* purely destructive, then we consider ourselves justified in continuing to support the B.B.C.

The point as to whether the whole licence question is not invalid owing to a flaw in the Wireless Telegraph Act of 1904 does not, as far as we can see, cause the G.P.O. much concern. That is a matter still to be settled.

TIME—AND WIRELESS.

(Continued from previous page.)

years. If thought be vibration, these incomparable stained-glass windows may have experienced within their atoms the stress and strain of thought influences the like of which made the Briton a free man. Our politics and wars, our fashions and crazes—where are their signs to seek? These are like the ever-changing colours on a bubble, but here in this age-old meeting-place are focused the influences of the changeless realities of our blood and state; here flowed the undeviating stream of human life, here beat the pulse of humanity.

IV.

Armstrong was charmed with the old place, not as an antiquarian, but because the cunning little slits in the walls—"lepers' squinch holes" or "priests' poke holes" or something like that—appeared to be ideal for "leading-in" wires. He thought, however, that the site was rather badly screened by the high trees in the manor park close by. I drew his attention to the rough-hewn font which had stood there since the days of Edward the Confessor. I told him how, because holy water was kept in it, Archbishop Lanfranc had decreed that the cover should be locked, and showed him the rents in the stone wherefrom the metal fastenings had been wrenched after Lanfranc was dust and a memory. He grunted and said that the thing was "in its design an unconscious groping after the form of the ideal loud speaker." Then he went out to look at the village Boy Scouts' aerial and I was left among the crumbly pews and pillars—but not alone.

Messages across the Time-space! "Jamming" over the ages! There was the 'scutcheon of some lord of the manor, with many quarterings.

SIR HUGH DE GANT AND DAME ALYS HIS WIFE.

What of Sir Hugh, what of Dame Alys? Did he clank down these very stones in mail to yawn in that pew while the clerk droned interminably, thinking the while of his dogs, his men-at-arms, or what not? Did she, his lady, sweep over those worn cobbles in the porch, wearing a two-foot sugarloaf hat? Did she say "Beshrew me, thou naughty wench!" Did she dream of Sir Hugh whilst he fought the Saracen at Acre? Were they held over that font as yowling babes? Are their bones, their loves, their once busy hearts, their children, buried in the mossy precincts? Messages across Time!

Here is a rough scratching on the east wall, *Hic jacet Johone Percy.* Honest John Percy! Honest, but unskilful carver! Dust and ashes these three hundred years. They were once here, living and breathing, even as you and I; hungry, curious mortals, the one to worship his Maker, perchance; the other, with his graving tools, thinking of his dinner, little dreaming that I, of the Ether Age, should come a-holidaying to tramp over the grave of the one and gaze upon the work of the other. Oh, John Percy, Oh, unknown (but unskilful) carver, it is good to hear from you. What have we added to Life, we with our wireless telegraph? I would—for a space—exchange everything wireless for a tankard of ale and a word with you in the inn. What have we added to life save complexities and vexation of spirit?

As I left the nine-inch thick church door a bent old man of some ninety years crept slowly over the immemorial turf till he reached the grave of his heart. Leaning heavily upon a stick he pointed to the tragic mound, whose headstone was already sunken and green, and uttered aloud words which I am glad I could not distinguish. Ah, love and youth, three score and ten years ago, you live yet in that old man's heart. Wireless messages across time are possible, and we fine fellows don't know everything in heaven and earth yet.

Armstrong said that the Boy Scouts' aerial was a wash-out, but he had heard that Sir Solomon Boggles, the "Lord of the manor," had installed a five-valve set.

I declare I heard Sir Hugh de Gant chuckle in his beard.

ANYWHERE WITHIN 40 MILES of a Broadcasting Station.

THE RADIONETTE V. 2

is the GUARANTEED equal of any 3-VALVE RECEIVER (Stamped B.B.C.) irrespective of design, construction or price for

SIGNAL, STRENGTH, PURITY OF TONE AND SIMPLICITY IN OPERATION.

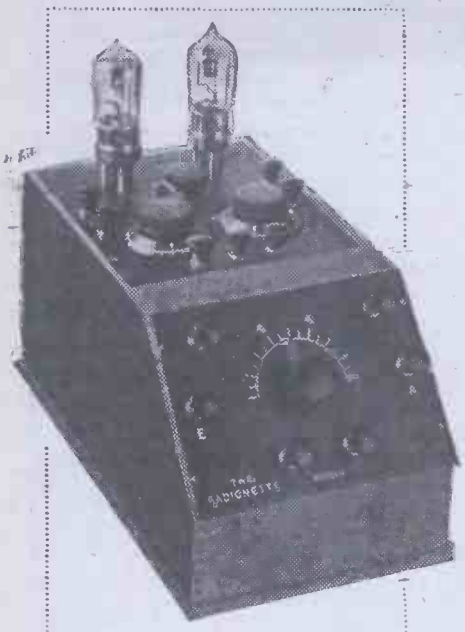
The GUARANTEED CAPACITY of the Radionette V. 2 is :

40 miles from Broadcasting Station with 1 Headphone
25 „ „ „ „ „ Loud Speaker

AND

With a couple of wires stretched across the ceiling of any room or other type of indoor aerial, will take 12 pairs of headphones within 15 miles of a Broadcasting Station.

The above are minimum results under ordinary average conditions.



The RADIONETTE V. 2 Amplifier Receiver:

Without Valves (Inclusive B.B.C. duty.) **10 gns.**

or complete with

2 Mullard valves, Ever-ready 60 volts H.T. Battery, 100 ft. Aerial Wire, 2 Crystor Cowl Insulators, 1 Crystor Cowl Lead-in Insulator and one pair SIEMEN'S 4000 ohms Headphones. Price **£14:10:0** Inclusive of B.B.C. Duty.

SEVEN DAYS FREE TRIAL

WIRELESS AGENCIES, LIMITED,
162, Shaftesbury Avenue, London, W.C. 2.

Dear Sirs,

Please send me your Radionette V. 2 for which I enclose the sum of.....on condition that you refund me this sum (less carriage 3/-) if I return to you undamaged within seven days of receipt.

Yours faithfully,

Name.....

Address.....

.....

(Please write clearly.)

Received Signals never heard before

Read the testimony of a user of Crystor Cowl Insulators

"I was recommended by Mr. —— (a well-known amateur)"
"to fit your Cowl Insulators to my aerial . . . . . the"
"effect was extraordinary; it was just as if I had switched"
"in another valve . . . . . I received signals I had"
"never heard before . . . . . S. D. (Ealing)"

THE ONLY WAY TO OBTAIN 100% AERIAL EFFICIENCY

USE

Crystor

COWL INSULATORS

(Patent Applied for)

CRYSTOR AERIAL INSULATORS .. .. Price 1/9 each
CRYSTOR VERTICAL LEAD-IN .. .. Price 6/- „
CRYSTOR HORIZONTAL LEAD-IN .. Price 6/6 „
LEAD-IN EXTENSION, 4-in: .. .. .. Price 1/6 „

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" 162, Shaftesbury Avenue, London,
" Dear Sir/s,

"I have great pleasure in writing to inform you that the Radionette " Crystal set I bought of you about two months ago is going great. I " receive all the broadcasting from Cardiff every evening *perfectly*. The " distance is about 20 miles, but everything is so clear and distinct, *and I " have been told by several* who have *one and two valve sets* in the " Rhondda district that they *are unable to pick up anything from Cardiff*, " and that I am the only one in this valley who is successful with a " Crystal set.

" I have written to the Director of the Cardiff Broadcasting Station to " let them know I get great results with your Radionette. I would like " to know if you can supply me with a two-valve Amplifier to work a " Loud Speaker with this set.

" Thanking you for full particulars and prices.

" And oblige, Yours faithfully,
A. E. JONES.

" P.S. You can make any use of this report re your Radionette Crystal Set."

The Radionette No. 1 outfit includes Radionette Receiver, a pair of Siemen's super-sensitive headphones, two Crystor aerial insulators, and 100 ft. Copper aerial wire. *Price (including Broadcasting Duty.)* **£3-10-0**

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A FEW NOTES ON EARTHS.

By Capt. H. SHAW, M.Sc., A.R.C.S., F.Inst.P.
(Principal of the Radio Correspondence College).

THE desirability of securing an effective earth connection is a matter to which the attention of all amateurs should be drawn, for its value in ensuring the efficiency of a station, and in increasing the operating range, is comparable if not equal to that of a good aerial. In many cases it may be the controlling factor between good and bad results, and in any case it is an essential feature of an efficient wireless station.

There is another consideration, however, which renders the provision of a good earth of the utmost importance, and it is with this aspect of the question that I propose to deal in the present article. It is reported that the ancient Egyptians employed masts to protect their temples from the effects of lightning, while the Greeks and Romans are known to have drawn "fire" from the sky, but it was not until 1752 that Benjamin Franklin conducted the celebrated experiment which enabled him to establish definitely the electrical nature of lightning. Franklin had already arrived at this conclusion from theoretical considerations, but had been unable to verify it experimentally. One day he saw a boy flying a kite, and the thought instantly occurred to him that here was a most convenient way of demonstrating his views. Accordingly Franklin constructed a kite from a silk handkerchief, attached it to a roll of twine, and standing under a cowshed for shelter, was able as a dark cloud passed over, to obtain large charges of electricity which he employed in charging up a Leyden jar and obtaining sparks. The kite employed by Franklin on that occasion may still be seen in the Science Museum, South Kensington, where it is now on exhibition.

The Voltage of Lightning.

A cloud is composed of an infinitely large number of very small droplets, and may possess under certain conditions a very considerable charge of electricity, causing it to be at a high potential, which is, however, generally different from that of neighbouring clouds. As no doubt all readers are aware, when the electrical pressure or voltage between two points becomes sufficiently great, the intervening air is unable to stand the electrical strain, and allows a spark to pass from one point to the other. The pressure necessary to produce a spark across an air gap of one inch is about 50,000 volts, so that the immensity of the voltages occurring in nature may be imagined when sparks several miles in length are known to occur.

This electrical discharge takes place not only between neighbouring clouds charged to different potentials, but frequently occurs also between one cloud and the earth, the discharge in every case passing along the line of least resistance.

The presence of a suitable conductor elevated from the earth, tends to offer to any such electrical discharge a path of least resistance, and it is partly for this reason that an efficient lightning conductor affords protection to the building upon which it is mounted. Contrary to the general opinion, however, churches and high buildings are by no means all protected, and churches which in view of their lofty spires would appear to require adequate protection, are only protected in a comparatively small number of cases.

Protection of Instruments.

Wireless aerials do not attract lightning in the generally accepted sense, but they accumulate undesirable charges of static electricity from the atmosphere, especially during stormy weather. This is occasionally demonstrated by the shock or spark which can be obtained from a fairly high aerial. Experiments have been carried out during storms with a condenser between the aerial and earth, when large charges have been accumulated and employed for experimental purposes, but inasmuch as the experiment is attended with a certain amount of danger its repetition is not recommended.

Lightning may be regarded, then, as an electrical discharge, preferring in general to make its way between the cloud and earth by the most convenient and direct path, and for this reason an aerial which is well earthed near a building will form an efficient lightning conductor, and may be regarded as tending to offer a certain amount of protection to the adjacent buildings. It should be remembered, however, that this conductor must be continuous and should take the shortest path to earth, so that any sharp turn, or coiling of the wire, is to be avoided. A faulty earth connection moreover renders the aerial a source of danger to the station, not because of its attraction for lightning, but because in the case of the lightning choosing this path, a clear course to earth is not provided for the discharge, which will then tend to flash across to the building in search of a better and easier way to earth, causing all kinds of mischief on its way. The instruments may be protected from this possibility by fitting a lightning arrester or choke coil, by means of which damage to the apparatus may be effectively prevented.

How to Obtain Good Earths.

An efficient earth connection is absolutely necessary to ensure really good results, and in order to secure this, it is essential that the lower end of the earth wire be buried in permanently damp soil, so that proximity to rain water pipes and drains is desirable. To obtain a permanent and reliable earth connection the most satisfactory method is to solder the earth wire securely to a sheet of copper about three feet square and one sixteenth of an inch thick, buried in permanently wet earth and surrounded by charcoal or coke to ensure a uniformly good contact at all times of the year. The sheet may be replaced by a copper vessel or tape, provided the total area of exposed metal is about 18 square feet; in the latter case, however, the tape should not be coiled, but should be buried in a long trench.

Galvanised iron of similar dimensions may be used in place of copper, but in this case a galvanised iron earth wire should also be employed. When it can be protected from rusting, iron is preferable to copper for the purpose of lightning protection, as its lower conductivity decreases the possibility of surges and side flashes.

If coke is employed to surround the earth plate, it should be thoroughly washed previously to remove any sulphur, which has a deleterious effect upon the metal. Considerable attention must be given to the connection between the conductor and the earth plate; soldering alone is insufficient, a good mechanical joint being necessary in addition.

In an area having clay subsoil which is permanently damp within a few feet of the surface—as, for example, the London clay—it is comparatively easy to secure a good earth connection at all times of the year, but on well drained areas such as gravel or chalk, it is often difficult to ensure a good earth connection in summer-time when rain falls only at infrequent intervals. It is useful to remember, however, as a general expression of a really practical rule, that the drier the ground the larger must be the surface of contact between the earth and the metallic mass of the conductor.

One of the above methods should be employed, whenever possible, as being the most reliable means of ensuring a permanent earth connection for the apparatus and at the same time provide reasonable protection from lightning. In many cases, however, especially in cities, these methods are impossible and other means have to be employed to get a satisfactory earth for the instrument. In such cases it is desirable to connect the earth wire to the nearest water main, taking care to ensure a thoroughly reliable connection. The wire should be well soldered to the pipe, but this alone should not be relied upon and a good mechanical joint should also be made.

Don't Use Gas-Pipes.

Special clamps can be obtained for this purpose or one can be made from a piece of sheet copper or brass. It is useless simply to wrap the earth wire round the water pipe, for although a good temporary earth may be obtained by this means, oxidation of the surface of the wire quickly causes a layer of oxide to form and separate the two conductors to the detriment of the electrical connection. Never use the gas main or electric light conduit for this purpose, as this practice is likely to prove highly dangerous in case of storms.

The steel frame of the building or of the window may be used as an earth if nothing better is available, but in any case the earth wire should be run as straight as possible direct from the instrument. Should it pass near to any other pipe or massive piece of metal it is desirable to connect to that also.

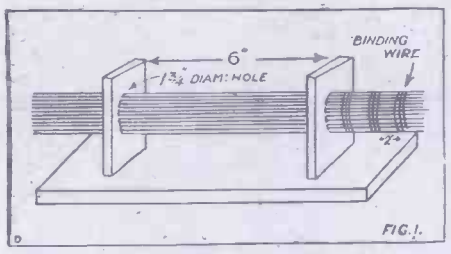
The aerial should always be connected direct to earth when not in use and especially during storms, thereby ensuring that the aerial is discharged before commencing to receive. This is conveniently done by means of a double pole switch, preferably on the exterior of the building, so that the aerial is connected to an outside earth when not in use. The switch should have a capacity of 25 or 30 amps., while the diameter of the earth wire should be at least equal to that of the aerial and lead-in.

Where earth plates are used it is advisable to test them annually in order to ensure that the earth contact of the plate is good.

A TRANSFORMER FOR A.C. CHARGING.

By R. G. DE WARDT, M.I.R.E., A.M.I.E.E.

WITH an alternating current supply it is possible to transform the voltage from the comparatively high voltage of the supply mains to the low voltage required for battery charging without any very great loss of energy such as occurs when direct current is used with a resistance. The output of the secondary of a transformer in watts is very nearly equal to the input to the primary, thus a transformer



giving an output of 5 amperes at 20 volts, or 100 watts, would have a primary input of about 1·2 amperes at 100 volts or 120 watts, the extra 20 watts used in the primary and not appearing in the secondary being absorbed in losses due to the heating of the conductors forming the primary and secondary windings and in the iron core due to hysteresis, etc.

Points of Efficiency.

Such a transformer is perfectly self-regulating in that its input varies with its output; for example, if only 2 amperes at 20 volts, or 40 watts, were being taken from the secondary the primary input would be about 55 watts, and if no current at all is being taken from the secondary, the input to the primary would be in the neighbourhood of 10 to 15 watts.

Although transformers giving greater efficiency than the one described in this article can be obtained, the type shown has been chosen for the following reasons:

1. It can be constructed with the tools ordinarily in the amateur's possession.

2. It radiates the heat produced by the losses in the windings and core very easily, and hence does not become excessively hot.

3. The primary and secondary are completely isolated from each other, and there is no possibility of their coming in contact; such contacts are possible with other types, and if they occur the full primary voltage may be impressed on the secondary with very dangerous results.

4. A transformer with a secondary in two portions enables the necessary rectification of the alternating current to be performed with two noden cells, whereas four are required for complete rectification when a plain secondary is used.

Construction of Core.

In this connection, a warning should be given that shocks from even 105 volt A.C. mains may have fatal results in exceptional cases, and that the utmost care should be exercised in dealing with such circuits. This fact has been borne in mind in designing this transformer and if the method of construction is followed there is no danger whatever in the use of this apparatus.

The transformer described is suitable for a supply at 100 volts 50 cycles, and will give an output of 20 volts 5 amperes.

The core is formed of a bundle of soft iron wires, each 15 inches long, of No. 22 or 20 gauge, the diameter of the core being 1¾ in. This core requires very careful construction as the success of the transformer depends, to a great extent, on the quality of the workmanship in the core. Each individual wire should be cut to length and carefully straightened. Two wooden uprights, each with a hole of 1¾ in diameter, should be mounted on a piece of wood at a distance of 6 in. apart, as shown in Fig. 1, and the core wires should be laid through the holes as each length is cut and straightened. Great care should be taken to get as many wires as possible into the core, in fact wires should be added until it is impossible to insert any more; about six pounds of wire will be required.

When this stage has been reached the wires should be bound together by pieces of thin wire at one end, as shown in Fig. 1, the core should then be pulled out, a binding band being fitted every 2 in. as it is pulled out until the whole is bound.

The bobbins on which the primary and secondary are to be wound next require attention. This consists of a piece of cardboard tube 5¾ in. long and 2 in. diameter, on which three cheeks cut from hardwood to the dimensions shown in Fig. 2 are fitted, one at each end and the other at an intermediate position, so as to leave winding spaces 2 in. and 3 in. long respectively. Most amateurs find difficulty in fitting cheeks to a tube, but the method shown in Fig. 3 is very simple and makes a thoroughly satisfactory job.

The tube and cheeks should first be thoroughly dried and shellac varnished inside and out. When the shellac is tacky four strips of tape should be laid along the tube with ends projecting over the tube and bound in position with thread. The cheek should be slipped over the tapes on to the tube, as shown at A in Fig. 3, each piece of tape being then taken over the cheek, stretched tight, and bound to the tube close up to the cheek, as shown at B, Fig. 3. The other cheeks should be affixed in their correct positions in a similar manner.

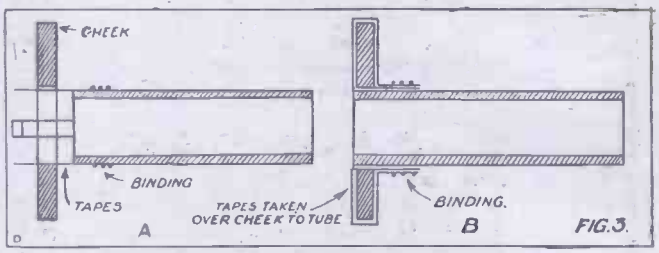
"Tapping" The Mains.

Before the bobbins are wound a layer of empire cloth should be fixed to the tube in both winding spaces.

The primary, consisting of 600 turns of No. 20 D.S.C. (about 1½ pounds), is next wound in the 2-in. space, the commencing end being brought through a hole in the end cheek, the finishing end being secured with thread. Each layer should be coated with shellac varnish as it is wound.

The secondary consists of 250 turns of No. 16 D.S.C. (about 1¾ pounds), the commencing end and a tapping at the 125th turn being brought out through holes in the cheek at the opposite end to that through which the primary was brought out. Each layer being varnished as in the case of the primary.

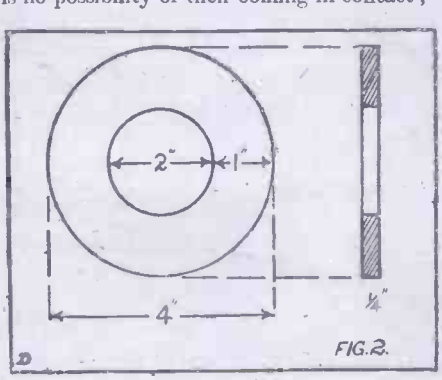
Insulating sleeving should next be slipped over each of the ends of the primary and secondary windings and secured in position.

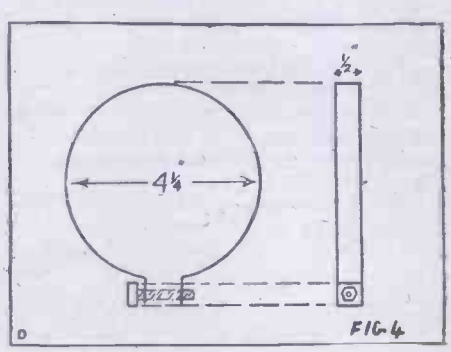


When this is done the core may be inserted in the bobbin, the first binding wire should not be removed to prevent the wires fanning out, but all the others should be removed as the core is inserted. When the core has been pushed through the bobbin, the first binding wire may be removed and the core adjusted to project equally either side.

The next step is to bend the core wires over the end cheeks to completely enclose the core and to form a closed magnetic circuit. Each wire should be dealt with separately, so that they all lie evenly. Care should be taken with the leads to the windings whilst this is being done.

(*Continued on page* 343.)





A TRANSFORMER FOR A.C. CHARGING.

(Continued from page 340.)

Two brass clips, as shown in Fig. 4, should then be fitted over the transformer to hold the core wires in place, and it should also be secured by a brass band screwed to the base-board, which should be of hardwood 12 in. long and 6 in. wide.

To enable the supply mains to be connected to the primary, an ordinary wall plug, as used on electric light circuits, is utilised. The socket portion of this wall plug should be mounted on one end of the board, and the leads from the primary connected to it, grooves being cut in the board to accommodate the leads if necessary.

The plug portion of the wall plug should be connected to a length of electric light flexible, the other end of which is fitted with a bayonet adaptor for inserting in a lampholder of the lighting system. This method of connecting the primary ensures that the whole of the wiring of the primary, including the flexible leads, is controlled by the switch and fuses on the lighting circuit.

For Different Main Supplies.

The leads from the secondary should be connected to three terminals mounted on an ebonite strip fixed at the end of the board remote from the wall plug, the two outside ends of the winding being connected to the outside terminals, the centre point of the secondary (the tapping at the 125th turn) to the centre terminal.

A section of the completed transformer is shown in Fig. 5, and in another article constructional details of a noden valve to be utilised with this transformer will be given.

In the case of other supply voltages at the same frequencies the only thing that has to be changed is the number of the turns on the primary and the gauge of the wire.

The number of turns depends on the primary voltage and its frequency, and for the transformer described may be determined from the following formula, which also allows for a differing frequency.

$$T = \frac{100000\ V}{4{\cdot}44 \times f \times 75}$$

Where T=number of turns required.
V=Voltage of the supply.
f=frequency of the supply.

The number of turns in each half of the secondary may be obtained from the following:

$$T_1 = \frac{p \times 20{\cdot}8}{V}$$

Where T_1=number of turns in each half of the secondary.
p=number of turns in primary.
V=supply voltage.

For voltages of 200 and over No. 22 D.S.C. may be used for the primary when the secondary output does not exceed 5 amperes. If the secondary output exceeds this value No. 20 should be used for voltages over 200, and No. 18 for lower voltages for the primary winding. In this case No. 14 D.S.C. should be used for the secondary, and the sizes of the bobbin cheeks increased as necessary.

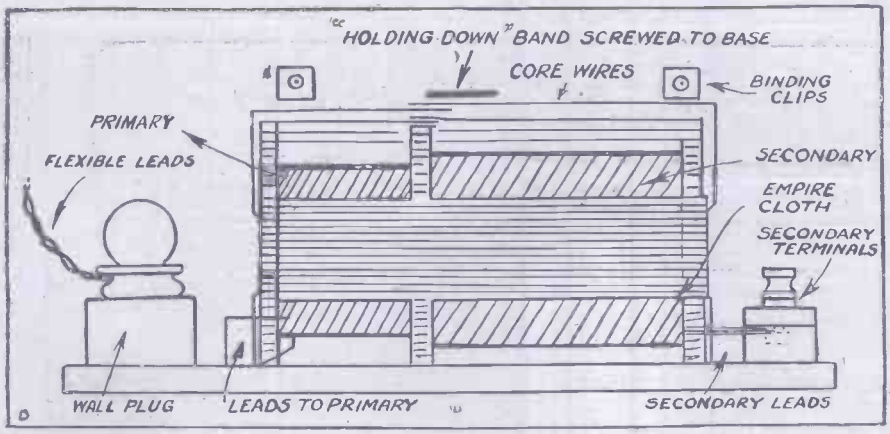


Fig. 5

AN EXPERIMENTAL THREE-VALVE SET.

By J. J. MASON.

MY first results were obtained on a crystal set consisting of a cylindrical coil with a slider and a pericon (zincite-bornite) detector. On this, and using a twin aerial 40 ft. long and 20 ft. high, I received G N F and F L; also some ships. I was so pleased with the results that I built up a small coil for short waves consisting of a former 3 in. diameter 4 in. long wound with 28 D.C.C. wire. The first night I tried this I heard 2 K Q working to 2 N V. 2 N V was also good. Others came in later—2 K O and 2 R G, but 2 K Q was always best.

From this nucleus my present set has been built up. Everything except phones and valves have been home made. The valves are B.T.H. and the phones are Brown's Type 120 ohms.

The set at present consists of one high-frequency valve, one rectifier, and one low-frequency amplifier. I have a tuned anode coupling between the high-frequency amplifier and the rectifier.

A crystal unit is used for the local broadcasting station, as valves are unnecessary.

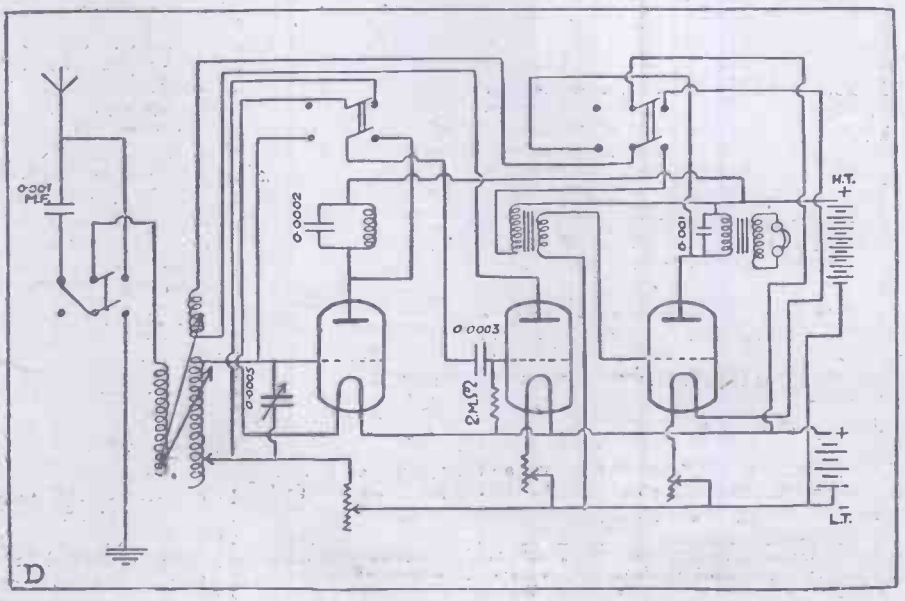
A roll shutter which is behind the panels above the set closes over the set when not in use. This was also home made. Some of my results on this set are as follows: Living in Dudley 5 I T can be heard all over the house with the phones hanging up, 2 L O, 2 Z Y, 5 N O and 5 W A can be heard loudly with the head phones on three valves.

2 Z Y and 2 L O I can get on one valve.

P C G G and the School of Posts (Paris) are much enjoyed on three valves. F L comes in with the aerial cut off. Croydon shouts, and telephony from St. Inglevert and Le Bourget is very clear.

I am appending the circuit of my set with values in the hope that it will be useful to readers of POPULAR WIRELESS.

The Editor will be pleased to consider contributions from readers. Articles should be kept short and to the point. If accepted, articles are paid for at our usual rates.



THE POSITION OF THE B.B.C.

By WILLIAM LE QUEUX, M.I.R.E.

This article was written before the recent press attack on the present broadcasting arrangements, and in it Mr. Le Queux expresses his candid opinion of the B.B.C.

IN Britain we have not yet succeeded in placing broadcasting upon proper lines, neither have we quite suited the regulations to the requirements of the listener. The British Broadcasting Company are doing a splendid work which the whole country is appreciating, therefore they should in every way be supported, not only by wireless amateurs, but also by the general public who delight to hear concerts and speeches coming from afar. Surely the rapid development of wireless telephony is a sign of progress, and the possibilities of "the magic bottle," as the Americans call it, are only in their infancy.

Gramophone Companies' Contracts.

The British Broadcasting Company are utilising wireless for the common happiness and education of the people of Great Britain, therefore the attitude towards it adopted by certain theatrical managers and gramophone companies is to be greatly deplored. There are, of course, many artistes who have contracts with the gramophone companies not to sing or play into any "sound-recording device," and the companies are now endeavouring to make out that a radio microphone is a "sound-recording device." I doubt, even though they may threaten to bring actions for breach of contract against their artistes who dare to broadcast their voices, whether it could be held that a telephone transmitter records sound. Surely it distributes it!

In any case, the objection raised by such companies, if continued, will bring upon them considerable unpopularity and a popular prejudice which no amount of newspaper advertising will ever remove. The forbidding of popular artistes to broadcast their voices for the common enjoyment and entertainment of the people will be regarded as a dog-in-the-manger attitude, and at once inflame public opinion against the whole gramophone trade.

Broadcasting of Plays.

It would be a thousand pities if this new and extraordinarily valuable form of entertainment, education, and advertisement were crippled in its initial stages and not assisted, as it has been so generously in America. We hear that our theatre managers are also expressing fear that the broadcasting of musical comedies and revues will interfere with their box-office receipts. But they have no need for apprehension. If they give the broadcasters full facilities they will find their receipts increase rather than diminish, for there is no better advertisement for a play than to transmit portions of it into the home circle.

Some time ago the same fear was felt by theatrical managers in America; until it was proved that broadcasting was a real and direct advertisement of a novel and exclusive type. As an instance, just proved, the Manhattan Opera House in New York was only half-filled each night, and the receipts were quickly dwindling when one day the management permitted "Tristan and Isolde" to be broadcast. And on the next night the house was filled to overflowing with "listeners-in" and their friends. And it has been the same with our own opera. This is surely sufficient proof that London managers have no need to hesitate to allow their performances to be sent out by wireless.

MR. WILLIAM LE QUEUX.

Assistance from the P.M.G.

The Americans have made radio-telephony a source of profit, pleasure, and enlightenment. Surely we are sufficiently progressive to do the same?

The British Broadcasting Company are hampered very heavily by regulations, which sometimes seem arbitrary, while those many unlicensed listeners-in are, in themselves, a body which will require a watchful official eye, but I happen to know from the lips of my friend the new Postmaster-General that he is anxious to do all he can to further rather than hinder the progress of broadcasting. It is therefore to be hoped that the theatrical managers and gramophone companies will at once adopt a conciliatory attitude and assist Sir W. Joynson-Hicks in his very difficult task.

Everyone interested in wireless, as well as the millions who are only listeners, feel that we should not be behind the Americans, and when we wireless men have the personal support of the Postmaster-General, I feel assured that those who try and hinder our efforts will act wisely and at once withdraw their opposition.

RADIO REFLECTIONS OF AN OCTOGENARIAN.

WIRELESS has come to stay. What a trite remark; what a hackneyed phrase, I hear you say.

I admit it, but still think the words appropriate.

It is a far cry back to the year of my birth, 1842, when it was on record that Morse made wireless experiments by electric conduction across wide rivers.

The following year, J. B. Lindsay said that if stations were provided across the Atlantic, not more than 20 miles apart, there would be no need to lay cables. Now, Marconi with his wonderful genius, his careful experiments and unflagging belief in his theories, has made dreams become realities.

Here we have a man happily endowed with the scientific imagination. It has been assumed that there is no connection between imagination and science. I think, however, that the scientific man devoid of that quality is not fully equipped for his work.

Hertzian waves it seems to me, an ignorant plodder in the paths of science, are influenced by causes which are not yet fully understood.

It has been stated by some that they have at times noticed a peculiar "swishing" sound whilst listening-in. One hardy individual who ventured to suggest that this sound might be due to the presence of very small meteorites in the atmosphere was told he was mad. It seems, however, that there may have been a certain amount of method in his madness after all.

Those interested should refer to the opinions of R. A. Watson Watt, in Pro. Roy. Soc., vol. 102, page 460, 1923.

By the way, the electrons have apparently come to stay, too, and modern physical science ascribes to them a part in all phenomena which comes within the purview of the modern scientist.

Science advances almost as quickly as these dear little electrons travel their thousands of miles per second, and it is most difficult for the man in the street to keep pace with its rapid progress.

The Comfortable Fireside.

There is, and always must be, a difference in listening to music, both vocal and instrumental, and hearing it through the medium of ether waves. In all music there is an element which we call expression, by which we mean variations in the volume of sound; in *pp* and *ppp* passages, for instance, the tone drops almost to a whisper, which drops off next to nothing when transmitted, and is, in fact, at times inaudible. The tone, therefore, should be managed to provide against this, and performers should be instructed to allow for a slight loss of volume of sound. In this connection, let me mention that I have lately read an announcement of an invention claiming to improve the wireless voice. The inventor claims in his own words that "My invention will amplify the tone of the wireless voice, but not its imperfections." I sincerely trust his confident assertion will be justified.

In conclusion, let me pay a tribute to those who have done so much to carry good music to the homes of the people. To me, an ancient buffer, somewhat lazy and indisposed to turn out and undertake a journey, especially at night, it is a great boon to sit in comfort by my own fireside and listen to the strains of immortal music and song.

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NOVEL TUNING DEVICE

THE simple tuner here described is used with a crystal detector in the reception of broadcasting, and as regards fine tuning is found to be a great improvement on the single slider type of inductance coil for which it is substituted. A piece of round hardwood ruler of about 1 in. diameter and 9 in. long is supported on a wooden base of the same length by 2 pieces of ebonite (2 in. by 1 in.) secured to the ends of both the ruler and base by small screws.

With a single wire 100 ft. aerial, about 150 turns of 24 S.W.G. enamelled copper wire are wound on the ruler and then slightly slackened so as to fit easily, but not too loosely. One end of this coil is fastened to the ebonite support and then connected with the aerial terminal, whilst the other end is fixed to the sliding clip and then taken to the earth terminal. Meanwhile, the slider inductance coil is disconnected.

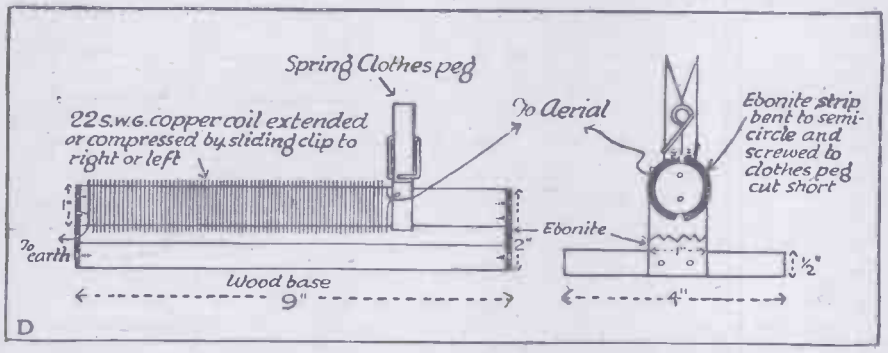
It is, of course, understood that the number of turns of wire required will vary with the length of the aerial and the diameter of the ruler used in each individual case, but the most suitable number will easily be found with a little experimenting.

Tuning is effected by sliding the clip along the ruler, the inductance varying as the coil is extended to the full length of the ruler or is compressed to its fixed end. On the tuning-point being reached the clip is allowed to grip the ruler and thus retain the coil in the correct position.

How it Operates

If the signals are heard at their loudest when the coil is compressed, *i.e.*, when each turn of the wire is touching the next, several more turns of wire should be added to increase the inductance, and if, on the other hand, it is found that they only come in when the coil is stretched to its full extent a few turns should be taken off and the inductance decreased.

The clip consists of an abbreviated clothes peg to which curved ebonite extensions are screwed. A complete receiver might easily be made by mounting the detector and the usual terminals on the same base, and the total cost would be negligible.



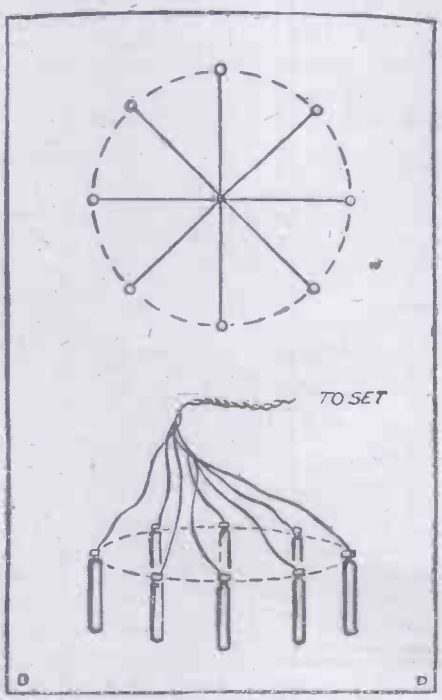
AN EFFICIENT "EARTH."

THE usual form of earth plate can be dispensed with by making use of the idea shown in the accompanying illustration. Most amateurs, at some time or other, find themselves with a number of discharged dry cells upon their hands, and these can be utilised to form a most efficient earth.

Remove the carbon rods from these cells and connect them to the earth lead of the set in the manner shown. It is a good idea to employ a stranded wire—the more strands the better—for the earth lead, as this will considerably simplify matters in connecting up the carbon rods. If a many stranded wire of the type referred to cannot conveniently be obtained, copper leads of from six to seven feet in length should be procured, and attached to the carbon rods. The loose ends should then be brought together and bound and soldered to the end of the earth lead.

No Digging Required

To save the labour entailed by digging a deep hole in which to place the rods, a strong iron pipe, such as a piece of gas-piping about an inch in diameter, should be driven into the earth for a distance of at least three feet. When this is withdrawn, it is an easy matter to drop in the carbon rod, attached as it is to its length of connecting wire. The number of holes required will, of course, depend upon the number of carbons used, and the holes should be so sunk that they form equidistant points around the circumference of a fairly large circle marked on the surface of the ground.



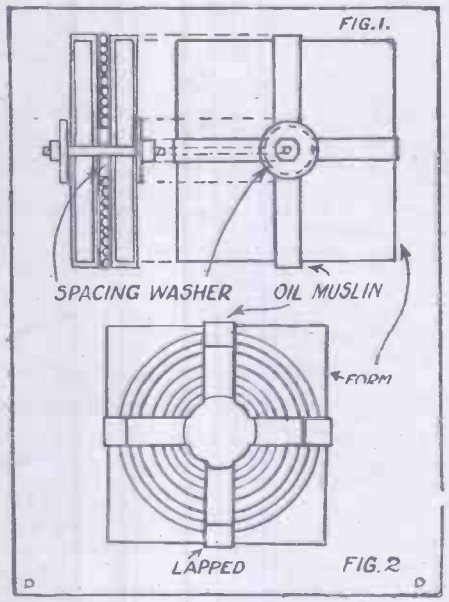
NEW METHOD OF CONSTRUCTING PANCAKE COILS.

TO construct a coil of the pancake type in the manner illustrated is comparatively a simple matter, and the results obtained from coils so wound are, generally speaking, all that can be desired.

Obtain two square pieces of wood, as shown in Fig. 1, and plane the flat surfaces until they are perfectly level, completing this part of the work with sandpaper to ensure a uniform surface. The two pieces of wood are then bound together by means of a bolt passing through the centre of each. Two washers of fairly large diameter are employed for clamping the free end of the oil muslin on the outer side of the wooden forms.

The Coils In Use

The spacing washer employed between the two boards should correspond in thickness to the wire which it is proposed to use for winding the coil. Strips of oil muslin are utilised in the manner shown in Fig. 2. The muslin is coated with shellac before commencing to wind the coil, and as the wire is wound into position it will stick to the muslin, and thus each turn will be kept in place. The coil should then be allowed to thoroughly dry before it is removed from the form. A further heavy coating of shellac should then be given to the coil, and after this second application has dried the coil will be perfectly rigid and ready for use.



The manner in which such coils should be mounted is left to the individual taste of the reader, but whether they are connected to flexible leads or to plugs used on coils of the spider web type does not in any way impair their efficiency.

With a spacing washer of one inch diameter, two of these coils wound each to 40 or so turns of 24 gauge wire should prove quite suitable for a variometer for broadcast reception.

POPULAR WIRELESS Beginners' Supplement

PART XIII. WIRELESS IN A NUTSHELL.

By MICHAEL EGAN.

ONE of the most useful analogies that can be employed in connection with the study of wireless is that of ordinary conversation. Each of us is equipped with a complete wireless outfit for transmission and reception. When we converse, or when we listen to others conversing, we are transmitting and receiving by wireless.

The analogy goes further than that. It serves to answer many of the puzzling questions with which the beginner at wireless is usually beset. How far does a wireless station send? How far can a wireless receiver pick up signals? Are the signals from broadcast stations louder than those from other stations? Has a valve receiver a greater range than a crystal receiver? Do I need an outdoor aerial or an indoor aerial, and should I have an amplifying valve or not in order to pick up broadcasting signals?

Range of Reception.

The answer to each of these questions is: *It depends.* I admit this is not a very satisfactory answer when one is in a great hurry to rig up a receiving equipment that will enable one to enjoy the broadcast programmes. Yet it is the best answer that can be given to such general questions, and this fact can best be appreciated by referring to the analogy of ordinary conversation.

The distance over which conversation can be carried on between two people depends upon two things: (1) The amount of energy used by the person who speaks, and (2) the sensitivity of the listener's hearing. Similarly the distance over which communication can be maintained between two wireless stations depends upon two things: (1) The amount of energy (or power) used by the transmitting station, and (2) the sensitivity of the receiving station. If you vary one of these factors, in either case, you vary the distance.

Since the beginner cannot vary either the power or the distance of a transmitting station at will, the sensitivity of the receiving station which he or she proposes to erect is of primary importance. If the transmitting station from which it is desired to receive is a long way off, a fairly sensitive receiving equipment will be required, and if it is close by, a comparatively insensitive receiver will give the same results.

Sensitivity of a Receiver.

A receiving equipment comprises three essential parts: (1) An aerial, for intercepting the transmitted wireless waves; (2) a detecting device for preparing the received currents for conversion into sound; and (3) a pair of telephones for actually converting them into sound. In addition to these, you may employ some means for amplifying, or increasing the strength of, the received currents.

To a very large extent, the sensitivity of the receiving equipment as a whole will depend upon the sensitivity of its least efficient part. Just as the strength of a chain is equivalent to the strength of its weakest link, the efficiency of a wireless receiving equipment is relative to the efficiency of its least sensitive part. It is advisable, therefore, to make each individual part as efficient as possible.

An Efficient Aerial.

The aerial is the cheapest part of a receiving outfit. The necessary wire and fittings can be procured for about ten shillings. The simplest and most efficient form of amateur aerial is just a single horizontal wire, stretched between two supports, from which a vertical wire hangs, the lower end of the latter being joined to the receiving instrument. This vertical wire can be joined to the horizontal wire at any point, but, for best results, it should be joined at the centre or at either end of the latter.

The aerial wire must not be allowed to come into contact with any material which allows electricity to flow through it. Otherwise, the small electric currents set up in the aerial when signals are being received will leak from the aerial to the "conducting" material, and thus flow away to earth without ever getting near the receiving instrument. In order to hear signals, the received currents *must* flow to earth *via* the receiving (*i.e.*, detecting) instrument.

Fortunately, there are certain substances which offer a very strong opposition to the passage of electricity through them. These are called "non-conductors" or "insulators," and the commonest of them are: ebonite, rubber, glass, porcelain, mica, etc., etc. By inserting a strip of ebonite, therefore, between the end of the aerial wire and the rope which connects it to whatever support is used (chimney or mast or tree, etc.), the aerial can be effectively protected, or "insulated." If these insulators were not used, the received currents would flow along the supporting ropes instead of down the vertical wire to the receiving instrument.

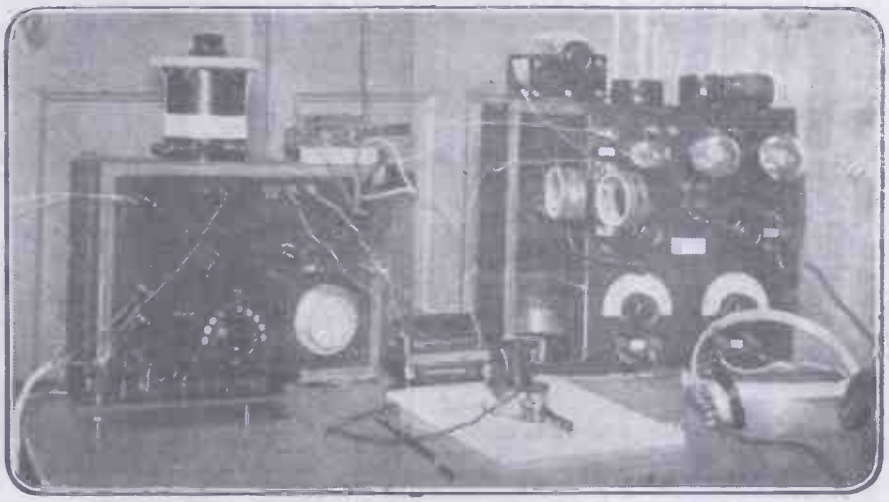
The vertical wire is usually called the "down lead" of the aerial. It must, of course, be insulated as carefully as the horizontal wire. This can be done either by making the lower part of it of rubber-covered wire, or by conducting the bare wire (if bare wire is used for the aerial) through an insulating tube to the receiving instrument. If the entrance of the wire is effected *via* the window of the room in which the receiving instrument is installed, this "leading-in tube," as it is generally called, can be jammed underneath the window.

Earths and "Tuning."

An aerial can be made either of bare wire or of insulated wire (*i.e.*, rubber-covered or cotton-covered). Moreover, it can be erected either outdoors or indoors. An outdoor aerial is preferable, because it can be made both high and long. The higher and longer the better, provided its total length *plus* height does not exceed 100 ft. If you have not a space of more than 45 ft. at your disposal, it is advisable to use a double-wire aerial. This consists of two parallel horizontal wires, spaced about 5 ft. apart, each of which is fitted with a separate down lead, or vertical wire. The lower ends of the down leads should be joined together before being brought through the leading-in tube as a single wire.

On being brought through the leading-in tube, the lower end of the down lead is joined to a terminal on the receiving instrument. It does not stop here, of course. It passes through a variable coil of wire (fixed inside the receiving box) to another terminal, and from this second terminal a separate wire is taken to the earth. In most households the water tap provides a very convenient earth. The aerial down lead therefore passes *through* the receiver to earth, and the currents set up in the horizontal wire follow the same path. By turning a small handle on the lid of the receiver box, different amounts of wire can be tapped off from the variable coil inside, thus altering the effective length of the aerial.

(To be concluded next week.)



Experimental Station 2 O G. Mr. A. Cooper's station at 16, Wentworth Road, York.

QUESTIONS & ANSWERS FOR BEGINNERS.

NOTE.—On this page the beginner will find a selection of questions and answers which will concisely deal with many little problems met with in the erection of a wireless receiver. Readers are invited to send their queries to the Technical Dept., Room 138, The Fleetway House, Farringdon Street, London, E.C.4, where they will be carefully and promptly dealt with. Replies are sent by post free of any charge.

HOW CAN MUSIC BE SENT BY WIRELESS? First of all a continuous wave is radiated from the transmitting station, then by means of a microphone the sound waves caused by the music are made to produce electrical current variations which in turn give rise to a variation in the continuous wave which is being transmitted. This variation corresponds exactly to the sound wave produced by the music. At the receiving station the reverse takes place. The continuous wave and its variation cause a varying current to flow in the receiving aerial which in turn is changed into varying sound waves by means of the telephones.

* * *

WHAT IS CAPACITY? In wireless and electrical work generally, the capacity of a condenser is its power of containing a quantity of electricity. In variable condensers this capacity is easily increased or decreased by changing the relative positions of the plates in the instrument.

* * *

WHAT IS A MICROPHONE? An instrument whereby sound waves are converted into electric current variations. The sound waves are made to strike a diaphragm in contact with a number of carbon granules through which a steady electric current is continually flowing. The waves cause the diaphragm to vibrate which in turn disturbs the carbon particles causing them to become alternately tightly or less tightly packed, according to the vibrations in the diaphragm. This variation in the "packing" of the carbon granules causes a continual alteration in the path through which the electric current has to flow. It is therefore easily seen that, according to the sound waves, so will the path provided for the electric current vary, and the amount of current will thus vary in proportion. By this means perfect control over the electric current is obtained by the sound-waves, and as they vary so will the electric current change. The receiving telephones act upon the same principle but in an opposite manner. In this case a varying current is made to vary the magnetic attraction of a magnet on a soft iron diaphragm, thus causing it to vibrate, these vibrations giving rise to sound waves.

* * *

WHAT IS MEANT BY HETERODYNING? The phenomenon caused when two wireless waves of nearly the same frequency become mixed up. In this case they alternately get in and out of step with each other, causing a series of notes in the telephones of any receiving set which is tuned to somewhere about their wave-length. This note is liable to seriously interfere with the reception of either one or the other of the two waves. The interference caused by valves oscillating will give the same effect by causing a wave to radiate which will heterodyne with the wave of the transmitting station which other listeners-in are trying to receive.

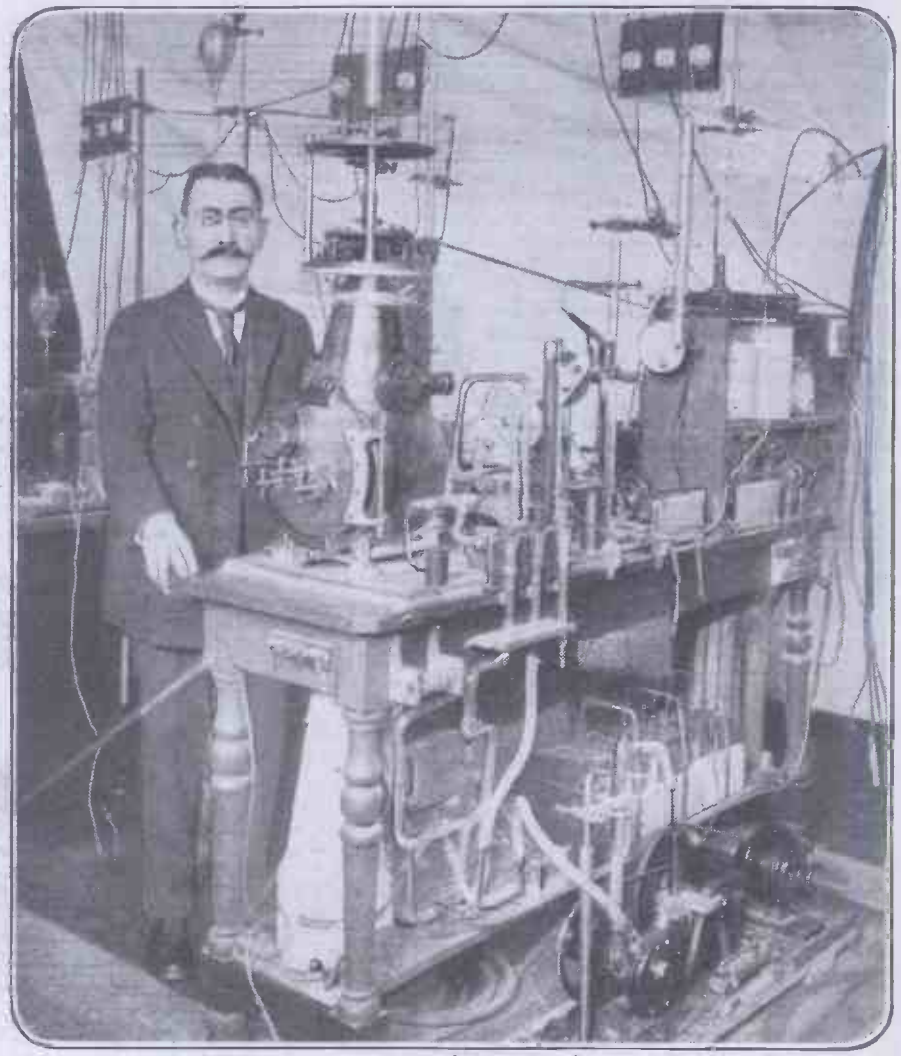
WHAT IS THE ADVANTAGE OF A VARIOMETER? The advantage of this instrument is that very fine tuning can be obtained without the need of adding capacity to a circuit, and thereby decreasing the energy available for operating the detector. It consists of two coils of wire joined electrically in series, and at the same time inductively coupled. The coupling can be varied by revolving one coil inside the other, or by varying the distance between the two coils. This has the result of changing the inductance of the circuit, and thereby altering its wave-length without introducing condensers and their disadvantages.

* * *

WHAT IS THE CARRIER WAVE USED IN TELEPHONY? As its name implies, it is a wave radiated by the transmitting station, and upon which the telephony is carried. The carrier wave consists of a continuous wave of unvarying amplitude as long as no telephony is to be transmitted. When speech is sent out the carrier wave is varied in amplitude according to the variations in electric currents which flow through the transmitting microphone.

* * *

WHAT IS INDUCTANCE? The electrical equivalent to inertia. It is the quality possessed by a circuit which tends to oppose any commencement, cessation, or variation in intensity of a current flowing through it. Every conductor has a certain amount of inductance, even a straight wire, but this inductance is very greatly increased by winding the wire in the form of a helix or coil. It can be increased still more by using a coil containing an iron core. Inductance has a direct relation to the wave-length of an aerial or a circuit, and by varying the inductance the circuit can be made to tune to any wave-length.



M. Dufour's invention, the cathode oscillograph, which is capable of recording the minute currents of high-frequency electricity.

FURTHER NOTES ON THE ACCUMULATOR

By R. G. de WARDT, M.I.R.E., A.M.I.E.E.

THE lead accumulator has been in use by electrical engineers for many years, but with the advent of broadcasting many persons are making their first acquaintance with this indispensable item.

The life of accumulators depends to a very great extent on the treatment they receive, and the instructions supplied by the manufacturers should be carefully adhered to. While it is easy to carry out these instructions if care is exercised, every amateur worthy of the name wishes to know more about the accumulator than simply how to treat it.

Power supplied from the accumulator, or secondary cell, as it should be more properly called, is derived in the first instance from prime movers, which generate energy so long as they are supplied with fuel, the power being given to the cell while it is on charge.

The First Accumulator.

The energy produced by the cell is therefore produced by the consumption of fuel in exactly the same way as the power produced by a primary cell, such as that of the Leclanché, which is produced by the consumption of the zinc. All the secondary cell does is to store the energy supplied to it whilst on charge until such time as it is wanted.

The process by which this storage of energy is effected is entirely chemical, the constitution of the surface of the plates being changed on discharge and coming back to their original condition on charge.

The first secondary cell was made by Planté, and consisted of two lead sheets separated by a sheet of felt, and rolled up together and immersed in a solution of dilute sulphuric acid.

Planté found, on charging such a cell, that a thin layer of lead peroxide was formed on the plate connected to the positive terminal of the charging battery, while the plate connected to the negative remained unchanged. When the cell was discharged a current was obtained for a very short time, and it was found that the lead peroxide had become lead sulphate, and that the surface of the plain lead plate had also become lead sulphate. On charging again the positive plate becomes covered with lead peroxide and the negative plate with plain lead in a spongy or finely divided form.

If such a cell charged to this condition is considered, the process by which the changes are produced can be studied. If the plates of the cell are connected together by a wire it is apparent that the current flows from the positive plate along the wire to the negative, and from the negative through the solution to the positive to complete the circuit.

What Happens Inside.

The electrolyte consists of a mixture of sulphuric acid and water, the sulphuric acid being a compound substance consisting of two parts of hydrogen, one part of sulphur, and four parts of oxgyen. When the current commences to flow in the electrolyte it splits up the sulphuric acid, the hydrogen particles, or "ions," as they are called (from the Greek for "wanderers"), taking positive charges of electricity and travelling to the positive plate, where they surrender their charges and combine chemically with the lead peroxide in conjunction with the sulphuric acid in the electrolyte, forming lead sulphate and water. The sulphur and oxygen ion released by the movement of the hydrogen ion travels to the negative plate and also forms a lead sulphate.

This process continues until such time as all the lead peroxide and spongy lead are changed to lead sulphate. When this state is reached the voltage of the cell is nil.

The result of the discharge is thus, that some of the sulphuric acid has been taken out of solution and forced to combine with the surface of the plates. The strength of the electrolyte is therefore weakened.

On charging such a cell, the current through the electrolyte travels in the opposite direction, and the hydrogen ions, still associated with a positive charge of electricity, travel to the negative plate, where they react with the lead sulphate and form lead and sulphuric acid. The sulphur and oxygen ion travel to the positive plate, and, together with the water in the electrolyte, react with the lead sulphate, converting it into lead peroxide and also forming sulphuric acid.

Explanation of "Gassing."

When all the available lead sulphate has been acted on, the hydrogen produced by the passage of the current is given off at the negative plate. Oxygen formed by the reaction of the sulphur and oxygen ion with the water in the electrolyte is also given off at the positive under the same conditions. The evolution of these gases is indicated by the stream of bubbles from the surface of the plates, and shows that the cell is fully charged.

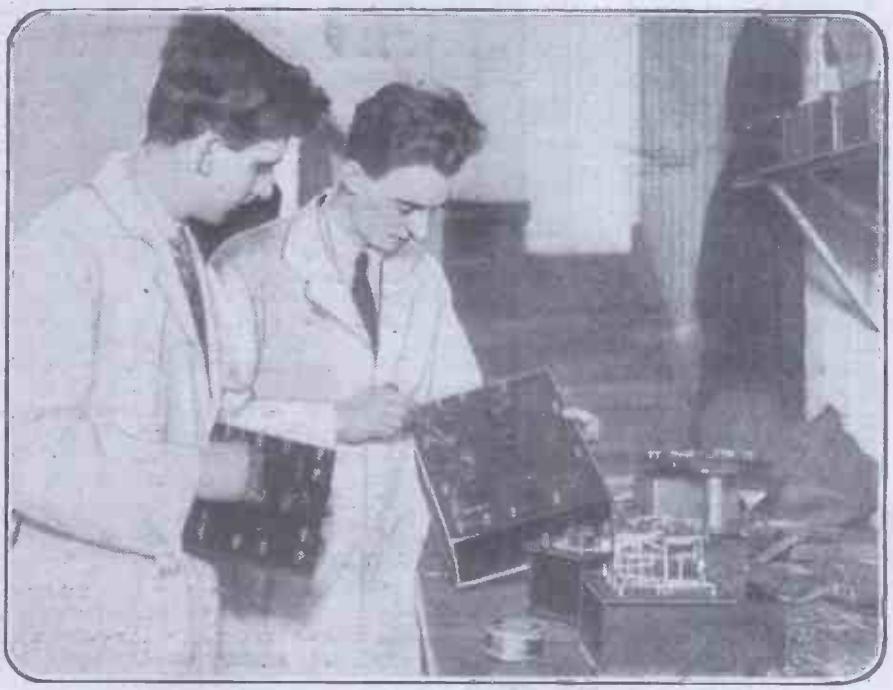
It will be seen from the above that the acid absorbed by the plates on discharge is given back to the solution by the chemical changes taking place on charge.

What Causes "Sulphating."

The lead sulphate formed by the discharge of the cell is of a different nature to the white lead sulphate known to commerce, and is called normal lead sulphate to distinguish it from the latter.

The white sulphate can be formed in a cell by leaving it standing in a discharged condition and can be easily recognised. Such a sulphated condition of a cell is very bad, as it cannot be converted back into lead peroxide or spongy lead, and if a cell has become sulphated, as it is called, the only remedy is a series of charges at a slow rate, which will ultimately cause the white sulphate to leave the plates and be deposited on the bottom of the cell.

From the foregoing it will be seen that the amount of energy that can be obtained from a cell is dependent on the amount of lead peroxide and spongy lead (or active material) present, and all the improvements that have been made since Planté's original invention have been directed to obtaining a large quantity of material in a form accessible to the electrolyte. Faure discovered several years later that by pasting lead frames with a mixture of red lead and sulphuric acid for the positives and litharge and sulphuric acid for the negatives he obtained a plate which had a very large proportion of active material in comparison to its weight. Such plates on charging are readily converted to the required lead peroxide and spongy lead, and it is plates of this type that are used in the portable cells used with wireless sets to-day.



Let the amateur do this! The making of a wireless set is the amateur's delight. The photo shows mass production of receivers.

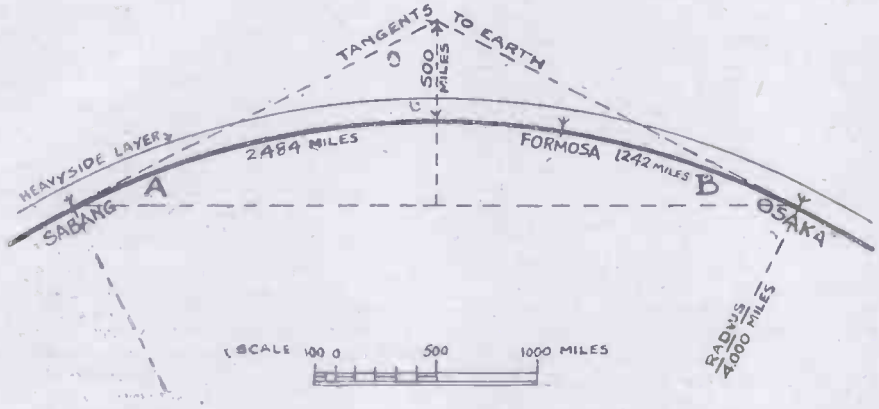
WHY BLAME THE HEAVISIDE LAYER?

BY R. W. RUSHWORTH.

MUCH has been written about the Heaviside Layer Theory—the theory that transmitted wireless waves are projected upwards, and upon striking a layer of gas at about 100 miles above the earth's surface—and termed the "Heaviside Layer"—are thence reflected back to the earth.

This theory appears to be supported by several eminent scientists, amongst whom are Sir Oliver Lodge, Professor Fleming, and Dr. de Groot.

It is not intended to discuss the actual existence of this Heaviside Layer, but it will be taken for granted that a layer of gas does exist at about 100 miles above the earth's surface, and now let us consider whether this layer affects wireless waves.



The adherents of the Heaviside Theory have different arguments to use in support of their views. The main theory that waves are projected upwards and, striking the layer of gas, are then reflected downwards is imparting to the transmitter a certain directional (upward) effect, which is contrary to the elementary principles of wireless, for in our infancy we are taught that wireless waves can be likened to the waves created on the surface of a pond when a stone has been thrown in, i.e. that they radiate in all directions from the point of the stone's contact forming ever-increasing circles. But when dealing with the ether instead of water we have another dimension to include—instead of the waves radiating upon a plane surface, we have them forming ever-increasing spheres, therefore they are radiating *in all directions* and not only upwards, for it must not be forgotten that wireless reception is possible at the bottom of a coal mine. This, then, would seem to be an objection to the theory.

An Alternative Theory.

The argument, originated by Dr. de Groot, in support of the Heaviside Layer Theory, and which has been termed "most conclusive," is as follows: A receiving station at Osaka, in Japan, can pick up signals from Sabang in Sumatra, which is 3,726 miles away, and yet "at a point between Sabang and Osaka, 2,484 miles from the former and 1,242 miles from the latter, Sabang can never be heard."

It is interesting to note the word "never." This implies some fixed obstacle, necessarily terrestrial, and cannot be applied to an ever-changing mass of gas which might easily allow of the intermediate station receiving signals sometimes.

Let us now consult a map and see exactly where this "silent" spot is. If we measure a distance of 2,484 miles from Sabang in the direction of Osaka, we find ourselves right upon the Island of Formosa, and we shall find rather to the south of the centre of the island Mount Morrison rising to a height of 13,600 feet. Now, supposing the receiving station on this island to be situated to the *North* of this mountain, it would be quite impossible for him to hear Sabang because of his proximity to this most formidable of screens, Mount Morrison, and that is why he would *never* hear the Sumatra station, because the mountain is *terrestrial* and is not a variable substance like gas. The station at Osaka, however, would be able to pick up Sabang because its comparatively great distance from Formosa would cause Mount Morrison to lose its screening effect to a great extent. That this is the real reason why Formosa can never hear Sabang there can be no doubt, as the writer, as a wireless operator during the war, has many times experienced this same phenomenon. For instance, on the voyage from Belfast to Dublin, the station at Larne, with a normal transmitting range of about 300 miles, would be very loud until quite suddenly the signals would be "quenched" so as to be only just audible—and this was proved to be caused by the ship's course bringing the Mourne Mountains in between; these acting as a screen—and later, when some distance farther south had been covered, the screening effect of the mountains grew less, and gradually Larne became quite loud again. This particular instance was noted on several occasions.

A Weak Point.

This should be a very satisfactory explanation of the phenomenon which, in the writer's opinion, has been erroneously attributed to the Heaviside Layer.

Yet another objection to the Heaviside Theory is that if the waves did have that upward directional tendency reception would only be possible in a comparatively limited zone, which would be only that area where the reflected waves met the earth. This means that it would be impossible to hear a station transmitting if the receiving station was very close; for the waves would go right over his head, as it were, "which," as Mr. Euclid would say, "is absurd."

In the illustration, which is drawn to scale, the thick line shows the surface of the earth, upon which are marked Sabang and Osaka, with Formosa in between, and the Heaviside Layer, as generally accepted, is shown parallel with and at a distance of 100 miles from the earth.

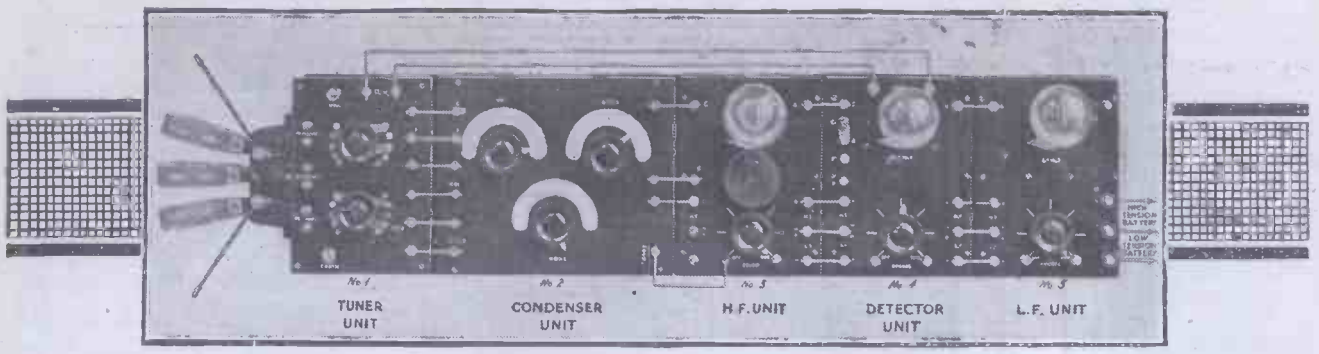
It will readily be seen that the Heaviside Layer would have to be at *least* 500 miles above the earth to cause the phenomenon previously mentioned, and the exponents of this theory put the distance at about 100 miles. Again, it is obvious from the sketch that stations anywhere along the line A B would also be "silent" spots, even at a hundred or so miles from the transmitting station, whereas we well know the possibility of reception at distances varying from, say, 500 to 3,000 miles.

"Silent" Spots.

In short, if the Heaviside Layer were responsible for the phenomenon in the Sabang-Osaka case, the same principle would hold good anywhere given similar distances. But experience shows that such is not the case.

It, therefore, would appear that the Heaviside Layer really does not affect wireless waves in this manner, but that the latter, whilst radiating in all directions, tend to travel round the earth's surface, and any "silent" spots would be caused by a terrestrial obstacle or screen in the path of the wave.

Master Lance White, aged 7, who recently broadcast from 2 L O.



American Broadcasting heard eight times on these Units —

Manchester Amateur receives American Concerts on his home-constructed Peto-Scott Units, using one Valve only.

THE wonderful efficiency of the "Peto-Scott" Unit system of Valve Receivers is again demonstrated in this letter from a Manchester Amateur. On several occasions recently we have received letters from enthusiastic users in various parts of the Country that they have received American Broadcasting, but owing to the difficulty of verifying these statements we have previously refrained from publishing them. In this case, however, Mr. Brittain effectively demonstrates that his is not a case of freak reception. We offer Mr. Brittain our congratulations on a noteworthy performance and trust that his efforts may prove a stimulus to the thousands of other experimenters who are using these Peto-Scott Units. We are gratified to hear of this success, although we are not altogether surprised. Our aim is to produce an extremely efficient Valve Receiver at a moderate price. But even at the moderate price at which these sets are sold the quality of the actual components is of the highest—Grid leaks, Condensers, Rheostats, etc., are all made with the most exacting care and with scrupulous accuracy. It is only the most careful attention to small details which enables such a high standard of efficiency being maintained.

If you are thinking of building your own Set, send 6d. for an interesting little Book describing the whole System.

Price List of Sets of Parts.

No. 1.	Tuner Unit - - -	27/6
No. 2.	Condenser Unit - -	42/-
No. 3.	H.F. Amp. Unit - -	13/6
No. 4.	Detector Unit -	17/6
No. 5.	L.F. Amp. Unit - -	33/6

Mahogany Cabinets to fit Nos. 1, 3, 4 and 5, 3/6. To fit No. 2, 7/-

Postage 9d. per unit extra, but paid on all orders over £2.

Read Mr. Brittain's letter:—

5, Leighs Fold,
Green Lane,
Patricroft.

Messrs. Peto-Scott, Ltd.

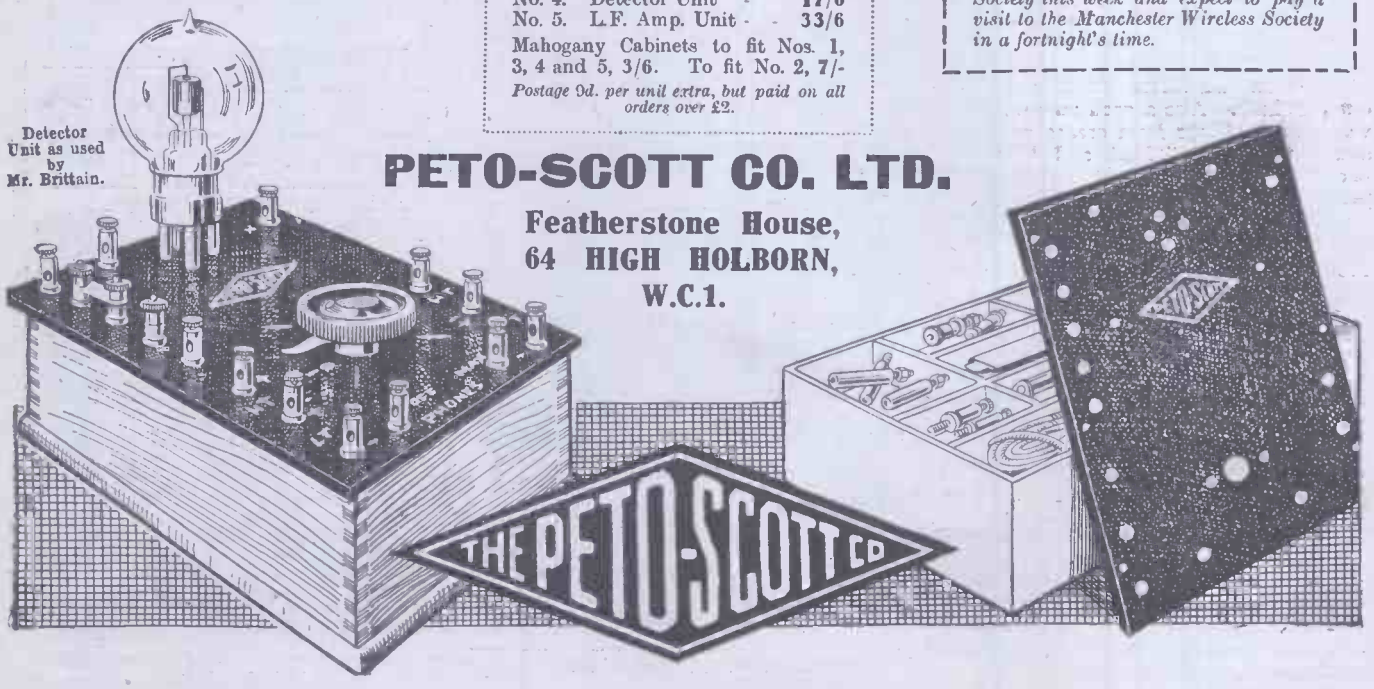
Dear Sirs,

No doubt you will be interested to know that the reception of the American Broadcast stations W J Z and W G Y on a single-valve home constructed set as described in my letter to "Popular Wireless" of March 17th issue, was made from a set of Peto-Scott (No. 4 unit) parts. To prove this is not a case of "freak" reception may I state that since that date I have received these stations eight times. I also get, apart from the above and B.B.C. stations, the F.L., Radiola, Posts and Telegraphs (all French stations) telephony.

Wishing you the best of success with such an excellent panel,

Yours faithfully,
J. H. Brittain.

P.S.—I am demonstrating my set before the Eccles and District Radio Society this week and expect to pay a visit to the Manchester Wireless Society in a fortnight's time.



Detector Unit as used by Mr. Brittain.

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COMPETITION RESULT.

THE £5 offered by the Editor for the best criticism of the B.B.C. concerts resulted in some thousands of entries. Evidently the subject was regarded as an important one by the readers of POPULAR WIRELESS.

After careful consideration the Editor has decided to award the £5 to Mr. A. G. Letts, 3, Cranbrook Road, Thornton Heath. Consolation prizes of £1 each will be sent to Miss D. E. Pithie, 68, Clarenden Road, Southsea, Portsmouth, and Mr. S. Monk, 134, Longfellow Road, Worcester Park, Surrey.

Since this competition was announced the B.B.C. programmes have been subjected to very severe criticism in the daily Press—too severe, if anything, because allowances must be made for the great difficulties the B.B.C. are experiencing; and wholesale destructive criticism is of little value.

From A. G. LETTS,
3, Cranbrook Road,
Thornton Heath.

As a keen listener-in and being specially interested in orchestral and instrumental items, I should certainly like to see more good music played at times, as the orchestra seem quite capable. The idea recently suggested of one evening per week given over entirely to better-class music is excellent. Not everyone is content to listen to sugar-coated melodies—they require music of character. What finer medium of bringing high-class music before the general public is there than broadcasting. The lecture-recital items are of great educational value and should certainly be increased.

From (Miss) D. E. PITHIE,
68, Clarenden Road,
Southsea, Portsmouth.

The concerts of the B.B.C. get very monotonous—one sees, week after week, much the same music, all somewhat out of date. Why cannot some of the new English composers be played? One reads about their wonderful concerts at the different halls. Also a good military band would be a change from orchestral music and the overture "Poet and Peasant" might be given a rest. It was on three programmes one night, and has been played several times at 2 L O. Let us have something new.

From J. MONK,
134, Longfellow Road,
Worcester Park, Surrey.

The broadcast concerts have one audience with many levels; but not so many of us want to reach the "Ragtime" level. The modern craving is for emotion, and in music this can be met by such compositions as "Faust" and "Tristan and Isolde." Then who does not feel exhilarated by the "Soldiers' Chorus" or "1812": and how many are there who would not find pleasure in Schubert's "Serenade" or Schumann's "Grenadiers" or a Strauss Waltz?

To appeal to all, the music should have a strong melodic strain. Standard English songs should also be given. But eventually London will have two simultaneous concerts on different wave-lengths.

CORRESPONDENCE.

The Editor, POPULAR WIRELESS WEEKLY.

Dear Sir,—I was much interested in Physician's valuable and timely article in a recent issue of POPULAR WIRELESS WEEKLY. In view of the enormous importance of the subject, I trust that you will find space for this letter.

Many experiments with the ossiphone convince me that one reason why better results (i.e. clearer reception) may be obtained through the body than directly through the ear, is that when sound waves pass first through the body, the body acts as a filter or damper, blotting out small but otherwise troublesome extraneous noises which are readily capable of producing perceptible effects on the ear drum direct. A curious and anomalous deduction is that an apparently deaf person may be able, with proper apparatus, to hear better through his body than one who is not deaf can with his ears.

The suggestion that wireless waves directly affect the ear is open to grave doubt, for the enormous difference between electro-magnetic (ether) waves and sound (air) waves renders it difficult to imagine that auditory nerves, developed by Nature for sound wave reception, would respond to ether vibrations.

It appears to me far more likely that there is some other and far more subtle receptive faculty at work. For instance, it is conceivable that the brain receives, simultaneously, two distinct impressions of the same thing, in two entirely different ways, one means of communication being the auditory nerves, and the other a functioning of the brain, which may be of a telepathic nature. That is to say that, in response to the sensation of sound, the brain is instantly "tuned" so that it functions as an independent receiver. Yours truly,

P. J. RISDON, F.R.S.A.,
Hove, Sussex.

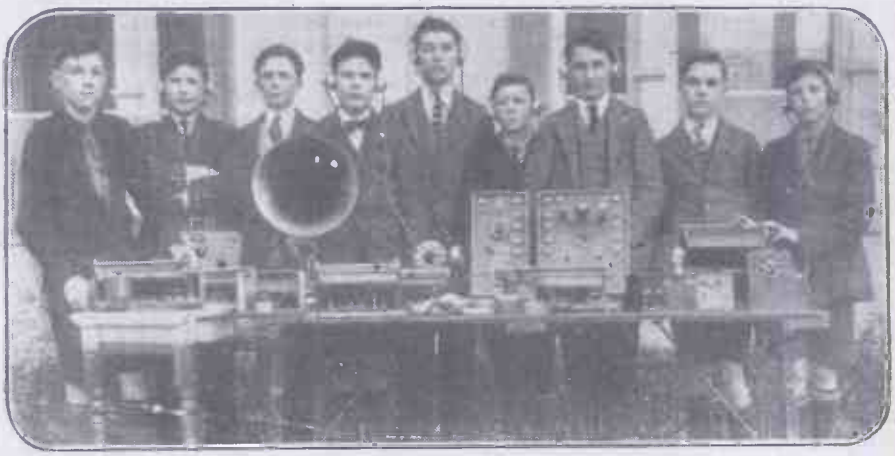
The Editor, POPULAR WIRELESS.

Dear Sir,—Referring to the query of "Pipped;" Dover, in your correspondence column of issue No. 23, dated 4th November, 1922, it will be found that a metal sheath placed round the dead end of the inductance will, if connected with the earth terminal, have the effect of permanising the increased volume of sound noticed by your correspondent when he touched the inductance former with his hand. I use a piece of thin zinc, about four inches wide, bent horseshoe shape, and slipped over the former at the dead-end side of the slider and resting on the baseboard, arch fashion. This is in close proximity to, but not actually touching the winding, and is connected by a soldered wire to the earth terminal. It is an easy matter to slip the metal sheet under the slider bars—I am using a two-slider arrangement—and since the metal need not entirely encircle the inductance it is only a matter of a little arrangement to deal with the longer wave-lengths.

En passant, the super crystal set described in a recent issue of POPULAR WIRELESS is "the goods." I don't grudge a moment of the few hours it took me to follow out your very clear instructions.

Yours faithfully,
H. O. FIELD.

Duniera, Wingletye Lane,
Hornchurch, Essex.



The club apparatus at St. Josephs College. Beulah Hill, S.E. 19. The school club numbers many keen amateurs among its members

W. & G.

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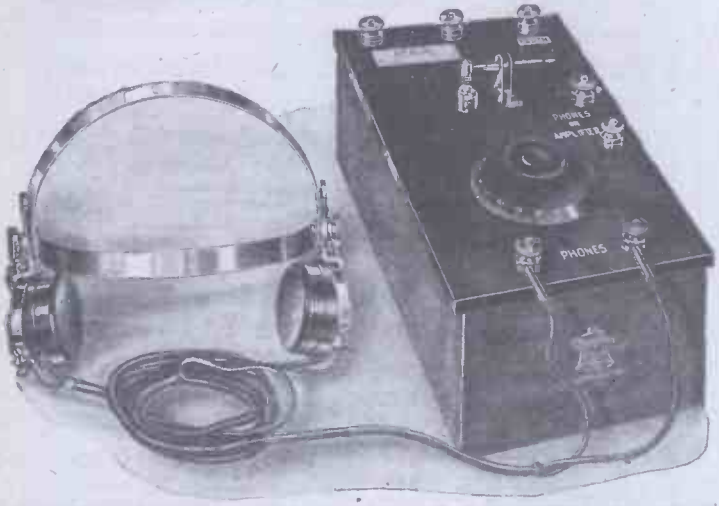

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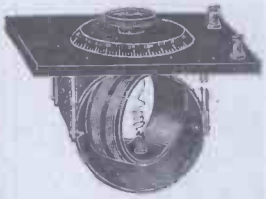

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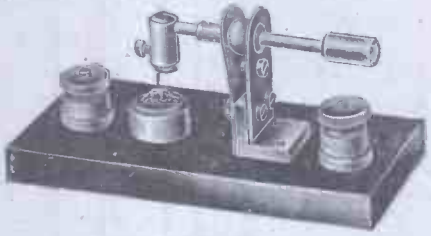

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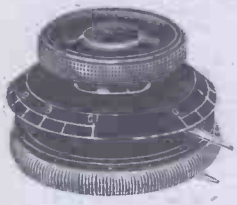

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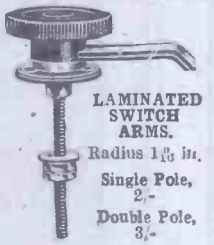

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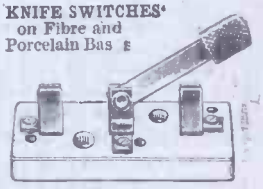

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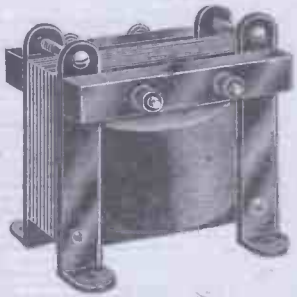

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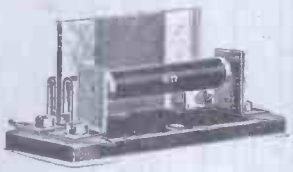

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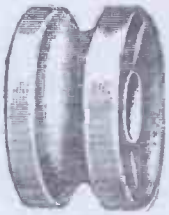

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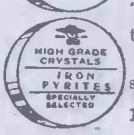

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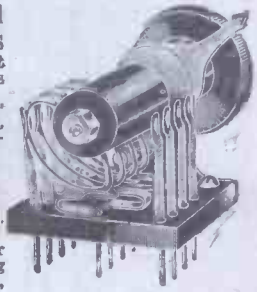


NO-CAPACITY SWITCHES VARIOUS SIZES.

THE TRANSMISSION OF POWER BY WIRELESS.

By A. H. DALY.

PRACTICALLY every second of the day the sun is radiating thousands of millions of horse-power in the form of light waves, and the stars of the solar system, which includes the earth, are nothing more or less than huge receiving stations for a certain percentage of this radiated energy. The question therefore arises: Will it ever be possible for man to copy the sun in this respect, and transmit electrical power by radio waves? For, fundamentally, radio waves and light waves are very similar to each other. Some famous scientists say no, but others equally famous say yes—once the key to the problem is found—while, again, others maintain that man has already found the key to the problem, namely, the transmission of electro-magnetic waves, and all that is now required is development—a factor which is taking place slowly but surely.

When it is remembered that thirty years ago Hertz excited his transmitter by a spark coil, which forced a few weakly watts into the aerial; while to-day the 1,000 kw. magnetron valve scarcely larger than Hertz's spark coil is capable of radiating nearly 1,000,000 watts, it is only reasonable to conclude that development towards electrical power transmission is taking place rapidly rather than otherwise.

What Dr. Tesla Claims.

Even to-day, although the energy picked up by a receiving aerial is very small, it is, nevertheless, a definite amount of energy which can be measured and calculated. For instance, the amount of energy received on a medium-sized frame aerial from a 200 kw. station 200 miles away is about one sixty-thousandth of a horse-power, or one eighty-millionth of a watt. This amount appears ridiculously minute, but it must be remembered that the 200 kw. transmitter radiates in all directions at once, and no matter where the frame is placed on the circumference of a circle having a radius of 200 miles from the transmitter—the same amount of energy will be received. In fact, it may be stated, in view of present-day knowledge, that no matter how far away from the transmitter the receiving aerial happens to be, some of the transmitted energy would be picked up by the aerial. This energy could, of course, only be detected provided the receiver was of a very sensitive nature.

The problem of sending power by radio is therefore not so much a question of transmitting the necessary power as the concentration of the power in one particular direction. A step towards this end is the Marconi wireless beam which is used on the wireless lighthouse. This is a case of concentrated energy, for the waves are radiated in one particular direction by means of reflectors just as the light beam is reflected by a polished metal surface or mirror.

Over twenty years ago Nikola Tesla succeeded in lighting electric lamps at a distance of nearly a mile from his transmitter, and he appears to have accomplished this, not by the usual method of wireless control, but by the actual transmission of power. *Dr. Tesla has also stated that he could construct apparatus which would transmit electrical energy by wireless to any part of the world with a loss of only five per cent.*

A statement like the above coming from such a great authority on wireless as Dr. Tesla is naturally listened to with respect, and if it is indeed possible for him to erect such an apparatus, Dr. Tesla should give his invention to the world, for radio power transmission would do a great deal towards mitigating some of the most pressing troubles of to-day.

By means of the radio telephone it is possible for the remote settler in the backwoods, desert or veldt to keep in almost constant touch with the nearest civilised community, and with Tesla's invention the self-same settler could, by probably erecting a similar apparatus, obtain power to drive his machinery, cook his food, and have to hand at all times light and heat.

There are many places on the earth—more or less remote—where huge industries would undoubtedly arise if it were possible to obtain the necessary power, and as it is commercially impossible to obtain this power by ordinary electric cable transmission, the only alternative is wireless power. It is also quite likely that parts of the earth which are at present uninhabitable owing to climatic conditions—and which are particularly wealthy in mineral deposits—might be made habitable for man if the necessary power were obtainable. For example, sections of the polar regions or deserts which, according to explorers, are very rich in minerals.

Application to Transport.

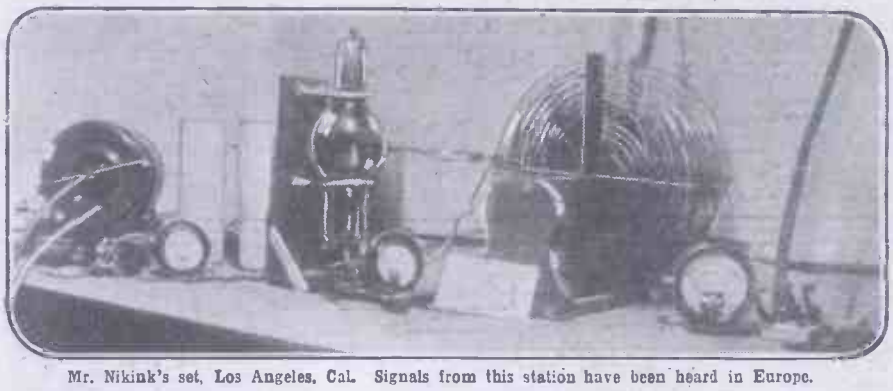
Probably also owing to the creation of many new industrial centres the greatest social evil and problem of our present age, namely, unemployment, would be eliminated.

Wireless transmission of energy would also mean a vast stride forward in the case of modern transport. All transport, whether it be on land, sea, or in the air, is controlled by the amount of fuel it carries. With radiated energy, however, the space now occupied by fuel such as coal, oil or water would be available for other purposes such as passengers and cargo, and the vessel or train would be able to travel almost indefinitely as far as fuel-distance was concerned.

Would It Be a Danger?

There has been a great deal of comment about the slow way in which the railways of the world are converting their steam-driven engines into the more efficient electric traction. But electric traction is not very popular with most railways because of the huge initial expense of laying out central and sub-stations and running expensive cables for perhaps hundreds of miles. Obviously, wireless power transmission would obviate this.

Wireless power, when it comes, will also give a tremendous impetus to aviation, for at present the lift, capacity and radius of action of all types of aircraft are controlled by the petrol carried.



Mr. Nikink's set, Los Angeles, Cal. Signals from this station have been heard in Europe.

In addition to the above, it is claimed that practically every dwelling in the country could be supplied with electric light at a price which would compare favourably with the present sum expended on the paraffin lamp. The same would also apply to heating and cooking.

In a number of books which have appeared of late years, the authors have foreshadowed the coming of radiated electric power, but in many cases their imaginations have seen it as a weapon of destruction—the "green ray" or the "beam of death" is a favourite name for the horror, and many people consider that electric power radiated in the form of a beam would be some such weapon and a danger to the community at large.

But this is hardly likely to be the case, for the power radiated by wireless could never hope to attain the enormous potential of even a lightning discharge, which takes place at a pressure of about fifteen hundred million volts. Yet the vibrations from this discharge are not felt.

Also the earth on which we live is charged to a pressure of many thousands of million of volts, yet no one appears to be the worse for it. So that it is safe to conclude that radiated power would be imperceptible to anyone not equipped with the necessary receiving apparatus; and finally, how and when is Dr. Tesla to be persuaded to give up his secret?

WIRELESS CLUB REPORTS.

The Editor will be pleased to publish concise reports of meetings of Wireless clubs and associations, reserving the right to curtail the report if necessary. Hon. secretaries are reminded that reports should be sent in as soon after a meeting as possible. Reports sent in cannot appear in this paper in less than ten days after receipt of same. An Asterisk denotes affiliation with the Radio Society of Great Britain.

Darwen Wireless Society.

The society held their first meeting in their new rooms on March 22nd, when many matters concerning the future activities of the society were discussed.

The hon. secretary reported a membership of 68, which the committee hope to increase now the society is in possession of rooms, and in a position to conduct experiments with their own apparatus.

Intending members will be welcomed at the society's headquarters in Arch Street any Thursday evening, or full particulars may be obtained from the hon. secretary.

Hon. sec., T. H. Mather, 8, Hawkshaw Avenue, Darwen.

The Wireless Society of Hull and District.*

A meeting of the above society was held in the Signal Barracks, Park Street, on Friday, March 23rd. After the minutes of the previous meeting had been read and confirmed, the hon. secretary read the report of the sub-committee appointed at the last meeting to make inquiries for new headquarters for the society. The committee recommended a room at the Co-operative Society Institute, Jarratt Street; the rent would be 3s. 9d. per night for one night a week. It was decided by the members present that a special meeting should be summoned to deal with the matter. Mr. A. B. Wakeling was then called upon to deliver his lecture on "Elementary Electrical Engineering," which proved very interesting and instructive, especially to the students of the society.

The Radio Society of Highgate.*

The first of a new series of elementary lectures on the theory of wireless reception and the construction of simple apparatus, organised by this society, was given on Friday, March 16th, by Mr. H. Andrewes, B.Sc.

The second lecture of the series was given on March 23rd by Mr. Stanley, B.Sc., A.C.G.I., his subject being "Tuners and Crystal Sets." The construction, advantages and disadvantages of the various types of tuning coil were explained, and hints given on the best ways of mounting the different coils.

A full programme of forthcoming lectures is available, and may be obtained from the hon. secretary.

Hon. sec., J. F. Stanley, B.Sc., A.C.G.I., 49, Cholmeley Park, Highgate, N.6.

Swansea and District Radio Experimental Society.*

At their headquarters, the Y.M.C.A. members of the Swansea and District Radio Experimental Society recently listened to a very interesting lecture given by R. G. Isaacs, Esq., B.Sc., A.M.I.E.E., of the University College of Swansea.

The lecture was devoted to applications of wireless valves, and the lecturer had brought instruments to demonstrate by experiments.

In the course of the lecture, Mr. Isaacs showed that valves are not only used for wireless receiving apparatus, but many other scientific purposes these days. One very interesting application is the measurement of the growth of plants hourly, by means of the valve; with certain apparatus one is able to measure as small as one-millionth part of an inch.

The lecture was well attended, and a hearty vote of thanks was proposed to Mr. Isaacs for his most interesting lecture, and for the trouble he had taken in preparing the experiments.

The membership of the society is steadily increasing, and the secretary, Mr. Herbert Morgan, 218, Oxford Street, Swansea, will be most pleased to welcome any new members.

Peckham Wireless and Experimental Association.*

The Peckham Wireless and Experimental Association hope to give a public demonstration at the Central Hall, Peckham, on April 26th next.

At the ordinary meeting on March 21st, the jumble sale of members' surplus apparatus was a great success. Nearly all lots put up were disposed of, and both purchasers and sellers were convinced that they had secured genuine bargains.

Mr. Voigt, member, was very interesting on the subject of high-frequency circuits, going minutely into the details of transformers and their connections.

Hon. sec., Geo. Sutton, A.M.I.E.E., 18, Melford Road, S.E.22.

Birmingham Experimental Wireless Club.*

A very enjoyable afternoon was recently spent by the members in visiting the Birmingham Broadcasting Station, by the courtesy of Mr. Edgar (director) and Mr. Amies (chief engineer). The highly efficient transmitter at the station was much admired by some 60 members who attended, and the thanks of the club are due to Mr. Amies and his assistant for their lucid explanation of the various instruments. The new dull emitting type of valve was used, and their great efficiency proved of absorbing interest.

On Friday, March 23rd, Mr. Amies attended the regular meeting of the club, and delivered a lecture on the problems of transmission of telephony, and gave much interesting statistical information regarding the Birmingham Broadcasting Station. A new type of microphone was specially referred to in the lecture, and a sample of same was shown. Mr. Amies has kindly consented to give the club a lecture, at a later date, on "Modulating Circuits for Speech Transmission."

Hon. sec., A. Leslie Lancaster.

The Hornsey and District Wireless Society.*

At a meeting held on February 26th, the subject of affiliation with the Radio Society of Great Britain was discussed, the consensus of opinion being that affiliation would be of considerable advantage to the society. The matter was referred to the committee.

A Dutch auction sale of wireless components took place, the chairman, Mr. W. L. Carter, acting as auctioneer. The funds of the society benefited to an appreciable extent by the sale.

On March 12th a demonstration of home-made apparatus was given by various members. Each member was allotted ten minutes to explain the method of constructing his apparatus.

On March 19th, Mr. James F. Doyle, of the Radio Society of Great Britain, was elected to serve on the committee. The evening was mainly devoted to questions. Many interesting subjects arising out of the questions were discussed. Mr. Carter dealt with the subject of oscillating currents and their relation to the aerial tuning condenser; Mr. Price dealt with high frequency and the tuned anode circuit; Mr. Manser described, with blackboard diagrams, the rejector circuit, and how to dispense with broadcast concerts when not required: and Mr. Doyle enlightened the meeting with his experiences of 3 a.m. reception of American telephony.

Hon. sec., Mr. H. Hyams, 188, Nelson Road, Hornsey, N.8.

Bath Radio Club.

At the club meeting on February 14th, Mr. L. E. R. Boxwell, of Bradford-on-Avon, Wilts. continued his series of lectures to the members. Mr. Boxwell, whose instruction is proving so popular, dealt with the thermionic valve. In a lucid manner he detailed its origin, construction, and functions, and earned for himself a very hearty vote of thanks from all present.

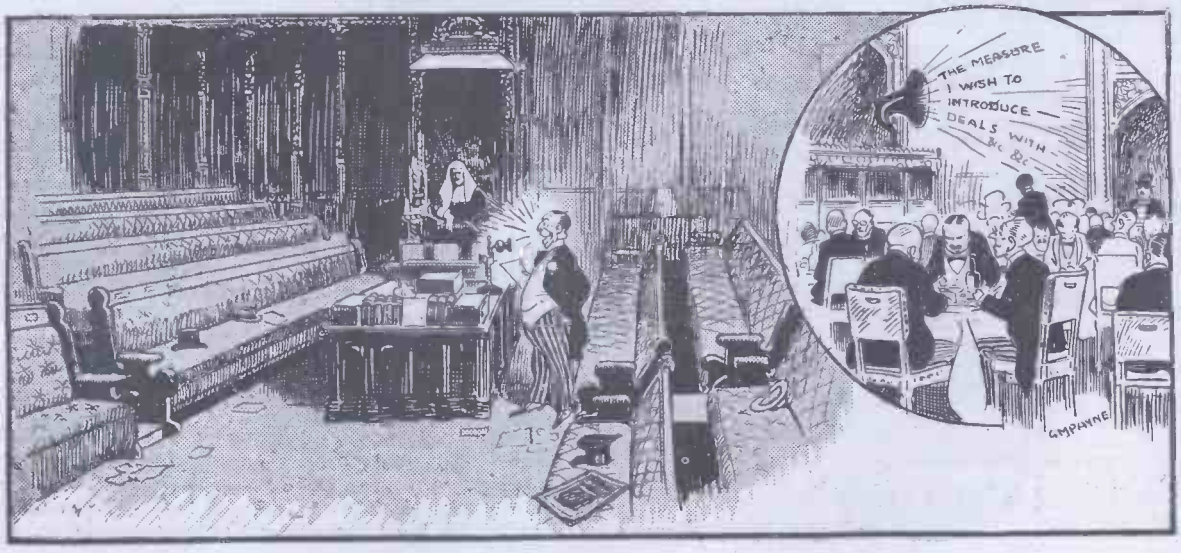
Hon. sec., Geo. J. Barron Curtis, F.S.A.A., F.C.I.S.

New Club.

A society has been formed at Rye under the name of "The Rye and District Radio Society."

The hon. secretary will be pleased to hear from any one desirous of joining.

TWO LOUD "SPEAKERS."



RADIOTORIAL

All Editorial Communications to be addressed The Editor, POPULAR WIRELESS, The Fleetway House, Farringdon Street, London, E.C.4.

Questions Answered

Owing to the enormous number of queries received daily from readers of POPULAR WIRELESS, I have temporarily decided to limit the number of questions sent in by one reader to three. Readers are asked to keep their questions as short and as concise as possible in order that the minimum of delay can be exercised in answering queries. Until further notice three questions from one reader will be the limit for one letter. All questions should be addressed to POPULAR WIRELESS Queries Department, Room 138, Fleetway House, Farringdon Street, London, E.C.4. Readers are requested to send the necessary postage for reply.

The Editor desires to direct the attention of his readers to the fact that, as much of the information given in the columns of this paper is of a technical nature and concerns the most recent developments in the Radio world, some of the arrangements and specialities described may be the subject of Letters Patent, and the amateur and trader would be well advised to obtain permission of the patentees to use the patents before doing so.

J. J. (Clapton).—Is it possible to use the H.F. amplifier described in POPULAR WIRELESS, January 20th, as a tuned anode amplifier instead of one having an H.F. transformer without altering the wiring of diagram No. III. ?

Yes. A plug in coil of either basket or honeycomb type can be made to fit into the socket B shown in Fig. III., page 782, having four legs fitting in to X, Y, W and Z. In order that this coil shall be properly connected to the H.F. valve and the detecting panel, the legs fitting into Y and W must be short-circuited by a piece of wire; a coil being connected to the legs corresponding with X and W, % being then a dummy socket. If it is intended to use the detecting panel belonging to the same unit system (POPULAR WIRELESS, November 25th), it is advisable to alter the grid leak on the detecting panel, taking it from the grid to L.T. minus instead of to G as shown on the diagram. The grid condenser is left exactly as shown. When changing back and using an H.F. transformer on the H.F. panel, the tuned anode coil is simply removed and the plug-in transformer inserted as before, while no alterations will be necessary in the detecting panel, the grid leak still being connected from the grid to the L.T. minus. The variable condenser across C and H.T. plus in Fig. V of the article dealing with the H.F. panel will be necessary whether the tuned anode or the H.F. transformer is employed.

* * *

R. S. V. (Edinburgh).—Can I employ reaction in an L.F. amplifying circuit consisting of one detector and two L.F. and pass the P.M.G. ?

Without attempting audio-frequency amplification, which is rather outside the scope of most amateurs, we are afraid you cannot do so. We would advise the introduction of one H.F. stage to replace one of the existing L.F. by means of tuned anode coupling with intervalve reaction (see P.W. No. 41). This will give a very excellent range of reception and will prove more useful to you than a second L.F. without reaction.

* * *

S. C. T. (Birmingham).—I have a two-valve set, using an R valve and one of unknown make. Although the signals are fairly good, I find I can only use 40 volts H.T., though the R valve should have about 60. If I add to the H.T. the signals go right off. What is the cause of this ?

In all probability the cause of your trouble is the unknown valve. It looks very much as if you have a soft valve working in conjunction with the R, thus prohibiting you from using sufficient voltage on the anodes to get the best results out of your set. Very many soft valves go completely dead when more than 30 or 35 volts are used on the plate. Your only remedy will be to get rid of the valve of unknown make, replacing it by one taking a voltage up to at least 60.

"INTERFERENCE" (Wolverhampton). — I am troubled with loud crackling noises apparently due to the proximity of a large power station. It completely spoils reception, and as I am told it is caused by stray currents leaking from the power main through earth to my set, there seems to be no chance of remedying the matter. Is this correct ?

Your only hope lies in constructing what is known as a capacity earth. This consists of three or four wires of the same length as the aerial and running directly underneath it and parallel to it, stretched at intervals of about three feet apart and 2 to 6 feet above the ground. These leads are connected together at one end the whole being connected to the earth terminal of the set. Care must be taken that this capacity earth is well insulated, in fact as great attention should be paid to this point as to the insulation of the aerial itself. This type of "earth" connection should eliminate the interference you have been experiencing.

* * *

A. M. P. (Tring).—I have a 50-volt direct current lighting supply. Can I transform it down to 6 volts for charging accumulators and lighting valves ?

This could be done, but in the case of the accumulators it is not necessary to use a transformer to cut down the voltage. In any case, as the current is direct, a very complicated arrangement would be necessary. For charging accumulators, one or two carbon lamps in series will be ample to cut down the current, but we do not advise the use of the electric-light mains for lighting valves. Even though the current is direct, it is only uni-directional intermittent current, and is not nearly steady enough for use for filament lighting where wireless valves are concerned. The current not being steady would cause a continual fluctuation, though perhaps unnoticed by the eye in the brightness of the valve filament, which would result in a constant variation of the electron flow from the filament to the plate, this resulting in a continual crackle in the phone. These irregularities could be damped out by means of special chokes, but as you have a very easy means of charging accumulators it would not be worth while going to the expense and trouble of fitting up an electric-light main supply to the valves on your set.

* * *

H. W. L. (Highgate).—I have an 11-in. x 5½-in. slider coil wound with 28 S.W.G. enamelled wire. What wave-length can I tune up to, and will this coil be any use for telephony ?

Your coil will tune up to about 4,500 metres, but will not be at all suitable for low wave-length telephony reception, as you will have great difficulty in tuning down below 400 metres owing to the dead end effect of the unused part of the coil. For broadcasting we would advise you to wind a smaller coil of about 100 turns of 24 D.C.C. wire, on a 2½-in. to 3-in. diameter former, tapping it every 15 or 20 turns, and using a ·0005 condenser for tuning.

* * *

A. P. C. (Ilford).—I have a one-valve set using reaction, but cannot cut out insistent howling.

In the first place, we must remind you that reaction directly coupled to the aerial circuits is not allowed by the P.M.G. during broadcasting hours on the band of wave-lengths between 300 and 500 metres. With regard to the howling, it is very likely due to an unsuitable reaction coil. See that this is not too large, and if a variable condenser is used across it this should not exceed ·0002 mfd. Another cause of howling may be that you are employing a soft valve, and are using too much H.T. voltage. See that all the internal wiring is well spaced and that the leads do not run parallel or close together.

* * *

A. P. D. (Aberdeen) writes for advice with regard to his 6-valve set as he experiences roaring sounds in the phones.

These noises may be due to a faulty accumulator or H.T. battery. Try the effect of changing your H.T. battery, and, if possible, borrow a good accumulator. If these tests fail you may be able to remedy the trouble by changing over the leads of the primaries of the L.F. transformers, or by earthing their cores. Make sure that all your

(Continued on next page.)

RADIOTORIAL QUESTIONS & ANSWERS.

(*Continued from previous page.*)

connections are tight and clean, as the very slightest speck of dirt will cause a very considerable amount of trouble in the way of providing unexpected noises in the 'phones. It is just as well to examine the telephones and the telephone cords, as these latter often break and cause a great deal of trouble. If your L.F. transformers are very close together you may find it advantageous to screen each of them with copper or iron sheet.

* * *

S. J. S. (London, E.).—You say that a crystal or a valve rectifier cuts a wave in half. Where does the other half wave go?

The term "cutting a wave in half" must not be taken too literally. A rectifying crystal so functions that its resistance electrically is much greater in one direction than in the other. For instance, it may be 100,000 ohms in one direction and only 10,000 in the other. Therefore, if placed in a circuit through which is flowing an oscillatory current, it will allow more current to flow in the one direction than in the other, as a simple application of Ohm's law will show. Therefore the result is not a complete stoppage of current flow in one direction and the result is a unidirectional flow of current broadly speaking, just because more current is flowing in the one direction and is capable of greater energy application than that flowing in the other.

Why do not crystal detectors in parallel give stronger signals, as I thought that appliances in parallel always allowed more current to pass?

Simply because although parallel crystal detectors might allow more current to pass in the one and energy applying direction so would they allow more current to pass in the other and opposing direction, and therefore as you will gather from the reply given to your first question, the result would be merely a similar difference in current between what might be termed the working and opposing directions.

* * *

P. D. (Norwich).—What are the connections for adding an L.F. amplifier to a crystal set? What alternations are necessary?

No alterations of the crystal set circuit need be made. The coupling of the valve amplifier circuit is obtained by means of an intervalve low-frequency transformer. This is connected so that the primary leads take the place of the phones on the crystal set—that is, the primary of the transformer goes to the telephone terminals. The phone blocking condenser is left as it is, connected across those terminals. The secondary of the transformer is connected to the grid of the valve and to the negative side of the low tension accumulator. The rest of the valve circuit is as usual, plate to the phones and thence to the positive high-tension battery, the negative of this battery being connected to the negative of the L.T. accumulator. The positive of this latter battery, of course, goes to the filament rheostat and thence to the filament of the valve. It is always advisable to insert a blocking condenser across the phones—about ·001 mfd. will be O.K., and a fairly large capacity condenser across the H.T. battery to smooth out any irregularities in its discharge.

* * *

J. M. T. (Crewe).—What is the best way to test a high-tension battery?

The only way is to test each cell or group of cells with a voltmeter. The test should be made as rapidly as possible, as the action of connecting the voltmeter across the cells really amounts to short-circuiting the battery for a moment; this should be done as quickly as possible. The cells should read over 50 per cent. of their nominal value, or otherwise trouble is likely

(*Continued on next page.*)

RADIOTORIAL QUESTIONS AND ANSWERS.

(Continued from previous page.)

to occur. If they read less than 50 per cent. of their proper value the faulty cells should be disconnected from those on either hand and then short-circuited. If the whole battery reads less than 75 per cent. you should get a new one in stock ready for any emergency, as it will probably give out at any moment.

* * *

A. J. S. (Coventry).—I am using a two-valve set (1 H.F., 1 detector), with tuned anode reaction. Instead of a coil and condenser I have a variometer in the anode circuit with the reaction coil coupled to it. How can I stop the valves howling?

As you are using reaction on the tuned anode you will find that the value or size of your reaction coil will make a great difference to the efficiency of the set. It will be rather difficult to construct a reaction coil suitable for coupling with a variometer, and probably your best plan would be to connect a small coil in the anode circuit in series with the variometer and react upon that. In any case several coils will have to be tried, both anode coils and reaction, before you find a suitable combination. Your suggestion as to loading the variometer for high wave-lengths is satisfactory up to a point, but the efficiency of the set will diminish as the wave-length increases above 1,000 metres or so. Avoid any loading of the variometer if you can, especially above 1,000 metres, for the single coil or variometer tuned anode method of tuning is not efficient on the higher wave-lengths, though it will give quite good results up to 2,000 metres.

* * *

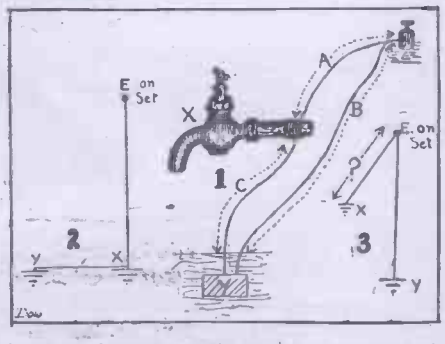
M. D. P. (Uxbridge).—Is it possible to use a two-coil holder with the unit set described by Mr. H. G. Hersey in the recent issues of POPULAR WIRELESS?

Yes, if you are using the detector panel alone, the primary coil (fixed) is connected to the aerial lead-in and the earth connection and is tuned by a ·0005 variable condenser, while the secondary coil is connected to the terminals G and F on the detector panel (Fig. VI.), page 570, POPULAR WIRELESS No. 26. If you use the H.F. panel in conjunction with the above, the primary coil will be connected as before, while the secondary will go to the terminals G and F on the H.F. panel, the G and F terminals on the detector being connected to O.G. and L.T. minus on the H.F. panel. A ·001 variable condenser should be used to tune the secondary coil. When using detector panel alone the reaction terminals R1 and R2 are short-circuited, reaction not being allowed on broadcast wave-lengths, whereas if the H.F. panel is employed the reaction coil is connected to those two terminals and is coupled to the H.F. transformer or tuned anode.

* * *

J. B. (Bedford).—I am not getting good results on my set and I think it is due to my earth. I have tried a 15 ft. lead to a water pipe and a 20 ft. lead to a plate in the ground, but neither seem very good. I have also tried these earths together and no improvement is obtained. Why is this?

In all cases in either an aerial or earth system where there is a branching in the circuit so that the oscillatory current tends to divide into two or more paths, care should be taken that these alternative paths are electrically symmetrical or balanced. The reason for this has been extensively dealt with in these columns



in respect of two wire aerials, position of the down lead in respect of the horizontal wires, etc. There are three normal methods of employing two earths on one set, and these are shown in the accompanying diagram. "1, shows" pictorially the two earths involved in your question, the farther of the two being connected direct to the set as well as via the other, the

(Continued on page 366.)

RADIOTORIAL QUESTIONS AND ANSWERS.

(Continued from page 364.)

water pipe earth. The branching here will be the water pipe itself from the tap to the ground; 2, and 3, show what may be termed series and parallel earths. In 3, the dividing branch is at E whilst in 2 it occurs between X and the actual ground, this branch being the water pipe. Therefore, it becomes clear that to avoid this branching which will cause a loss in efficiency the "arms" or branches must be electrically balanced. As this involves unnecessary trouble we would recommend the adoption of just one earth, the direct earth to ground if latter is fairly moist, employing two or three parallel wires of equal length in order to reduce the ohmic resistance of the earth connection.

* * *

G. W. (Gravesend).—Without speaking into the phones, but just wearing them as usual, I find I can converse from upstairs with friends downstairs via the phones leads which go from the set to the room down below. Why is this?

Your telephones are acting in the same way as an ordinary land line phone. The sound you make when speaking will cause the diaphragms of the phones to vibrate, and this will cause a change in the magnetic field caused by the pole pieces of the permanent magnets in the earpiece. The variation of magnetic field will cause slight currents to flow in the windings of the phones, and this current will affect the telephones connected to the leads which go downstairs. Thus, every time you speak an electric current flows from your phones through the phones downstairs, and this current sets those diaphragms vibrating, thus reproducing the sounds you have uttered.

* * *

J. H. B. (Manchester).—How is the amplifying (H.F.) panel described in POPULAR WIRELESS, No. 34, added to a crystal set?

The terminals G and F are connected to the A and E terminals of the set, that is, across the tuning coil. The crystal and phones are disconnected and are connected to the amplifier terminals O.G., and a fresh terminal added for the connection from the other end of the H.F. transformer secondary. Then the L.T. minus and H.T. minus will be connected as shown in the diagram in POPULAR WIRELESS No. 34, the only difference being that the secondary instead of going to O.G. and L.T. minus will go to O.G. and the new terminal. The crystal circuit is therefore a closed circuit consisting of the secondary of the transformer, the crystal, phones and the bypass condenser across the phones. It is advisable, in order to obtain the best results, to tune this circuit by a ·0003 mfd. variable condenser connected across O.G., and the new terminal between L.T. minus and O.G.

* * *

G. M. F. (Harrow).—Using a crystal set with two-slider tuning coil I find that the coil rapidly wears down so that the tuning becomes smudgy. How can I obviate this?

A good plan to prevent any possibility of short circuiting the various turns of the slider coil is to wind a thread between each turn of wire when you wind the coil. This will space the turns so that the slider will make a much sharper contact, as it will only rest on one turn at a time instead of two, as is very often the case. Besides ensuring better contact for the slider the winding of the threads between the turns of wire also helps to diminish the self-capacity of the coil, thus tending to give a sharper tuning.

RECENT WIRELESS INVENTIONS.

The following abstracts are published by arrangement with our Patent Adviser, Harold J. C. Forrester, Chartered Patent Agent, of Jessel Chambers, 88-90, Chancery Lane, W.C.2.

Grant of the following Patents can be opposed, and printed copies of the full specifications, with drawings, can be purchased from our Patent Advisers.

192,673.—G. HOLST & NAAMLOOZE VENNOOTSCHAP PHILIPS' GLOEILAMPENFABRIEKEN.—VALVES.—The open end of a box-shaped anode of chrome iron is closed by fusing it into a glass seal which carries the other electrodes within the anode. The anode may be jacketed with a cooling liquid and may contain a small quantity of argon or phosphorous peroxide. In a modification the anode may consist of a cylinder glass-sealed at both ends, each seal carrying one of the inner electrodes.

192,744.—G. S. KEMP.—CONDENSERS.—The metal plates of a multiplate air condenser are spaced apart by rubber distance pieces which may be formed by rings, pads, or tubes. The plates are held in position by clamping means or are threaded on rods passing through diametrical lugs.

192,785.—L. G. PRESTON & G. SHEARING.— TRANSMITTING.— In transmitting sets using two valves in series or parallel groups of two valves in series the grid of the series valves have continuous oscillations imparted thereto, and are both inductively coupled to a closed intermediate circuit. The aerial and intermediate circuits have the same inductance-capacity, except when the latter is short-circuited by the operation of a transmitting key, whereupon the aerial oscillations cease. The continuous oscillations may be applied to the grid circuits by reactive coupling either with the aerial circuit or with coils energised from an independent source.

192,795.—L. G. PRESTON & N. SHUTTLEWORTH. — INDUCTANCES.—Inductance coils for high-frequency work are shielded from the effects of neighbouring metal-work by partially or wholly surrounding them with coils, strips, or boxes of copper or other conducting metal. A box may consist of a cylindrical coil with or without a pair of end pancake coils, each coil being short-circuited, earthed, or short-circuited through a high inductance coupled to the grid circuit of a valve transmitter.

192,936.—W. E. BARBER & H. J. WARNER.—FRAME AERIALS.—A pair of parallel rectangular metal frames of tubular or other section are held apart by insulating rods. The wire is stretched over the spacing rods, washers or flanges thereon separating the turns. By constructing the frames with a gap and by suitable connections the frames themselves may be included in series with the aerial wire.

We have arranged for Patent Enquiries addressed to our Patent Adviser to be answered direct by post, any enquiries of general interest being also answered in our columns.

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Popular Wireless

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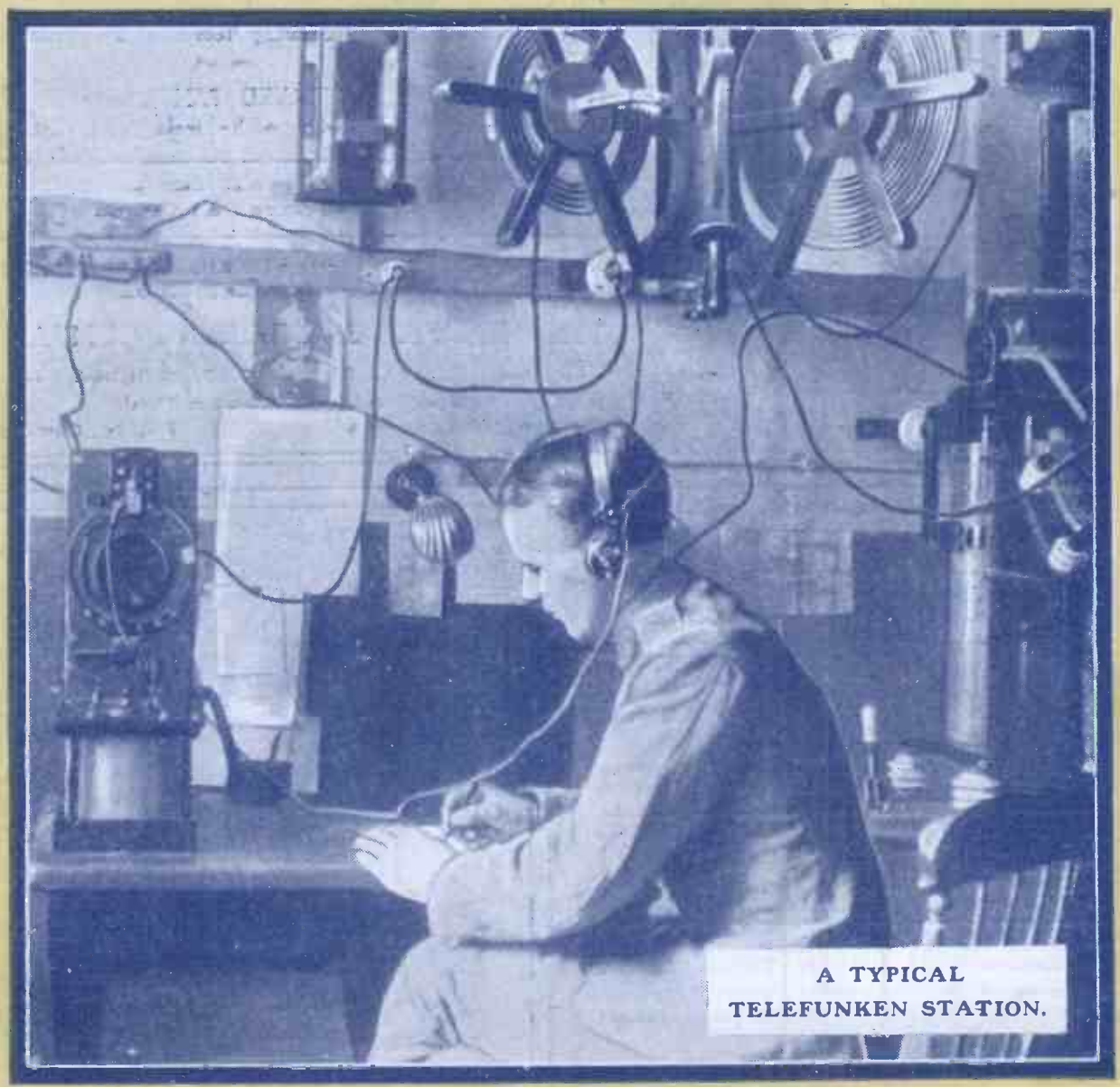
SCIENTIFIC ADVISER: SIR OLIVER LODGE, F.R.S., D.Sc.

April 28th, 1923.



A TYPICAL TELEFUNKEN STATION.

FEATURES IN THIS ISSUE.

Page of Pictorial Valve Diagrams.
Navigation by Wireless.
A Unit Broadcast Receiver.
Choice of Crystals.
Notes on Power Amplification.
Valve—Crystal Circuits.

And a long illustrated article by Dr. N. W. McLachlan, M.I.E.E., in which, exclusively to this journal, he describes his wonderful new invention.

POPULAR WIRELESS

April 28th, 1923. SCIENTIFIC ADVISER, SIR OLIVER LODGE, F.R.S., D.Sc. [Every Friday.

TOPICAL NOTES AND NEWS.

Wireless on Light Cars.

ONE of the latest developments is the application of wireless to the light car. Mr. W. Appleton, of Radio Instruments, Ltd., has fitted a seven-valve set into his dash board on a No. 15 H.P. Fiat saloon car. The aerial is a single strand running round the roof of the car, from the two rear upper corners of which project two Amplion loud speakers. The aerial being non-directional, the set is remarkably satisfactory up to 30 miles or so, in whichever direction the car is travelling. Best results have been obtained with no earth wire at all, the use of a capacity earth to the frame of the car resulting in magneto noises.

* * *

A Radio Christening.

PARENTS who are at a loss for names for their children are now turning to radio to help them. Recently, the parents of a little girl could not agree as to her name, and decided to name her after the first lady to broadcast from Cardiff the following day. The result was quite satisfactory, and the announcer at Cardiff congratulated the parents by radio, and sent the baby her first radio kiss.

* * *

A Broadminded Theatre Manager.

MR. LESLIE HENSON has given the theatre managers a lead in expressing his desire that the play "Tons of Money" at the Aldwych should be broadcast. Evidently Mr. Henson does not agree with those managers who regard broadcasting as a rival and a danger to their interests. After all, what better publicity can a play have than to be broadcast?

* * *

That Home-made Set.

THE controversy raised by the daily press over the Broadcasting licences and programmes is well on its way to settlement in the case of the former. Sir William Joynson-Hicks, the P.M.G., has decided to issue a licence for home-made sets at 10s., 5s. of which is to go to the B.B.C., and the question now under consideration is whether the portions of the set that are bought should bear the B.B.C. stamp. Surely, this latter will not alter the position of the B.B.C. with regard to the licences at all if the amateur is allowed to build as much of his set as he can, complete bought parts being stamped. This appears to me to be the fairest way out of the chaos that has resulted from the lack of "home-made" licences.

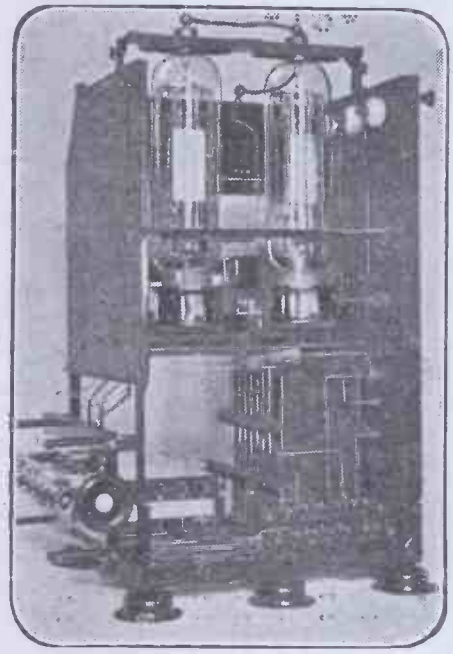
* * *

Experiments from Poldhu.

I HEAR that Senator Marconi, who has recently left Falmouth on his trip to Spain and Madeira, intends to carry out experiments with the once well-known station, Poldhu. The purpose of the voyage is to further the development of directional wireless and the propagation of wireless waves in one direction only.

Safety Device for Ships.

PROVISION for the safety of ships at sea still takes up the attention of a great many wireless scientists, and an instrument has recently been evolved by which, it is claimed, a ship will be enabled to steer clear of rocks and other vessels in the densest of fogs. The "Frontiersman," a yacht leaving shortly for the North Pacific and Japan in connection with the world air route preparations, is to be fitted with the instrument, which will warn the man on the bridge of the proximity of any object with metallic content, such as another ship or a rock, thus enabling the vessel to run fairly fast in fog. The apparatus operates on the principle of the distortion of electric strain by the presence of metallic objects either above or below the water.



A 1½ kw. C.W. Transmitter

A Great Discovery.

SOME little while ago POPULAR WIRELESS, in an article entitled "The New Radio Danger," written by Mr. A Sharman, drew attention to the fact that interference could be caused by owners of crystal sets. Since then two of our contemporaries have "discovered" this, and, concerning it, have indulged in most exciting verbosity. Such enterprise is truly remarkable; and I await in breathless suspense the day when these two worthy lights of radio journalism will "discover" the fact that valve sets also can cause interference.

Cardiff's Popular Uncle.

UNCLE DONALD, of the Cardiff station, is immensely popular with the children, and his "Kiddies' Corner" every evening is eagerly awaited. A very good plan that "Uncle" has adopted is to give a chapter a day of some well-known book beloved of children. At present Lewis Carroll's "Alice in Wonderland" is being broadcast.

* * *

A Wonderful Transmission.

ONE of 2 L O's best performances was the recent broadcasting of dance music as played by the Savoy Havana Band in the ballroom of the Savoy Hotel. It was both musically and technically a practically perfect transmission. I hope 2 L O will repeat the experiment.

* * *

Wireless Cigarette Cards.

THE B.D.V. cigarette people are certainly to be congratulated upon their enterprise. They have introduced a series of 25 cigarette cards which cover the construction of a simple crystal receiver. Each card of the series deals with one component or gives a diagram on the front in colours, whilst on the reverse is a brief but perfectly clear and technically sound explanation. Having always smoked B. D. V.'s, I consider myself safe, and will be able to meet with equanimity the cry "Have you any *B.D.V.* cigarette cards, sir?" Many of the smokers of B.D.V. cigarettes, however, will doubtless be inclined to collect the cards themselves.

* * *

A Useful Accessory.

PRICES Ltd., of Battersea, London, have sent me a generous supply of their "Blancol" accumulator oil to try out. It hardly needs personal investigation on my part, because I happen to know that the Post Office, the G.E.C., and other large companies have used it for years. A thin film of this liquid covering the acid prevents "creeping," with its resultant corrosion, "spraying" whilst the cell is on charge, and those noxious fumes that tend to arise. Also the Post Office engineers state that the use of this oil has saved them 40,000 gallons of distilled water a year by reducing evaporation to a neglible amount.

* * *

Mind the Lightning.

IT seems that with the advent of "summer" lightning many minds have heavily turned to thoughts of fire. With 500 feet masts such fears may be justified, but, personally, I consider that with the average amateur aerial, risks of danger from lightning discharges are negligible. Anyway, with an earth arrester or earthing switch connected between the aerial and earth, not only is all danger

(*Continued on page* 374.)

NOTES AND NEWS.

(*Continued from page 373.*)

climinated, but the aerial becomes a lightning conductor, and actually protects the building to which it is attached. If one explains this to an insurance company, however, I am afraid they won't reduce one's premium.

* * *

Not Closed Down.

AMATEURS interested in the Radio-Electrique, Paris, have lately been mystified owing to the apparent disappearance of that station's transmission. The station has not shut down, however, but the wave-length has been changed to about 1,780 metres. The transmissions take place at the usual time.

* * *

That Licence Problem.

THE P.M.G. has stated in the House of Commons that he does not believe that the agreement entered into with the B.B.C. by Mr. Kellaway (past P.M.G.) is in the public interest, and declared himself opposed to anything in the nature of a monopoly. He has declared his intention of forming a committee to investigate the points at issue, and states in a letter to another member of the House that no legal steps will be taken against constructors of home-made sets until something in the nature of a definite line of action has been decided upon. Meanwhile, the 40,000 or so odd applications for licences of an experimental nature have been forwarded to a board of technical experts for examination, as he (the P.M.G.) states that he is not only entitled but compelled by law to issue experimental licences to those applicants he is honestly satisfied are genuine experimenters.

* * *

Harrods' Gala Concert.

NEXT week's issue of POPULAR WIRELESS will contain full details of the magnificent programme arranged by Messrs. Harrods and broadcast from the London Broadcasting Station, with some specially written articles by some of the leading artistes that appeared. Miss José Collins, whose photograph is herewith reproduced, is of course not a new star of the stars that have broadcast. Listeners-in have enjoyed her wonderful voice during the transmission of "The Last Waltz" on several well-to-be remembered occasions.

Miss Jose Collins.

* * *

The Wireless Club, Ltd.

THERE will be a public meeting at the Manchester Hotel, Aldersgate Street, E.C. 1, at 6.30 p.m., Monday, 30th inst., held by the above-mentioned club, to discuss several important points relating to the licence controversy, the acquisition of premises, etc.

Miss Madge Titheradge, who appeared in Harrods' Gala Concert broadcast from 2 L O.

A Correction.

IN the advertisement of Wireless Agencies, Ltd., which appeared in last week's issue of POPULAR WIRELESS, the guaranteed range of the Radionette V2 was given as 40 miles from a broadcasting station with one headphone. This was a printer's error; it should have been *headphones*, several pairs of which can of course be used.

* * *

THROUGHOUT this week 2 L O's morning concert programme between 11.30 and 12.30 is being provided by Messrs. Waring and Gillows. Listeners-in will be able to judge the effects of a variation in broadcast concert programme management with its useful element of competition.

* * *

WE are indebted to the courtesy of the London "Evening News" for the use of the photo of Dr. N. W. McLachlan that appears on page 375 of this issue of POPULAR WIRELESS.

ARIEL.

Broadcasting Programmes

What you can hear every evening of the week on your set.

TELEPHONY AND MUSIC TRANSMISSIONS

Station.	Call sign.	Wave-length in metres.	Remarks.
London Broadcasting Station, Strand	2 L O	369	11.30 to 12.30 every morning and usually every evening, 5.30—6.15 p.m.; 7 and 9.45, News; 7.30, Orchestra; 8.25 to 10.30, Music. Sundays from 8.30 p.m.
Newcastle Broadcasting Station	5 N O	400	11.30 to 12.30 every morning. 5.30 to 10 p.m.
Manchester Broadcasting Station	2 Z Y	385	11.30 to 12.30 every morning. Every evening usually from 5.30 to 10 p.m.
Birmingham (Witton) Broadcasting Station	5 I T	425	11.30 to 12.30 every morning. Every evening usually from 5.30 to 10 p.m. (News, Concerts, etc.).
Glasgow Broadcasting Station	5 S C	415	11.30 to 12.30 every morning. 5.30 to 10 p.m.
Cardiff Broadcasting Station	5 W A	353	11.30 to 12.30 every morning. 5.30 to 10.30 p.m.
Croydon	G E D	900	Throughout day to aeroplanes.
Paris	F L	2,600	11.15 a.m., Weather Report; 6.20 to 7 p.m., Weather Report and Concert; 10.10, Concert.
Königswusterhausen	L P	2,800	4 to 6.30 p.m.
The Hague	P C G G	1,085	Sundays, 3 to 5.40 p.m., Concert. Thursdays, 8.40 to 9.40 p.m., Concert.
Haren	O P V H	1,100	12 noon and 4.50 p.m. Telephony.
Radio-Electrique, Paris	——	1,565	5.5 p.m., News Items; 5.15 to 6.10, Concert; 8.45 p.m., News Items; 9 to 10 p.m., Concert. 2 to 3 p.m. Sat., Concert.
School of Posts and Telegraphs, Paris	——	450	Every Tuesday and Thursday, 7.45 to 10 p.m. Saturdays, 2.30 to 6 p.m.

Note.—See announcements in daily Press for last minute alterations in times of Broadcasting Programmes. No Broadcasting during hours of public worship on Sundays.

NOTE.—The Bar Lightship, Liverpool, sends telephony at 7 a.m., 9 a.m., 11 a.m., 12 noon, 1 p.m., and every two hours until 9 p.m. Calls "Dock Office." Liverpool answers "Bar Ship."

In addition to the regular transmissions carried on between the British amateur stations, much telephone conversation may be heard from St. Inglevert (A M), Le Bourget (Z M), and Brussels (B A V). These stations are quite powerful, but they call for a little extra care in tuning. Wave-length, 900 metres.

All times given at G.M.T.

A NEW RECORDER FOR HIGH-SPEED WIRELESS

By Dr. N. W. McLACHLAN, M.I.E.E., of the Marconi Research Works, Chelmsford.

In this article, which is exclusive to POPULAR WIRELESS, Dr. McLachlan describes in detail his wonderful invention, which will without doubt revolutionise high-speed wireless telegraphy.

THE instruments which it is intended to describe in this article represent the application to wireless telegraphy of a peculiar effect which has been the subject of recent investigation. Using existing mathematical formulæ for the force of attraction between an electro-magnet and a piece of iron, also for the pull required to make the iron slide over the poles of the magnet, a certain figure is obtained. A recording instrument was constructed in which this known principle was employed. It worked with a high degree of precision and required such small operating currents, that a detailed examination was made of the properties of its magnetic circuit. These measurements revealed the interesting fact that the operative forces were many times greater than those obtained by calculation as indicated above. The actual force is in some cases more than 50 times its calculated value, but this figure depends on the extent to which the iron is magnetised.

How it Works.

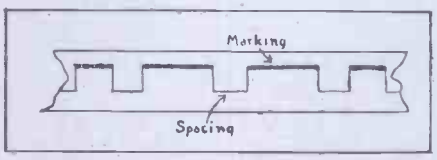
The recorder consists of a soft iron drum with an annular recess in which is situated one or more coils of insulated fine wire, the ends being connected to corresponding pairs of slip rings by means of which current is fed to the coils. The complete drum is mounted in ball bearings, and its periphery, which is faced with cast iron rings is machined to run true to one ten-thousandth part of an inch. A small steel shoe rides on the surfaces of the rings and fits them as perfectly as possible, in fact the shoe is generally ground in with fine carborundum paste.

The drum is rotated, through a reduction gear, by an electric motor of $\frac{1}{10}$th horse-power. When the rings are free from grease or moisture and a current is passed through one of the coils, the force necessary to prevent the shoe moving relatively to the drum is much greater than that predicted by calculation. The shoe is connected to a bell-crank lever to which is fitted a silver syphon dipping into an inkwell overhead, the lower extremity of the syphon resting on a paper tape which is drawn from a coil beneath the instrument, by an arrangement termed the paper drive. When the revolving drum is magnetised by the signal current the shoe is carried round with it, thus pulling the lever mechanism on to a stop. It remains here until the current ceases, when a spring draws it back to its initial position, where it rests on another stop. These operations are termed, respectively, marking and spacing, and as the syphon point is carried over the moving paper tape it scribes the Morse characters in rectangular formation in the manner shown in the accompanying diagram.

Small Current Required.

To the lever are fitted relay contacts, and since the pull on the mechanism is large compared with the mass of the moving parts, the instrument will simultaneously record an incoming wireless message and relay it to a land line, at the terminal point at which the signals may be employed to work a printing machine or other apparatus. Under such conditions the recorder is connected directly in a valve circuit at the receiving circuit. It works on a small current and displaces the usual relay, and the record on the tape acts as a check on the message sent to headquarters.

In order to secure rapidity of action when the syphon is making the up and down strokes, a modification of a well-known telephonic artifice termed a shunter condenser is employed. With a comparatively small current, the syphon point moves $\frac{1}{16}$ inch in $\frac{1}{1000}$ second. The tape records are remarkably legible and show the highly positive action of the apparatus. The



highest recording speed which has been attempted so far is 360 words per minute.

In relaying to a land line it is desirable that the duration on the marking and spacing stops should be equal and as long as possible. The instrument is adapted to fulfil this condition, and the duration of marking and spacing can be varied at will whilst it is functioning. This is accomplished by altering the tension of the control spring and the effect of the adjustment is visible on the tape record.

During a demonstration at the Institution of Electrical Engineers, messages were received from Paris (U F P), at a speed of 100 words per minute and recorded direct with the recorder in a valve circuit, the current being about 2 milliamperes.

Can also Oscillate.

Owing to its robustness the recorder is eminently suitable for use on ships, where it is unaffected by the rolling and pitching, and excellent results were obtained recently on the "Majestic." A key for the transmission of high-speed signals, which work on the same principle, was also demonstrated. With this instrument it is possible to obtain a working force of 35 lb. and more with a comparatively small current. Since the moving parts of the key only weigh a small fraction of a pound, the time taken to move from the spacing to the marking stop is extremely small. This enables signalling to be effected with precision. As in the recorder, a valuable feature is the ease with which marking and spacing can be varied whilst the key is operating.

In addition to performing the functions just described, the recorder can, by a special connection between the coil and its own relay contacts, be made to oscillate. If an alternating current is passed through the coil (under normal conditions), the syphon point traces out a record in which all the undulations are above the base or datum line. This is due to the magnetic effect being independent of the direction of the current. Thus the instrument performs an operation which may be termed electro-mechanical rectification.

(*Continued on next page.*)

Dr. McLachlan and his wonderful machine.

BROADCASTING OPERA FROM 5 S C.

By C. CREED MILLAR (2 M G).
Our Special Representative in Glasgow.

THE Glasgow station, which has been in operation for some weeks now, has been broadcasting extracts from the opera as played at the Coliseum Theatre in Glasgow by the British National Opera Company,

In the earlier part of the first night, transmission was not very good, but an improvement was effected later that evening, and since then there has been a considerable increase both in volume and clearness, almost every night. Observers have noticed that some nights the opera is much better than others, but whether this has been due to alterations in the transmitting arrangements, or to the fact that some operas lend themselves to broadcasting more than do others, is not clear. Possibly both have caused this effect.

Value of Reports.

It will be agreed that it is somewhat difficult for a person with a receiver only a few miles away from the broadcasting station to observe slight increases or decreases in power or modulation. It will therefore be of much greater interest to see what results have been reported from more distant parts.

The general manager of the British Broadcasting Company, Mr. J. C. W. Reith, who is a Glasgow man, is at present in that city looking after 5 S C. This being the newest station of the company, and the only Scottish one as yet, the manager seems to be taking a special interest in it. He stated that the opera had been heard in places as far distant as Madrid and Stockholm, as well as Torquay, Penzance, and many other nearer places. Notwithstanding these long-distance receptions, there appeared to be considerable trouble, if indeed it was not altogether impossible, in bringing in 5 S C in Aberdeen and a district on the Solway.

The company, he said, was always very glad to have reports, especially from long distances. Scottish listeners-in appeared to be very loath to send in reports and criticisms. 2 L O receives hundreds of letters from both children and adults every day, and it was hoped that Scottish people would let the director at 5 S C know how they were receiving the transmissions, and what they thought of the programmes.

An amateur, who is situated in Dumfries, states that 5 S C is usually received very well, although at times the results are not so good. The transmission of Acts I. and III. (Part 1) of "Il Seraglio" was heard extremely well; not the slightest fault could be found.

On an Indoor Aerial.

In Moffat, which is some ten miles nearer Glasgow than Dumfries, good results have been obtained with an indoor aerial and a three-valve set (1 H.F., 1 detector, and 1 L.F.) with reaction coupled to the tuned anode coil. This gentleman hears all the English broadcasting stations, and says that Glasgow and London are about equal in signal strength. This, however, was before 2 L O was reduced in strength, as appears to have been done. Probably the high-frequency valve was not amplifying 5 S C to such an extent as it was bringing up 2 L O.

The writer had a surprise visit from his Dingwall correspondent and had a most interesting chat with him. He also was of opinion that 5 S C's power was not very great and stated that it was little, if at all, better than London used to be.

He was of opinion that many of the failures to tune in long distance broadcasting were due to radiation from neighbouring receivers and mentioned a specific case where his failure had been traced to this cause.

Nearer Glasgow crystal users report good results. At West Kilbride and Rothesay, both of which are outside the usual crystal range of 25 miles, good results are obtained, so that it would seem from this that 5 S C's normal crystal range is as good as that of the other stations.

Among the many good reports were complaints of a "hum" which is sometimes rather noticeable, especially on opera nights.

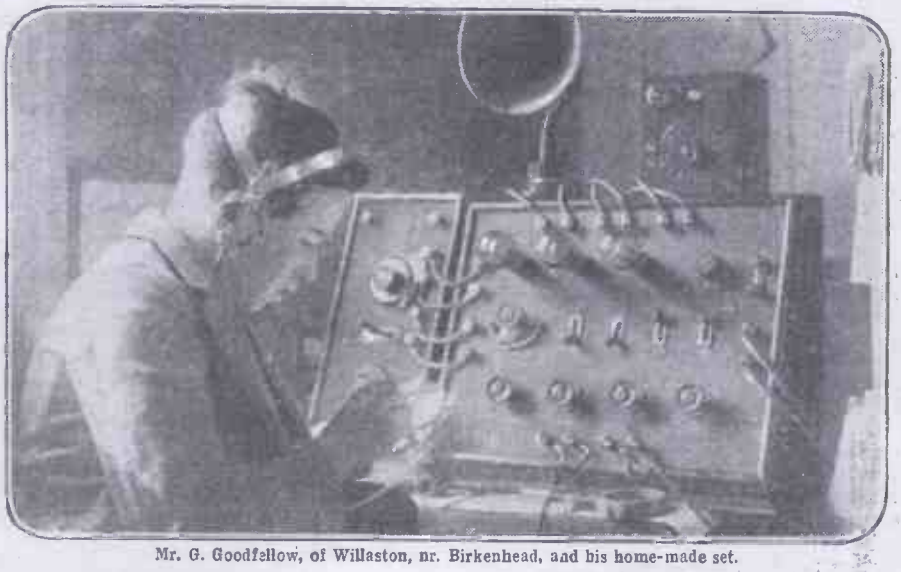
Cause of that "Hum."

The suggestion has been made that this may be caused by the cable from the theatre to the station running close, and perhaps parallel to, power mains, thereby taking up induced currents. On the other hand, it is probable that this is the slight hum from the alternating current supply to the valves, and in addition, the usual theatre noises caused by the audience, such as rustling of programmes, shuffling of feet, coughing, and the like. Such a sound is noticeable in all theatre transmissions.

Useful for Demonstrations.

Dealers are taking advantage of the additional interest offered by the opera to demonstrate their sets in Glasgow and the surrounding towns. An audience of several hundred people recently enjoyed the fare provided by the Western Electric Company at Paisley. The apparatus consisted of a loop aerial, three valves, and one of the firm's excellent loud speakers. At Greenock, Rothesay, and Skelmorlie, in addition to many other places, great demonstrations have also been given.

Scottish enthusiasts look forward to the next theatre transmission. It is almost unanimously agreed that a programme which includes an extract from a play is much more interesting to listen to than an ordinary concert programme.



Mr. G. Goodfellow, of Willaston, nr. Birkenhead, and his home-made set.

A NEW RECORDER FOR HIGH-SPEED WIRELESS.

(*Continued from page 375.*)

We have already indicated its amplifying properties, so that these phenomena can be epitomised by saying it oscillates, rectifies and amplifies electro-mechanically, just as a thermionic valve does electrically.

In conclusion, it may be of interest to offer a few remarks on the phenomenon exhibited when the drum and shoe are magnetised. From experimental evidence to date, the sliding force between the two elements exceeds the force required to pull the shoe radially off the drum. Now the molecules at the surfaces of separation are oriented according to the degree of magnetization and this may cause some form of interlocking. As an alternative mode of viewing the matter there is the question of cohesion which is exhibited when two flat plates (surface plates) adhere. If this is so, the magnetic attraction must bring the surfaces sufficiently close to exclude air. At the moment, however, neither of these explanations must be accepted as being final.

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Among the thousands of unsolicited letters of testimony is one from a Derbyshire user, who says: *"We were able to get the opera at Covent Garden Theatre with your Two-Valve GECoPHONE. It was excellent, and all the instruments in the orchestra could be plainly heard. Also the applause. We were, so to speak, actually at the opera, and not striving to hear something a long distance away."*

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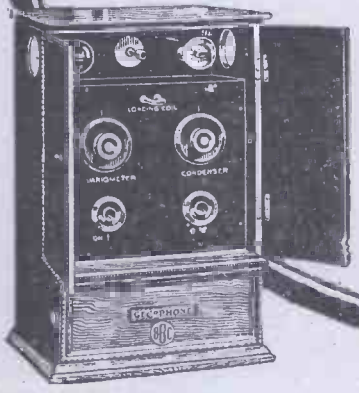


A UNIT BROADCAST RECEIVER.

By **H. G. HERSEY** (Member of the Wireless and Experimental Association).

Each article of this series is complete in itself, and all the apparatus described by Mr. Hersey has been actually made and tested before these articles have been passed for press by the Technical Editor.

PART 4.—THE L.F. PANEL.

THE signals received upon the tuning and detector panels may be found to need some form of amplification should the reader be situated many miles from a broadcasting station. To those living near a broadcasting station, however, no further need of amplification should be required. Living near a station has, however, certain disadvantages attending it where selectivity is concerned. It requires no small amount of skill and selective tuning apparatus to tune out the station should one desire to receive another station more distant.

The Intervalve Transformer.

For the purpose of rendering the signals very loud, or to operate a loud speaker, low-frequency amplification is resorted to. This means that the signals, after being detected by the rectifying valve, are passed through a low-frequency transformer to another valve. The transformer consists of a number of turns of fine wire wound upon

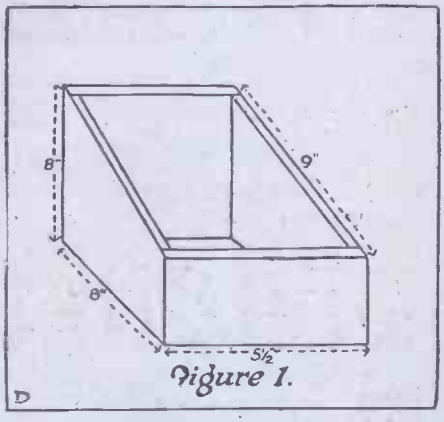


Figure 1.

an iron centre or core. Over this winding is wound a second number of turns, usually of a finer gauge wire than the first. also possessing many more turns, the ratio from one to the other being from 3—1, 4—1, or 5—1, according to the design of the maker.

The signals from the detecting valve are passed through the inner winding, which, by induction, cause the signals to be reproduced in the second or outer winding, except that they are stepped up in voltage. The signals from the second coil are now passed through a second valve by applying them to the grid or filament. In turn, the signals are reproduced in the plate circuit of the second valve magnified some four to five times, according to the efficiency of the apparatus.

The panel base should be designed upon the same lines as the preceding panels, the dimensions being as per Fig. 1. A piece of ebonite, 5½ in. by 9 in. by ¼ in. is next purchased. This should be marked out as shown in Fig. 2. In all, eight terminals are required, and they are placed, two upon the left-hand side, six upon the right-hand side in the positions indicated. The letters A, B represent the positions to be taken up by the valve-holder and filament resistance. Between these are two spaces, T and C, the former for the transformer, and the latter for a small fixed condenser, both to be mounted under the panel. The condenser should be about ·0002 or ·0003 mfd., and may be made up according to previous instructions in POPULAR WIRELESS, or purchased locally, its function being to bye-pass any radio frequencies that may be present in the plate circuit, and would otherwise be choked by the transformer primary winding. The panel so marked out is ready for the various parts to be assembled.

The valve-holder is placed in position and secured to the panel by nuts upon the legs, next the filament resistance, according to type purchased, and the method called for, for mounting. The terminals may next be screwed in their position. The intervalve transformer is next purchased and mounted under the panel in position T. The transformer should be skeleton type, i.e. unmounted, also the terminals or tabs to which connections are to be made should be marked OP and IP, OS and IS, or P1, P2. and S1, S2.

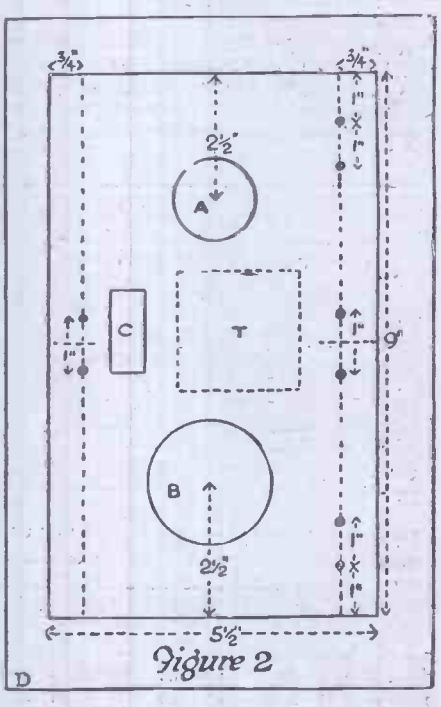


Figure 2

The Wiring.

The transformer should not be too small, otherwise there will not be the very large number of turns upon the windings which go to make an efficient transformer. There are usually four angle pieces upon the transformer, with holes already drilled. The transformer is secured to the panel by passing screws through these holes and the ebonite. The screws should be preferably countersunk into the panel for neatness. The condenser is now mounted against the panel in its position, C, by screws, or clamping with a strip of ebonite or fibre if made up.

The panel should now be wired, the wire used to be of No. 22 or 24 S.W.G. D.C.C., or, better still, bare wire insulated with coloured sistoflex sleeving, the colouring according to the circuits, i.e. red for LT + and HT +, green for negative, etc. The filament circuit is wired up, commencing from LT +, Fig. 3, to the resistance, from the resistance to right-hand filament leg, another lead from left-hand filament leg is taken to LT —. Join up HT — and LT — ; now connect from P2 to the anode leg of valve-holder, and P1 to the terminal HT +.

From terminal T1 take two leads, one to the condenser, and one to OP of the transformer. From T2 take two leads, one each to the other side of condenser and one to IP of transformer. From the transformer secondary tags or terminals take leads IS to left-hand filament leg, and OS to grid leg of valve-holder, completing the wiring. Should the transformer be labelled P1 and P2, S1 and S2, the P1 and S1 are usually the inside ends. The panel can now be screwed to the base, and it is ready for work. The connections to detector panel are shown in Fig. 4.

This panel, although designed for use with the detector, will prove itself of the utmost value for increasing signal strength, should it be connected to any type crystal receiver set, the terminals lettered T1 and

(*Continued on page* 380.)

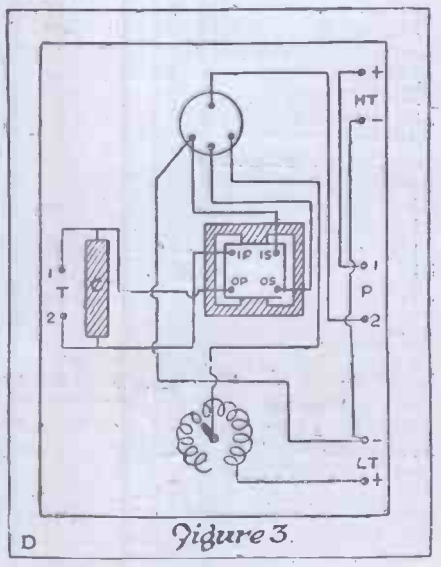


Figure 3.

A UNIT BROADCAST RECEIVER.

(*Continued from page 379.*)

T2 being connected to the 'phone terminals of the crystal set. Used with the detector tuner panel, it should be connected by T1 to P1, and T2 to P2. The valve used with this panel should be of the hard or R type.

A few words about the H.T. battery will be useful and of assistance to many. The ideal H.T. battery consists of one which will permit inefficient or defunct cells being cut out, also there should be a means

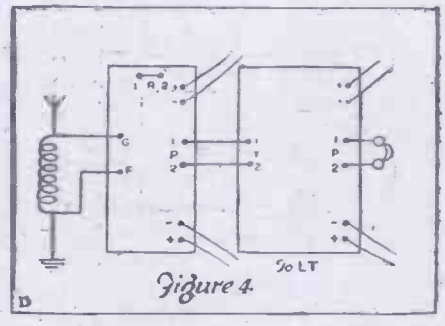


Figure 4.

of varying the voltage. Owing to the high internal resistance of the battery, a fairly large capacity should be connected across its extremities. This also acts as a reservoir. As a precaution to short circuiting, a suitable resistance should be placed in series with the battery. The writer very much regretted not having one fitted in the earlier days. It would at least have saved two valves, which were burnt out through a loose lead springing and just touching the L.T. terminals.

An Adjustable H.T. Battery.

The battery box may be made according to Fig. 5. It is capable of holding 18 flash-lamp batteries, and giving approximately 72 volts H.T. supply. Upon the front of the box two terminals are screwed and marked + and −. Six valve leg pins from old valves are obtained and mounted upon the front in the position shown. A socket is next obtained for a plug. To this a length (about 1 ft.) of rubber-covered flex is soldered. The flex is passed through the front below the pins and soldered to H.T. + terminal.

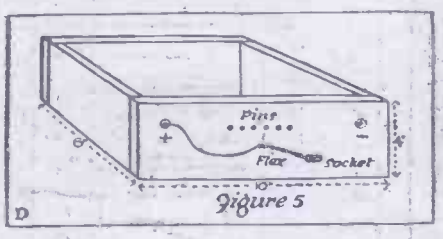


Figure 5

Against the right-hand side of the box a large blocking condenser should be placed and fixed by means of screws. This condenser is about ·2 mfd. capacity. If possible, it should be purchased from a disposals dealer, the price being about 2s. The condenser is sealed inside a metal case. The making up of this condenser would require much tinfoil and waxed paper, and, when finished, probably result in a bulky article. The condenser is connected between the positive and negative terminals.

A safety resistance is next made by purchasing 8 yards of No. 36 S.W.G. D.C.C. or D.S.C. resistance wire. This is wound upon a small bobbin or reel non-inductively, i.e., looped in the centre, the loop then placed in the centre of the bobbin, and the wire wound on double. The resistance is mounted by the side of the condenser, and connected in series with the battery. Eighteen flash-lamp batteries are now purchased, and connected in series, the negative end being connected through the resistance to the negative terminal. From the eighth, tenth, twelfth, fourteenth, sixteenth, and last battery leads are taken to the first, second, etc., pins.

The Voltage to Use.

It will be seen that by plugging in the socket to a pin various H.T. voltages may be obtained to suit the valves in use, the H.T. values being approximately 32, 40, 48, 56, 64 and 72 volts. This method is to be preferred to a switch, for often with the latter certain sections of the battery are momentarily short-circuited when adjusting the H.T. voltage, also more than one socket might be used so that the full 72 volts could be used for either H.F. or L.F. amplification, while only 30-40 volts might be used upon a soft detecting valve in a multi-valve set. Referring back to the L.F. panel, should a greater volume of sound be desired, a two-valve L.F. panel might be constructed, allowing extra width of panel to take the extra valve.

In the next article, it is hoped to deal fully with an H.F. rejector circuit panel, embodying all the necessary adjustments that go to make an efficient panel.


Harry Woods, the well-known footballer (a Newcastle United forward), listening-in.

USEFUL HINTS.

A GREAT deal of unnecessary trouble will be avoided by carefully mapping out the wiring of your panels and the relative positions of the various instruments before commencing to assemble your set. An hour or two spent in drawing up a detailed diagram of the panel connections may save days of feverish excavations after some mysterious howl that could have quite easily been avoided by a little forethought. Such things as grid connections and transformer connections should be carefully thought out, the former being kept as short as possible, while the latter and any coils should be well spaced to avoid any possibility of inter-action. The most efficient wire used for wiring up a panel is No. 18 or 20 tinned copper.

* * *

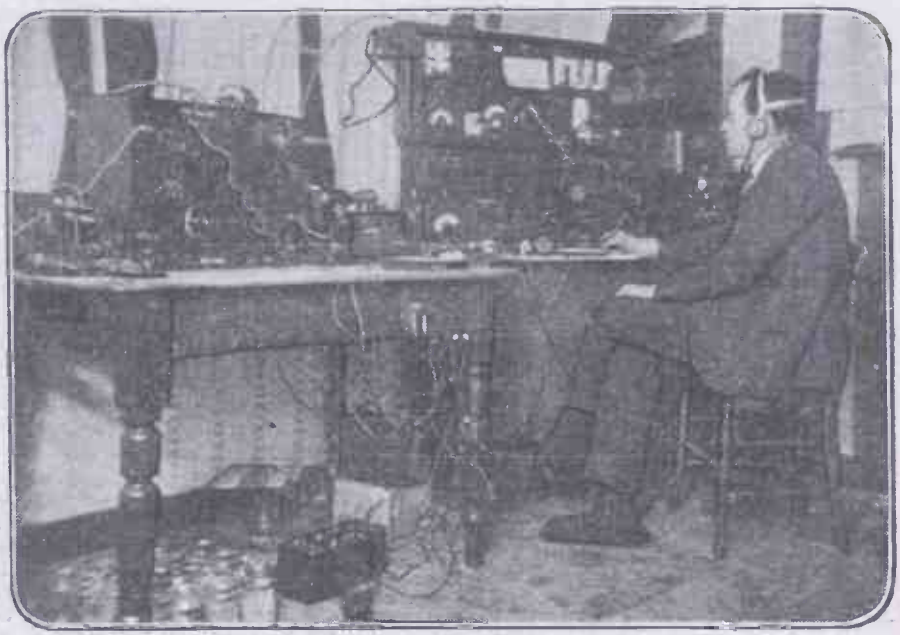
No wood should be used for wireless sets where any leakage is possible, unless it has been carefully treated first. It should be well dried and impregnated with paraffin wax before use.

* * *

Having built a set, the whole wiring should be traced out internally from aerial to 'phones, using a theoretical diagram as guide before testing out the set.

* * *

Do not forget to remove all pencil marks from your panel before testing the set. They may cause leakage.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ENTERPRISE AT THE CARDIFF BROADCASTING STATION.

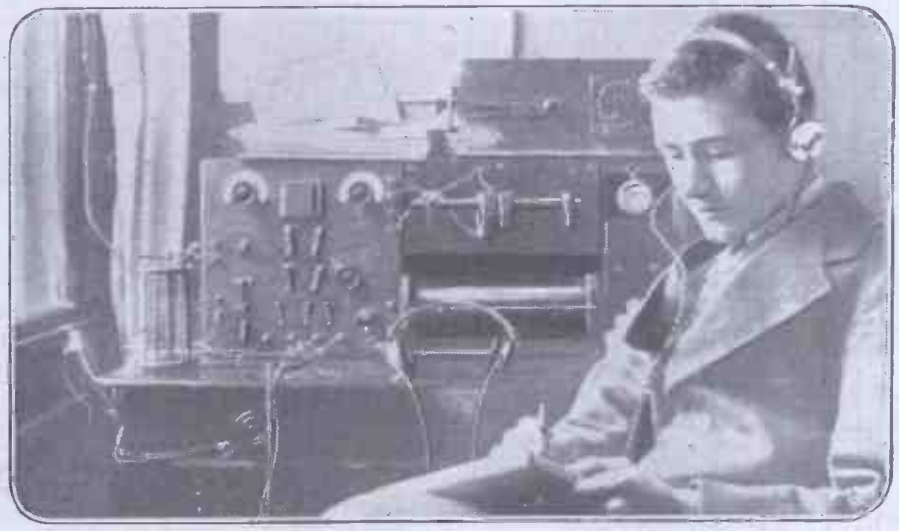
Our special representative in Cardiff recently interviewed the station director at 5 W A—Major Corbett-Smith. In the following article readers of POPULAR WIRELESS will see that Cardiff has a real live wire for its broadcasting director.

TO-DAY, Cardiff (5 W A) stands second to none among the broadcasting stations; this in the estimation of people able to judge not only of the quality of its transmission, but also of the excellence of its programmes.

True, the promised up-to-date microphone is not installed at time of writing. True, again, the Welsh valleys are complaining of difficulties in reception which, in my opinion, result from local conditions. The transmission itself is well-nigh as good as it can be. Moreover, the successful work in the studio—and that is what particularly concerns me at present—is not entirely due to the available native talent, of which Mostyn Thomas, the superb baritone, is a sample.

The station is fortunate in this latter respect, and still more fortunate in that the disposal of the wealth of material is under the guidance of a director possessing marked executive ability. When to this are added real musical power, a scientific and literary education, the gift of oratory, and an extremely effective voice for the 'phone, then the station must be expected to forge ahead.

Such a director is Major Arthur Corbett-Smith, late R.F.A.; M.A. Oxon.; F.R.G.S.; Barrister-at-law; poet; dramatist; essayist and composer of music; with every line of work here represented bearing the mark of distinction. Indeed, I find it difficult to do justice to my subject within the scope of an article, for in the interview specially arranged for me as the representative of POPULAR WIRELESS Major Corbett-Smith became revealed as a quite outstanding personality; a gentleman of wide and deep culture; modest withal.



Mr. E. J. Nield, 17, Woodbrooke Road, Bournville, Birmingham, and his home-made set.

Interpretation of the Beautiful.

"When I came to the station," the major said, "I knew very little either of wireless or of broadcasting work. Was I about to enter a field of labour in which I might be compelled to thrust aside the aspirations of a life-time? My answer to my own question is, I found I had taken up a fresh career in which the accrued experience of past years is of the greatest possible value to me. I have found, in fact, no break between past and present; I am still able to strive after those ideals I never lost sight of, whatever part of the world I happened to be in and whatever the professional duties I became engaged in."

Naturally, and not simply because I was acting as interviewer, I expressed an eagerness to hear more on this head.

"My life-work," replied Major Corbett-Smith, "is summed up in one word—Interpretation; interpretation of the beautiful and noble to the best of my ability, and for the benefit of my countrymen. Let me tell you how broadcasting is going to help me to realise at least one of my ideals. Think of those enthusiastic listeners-in, the children. The future of our country lies with them.

Arrangement of Programmes.

To me it is of the greatest importance that British children should receive an education that will develop deep love for the land of their birth. This can be accomplished in some measure by the teaching of our national history along lines different from those followed in school books. I intend to give lectures to the juveniles on the meaning and growth of sea-power. I shall begin, perhaps, with King Alfred, the founder of the Navy, and come right down to the day when the German fleet sailed to this country in complete surrender. That day, in my opinion, heralded the end of sea-power. Not an abrupt end, of course. Sea-power will last some time yet, but it is definitely in decline.

"Air-power is going to take the place of sea-power, and as a preliminary to lectures on aircraft I shall talk to the children on air currents and other things fundamental to flying. I want every child I can reach by wireless to take his or her share later on in demanding that Britain shall be made secure. And I want every child to understand that security can be obtained in one way only—through the creation of air-power. Other subjects will be handled, and all in a manner suited to the young mind."

Major Corbett-Smith then proceeded to outline projected changes in the nightly programmes. In the near future each night's work is to be made distinctive in one respect. The musical side is to be maintained as usual and improved as far as limits will allow. But Monday is to be labelled "Men's Night," when, among other things interesting to the male listener-in, the sport of the previous week-end will be discussed. Tuesday might serve as a "Literary Night." Wednesday devoted, apart from the music, to addresses on outdoor subjects such as zoology and gardening; it will be "Country Life Night." On Thursdays, amateur wireless, astronomy, and kindred subjects will be introduced, thus providing a "Science Night." The ladies, too, will not be left out in the cold, so Friday is to be known as "Women's Night," and opportunities will be given for the discussion of domestic affairs and the fashions. All the subjects will be presented by experts; and as Members of Parliament are available at week-ends, Saturday is to be "Political Night." The programme then will include political debates as well as addresses on important state matters.

Major Corbett-Smith, as "Mr. Everyman," will be in each week-night programme. It is certain that any crowding-out of "Mr. Everyman's" chats by a re-arrangement of the programmes will meet with very serious opposition. He has taken firm hold on the imagination and affection of an ever-increasing "wireless" public. We in South Wales cannot do without his personal participation in each evening's work.

Reference must be made to the rendering of two numbers of "Parsifal" on Good Friday by the station orchestra of six performers and with the director as conductor. "It should be given by a hundred performers," the major said, "but I have an orchestra worthy of the highest confidence, and enthusiastic in support of my endeavour to provide the finest music."

The Connecting Link.

I suggested that, taking the small size of the studio into consideration and the possibility of the employment of a large number of instrumentalists therein bringing about the effect of "blasting," six efficient musicians would produce a better broadcasting result than one hundred. Major Corbett-Smith agreed. "We can but do our best, however," he concluded, "and look forward to a removal of our difficulties. The changes I have outlined are an earnest of the future. Meanwhile, I shall be happy at all times to co-operate with POPULAR WIRELESS in disclosing our intentions to the public and in giving an idea of the immense amount of work needed in the successful control of a broadcasting station. I look on POPULAR WIRELESS as a valuable link between the Cardiff Station and the listeners-in, and I hope to have the pleasure of meeting the representative of that paper at regular intervals."

USEFUL HINTS ON POWER AMPLIFICATION.

By "VARIOTRON."

This article will interest all readers possessing loud speakers. The data given are based on actual experiments made by the author.

CONSIDERABLE interest has lately been aroused in this country by the advent of the Magnavox Loud Speaker, an invention due to E. S. Pridham, O. B. Moorehead and P. L. Jensen, three San Francisco inventors. This instrument is capable of delivering a large volume of sound, but in order to do this it is necessary that the input be comparatively large. The energy from a radio receiving set may be of sufficient strength to work a loud speaker in an ordinary room, but when it is desired to fill a dance hall or a theatre with sound the output from the receiving set must first be magnified. This is accomplished by means of a power amplifier, which is generally an audio frequency magnifier of special design, the name "power" being given to it because it handles currents which are comparatively large when compared with the currents flowing through the circuits of an ordinary radio receiver.

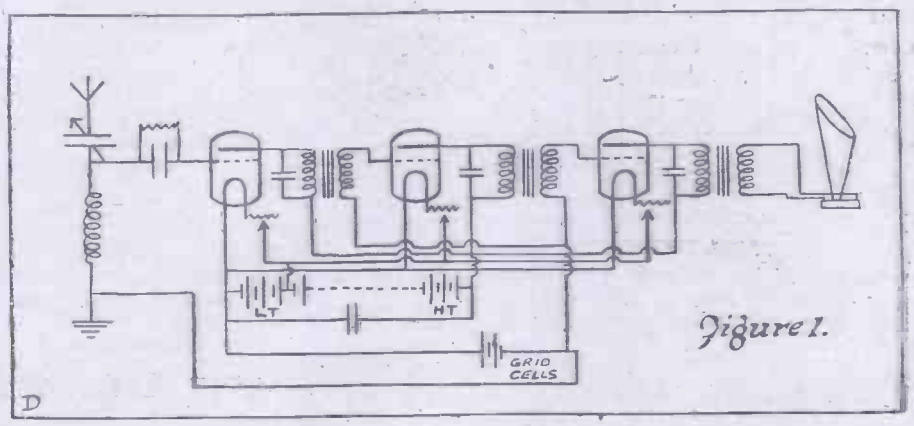


Figure 1.

No doubt many readers wishing to get louder signals have installed a two or three stage note magnifier, and perhaps are not satisfied with their signal strength. In such cases the proper way to obtain a power output is to take out the ordinary amplifier valves, and substitute valves which are designed to carry heavy loads, i.e. power valves, as used for transmission purposes, and at the same time to increase the plate voltage. This will result in a considerable increase of signal strength.

Until quite recently it was thought that it was first necessary to amplify the signals by means of an ordinary note magnifier, before attempting power amplification, but this is not so, power valves will be found to be quite sensitive to weak impulses, such as come from the detecting valve, and may be used without any preliminary note magnification.

Grid Control Necessary.

Power valves using 200 to 300 volts on the plate, may be used to magnify the signals from even a crystal detector. If it is desired to substitute power valves for the ordinary amplifying valves, and to increase the plate voltage, it is first necessary to make sure that the audio frequency transformers will stand up to this increased pressure. In the case of many of the cheap audio frequency transformers now being sold, the use of a high tension battery of 100 volts or more will cause a burn-out. It will be found best to use Marconi-Osram L.S.2 valves, and if these be run at their rated plate voltage, or slightly below, they will be found to be freer from distortion than the ordinary hard receiving valve.

The use of a grid battery as in Fig. 1 will be found advisable, as it tends to stabilise the circuit, reduce normal plate current, and to prevent distortion.

Fig. 2A shows the familiar characteristic curve of a three-electrode valve. It is well known that for the valve to function properly as an amplifier, it should be worked on the slope of the curve at such a point as A. Any increase of anode voltage moves the curve to the left, and assuming the grid to remain at zero potential, then the addition of sufficient H.T. voltage will cause the curve to move to the left as in Fig. 2B, and we shall find ourselves working at the point B on the bend of the curve, where one-half of the wave will cause a greater increase of plate current than the other half, with consequent distortion. It thus becomes necessary to make the grid negative, so that we work on the slope of the characteristic curve, and not on the bend. As a general rule, the greater we make the potential on the plate, the greater must we make the negative potential on the grid.

In order to prevent burn-outs, use is often made of the device shown in Fig. 3, whereby the normal plate current does not pass through the primary winding of the transformer at all, but through a choke coil. A is the choke coil of 30 henries inductance, and B is a 4-microfarad condenser. The normal plate voltage is applied through A, the condenser B preventing any current from flowing back through the primary winding of the intervalve transformer.

To Avoid Distortion.

The audio frequency oscillations in the plate circuit flow through the condenser B and the primary of the intervalve transformer, the voltage across the latter being amplified by the transformer, and applied to the grid circuit of the next valve in the usual way. By selecting a good make of transformer a two or three valve power amplifier may be easily constructed without the use of choke coils or condensers. Fig. 4 shows the circuit diagram. It will be noticed that the ends of the secondary winding of the intervalve transformers which are connected with the grid, are all joined to a common wire which is connected to the negative terminal of the grid battery. The voltage of the latter should be about 12 volts when 100 volts are used on the plates of the valves, and from 30 to 40 volts

(Continued on page 387.)

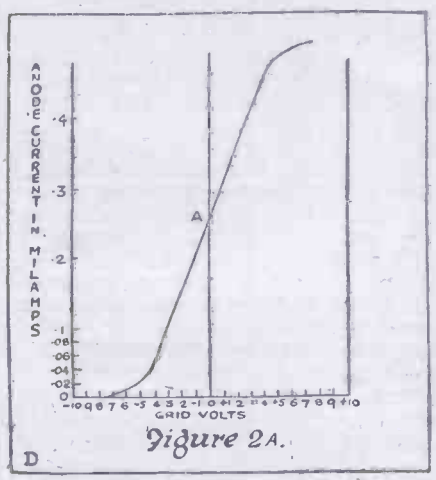


Figure 2A.

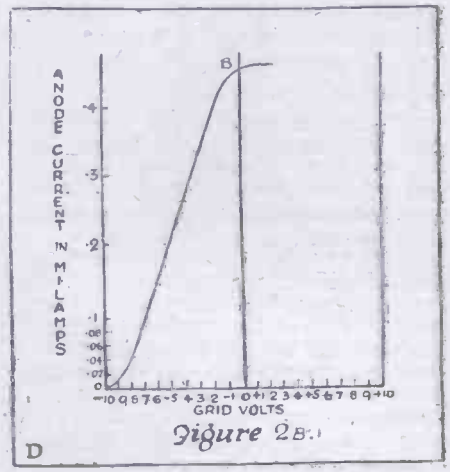


Figure 2B.

Broadcast Reception without Complications

The above illustrations depict the series of " COSMOS " RADIOPHONES as manufactured by the Metropolitan - Vickers Electrical Co., Ltd., of Trafford Park, Manchester. They have been specially designed for reception from the British broadcasting stations. The outstanding feature of these sets is simplicity, without sacrifice of efficiency; all unnecessary complications are avoided, and the sets are, therefore, eminently adapted for the non-technical user, and can be operated without difficulty by anyone without special knowledge or skill. All the sets, Valve as well as Crystal, are entirely self-contained, the only wires that have to be connected up by the user being the aerial and earth leads.

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R 218

NOTES ON BLACKLEAD.

By E. C. CRAVEN.

GRAPHITE, *alias* plumbago, *alias* blacklead, is, as no doubt most readers are aware, one of the many forms of the Protean element carbon. In spite of the implied moral stigma of its aliases, graphite should not be regarded otherwise than as an excellent friend by the experimenter.

Its great usefulness arises from the fact that it has a conveniently high resistance, which is perfectly definite for any particular sample, and so enables us to prepare resistances of a compact form, of low capacity, steady in value and moreover easily altered or renewed. The common pencil line grid leak is a good example of the convenience of graphite for making a high resistance, say about 2 megohms. If this had to be made from resistance wire the coil would consist of a huge number of turns, and even if the wire were wound non-inductively the coil would still possess a high capacity. Should the insulation break down or the coil burn out it would be a formidable undertaking to repair the damage.

Lead Pencils On Test.

The actual resistance of various samples of graphite may run from 3,000 to 30,000 times the resistance of pure copper, whereas the ordinary high resistance wire is only some 50 times the resistance of a copper wire of the same size. When we come to blacklead pencils, however, we are not dealing with pure graphite, but with this body in admixture with clay or charcoal or the like, according to the hardness of the lead.

The following measures of the resistances of lead pencils were made. New pencils were taken and contact made at the ends of the lead by means of mercury :

		ohms
Rowney's "Kandahar" ..	2H.	1970
" " ..	H.B.	82
" " ..	2B.	47
" " ..	4B.	2360
" "Victoria" ..	B.	42
Wolff's "Royal Sovereign"	H.B.	18

It is clear that some circumspection is needed in selecting a lead for making leaks, or, as has been suggested, making a potentiometer. Possibly the usual H.B. pencil will always show a fairly low resistance.

Variable-Grid Leaks.

Variable grid leaks appear now to be coming into favour. It was thought the following test of the "Filtron" variable grid leak might interest readers. This consists of a groove cut in the form of an Archimedean spiral in a disc of insulating material, which has been rubbed round with graphite. Contact is made by a piece of blacklead, which is carried on a revolving switch arm carrying the lead along the groove, which is some inches in length. A pointer was fixed to this arm and the resistance of the leak measured for various angles of rotation of the arm, starting from the end of the smallest turn of the spiral. Measures were made on the leak as received and again after running the lead point round a dozen times or so. The results were as follows :

Rotation of Contact Arm.	Resistance in Megohms As received.	After "use."
0°	Very small	Very small
90°	0·4	0·4
180°	0·8	0·7
270°	1·2	1·0
360°	1·6	1·3
540°	3·2	3·0
720°	4·1	3·6
1080°	7·6	7·0
1170° (total)	10·7	8·9

It is clear that graphite is rubbed off from the contact to the groove, but no doubt in time a steady state will be reached. This I shall be able to determine by repeating the test at intervals after employing the leak in my receiver.

Another property of graphite which combined with its conductivity renders it very useful is its lubricating value. Wherever a push-in contact occurs such as coil plugs, transformer legs, or the like, these will go in and come out much more sweetly if they are first cleaned with the very finest emery cloth and then rubbed over with blacklead. This process repeated occasionally will prevent corrosion and ensure good contact. This is a tip worth knowing. The same process may be applied to studs and switches of any kind where a rubbing contact occurs, and is well worth knowing.

USEFUL HINTS ON POWER AMPLIFICATION.

(*Continued from page* 384.)

when the plates are at a potential of 250 volts or more.

As the plate current is rather heavy, the drag on an ordinary H.T. battery of dry cells will be so great as to very quickly run them down. It is best and cheapest in the long run to install a plate battery of small accumulators, or failing that, current from the mains or from a motor generator may be used, a system of choke coils and condensers being used to get rid of the hum. The owner of an ordinary note magnifier can easily convert this to a power amplifier, and should he be uncertain of his transformers, it is not a difficult matter to fit choke coils and condensers as mentioned above.

To avoid distortion, make the negative grid potential variable, and adjust this potential till distortionless signals are obtained. Use a good make of low frequency transformer ; the cheaper transformers with inferior iron cores will almost certainly distort signals. Do not overload your loud speaker, or it will give distorted signals. It is far better to use more than one loud speaker. If more than one is used, they should all be connected in parallel, and if each shares its portion of the output, and is not overloaded, there should not be much fear of distortion. A fixed condenser of large capacity connected directly across the terminals of a loud speaker, will sometimes improve the clarity of the signals.

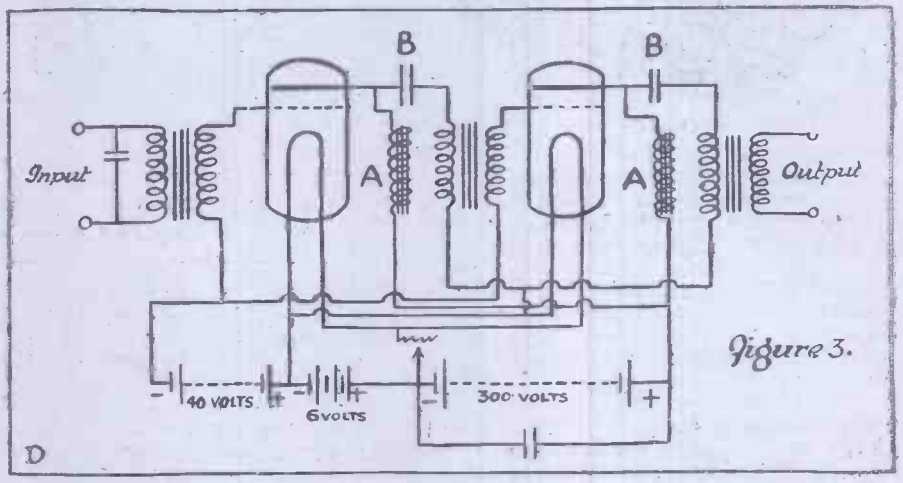


Figure 3.

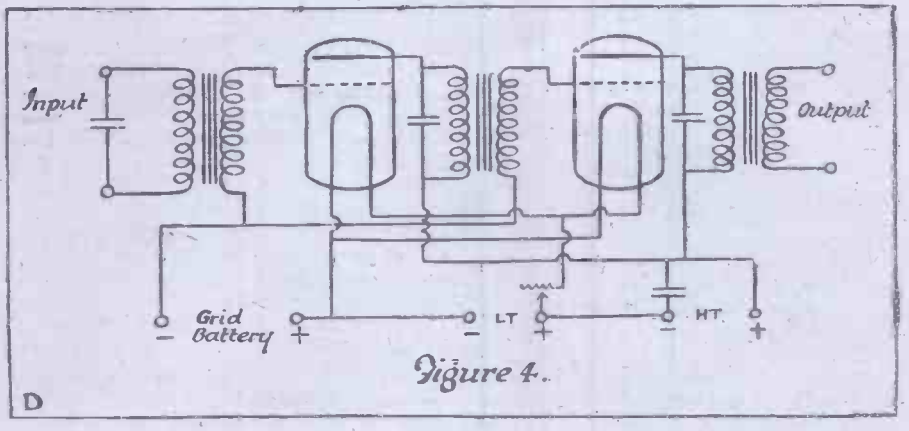


Figure 4.

A THEATRE MANAGER'S VIEWS ON BROADCASTING.

MUCH has been heard of the various opinions which managers of theatrical companies, and of theatres themselves, have either in favour of or against the broadcasting of their plays. As the broadcasting of the opera from the Glasgow station, 5 S C, has been the leading feature of interest in Scotland for the past few weeks, it seemed that it would be rather interesting to have the opinion of the manager of the Coliseum Theatre, from which the opera was transmitted.

Miss Dorothy Dickson and Mr. Leslie Henson listening-in between the acts of "The Cabaret Girl" on their "Gecophone."

Mr. L. Lewis, the manager, was good enough to give his views on the question.

He said he did not think that people would put themselves to the comparative inconvenience and expense of coming to the theatre when they could hear the opera perfectly well at their own firesides for practically no cost and without the trouble of going out.

Does Competition Exist?

Where opera was concerned, he did not think that the broadcasting of one or two acts acted as an incentive to people to come and hear the whole opera. Comic operas, pantomimes, and the like were in a different category. In these cases listeners-in became curious to know what the actors were doing, apart from speaking and singing; it is sometimes rather difficult to follow the plot of a play when one only hears it. Grand opera, he thought, sounded very nearly as good through the wireless as if heard direct. The general opinion among theatrical managers was antagonistic towards the broadcasting of their plays, though a minority favoured it.

Glasgow, in his opinion, was in an entirely different position from London. In the capital there are always enough people who will go to the theatre or opera house; those who hear it by wireless would probably not have heard it at all otherwise. The theatre could be filled whether the play was being broadcast or not. In Glasgow, and presumably this applies to all the provinces, there is competition between the theatres and broadcasting. Many people, who would otherwise have been at the theatre, are content to listen-in to it, thus causing the box-office receipts to drop.

From the point of view of the Broadcasting Company, it was good for business that they were able to include extracts from opera in their programmes. In Glasgow the sale of apparatus has reached large dimensions, and, as Mr. Lewis said, the opera has been a great incentive to people to commence listening-in.

At first two acts were transmitted, later it was cut down to one, and from the theatre point of view he would like to see it cut out altogether.

The General Opinion.

Mr. Hunt, the manager of the British National Opera Company, was then invited to give his opinion.

He was very doubtful whether people were kept away or not. The really musical people were not content to hear the reproduced version, nor were they satisfied with mere extracts. They would come to the theatre just the same, whether they could hear the opera at home or not. On the other hand, by being broadcast, the opera was brought to thousands of people who otherwise would not have heard it. Many of these people, he thought, would acquire a liking for opera, and would in time become regular patrons. But for hearing the broadcast version, many of them might not have come to the theatre. On the whole, he was of opinion that the one effect counter-balanced the other, and bookings were not appreciably affected either way.

The general opinion of theatrical managers, however they may view the broadcasting of one or two acts, seems to be almost unanimously against the transmission of a whole play.

C. C. M.

COIL TAPPINGS.

WHEN winding a coil from which it is desired to take tappings at intervals, great attention is usually paid to winding the wire uniformly and evenly round the former until the point at which it is desired to take the tapping is reached. The tapping is then generally made in a perfunctory manner by twisting a small loop in the wire, as shown in Fig. 1, before proceeding with the more fascinating business of continuing the coil winding.

When the coil is completed, it will probably look very spick and span, especially if the loops of the tappings are small, and the proud constructor will no doubt tell himself that it is equal to any tapped coil that could be purchased ready-made.

Frequent Cause of Trouble.

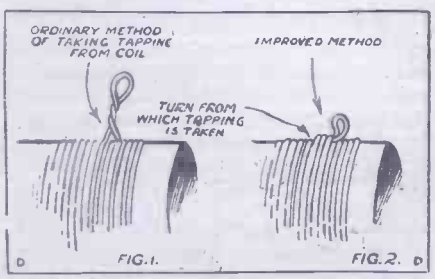
When the coil has been in use for some time, however, it will be noticed that tappings so constructed are apt to pull the wire away from the former, with the result that the coil begins to present anything but a neat and tidy appearance.

The wire may be blamed or even the former, but this is not the real cause of the trouble. The fault lies in the construction of the tapping which has been made in a way that allows of a certain amount of "play" in the wire should any strain be placed upon the tapping loop.

After the connecting wire has been soldered to the tapping, and after the coil has been in use for some time, the strain imposed at the particular point where the tapping is constructed tends to pull the wire away from the former, and as the base of the tapping is in no way fixed, the particular turn of wire of which it forms part will be loosened. A simple method of obviating this is shown in Fig. 2.

Preserves and Appearance.

The loop forming the tapping is twisted exactly the same as shown in Fig. 1, but instead of immediately proceeding with the winding of the coil, bend the tapping down flush with the former and wind the following two or three turns over the base of it. Then raise the loop of the tapping up again and continue winding the coil until it is desired to make a further tap, and so on, until the coil is completed.



By adopting this simple precaution, the danger of loosening the coil windings, or of dragging the turns out of place, is obviated, and an inductance so wound will not only look neat and tidy upon completion, but will preserve its good appearance for a very long time.

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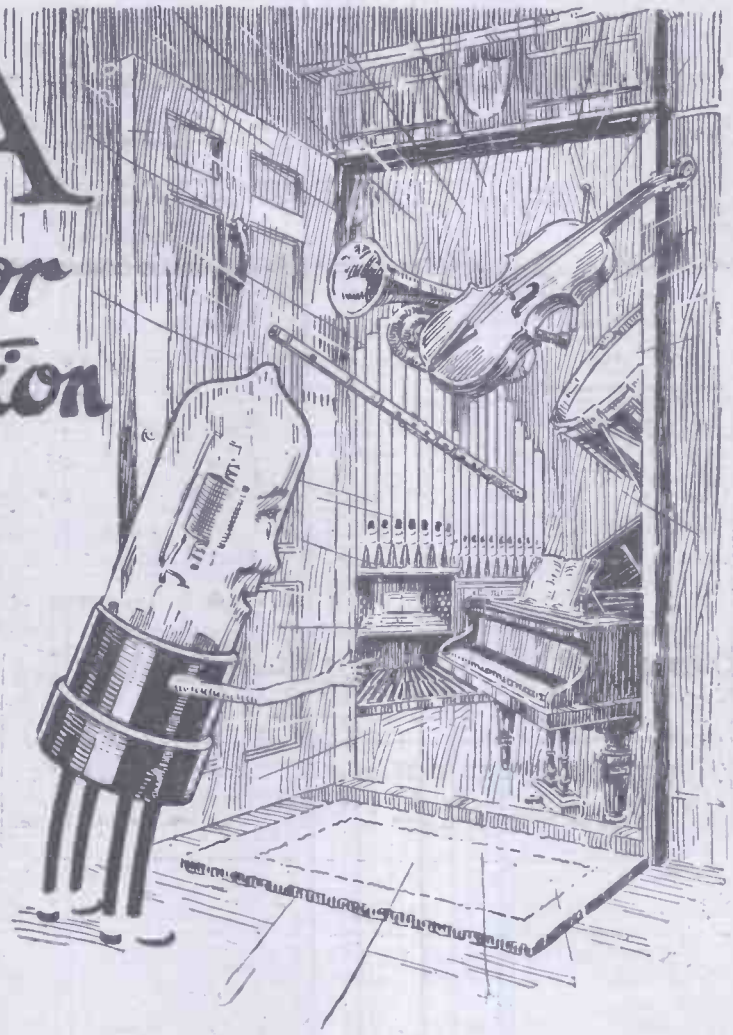

A CONVINCING STATEMENT.

The International Meteorological Expedition operating in the North West district of West Australia, and using a portable wireless equipment, consisting of a 3-valve receiver with small portable aerial, received quite easily the time signals from all the high power stations in the world.

They reported very satisfactory results despite the fact that conditions were very unfavourable indeed.

Needless to say, Mullard "ORA" valves were used.

The admirable manner in which these valves sustained several trans-shipments, submersion in water during landing, and severe rough handling generally, is the subject of a very interesting letter sent to us recently by Mr. John Wishaw of Mount Lawley, Western Australia.

For receiving vocal and instrumental items you must have

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For efficient results the "Ora" Valve requires 3·6 to 4 volts on the filament and 30 volts or over between the anode and filament.

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VALVE–CRYSTAL CIRCUITS.

By T. Mc L. GALLOWAY.

A WELL-ADJUSTED crystal detector is in every way as good as a single valve detector circuit without reaction. Its advantages are many—it is cheap, easy to work and, most of all, it requires no accumulators or high-tension batteries. To put the matter in a nut-shell, a single valve detector is not worth its current. A crystal does not amplify, but it rectifies more efficiently than a valve, that is, it will function on less current being applied to it than a valve needs. A crystal receiver will give, on an outdoor amateur aerial, comfortable signals up to ten or fifteen miles from a broadcasting station. If it is desired to increase the volume of the signals received within these distances, a low-frequency amplifier may be added to the existing crystal set.

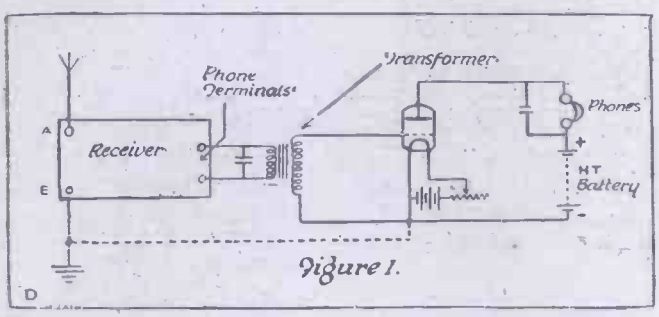


Figure 1.

This is accomplished by removing the telephones from their terminals and connecting in their stead the primary winding of a low-frequency transformer, which will cost between 12s. 6d. and £2, according to quality. The secondary winding is connected across the grid and negative filament terminals of the valve, and the telephones are inserted between the plate of the valve and the positive terminal of a high-tension battery of about 40–60 volts.

For Various Ranges.

The negative of this battery is connected to the negative terminal of the filament accumulator. The primary of the transformer and the telephones are bridged with fixed condensers of about ·001 MF. Better signals may result from earthing the negative terminal of the accumulator. The circuit arrangement is shown in Fig. 1.

For distances over fifteen miles the oscillations will be rather weak, and should be magnified before reaching the crystal. This should be done by using the valve as a high-frequency amplifier. The circuit used is shown in Fig. 2.

First an inductance is obtained, which, with a variable condenser, will cover the wave-range in the aerial circuit over which it is desired to receive. To the aerial is connected the grid of the valve, and the negative terminals of the high-tension battery and accumulator to earth. A condenser, K, should be connected across the high-tension battery to by-pass any H.F. oscillations. To the plate of the valve, the aerial terminal of the crystal receiver is joined, while the earth terminal is joined to the positive side of the H.T. battery. The telephones are merely joined to their own terminals on the crystal set.

To commence operations, heat the valve filament and turn both the wave-length adjustments at once. If nothing is heard, it will probably be necessary to put K1, a capacity of ·0003 MF. across the crystal

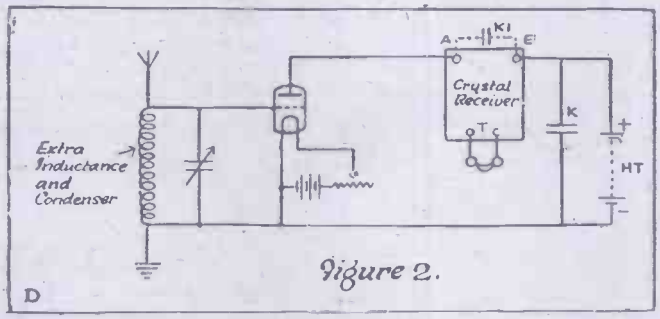


Figure 2.

receiver. This circuit is a good one, but requires a little patience at first. The writer has understood 2 L O at 400 miles using this combination.

This circuit may be further extended by the addition of a low-frequency valve, added as in Fig. 1 to the 'phone terminals of the crystal set.

Another way to increase the signal-strength is to make the same valve function

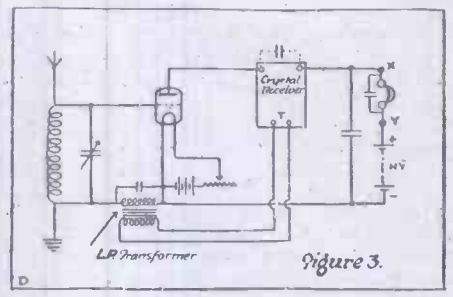


Figure 3.

also as a low-frequency amplifier. This is carried out as follows: The telephones are removed from their terminals (see Fig. 2), and inserted, with a condenser of ·001 MF. across them, between the H.T. battery and the earth terminal of the crystal receiver. The telephone terminals of the latter are connected by the primary winding of a low-frequency transformer, whose secondary winding is connected between earth and the negative terminals of the accumulator and H.T. battery. The circuit arrangement is shown in Fig. 3.

Efficient but Critical.

The signals are first amplified at high frequency, then rectified by the crystal, then amplified by the valve again at low frequency. This circuit also is, at first, a trifle difficult to work, but it gives very good results, and is absolutely silent. The quality of speech and music received leaves nothing to be desired. At 34 miles 5 S C can be enjoyed with the telephones on the table, and the writer has heard all the broadcasting stations with this circuit, very faintly, but readably.

Covering wire with silk and cotton insulating material in a large wireless works at Acton.

NAVIGATION BY WIRELESS.

THE first vessel to benefit by the "wireless lighthouse" established by Marconi's Wireless Telegraph Co., Ltd., on Inchkeith Island, in the Firth of Forth, is the S.S. Royal Scot, owned by the London and Edinburgh Shipping Co., Ltd. This boat, which is employed on the London and Leith service, has been fitted with a special type of wireless receiver which will detect the signals sent out by the "wireless lighthouse," and enable the navigating officer to pick his way through the dangerous channels of the Firth of Forth in the thickest fog.

The Royal Scot has just returned to Leith after her first round trip to London with this apparatus on board, and reports that the "lighthouse" signals were received perfectly during the whole time the vessel was within range, and that the ship's officers were easily able to use the apparatus.

Of importance to shipowners is the fact that this device will frequently enable their vessels to save a tide.

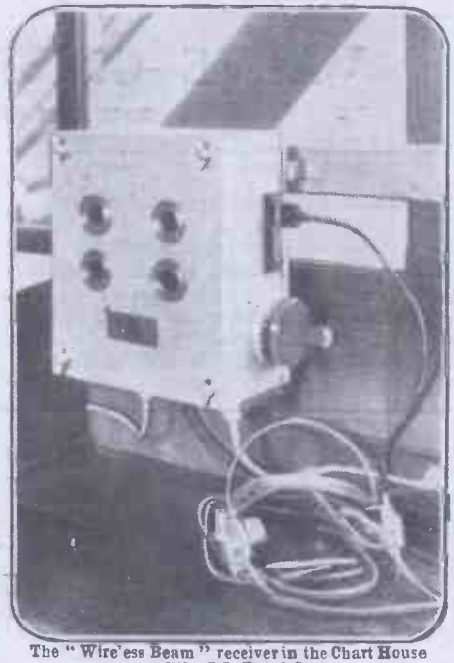
The receiving apparatus is extremely simple. Only one handle has to be operated. This switches the gear into use, and is also calibrated so as to give a very fair indication of the distance from the shore, in addition to the actual bearing. Thus the navigating officer can determine whether he is inside or outside his course.

Irrespective of Weather.

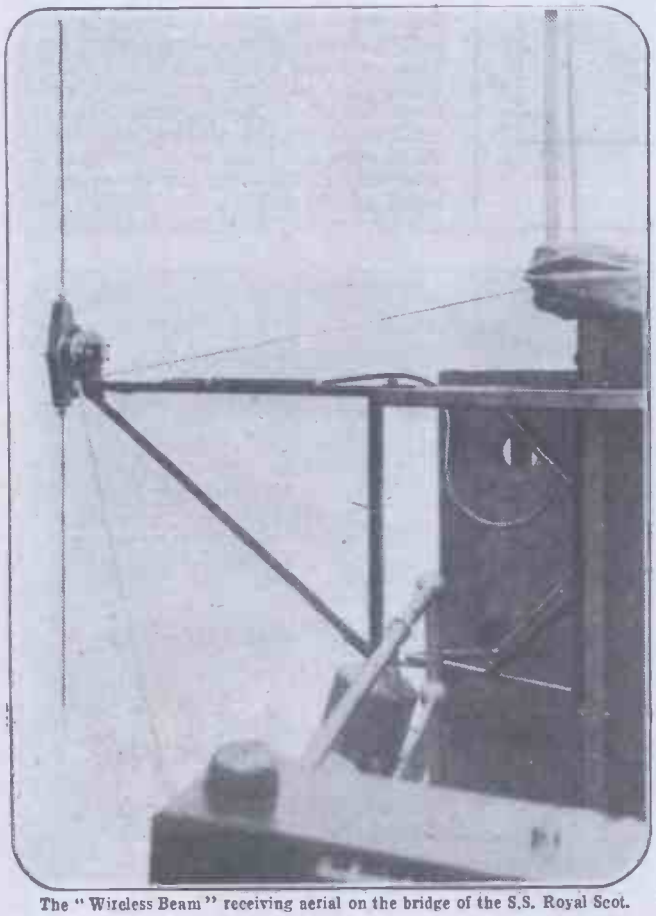
The transmitter sends out a directional wireless beam which gives a distinctive signal as it passes through each point of the compass.

A conspicuous feature of the transmitting station is a metal framework tower, some 30 ft. high, supporting four metal arms. These, in turn, support a series of vertical wires. The whole revolves on a circular base, driven by an electric motor. The frame is, in effect, an electric reflector, and the wireless waves are projected so as to sweep round the surrounding sea in just such a way as a light would from a lighthouse. Thus, instead of fixing a point by visual means, the result is obtained aurally, and is in no way interfered with, whatever the weather conditions may be.

The London and Edinburgh Shipping Company is to be congratulated upon its enterprise in installing the first commercial beam receiver.



The "Wireless Beam" receiver in the Chart House of the S.S. Royal Scot.



The "Wireless Beam" receiving aerial on the bridge of the S.S. Royal Scot.

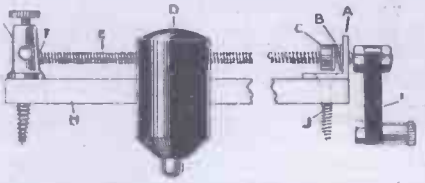
AN IMPROVED SLIDER.

THE diagram illustrates a simple and cheaply made fitment, which may be added by anyone using an inductance coil requiring a sliding contact. The actual additions consist of (E) a length of 4 B.A. screwed rod; (A) a small piece of brass bent L shape; and drilled to take the 4 B.A. rod, and the usual screw which secures the ¼-in. slider rod; (B) a spring washer; (I) two or three 4 B.A. nuts, and a bit of ebonite to make a small winding handle.

First bend the piece of brass A, then drill it to take the screw J, and fasten it down. Next take a pair of dividers and mark, by scratching, the terminal G, the slider D, and the brass support A. This should be done carefully to ensure that the screwed rod E will be exactly parallel with the ¼-in. rod H. The 4 B.A. rod is then measured off and cut the end at F being pointed. The collar C, which may be a 4 B.A. nut, is then run on and soldered to prevent it moving. The slider D is next drilled, using a ⅛-in. drill, and tapped 4 B.A. The drill should be put in half-way from each side to limit any error in drilling. Now the terminal G is drilled to a depth of about ⅛ in. to provide a bearing for the point F. Then drill the support A.

Permits Accurate Tuning.

To assemble, run the rod E through the slider, put on the spring washer B, and



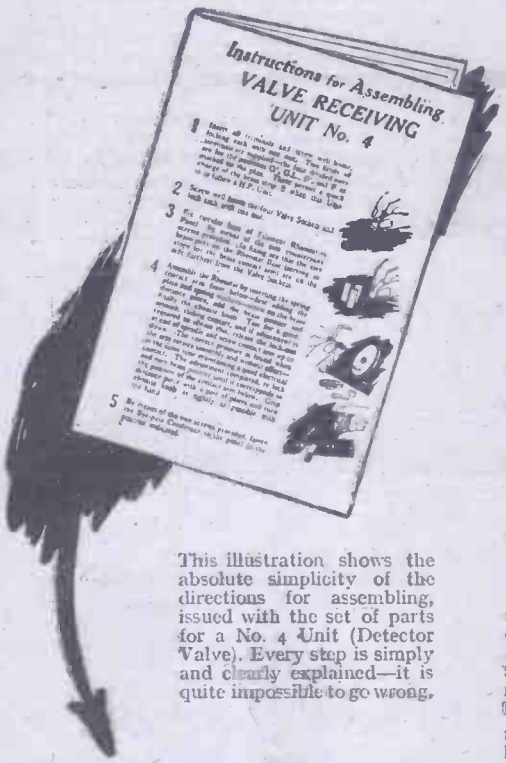
insert the end through the bearing A. The spring is compressed to allow the terminal G to be screwed home, and then released; it will then press the point F home, and hold it there. All that remains to be done is the fitting of the handle which may be fashioned from 4 B.A. nuts and a bit of $\frac{3}{16}$ in. ebonite.

This little device will ensure most accurate tuning, allowing a selection of any turn of wire, whilst holding the slider firmly in position and preventing its accidental displacement.

Let *others* speak for the efficiency of Peto-Scott Units

These two letters, typical of hundreds recently received, effectively demonstrate that it is no longer necessary to purchase expensive Instruments to get good results. Peto-Scott Units can be sold at such low prices because every component has been designed and manufactured by us in our own factory, and the quality is maintained at such a high level because every transformer, grid leak, condenser—in fact, every working component—is actually tested under working conditions before being passed for issue.

With the more liberal issue of Experimenters' Licences, make up your mind that Wireless is no longer an expensive hobby.



This illustration shows the absolute simplicity of the directions for assembling, issued with the set of parts for a No. 4 Unit (Detector Valve). Every step is simply and clearly explained—it is quite impossible to go wrong.

Receives American Concerts!

5, Leighs Fold, Green Lane, Patricroft.

Messrs. Peto-Scott, Ltd.

Dear Sirs,—No doubt you will be interested to know that the reception of the American Broadcasting stations W J Z and W G Y on a single-valve home constructed set as described in my letter to "Popular Wireless" of March 17th issue, was made from a set of Peto-Scott (No. 4 unit) parts. To prove this is not a case of "freak" reception may I state that since that date I have received these stations eight times. I also get, apart from the above B.B.C. stations, the F.L., Radiola, Posts and Telegraphs (all French stations) telephony.

Wishing you the best of success with such an excellent panel.—Yours faithfully, J. H. Brittain.

P.S.—I am demonstrating my set before the Eccles and District Radio Society this week, and expect to pay a visit to the Manchester Wireless Society in a fortnight's time.

Gets every Broadcasting Station at Hastings.

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15/4/23.

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Build your own Set and get *all* the Broadcasting

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Before buying a Valve Set think carefully over these points, or better still, send 6d. at once for our Booklet "Radio," which gives a more detailed description of the Peto-Scott System of Standardised Radio Units.

¶ *Catalogue of Wireless Components, 32 pages fully illustrated, post free, 3d.*

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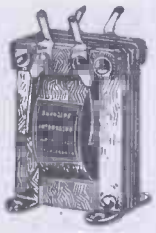

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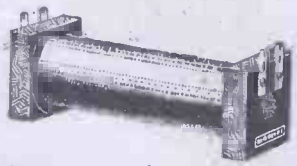

A GOOD TELEPHONE TRANSFORMER built in your set enables you to use low-resistance headphones or loud speaker, with the following advantages:

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REPAIRS to Headphones by competent staff.	
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POPULAR WIRELESS Beginners' Supplement

PART XIV. WIRELESS IN A NUTSHELL (Conclusion).

By MICHAEL EGAN.

This is the last article of the special beginners' series written by Mr. Egan for new readers of "Popular Wireless." If there still remain any elementary points which readers are not quite sure about, they are requested to write to the Queries Dept. Further articles for the beginner will appear from time to time.—EDITOR.

THIS provides one means of tuning the aerial to signals of different wave-length. The longer the wave-length the longer the wire that should be tapped off from the coil. An aerial may also be tuned by means of a variable condenser. This is an instrument which can be filled with, and emptied of, electricity at various rates. The smaller the condenser the more rapidly it can be filled and emptied. If the currents flow up and down the aerial (i.e. in and out of the condenser) very rapidly, a small condenser will suffice, whereas if they flow slowly a larger condenser will be required. By varying the size, or capacity, of the condenser, therefore, the aerial can be prepared to assist the flow of currents of various frequencies, which are, of course, produced by waves of different length. A complete aerial equipment therefore comprises a length of wire, a variable condenser and a variable coil of wire.

High Frequency Currents.

When a receiving aerial is struck by wireless waves, small currents of electricity are set up in it. Each complete wave causes a current to flow, first in one direction and then in the other direction, along the wire. These currents, in flowing up and down the aerial (to the point at which connection is made with the earth, and back again), pass through the receiver box, as described above. They occur, of course, at the same frequency as that of the waves which cause them. If the frequency of the waves which carry the signals is, say, 1,000,000 per second, it means that 1,000,000 little electric currents flash in and out of the receiver box during each second.

This frequency is far too high to permit of the currents being used to produce sound vibrations. In the first place, it would be impossible to evolve any mechanical device which could vibrate at the rate of 1,000,000 vibrations per second. Of course, all wireless messages are not carried on waves of such high frequency. Nevertheless, even the longest waves used in practice (i.e. waves of lowest frequency) are of too high a frequency to render this possible. Then again, even if it were possible to do so, we should be unable to hear the resulting vibrations—in most cases, at any rate—because the human ear is incapable of "sensing" vibrations above a certain frequency.

There is yet another difficulty in the way of converting these small electrical vibrations into sound vibrations. As I have said, they flow alternately in opposite directions. This constitutes the fundamental problem of reception. If, instead of flowing alternately in opposite directions, the received currents all flowed in the same direction, the problem of utilising them to produce mechanical vibrations would not present such difficulties. They could, for instance, be gathered into *groups* of uni-directional currents (i.e. currents which flow in one direction only). The little currents of each group could be *added together*. So long as they tried to act alternately in opposite directions this could not be done, of course, because they would simply negative one another and "cancel out."

The Work of a Detector.

By adding, say, 1,000 small currents together, each of which flowed in the same direction, it would be possible to produce one fairly big pulse of current, and this single pulse could then be used to produce a single mechanical vibration in some suitable instrument. There are therefore two processes involved: (1) the grouping of the currents, and (2) the converting of the vibrating, or oscillating, currents into non-oscillating, or uni-directional currents. The grouping of the currents is really a problem for transmission, and, in fact, the grouping does actually take place at the transmitting station in practice. The primary function of the receiver is therefore to convert the received oscillating currents into uni-directional currents.

There are two ways of doing this. One is by means of a crystal. Certain kinds of crystal possess the distinctive characteristic of allowing electricity to pass through them in *one direction only*. By placing such a crystal in the path of the received currents, the latter can thus be made uni-directional. The crystal obstructs every alternate current. The same function can be performed by a valve, a device which was specially invented for the purpose. A steady current of electricity flows across the valve, and in the path of this current is a small wire, known as the grid, which is connected to the aerial. The received currents flow from the aerial on to this grid, making it alternately assist and repel the steady uni-directional current in the valve. This uni-directional current is thus caused to pulsate at the frequency of received signals, without changing its direction.

This process, whether carried out by a crystal or a valve, is usually referred to as "rectification." The received currents are said to be "rectified." On being rectified, they are passed through the telephone coils, and each group of impulses effects an increase in the pulling power of the magnets on which the coils are wound. The diaphragms of the telephones are thus vibrated at the frequency of the *groups*—which is the same as the frequency of the sound waves addressed to the microphone at the transmitting station. A valve can also be used to increase the strength of the received currents either before or after they have been rectified.

In Conclusion.

In the foregoing series of articles, which this one concludes, I have endeavoured to explain, in a non-technical way, some of the general principles on which the science of wireless is based. If the reader now wishes to gain a wider and more technical knowledge of these principles, he or she will find many elementary text-books on the subject. In helping to create such a wish, these articles will have achieved their primary object.

The Aunt and Uncles of 2 L O. Left to Right: Auntie Sophie (Miss Dixon), Uncles Jeff (Mr. Jeffiries), Rex (Mr. Palmer), Arthur (Mr. Burrows), and Caractacus (Capt. Lewis).

QUESTIONS & ANSWERS FOR BEGINNERS.

NOTE.—On this page the beginner will find a selection of questions and answers which will concisely deal with many little problems met with in the erection of a wireless receiver. Readers are invited to send their queries to the Technical Dept., Room 138, The Fleetway House, Farringdon Street, London, E.C.4, where they will be carefully and promptly dealt with. Replies are sent by post free of any charge.

WHAT IS THE DIFFERENCE BETWEEN A RESISTANCE AND A POTENTIOMETER? In principle they are both alike, in that they both consist of an instrument containing a coil of wire or some equivalent conductor which offers considerable resistance to the flow of electricity through it. Thus in the resistance the instrument is used to vary the amount of current flowing through a circuit, by varying the resistance offered to that current. A potentiometer, however, is a similar instrument having a very high resistance indeed, so that very little current can flow through it. This instrument is connected across a battery, and a tapping is taken by means of a slider to the circuit which the potentiometer is required to influence. The potentiometer is used to vary the pressure or potential in any circuit, such as the grid of a valve.

* * *

WHAT IS AN OHM? The ohm is the unit of resistance. The amount of resistance present in a conductor determines the amount of current that will flow according to the pressure or voltage applied. Thus one volt pressure can only force one ampere of current through a wire whose resistance is one ohm. If the resistance is doubled only half the amount of current will get through, unless the pressure is increased.

* * *

WHAT IS A REJECTOR CIRCUIT? A closed circuit which is shunted across some part of a receiving circuit and which is so tuned that it will oscillate to the frequency of any station which is causing interference, but will not oscillate to the frequency of the waves from the station it is desired to receive. Thus, while rejecting the signals from the desired station it acts as a by-pass to signals of a slightly different frequency and which are likely to cause interference.

* * *

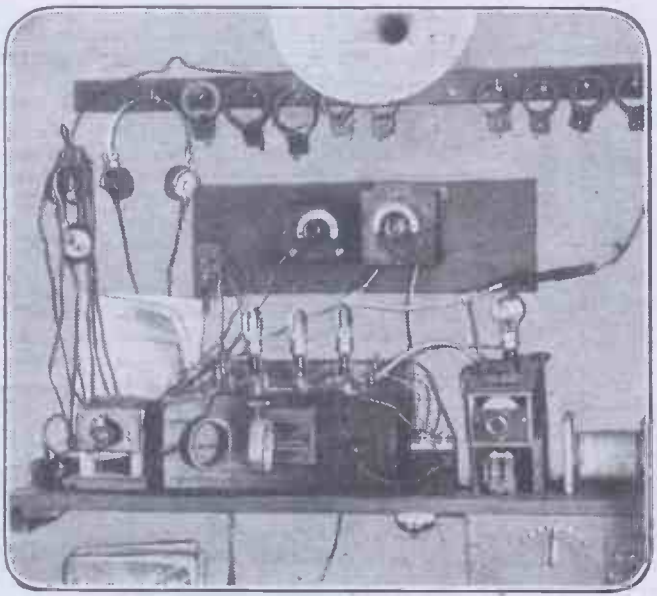
WHAT IS A GRID LEAK? A high resistance path connected either across the grid condenser or from the grid to earth which enables the charges built up on the grid condenser to leak away, thus preventing them from impeding the action of the received impulses upon the grid.

* * *

WHAT IS MEANT BY AMPERE-HOUR CAPACITY IN CONNECTION WITH AN ACCUMULATOR? A figure which gives the product of amperes and the number of hours, thus giving the rate at which a current can be taken from an accumulator. For instance, an accumulator of 50 ampere-hours capacity will deliver 5 amperes for 10 hours or 1 ampere for 50 hours. This capacity and discharge rate is usually given on accumulators as the ignition capacity, which means that the figure has been calculated from the intermittent discharge of the accumulator rather than from the continuous discharge. Thus, when an accumulator is marked 50 amp.-hours it usually means that if used for intermittent discharge such as operating a spark coil, the accumulator will last for 50 hours discharging at one amp. rate, but if used for continuous discharge such as the lighting of a lamp or valve the ampere-hour capacity is half the above or 25 hours at one amp.

* * *

WHAT IS ALTERNATING CURRENT? An electric current which reverses its direction of flow in a conductor at certain fixed times just as a pendulum reverses its swing. The number of reversals per second is known as the frequency. High frequency currents are of the same character as alternating, but of a very much greater frequency.



A highly efficient amateur set constructed by Mr. Hand of 7, Star Terrace, Moravion Road, Kingswood, Bristol.

* * *

WHAT IS MEANT BY COUPLING? A method employed by which energy is transferred from one circuit to another without any electrical connection between the two circuits. Thus in the case of the loose coupler the received oscillations from the aerial rush through the primary coil and set up a fluctuating magnetic field around its winding. This field is constantly in motion around the secondary coil winding, and induces in that coil oscillating currents similar to those in the primary. The degree of coupling will determine the amount of energy transferred from one coil to the other, so that the tighter the coupling the more effect will the magnetic field from one coil have upon the other coil, and the more energy will therefore be transferred.

* * *

WHAT IS A LOADING COIL? An inductance added in series with a circuit in order to increase the wave-length of the circuit.

* * *

WHAT IS MEANT BY DIELECTRIC CONSTANT? The dielectric constant of a medium is determined by the ratio of the capacity of a condenser having that medium as a dielectric to the capacity of the condenser having air as its dielectric. Both condensers must be exactly identical in size and area of the plate and in the thickness of the dielectric, the only difference being that the material used as dielectric is varied. The dielectric constant of air is taken as unity, so that if a certain condenser whose dielectric is air has a capacity of one microfarad and a similar condenser whose dielectric is mica (the thickness of the mica being the same as the thickness of the air dielectric) is found to have a capacity of 5 microfarads then the dielectric constant of mica is said to be 5.

* * *

WHAT IS THE FILAMENT OF A VALVE? A thin conductor, usually of tungsten, about 0·06 mm. thickness, which is rendered incandescent by passing an electric current through it. This incandescence is necessary in order that a stream of electrons may be emitted from the filament and flow across the valve on to a positively charged plate which is connected with an external circuit. It is by varying this flow of electrons that the received oscillations are amplified and rectified, the electron stream being in one direction only and acting as a one-way valve.

* * *

WHAT IS MEANT BY THE IONISATION OF A GAS? The liberation of the electrons contained in the atoms of the gas, thus setting free the positively charged nucleus or ion contained in the atoms. A gas which is normally non-conductive is rendered highly conductive after ionisation has taken place.

PICTORIAL VALVE DIAGRAMS.

By O. J. R.

HAVING graduated as a fully fledged crystal set operator, it is only natural for an enthusiast to try his hand with valves. On this page is shown three pictorial valve circuits which have been specially drawn for those readers who have arrived at this stage. Each diagram is practically self-explanatory, so that it will only be necessary to describe each one briefly and include a few remarks concerning the operation of valve circuits generally.

To obtain Louder Signals.

The next progressive stage from the crystal set is usually the single valve low-frequency amplifier, or note magnifier, shown in diagram A. This circuit is suitable either for a valve or crystal receiver and coupled to the receiver 'phone terminals at B the signals will be five times louder than before. The low-frequency intervalve transformer, C, should have a step-up ratio of 5 to 1, and the small fixed condenser connected in shunt with the primary winding may have a capacity of ·001 or ·002 mfd.

This circuit is employed when the signals already received are fairly strong, and where it is desired to make them still louder, and providing the correct amount of plate and filament current is applied to the valve the results obtained will be highly satisfactory. It should be clearly understood that low-frequency amplification (or audio-frequency, as it is known in conventional circles) means magnification of sound after rectification has taken place. It has little or nothing to do with *distance*. It is pure note magnifying. The range of the receiver will remain the same or perhaps it may be increased very slightly, so little, in fact, that it is not noticeable.

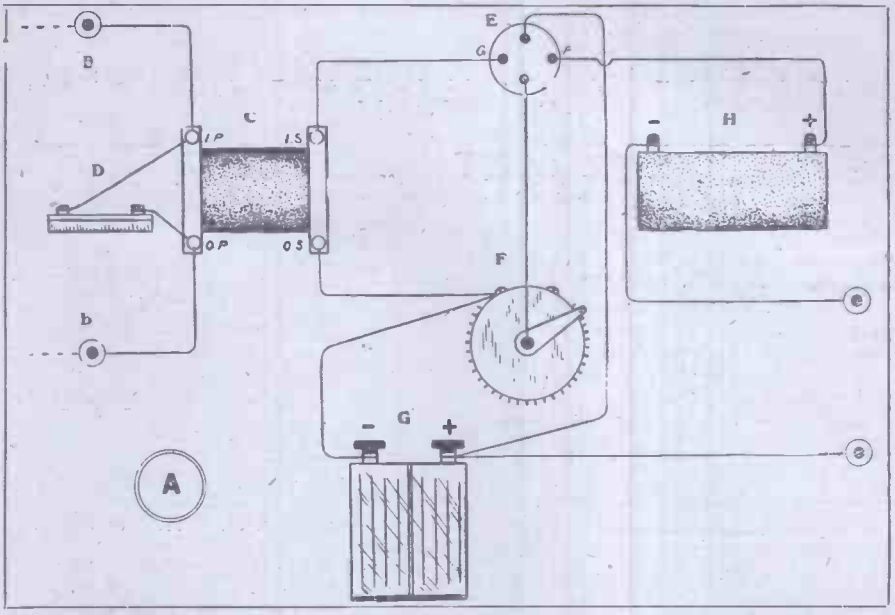
Low-frequency amplification should not be employed where the signals already received are weak, or indistinct, owing to the receiver being situated too far away from the broadcasting station. This would be a case of increasing the receiving *range* (not the note strength) and to do this we employ high or radio-frequency amplification, which means magnification of incoming oscillations in the aerial prior to rectification.

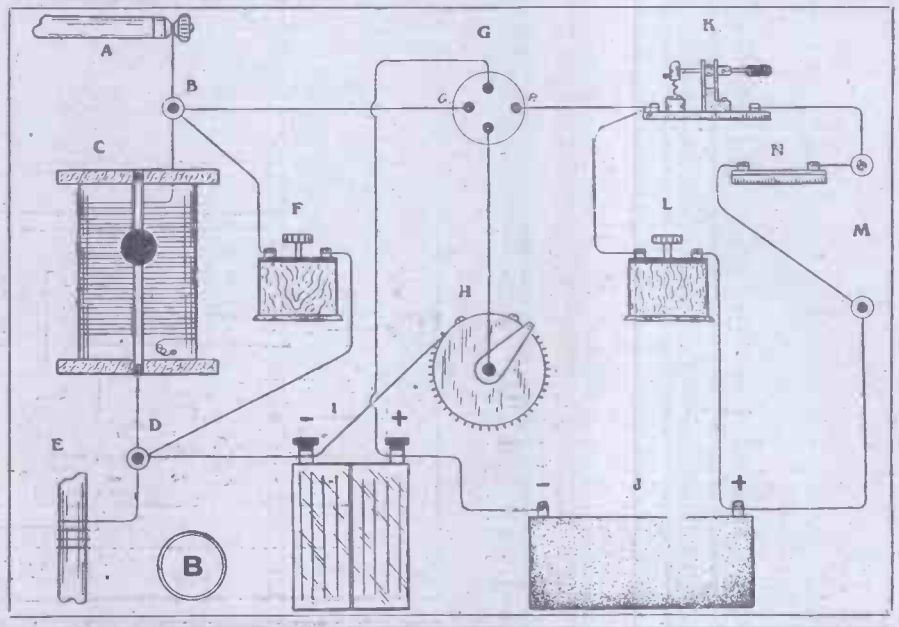
High-Frequency Amplification.

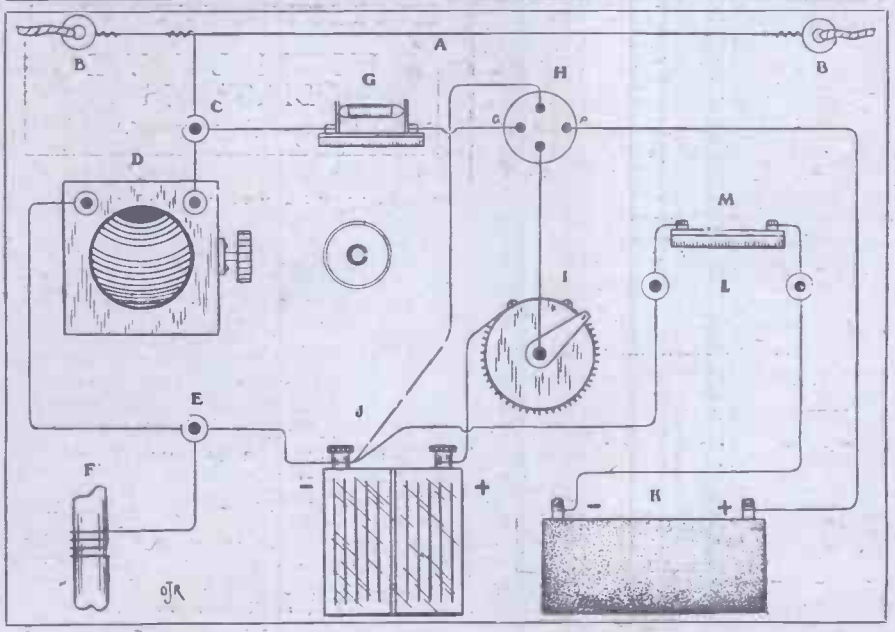
Such a circuit is shown at B, where the signals are first magnified by the valve and afterwards rectified by the crystal detector in the usual way represents a tuning coil or a variometer provided for the purpose of forming a closed detector circuit. A variable condenser can be used. The note magnifier shown in diagram A may be coupled to the 'phone terminals for the purpose of increasing the volume of the now strengthened signals.

Diagram C represents a single-valve receiving circuit suitable for the reception of spark signals and telephony. The tuning is accomplished by a variometer, but this may be replaced by any other suitable tuning device. If the existing slide inductance of the crystal set is employed it is advisable to connect a ·0003 mfd. variable condenser in

(Continued on page 398.)







ANALYSING COMPLEX CIRCUITS

By ALBERT BULL.

VERY often great difficulty is experienced by wireless enthusiasts in obtaining a clear conception of the various circuit diagrams which appear from time to time for their guidance, and it is with the object of assisting those who find the diagrams a little confusing that I write this article, which, it is hoped, will suggest a system whereby such difficulties may be overcome and after little practice entirely eliminated.

Now in the first place let us deal with an analysis of a very simple electric bell circuit containing two indicators (see Fig. 1). I

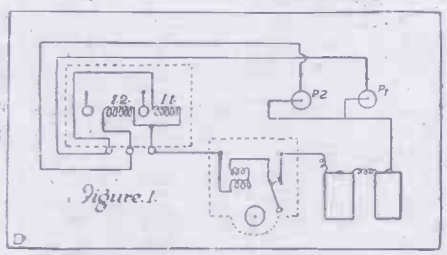


Figure 1.

have purposely included several unnecessary markings which only serve to make a diagram more incomprehensible and difficult to follow. In the first place let us remove all superfluous markings and, using the conventional sign for the battery, we have quite a different and clearer view of the same circuit (see Fig. 2).

"Building Up" Process

Now we may see at a glance that by closing either P1 or P2 that the current flows from battery to push, push to indicator coil, thence to tumbler bell, then back to battery; furthermore, we can see quite clearly that we may add extra indicators, pushes *ad lib.* and still not interfere with the principle of the circuit.

All this is so obviously simple that one

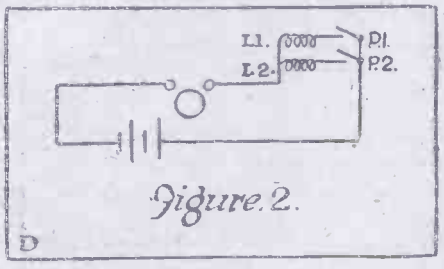
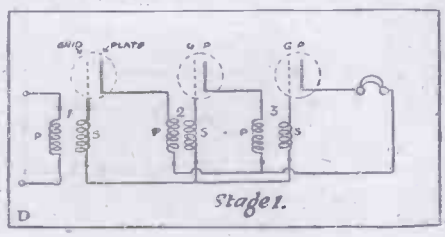


Figure 2.

may wonder whether the same simplicity applies to the wireless circuit, and we cannot do better than to analyse an ordinary 3-valve note magnifier by dealing with it in stages.

In stage one the apparatus in use will include 3 valves, 3 transformers, and the high-



Stage 1.

resistance 'phones; it will be interesting to observe the simplicity of the connections.

Here we have the nucleus of the whole circuit. Note that the three grids are joined respectively to the secondary of each transformer, the remaining ends of secondary windings being joined together, or, speaking technically, "common."

In Simple Stages

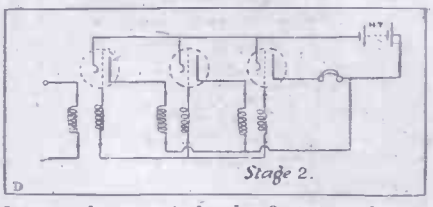
This stage will prove very easy to memorise, and to those who anticipate sitting for examinations in wireless it should commend itself, because later it will be seen that with a slight alteration in the connections a complete wireless receiver may be obtained.

In stage two we shall complete the telephone circuit by showing only part of the filament circuit connections, and the H.T. battery, together with the apparatus as shown in stage one.

Now if we may assume that the switch for the telephone circuit is in the valve and that it is made up of liberated electrons we must liberate them, and as this can only be done by rendering the filament incandescent, a suitable battery must be joined up to them, and this may easily be done as shown in stage three.

Condensers may be introduced perhaps with advantage, in parallel with the headphones and H.T. battery. Omitting the dotted line, we have a 3-valve note magnifier complete.

Referring to the dotted line in stage three, by introducing a grid leak and con-

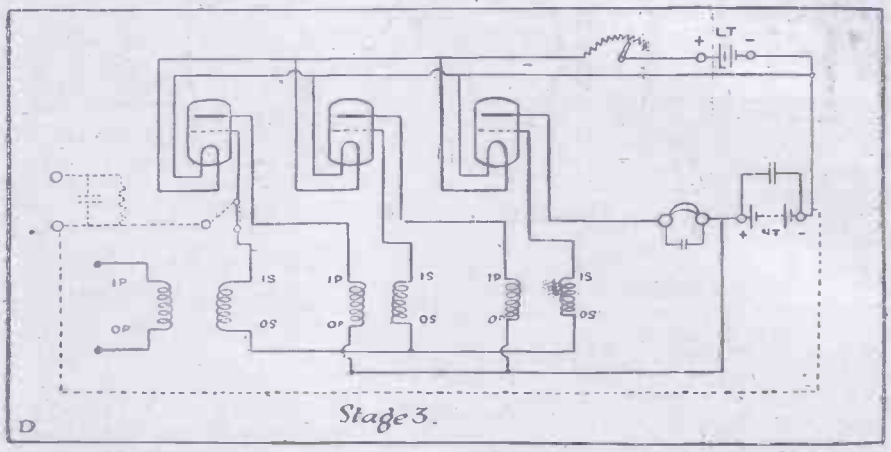


Stage 2.

denser, also a switch, the first transformer may be cut out, and the combination then constitutes a receiver.

For clearness the strokes which represent the iron core of the transformer have been left out.

The simple method shown above applies to the most complicated electrical circuits, and will be found most interesting after a little practice. The student would be well advised to try it, bearing in mind the fact that, although dealing with "wireless," a path must be made for current in his set.



Stage 3.

PICTORIAL VALVE DIAGRAMS

(*Continued from page* 397.)

shunt with the coil as shown in diagram B. It may also be connected in series with the aerial lead-in, in which case the wavelength range of the coil would be reduced. This is often a desirable feature when tuning to the broadcasting wave-lengths on a large coil. The most critical factor in a valve rectifying circuit is the value of the grid leak and condenser, and to ascertain the value most suitable to the particular type of valve in use often necessitates a few experiments with a number of different leaks until maximum results are obtained.

It should not be necessary to suggest that the lead-in wire should be soldered to the aerial and the earth lead to the water-pipe. A natural earth is always preferable where circumstances permit it, and in either case the most important thing is to keep the earth lead as short as possible. The voltage rating of the accumulator and high-tension battery will, of course, depend on the type of valve used.

The high-tension current should be varied, by means of the wander plugs, every time the filament current is varied. Experiments will determine the correct amount of H.T. current to apply to the plate at different filament temperatures.

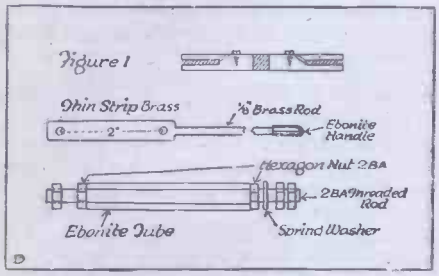
The success of any valve receiver will depend almost entirely on experiments. Several fixed condensers of different capacities should be at hand, and each one tried in turn across the 'phone terminals. The maximum capacities of variable condensers may also be increased or reduced by varying the number of the plates. A small variable condenser may sometimes replace a fixed condenser with advantage. There are many little "dodges" for the valve operator to try. A Mansbridge type fixed condenser, having a capacity of 2 or 3 mfd., will give a still greater increase in volume when connected in shunt with the high-tension battery terminals and often prevent "frying."

AN EXPERIMENTAL FOUR-VALVE SET.

THIS four-valve set has given excellent results with a minimum of trouble.

The construction is very simple, and there are several useful features that will assist the experimenter.

The set consists of one stage H.F. amplifier, one rectifier, and two stages of note magnification. (See Fig. 3.) The L.F.



transformers are "igranic," and give excellent results, and practically all the distortion is eliminated by their peculiar winding process.

The grid-leak and condenser is on the front of the panel under the first valve (see

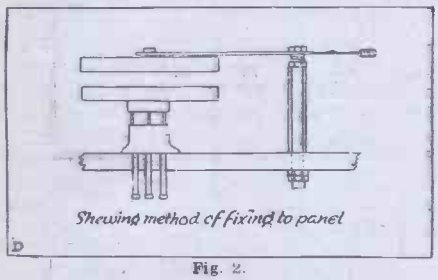


Fig. 2.

photo), and both are interchangeable; the best values being 2 megohm and 0·0005 mfd.

The H.F. Reaction.

The tuning condensers are: 1. ·00075 for the primary (shunting coil); 2. ·0002 for tuning the H.F. transformer primary; 3. Vernier condenser in circuit between the aerial and primary of first L.F. transformer.

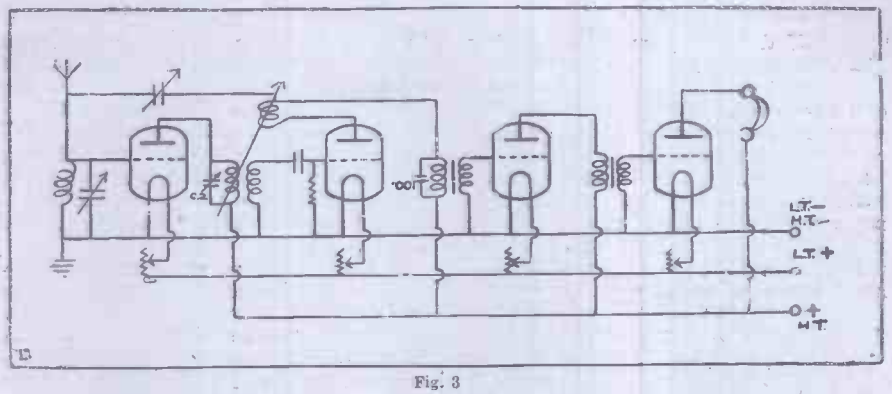


Fig. 3

The reaction is a coil of 60 turns of No. 36 S.W.G. D.S.C., and is splendid in operation, working over the high-frequency transformer and causes no undue oscillation. (See Figs. 1 and 2.)

First cut and turn an ebonite disc 2 in. diameter by ¼ in. thick, and groove about ½ in. deep, as in Fig. 1. Then drill a hole through the centre to take a piece of 2 B.A. threaded brass rod, and drill two very small holes from the outside to the inside of the groove. Two small holes, to be threaded, should also be drilled for 8 B.A. for the coil connections. Then wind with 60 turns of No. 36 S.W.G. D.S.C., soldering the ends to each of the 8 B.A. screws.

BOOKS & CATALOGUES, etc.

AMATEURS who are freshly taking up wireless and who wish to learn something of the theory of the science will do well to read "A Beginner in Wireless," by E. Alexander (Messrs. Drane). This book is very brightly written, and takes the reader over the theory of wireless without making it at all tedious, viewing it all the time from the practical standpoint and including several chapters dealing with the construction of wireless sets. The volume is profusely illustrated by photographs and diagrams, and all who wish to know why and how their set works should read it.

* * *

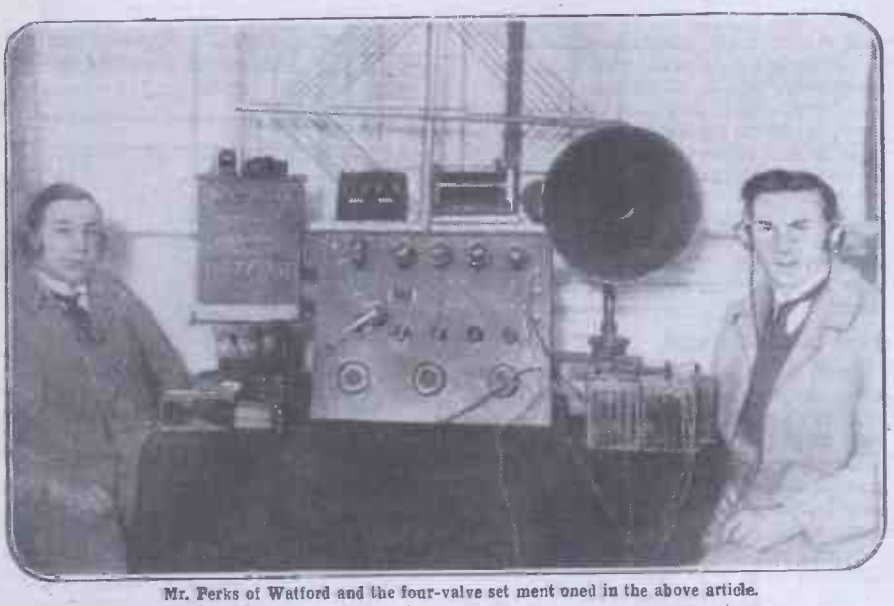
An interesting innovation has been published by Messrs. Simpkin, Marshall, Hamilton, Kent and Co., Ltd., and takes the form of a wireless log-book. This book should be of use to experimental and amateur stations rather than to those who are interested in broadcasting only. A very useful collection of data regarding the transmissions of stations heard in the United Kingdom, and a page setting forth the Eiffel Tower time signals.

* * *

We have received a leaflet from G.W.I., Ltd., Imperial Works, Shanklin Road, Crouch End, N., dealing with the repair of electric light bulb filaments and, what is of more interest to our readers, repair of valve filaments at a moderate price.

* * *

Crystal enthusiasts will do well to try the new crystal "Talite" which appears to be very sensitive. We have tested a sample forwarded to us by Messrs. Harding, Holland and Fry, Ltd., the sole selling agents, and have found it to be very efficient and quite as good, if not superior to any other crystal that we have experimented with.



Mr. Perks of Watford and the four-valve set ment oned in the above article.

A FEW NOTES ON EXPERIMENTAL TRANSMISSION.

By 2 K F.

A FEW details of some successful low-power experimental transmissions may prove of interest in these days of high-power broadcasting. In 1920 the call sign 2 K F was issued with a permit to conduct various experiments in connection with C.W. and radio telephony, and it was from February of that year that these notes were made, although many interesting "stunts" were carried out and much useful work done in the days prior to 1914 with spark transmission.

The first post-war transmission from 2 K F, then at Chelsea, was conducted on a very "freakish" circuit, and using very low power. The circuit is shown in the accompanying diagram, and, although seldom used at the present day, may be familiar to some readers. With a voltage of only 60 from dry cells, using an ordinary "R" type valve as oscillator, a distance of some miles was covered, the receiving station being situated at Forest Hill and two valves being used for receiving.

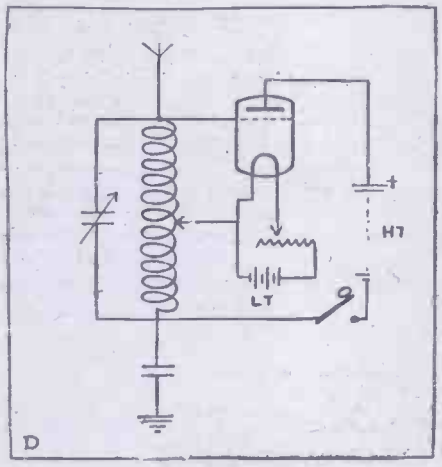
An Interesting Experiment.

The house electric-light supply next claimed my attention, and, after a few minor alterations had been made to the transmitter, this voltage—200 D.C.—was applied direct to the plate, and an aerial radiation of 150 to 170 m. a. obtained on a wave-length of 1,000 metres. Reports of reception of C.W. signals were made from Hull and Reading, and at the first mentioned town only a single valve was used for reception. Telephony was then attempted, using the same circuit, the microphone being connected across a few turns of the A.T.I., and although this method was not thoroughly reliable, it worked exceptionally well the only trouble being due to occasional "packing" of the microphone, an ordinary solid-back type instrument. The telephony was received at distances from 30 to 50 miles, and when jamming was not fierce, for the 1,000-metre wave was in those days a very busy one, reliable communication was carried on with 2 L Z at Wickford and 2 J X at Ilford, two valves being used for reception at each station.

In 1921 the station was dismantled and re-erected at Merton, where a much better aerial was possible and quieter conditions prevailed. The aerial was erected in the garden, and supported by two ex-government masts, each 50 feet in height, being built up with 5-feet steel sections. The aerial consists now of two wires, spaced 6 ft. apart 50 ft. in length, and having a single wire as down lead. This is brought direct to the operating cabin, situated in a hut beneath the aerial, and the earth lead being only 5 ft. or so in length, taken to three copper gauze mats buried 3 ft. in the earth. Having completed these arrangements and run suitable leads from the house-lighting supply plant, experimental work was again commenced. A B.T.H. 600-volt generator was obtained and coupled to a ½-h.p. D.C. motor, and this method of obtaining H.T. current for transmission is still in use.

Several circuits were tried before a reliable circuit was decided upon as a standard transmitter, and this circuit employs grid control for telephony. The circuit is similar to that used by 2 O M and many other London transmitters, and proves to be very reliable and efficient; but much experimental work had to be carried out by the inventor of the circuit (2 O M) before it attained its present state of reliability.

A very interesting experiment was carried out some months ago, using a frame aerial only 3 ft. above the ground for transmitting telephony, a radiation of ·4 ampere being obtained; speech was reported—strength R.3—at Brentford, three valves being used for receiving. Duplex telephony was then attempted, and a voltage



of 100 from the house mains applied to the transmitter, a small outside aerial being used with the receiver.

This experiment proved successful to a certain extent, but difficulty was found at the receiving station in eliminating the noise of the local generator during reception. During a test a call was received from 2 T V at Northampton, who reported C.W. strong and speech readable, and this with only one-watt input. This, however, is by no means a record, for in November of last year an experimental station at Sydenham, 5 miles distant, established communication with 2 K F using a plate voltage of six volts; the speech, although very weak indeed, was clear, and for several minutes signals were exchanged. On this occasion three valves were used at 2 K F, rectifier and 2 L.F. valves.

Heard on the Continent.

Prior to the transatlantic amateur tests, many long-distance transmissions were carried out, and the following reports were received. The first French amateur station, 8 A B, reported signals good on one valve at Nice (800 miles). It may be mentioned at this point that 8 A B has had some wonderful results on the receiving side, and has, I believe, worked 2 J Z at Aberdeen on several dates during the winter. A report was given from an amateur in Glasgow who received 2 K F well on one valve, and similar reports were given from Brussels and Antwerp. A ship's operator whilst in the Channel en route for Plymouth picked up speech from 2 K F, using a rectifier and 2 L.F. valves, and his letter stated that the telephony came in exceptionally clear, and an amateur at Leiden, in Holland, using the same number of valves, also reported speech O.K.

Wireless on Racing Cars.

These results are sufficient to prove that the transmitter is certainly efficient, both when using full and very low power, and the same results are obtained on various wave-lengths between 170 and 440 metres. The aerial, closed circuit and grid coils, for a three-circuit tuner is used, are wound on pancake type formers with Litzendraht wire, and the moving coils are hinged, opening like the leaves of a book. A tuner of this type permits very fine adjustments being made, and the correct point found and retained, it being essential with this type of circuit.

Now, owing to the fact that experimental work has to be carried out after 10.30 at night, and that most amateur receiving stations close down with the broadcasting stations, reports are not so plentiful, but occasionally a letter is received from a distant town reporting reception of signals from this station, and these are always welcome, for they assist experimental work very much.

Recently transmission was effected from a moving car on Brooklands racing track to a receiving station on the Members' Hill, and speech was received quite well, the car travelling at 45 to 50 miles per hour.

The Editor of "Popular Wireless" welcomes photographs of amateur sets from readers, or anything else of particular wireless interest. 10s. 6d. will be paid for each photograph used.

Wireless assists to while away the hours of tedious housework.

CORRESPONDENCE.

To the Editor, POPULAR WIRELESS.

Sir,—I know I am voicing many hundreds of amateurs when I express annoyance at the setbacks occasioned by the misleading advertisements and the uninformed clerks of many radio stores.

Some time back attention was drawn to an advertisement of a crystal set which, it was stated, had received telephony from Berlin, Paris, New York, etc. It is obvious that any crystal set will attain this marvellous degree of efficiency so long as it is installed within, say, 15 miles of a broadcasting station in the cities above mentioned! Nevertheless the advertisement *was* misleading—to novices, at any rate, and these are the people chiefly concerned with the simple crystal set.

And now there are firms advertising the fact that they will construct any kind of receiving set to any specification or will carry out any odd constructional job that the customer is unable to perform for himself owing to being absent from his workshop or through lack of the necessary tools or other facilities.

A few days ago I betook myself by 'bus to one of these places, but unfortunately missed it. As time was pressing, I then took a taxi, and on arriving at my destination asked that four ebonite rods about six inches long should be fixed to the knobs of four variable condensers so as to give to each a long control handle which would stick straight out from the panel.

I was brusquely informed as follows: "Oh! we can't possibly do anything of that sort—quite out of our line. However, we can sell you extension handles which we have in stock, and which strap on to the condenser knobs so that the handles lie in the same plane as the face of the panel." Net result—nothing accomplished, one hour wasted, not to mention 2s. 2d. for 'bus and taxi fare. Some, not all, of these advertisements are obviously meant to attract the unwary to the shop; there is always the possibility of a few spacing washers, etc., being sold.

As to uninformed clerks—well, these might be amusing except for the fact that it is annoying not to be able to get the information one is seeking. They have a great deal of "bounce" which, I suppose, enables them to continue in their jobs unashamed. Day after day they cover themselves with ridicule, being bowled over by questions concerning components which they ought to be able to reply to by virtue of their being the salesmen of the same.

In this respect I might relate my experience at the shop of a firm who have lately put on the market a rather unusual component part with somewhat special features. I made my enquiries and each clerk or salesman in turn, after the initial "bounce" had resolved itself into confusion, handed me on to his immediate superior.

At last I was introduced to the great Mr. X.

"He knows all about it; he's the man you want."

Alas! I heard Mr. X. whisper to a youth to bring him the leaflet, as he could do nothing without it. I can assure you that he could explain nothing *with* it!

Net result—no sale and time again wasted.

At yet another shop belonging to one of our big radio firms I asked to see their ·001 variable condensers. The vanes were beautifully spaced, but very close indeed to one another. Any slight mishap would have caused a short in the condenser. As I required this instrument as a variable by-pass to shunt the H.T. battery and 'phones, it was not desirable to employ a condenser with such a very small margin of safety. Accordingly I informed the salesman that for this reason I feared that the condenser was unsuitable for my purpose. He looked at me very compassionately, and explained that what I needed was a fixed condenser. I begged to differ; whereupon it was conveyed to me that it was ridiculous to employ a variable condenser, in any circuit whatsoever, shunting the H.T. battery and 'phones.

Well, well—I'm not grousing. The uninformedness of clerks and salesmen is not *their* fault, but they might get rid of their "bounce."

Firms with misleading advertisements we all hate.—Yours truly, "OLIG."

Savoy Court Hotel,
Granville Place, Portman Square, W. 1.

A CRYSTAL-VALVE REACTION CIRCUIT.

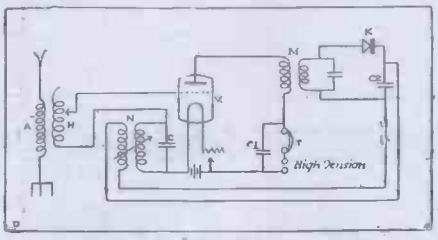
By SEXTON O'CONNOR.

A VERY small percentage of wireless enthusiasts find themselves in the fortunate position of being able to indulge in the possession of a multi-valve receiver. Those lucky enough to live within fifteen or twenty miles of a broadcasting station are generally content to limit their expenditure, in the first place at all events, to that involved in the purchase or manufacture of a simple crystal set.

After enduring a certain period of apprenticeship with the humble hertzite, galena, perikon, or carborundum, as the case may be, sooner or later the inevitable ambition arises to matriculate in the mysteries of the valve, and so to achieve higher things.

Unfortunately the way of the valve merchant is decidedly expensive. There is not only the initial outlay to be considered, but also the equally important question of upkeep. Burnt-out valves must be replaced, accumulators recharged, and H.T. batteries renewed.

Generally, therefore, the next step is to build up or otherwise acquire a single-valve



tuner, and here a certain degree of disillusion comes to the wireless graduate.

Unless reaction is employed (and this is forbidden by the powers that be) a single-valve receiver is very little superior in the reception of telephony to a well-designed crystal circuit.

No Re-Radiation.

Nevertheless, if one is in possession both of a crystal and a valve set, considerably improved results may be obtained by suitably combining the two elements together. In addition much valuable experience and training may be acquired in the elusive ways of wireless.

For example, louder signals can be secured over a given range by inserting a crystal detector between the aerial and the grid of a low-frequency amplifier. In this arrangement the signals are first rectified by the crystal, and are then magnified in volume by the amplifier.

On the other hand, a wider range in reception is given by inserting a crystal rectifier in the plate circuit of a high-frequency amplifier, the grid of which is coupled directly to the aerial. Here the extremely minute quantities of energy received by the aerial are boosted up by their passage through the H.F. amplifier, until they become capable of detection by the crystal.

A third and more advantageous method of combining a crystal and valve is shown in the accompanying diagram. In this arrangement the valve gives double amplification. In the first place it acts as a high-frequency amplifier upon the energy received from the aerial, and in the second place it amplifies the low-frequency impulses back-fed to the grid circuit from the crystal rectifier.

Double Amplification.

It is, from one point of view, a crystal-valve reaction circuit; but it does not infringe the Post Office regulations, in that it does not oscillate and cannot therefore cause radiation from the aerial.

As will be seen from the diagram, the crystal detector K is arranged in a separate circuit, coupled at M to the output from the valve V, and back-coupled at N to the input or grid circuit of the same valve. The telephones are inserted as usual in the plate circuit of the valve.

It will be noticed that the grid inductance is divided into two portions. The part H is coupled to the aerial, and feeds the received impulses to the grid, the high-frequency oscillations being by-passed across the coil of the transformer N by the condenser C.

A similar condenser C1 shunts the telephones and high-tension battery in the plate circuit, so that the amplified high-frequency effects have also a clear path over the plate circuit.

This high-frequency energy is transferred from the plate circuit through a coupling M, which may be shunted by a tuning condenser to the crystal detector K which rectifies it into audible form.

The resulting low-frequency pulses are collected across a condenser C2, and are led through the coupling N back to the grid of the valve. Here they give rise to low-frequency variations of potential on the grid, and reappear in due course in amplified form in the plate circuit, and so pass through the 'phones.

It will be noticed that a double amplification of the signal energy is obtained. First the high-frequency impulses are magnified in their initial passage through the valve, and secondly the detected energy resulting from the amplified energy is again strengthened in its subsequent passage through the relay tube.

As the energy back-fed from the crystal is a low frequency pulse, it will not set the valve into oscillation by reacting with the incoming signal energy, and cannot, therefore, give rise to interference effects by causing the aerial to radiate.

THE CHOICE OF CRYSTALS.

By V. G. E. D.

FIRST of all, let us understand why a crystal is necessary, and then we shall treat it with greater respect, instead of pressing and jabbing it anywhere and anyhow, as it is only by careful adjustment, both with pressure and point of contact, that good results can be obtained.

The minute currents generated in the aerial are of an oscillating nature, and the function of the crystal is to rectify these oscillations and allow them to pass in one direction only to the headphones, which cause the currents to turn into audible sounds.

Galena is a lead sulphide, rather brittle and extremely sensitive. The best specimens show bright bluish-grey faces, which become dull on exposure. Contact can be made with brass, copper, German silver or graphite; very light contact is necessary. Galena resembles molybdenite, but is much harder. The latter crystal is about the only one which can be filed, although, should you want to make a new surface, it is better to peel off a small flake, as it is generally laminated in structure. Contact can be made with a flat silver spring on the flat surface of the crystal, using a fair amount of pressure.

Silicon is not so sensitive as galena, but is more stable. It is a prepared element and light grey in colour. Contact is made with gold, copper, or brass. Zincite is an oxide of zinc, very brittle and ruby-red in colour. Contact is made with bornite, tellurium or copper pyrites, the latter making the best combination, care being taken as to pressure and to see that the "end on" grain is the point of contact, not the flat surface. Copper pyrites is a double sulphide of copper and iron, being brass-yellow in colour.

Bornite is also a double sulphide of copper and iron. A new surface gives a bright dark brown appearance, which changes into many brillian tcolours on exposure. Graphite makes good contact with galena.

Handle Them Carefully.

Carborundum is an artificial substance and extremely hard. Dark steel-grey specimens are the best. Contact is made with a steel spring, using a pressure of about 2 lb., and it is necessary to employ a battery and potentiometer with this combination. Permanite, amaxite, electronite, etc., are all manufactured crystals which give good results, some specimens being extra good. The writer has a piece of one of these which has been worn down to the size of a small pea, and is now only used for "show" purposes, as the results are still exceptionally clear and loud.

A crystal does not magnify, so it is essential not to allow any current to flow to earth before reaching your set, owing to dust or bad connections, as this means a loss of efficiency. Use tweezers to adjust the crystal, as fingering deteriorates it. "Cat whiskers" should be fine gauge (32 or 34), and when out of use do not leave it pressing on the crystal.

WIRELESS CLUB REPORTS.

The Editor will be pleased to publish concise reports of meetings of Wireless clubs and associations, reserving the right to curtail the report if necessary. Hon. secretaries are reminded that reports should be sent in as soon after a meeting as possible. Reports sent in cannot appear in this paper in less than ten days after receipt of same. An Asterisk denotes affiliation with the Radio Society of Great Britain.

Hackney and District Radio Society.*

The weekly meeting of the above society on Thursday, March 22nd, at the Y.M.C.A., Mare Street, Hackney, was of an informal nature. Mr. Ince, a member of the society, brought along his two-valve "Aristophone" set for exhibition and criticism. The general simplicity of the design was admired. Mr. E. F. Walker, ex-secretary of the society, also brought along a five-valve set, sloping cabinet type, which he had made at home, consisting of one H.F. det. and three L.F valves. In appearance and finish this set could compete with professionally built sets. To it was connected an Amplion loud speaker, and for test purposes the window was thrown open and the loud speaker turned facing the street. Within a few seconds of 2 L O's musical strains reaching the street a crowd began to collect. It was noticed that although in the club room the tremendous volume of the music and speech seemed somewhat distorted, from the street there was not the slightest distortion, and every word was clearly heard. Even from the opposite side of the road, nearly 100 yards away, every word was distinct. This unusual test was apparently of sufficient interest to the passers-by to keep them waiting for some six minutes during one interval. Towards the end of the evening the crowd became so great that the test was closed at the request of the police!

Hon. sec., Mr. C. C. Phillips, 247, Evering Road, London, E.5. (Letters only.)

* * *

Warrington Radio Association.

A meeting was held in the Y.M.C.A., Market Gate, Warrington, on Thursday, March 22nd, when there was a good attendance.

Mr. R. W. Taylor, M.P.S., gave a very interesting address on "Crystals and Crystal Detectors, with Suggestions as to Why They Act." Apparatus was displayed which helped to make the lecture all the more interesting. A very hearty vote of thanks was accorded to the lecturer at the conclusion of his address, and a very interesting discussion then followed, the lecturer replying to points which were raised.

Sec., W. Whittaker, Brickmakers' Arms, School Brow, Warrington.

Sutton and District Wireless Society.*

The secretary is pleased to report that the society is making steady progress, both as regards membership and in the character of the meetings held.

At the meeting to be held on Wenesday, May 9th, Mr. G. G. Blake, M.I.E.E., will give a lecture on "Some Historical Notes on Radio Telegraphy and Telephony," which will be illustrated by lantern slides.

Hon. sec., E. A. Pywell, Stanley Lodge, Rosebery Road, Cheam, Surrey.

* * *

Radio Society of Barnet and District.

A number of wireless enthusiasts from Barnet and the surrounding districts met at the Barnet P.S.A. hall on Thursday evening, March 22nd, to discuss the possibility of forming a local radio society. Mr. C. Randall, the Barnet postmaster, himself a keen wireless experimenter, was voted to the chair, and an enthusiastic meeting resulted. It was unanimously decided that a society should be started, and that it should be named the Radio Society of Barnet and District. Mr. J. Nokes, assistant-postmaster of Barnet, was appointed hon. sec., and a small committee was formed.

Those desirous of becoming members should communicate at once with Mr. J. Nokes, whose address is Sunnyside, Stapylton Road, Barnet, Herts.

* * *

North Middlesex Wireless Club.

The 111th meeting of the above club was held on March 21st at Shaftesbury Hall, Bowes Park, N.11, the president, Mr. A. G. Arthur, being in the chair.

The lecturer for the evening was Mr. C. W. Wordham, and he gave a very interesting paper on "Simple Harmonic Motion and its Applications to Wireless." The lecturer made this somewhat technical subject very clear by means of diagrams and every day illustrations—*e.g.*, the pendulum and piston—and showed how the sine curve was evolved. A discussion followed in which many members took part.

The hon. sec. will be pleased to hear from anyone interested in the club.

Hon. sec., Mr. H. A. Green, 100, Pellatt Grove, Wood Green, N.22.

The Kensington Radio Society.*

The usual monthly meeting was held at 2, Penywern Road, Earl's Court, on Thursday March 1st, at 8.30 p.m.

Mr. Norris gave a most interesting paper on his experiences with crystal rectifiers and the various types used. The lecturer proved that the day of the crystal is not quite finished when he exhibited a home-made crystal set on which he receives the Manchester concerts.

The hon. sec., Mr. John Murchie, 2, Sterndale Road, W.14, will be pleased to forward particulars to anyone desirous of joining the society.

* * *

Sunderland Wireless and Scientific Association.*

A meeting of the above association was held on Saturday, March 24th, at Westfield House.

Mr. W. T. Maccall, M.Sc., M.I.E.E., presided. Mr. M. G. Scroggie, B.Sc., of the Univ. of Edinburgh, lectured upon "Some Experiments on Wireless Reception, with Special Reference to Valve Amplification." The lecturer described in a clear and simple manner original work that he had performed in the subject of resistance retroaction. Circuits were described that were very well adapted for note magnification and for recording. Secondly, an extraordinarily sensitive method was described whereby a valve was employed to measure high insulation resistances, and further work will probably lead to the evolution of an inexpensive instrument for practical use far surpassing the existing types in sensitiveness.

Mr. E. Forster proposed and Mr. H. G. MacColl seconded a hearty vote of thanks to the lecturer.

* * *

The Sydenham and Forest Hill Radio Society.

The above society has been formed by an energetic band of wireless enthusiasts, and has now been in existence for some considerable time. Interesting lectures have been given by Mr. M. E. Hampshire on "Sensitising of Wireless Headphones"; Mr. Cox, on "Duolateral Coils," and Captain S. H. Huss, on "Elementary Wireless and Simple Crystal Circuits."

This society caters both for the advanced and the most elementary persons who are interested in wireless. Anyone desiring information on anything appertaining to wireless is most cordially invited to come to the society's meetings, which are held every Monday, between 7 and 10 p.m., at the Greyhound Hotel, Sydenham (in the chess room). They will be most welcome, and any assistance will be gladly given.

Application to be made to the hon. sec., M. E. Hampshire, 139, Sydenham Road, S.E.26.

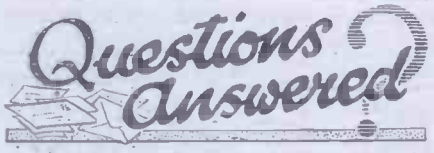
WILL IT BE A RADIO CUP-TIE FINAL NEXT YEAR?

RADIOTORIAL

All Editorial Communications to be addressed The Editor, POPULAR WIRELESS, The Fleetway House, Farringdon Street, London, E.C.4.

Mr. Egan, in the first part of his concluding article, mentioned the importance of efficiency in respect of every component and every individual unit of a receiving station. He supplied a very apt analogy—no other than that of the old saying about the links of a chain. It is a well-known fact that the strength of a chain depends upon the strength of its weakest link, and this fact is embodied in what has now become one of the most well-known proverbs. It may have originated before the days of Confucius, but, nevertheless, it is applicable to wireless in this, the Ether Age, as an extremely apt and "worth remembering" analogy. A receiving set may be efficient and as sensitive as the maker or manufacturer claims, but one corroded aerial or earth connection may cause inefficient reception or even failure. Therefore, it behoves every listener-in to pay attention to detail. The Queries Department of POPULAR WIRELESS receives literally hundreds of letters from readers whose troubles can be traced as arising from what to them must appear eventually to be absurdly insignificant causes. However, it is not my intention to lead readers to believe that the Technical Staff deride such questions. We must all of us pass through the "beginners'" stage, and it is my desire to help those who are doing so. One reader writes to me suggesting that greater attention should be paid to the queries of regular readers than to those received from new readers, and outlines a coupon scheme for such an arrangement. My reply was to the effect that it is the policy of POPULAR WIRELESS to reply to every individual query as carefully as is possible. It may take one of the staff an hour's expert labour, or it may even be necessary to consult an eminent authority in certain rare cases, but what I want to make clear is that the above reader's suggestion is absolutely unnecessary because closer attention could not be paid to old or new readers' questions than is paid to every individual question at present.

THE EDITOR.



Owing to the enormous number of queries received daily from readers of POPULAR WIRELESS, I have temporarily decided to limit the number of questions sent in by one reader to three. Readers are asked to keep their questions as short and as concise as possible in order that the minimum of delay can be exercised in answering queries. Until further notice three questions from one reader will be the limit for one letter. All questions should be addressed to POPULAR WIRELESS Queries Department, Room 138, Fleetway House, Farringdon Street, London, E.C.4.

Readers are requested to send the necessary postage for reply.

The Editor desires to direct the attention of his readers to the fact that, as much of the information given in the columns of this paper is of a technical nature and concerns the most recent developments in the Radio world, some of the arrangements and specialities described may be the subject of Letters Patent, and the amateur and trader would be well advised to obtain permission of the patentees to use the patents before doing so.

A. H. G. (Sidmouth).—I cannot understand how wireless waves can oscillate up and down an aerial when a condenser is placed in their path thus breaking the circuit.

In the first place it is not the ether waves that oscillate up and down the aerial at all, but merely a current caused by the ether waves striking the aerial. This current is caused to oscillate because there is a potential or pressure varying from point to point and moment to moment up and down the aerial's circuit. This rapidly changing potential charges first one side of the condenser positively, when the opposite side will be negative, and then negatively, when the opposite side will be positive, so that the condenser acts very much like a spring, being first compressed and then released. Thus you see that although there is no electrical contact between one side of the condenser and the other, the variation of pressure on one side is transferred to the other side by means of the electro-static properties of condensers, similar to the way in which the pressure applied to one end of the spring can be felt at the other end.

L. R. (Cricklewood).—I have been told that it is not advisable to dip basket coils in shellac or wax. Why is this? If this is so, how can they be held together?

Certainly it is not advisable, although unavoidable with the basket type of coil, to dip them in paraffin wax or shellac. Owing to the fact that both these substances have a greater spec. ind. cap. than air, the operation tends naturally to increase the self-capacity of the coils. This is of course an undesirable factor. However, a fairly thin solution of shellac can be used, and if well drained and the whole securely tied with thread, the resultant increase in self-capacity will be almost negligible.

* * *

"ACCUMULATOR" (Dover).—I have heard of testing accumulators with cadmium as a reliable method. How is this done?

This method is useful when a fair indication of the condition of a cell that has over-sulphated or "sealed" is required. This prevents the voltage reading across the terminals from being a sufficient test of a cell's condition. Therefore to provide a further control a cadmium electrode should be placed in the electrolyte of the cell encased in a perforated glass or rubber tube in such a manner that it is in contact with only the acid. By connecting a suitable voltmeter to the cadmium rod and the main negative plate the following indications are available. If cadmium rod shows ·15 to ·2 volts negative to the main plate, fully charged; but if cadmium rod shows ·25 to ·27 volts positive to main plate, cell is fully discharged. This test should be applied quite independently of the terminal voltage reading of the cell.

* * *

T. D. (Wakefield).—What is a Tungar Rectifier as used in A.C. charging? Is it chemical in action like a Noden valve?

No; the Tungar Rectifier, a patent of the B.T.H. Co., Ltd., is similar in principle to the thermionic valve with the exception that it has no grid. The cathode consists of a low voltage tungsten filament, while the anode is of graphite. The bulb is filled with argon.

* * *

P. H. A. (Dudley).—Why is it that some apparatus which I know to be of foreign manufacture is stamped B.B.C.? I thought foreign wireless apparatus was not permitted to enter the country for two years?

No; this is not the case. There are no restrictions on the importation of the majority of classes of wireless apparatus, but for the most part foreign apparatus cannot be employed under the stamp B.B.C. There are, however, certain exceptions. For instance, all foreign apparatus in stock before the formation of the B.B.C. was allowed to be used up by firms belonging to the B.B.C. under B.B.C. licences.

* * *

I. T. M. (Surrey).—I have a one-valve set employing honeycomb coils with a ·001 condenser in parallel, but I cannot hear Marconi House at all clearly. Why is this?

Your question is not very clear, but we would suggest that provided the grid leak is suitable and the aerial and earth are O.K., you are probably using too large an A.T.I. Try the effect of connecting the condenser in series with the coil in order to bring the wave-length down a little. Also make sure that the valve is getting the correct amount of H.T. voltage and L.T. current. If the variation of these latter fails and the placing of the condenser in series has no effect, try changing the value of the grid leak.

* * *

A. T. C. (Birmingham).—Which is better for telephony reception, a long single aerial or a double one nearly the same length?

We prefer the single aerial for wave-lengths below 500 metres, as the fundamental or natural wave-length of the aerial is not so high as in the case of the double type.

* * *

"AERIAL" (Woodford).—Which is better—a twin aerial of 40 feet or a single one a few feet longer?

We prefer a single aerial if you can have it fairly high, 25 feet or more, and provided it is not less than

(*Continued on page* 412.)

RADIOTORIAL QUESTIONS & ANSWERS.

(*Continued from page 410.*)

50–60 feet long. If you cannot obtain this length we would advise the use of a double aerial, with the wires spaced 4 feet apart and a double lead-in to the set from either one end or the middle.

* * *

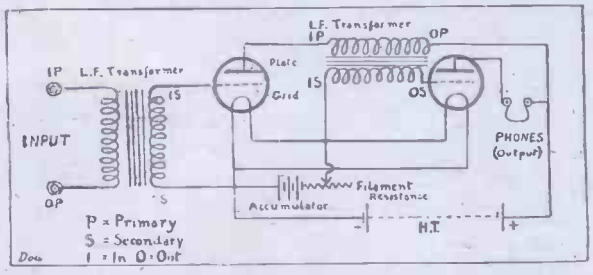
A. B. C. (Harrow).—What size basket coils do I need for 2 L O, Hague, and the Radio-Electrique, Paris?

For 2 L O a coil of about 35 turns will be about right, using a ·0005 mfd. variable condenser. The Hague will need about 130 turns with the same condenser, and the Radio Electrique about 250 turns, as that station has recently raised its wave-length to somewhere about 1,900 metres, instead of the former 1,565.

* * *

"Amplifier" (Wandsworth).—I want to build a two-valve L.F. amplifier to add to my detector panel when I wish to use a loud speaker or magnify weak signals. What is the circuit I should use?

The accompanying diagram will show the wiring up of the two valves and they can be mounted upon a separate panel having their own H.T. battery and accumulator. All the connections necessary for the detector panel will be the two terminals marked "input" (I P, O P) which are connected to the 'phone terminals of the

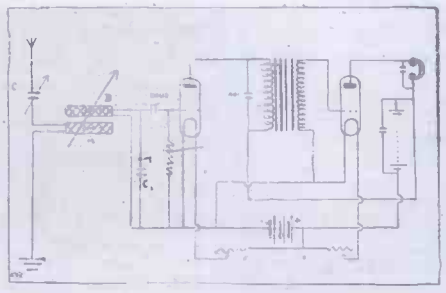


detector panel. The second L.F. transformer should have a ·001 mfd. condenser across the primary, and the phones and H.T. battery should also have fixed condensers across them; but these have been omitted from the diagram for simplicity. These condensers are not essential, though they are advisable in order to obtain the best reproduction of sound. The loud speaker is connected in the place of the 'phones shown in the diagram. The lettering I P, O P, I S, O S, stand for input primary, output primary (beginning and end of primary windings), input secondary and output secondary (beginning and end of secondary windings).

* * *

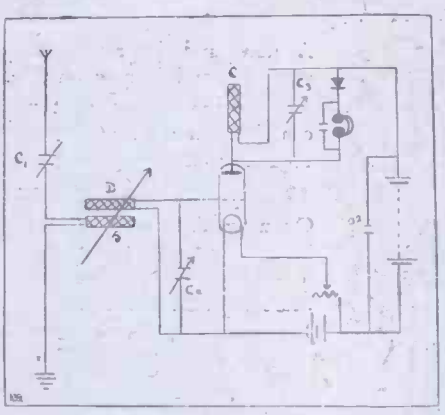
"Two-Valve" (St. Albans).—Will a two-valve set without reaction be of any use for comfortable signal strength from 2 L O?

Yes, as you are only about 20 miles away from London a two-valve set will be quite O.K. The above circuit will give you an idea of the connections for a quite efficient two-valve set without reaction, and, of course, therefore is capable of causing interference. The two coils A and B are of the honeycomb type, and are mounted in a two-coil holder so that the secondary, B, is loosely coupled with the A.T.I. (A). For broadcast wave-lengths suitable coils will be, primary 50 turns and secondary 75 turns. The condenser C is of about ·0005 mfd. capacity, and is in series with the aerial circuit. In the secondary circuit the variable condenser is of ·001 mfd. capacity, the grid condenser ·0003 mfd., and the grid leak about 2 megohms. The latter should be varied until a value is found that suits the valve used as detector.



D. E. R. (Isleworth).—I am thinking of using a dull-emitter valve and a crystal for my receiving set, will that be quite O.K.?

Yes, either a dull-emitter or an ordinary valve can be used for this type of circuit. Your best plan would be to use the valve as an H.F. amplifier as in the diagram.

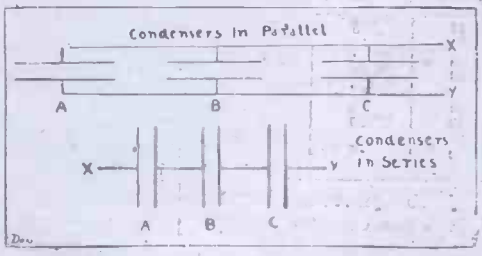


The coils A and B are honeycomb coils of 50 and 75 turns, while C is also of the same type, and should be about 75 turns also. This latter coil may be tuned by a ·0003 mfd. condenser as shown. It may also be coupled back on to B in order to produce a reaction effect, though this is not allowed on broadcast wave-lengths. The above values of coils are for broadcasting wave-lengths, and should be replaced with larger coils for the higher wave-lengths. The best type of crystal to use is one of the treated galena types such as talite, permanite, hertzite and so on. The values of C^1 and C^2 are ·0005 mfd. and ·001 mfd. respectively, while the H.T. battery should be 30-50 volts, and the L.T., in the case of the dull-emitter valve, may be of the dry-cell variety such as the Hellesen "Storm" large capacity dry cell, having a voltage of 1·5 volts. Two of these cells in series will be quite O.K. provided a filament rheostat of about 8 ohms is employed. If the valve is of the very low consumption rate, ·11 amp., then a larger resistance should be used.

* * *

L. I. (Maidstone).—I cannot understand why putting condensers in series reduces capacity when placing batteries in series voltage is increased, or when resistances are placed in series resistance is increased. Surely the capacity of a condenser depends on the voltage it can store?

Voltage or difference of potential will depend upon the quantity that the condenser or condensers can store. This depends upon three things; the



active surface of the plates, the thickness of the dielectric, and the nature of the dielectric. Referring to the diagram you will notice that condensers placed in parallel result in an increase of plate area representing the sum of the plate areas of the individual condensers. Placing them in series, however, results roughly in a thickening of dielectric because only the two terminal or end plates shown in the diagram can be termed active, as the charge from the one to the other must be induced across the dielectric of A from X through the intervening plates and across the intervening dielectrics to Y. Bearing in mind the above remarks the result will be obvious.

Now, with regard to resistances, note the second diagram. In the first case with three resistances in series of 4, 6 and 8 ohms, the current flowing through must traverse each in turn, and therefore the path will represent a combined resistance of 18 ohms between the points X and Y. Now should these three resistances be placed in parallel there will be

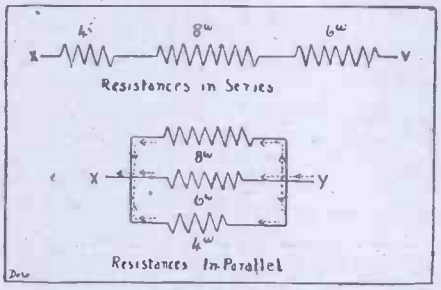
(*Continued on page 414.*)

RADIOTORIAL QUESTIONS AND ANSWERS.

(Continued from page 412.)

three paths presented to the current through which it can divide and pass. The current flowing through each will depend upon the resistance of each and the difference of potential existing between X and Y.

Now Ohm's Law says Current = $\frac{\text{Voltage}}{\text{Resistance}}$, therefore if the voltage is 24 volts the current flowing in each will be $\frac{24}{8}$, $\frac{24}{6}$, $\frac{24}{4}$ i.e. 6, 4, 3 amps. Therefore total current passing through the combined paths will be 13 amps. Ohm's Law stating again that Resistance = $\frac{\text{Voltage}}{\text{Current}}$ shows that the combined resistance will be $\frac{24}{13}$ *i.e.* $1\frac{11}{13}$ ohms. But the rule is that both in the case of condensers in series and resistances in parallel the reciprocals of the separate values added together will equal the reciprocal of the combined value. A reciprocal is a value divided into 1. Thus in the case of the resistances in point $\frac{1}{4} + \frac{1}{8} + \frac{1}{6} = \frac{13}{24}$, $\frac{13}{24}$ being reversed = $\frac{24}{13}$ = $1\frac{11}{13}$ ohms. To get a clear idea of the points at issue regard a conductor as having a value of conductivity which *increases* when conductors are placed in parallel, allowing more current to pass, and decreases when they are placed in series.



* * *

J. H. G. (Hampstead).—I have a crystal set tuning up to 3,000 metres. Could I hear the Paris time signals sent at 9.30 every morning? How are they sent?

Yes; you should be able to hear them quite easily, but they are sent at 9.25, not at 9.30. At 9.25 the station sends in Morse the words "Observatoire de Paris," followed by three I's. Then there is a pause until 9 hrs. 26 mins, 10 secs. Then three dashes are sent out, the last dash ending at 15 seconds after 9.26. Then follows a pause of 5 seconds, followed by three more dashes taking up another 5, another pause of 5 seconds and then at the half-minute mark the long dash is sent out, followed by three more dashes from 35 to 40 seconds, another space of 5 seconds, another three dashes taking up another 5 seconds and a pause of 10 seconds. At 9.27 the letter X is sent out every 5 seconds until the last is sent out 45 seconds after the minute. There is a pause and then at 55 seconds three dashes are sent out, the last dash ending exactly at 9.28. Then there is a pause of 7 seconds when the letter N is sent out, the dot coinciding with the 10th second; this is repeated every 7 seconds (the dots therefore coming on the 10th, 20th, 30th, 40th and 50th second), after which there is a pause of 5 seconds when three more dashes are sent out, the last ending at 9.29. Six seconds afterwards the letter G is sent out, the dot coinciding with the 10th second, and this is repeated every 6 seconds, the dots coming on the 10th, 20th, 30th, 40th and 50th second, when there is a pause of 5 seconds followed by three more dashes, the last ending at 9.30 exactly. The station then sends the "finish" sign, followed by the letters F.L., followed by the "end of transmission" sign.

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RECENT WIRELESS INVENTIONS.

The following abstracts are published by arrangement with our Patent Adviser, Harold J. C. Forrester, Chartered Patent Agent, of Jessel Chambers, 88-90, Chancery-Lane, W.C.2.

Grant of the following Patents can be opposed, and printed copies of the full specifications, with drawings, can be purchased from our Patent Advisers.

193,010.—C. LORENZ AKT.-GES.—VALVE RELAYS.—A transformer in the plate-telephone circuit has its primary winding shunted by a capacity and inductance in series. This circuit is tuned to the higher frequencies beyond the speech range so that such energy is by-passed instead of being amplified across the transformer. Whistling and similar noises are thus eliminated without resorting to complicated filter circuits.

193,203.—P. C. RUSHEN.—TOY WIRELESS SETS.—The electrodes of a spark gap are badly insulated by a thin layer of varnish, enamel, or metallic oxides, and placed very nearly in contact so that only a low tension is used. The electrodes may consist of scythe-shaped strips eccentrically pivoted so that the gap can be adjusted. Instead of coating them, resilient strips of magnesium ribbon may be secured to them by clips. A crystal detector is connected by a resilient arm to a turning knob, and the "cat's whisker" consists of a resilient pointer also carried by a turning knob.

We have arranged for Patent Enquiries addressed to our Patent Adviser to be answered direct by post, any enquiries of general interest being also answered in our columns.

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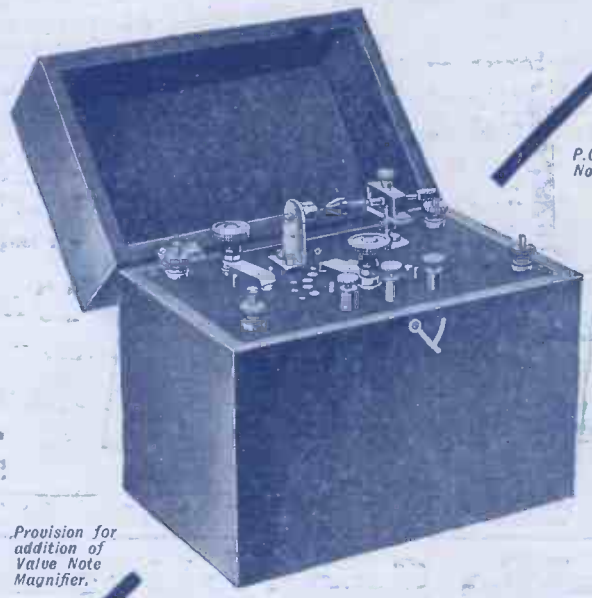

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