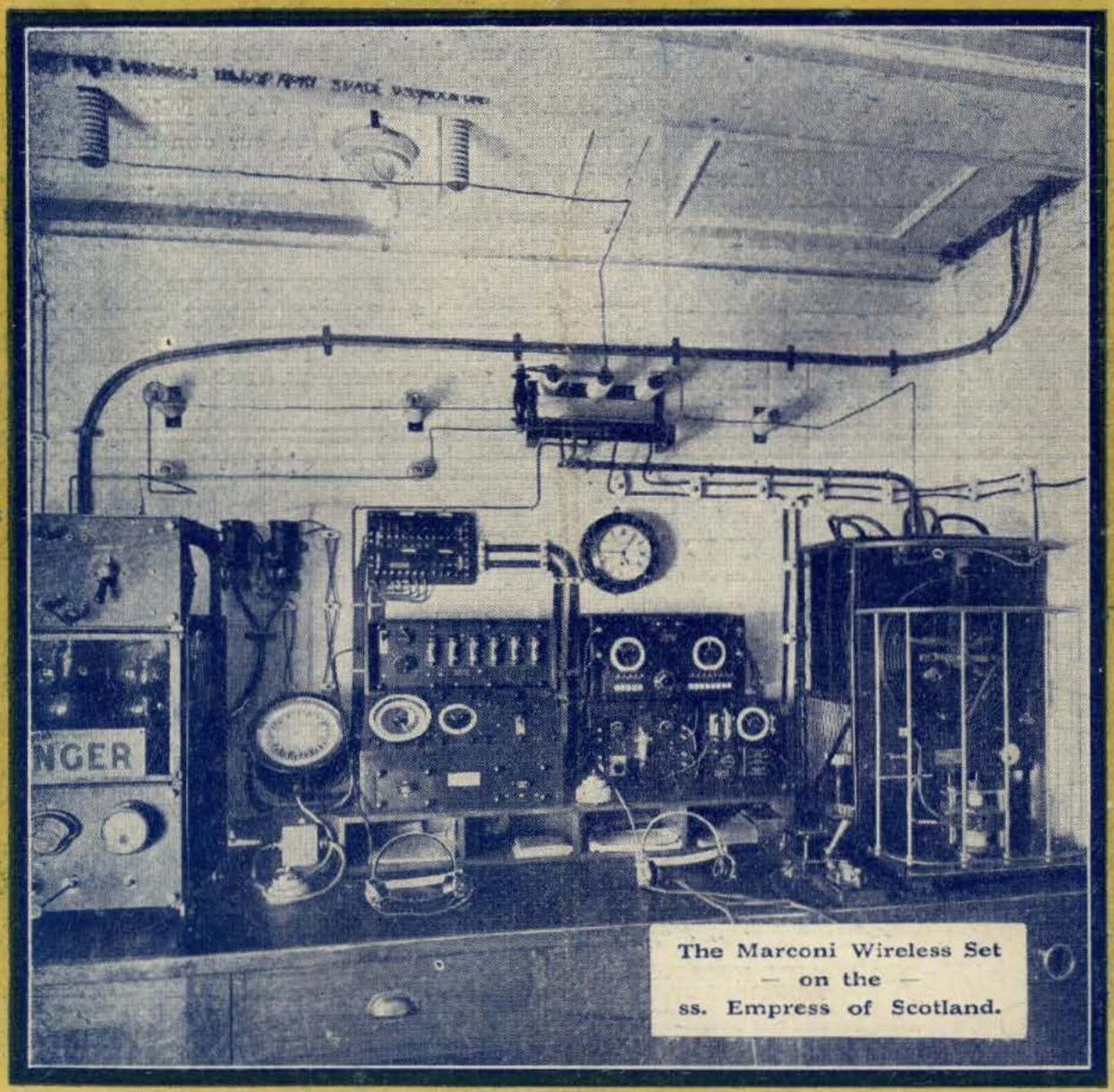
POPULAR WIRELESS WEEKLY, MARCH 10, 1923. REGISTERED AT THE G.P.O. AS A NEWSPAPER.

WIRELESS AT THE EXHIBITION (THE REVIEW CONTINUED)

Popular Wireless

No. 41. Vol. III. PRICE THREEPENCE WEEKLY. March 10th, 1923.



The Marconi Wireless Set — on the — ss. Empress of Scotland.

FEATURES IN THIS ISSUE.

A Vernier Condenser. | How to Make a Fixed Condenser.
Practical Tips on Aerial Construction. | A Unit H.T. Battery.
Another Article by Sir Oliver Lodge (Scientific Adviser to "Popular Wireless").
A Four-Page Beginners' Supplement.
Constructional Hints to Amateurs and many other interesting articles.

POPULAR WIRELESS

March 10th, 1923. SCIENTIFIC ADVISER, SIR OLIVER LODGE, F.R.S., D.Sc. [Every Friday.

TOPICAL NOTES AND NEWS.

The New G.E.C. Laboratories.

THE other day I had the pleasure of attending the opening of the new research laboratories of the General Electric Co., Ltd. The new laboratories are situated at North Wembley, and are a triumph of lavish detail and efficiency.

It is impossible to give an adequate description of the many experiments I witnessed, but in future articles in POPULAR WIRELESS I hope to record many interesting impressions.

* * *

Sir Joseph Thompson.

AMONG the speakers at the opening ceremony were Sir Joseph Thompson, O.M., F.R.S., Master of Trinity, and the Right Hon. Lord Robert Cecil, K.C., M.P.

Sir Joseph Thompson recounted how the Chancellor of Cambridge University (the Duke of Devonshire) once came round the laboratory, and was shown some experiments with electrons. All he said was, "Have you patented it?"

"It was extraordinarily difficult," said Sir Joseph, "to judge what might come out of a new invention. The best informed made great mistakes in their estimates. Kelvin, asked to join the first wireless company, said that he had wanted to make the condition that the capitalisation of the company should not exceed £100,000, because 'that seems the utmost amount of capital that can find useful employment in wireless telegraphy.'"

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5,000 Volts D.C.

I WAS very interested in the valve-test room, where I saw a transmitting valve enjoying a pressure of 5,000 volts D.C. on its plate! After a few seconds of this the plate became red-hot, and I backed away to safety. But nothing happened!

* * *

Wireless and the Deaf.

THERE have been numerous incidents reported lately of people seemingly deaf to ordinary conversation who are able to hear wireless signals quite easily. Among the theories advanced to explain this is that the condensation of the sound waves which in the case of ordinary headpieces are directed straight into the ears, tends to act in the manner of an ear-trumpet, as it were. Another feasible explanation is that the headpieces pressing directly on the skull-bone transmit to it the vibrations of the diaphragms mechanically. The third, detailed in an article that appeared in a daily paper, is that our bodies vibrate to the ether waves. Evidently the writer is unacquainted with the difference between radio and audio frequencies. In any case, fancy vibrating 1,000,000 times per second! I would wager that even the inimitable "F.W.T." did in no way approach this figure when he broadcasted recently, even although, as he told me, he had "an unholy wind-up."

* * *

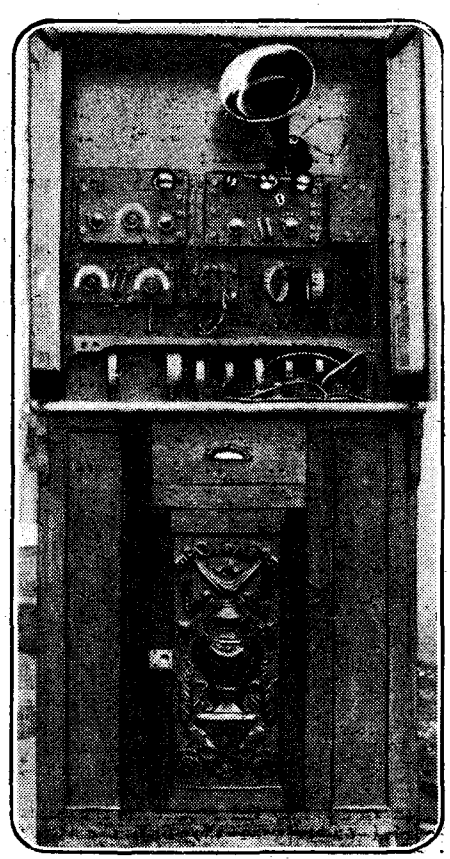
Radio for Miners.

CANNOCK miners enjoy the pleasure of wireless broadcasting while on their week-end jaunts by charabanc, through the initiative of Mr. A. P. Sanders, of Chasetown, who claims to possess the first charabanc in England fitted with wireless. On the roof there are cycle rims fore and aft on the naval aerial plan, and between the two rims, 15 ft. distant from each other, there are five separate wires, thus giving a total aerial of 75 ft. The earth wire runs through the chassis. A Burndept four-valve set and loud speaker are used.

* * *

A Wireless Dance.

A WIRELESS dance was held recently in the Town Hall of Kendal. The set used was lent and operated by Mr. C. A. Reiss, one of the pioneer British amateurs. It consists of seven valves, with three stages of "power valve" amplification. The filaments of these valves take 2 amps. at 24 volts, with 400 volts on the plate. Mr. Reiss tells me that he made the music audible throughout the large hall. That, from what I know of this worthy and energetic amateur, would indicate that he obtained "*some* vibration."



A Home-made Cabinet Receiver by Mr. C. H. Mauger, 31, Shandeloss Rd., New Cross, S.E.

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Encouraging Wireless.

AT a council meeting of the Central Associated Chambers of Agriculture, Sir Douglas Newton, M.P., suggested that wireless should be more extensively employed in the broadcasting of early meteorological information. He said that he thought that they would be doing much better as a chamber if they concentrated on getting the present restrictions on wireless sets reduced or completely abolished, and their general use in rural districts encouraged.

* * *

At the Exhibition.

EVEN apart from the most interesting wireless section that is this year included, I have always considered that visiting the "Daily Mail" Ideal Home Exhibition is one of the pleasant necessities of life. I must confess, however, that when I dropped into the Olympia the other day for a couple of hours, most of my time was spent in the gallery looking round the stalls devoted to wireless gear. The display is most attractive, and everyone interested in matters radio should make a point of going along to see the stalls. Wireless is one of the new and most progressive of the sciences of this most progressive age, and the radio exhibitors have fully carried out the spirit of "progressiveness" in their display. For those who will go along and apathetically wander up to the gallery expecting to see a series of plain benches covered with coils and condensers and other oddments, there awaits a most pleasant surprise.

* * *

The Wireless Concert.

NEEDLESS to say, I found a few spare moments to drop into the large hall devoted to wireless concerts. When I arrived there were fully a thousand people intently and interestedly enjoying some items from 2 L O. The reproduction was excellent. I had half expected that the loud speakers would prove too "gramophony" to create a very good impression, but after listening to the items from different parts of the hall I have no hesitation in saying that it is as yet the best thing in loud-speaker work that I have heard. The apparatus is concealed by large curtains, through which project two loud-speaker horns, and judging from remarks that I

(*Continued on next page.*)

NOTES AND NEWS.

(*Continued from previous page.*)

overheard, quite a few people believed that the performers were actually behind the curtains instead of in the studio of the London Broadcasting Station some few miles away!

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"Popular Wireless" Stall.

HUNDREDS of amateurs, both advanced and otherwise, have visited the P.W. stall to obtain advice from the experts that are constantly in attendance. And hundreds of others have stopped to examine the interesting exhibits that are to be seen under the P.W. "canopy." "Freak" sets and first-class apparatus made by readers are included, and, last but not least, there is on view the famous 6-valve portable Marconi set which I have used on those interesting "stunts" which have been chronicled in P.W. Don't forget to pay a visit to the P.W. stall when you visit Olympia and collect your copy of an "Outline of Wireless," which is a complete 24-page illustrated magazine—same size as P.W.—written by the Editor of P.W. and other experts specially for the beginner in wireless.

* * *

A Correction.

IN the issue of POPULAR WIRELESS No. 40, week ending March 3rd, a regrettable misprint occurs in the advertisement of L. T. Hall, of 18, Leamington Street, Golden Square, W.1. The Sterling 4,000-ohm headphones are 32/- per pair and not 12/- as quoted.

* * *

Another Wireless Concert.

THERE was a large attendance at the Ripon Hall recently when a wireless concert was given. The orchestral items, in the opinion of the experts present, were perfect, being heard outside the hall as the volume was large. The time signal from Eiffel Tower, Paris, caused some amusement, and the watches of the audience were calibrated by it.

* * *

Dispensing with the Microphone.

IN the Thomas transmitter, a recent American invention, a minute electrical discharge takes the place of the mechanical disc-microphone. This discharge flows between two points, separated by a very small fraction of an inch. It is affected by sound waves, just like the diaphragm, but being non-material and having no perceptible inertia, it responds equally well to all vibrations. Hence, it is claimed, music broadcasted by means of it is transmitted in all its original purity.

* * *

Radio Association.

THE Birmingham branch of Radio Association was successfully inaugurated recently. A strong committee was elected, and there is every prospect in the near future of this branch taking the lead in local radio affairs. The hon. sec., W. J. Butler, 15, Algernon Road, Edgbaston, will be pleased to hear from prospective members.

ARIEL.

The latest photograph of Professor A. M. Low.

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 ..	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	5NO ..	400 ..	As a rule from 7 to 10 p.m.
Manchester Broadcasting Station	2ZY ..	385 ..	Every evening, usually from 4.30 to 10 p.m.
Birmingham (Witton) Broadcasting Station	5IT ..	425 ..	Every evening, usually from 6.30 to 10 p.m. (News, Concerts, etc.).
Glasgow Broadcasting Station	5SC ..	415 ..	Commencing shortly.
Cardiff Broadcasting Station	5WA ..	353 ..	5 to 10 p.m.
Croydon	GED ..	900 ..	Throughout day to aeroplanes.
Paris	FL ..	2,600 ..	11.15 a.m. Weather report; 6.20-7 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 p.m. (Concert.)
Haren	OPVH ..	1,100 ..	12 o'c. and 16.50 o'c. 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, 7.45-10 p.m. Saturdays, 4.30-7.30 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 are G.M.T.

SOME WIRELESS OBSERVATIONS.

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

This is the second of a series of articles, primarily intended for the experimenter and research worker, written specially for POPULAR WIRELESS by our Scientific Adviser. The Editor will be glad to hear from experimenters giving their views on subjects suitable for future articles on this page.

PART II.—CONDITIONS FOR MAXIMUM INDUCTANCE.

THE conditions under which a coil can have maximum self-induction (or inductance) for a given length of wire seem to have been laid down by the great mathematician Gauss, in or about 1865, but in what form that can have been done then I do not know. Anyhow, Clerk Maxwell, in his great Treatise, published in 1873, gives a number of complete formulæ for self-induction, and clearly specifies the condition for its maximum. He evidently paid great attention to the subject of mutual and self-inductance, being probably stimulated thereto in connexion with his early determination of the absolute value of the ohm (or British Association Unit, as it used then to be called).

The first condition is that the winding should be as compact as possible, so as to bring every part of the wire as close as may be to every other part, so that as many as possible of the lines of force due to each may thread the others. That will be achieved by making the section of the wound space in the bobbin of the coil either round or square, not oval or oblong. That much is pretty obvious because that is the most compact shape; but it is not at all obvious how big the diameter of the coil should be, in proportion to the size of the channel which contains the winding. That is what has to be worked out mathematically.

Although the working out may be considered complex, the result can be stated with great ease. Taking the channel for the wire as square, the outside diameter of the coil must bear to the inside diameter the ratio $\frac{4}{2}\frac{7}{7}$, which for all practical purposes is the same as $\frac{7}{4}$, or $1\frac{3}{4}$. Hence the shape of the coil which gives maximum self-induction can be expressed in these figures: the breadth and depth of the winding 3, the internal diameter 8, and the external diameter 14.

"Banked" Coil Arrangemen's.

We may take that as granted, and in this shape the coils employed in wireless telegraphy ought to be wound (though they seldom are), no matter whether the turns are packed close together or not. That is the best and most efficient shape; and by adhering to this shape—other things being equal—the deleterious capacity and resistance in the coil are reduced to a minimum.

It need not be supposed that the shape must be very precisely adhered to. It is a common property of maxima and minima that a slight fluctuation on each side makes but a small difference. That shape is the ideal to aim at, but some variation is allowable.

For instance, suppose, having got one coil, we want to put another alongside it n series with it, the self-induction will be immensely increased by an amount which is quite well known if the positions are given. But the shape will no longer be the best. Still, the difference is not very important; and something like the best shape can be restored by having four coils instead of two, and putting them in pairs side by side, with one pair big enough to fit over the other. Numbering the four coils 1, 2, 3, 4, it will be best to connect them together in that order, so that the extremities of the wire, at which the greatest difference of potential will occur, are as far separated from each other as may be. The connexion 1, 2, 4, 3 or 1, 3, 4, 2, is slightly less desirable.

Studying Length and Breadth.

The effect of putting one coil outside another, instead of side by side, is only that the mean radius of the whole winding is increased somewhat; otherwise the expression for the self-induction is the same in the two cases. It is as broad as it is long, so to speak. Or, rather, whether the length exceeds the breadth, or the breadth exceeds the length, makes no difference. That is not obvious, but so it comes out from the formula, which is symmetrical as regards length and breadth of cross-section.

The advantage of a combination of coils like this is that it enables the wave-length to be easily changed; that is to say, it enables a coil to be selected which shall give approximately the order of wave-length required, fine adjustments being done by means of supplementary adjustable capacity, or by an adjustable separate self-induction, or both. But we will not trouble about these tuning details, which are quite well known and understood.

Although I have emphasised the value of a maximum self-induction shape, such considerations must not be allowed to override practical convenience; and, instead of packing multiple coils into a square section it is usually much more convenient to arrange them either side by side, or one outside the other. That is to say, to arrange them so as to form either a cylinder or a disc. And, again, such an arrangement has an advantage; for, though the self-induction will be less than it might be with a given length of wire, the terminals are thereby kept far apart, and the capacity therefore is diminished, too.

Hence I do not propose to consider any arrangement except one or other of these plans for multiple coils. When we are dealing with the single coil, however, there is no question but that the best shape is as stated above, viz., external diameter 14, internal diameter 8. Further details about this we will consider later.

(Another article by Sir Oliver Lodge next week.)

AN ACCUMULATOR TIP.

BOTH the "creeping" and spraying of the electrolyte of accumulators while under charge, and when in use, can be absolutely prevented by covering the acid with a layer of black coal oil. About $\frac{1}{8}$ in. deep will suffice. It does not prevent the necessary free gassing, but, curiously enough, destroys the rather offensive odour given off by cells on charge. No other oil will satisfactorily replace black coal oil for this purpose.

The re-erected cabin of H.M.S. Impregnable now serves as a demonstration-room for Messrs Autoveyors

SOME PRACTICAL TIPS ON AERIAL CONSTRUCTION

By R. A. RICHARDS

ON certain points encountered in erecting a wireless aerial one finds articles to which one refers for instruction extremely reticent. Thus, while the various types of antennae are exhaustively dealt with from the point of view of connection and position, accompanied by copious line diagrams, few really practical hints are found. This article aims to describe the salient features of an aerial that has been erected in an exposed position and is intended to face all weather conditions.

I will deal first with the indoor work—the equipping of the two spreaders. These were not of the purchased variety, being merely bamboo curtain poles six foot six inches long and about two inches in diameter.

The ends were first plugged and filed clean and finished with a protective dab of varnish. Next, at about an inch from either end of each pole a hole was drilled to accommodate a galvanised iron eyebolt. Two similar holes were made on each spreader at about an inch distance from either of these. The bolts used had each two nuts, that they could be screwed rigid to the spreaders, and they were inserted and fastened with the two inside bolts facing in the opposite direction to the outside.

Now to secure anything in the nature of a permanency in an exposed construction such as this, rope and cord must be avoided as far as possible, only the very best quality being used at any time. Where possible, use wire. This last was the maxim used in the fitting of the antennae described.

With this in view a coil of six-stranded galvanised iron wire and a small reel of single strand galvanised wire were bought.

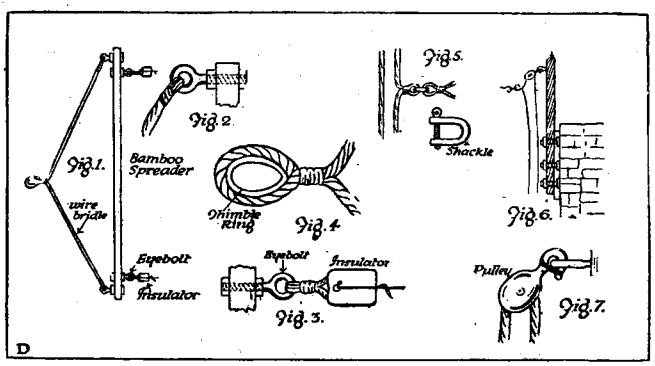
A length of the thicker wire was arranged to form the bridle to each spreader, the lengths being arranged so that the middle of each could be stretched out to a distance of a little over a foot from the spreader when about three inches was hooked through each further eyebolt (Fig. 1).

Useful Halyard Hints.

The middle of each length was then tightly looped round a small galvanised thimble (Fig. 4) and secured with a number of turns of the thin wire to bind it in place. The ends of the bridles were then unravelled for a distance of about six inches and, after passing through the eyebolts as when measuring off, the loose strands were meshed together and securely bound with neat coiling (Fig. 2).

To the two inner eyebolts of each spreader insulators were attached, and the method of fastening those may be gathered from Fig. 3. In this case pillar insulators were used, but any type may be fastened in the same way, *i.e.*, by threading wire in and out through the holes in the insulator and the loop of the eyebolt in the form of a figure 8, finishing up with a number of turns round the waist of the 8 and twisting the two free ends of the wire.

The two spreaders are now complete, and the next concern is their fitting to their respective supports. Fig. 5 shows how the thimble in the bridle was joined by shackles to a similar thimble in an endless halyard passing through a pulley and fastened by a cleat. The best hempen rope should be used, as it lasts; and sail-makers' twine used for binding round the thimble in the same way as wire was used on the spreader bridle.



Another tip is illustrated in Fig. 7, which shows a pulley hooked into an eye and wired across to prevent it jumping off. Fig. 6 shows the halyard system, and also the best method of fixing a post to a chimney stack. First a length of 3 in. by 3 in. wood with recessed holes containing bolts is nailed to wooden fillings between the bricks, and to the projecting bolts is secured the post with drilled holes to receive them, then nuts and washers are screwed on, and the post is clamped to the chimney.

MAKING A FIXED CONDENSER.

MANY amateurs prefer, if possible, to make their own apparatus, and a very good start may be made by making two or three small fixed condensers. They are very easy to make and are well worth the time expended. One will here be described, and others may be made that will only differ in the number of plates and separators used.

First you will require two pieces of ebonite about $\frac{3}{16}$ in. thick. One piece will

Fig 1.

be one and three-quarter inches by one and a quarter, the other will be exactly one and a quarter inches square. The larger piece will have three holes $\frac{1}{8}$ in. diameter at each end, and the smaller will have a hole at each corner to take the screws that will be used.

Fig. 2 shows the position of the holes. Then cut, say, a dozen tinfoil plates (or copper if you have it), as in Fig. 3. They are one inch square, and have a quarter inch square lugs. Now for the separator, or what is technically known as the di-electric.

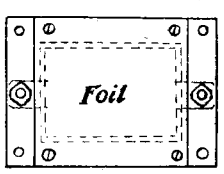


Fig 2.

This should be as thin as possible, and may be paraffin-waxed paper, or, better still, very thin sheets of mica.

To assemble the condenser it is as well to just smear a little wax on the mica. The paper, or mica, should be one and a sixteenth inches square. Carefully stick a tinfoil to each sheet so that there is a margin all round (as shown in Fig. 2: dotted lines).

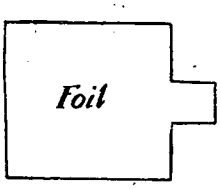


Fig 3.

Do eleven like this and place the first one on the larger block so that the lug lays over the centre hole.

The next one goes on top of this, but with the lug in the opposite way, the separator on top of the first foil.

This is repeated, each one having its lug laid alternately in the opposite direction, so that when the whole condenser is finished you will have six lugs on one side and five the other: but remember that they must be alternate.

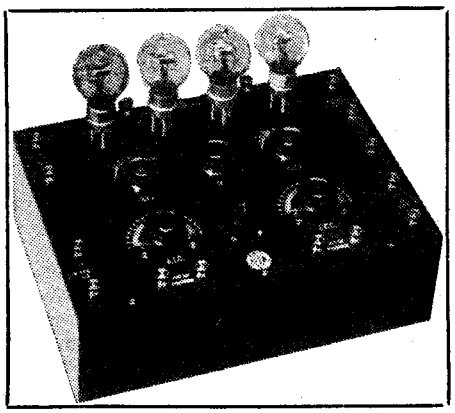
Now fasten the smaller block down with four screws that should have been arranged with regard to thickness, and holes made to receive them. When screwed down fairly tight, warm the whole by holding it near a gas flame or any form of heat that will allow the whole plates and separators to squeeze very much tighter together. Now carefully make a hole through the lugs. Pass a brass bolt up from underneath the side and put a small brass washer on before screwing down the nut. Another nut will be wanted to act as the terminal to take your connecting wires. Repeat this on the other side and your condenser will be ready for use.

POPULAR WIRELESS EXHIBITION REVIEW.

A Continuation of last week's Summary of the Wireless Exhibits at the "Daily Mail" Ideal Home Exhibition, Olympia.

GENERAL RADIO CO.

The display of Radio apparatus in the G. R. C. stand at the "Daily Mail" Ideal Home Exhibition will enable the visitor to choose a receiving set which will exactly suit his purse and purpose. From the smallest Crystal Sets to the most elaborate Drawing Room Cabinets with semi-automatic control, and a complete range of parts, including the famous "Brandes" Headsets, will be on view.

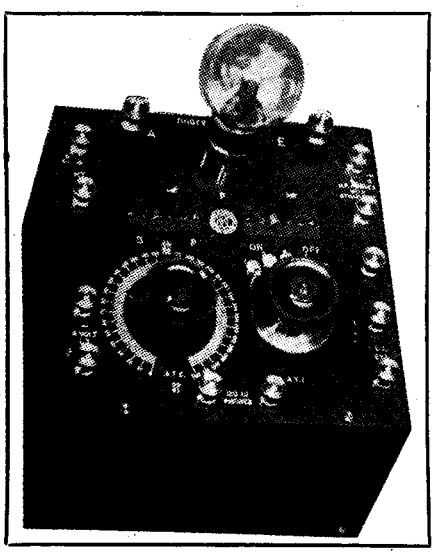


Four-valve Broadcast Receiver by Messrs. Tingey, Ltd.

The General Radio Company manufacture the most complete line of Broadcast Receiving apparatus made, and every part is produced throughout in their Twyford Abbey Works by skilled workmen of long experience. The outstanding features of the G. R. C. Receiving Sets is their simplicity of operation, excellent finish and apparent simplicity.

An exhibit of special interest to all visitors will be an enlarged photograph of the Prince of Wales transmitted by wireless by the new method of electrical transmission of photographs invented by Captain W. S. Stephenson, M.C., D.F.C., M.I.R.E., the Chief Engineer of the General Radio Company.

This system was developed for the exclusive use of the "Daily Mail" in Great Britain.



A One-valve Tingey Broadcast Receiver.

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RADIO COMMUNICATION CO.

This well-known firm is showing "Polar" 7-valve Long Range Loud Speaker Receiving Sets both in sloping ship's panel form and complete in sectional book-case cabinets. "Polar" 4-valve Short Range Loud Speaker Receiving Sets in the two arrangements above. "Polar" 2-valve Receivers with additional 2-valve L.F. amplifications if required. "Polar" Crystal Sets.

Various "Polar" accessories, including the now famous "Polar" Condenser, and also two interesting new specialities which we are just placing on the market: viz.:

"Polar" Cam Vernier Coil Holders, a design in which, in addition to the ordinary adjustment of the moving coils, there is available a fine adjustment for about 10° at any given position of the coil. This fine adjustment is controlled by the same handles and renders it easy to obtain extreme accuracy. The precision which this small accessory secures will, we are confident, render it a necessity to amateurs who are aiming at long distance reception.

"Polar" H.T. Battery and filament circuit fuses. These special fuses have been perfected by our engineers. They resemble the familiar American automobile fuses in appearance, but have filaments of special alloys which will carry continuously the maximum currents required by valves for which they are designed and which infallibly blow before the valve filament reaches fusing point. In addition they have the quality of fusing considerably below their normal carrying capacity under suddenly applied currents, so that they afford an infallible protection against H.T. shorts, protecting at the same time the valve filament and the H.T. battery from the effects of these.

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METROPOLITAN-VICKERS CO., LTD.

The Metropolitan-Vickers Electrical Co., Ltd., are exhibiting the Cosmos Radiophones, which are 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. All the sets have been approved by the Postmaster-General, and may be used under ordinary broadcasting licences.

The Cosmos Crystal Set, within a short distance of a broadcasting station, gives reproduction as perfect as can be obtained with any more expensive sets, headtelephones being used. In case it is desired to use a loud speaker with the crystal set, an inexpensive and very compact valve-amplifier is supplied which fits into the box of the crystal set, thus forming a simple crystal and valve set combined. The Amplifier is made in two forms, with one and two amplifying valves respectively.

The Cosmos Valve Set is built up of units, enclosed in an outer case of exceptionally handsome appearance. The Tuner Unit (including one high-frequency and amplifying valve and one detecting valve) and the Battery Unit (containing high and low tension batteries) form a complete receiving set, and are connected up by a single plug connection. A two-valve note-amplifying unit may be added, and this again is connected up by a single plug. The plugs are so connected that they cannot be inserted the wrong way. All the units mentioned fit into the standard outer case. This case is, moreover, arranged so that it will fit upon a cabinet into which are built a loud speaker and horn, thus forming a self-contained "loud-speaker set." Cabinets of more elaborate design are supplied to suit any style of furniture or decoration, and an example of a Jacobean cabinet is exhibited.

A useful accessory is the Cosmos Protective Device, which avoids the necessity for earthing the aerial after using a wireless receiver, since it affords automatic protection against lightning and heavy currents. Between the aerial and earth

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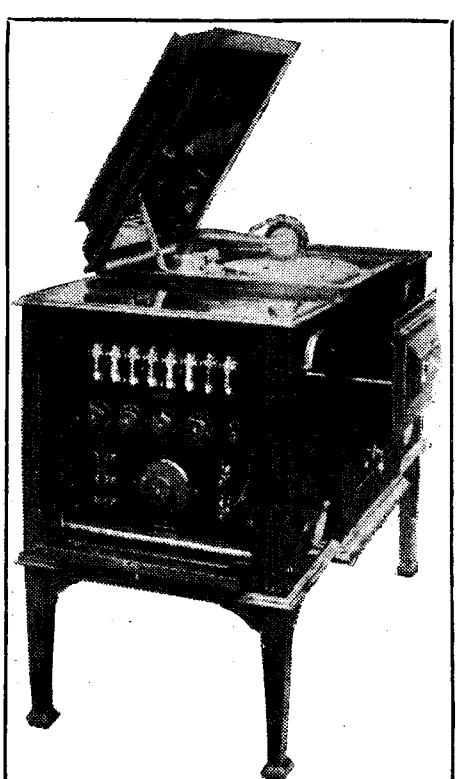
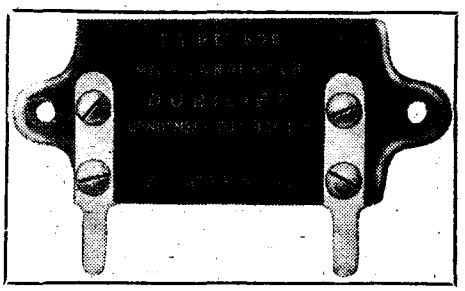


A Handsome Cabinet Set by the Marconi Scientific Instrument Co., Ltd.

POPULAR WIRELESS EXHIBITION SUPPLEMENT

(Continued from previous page.)

terminals there is a spark-gap between carbon blocks separated by mica, and there is a fuse in circuit with the wireless receiver. A model is shown of the experimental aerial and research buildings at the company's works at Trafford Park, Manchester, which are at present being utilised to accommodate the temporary Manchester broadcasting station (2 Z Y) of the British Broadcasting Company.



A Small Fixed Condenser. (Dubilier Co., Ltd.)

STERLING TELEPHONE & ELECTRIC CO., LTD.

"*Sterling*" *2-Valve Receiving Set.*—A self-contained apparatus embodying all the most recent improvements, fitted in a vertical walnut cabinet with folding doors, or alternatively in a sloping cabinet. The panel is mounted with a Filament Rheostat and a "Sterling" Variometer with Drum Switch of special design which permits of tuning over a range of approximately 280 to 2,800 metres. Access to the two valves and the necessary accessories is through a hinged top, and to the battery compartment in the base through a detachable front panel. Average range about 80 miles.

"*Sterling*" *Crystal and Valve Set.*—This Receiving Set is an instrument with unique features; it not only marks a distinct advance on all self-contained single valve sets but has a longer range than any 2-valve set on the market. The valve serves not only to amplify the high-frequency signals, but also to re-amplify the low-frequency signals detected by the crystal. The latter is of unique design, foolproof, dustproof, and with special milled-head adjustment on the front panel. The panel is also mounted with Filament Rheostat, two "Sterling" Variometers and Drum Switch of special design, for tuning over a range from about 280 to 2,800 metres. The cabinets are made in the same forms as the 2-valve sets, and the outfit includes a valve of very high efficiency, permitting of the use of a Dry Battery. Average range about 150 miles.

Sterling "*Unit*" *System.*—This novel system has been designed to enable users of Wireless Receiving Apparatus to acquire and build up their Sets in units according to circumstances and requirements. The essential feature of the system is that no connecting wires are required to join up the units, these being instantaneously coupled together mechanically and electrically by means of special "Unit" Connectors. The units consist of Tuner, H.F. Amplifier, Detector, L.F. Amplifiers (1, 2 and 3 valves), and Connector. Other features of the system are the strength and compactness of the units and their attractive finish, the general design being a black hardwood base with moulded edges, surmounted with metal, cover, highly polished with black surface, and fitted with the necessary valve sockets and controlling handles.

"*Sterling*" *No. 1 Crystal Set.*—A well-tried out and popular Crystal Receiving Set, one of the most efficient on the market, with specially selected Crystal and Aerial Tuning Switches for coarse and fine adjustment. The range is about 25 miles, but an extra coil is provided for reception of Eiffel Tower time signals.

Magnavox Loud Speakers.—Examples of these well-known Loud Speakers, complete with "Sterling" Power Amplifiers (2 and 3 valve) and Input Intervalve Transformers, the combinations giving unequalled clarity of voice production and sound adjustment.

* * *

A. GRAHAM & CO.

The exhibit of this firm comprises a full range of their well-known "Amplion" Loud Speakers and "Graham" Headgears.

The Marconi-Graham combination of a high-grade Gramophone and Wireless Receiving Set in a Console Cabinet is also in evidence.

Other auxiliary apparatus such as the "Graham" Power Amplifier form a feature of this exhibit.

The "Electravox," an improved Gramophone Combination, specially designed for the electrical and wireless transmission of musical and other records and provided with an announcing microphone, is shown.

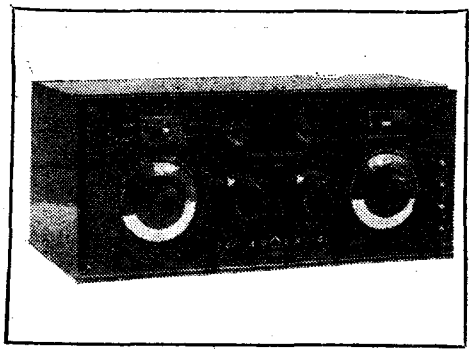
* * *

C. F. ELWELL, LTD.

In response to the wide demand for Receivers which will tune-in to the wavelengths used by Continental Stations (Paris, The Hague, etc.) the following additions have been made to the existing range of Aristophone Panels.

A 2-valve, a 3-valve and two 4-valve receivers have been designed, particulars of which appear below.

In these instruments, the reaction principle of amplifying signals has been employed, which, as is well-known, enables the utmost volume to be derived from the received signals, and increases very greatly the number of stations to which the sets can listen-in. These sets have all been approved by the Postmaster-General, hence it is impossible for them, even though oscillations be set up within the instruments themselves, to cause radiation from the aerials to which they are attached. The special selective tuning circuits used in these designs give a still further increase to the range of the receivers by eliminating interference from outside sources, and thus accentuating the signals which it is desired to receive.



A Two-Valve Set by the General Radio Co.

Following Elwell practice, both high and low tension batteries are included in the cases of the instruments themselves. The cases are supplied with heavy nickel plated carrying handles, and the batteries being contained within, the entire sets are easily moved from room to room and put into operation again with the minimum of trouble. Finally, the sets are most attractive in appearance, and are never unsightly even in the most elegant rooms.

* * *

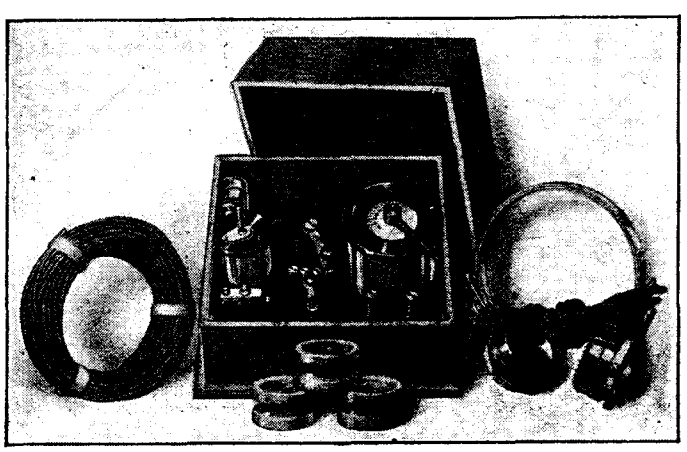
THE DUBILIER CONDENSER CO. (1921), LTD.

The rapid expansion of popular interest in all radio matters is emphasised by the exhibits to be found on the stand of the Dubilier Condenser Co. (1921), Ltd., which show the principles adopted in the well-known condensers manufactured by this firm for use on the larger wireless installations applied to the requirements of radio receivers.

For use with wireless receiving apparatus, four patterns of fixed condensers are shown, known respectively as the Type 600, with and without grid-leak attachment; the Type 600A and the Type 577 condensers. These condensers are all constructed with carefully selected mica dielectric, and are built up on the same principles as those adopted for the larger power condensers.

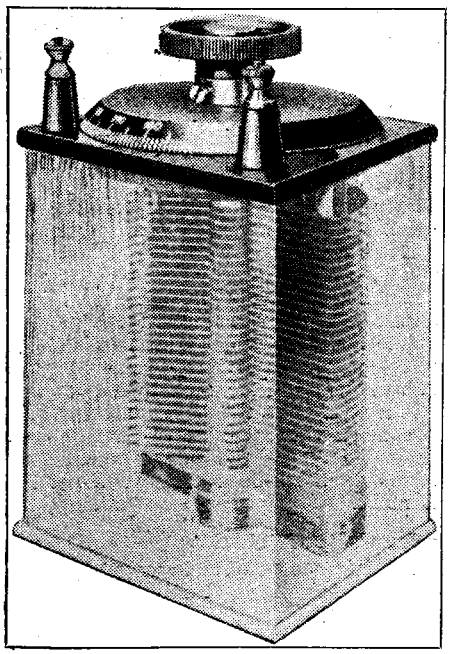
These condensers are enclosed in a moulded insulated case, and have very high insulation resistance and the absolute minimum of losses.

(*To be continued next week.*)

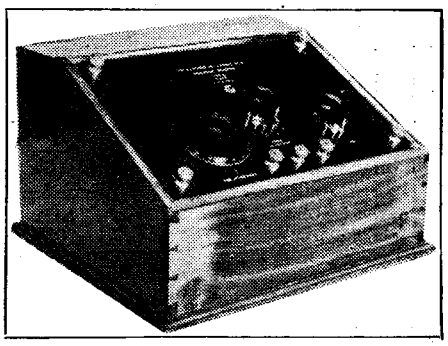


A Neat Crystal Set sold by Messrs. Gamage, Ltd.

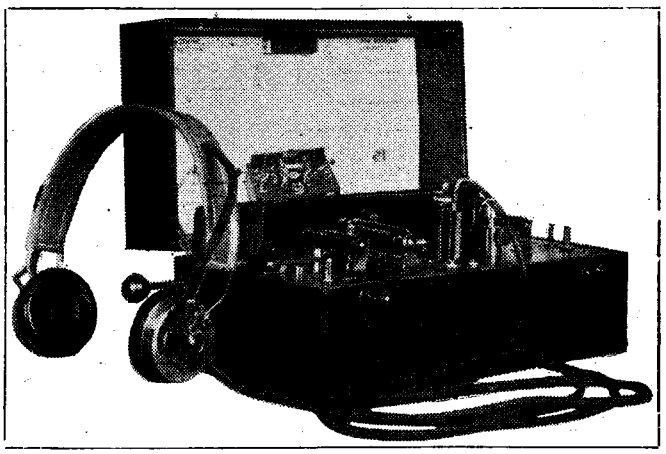
SEEN AT THE EXHIBITION.

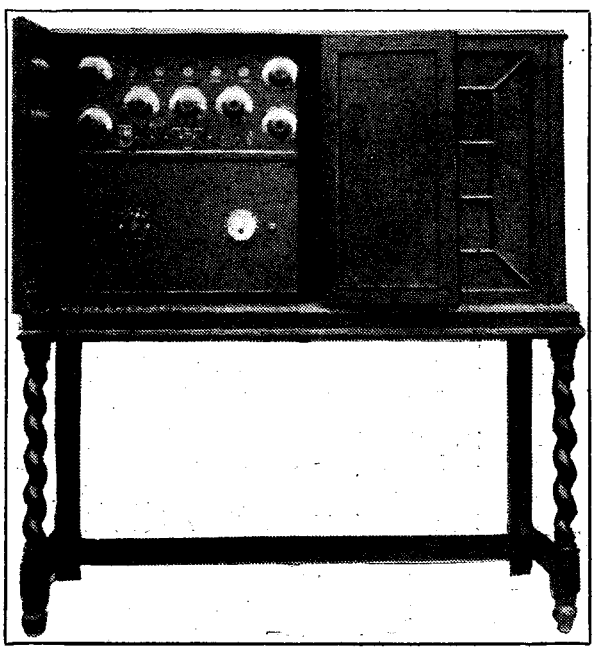


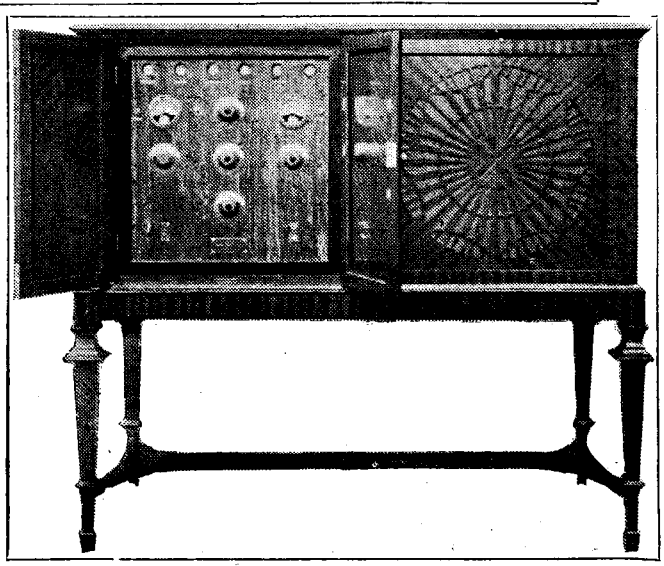
A VARIABLE CONDENSER, BY DUBILIER CO.; A "CONCERT GRAND" AMPLION LOUD SPEAKER, BY A. GRAHAM & CO.; AND A TWO-VALVE BROADCAST RECEIVER, BY METROPOLITAN VICKERS, LTD.



BROADCAST RECEIVER, BY THE ELECTRIC APPLIANCES CO., LTD. (above); AND A MARCONI CRYSTAL-VALVE RECEIVER (right).







ONE OF THE G. R. C. COUNTRY HOME SELF-CONTAINED FIVE-VALVE RECEIVERS IN JACOBEAN CABINET (left), AND THE "ARISTOCRAT" MODEL, EQUIPPED WITH SEMI-AUTOMATIC CONTROL.

A TUNED ANODE COUPLING

By T. Mc. L. GALLOWAY.

IT is the bounden duty of each experimenter to make absolutely certain that his receiving set cannot cause any interruption to his neighbours by self, or at least, by aerial-oscillation. Not only is it impossible to receive intelligible telephony when a set is oscillating, but no one for miles around can receive it either.

But reaction is a great help in "boosting up" faint telephony and spark, and a set without reaction is not half so efficient as one in which judicious reaction is used. From the above we infer the following:

(1) A reacting set is a nuisance to other people;

(2) A non-reacting set is more or less insensitive, and, moreover, cannot receive continuous wave signals.

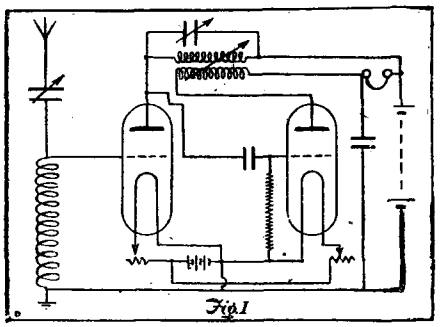


Fig. 1

How, then, can this difficulty be overcome? A separate heterodyne may be used, with its attendant filament and anode current; or the set may be allowed to generate feeble local oscillations, which do not excite the aerial, in this manner.

Permissible Reaction

Let us consider the case of a two-valve set, which has one radio-frequency amplifier and a detector, with reaction back into the aerial circuit. This is a very bad "howler," but may be entirely cured by coupling the reaction coil to the H.F. transformer, or anode coil, as shown in Fig. 1.

Suitable dimensions for an anode coil for broadcasting are: 52 turns of 22 S.W.G. D.C.C. wire on a 3-in. former, bridged by a variable condenser of ·0003 mfd. capacity.

The reaction coil may be 45 turns of 26 S.W.G.D.C.C. wire on a 2½-in. former. This coil is arranged to slide out and in the anode coil.

Some sort of fine adjustment is necessary for receiving weak telephony. The reaction coil may be supported on two $\frac{3}{16}$ in. brass rods which pass through brackets attached to the coil. If a piece of 2 B.A. screwed rod, about 6 in. long, is fastened to the coil by locked nuts, one pair on either side of a piece of ebonite fitted into the end of the coil, and to a screwed support, the coil's position may be varied to a thousandth part of an inch with ease. (See Fig. 2.)

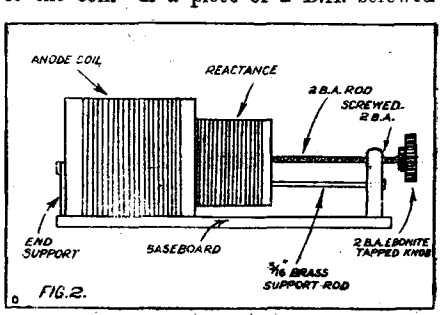


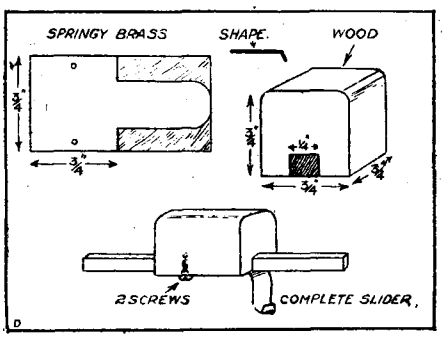
FIG. 2.

In conclusion, the making of such a set will not only be justified by the results it gives, but will give the owner the assurance that "he's not howling, anyway!"

A NEAT SLIDER

THE brass plunger is cut from a small piece of thin brass, which is well hammered to make it springy, to the dimensions shown in the diagram. A small block of wood is made, with a slot cut out for the slider rod. An easy way to make the slot is by heating the tang of an old file, and burning it out, and then well soaking the block in paraffin wax.

The holes are then drilled in the brass, screwed on to the block, and the narrow strip is bent in the form shown.



CATALOGUES

A VERY useful catalogue of all sorts of electrical equipment, including wireless accessories, has been received from Messrs. Ward & Goldstone, Ltd. This "Encyclopædia Electrica," as it is called, fully embraces all electrical necessities in connection with wireless sets. It gives useful tables of resistances and weights of wires, and should prove of interest to many wireless enthusiasts. Useful charging plants are also included in the catalogue, and the whole book will prove of great interest to all those connected any way with electricity, besides those whose electrical experience is confined to wireless.

* * *

We have received a copy of the "List of Wireless Sets and Components" from the Griffin Wireless Supplies Co. This little catalogue gives very complete lists of all those odds and ends that are so necessary to an efficient wireless set. At the end of the book a page is devoted to a list of wireless text-books that should prove very useful to the amateur who is taking the subject up seriously.

* * *

The Chloride Electrical Storage Co., Ltd., have brought out a new catalogue of batteries specially constructed for wireless purposes. A large variety of high-tension accumulators are shown, while useful tables showing the prices, types, and actual ampere hour capacity of all the accumulators are given at the end.

SERIES AND PARALLEL

WHEN you place anything in *series* it is so inserted in the circuit that the current *must* pass through it and no alternative path is provided. If you place anything in *parallel* with something else the current is allowed to divide and pass through both instruments. In *series* the circuit is broken and the instrument is inserted at the broken point, but in *parallel* indicates that the original circuit is not broken, but that the instrument placed in parallel is connected across two points.

Extra telephone receivers should be connected in *series*. The circuit is broken by disconnecting one of the telephone leads connected to one of the telephone terminals on the set, joining one of the leads of the additional phones to it, and connecting the remaining lead of the latter to the terminal on the set. Thus the current flowing from the one telephone terminal on the set passes through each pair of telephones in turn before it flows back through the other terminal.

"Cascade" and "Shunt"

Batteries are joined up in *series* to provide an increased voltage. Unlike leads are connected together; thus the positive lead from one battery must be connected to the negative lead from the other. The positive terminals will always be marked with a red "plus" sign or just with red paint, while the negative will be marked with a black, blue, or violet "minus" sign or mark. Connecting a 15-volt unit in series with a 60-volt high-tension battery will give a combined voltage of 75 volts.

To increase wave-length a condenser can be connected in *parallel* with an inductance coil, but the more efficient method is to connect another coil in *series*. The condenser should be provided merely to allow fine tuning and not to increase to any considerable extent the wave-length range.

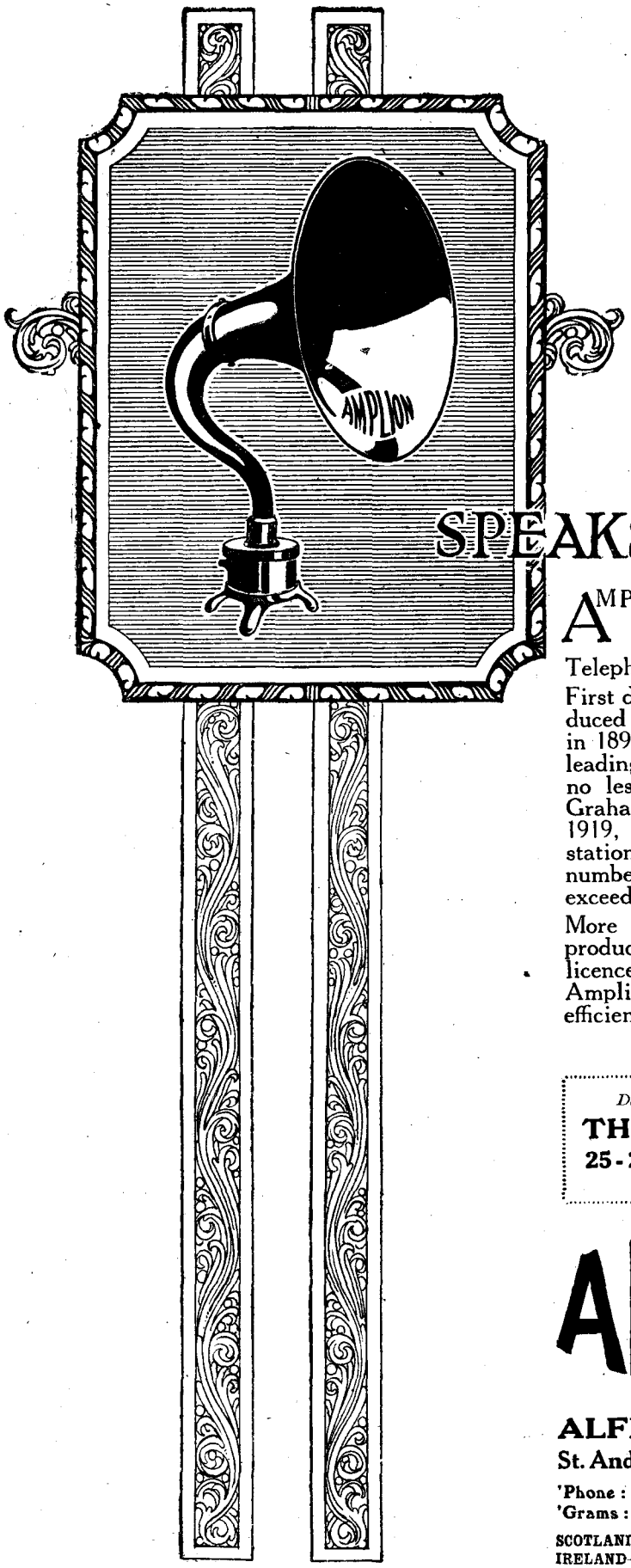
To reduce wave-length range a condenser can be connected in *series* with the aerial or earth lead.

Capacity is reduced when condensers are placed in *series*, and increased when they are placed in *parallel*.

Resistance is increased when conductors are placed in *series*, and reduced when they are placed in *parallel*.

You may hear the term *cascade* in connection with valves or other things, but it is really another application of the term *series*.

Then, again, there is *shunt*, which is just another name for *parallel*, except that *shunt* is more often used where the characters of the instruments placed in *parallel* appreciably differ.



SPEAKS FOR ITSELF

AMPLION RECEIVERS are designed and produced by the world's original and largest manufacturers of Loud-Speaking Telephones.

First demonstrated in 1887, commercially introduced in 1893, adopted by the British Admiralty in 1894, and by Foreign Governments and the leading Steamship Lines in the following years, no less than 12,000 vessels were fitted with Graham's instruments by the end of the year 1919, besides installations in numerous power stations and for other purposes. To-day the number of Graham Loud-Speakers in use exceeds that of all other makes combined.

More Loud-Speakers than ever are now produced in the Graham Factories or under licence, and in the Wireless field the Graham Amplion represents the utmost technical efficiency and unequalled commercial value.

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IRELAND—Mr. Alex. R. Munday, 41, Chichester Street, Belfast.

A VISIT TO THE BIRMINGHAM BROADCASTING STATION.

(By our Representative in Birmingham.)

MY visit to the Birmingham Broadcasting Station (5 I T) was made after dark.

I travelled from the centre of Birmingham by a bumping tram route to the very outskirts of the city and, here at Witton, in what has already become known as a very hotbed of wireless enthusiasts, after a ten to fifteen minutes' walk, I at length came to an extensive aggregation of buildings, in one of which the Birmingham Broadcasting Station is temporarily housed.

Here and there in the mass of shadowy buildings there were brilliantly lit windows, whilst the road around them, with cross-roads and sectional ways running off in all directions were illuminated by great arc-lamps.

Quite a Sufficient Introduction.

A commissionaire led me by way of a double flight of stairs, a long hallway, a narrow hanging bridge, a long winding passage, to a door. "There," he said, pointing.

I entered and found myself in a kind of reception room in which there were a dozen persons, some conning music, some talking, yet all waiting. It was obvious I had arrived at my desired destination, and even as I stood there I was asked whether I was Mr. —, an expected vocalist.

"I want to see the station at work," I explained. "'Popular Wireless' readers would like to know something about the Birmingham Station." The introduction was sufficient. Within a couple of minutes I was talking to Mr. A. E. Thompson, the manager and engineer-in-charge, and before I left the station, a couple of hours later, I had had long and interesting conversations with him, and with Mr. Percy Edgar, Birmingham's most popular entertainer, now the director of Birmingham broadcast concerts, and Mr. F. H. Amis, a Birmingham B.Sc., who is in charge of the transmissions.

An Interesting Record.

Mr. Thompson, the engineer-in-charge, is well-known as a radio-specialist, both here and in many Continental cities. At the outbreak of the war he was sent to the War Office on confidential work in connection with communications, while later in Russia he was in charge of several wireless stations, and for his work there was decorated with the Order of St. Anna.

Mr. Percy Edgar has been a professional entertainer in Birmingham for 15 years, and both as a Dickensian actor and a concert director is well-known throughout the Midlands.

At the very outset my attention was attracted by a large wall-map of the British Islands hanging in the ante-room. It was decorated in every square inch with one or more multi-coloured pins.

"What does this mean?" I asked.

"It means," replied Mr. Thompson, "that a listener-in at each point has heard Birmingham and has notified us of the fact." The record revealed that there had been listeners-in in every county of the kingdom. From the South, from Scotland, Ireland and Wales there had come the proof that Birmingham's concerts had been picked up.

And from this point there started a most interesting evening, during which I learnt many things about the Birmingham Station. Started in early November its first concert was practically an antidote to the election, for it was on the night of the poll that its transmissions could first be heard. Since then it has kept going without a break and without any trouble of any kind.

Mr. A. E. Thompson and Mr. Percy Edgar talking to the children.

The Rated Range.

The station was set up in three days. At three o'clock in the afternoon the aerial was tested, and at five o'clock they were transmitting the first Birmingham concert. The quality of the transmission was exceedingly good, a fact which Sir William Noble, Chairman of the British Broadcasting Station, listening-in at Coventry, the other day, bore out when he telephoned a message of congratulation to Mr. Thompson.

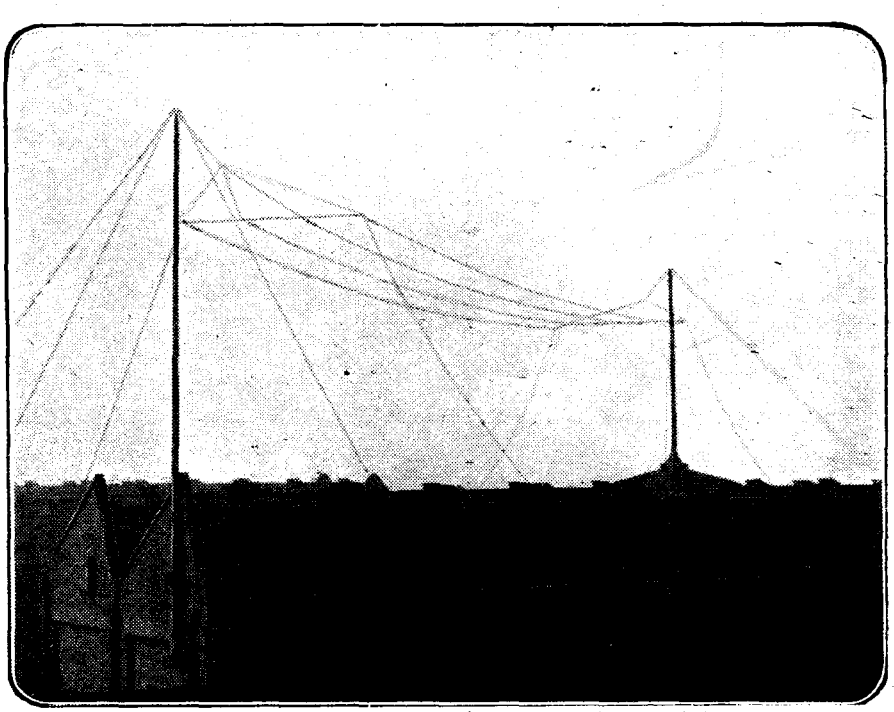
The rated range of the station is 100 miles, and the wave-length used is 425 metres.

The aerial is a four-wire L-type, 110 feet long and 80 feet high, the parallel wires being 6 feet apart on spreaders 18 feet long. The direction is North to South.

Describing the Generators.

The power supply is obtained from a three-unit motor generator set, consisting of high and low voltage D.C. generators, coupled to a driving motor. The main supply is 400 volts D.C., an automatic starter providing for starting and stopping by means of a press-button control. The driving motor develops 4-H.P. at a speed of 1,750 r.p.m. The high voltage generator, supplying the plate current to the transmitting valves, is a direct current shunt

(*Continued on next page.*)



The Aerial System at the Birmingham Broadcasting Station.

A VISIT TO THE BIRMINGHAM BROADCASTING STATION.

(Continued from previous page.)

wound machine with two commutators, designed to deliver continuously 1.25 amps. at 1,600 volts pressure. The low voltage generator supplies filament current for the valves—28 amps. at 14.5 volts pressure, plus excitation current for the high voltage generator.

The low voltage generator is self-exciting and its potential is regulated by means of a field rheostat on the power panel. On the plate current supply is a circuit breaker, working with an over-load of 25 per cent.

Controlling the Wave-length.

The transmitting panel comprises four 250-watt valves, two oscillators and two modulators—and a 50-watt valve for amplifying speech input. The former includes a tuned circuit with variable inductance and capacity, and the energy is transferred to the aerial by indirect magnetic coupling. The plate current is supplied through choke coils. Variations of potential in phase with the plate current variations are impressed on the grid on account of the magnetic coupling between the plate and the grid coil. The oscillators and modulators are both supplied through a low-frequency choke coil.

Speech is impressed on the grids of the two modulators after the necessary amplication. Between the plates of the modulators and oscillators is a high-frequency choke coil. The frequency of the carrier wave is controlled by the value of the capacity and the inductance in the oscillatory circuit and of the variable inductance in the aerial circuit. This inductance is adjusted by means of a variometer, the movable coil serving at the same time to vary the coupling between the aerial circuit and the grid and plate circuits in such a manner as to ensure the frequency range for which the set is designed.

The Microphone Circuit.

The grid circuit of the modulators is given a negative potential by means of a resistance connected between the negative terminal of the 1,600 volt generator and the filaments to ensure that the valves will operate under the conditions most favourable for the prevention of distortion.

The plates are fed through an electric filter to eliminate commutator noises. The speech input amplifier consists of a three stages with suitable control for the current in the microphone and in the different filaments, and permits also of a variation in the degree of coupling between the different valves and therefore of the control of the amount of amplication. By means of a loud-speaking receiver, connected across the output terminals of the amplifier as well as by means of an ordinary crystal receiver, the operator observes the quality of the transmissions and varies accordingly the amount of amplication.

The studio is the usual broadcasting studio. It is thickly carpeted and the walls and ceiling are heavily draped, the only gap in these revealing a sounding board. It contains a Weber reproducing piano, an Aeolian cabinet gramophone with a microphone upon a high stand.

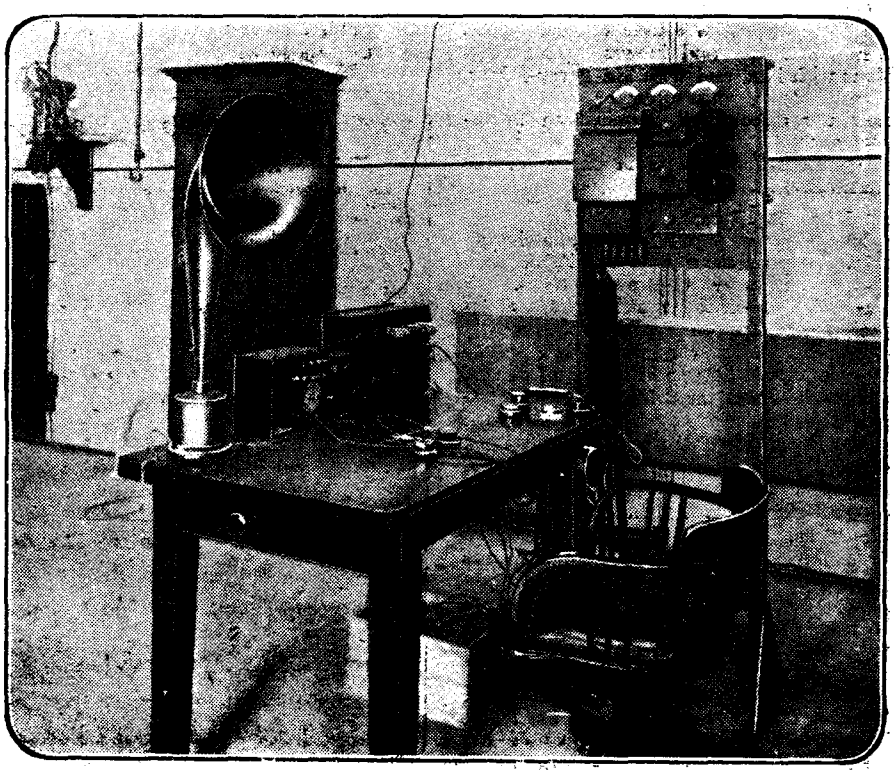
The Concert Studio at the Birmingham Station.

Three Small Rooms.

On the wall, at the right and in the rear of the microphone, is a signalling panel, communicating with the operating room and including a tumbler switch for closing the microphone circuit as well as a telephone. A few chairs and a small table complete the studio's list of contents.

Between the studio and the operating room is the waiting or ante-room in which the artistes rest. Thus three comparatively small rooms at the present moment represents the Birmingham Broadcasting Station which nightly interests many thousands of listeners-in.

But as I have said, Witton is only the temporary home of the station. At an early date it is hoped to secure premises in the centre of the city, from which it will be easy to run cables to the theatres (the present distance is somewhere near four miles) and thus make it possible to transmit opera and musical comedy and provide as striking a programme as any station of the British Broadcasting Company. When the shift is made then will end the first chapter in the history of 5 I T.



The Test and Control Room at 5 I T.

HOW TO MAKE A VARIABLE CONDENSER

By A. W. DRANSFIELD.

THERE are various ways of constructing variable condensers, and the moving-vane type is rather more difficult unless the parts are already stamped out. But the following can easily be made from odds and ends, and will cost far less to construct, being at the same time quite an efficient piece of apparatus.

In the first place, a lot of old photograph plates will be required. These are not at all difficult to obtain, and in any case may be bought for a few pence. We will assume that the size about to be used will be quarter-plate. That will be 4¼ in. by 3¼ in., so 29 will be the number required. These will be used as the separators, and technically known as the dielectric.

The next thing to get into shape will be the plates. These are made out of thin zinc. No. 8 gauge will do quite well, and should be cut as shown in Fig. 1. But it will be noticed in the other drawings that some of the plates have two holes, so in the first place make 14 plates with one hole, and 13 with two holes; the plates with two holes will be the moving plates.

The next process will be to cut a lot of strips of thin cardboard that will be just a little thicker than the zinc. These strips will be ¼ in. wide. Then shellac all the glass plates and also the card strips; then stick the strips to the plates in the form of a three-sided frame, as in Fig. 2. A good plan is to lay a moving plate on the glass whilst placing the card on, as the zinc has to eventually slide in and out of the frame.

Method of Assembling.

Now comes the assembling, which will take a little time and is rather a fiddling job. First lay a plate, with frame up, on a board, lay on a "fixed" zinc, then another glass plate, and then a moving zinc, making certain that the tab projects the opposite way to the tab on the moving zinc; then comes another glass plate, and so on with the whole lot of plates and glass. The pile should be bound together with black insulating tape to hold the whole lot together, as in Fig. 3.

When complete, there should be 14 plates with one hole one end, and 13 with all the tabs with two holes the other end. Between the spaces of the fixed plates packing pieces will be wanted, and these may be made out of the odd ends of zinc cut when forming the tabs.

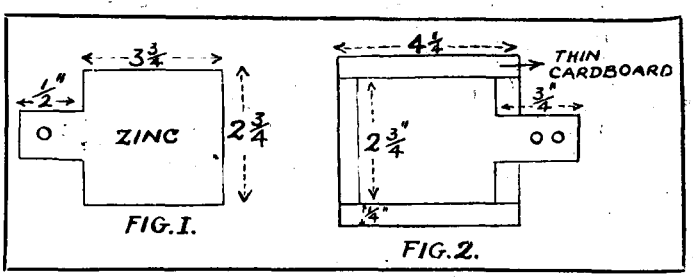
The neatest way, of course, will be to put a long bolt through the lot, but it will be sufficient to tightly wire them together.

Straightening Kinked Plates.

A good metallic contact is desirable between all the plates. The moving plates will require some packing pieces, and a piece of brass tube split to form the handle should be placed on the centre plate, as in Fig. 3. The two bolts will hold this quite rigidly. Should the zinc plates not be perfectly flat, they can be heated and placed between two flat boards with a heavy weight on top.

Building the box is really not a difficult job, and to get the measurements best the condenser should be laid on a board and measurements taken by drawing the moving plates out. All that is required is a hole at one end to allow the handle to project. Care should be taken that the handle is left long enough to give the plates as much movement as possible.

Further description is hardly necessary if the diagrams are studied before commencing. In order to ensure that the holes in the plates will be in line they should be clamped together and drilled simultaneously.



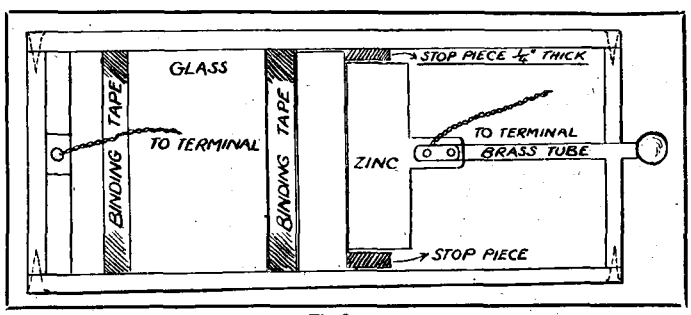


Fig 3.

Finally, remember that with all radio apparatus attention to detail is attention to efficiency.

ADDITIONS TO "POPULAR WIRELESS" DIRECTORY OF AMATEUR TRANSMITTERS.

Call Sign	System	Name	Address
2 A V	C.W. & R/T	D. H. W. Swincy	18 Southchurch Road, Southend-on-Sea.
2 C W	,, ,,	Com. Hippisley	Ston Easton Park, Bath.
2 I L	,, ,,	H. R. Goodall	Fernlea, Winchester Road, Basset, Southampton.
2 J O	,, ,,	,, ,, ,,	30, Castle Street, Clitheroe, Lancs.
2 T T	Telephony	Peter Hamilton, Jr.	The Villa, Glenfield, Paisley, N.B.
2 U F	C.W. & Telephony	H. Bailey	51, Manchester Road, Denton, Manchester.
2 Y G	Sp., C.W. & R/T	L. G. Boomer	Kennington, London.
2 Z B	,, ,, ,,	C. R. Small	Clacton Electrical Co.
2 Z S	C.W.	F. J. Dinsdale	14, Highfield View, Stoneycroft, Liverpool.
5 A Q	,, ,, ,,	D. Douet	10, Ruvigny Gardens, Putney, S.W.15.
5 C F	,, ,, ,,	Frederick Wise	7, Vernon Road, Hornsey, N.8.
5 D P	Sp., C.W. & Telephony.	Sea Scout Headquarters	Clacton-on-Sea
5 F S	Telephony, C.W. & Tonic Train	W. A. Andrews	Balmoral Mansions, St. Andrew's Park, Bristol.
5 H Y	Sp., C.W., I.C.W., Telephony, Duplex & Directional Telephony	B. Honri	Cromwell Hall, East Finchley, N.2
5 M C	Telephony	W. Woodhams	24, Marlborough Place, Brighton.
5 M O	C.W. & Telephony,	W. G. Dixon	Dipwood, Rowlands Gill, Newcastle-on-Tyne.
5 M P	,, ,, ,,	Colin Bain	51, Grainger Street, Newcastle-on-Tyne
5 P U	——	T. Allison	33, Wilton Grove, Merton Park, S.W.
5 Q B	Telephony, Sp. & C.W.	Alan G. Bainton	The Hollies, 8, Palace Road, S.W.2.
5 Q V	Sp., C.W. & Telephony	F. L. Stollery	Fairmead, Vista Road, Clacton-on-Sea.
5 Z H	——	T. Allison	The Cromwell Engineering Co., 127, Fulham Road, S.W.

THE HEAVISIDE LAYER AND THE "GLIDING WAVE."

By A. H. DALY.

IT is reported that Leafield wireless station in Oxfordshire can be heard quite clearly in Melbourne, Australia, which is approximately 11,000 miles away —or nearly half way round the earth. This means that wireless waves radiated by Leafield travel over a wall of earth many hundreds of miles high before reaching Melbourne, and what is causing a great deal of argument at the moment is how these waves climb this wall of earth between two countries such as England and Australia.

Many of our scientists are of the opinion that for the most part wireless waves radiated from a transmitter travel upwards into the upper atmosphere and strike a layer of gas which reflects them down to earth again at some distant point, and in this way the waves surmount the curve of the earth which separates two stations like Leafield and Melbourne.

No Earth Connection.

This idea is embodied in the Heaviside layer theory, after Oliver Heaviside, who, in 1900, put forward the suggestion that there was a layer of gas suspended some distance above the earth's surface which was capable of reflecting wireless waves.

On the other hand a number of scientists have rejected the Heaviside theory and submit instead that wireless waves travel from one place to another by earth conduction and never leave the earth at all. This is known as the "gliding wave theory."

The latest addition to the controversy is in the form of the articles which have appeared in the American publication, "Popular Radio." The article favouring the Heaviside layer is by Sir Oliver Lodge, and the article supporting the "gliding wave" theory is by Dr. Thomson, an American scientist.

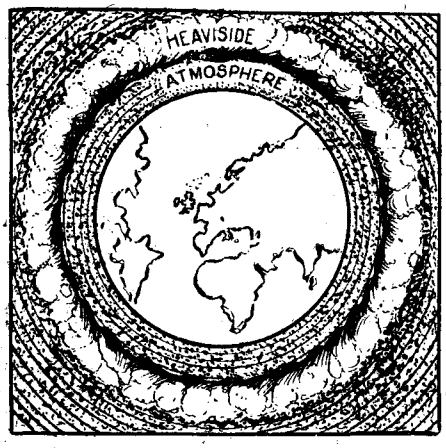
In order to get at the root of the argument it is necessary to go back to the early days of wireless. The discovery of wireless or electro-magnetic waves was made by Hertz about 1888. His transmitting apparatus consisted of two metal plates—each plate being connected to the spark gap of an induction coil—this arrangement was known as the Hertz oscillator and when in action radiated wireless waves in ether. It must be understood that the Hertzian apparatus was not in any way connected with the ground or earth—this is a very important point in the argument.

Only "Half" Waves.

It was found that the waves radiated by the Hertz oscillator were very similar to light waves with however a vast difference in frequency. Now although it has been found that light waves bend to a certain extent, this is for all practical purposes almost negligible, and the tendency is for light to travel in a straight path from its source. Consequently, when it was found that the waves radiated by a Hertz oscillator would not climb over obstacles such as hills, it was naturally concluded that wireless waves like light waves also travelled in a straight path from the transmitter, as far as practical work was concerned.

When, however, Marconi spanned the Atlantic in 1901 everybody received something of a shock. Scientists suggested that as there was a layer of conducting gas in the upper atmosphere, very possibly the waves from Poldhu struck this at such an angle that they were reflected down towards America, for it was known even then that electrical conductors reflected wireless waves, and so the Heaviside theory was first put forward.

But—says Dr. Thomson in his argument against the Heaviside theory—the waves radiated from Poldhu were not real Hertzian waves, for the Poldhu station could only radiate "half" Hertzian waves because Marconi's transmitter was connected to earth--whilst Hertz's apparatus had no connection with the earth at all. It



follows from this that the Marconi system is only a "half oscillator" and only radiates "half" Hertzian waves, and the waves are really guided by the earth surface—especially by the sea surface which is more conductive than the land.

According to Dr. Thomson there are some scientists who still believe that the waves radiated from a Marconi transmitter are the same as those radiated by a Hertz oscillator—and he goes on to say that the Heaviside layer strains the imagination too much, for in order to reflect wireless waves this layer of gas would have to be perfectly smooth.

In his article, Sir Oliver Lodge says that he knew from the first that the Marconi grounded system radiated only "half" Hertzian waves, in fact he appears to have proved this even before Marconi's transatlantic achievement. He was fully aware that the use of the earth by Marconi would produce "half" waves which would travel along the ground as far as it was conducting; and it was therefore quite natural that waves would travel better by sea than over land.

Regarding the unevenness in the surface of the Heaviside layer which Dr. Thomson maintains would make proper reflection impossible, Sir Oliver Lodge states that during the day the heat currents from the earth might cause irregularities, but at night when the sun's rays are withdrawn the layer is probably a quite regular surface owing to its composition.

In addition to this Sir Oliver Lodge says that if we depended solely upon the "gliding wave" theory—wireless communication would be as good during the day as at night, but this is not the case so the atmosphere must affect the wireless waves.

Dust from the Sun.

Another great adherent to the Heaviside theory is Professor Fleming, but he also appears to have realised long ago that some of the wireless waves radiated from a Marconi transmitter travel along the earth's surface, for in an address to the Wireless Society of London in 1914 he says:

"I remember witnessing in 1900 experiments carried out by Marconi in which signals were received from the Isle of Wight by means of a zinc cylinder standing on a chair placed in a room. This seems to indicate that some part of the effects must be due to waves passing through the earth and not by pure space waves."

The suggestion is also due to Professor Fleming that at heights of about 50 miles —where the ordinary atmosphere disappears and is replaced by hydrogen and helium the most likely agent in making the gases conductive is dust thrown off by the sun which is carried to earth by the pressure of light waves.

Undoubtedly, however, the most conclusive argument in favour of the Heaviside layer is that put forward by Dr. de Groot, in the following manner.

Sabang is a wireless station in Sumatra with a range during the day of 150 miles. On some nights this station can be picked up at Osaka, a Japanese wireless station 3,726 miles away from Sabang. 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.

112 Miles Above the Earth.

This means that Sabang can be heard at a distance of 3,726 miles, but not at a distance of only 2,484 miles. Dr. De Groot has shown that above the point 2,484 miles from Sabang the waves—which eventually reach Osaka—are striking the Heaviside layer, and cannot be heard because they are 112 miles above the earth's surface. At this point the waves are reflected down and strike the earth at Osaka.

Now if the waves travelled along the surface of the earth—which is the "gliding wave" theory—all places between Sabang and Osaka would pick up the latter's transmitter. Dr. De Groot has also found that this phenomenon happens with many other stations in the tropics.

POPULAR WIRELESS Beginners' Supplement

PART VIII.—WAVE-LENGTH AND FREQUENCY.

By MICHAEL EGAN.

ABOUT the first thing one learns from a text-book on wireless is that "if you double the frequency you halve the wave-length, and if you halve the frequency you double the wave-length." At first sight this seems quite a fair, straightforward kind of statement. There's a strong element of justice about it that helps it to carry conviction. It cuts both ways, as it were. If you double one you halve the other.

The simplicity of the statement makes it an extremely easy one to memorise—so easy, in fact, that the beginner is often tempted into accepting it at its "face value," without bothering as to its why and wherefore. "The thing is quite obvious," I was told the other day by a young friend who had been presented with a crystal set during the previous week-end. "If you halve one, you *must* double the other; otherwise, everyone would have to send on the same wave-length. Don't you see?"

But I was determined to be honest. I protested that the thing was *not* obvious to me. "In fact"—so I argued—"it seems an extraordinary coincidence to me that the thing should turn out to be so beautifully simple. Tell me clearly: Why should the *frequency* of a wave and the *length* of a wave have anything whatever to do with one another? Why should they affect one another in any way; and, above all, why should they affect one another in this particular way?"

Rate per Second.

I must say that my young friend treated me quite decently. With just the faintest trace of pity in his tones, he set out on a long explanation. "Let us take a simple example," he said. "Suppose you divide one of them by 2; isn't it obvious that you will have to multiply the other by the same amount in order to make things equal?" It was no use, however. My young friend found me quite hopeless on the subject, and, after half an hour's patient trying on his part, he suggested gently that it would not be a bad idea if I wrote to POPULAR WIRELESS on the matter. (As you see, I am acting on his advice.)

Now, before we go any further in searching for the cause of this strange relationship between the frequency and the length of wireless waves, it will be advisable to make ourselves quite clear as to what we mean by the terms "frequency" and "wave-*length*."

If I call at a friend's house three times each day, it might be said that the "frequency" of my arrivals is three per day, or twenty-one per week. Similarly, the frequency of wireless waves is the number of times a wave arrives at a receiving aerial in a given time—for instance, in a day or an hour, or a minute, or a second. In practice, when speaking of the frequency of waves, it is usual to calculate the number of arrivals *per second*, owing to the enormously high numbers that are dealt with. If we were to calculate the frequency in, say, *hours*, the number of waves that arrive in that time would run into thousands of millions.

Of course, the rate, or frequency, at which wireless waves *arrive* at a receiving station is the same as that at which they *leave* the transmitting station. If they leave the transmitting station at the rate of 1,000,000 per second, they will arrive at the receiving station at the same rate. In fact, this is approximately the frequency of the waves sent out by the various broadcasting stations. The frequency of each station varies slightly from that of the others, but they are all in the neighbourhood of 1,000,000 per second. So much for frequency.

A Fixed Law.

The wave-*length* is the distance between any two successive waves. It may be measured from the top of one wave to the top of the next. Wireless waves may vary in length from about half an inch to twenty miles! These are the shortest and longest waves that scientists have yet been able to produce. No doubt, in time, they will succeed in producing waves of a hundredth part of an inch and a hundred miles in length.

Now, *all wireless waves, whatever their length, travel at exactly the same speed.* Tiny little waves that measure only an inch from crest to crest move through space at exactly the same speed as the huge waves that measure miles from crest to crest. There is no "reason" for this. All that can be said is that it is nature's way of doing things.

Let us leave the subject of waves for a moment and imagine we are dealing with railway trains and motor-cars. Suppose we could send out a number of long trains one after the other on a straight railroad from, say, London to Manchester. That is to say, as soon as one train has left the station at London it is followed immediately by another of equal length, and that by a third, and so on—all travelling immediately behind one another and all moving at the same speed.

And suppose that, as the first train left the London station, we started a similar exodus of motor cars from a London garage on a road that ran parallel to the railway track, the motors also following immediately behind one another and travelling at the same speed as the trains.

An Analogy.

The first train and the first motor-car will, of course, arrive at Manchester at exactly the same moment, since they started out together and travelled the whole of the distance at exactly the same speed. A steady influx of trains and motor-cars now takes place at Manchester. No sooner has the first train entered the station than it is followed by another. Similarly, no sooner has the first motor-car arrived (at the adjacent garage) than it is followed by a second.

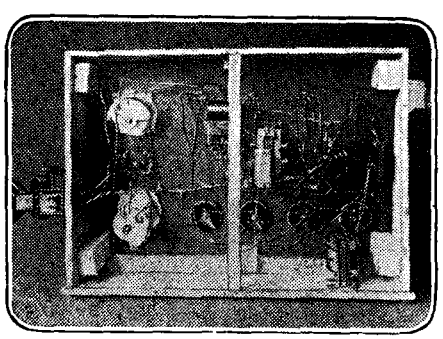
Now, owing to the difference in size, or length, between a train and a motor-car, several motor-cars will arrive in the time taken for a complete train to arrive. Whilst one long train is drawing into the station a whole group of motor-cars will have arrived at the garage. If the lengths of a train and motor-car are 90 yards and 3 yards respectively, 30 motor-cars will arrive in the time taken for one train to arrive.

In other words, the frequency of arrivals of the smaller vehicles is much higher than that of the larger ones. It is obvious also that if the motor-cars were half as long as the trains, they would arrive at twice the frequency of the latter. And if they were only a quarter as long as the trains, they would arrive at four times their frequency, *i.e.*, for every one train that arrived four motor-cars would arrive.

By substituting the words "long wave" and "short wave" for "train" and "motor-car" respectively in the above analogy, it will be easy to understand why it is that, "if you double the frequency you halve the wave-length, and if you halve the frequency you double the wave-length."

What makes this law hold good is the fact that *all* wireless waves travel at the same speed. If big waves travelled more rapidly, or more slowly, than small ones, all our calculations on the relation between wave-length and frequency would be upset. For instance, if, in the case of the trains and motor-cars, the former were travelling much more rapidly than the latter, the difference in speed might be such that three trains swept into the station in the time taken for one motor-car to crawl into the garage.

Wireless waves travel at a velocity of 300,000,000 metres per second. The wave-length of the various broadcasting stations is something over 300 metres in each case; therefore, their frequencies will be something under 1,000,000 per second in each case. If you look on page 58 of this issue you will see the exact wave-length of each broadcasting station. Can you work out the exact frequencies?



Inside view of a four valve set made by Mr. G. Williamson "Dunedin," London Lane, Bromley, Kent. A good example of amateur ingenuity.

THE VALVE FOR BEGINNERS.

By SEXTON O'CONNOR.

PART III. (Conclusion.)

IN the last article it was pointed out that before ether waves of the form represented in Fig. 1 can be used to vibrate the diaphragm or earpiece of a pair of phones, so as to become audible to the ear they must be rectified or "cut in half" through the line XY.

One half of the wave (say the part above the line XY) then remains in the form of a series of "pulsations" or energy "pushes," which are all applied in the same direction, say upwards. Fluctuating energy of this sort can be collected so as to operate the phones, whereas a true alternating current, represented by the full wave and alternating in both directions, would produce no audible effect.

It has also been shown that the current flowing in the plate circuit is that derived

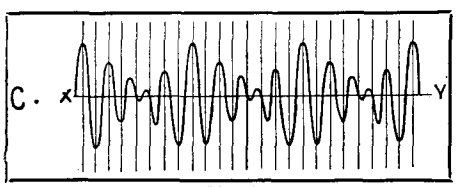


Fig. 1

from the H.T. battery which has its circuit completed by the stream of electrons passing between the filament and plate. The strength of this stream, and therefore the H.T. current, is controlled by incoming signals when they are applied to the grid, just as the volume of the stream of water from a supply pipe is regulated by an ordinary tap. When the grid is positive, the tap is open, and a full flow occurs. When the grid is negative, the tap is nearly closed, and only a small stream passes.

Nothing would be Heard.

Should the grid for any reason become strongly negative, the tap is in effect fully closed, and therefore no current will flow in the plate circuit.

At no time, however, can the direction of the current be reversed (refer to the concluding paragraph of this article), and in this respect the valve is automatically a rectifier. However, the full process of rectification is not quite so simple as this would make it appear.

If we could photograph the energy that is leaving the aerial of a broadcasting station

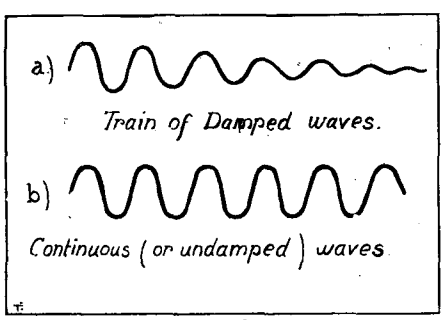


Fig. 2

immediately before the "music" starts, or even at the precise moment of time between two successive words of a song, we should find it to consist of a continuous "train" of waves, each wave being identical and regular in shape, somewhat as shown at the lower part of Fig. 2.

If the station is working on a wavelength of 300 metres, no fewer than one million of these waves would strike against the receiving aerial in each second. Such waves are therefore generally referred to as "high-frequency" waves or oscillations, to distinguish them from "low-frequency" oscillations which can be heard in the phones.

When high-frequency waves at one million per second are rectified by a valve, the resulting "pulses" in the plate current are far too rapid to operate the metal diaphragms of the phones. Even if they did, nothing would be heard, for the reason that the human ear is unable to detect sound vibrations higher than 25,000 or 30,000 per second.

"Carrying" the Music.

In the case of broadcasted music, a continued series of high-frequency waves of this kind is sent out from the aerial without a break, and underlies, so to speak, the actual "music" vibrations. They act, in effect, as a "carrier" wave, into which the music or "low-frequency" vibrations are fed. In one sense the "carrier" wave takes the place of the line wire in the ordinary telephone, because without it the "musical" tone frequencies could not be radiated.

The result of combining the "musical" frequency with the "carrier" frequency results in the curious wave formation shown in Fig. 1, where the heavy line in reality represents a kind of envelope covering hundreds of thousands of high-frequency oscillations, each swinging to and fro at a constant frequency but with varying amplitudes or height which represents the strength of the wave at each point.

If the curve is examined carefully it will be seen to consist of a repeated series of what are called "damped" waves, *i.e.*, the first wave is very high or more correctly of large amplitude, and is followed by a succession of diminishing waves. A simpler form of "damped" wave is shown at *a*, Fig. 2.

The main task of the valve when rectifying is to "detect" or disentangle from the carrier wave this "overlying" low-frequency or damped wave and render the latter audible in the phones.

The simplest means of accomplishing this result is to insert in the grid current a condenser shunted by a high-resistance leak. The latter is better known to fame as the "grid leak," and is a fertile source of vexation to earnest students of the wonders of wireless.

It will perhaps be remembered that the grid is alternately thrown positive and negative by the incoming waves. The important fact so far as rectification is concerned is that each time the grid becomes positive it attracts and "traps" a number of electrons. The number so caught up is very small compared with the number which flow through the open spirals of the grid to the more highly charged plate. Nevertheless a small number are so arrested by the grid, and these must of course form a small current flowing in the *grid circuit.*

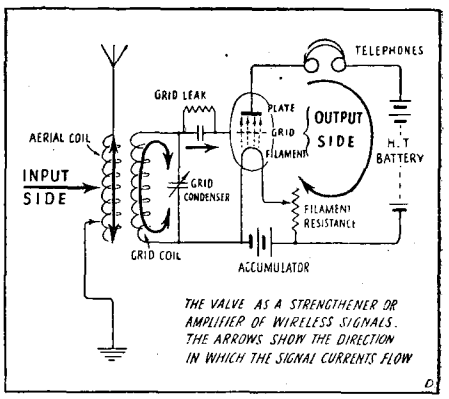


Fig. 3

In the ordinary way, this grid current simply passes through the grid inductance coil and back again to the filament battery. It has no appreciable effect, except that it represents a small "wastage" in the efficiency of the valve.

The Grid Leak.

When, however, the grid leak and condenser are inserted as shown, the electrons trapped by the grid no longer find an easy return path to the battery. They are first stopped dead by the condenser, and only after looking around for a way out do they discover the famous "leak" and finally manage to wriggle through with some difficulty and delay—owing to its high resistance.

This performance of the electrons with the grid leak gives rise to a particularly useful result in the case when a damped or "musically moulded" wave is being received. The first low-frequency impulse (of large amplitude) throws the grid decidedly positive, and in consequence a

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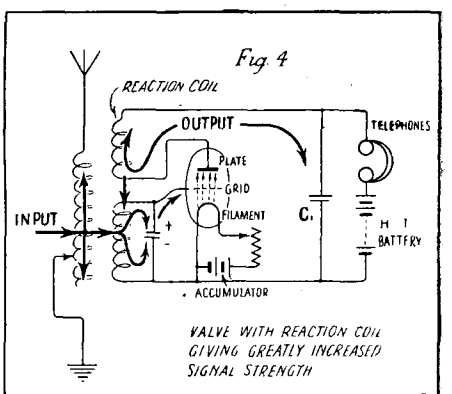


THE VALVE FOR BEGINNERS.

(*Continued from previous page.*)

comparatively large number of the *negative* electrons are caught by it and are heaped up or accumulated on the plate of the grid condenser. The succeeding smaller impulses are not, however, so powerful (*see* Figs. 1 and 2), and by the time the smallest wave has arrived, the accumulation of negative electrons upon the grid condenser has gradually been relieved through the exit path afforded by the "leak."

The fact that changes in the grid potential are instantaneously reflected by current variations in the plate circuit is the outstanding advantage that has made the valve so wonderfully useful and efficient as a wireless receiver. In particular, it is because of this property that the principle of "reaction" or "back-coupling" becomes possible.

Briefly Dealing with Reaction.

In the ordinary use of the valve (without reaction) the amplified energy in the plate circuit is passed directly through the phones.

If, however, instead of doing this, an additional inductance coil R, as shown in Fig. 4, is inserted in the plate or output circuit, and is then brought round and "back-coupled" or linked with the inductance in the grid or input circuit, greatly increased magnification can be obtained.

To use a common analogy, instead of increasing the original store of energy by a "simple interest" factor, it is made to grow at a "compound interest" rate.

This is due to the fact that a part of the amplified energy in the output circuit is "poured back" through the coupling between the "reaction" coils and again enters the input circuit, where it is further strengthened by a second passage through the valve.

The maximum effective increase in signal strength without distortion, when using reaction, is obtained at the stage in coupling which is reached just *before* the system actually starts to "oscillate." But a considerable increase in strength can be obtained from a much looser coupling than at this danger point, and it is advisable always to work on a coupling some distance removed from the point at which "interference" or self-oscillation sets in.

Final Remarks.

It will be noticed in Fig. 1 that a fixed condenser marked C 1 is connected across the high-tension battery and phones. This provided in order to give an easy passage to the "high-frequency" impulses which are undergoing "reaction" strengthening, and is known as a "by-pass" condenser.

The general conception of an electric current is a kind of fluid which travels from the positive pole of a battery to the negative. According to the electron theory, a current consists of myriads of small negative "charges" called electrons, and these come from the negative pole, and pass through the circuit to the positive pole. For all practical purposes it is immaterial which view is held, but the latter is undoubtedly the more accurate.

HOW TO DEAL WITH A FAULTY CRYSTAL SET.

PERHAPS you were receiving beautiful signals yesterday, and to-day, although you know that your own particular broadcasting station is still in the best of health, not a sound can you "wangle" from your crystal receiver. You know just exactly where the slider on the coil or the switch and variable condenser should be in order to receive that station, but feverish crystal detector adjustments produce no results at all. Try a little condenser or coil adjustment, because it is quite possible that the broadcasting station has changed its wave-length slightly—that frequently happens. After a fair amount of delicate (note the word) crystal adjustment, the detector can be ruled out as the cause of failure. It is indeed rarely that a crystal will fall from good signals to nothing at all in the course of 24 hours, though it is always advisable to have a spare crystal or two (complete in cups), so that they can be quickly screwed in in place of the regular crystal at a moment's notice at hand. If you possess auxiliaries of this nature try them—a good detector will compensate for inefficiency in other directions.

The Worst Offenders.

Now then for the connections. First of all run over all the terminals, tighten them up and clean the doubtful looking ones with very fine emery cloth or a clean, dry rag. Remember that the current of electricity that you are dealing with is too weak to jump over a film of dust, verdigris, or anything else that might collect between the wires, tabs, or plugs and their terminals, although perhaps it might be almost imperceptible to the naked eye. Those little screw terminals behind the ear-pieces of your telephone receivers are the worst offenders in the foregoing respects and should receive most particular attention.

If you possess one of those receivers that employ a coil of wire with a sliding contact that runs up and down it, then that latter should be cleaned up. Run an absolutely dry and clean rag up and down the bare part of the wire on which the slider makes contact until it is perfectly bright. Then clean the slider itself by placing between it and the wire a piece of rough paper and pulling this latter to and fro for a few moments. You will be surprised at the amount of dirt removed. Finish the job by running the slider up and down the coil a few times.

Three Important Points.

Perhaps your set has its coil concealed inside and is fitted with a switch that is provided with several contacts. That, however, can be cleaned up in much the same way as described for the sliding adjustment coil.

If "no results" is still the case, test the telephone cords. One of the wires running from the two connections that are fixed to the set, up to the earpieces, may have become broken inside the cord. Too much twisting and kinking of the telephone cords will often cause this to happen. You can invariably trace a faulty telephone cord by gently running the fingers up and down it, squeezing and compressing it both sideways and lengthways. This will probably cause the broken ends of the wire to touch and a click, grating noise, or even signals will definitely locate that as the cause of all the trouble.

If your set is fitted with what is known as a variable condenser—an instrument capable of adjustment that plays almost as important a part in the tuning of the inductance coil—then that may be the destroyer of reception. Possibly the little semi-circular sheets of metal—known as the vanes—inside have become bent or misplaced, with the result that those that move when the knob is twisted are touching those that are fixed. This causes what is known as a "short circuit," which means to say that the current can quickly jump from the moving vanes to the fixed vanes where they touch each other without troubling to go through the coil and other parts of the set at all, because in the majority of cases the variable condenser is joined up right across the coil. Test this anyway by disconnecting one of the wires that are fixed to the variable condenser. By so doing you remove that possible "short circuit."

Another possible cause of the trouble lies in a very inaccessible place—inside the telephone receiver earpieces. However, it is not very often that both earpieces will develop a fault simultaneously, although if one breaks down it causes the other to stop working as well. This is because the current of electricity representing the signal must flow through first one earpiece and then the other. If a break in the circuit exists in either the one or the other it is obvious that the current is held up and can pass through neither.

After All That.

This can quickly be tested by connecting the two small terminals behind the earpiece of one receiver together with a small piece of thin copper wire, testing for results, removing the small piece of wire and trying out the same test on the other receiver. If the set should work during this test, then the receiver earpiece that has its small terminals connected together will be the faulty one.

After all those tests I am going to cause you to dislike me and suggest that the failure may be due to aerial or earth faults, or even purely unsuitable atmospheric conditions. This latter is called "fading" by technical wireless people, and covers all sorts of failures that they cannot otherwise satisfactorily explain. However, it is very advisable to get to know just what might happen and how to run over a set in a minute.

All those tests that I have just described wouldn't take an expert longer than a few moments to carry out, and did the fault exist in the set or its immediate connections it would be located very quickly; if not, the set would be passed as "O.K.," and then the aerial and earth examined. The efficiency or otherwise of these are, however, dealt with in other articles in this supplement.

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. Which is the positive terminal of a pocket lamp battery ?

A. The shorter brass strip is usually the positive terminal.

* * *

Q. What does " in series " mean ?

A. This means that the additional instrument has been connected in to the existing circuit so that *all* the current will have to go through the new piece of apparatus as well as through its former path. No parallel or alternative path is provided, as in the case of a " shunt " connection.

* * *

Q. What is a primary battery ?

A. A primary battery is one in which the chemical substances are so arranged as to generate an electric voltage and current. A secondary battery, however, is only really a storage cell. Electricity is stored by means of making an electric current change the formation of certain chemicals, which afterwards go back to their original state and thus give rise to an electric current. The primary battery needs no such initial electric current, but generates the electricity directly from the action of various chemicals.

* * *

Q. What is a " carrier " wave ?

A. The continuous wireless wave sent out by a telephony station. Upon this wave are imposed impulses corresponding with the variations of the speaker's voice, and these impulses ride along on the " carrier " wave, as it were ; hence the name " carrier."

* * *

Q. What is meant by so many watts ?

A. A watt is the electrical unit of power. It is the power used when one ampere of current is forced through a resistance of one ohm. Or it is the power expended when one volt (pressure) forces a current of one ampere along a conductor. It is the mathematical product of one volt and one ampere. One horse-power is equivalent to about 746 watts.

* * *

Q. In wireless diagrams, which is the positive terminal of the batteries ?

A. The long strokes generally denote the positive terminals of the batteries, and the shorter and usually thicker lines represent the negative poles.

* * *

Q. What is a loose coupler ?

A. An electrical apparatus consisting of two coils through one or both of which a current is flowing. They are not connected together in any mechanical way, but are fairly close together, close enough to allow the magnetic field of one—caused by the current flowing inside it—to act on the other coil, and vice versa. The coils are usually movable, so that the distance between them may be varied ; that is, the coupling is varied. By this means the action and reaction of one or the other may be regulated.

Q. If a set causes interference, how far can that interference be heard ?

A. This, of course, depends largely upon the power of the oscillations sent out, and upon the sensitivity of the receiving station. Usually the interference will not be objectionable at a distance of more than a mile away ; very often it is less, though it may be heard faintly up to three or four miles by those who have multi-valve sets.

* * *

Q. Can burnt-out valves be repaired ?

A. Yes ; there are one or two firms that have lately taken up the repairing of burnt-out valves.

Q. What causes atmospherics ?

A. There are many causes of the disturbances called atmospherics. In some cases the presence of a thunderstorm will electrify the air, and thus give rise to small discharges of electricity down the aerial. Low-lying rain-clouds sometimes become electrified, and these also cause discharges down the aerial. Electrical storms on the sun—very often of tremendous power—frequently so upset the surrounding space that electro-magnetic disturbances of varying intensities are caused around the earth, and these also give rise to the peculiar discharges known as atmospherics.

The Countess of Westmorland broadcasting from the Manchester station.

[Photo, Metropolitan, Vickers.

Q. Does the length of the lead-in have any effect on the efficiency of the aerial ?

A. Yes ; a long lead-in should be avoided, if possible, though not if this will entail lengthening your earth wire very considerably. The lead-in should be as direct as possible and as vertical as possible, otherwise the effective height of the aerial will be lessened.

* * *

Q. Should all the cells in the accumulator " gas " when fully charged ?

A. Yes ; if you find that one cell is not gassing, it will probably contain an internal short circuit. This must be searched for and removed. You will possibly discover that a small piece of one of the plates has crumbled off, and is lodged between two plates, thus shorting them. The sediment that collects at the bottom of accumulators may be touching the plates. If this is the case, clear the cell out and re-fill with fresh acid of 1·25 sp. gravity, and then put the battery on a slow charge until all the cells have been gassing evenly for about two hours.

Q. How do I obtain an experimental licence ?

A. Write to the secretary of the G.P.O., London, and ask for an experimental licence form. This must be filled in and returned to the G.P.O., together with two references stating that you are of British nationality. Do not send the necessary fee, 10s., until you are asked for it.

* * *

Q. I can tune down to about 250 on my set. How can I get lower wave-lengths than this ?

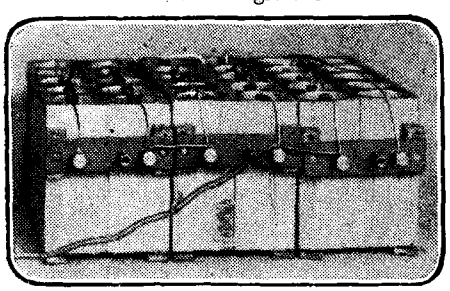
A. You will find that a small condenser in series with your aerial will enable you to tune down to about 190 metres. If you are using a variable condenser for tuning, connect it between the aerial lead-in and the aerial terminal on the set. A ·0005 mfd. condenser will do quite well, if you do not already possess one. If you have one connected in parallel, disconnect it and place it as above, when you will find that your wave-length minimum will be much lower.

A UNIT H.T. BATTERY.

THERE have been many articles published dealing with H.T. batteries reconstructed from disused dry cells, but very little has been said about the containers, which is an important and difficult part, especially when forty or fifty are required, and after many failures I have made them up in the form shown in the photograph. As will be seen, they are made up of ten cells each, with an ebonite strip in the front to carry negative and positive terminals with a valve leg in the middle drilled out to $\frac{3}{16}$ in. and a spring fitted in the side to ensure good contact: $\frac{3}{4}$ in. of $\frac{3}{16}$ in. brass rod is next drilled $\frac{1}{8}$ in., $\frac{1}{4}$ in. deep, and then $\frac{1}{16}$ in. through to solder a flexible lead; the wire, of course, being taken right through and soldered from the top, ensuring a neat finish and reliable plug.

In Blocks of Ten.

The containers are made from the wooden boxes sold by stationers for the purpose of posting glass bottles, and are made and turned from one piece. It is necessary to saw a piece off the top as they are rather long for the purpose, but when measuring off allow about $\frac{1}{2}$ in. extra depth, the reason for which will be given later.



An H.T. Battery unit.

After cutting off it is advisable to glass-paper the inside and top. They are now boiled in wax. Now get some 20-gauge music wire and make 28 staples $\frac{1}{2}$ in. across with $\frac{3}{4}$ in. prongs, and square corners. While the boxes are still hot with the wax, fasten them together with these at the top and bottom (the reason for fastening while hot is to obviate the blunt staples splitting the wood).

Screw two pieces of wood at the end for the ebonite strip, and a small piece of ebonite at each corner at the bottom for legs.

Now replace in the wax, which should not be too hot, to fill up the spaces between the boxes, and the whole ten will come out as one solid block. Now pour about a dessertspoonful of wax in each. This is necessary, as the boxes being made of soft wood, and the grain running down, they are liable to leak if this precaution is not taken.

The following few remarks as regards the sacks may be of interest. The best method of removing these is to saw up the soldered seam with a hack saw, care being taken to only just go through the zinc, and then sawing off the bottom as closely as possible. It is then quite simple to remove the sack by opening out the zinc, and very often this can also be used.

If the sacks are found to be coated after cleaning, put them in dilute spirits of salts for a few hours, after which they will be found to be quite clean.

For separators I have found rubber rings to be the best.

These units will give about 15 volts, and the recharging is considerably simplified by having them in clusters of ten.

AN INDUCTANCE COIL FOR BROADCASTING RECEPTION.

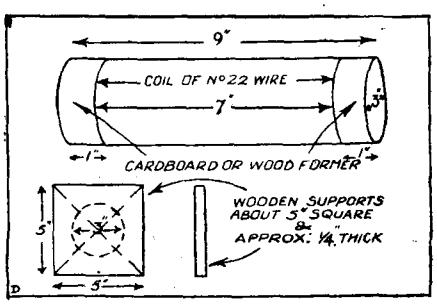
IT is a common saying that one must walk before one can run, and as this article is intended for the beginner it is presumed that a crystal detector is to be used in conjunction with the coil about to be described. For the benefit of those readers who wish to make the piece of apparatus in question, dimensions are given in the accompanying illustration, but, with the exception of the actual former on which the wire is wound, they need not be strictly adhered to.

A piece of cardboard tubing or a wooden cylinder about 3 ins. diameter and about 9 ins. long should be obtained, together with two pieces of wood approximately 5 ins. square and from $\frac{1}{4}$ in. to $\frac{1}{2}$ in. thick. These two pieces are to form the supports for the coil. Two square brass rods 10 ins. long fitted with ordinary sliders are also necessary, and can be purchased from any of the numerous dealers who retail component parts of wireless apparatus.

If a cardboard former is used a further brass rod $\frac{1}{8}$ in. in diameter and about 10 ins. long should be bought, care being taken to see that this rod is threaded for a short distance at each end and fitted with nuts.

Winding on the Wire.

Four brass screws and 4 ordinary terminals will complete the items required. The former or tube on which the wire is to be wound should then be thinly painted with shellac, and as this begins to dry the wire should be wound over it; $\frac{1}{2}$ lb. of single cotton copper wire of No. 22 gauge should do for this purpose. Beginning at one inch from one end of the tube, wind the wires firmly and evenly to within one inch from the other end.



As an added precaution, the wire may then be given another coat of shellac to keep it in position and to obviate any chance of its slipping or overlapping. Attention should then be given to the two supports.

After finding the centre of each, a circle should be described from this point with a compass, the diameter of this circle being the same as that of the inside diameter of the cardboard tube or of the wooden former. Within the bounds of this circle a cross-piece should be fitted at either end.

The terminals should then be mounted on the base board, one end of the coil being connected to the earth terminal. The two brass rods with their attendant sliders should be fitted over the coil, at the same time as the former is joined to the upright supports. The top slider rod should then be connected to the terminal marked "Aerial."

A coil so constructed will cover a range of wave-lengths from 200 to 600 metres approximately, and will therefore not only include the broadcasting wave lengths, but will also enable the operator, if he is "au fait" with the Morse code, to pick up signals from ships on the commercial wave-length of 600 metres.

BOOK REVIEW.

The Radio Pathfinder.. By Richard Ranger. (William Heinemann. Price, 6s. net.)

This book strikes a distinctly new note in radio literature. The text is crisp and informative without being unduly technical—just the thing for the new amateur. The illustrations are certainly very original: an electron is shown as something between a puckish imp and a gnome, but the idea of showing the various effects manifested by the valve in this fashion is not to be sneered at: in fact, the new amateur will find it distinctly helpful and very far from boring.

CATALOGUES.

We have received from Radio Instruments, Limited, a tastefully prepared little brochure describing their cabinet type receivers. These range from a table model, in appearance similar to that of a hornless gramophone, to the more ambitious cabinets of Jacobean and Chippendale design, which are absolutely complete in themselves, having small frame aerials embodied in the actual construction. For those that are able to obtain one of these instruments is provided a handsome piece of furniture as well as a set whose reliability is guaranteed.

A VERNIER CONDENSER FOR PANEL MOUNTING

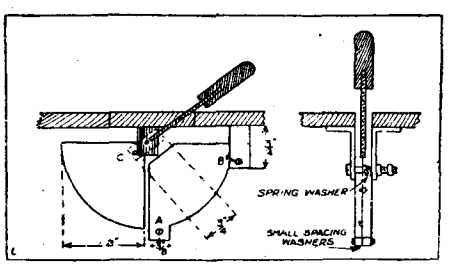
MOST circuits employing a valve are very critical, and a Vernier condenser is practically a necessity. With many amateurs space is a great consideration when constructing a panel. The following is a very effective and compact Vernier condenser for panel mounting.

It consists of one movable plate revolving between two fixed plates. The plates are cut out of sheet zinc or aluminium, the fixed being a quadrant of a circle 2 inches in radius, fitted with lugs $\frac{3}{8}$ in. square at the two corners, A and B (see Diagram). These lugs are drilled with a 4 B.A. clearing drill. The movable plate is the same size as the fixed plate, the only difference being the absence of the lugs.

Method of Adjustment.

A small hole is drilled in the right-angled corner, C. A piece of copper or $\frac{1}{16}$ brass about $\frac{5}{16}$ in. by $\frac{3}{4}$ in. is next cut out and drilled in the centre, and is also drilled $\frac{1}{8}$ in. from one end. A piece of threaded rod $1\frac{1}{2}$ in. long is cut $\frac{1}{4}$ in. down its length, and the piece of copper soldered into the slit.

An insulated handle is prepared by drilling one end of a piece of ebonite rod 1 in. long half-way down its length, and tapping the hole to fit the threaded rod from



the plate. The movable plate is bolted to the strip of brass or copper. Two pairs of fairly strong brackets are cut from $\frac{1}{16}$ in. brass, one pair being $\frac{3}{4}$ in. by $\frac{3}{8}$ in. for holding the fixed plates, and the other pair being $\frac{5}{8}$ in. by $\frac{3}{8}$ in. for pivoting the movable plate. They are now drilled 4 B.A. (clearing) on their longest arm $\frac{1}{4}$ in. from the end.

When mounting the condenser it is necessary to cut a small slit in the panel for the controlling rod to project through. This can be easily accomplished by marking out the slit with a scriber and then drilling a series of holes close to one another down the panel. These are connected to each other, and finally squared by means of a small file to form a rectangular slit which should be $\frac{1}{4}$ in. by $1\frac{1}{2}$ in.

Assembling the Parts.

The condenser is now ready for assembling. The two smallest brackets are screwed to the panel on either side, and at equal distances from either end of the slit in the panel. The piece of brass holding the movable plate is pivoted between these by passing a bolt through it and the two brackets. It will be found necessary to nsert a spring washer on the pivot, in order to make the condenser work fairly stiffly. This is essential because, were it otherwise, it would swing out directly the hand let go the controlling handle.

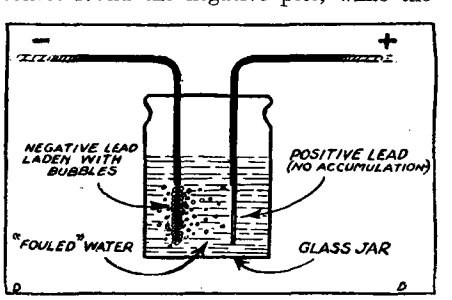
The two larger brackets are screwed to the panel directly in a straight line with the others and $1\frac{3}{4}$ in. from them. It is very important to have them in the same straight line, or great difficulty will be experienced in preventing the plates from touching. The plates are fixed to these brackets by a nut and bolt, and are separated by two small spacing washers. Another nut and bolt with spacing washer is passed through the other lug for additional firmness.

The ebonite handle is screwed on to the screw projecting through the slit in the panel. By moving this handle backwards and forwards it will be found that the movable plate swings smoothly between the fixed plates. Good connection can be made to the movable plate by putting an extra nut on the end of the pivoting screw, and using this as a terminal. This method can also be used with the fixed plates.

SIMPLE POLARITY INDICATOR

A QUICK yet simple method of ascertaining the polarity of the leads taken from a source of electrical supply is shown in the accompanying diagram. A glass container is filled with water, and the ends of the two leads, bared of all insulation, immersed in the liquid.

The action of the circuit thus completed by the water will cause small bubbles to collect round the negative pole, while the



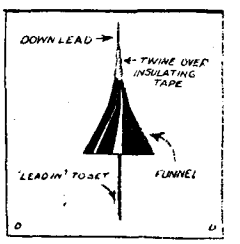
positive lead remains to all intents and purposes free from any such accumulation.

The writer first remembers this method of finding polarity being demonstrated at a lecture in 1913, when the lecturer used a single dry cell, two lengths of bell wire, and an ordinary half-pint glass. The water used was drawn from a drinking tap, and "fouled" with common table salt. It should be remembered that the results are less apparent when pure water is used.

It is a handy wrinkle, but one which is hard to beat for simplicity; and, moreover, possesses an added advantage in the fact that the material required to determine the polarity is easily obtainable and costs practically nothing.

HOME-MADE CONE INSULATOR

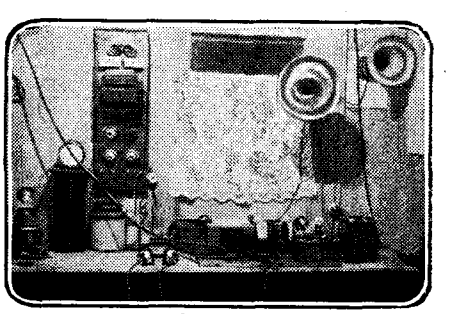
THE expression "cone insulator" will be familiar to all professional wireless operators, and also to a good many advanced amateurs. This type of insulator does not appear to be so well known to the beginner, however, as it is the writer's experience that such insulators are only conspicuous by their absence on the majority of amateur installations. The insulator is used at the bottom end of the down lead from the aerial, and is constructed and installed with a view to preventing rain from running down the lead-in and reaching the apparatus; and in some cases it is so constructed that it may be used to relieve the tension imposed by the strain of the down lead.



An ordinary funnel of the type used by oil merchants for distributing paraffin oil makes an ideal insulator, if treated in the following manner.

To Prevent Corrosion.

The down lead should first of all be run through the funnel until it is in the required position. The point of the funnel should then be closed by plugging it tightly with sealing-wax from the inside of the funnel. Insulating tape should then be firmly bound, as shown in the illustration, over the last inch or so of the tube of the funnel



A neat home-made receiver by Mr. F. G. Allen, of 58, King's Road, S.W. 19, London.

and along the down lead for a distance of about 2 in. The tape, in its turn, should be firmly secured by means of stout twine. The whole funnel should then be heavily coated with shellac or bitumastic to prevent corrosion. By the installation of such an insulator water collecting on the down lead during bad weather and running down towards the set will be prevented from reaching the apparatus.

TO READERS.

Readers are invited to send along the results of their experiments for publication in POPULAR WIRELESS. If accepted, they will be paid for at our usual rates. Copy should not exceed 1,000 words in length. Diagrams need only be roughly drawn.

GEARY GOES IN FOR WIRELESS.

Wireless is not always the desperately staid and serious business that some people make out, as the adventures of Geary, given for the first time to the world in "Popular Wireless," prove quite clearly.

By HIGHAM BURLAC.

I HAVE mentioned my neighbour, Geary, before. He is the fellow who began scoffing at my spare time larks with a wireless receiver, but was brought into a proper frame of mind by my wireless waltzes on the lawn. Six months after he got his first set he had become such a radio-fiend that when his amplifiers were given a real chance they used to disrupt the ordinary life of our peaceful burg. He could shatter the glass in a greenhouse when he turned on the man at the Croydon Aerodrome speaking F-r-rench. With Eiffel Tower's time-signals shot out of a Super-sonorous Triple-amplifying Hydraulic Mark 1 Stentorium he blew a Professor of Chemistry off a tricycle and imbedded him in the east wing of the Clapham Cat's Home. M'yes.

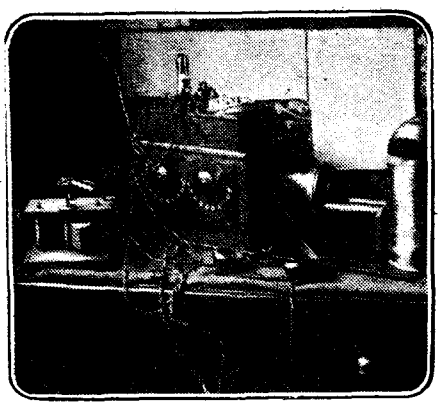
But I'll say this much for Geary—don't imagine I have anything against him—he's thorough. No half measures for Geary, but one-and-a-half. He's the sort of chap who buys a book about Correggio before he starts to hang a picture, and then requires one wife, one servant and various assorted kids to stand by and hold things. Believe me, Geary's domestic bliss was worn as thin as Johnny's pants before the banisters were studded with nails, over the business of installing his first wireless receiver.

Mining Operations.

The bother began about the aerial. Geary proposed to erect an eighty-foot mast. Nothing mean about Geary. I pointed out that at least two of the guy-ropes of such a mast would have to be anchored in Balham, whereas his licence authorised him to operate in Clapham only, and in the premises, demesne and messuages of 12, Acacia Gardens at that. Geary looked grave and bought "Every Man his own Lawyer," the author of which unhappily overlooked wireless telephony. I advised Geary to take Counsel's opinion on the matter or to petition the municipal powers of Balham, but he had a sudden cold fit and said he would like a poor aerial—as an incentive to greater manipulative skill and superlative choice of design.

So he contrived to fix an aerial to "Marconi's Crow," the weathercock on his summerhouse, of which I told you on another occasion. Have you ever seen an excited pup trying to pick up a plate which lies on a slippery floor bottom upwards? If not, better try it. For side-splitting properties I bracket this equal to the performance of a monkey which has eaten a piece of bread dipped in weak toddy. If you have, then you need no description of friend Geary chasing a dancing and elastic downlead on a windy day, with a rapidly cooling soldering-iron in his hand.

Then there was that earth-plate. After trying in vain to scrounge in succession the family bath, young Bill Geary's bicycle, the dustbin, and the geyser, he decided to bury a tin trunk large enough to hold a couple of St. Bernards. "Bury it deep," I croaked, hoarse with an emotion not recognised in Sunday schools. I also had once made an "earth" and the importance I attributed to the earthplate in a



Mr. G. Kennedy's home-made Set, 5, High Barnes Terrace, Chester Road, Sunderland.

wireless station decreased as the hole got deeper.

Well, the Geary gang flung themselves into a fury of energy upon the surface of the kindly earth and delved like "pukkha" navvies. Whenever Geary went on shift I used to sing "Don't go down the mine, Daddy," and ask him to keep a good look out for fossils. At two feet below the ground the explorers came upon bones. Many bones, with real meat. What thrifty dogs Clapham must have bred long, long ago! A hefty knuckle of lamb now resides under a glass case in Geary's study. He calls it a relic of neolithic man.

To cut a long story short—they found the water main—with a pick. Still, as I said to Geary, there's nothing like a good damp "earth."

He began with a crystal detector, which to Geary was as a stoneless catapult to a boy. He said the signals were anæmic. I should like you to have seen him, telephones clamped to his ears as limpets to a rock, turning round to glare at the luckless canary if that fowl but uttered one joyous "cheep." A study of righteous but restrained indignation. If anyone sniffed, Geary would slowly divest his head of the telephones and with admirable self-control refer impersonally to the Tower of Babel, the cockatoo house at the Zoo, and the local boiler factory. In fact, Geary, when disturbed, reminded me of the schoolboy's essay, in which appears the following moving sentence:—

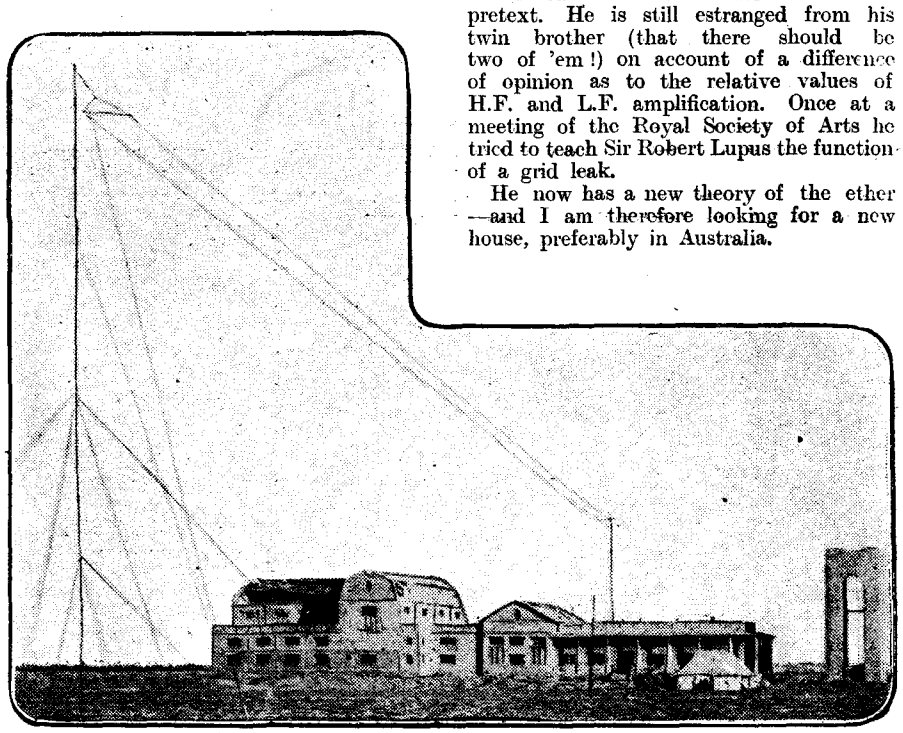
The elephant is a noble beast, but when enraged he will not do so.

Well and Truly "Bitten."

Things improved when Geary began to adventure with valves, though his accumulators worried him so much that he thoroughly showed up electricity in a series of brilliant letters (unpublished) to the "Clapham Free Advertiser." For one tremendous month he performed his own cell charging in the cellar, incidentally poisoning the canary and turning all the cutlery green. This enterprise came to a sudden end owing to Geary's attempt to test the voltage of ten cells in series by means of a £20 milliammeter borrowed from Clapham College—without explicit permission—by Geary, jnr.

Nevertheless, in spite of preliminary setbacks, even in spite of my expert assistance, Geary succumbed to the bacillus which inhabits wireless apparatus and would foam technicalities on the smallest pretext. He is still estranged from his twin brother (that there should be two of 'em!) on account of a difference of opinion as to the relative values of H.F. and L.F. amplification. Once at a meeting of the Royal Society of Arts he tried to teach Sir Robert Lupus the function of a grid leak.

He now has a new theory of the ether—and I am therefore looking for a new house, preferably in Australia.



The Turkish station at Bagdad (S.T.K.). A 100-kw. Telefunken set was used. The station was wrecked in 1917.

THE RADIO ASSOCIATION

Formed some months ago in order to protect the amateur and "listener-in," and to generally assist wireless enthusiasts, the Radio Association has made great progress. The following report has been sent to the Editor by the Hon. Secretary.

THE Executive Committee beg to announce that the Hon. Sir Arthur Stanley, C.B.E., C.B., M.V.O., has accepted the presidency of the Radio Association.

It need hardly be pointed out the great value this acceptance will be to the association. Sir Arthur Stanley is treasurer of St. Thomas's Hospital, chairman of the joint council of the British Red Cross Society and the Order of St. John. He is the son of the 16th Earl of Derby, chairman of the Automobile Association, and president of the Junior Car Club. He is particularly interested in the installation of radio sets in hospitals.

After a period of comparative obscurity, the progress of the Radio Association in establishing itself as a permanent body for the protection of licence holders and potential licence holders has apparently taken many by surprise. The applications for enrolment forms are pouring in, and the executive committee take the opportunity of informing all applicants that their letters are being dealt with as quickly as possible.

Those members prepared to assist in the establishment of branches in their districts are requested to communicate at once with the organising secretary, who will render all help possible, and send speakers if required. A list of district secretaries is given below.

Licence holders are reminded that the subscription to the association is 5s., and for this modest sum adequate protection is offered, and the member has the opportunity of hearing interesting lectures, taking part in debates, and receiving general technical advice. Tuition in Morse is also given.

All those interested in wireless are informed that the Radio Association is composed entirely of amateurs, and in view of passing events it is more important than ever that an association composed of amateur experimenters and broadcasting licensees should be in being. The Radio Association is an accomplished fact, and it has come to stay.

An enrolment form, set out below, should be completed and forwarded at once to the organising secretary, Capt. G. Drury Coleman, 44, Great Russell Street, London, W.C. 1.

PROVINCIAL HON. DISTRICT SECRETARIES.

Aberystwyth.—A. W. Miller, 39A, Queen Street.

Altrincham.—Frank Bevan, "Hammersley," Gasket Road.

Ayr, N.B.—J. Blair, 24, Marchfield Road.

Birmingham.—F. H. Bevan, 51, Summer Row.

Bristol.—V. W. Russell, 14, Park Row.

Bognor.—Wm. H. Sinnott.

Blaxwich.—A. V. Perry, 66, Park Road.

Cardiff.—D. V. Hutchinson, 3, Severn Grove, Canton.

Chatham.—A. E. Ryeland, 381, High St.

Derby.—F. S. Gelsthrop, 20, Corn Market.

Dublin.—James Kitchin, 24, Northumberland Avenue, Kingstown.

Edinburgh.—H. A. Herdson, 103, Comiston Road.

Glasgow.—H. Buchanan, 26, Findlay Street.

Gravesend.—Frank Ballard, Lock Offices, Canal Basin.

Halstead.—G. H. Hayward, Ipswich House, High Street.

Liverpool.—S. Firth, 6, Cambridge Road, Great Crosby.

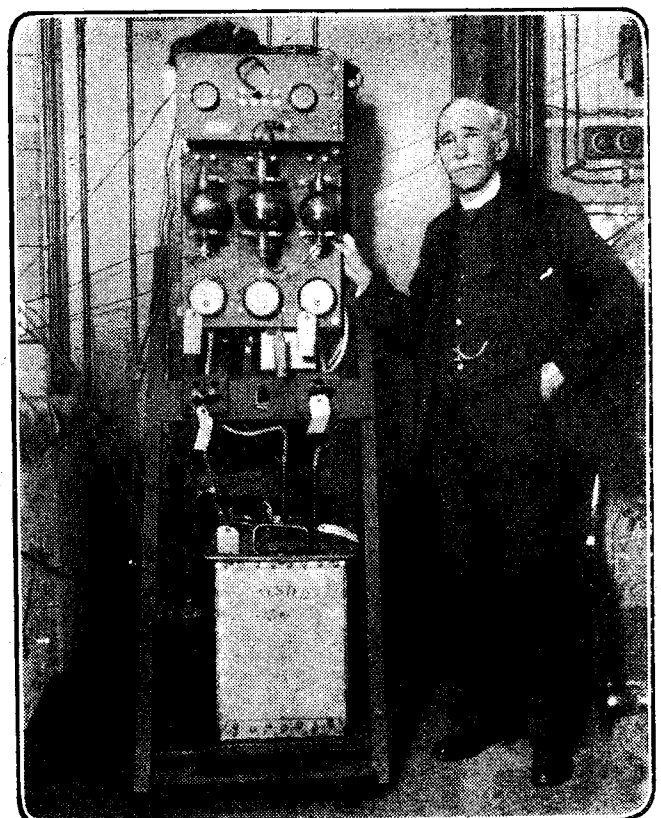
Leeds.—A. Bull, 40, Bentley Lane, Meanwood.

Loughborough.—D. Price Jones, 45, Foothill Road.

Morayshire.—Thos. B. Miller, "Ash Lea," Hopeman, N.B.

Newcastle-on-Tyne.—Norman Thompson, "Lyndhurst," Swindon Terrace, Heaton.

Rugby.—J. Gambrell, "Wyndsore," 36, Manor Road.



Dr. J. A. Fleming, the inventor of the valve, who recently broadcast a lecture from 2 L O.

Rotherham.—Geo. Smith, 19, Katherine Street, Thurcroft.

Sheffield.—Jas. F. Grimbly, 13, Fairthorn Road, Firth Park.

Southsea.—John H. Harrold, 11, Albert Grove.

Stourbridge.—J. P. Smith, "Sherwood," Bridgenorth Road, Wollaston.

Tipton.—F. J. Pearson, 13, Ashton Street, Loll End.

Warrington.—W. H. Taylor, 37, Bridge Street.

Welshpool.—A. E. Bond, Havelock Ter.

Watford.—H. R. Scobell, 322, St. Albans Road.

Whitby.—R. G. Oliver, 12, Waverley Avenue.

Wakefield, E. Watson, "Ash Lea," Outwood.

METROPOLITAN.

Acton.—L. A. Salinger, 83, Henchman Street.

Brockley.—C. R. Rice, 111, Upper Brockley Road, S.E.

Brixton.—D. G. Fowler, 84, Brixton Hill, S.W.

Central.—J. Treadwell, 4, Shipton Street, S.E.

Clapham.—H. Sinclair, 115, High Street, S.W.

Kensal Rise.—R. W. Mann, 23, Lindon Avenue.

Kentish Town.—T. W. Cavanagh, 13, Sandall Road.

Shepherd's Bush.—F. Gain, 8, Clematis Street, W. 12.

South Norwood.—C. H. P. Nuther, 243, Selhurst Road, S.E. 25.

Woolwich.—H. W. Atkinson, 226, Plumstead Common Road.

Wood Green.—S. H. Tripp, 100, Lindhurst Road, N. 22.

Wandsworth.—O. C. Lay, 46, The Grove, S.W.

WRITE to the nearest branch secretary or head office.

SUBSCRIPTION FORM.

To Professor A. M. LOW, D.Sc., A.C.G.I., F.C.S., F.I.P.I., Hon. Treasurer.
RADIO ASSOCIATION, 44, Great Russell St, (Opposite British Museum) London, W.C.1.

Date.....192....

Dear Sir,

Please enrol me as a Member of the Radio Association, for which I enclose annual subscription of 5s.

Name in full .....
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Occupation .....
Address .....
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Are you a Member of any Local Wireless Club or Societies? If so, state names and addresses
.....
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An Apology

from the pioneers of the Standardised Unit System

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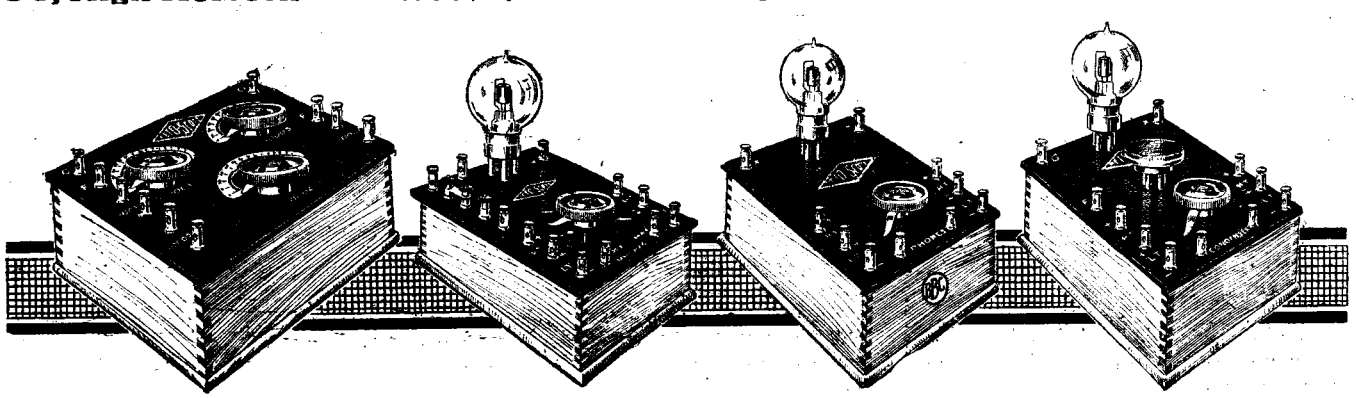

WIRELESS CLUB REPORTS.

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 Portsmouth and District Wireless Association.*

A meeting of the above association was held at the club-rooms on February 7th, with Mr. J. H. C. Harrold, A.M.I.R.E., in the chair. Mr. A. Gall, the treasurer of the Association, had been booked to give a lecture, and gave a most interesting talk on "Hints to Amateurs." Mr. Gall advised all amateurs who were erecting their own sets not to scamp their work, but that, while they had the opportunity, to do the work well and gain better results. He then explained various details which amateurs are apt to overlook when erecting a set, but which improved their sets. Mr. Gall then explained various circuits as used by amateurs in the United States. A hearty vote of thanks was given Mr. Gall for a most interesting talk.

After the lecture, an auction sale was held. The club had a great number of component parts for which it had no use, and these were disposed to members very much below cost.

The secretary, Mr. S. G. Hogg, would welcome inquiries as regards membership to the club. His address is 9, Pelham Road, Southsea.

The Wireless and Scientific Society of Bridlington.

On Tuesday evening, February 6th, Capt. W. E. Dennis, of Hull, lectured on "Wireless for the Amateur and Broadcasting." After outlining the ether theory and describing the methods by which disturbances were set up in it, he went on to the action of the spark transmitter and its circuits. He then outlined the action of the valve for the detection of wireless signals and explained heterodyne reception, with all its advantages and disadvantages, the latter chiefly from the point of view of the "other person."

At 20.30 the Eiffel Tower commenced to transmit, and for a period of about twenty minutes broadcast an excellent concert for the special benefit of the society. The best thanks of the society are due to Captain Metz for so kindly arranging for the transmission from the "Grandfather of Wireless."

Prospective members are requested to forward their names and addresses to the hon. secretary.

Hon. sec., Mr. Maurice A. R. Horspool, Darley, Marton Road, Bridlington.

Acton and District Radio Society.

This society held their first meeting on Wednesday, February 7th, at headquarters, Borough Council Offices, Winchester Street, the president, D. V. L. Fellows, Esq., better known to listeners-in as 5 C P, in the chair. The greater portion of the evening had to be given up to framing and discussing the rules and appointing officers.

A very interesting demonstration was given by one of the members with a special super-regenerative set of his own construction.

The society now totals forty-five members, and it is hoped before the next fortnightly meeting to have an aerial erected and a three-valve panel, which has been presented to the society in working order.

The secretary, W. J. Akerman, 4, Church Road, Acton, W. 3, will be pleased to receive applications for membership.

Wireless and Experimental Association.*

The Wireless and Experimental Association's meeting at the Central Hall, Peckham, on the 14th of February, was so crowded that several members had to stand round the room.

We have at last secured more ample accommodation at the Camberwell Library, and are "moving in" as soon as we can.

We all rejoiced in the signal honour conferred upon Sir Frederick Hall, Bart., our vice-president, and signified the same in the usual manner.

The little printed cards giving names and addresses of the committee are admirably filling the purpose intended.

Questions too numerous even to tabulate were completely answered by our technical staff, and the wavemeter and loud speaker propositions were satisfactorily handled.

Assistant hon. sec., G. H. Horwood, 557, Lordship Lane.

Grays and District Radio Society.

At a meeting held on February 1st, Mr. L. Freeman, the organiser, put before a good audience the proposition of starting a wireless club for the district. After much discussion it was decided to form a committee to draw up rules, etc., and report to another meeting the next week, which was held at the Victoria Hall, Grays, on Thursday, February 8th.

The above society was formed and put on its legs at this meeting, and the whole of those present, numbering 39, became members. It was decided to hold meetings the second Thursday and fourth Tuesday of each month.

Anyone interested in wireless should become a member if they reside in the district. Full particulars will be gladly sent to anyone writing to the hon. sec., Mr. Melville Richards, c/o Engineer's Office, 56, High Street, Grays, Essex. The first meeting of this society was broadcasted by 2 L O, and resulted in several being present who had not seen the advert in the local paper. Mr. L. Freeman was responsible for the idea, and it is one that no doubt the B.B.C. would carry out for any other proposed society, as it helps to build up "listeners-in."

Birmingham Experimental Wireless Club.

A very interesting evening, consisting of discussions on many wireless topics and difficulties, was held at the Digbeth Institute on February 9th. Some remarkably efficient apparatus was shown by the president, Dr. Ratcliffe, and also by Mr. Matthews, hon. treasurer. Dr. Ratcliffe gave much instructive information on the working of his set, and both the workmanship and the efficient method of coupling and reactance adjustment were much admired by all the members present.

Dr. Ratcliffe gave some interesting details of some new experiments he has been making on the accoustical improvement of loud speakers and telephones generally for reproduction of speech and music, and we are looking forward to hearing the result of his experiments when nearer completion.

Other members contributed to the discussion. We find these meetings very helpful to members, as we encourage our members to bring any difficulties they may have forward for general debate.

Hon. sec., A. Leslie Lancaster, c/o Messrs. Lancaster Bros., Shadwell Street, Birmingham.

The Wireless Society of Hull and District.

A meeting of the above society was held in the Signal Barracks, Park Street, on Monday, February 12th, at 7.30 p.m. Two points arose in the minutes of the last meeting which caused some discussion; the question of assisting the wireless society of the employees of Messrs. Atkins Ltd., Hull, in which case Mr. W. J. Featherstone volunteered to interview the manager: and, secondly, Mr. Featherstone agreed to do what he could to help a blind discharged soldier, who wished to possess a wireless set. Mr. G. H. Strong (in the chair) then called upon Mr. F. Brazendale to read a paper on "The Construction of a Single Valve Set and Note Magnifier." The paper proved very interesting and helpful, and a vote of thanks to the lecturer was proposed by Mr. A. W. Spreckley, and seconded by Mr. Featherstone.

LADY MACBETH HEARS THE SAD NEWS.

RADIOTORIAL

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

I have received some hundreds of letters from readers criticising my recent remarks on the licence question under the heading "The Licence Dodger." Some of the letters are frankly indignant in tone, others hopelessly despondent, others defiant, others (with no signature) admitting "guilt."

On the whole, I gather that the majority of readers who wish to make their own sets are quite in agreement with my suggestion: that the licence fee should be increased for those who wish to make their own gear. The general trend of complaint seems to be in the direction of uncertain policy of the G.P.O. with regard to this important question.

But it is quite likely that by the time these words are read the whole business will have been satisfactorily settled, and an arrangement come to whereby the amateur making his own gear pays extra on his licence fee. I wish it to be clearly understood, however, that I hold no brief for the B.B.C. or the G.P.O. My attitude to the whole question is impartial; only I want both the B.B.C. and the amateur to get fair play. And I am glad to say that most of my correspondents not only realise this but admit the same desire.

My remarks re the "dodger" who frankly refuses to pay any licence fee at all, and who deliberately sets out to "do" the G.P.O. and the B.B.C., holds good. Nothing can excuse this form of selfishness, for it means that this type of "dodger" is letting other amateurs pay for his amusement.

In the meantime, bear in mind that things move slowly in the official world, but if it be sufficiently "broadcast" that amateurs want another class of licence there is little doubt they will get it.

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, The 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. J. N. (Hornchurch) asks for a criticism of a four-valve set.

The diagram is just the usual conventional type, but you should have a ·001 mfd. fixed condenser across each low-frequency transformer primary. Your filament resistance should not get red hot. Do not use more than six volts for your low-tension supply, and wind the resistances (have one for each valve for preference) with thicker wire. Try No. 22 Eureka, and about 6 or 7 feet of it. You should also have a fixed condenser across your phones, ·001 mfd., and across your high-tension battery of about ·02 mfd. We think you will find that a larger variable condenser across your secondary tuning coil would be better. Try ·001 mfd. instead of ·0004 mfd. You state that your tuning is done by a variometer, though you show it as a coupled inductance in the diagram. If it is a variometer the last-named condenser is not needed, and the two coils (rotor and stator) should be connected in series with each other, and the whole in series with the aerial and earth the connections to the grid and filament of the first valve being taken from the top and bottom of the variometer windings.

* * *

P. J. L. (Sutton).—Where do I apply for an experimental licence?

Write to the Secretary, G.P.O., London, and ask for a form for this licence. This must be filled in as directed, and returned to the secretary.

* * *

R. W. P. (Tufnell Park).—What are the connections for a crystal and potentiometer?

Inductance to crystal, crystal to slider of potentiometer, ends of potentiometer are connected to two dry cells in series—total about 3·5 to 4 volts. From the junction between these two cells the connection to the phone terminals is taken, and from the other side of the phone terminals back to the inductance and earth. The phones will thus be connected to the middle or neutral point of the batteries, and the middle position of the potentiometer slider will be zero, movement to one side giving a potential in one direction, and to the other side a potential in the opposite direction.

A. B. C. (Hampstead).—What is meant by the effective height of an aerial?

The height which really counts as regards the effectiveness of the aerial as a receiver of electro-magnetic impulses. The effective height does not necessarily mean the maximum height of the aerial above the earth. A straight vertical wire with no horizontal run, would only have an effective height of about ⅔ its total height. This is because the induced E.M.F. at the upper end is not so useful in producing a current as that in the lower part, although the induced pressure is the same. The addition of the horizontal portion increases the capacity of the aerial and increases the effectiveness of the highest part of the aerial. If the horizontal is sloping downwards considerably, the effective height is again lowered, but if it is about level or sloping slightly upwards, the effective height of the aerial system is about equal to the actual height of the vertical wire.

E. N. (Moseley).—Which are the H. and which are the L.T. connections to the V 24 type of valve, which has one connection at each end and one each side? Which is the plate and which the grid connection, as the one that I possess is so blackened that it is difficult to follow the internal connections?

The two filament contacts are situated at the extreme ends of the valve, while the two side contacts are for the H.T., the coloured one representing the plate contact.

(*Continued on next page.*)

RADIOTORIAL QUESTIONS AND ANSWERS

(Continued from previous page.)

O. L. (Woking).—How does an aeroplane earth its wireless ?

The engine, bracing wires, and all the other metal parts of the machine are electrically connected, and employed as a capacity or balancing earth in most cases. In some other cases special wires are stretched between the fabric of the wings to serve the same purpose. Thus the trailing wire—which is let out from the machine like a fishing line, with a 2-lb. weight on the end of it to keep it more or less taut—the aerial, and the capacity earth form, as it were, a huge condenser, and function for purposes of both transmitting and receiving, just in the same way as an ordinary amateur aerial with its direct ground, water-pipe, or some such similar earth.

Does the height or direction in which an aeroplane is flying affect its wireless results ?

Owing to the fact that the trailing aerial wire tends to adopt the form of an "L" aerial, and its consequential directional qualities, it is found that transmission and reception is better when the machine is flying towards its communicating station. The higher that a machine flies, the greater seems to be the range of wireless communication possible, except where it is separated from the earth by low-lying clouds or mist. When it is flying immediately beneath these, the greatest ranges are obtainable. This is, of course, caused by the reflecting properties of moisture-laden atmosphere of the dense nature of low and consequently heavy clouds.

Does not the vibration caused by the engine and the bumping that seems to occur when the aeroplane alights on the ground tend to break valves which are supposed to be so delicate ?

The instruments are mounted on strong elastic springs, in order that vibration should be absorbed and not imparted to the valves. It must be added, however, that, in spite of such precautions, the life of the "aeroplane valve" is not a long one.

* * *

R. Y. T. (Nottingham).—Why does it always seem necessary for me to remove my earth wire before I can tune in 2 L O ? Would I not hear louder music from Marconi House if I could tune it in while my earth wire was connected to the set ?

Yes, you would obtain better results if you could obtain a correct tuning without the necessity of removing your earth wire. Possibly either your tuning coil or aerial has too great a capacity value, and will not permit the efficient tuning down to the shorter wave-lengths. If your aerial is, say, 60 or more feet long, a single wire will suffice. Perhaps you are employing a very long earth lead, in which case the capacity and inductance due to it, apart from the question of resistance, would preclude the efficient reception of short wave-lengths. Try placing a variable condenser in series with the earth lead and the earth terminal on the set. This will have the effect of reducing the capacity of the open (aerial) circuit.

* * *

"CAPACITY" (Croydon).—When constructing condensers, does it matter whether the plates are thick or only foils ? I mean, does it impair the efficiency of the instrument or alter its effective capacity ?

No ; as long as the material used is of a good conductive nature, the thickness is immaterial. The reason of this is because in a condenser you are dealing with static electricity, which, of course, rests on the surface of the plates.

* * *

S. E. D. (Thorpe Bay).—Why do not H.F. transformers have iron cores in the same way that L.F. transformers do ?

Because the presence of an iron core would greatly increase the inductance of the transformer. This increase in inductance would cause a very great increase in the impedance of the circuit, and this would choke the high-frequency oscillations and prevent them getting through to the grid of the detecting value. In the case of the low-frequency transformer, the large number of turns and the impedance are necessary as they choke any high frequency oscillations that are present, and also assist in tight coupling between the primary and secondary of the transformer, thus giving the maximum output.

(Continued on page 92.)

RADIOTORIAL QUESTIONS AND ANSWERS.

(*Continued from page* 90.)

E. K. R. (Wembley).—Why is it that my set will work quite well without any H.T. applied to it? It is a single valve set, and I am able to take off the H.T. battery, short the H.T. terminals, and still hear 2 L O quite well.

Your valve is acting in the manner of a two electrode Fleming valve rectifier, and merely rendering the received energy uni-directional. In the circumstances you should obtain much better results with the H.T. battery in circuit. If you are not, then there must be some slight fault in the circuit.

* * *

"ELECTRON" (Glasgow).—I find that I get better results when I disconnect the grid leak. Why is this? Is there any reason why I should not leave the grid leak disconnected if results are good?

No reason at all. Doubtless your grid condenser is "leaky." That means to say that probably the insulation resistance between the two terminals is somewhere around the order of grid leak resistance—*i.e.*, two or three megohms.

* * *

"PHONES" (Warminster).—I have two pairs of telephones of similar make, one pair of which will work all right by itself but the other won't. If I place them in parallel they both work, but if I place them in series neither pair will work. What is the cause of this peculiar behaviour?

No doubt there is a broken or imperfect connection in one of the earpieces, or the leads of the pair that will not function alone. Therefore, it is obvious that when placed in series, this bad connection would prevent the current from flowing through the other pair of telephones as well. When, however, the two pairs are placed in parallel, the pair that are OK would function and allow a free path—more or less—for the current, and would induce or allow a slight diversion of current into the faulty pair. This would be quite sufficient in the case of high resistance 'phones to enable them to reproduce signals more or less inefficiently.

* * *

"TRADER" (Brighton).—Is any licence or special permit required to make wireless apparatus?

No, not if the articles manufactured do not infringe existing patents. In this case licence for manufacture must be obtained from the patentees.

* * *

"QUERY" (Sheffield) asks for a criticism of his two-valve, tuned anode circuit, containing one H.F. valve and one detector.

Your circuit is fairly correct, but you will need to have the grid leak connected from the grid to the earthed filament, and the grid condenser in series between the plate of the H.F. valve and the grid of the detector. You will find that a '0002 or '0003 mfd. variable condenser will be most suitable across the anode coil; we do not think a '0005 or larger would be at all satisfactory. You can use variometer tuning for the anode if you wish, but the tuning will be very critical. Why not let the reaction coil couple with the anode coil, having each of the basket type? This would then obviate the risk of causing interference.

(*Continued on page* 94.)

RADIOTORIAL QUESTIONS AND ANSWERS.

(*Continued from page 92.*)

H. A. D. (London, E.C.).—Why is it that H.F. transformers are always wound with very fine wire, whereas resistance is supposed to be detrimental to efficient working?

The reason why H.F. transformers are wound with fine wire and thus given some fair resistance, is in order that they should possess just a slight tendency to aperiodicity. This means to say that there will be a certain amount of choking, although very small, which will cause the H.F. circuit to provide rather rough tuning. It is not advisable to introduce the extremely fine tuning possessed by a tuned anode circuit, for instance, where rather faint signals and not a great amount of wireless skill is available.

* * *

"RADIOFAN" (Bristol).—Instead of employing a single crystal which has even at its best a very great resistance, if four or five crystals were placed in parallel, surely a greater current would be available to flow through the phones?

At first it would appear that such would be the case, but unfortunately it is not so. Now, the function of a crystal detector is to rectify an oscillating current. It does this by offering a large resistance in one direction and a smaller in the other. For example, these resistances might be 100,000 and 10,000 ohms, so that it is not absolutely a unidirectional current that results, but an alternating current to a certain and very great extent stronger in the one direction than the other. As there is a resistance of 10,000 ohms in one direction and 100,000 in the other, we can say that there will be 10 times the current flow in the former direction. Now, if we place another similar detector in parallel with the original detector, the result will be that the resistance in each direction will be halved—*i.e.*, 5,000 and 50,000 ohms—so that you see the resultant current flow will still be only 10 times stronger in the one direction than the other, and although more might flow in the easier direction, there will, on the other hand, be more flowing in the opposing direction. Thus you will see that no real advantage results in the employment of more than one crystal detector on the one set.

* * *

F. C. (Radlett).—I have one of the Siemens-Halske valves, but cannot obtain any good results out of it. Why is this?

Probably you are expecting a hard valve to detect as efficiently as a soft one. When buying this type of valve you should endeavour to get a soft one if you wish to use it as a detector, remembering at the same time that you will probably have to alter the value of your grid leak to suit the valve. The harder variety of these valves will give good results as amplifiers if you use about 80 volts or so on the plate, and about 4 volts on the filament.

* * *

E. B. (Wanstead).—What is the best all-round insulating material for both indoor and outdoor work, apart from ebonite, which is so expensive?

A good, hard, dry wood well baked in paraffin wax.

(*Continued on page 96.*)

RADIOTORIAL QUESTIONS & ANSWERS.

(Continued from page 94.)

A. P. L. (Douglas).—When connecting an L.F. transformer and panel to a detector, does it matter whether the primary of the transformer comes between the plate and the H.T. battery, or between the H.T. battery and earth?

Not unless a further stage of L.F. amplification is contemplated, when it will be advisable to have the primary of the L.F. transformer nearest to the plate.

* * *

L. M. (Bedford).—I believe I am right in saying that using a mica dielectric a condenser would have five times the capacity of one of the same size using air. Does it always work in direct proportion? Supposing I double the number of plates, does that double the capacity? If I double the distance between the unlike plates, does that *halve* the capacity, and so on?

Yes, you are quite correct on all those points.

* * *

J. H. (Plumstead). I have made a variometer, using 26 gauge wire instead of 36. Will this be detrimental to the working of the instrument?

No, provided you have sufficient turns of wire to cover the wave-lengths required it will probably improve matters.

Using a perikon detector, how should the batteries and potentiometer be connected?

These are not necessary if you use that type of detector.

* * *

K. R. (Radlett).—asks for a criticism of his four-valve set.

Since you are using one H.F. valve and reaction we would advise the use of the loose-coupled type of tuner, using honeycomb coils and a two-coil holder. No, we would advise the reaction on the tuned anode coil rather than on the secondary of the aerial circuit. You will find this type of reaction is quite effective and it eliminates practically all chance of causing interference. We do not think you will find it satisfactory to work with one filament control for all the four valves. At least three controls should be used, one for H.F., one for the detector and one for the two amplifiers. The grid potential control potentiometer is not necessary, though it is desirable if very fine tuning is to be aimed at and if you wish to get the most out of the set. Yes, the control should act upon the grid of the H. F. valve.

* * *

J. T. C. (Swindon).—Can I use three 2-volt 40-amp. accumulators connected in series for the lighting of my valve filaments?

Yes, these cells will act quite well. No, you do not have to alter the connections when they are to be charged. Keep them in series all the time.

* * *

S. E. N. (Southampton).—Can a variometer be used for an anode coil on an H.F. amplifier?

Yes: this type of tuning will be found to be quite effective, and the tuning will be very critical. If you intend to use reaction coupled to this variometer it will be necessary to experiment a little before you find suitable valves for both coils. Unless the reaction coil is suitable there will probably be a great deal of howling due to too tight a coupling.

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