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Popular Wireless

and Wireless Review

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EVERY FRIDAY

No. 108, Vol. V.

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

June 21st, 1924.

A CHALLENGE TO MR. MARCONI

Sir Oliver Lodge Praises P.W. "Unidyne"

OUR SCIENTIFIC ADVISER'S REPORT IN THIS ISSUE

THE invention of the P.W. "Unidyne" circuit, which has created such tremendous interest in wireless circles, has now been thoroughly investigated, not only by trade experts, but by one of our greatest scientists. Wireless amateurs everywhere are installing the P.W. "Unidyne" with splendid results.

IN this issue the reader will find a highly favourable technical opinion and report on the P.W. "Unidyne" by the greatest living wireless pioneer, Sir Oliver Lodge.

IN this issue we also reiterate our challenge to Mr. Marconi and others to refute the claims of the P.W. "Unidyne."

"THE H.T.-LESS SET THAT WORKS"

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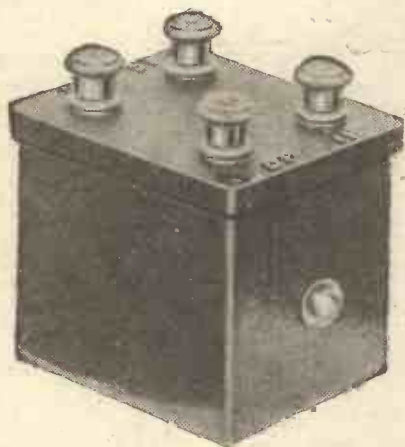
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POPULAR WIRELESS

AND WIRELESS REVIEW.

June 21st, 1924.] THE RADIO WEEKLY WITH THE LARGEST CIRCULATION. [Every Friday, Price 3d.

Technical Editor:
G. V. DOWDING, Grad. I.E.E.

Editor:
NORMAN EDWARDS, A.M.I.R.E., F.R.G.S.

Scientific Editor:
Sir OLIVER LODGE, F.R.S.

RADIO NOTES AND NEWS OF THE WEEK.

The Prince to Broadcast.

DOMINION Day Dinner will be honoured by the presence of H.R.H. the Prince of Wales. Speeches by the Prince and by the High Commissioner of Canada will be broadcast from 2 L O, so July 1st is a date to be remembered and reserved by all loyal listeners.

The B.B.C.'s Producer.

ABERDEEN'S popular station director, Mr. R. E. Jeffrey, is now taking charge in London of the dramatic productions of the B.B.C. Mr. Jeffrey is not new to this kind of venture, for he has already produced several plays in London. His appointment looks as though the B.B.C. intend to develop the wireless drama. I hope Mr. Jeffrey will refrain from giving us two or three plays consecutively in one evening. Those who do not care much for radio drama will never acquire the taste if they are given overdoses.

Marconi's Yacht.

WHEN Poldhu was calling Senatore Marconi's yacht recently (upon a wave-length between 50 to 100 metres) the vessel was lying off Dover. Originally built for an Austrian arch-duchess, the Elettra is beautifully fitted, and possesses a magnificently equipped experimental laboratory. Readers who heard the messages passing would do well to make a note of the adjustments, for they may be able to overhear some more of the interesting tests that are now being carried out.

CKAC.

MONTREAL now possesses a first-class high-power broadcasting station, which is owned by the French-Canadian newspaper, "La Presse." Since last winter, when this station was heard in England, the power has been greatly increased, and now a 7,000-watt transmitter is installed. This makes it one of the most powerful broadcasting stations in the world, and when conditions are favourable CKAC should be heard in Europe very clearly.

Canadian Wireless.

CANADA is discovering that communication by radio is a valuable asset in the Frozen North. Blizzards, snow, wild animals, and crashing trees are great foes to the land-line, but wireless requires no maintenance except upon the station premises.

Readers of the late Jack London's stories will recognise the names of the new stations which the Canadian Government are erecting, as the outposts of the Arctic. The Yukon and Mackenzie valleys, are to be linked by a chain of stations 1,600 miles long, and Dawson City can already be reached by radio.

not for what we receive, it looks as though they ought to stop the leak!

Wireless Frauds.

FOR systematic wireless frauds two men were sentenced in London to fourteen months' and to fifteen months' imprisonment, both with hard labour. Their names were George Wilde and James Wilde, and apparently George and James were not the only ones who were wild.

The New "Fading."

RADIO rogues are getting bolder, and a large number of shady gentlemen have now taken up wireless with the idea of enriching themselves at other people's expense. One system that they adopt is to advertise a wireless set which will be sent upon receipt of a first instalment. As soon as sufficient instalments have been received, the promoters commence to "fade" very badly. It is generally no use trying to tune them in again, because they have changed their wave-length, and are practising their hobby elsewhere. Readers should deal with reputable firms, or else be careful of how they part with their money.

That Aerial Switch.

DURING a thunderstorm an outbreak of

fire in Elwood Street, Finsbury Park, London, N., resulted in a call for the London Fire Brigade. Listeners who never bother to earth their aerials, and those who try to get nice sparking effects, should notice that the brigade discovered some of the indoor aerial-lead was missing. The point to remember is that an aerial which is directly earthed outside the house is a protection for the property.

Ulster Broadcasting.

THE arrangements for the Belfast station are well in hand, and probably we shall be listening-in to the Ulster programmes before the end of August.

(Continued on page 598.)



Entrance to the studio of the new Cardiff broadcasting station.

Radio Plays.

ENTRIES for the £50 prize offered by the B.B.C. for the best new and original play can be sent in until the end of July when the work of judging will commence. There is an entrance fee of 1s. 6d. to defray expenses, and MSS. should be sent to the London Play Co., Authors' Agents, 5, Piccadilly, W., on or before August 1st.

The Leak.

ENGINEERS have estimated that the actual current in an average receiving aerial is just about three trillionths of the total energy broadcast by the transmitting aerial. If the B.B.C. are charging us for what they send out and

NOTES AND NEWS.

(Continued from page 597.)

A suitable site for the new studio has been chosen at 31, Linenhall Street, Belfast.

Leeds and Bradford.

GOOD aerials have been provided for in Bradford and Leeds. They are of the four-wire cage type, spaced at intervals by 4-ft. ash hoops. Mr. Peter A. Florence, who is in charge of the arrangements, tells me that probably Leeds and Bradford will operate upon the same wave-length.

How to "Graduate."

I AM more than ever convinced that the only way to enjoy wireless is to "graduate" from a crystal set to one valve, one valve to two, etc.

I saw a novice handling a new 4-valve set the other evening, and he told me rather plaintively that although he wanted a set to get all B.B.C. stations, he had no idea that he was going to get them all at once, and all loud!

The I.P. Exhibition.

THE Institute of Patentees is holding an Exhibition of Inventions from August 11th to August 16th, in Aldwych House, Kingsway, London. There is to be an electrical section, which includes wireless apparatus, and monetary prizes are to be given for the best inventions. Assistance in the disposal of their patents will be given to inventors. Those intending to exhibit should apply to Capt. G. Drury Coleman, A.I.S.A., 44, Great Russell Street, W.C.1, for full particulars.

Quick Work.

SIMULTANEOUS broadcasting reached high-water mark on the occasion of the opening of 6 L.V. Within a few seconds we had selections of local dialects from the different B.B.C. stations that were amazingly realistic. Manchester's home-truths especially must have had a familiar ring in Liverpool! The rapidity with which the whole change-over was carried out reflects the greatest credit upon Mr. A. C. Shaw, who was in charge of 2 L.O.'s S.B. room.

Ex-Premier to Broadcast.

SPEECHES by Mr. Lloyd George and Sir Donald Maclean are to be broadcast on Monday, July 7th, at 8 p.m. This will be upon the occasion of the Jubilee Conference of the Brotherhood Movement, which is holding a Commemoration Service for the late Dr. Clifford, in Westminster Chapel.

Mr. Churchill at 2 L.O.

ANOTHER interesting speech from 2 L.O., which is due shortly, is that by the Rt. Hon. Winston Churchill, upon "English." This is to be delivered on Commemoration Day at the London School of Economics, Friday, June 27th, at 6 p.m.

A Wireless "Strafe."

BERLIN reports an attempt by armed men to destroy the wireless station at Königswusterhausen (L.P.). When the guard fired, the assailants escaped after

crashing down one mast. There may be a political explanation of the incident, but it is also suggested that it was due to wireless enthusiasts who suffered so severely from L.P.'s jamming that they became desperate.

The 25 kw. Station.

THE date of the preliminary transmissions from the new 25 kw. station at Chelmsford is given provisionally as June 26th. The B.B.C. have definitely announced that the call letters are to be 5 X X, and the wave-length 1,600 metres.

Radio Degrees.

THE Radio Association has decided that there should be a British degree, which is awarded solely for radio science. They are therefore instituting a Fellowship of the Association which is open to both amateur and professional wireless

Free Wireless Sets
For Readers.

"P.W.'s" VISIT TO BOURNEMOUTH.

Do you want a two-valve "Unidyne" set complete with valves, a "P.W." Combination receiver, or a pair of H.R. telephones?

Read on Page 600 the details of the "Popular Wireless" tour of the provincial B.B.C. centres, where every reader will have the opportunity of meeting the inventors of the "Unidyne" and winning a fine wireless prize.

workers. This will be the only purely radio degree in the United Kingdom.

A Great Man's Birthday.

SIR OLIVER LODGE was simply overwhelmed by congratulatory messages last week, when he celebrated his 73rd birthday. The great number of felicitations which poured in upon him shows how high is the esteem with which not only Britain, but the whole world, regards our greatest living wireless pioneer.

Hull's Oscillations.

HULL is getting a very bad reputation as regards "howling," and I hear that on some nights interference from this cause is so bad that reception is almost impossible. A number of my correspondents are asking, "What is the best remedy?" This lies entirely in the hands of the Hull oscillators. They must observe the golden rule of radio (as laid down in the 1st Book of Eckersley). "Don't do it. Don't please do it. Please don't do it!"

Rugby's Aerial.

EVERYONE agrees that a good mast for the aerial is money well spent, but the Postmaster-General says that the addition of the four new masts at the Rugby wireless station is to cost £62,000. The aerial is about 1½ miles long, and no less than 820 feet high, so judging by size and cost Rugby means to bring-in Australia on a crystal set.

Where Will it End?

OSCILLATING crystals are the latest wireless development, due to the researches of a Russian electrician. I wonder where it will all end! It seems possible that soon, with the latest patent crystal "—ite," a negative bias on the cat's-whisker will be necessary, to prevent it from howling its head off.

Aerial Efficiency.

EDINBURGH Town Council has been busy over the question of aerials, many of those erected recently in the city being described as dangerous to the public. It is unfortunate for Edinburgh listeners that indoor aerials are so often unavoidable there. A good outdoor aerial strengthens weak signals immensely, and there is a lot of truth in the old approximation: "An indoor aerial means an extra valve."

Amongst the Amateurs.

WHO was the London amateur that spent his Whitsun practising Morse on about 220 metres? If this paragraph reaches his eye, I hope he will remember in future that the Morse code is best mastered on a dummy key, or on open circuit. He certainly ought not to "take the air" until he knows the difference between "C's" and "F's," because he prevents other people from "fommunifating" whilst he is trying to do so.

A Broadcast Invitation.

IN a generous moment Captain Edward A. Salisbury, who owns a big ranch in California, broadcast a wireless invitation to dinner. Twenty-seven thousand people who were listening-in to Los Angeles immediately wrote saying they would be there at the time named! Not wishing to disappoint his visitors, Captain Salisbury engaged fifty men to dig trenches in which to roast oxen, and thirty-five cooks. He ordered 20,000 lbs. of beef, 50,000 buns, 30,000 apples, 1,000 lbs. of sugar, 800 lbs. of coffee, and 30,000 paper plates!

The Late Arrivals.

MOST of the visitors drove over, and after counting 15,500 cars Captain Salisbury lost count, and had to estimate! He calculates that 68,000 people turned up, but the last 25,000 were too late, for when they arrived his ranch looked as though the locusts had been over it. Although a noted traveller, and used to big crowds, Captain Salisbury admits that radio has given him the surprise of his life!

Lifeboat Wireless.

WHEN the P. and O. steamer "Maloja" left Tilbury on June 6th for Australia, she carried the new Marconi lifeboat-wireless installation on board. Its transmitter is designed for fifty miles range crystal reception, and could be heard for hundreds of miles by ships using valve detectors. The directional properties of the lifeboat's receiver are an additional advantage, and would enable the crew to assist in any search being made for them by ships summoned to the vicinity by wireless.

ARIEL.

THE P.W. "UNIDYNE" PRINCIPLE. A REPORT ON THE CIRCUIT. INVENTORS' CLAIMS UPHELD.

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

At my request Sir Oliver Lodge recently investigated the claims of the P.W. "Unidyne" principle, and his formal report is published below. Readers are requested to turn to the feature "Mainly about Broadcasting" for further details concerning the "Unidyne" and the challenge made concerning it.—The Editor.

THE conducting power of a valve must depend on the state of ionisation of its contents—that is, on the number of free electrons in it. If they are few, it will act as a poor conductor, requiring a high E.M.F. to produce a required current, and soon reaching saturation. If they are many, a low E.M.F. will produce the same current. It may be possible, also, to coax the electrons near the grid, where they are easily tractable by its fluctuating potential, and in that way to secure easier conduction than if the negative charges have to be drawn up from the filament.



Sir Oliver Lodge, F.R.S.

It would seem that this end can be secured by giving the grid a positive bias, so that electrons accumulate in its immediate neighbourhood and are available for transmission to the plate, in accordance with the received alternations, provided the alternations are strong enough to overcome the bias.

The necessary strength of alternations can be secured by reaction, and under those conditions a low-tension battery is able to transmit the required current through the low-resistance valve, a high-tension battery ceases to be necessary, and, in fact, has no advantage.

In the P.W. "Unidyne" set submitted to me for test, these ends appear to have been secured in a remarkably simple manner. A diagram of its connections is annexed, and the switch enables the set to be used with a single valve without low-frequency magnification, as for a head-phone, or to be used as a two-valve set for a loud speaker. It will be seen that there is no high-tension battery, the E.M.F. of the filament battery being sufficient. And I have ascertained that adding more cells, for the purpose of plate magnification, gives no advantage when the adjustments are properly made, and that the set works perfectly as it stands.

"Good Results."

I am not acquainted with all the devices that have been made by others, and am not concerned with the question of novelty, which must be otherwise decided. But I can report that the set in its simplicity, as depicted in the diagram, works well and gives good results, both as regards clearness of articulation and selectivity.

A set on these lines was taken down by the inventors to my laboratory at Egham, was tested by my assistants there in the inventors' presence, and left for further tests afterwards. A report on these tests is annexed.

REPORT TO SIR OLIVER LODGE ON TESTS OF P.W. "UNIDYNE" SETS.

Messrs. Norman Edwards, G. V. Dowding, K. D. Rogers, and the gentleman respon-

the voltage to be increased in steps of $1\frac{1}{2}$ from $1\frac{1}{2}$ to 18 volts. We find that there is nothing to be gained by adding voltage to this part of the circuit. Its effect is the same as varying the coupling between the aerial inductance coil and the reaction coil—that is to say, the same result can be obtained by varying the coupling and the high resistance. In fact, when the best adjustment is obtained this increase of voltage does not improve the reception.

The outstanding advantage of the P.W. "Unidyne" receiver is the total abolition of high-tension batteries on the plate circuit. I look upon the chief drawback to high-tension batteries as being their great liability to be accidentally short-circuited, which, apart from damaging the battery, is frequently the

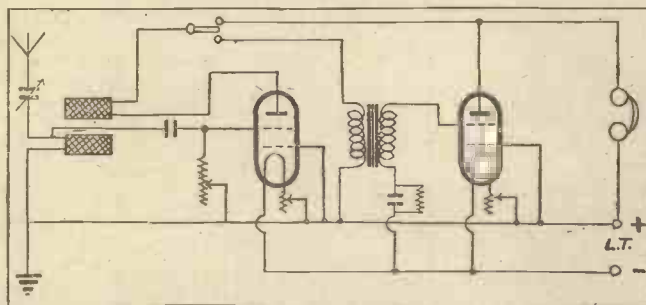


Diagram illustrating Sir Oliver Lodge's report on the P.W. "Unidyne" principle.

sible for the manufacture of the apparatus arrived here last evening by motor-car at 7.30 p.m., and brought two P.W. "Unidyne" sets with them. Both were two-valve sets.

"Splendid Reproduction."

When the broadcasting commenced at 8 o'clock the commercial sample set was put on, and after a short test with this it was replaced by the experimental set.

The first station received was Cardiff, and the reception was quite good. After this we went over to London. The aerial being strange, it required a short time to find out the relative positions of the stations on the tuning condenser. After about fifteen minutes' rough tuning we went on to Newcastle, and this gave splendid reproduction in the loud speaker. As the demonstrators were obliged to return to London in time for two of these gentlemen to get home, they left one of the sets with us to make further tests.

Outstanding Advantages.

This afternoon, June 4th, Cardiff, Bournemouth, Birmingham, and London were picked up with ease. At the moment I am writing the loud speaker is giving the French talk from London, and I can just hear it in the lower room where I am writing. I cannot, of course, hear the exact words, but the reception as heard upstairs is very fine.

We tried last night the effect of introducing an extra battery in series with the telephones, in accordance with your sketch. The battery we used has a switch permitting

cause of valves being burnt out.

For tuning in the various stations the adjustments have to be nicely made to get the best results, but this does not imply that the stations are at all difficult to find; in fact, they are very easy to find, because of the clear reception of the carrier wave, and when once heard it is a matter of careful movement of the tuning condenser together with the best adjustment of the reaction coupling to bring in the station distinctly, and when this is done the reception can be rendered pure by the use of the variable high grid resistance.

Sir Oliver's Congratulations.

The aerial tuning is very sharp, and is controlled by the variable condenser, which has a vernier attachment. A very important adjustment is the current that flows through the filament. The resistance for regulating this current, used on this instrument, is a form of rheostat, making use of compressibility of carbon granules.

It may appear that the apparatus has a complexity of adjustments; still, it is quite simple to handle, as one can always make them one at a time until the best positions are secured, and there are no more than what are really required in any set using reaction.

For efficiency and distortionless reproduction the set is certainly decidedly good, and although we have not heard any atmospheric with the set, one cannot say that it would not receive them. It is quite as selective as any of the usual sets on the market.

(Continued on page 600).

FREE UNIDYNE SETS FOR READERS.

OUR VISIT TO BOURNEMOUTH.

By the Editor.

TO-MORROW, Saturday, June 21st, the inventors of the POPULAR WIRELESS "Unidyne" principle, Mr. George Dowding and Mr. K. D. Rogers, and myself will visit Bournemouth by motor-car, arriving early in the afternoon.

In order to stimulate a general interest in the POPULAR WIRELESS "Unidyne" circuit, and in summer wireless generally, we have arranged, when visiting the B.B.C. centres in turn, to present prizes to POPULAR WIRELESS readers, consisting of two-valve "Unidyne" sets, complete with valves, POPULAR WIRELESS combination sets, and H.R. head telephones.

We hope to visit in all twelve B.B.C. centres, and in each case three prizes will be awarded under the conditions printed below. The first prize will be a two-valve "Unidyne" set (supplied by Messrs. the Bower Electric), with two Thorpe 4-electrode valves; the second prize a simplified POPULAR WIRELESS Combination Receiver (supplied by Messrs. Peto-Scott, valves by Cossors); and the third prize, a pair of H. R. Brown's feather-weight 'phones.

In every case the following rules and conditions will govern the award for the prizes, and my ruling as Editor of POPULAR WIRELESS must be accepted as final. The conditions are as follow:

I, Mr. Dowding, Mr. Rogers, and myself will arrive in Bournemouth, Saturday afternoon, June 21st, and will drive slowly through the town. Readers of POPULAR

THE P.W. "UNIDYNE" PRINCIPLE.

(Continued from page 5.9.)

The points which strike me chiefly after making the tests are:

The smallness and neatness of the set compared with its volume of reproduction, for the set measures only 7½ in. deep, 10½ in. long, and 7½ in. wide.

Secondly, the decidedly low first cost, and the inexpensiveness of the valves, for a two-valve set. Valves 17/6 each.

Thirdly, the general excellence of the reception, the results being better than we were prepared to expect.

(Signed) EDWARD R. ROBINSON,
(Research and Technical Assistant
to Sir Oliver Lodge).

3, Grange Road, Egham.

June 3rd, 1924.

I consider that I may congratulate the inventors on having produced a set for amateur receivers of remarkable simplicity and effectiveness. I was surprised to find it work as well as it does, without the magnification usually obtained by a high-tension battery and the customary high-resistance valve.

(Signed) OLIVER LODGE.

June 5th, 1924.

WIRELESS in that town are invited to keep a look-out for our car, and the first reader who identifies Mr. Dowding and Mr. Rogers to my satisfaction, and who hands me a copy of POPULAR WIRELESS with his name and address written on the cover, will be entitled to a Two-Valve "Unidyne" Receiver.

2. The fact that one reader, in approaching the car and identifying Mr. Dowding and Mr. Rogers, may attract the attention of other readers, and so give them a clue, necessitates my ruling that readers "hunting" in pairs will be disqualified, and that the second and third prizes will not be awarded in the same street as that in which the award of the first prize is made.

When prize number one has been claimed, we shall drive into another street until prize two is claimed; and then into another street until the third prize is claimed.

3. Should two or more readers simultaneously hand me copies of POPULAR WIRELESS and identify the inventors of the "Unidyne," my ruling as to the winner must be accepted as final.

4. The winners will be relieved of their signed copies, and given in exchange a receipt, which will entitle them to a prize. The prizes will be forwarded by post on our return to London.

5. The above rules and conditions will apply to every B.B.C. centre we visit, and will remain in force until our tour is over.

6. Prizes can only be claimed by identification of Mr. Rogers and Mr. Dowding, with myself (or assistant) as witness, in the motor-car in which we shall travel during our tour to Bournemouth. We may travel in two cars, but not more.

On Saturday, June 28th, we shall visit Cardiff. If I am prevented from joining the party, Mr. Dowding or Mr. Rogers will act as judges.

One of the eight hundred and twenty foot masts at the Rugby station, now in course of construction. Sixteen of these masts are to be erected, supporting an aerial over 1½ miles in length.

THE RUGBY STATION.

(From Our Own Correspondent.)

ENOUGH work has been done at the Rugby Imperial Wireless Station to anticipate its technical fame in the future as not only the largest wireless station in this country but the largest wireless station in the world. It is intended to be capable of communication with any part of the world and to be capable of being in constant touch with Australia. Yet long before it is within measure of completion there has come news of the interesting development of the directional or beam system of wireless transmission, which will reduce the need for high power stations of the Rugby type.

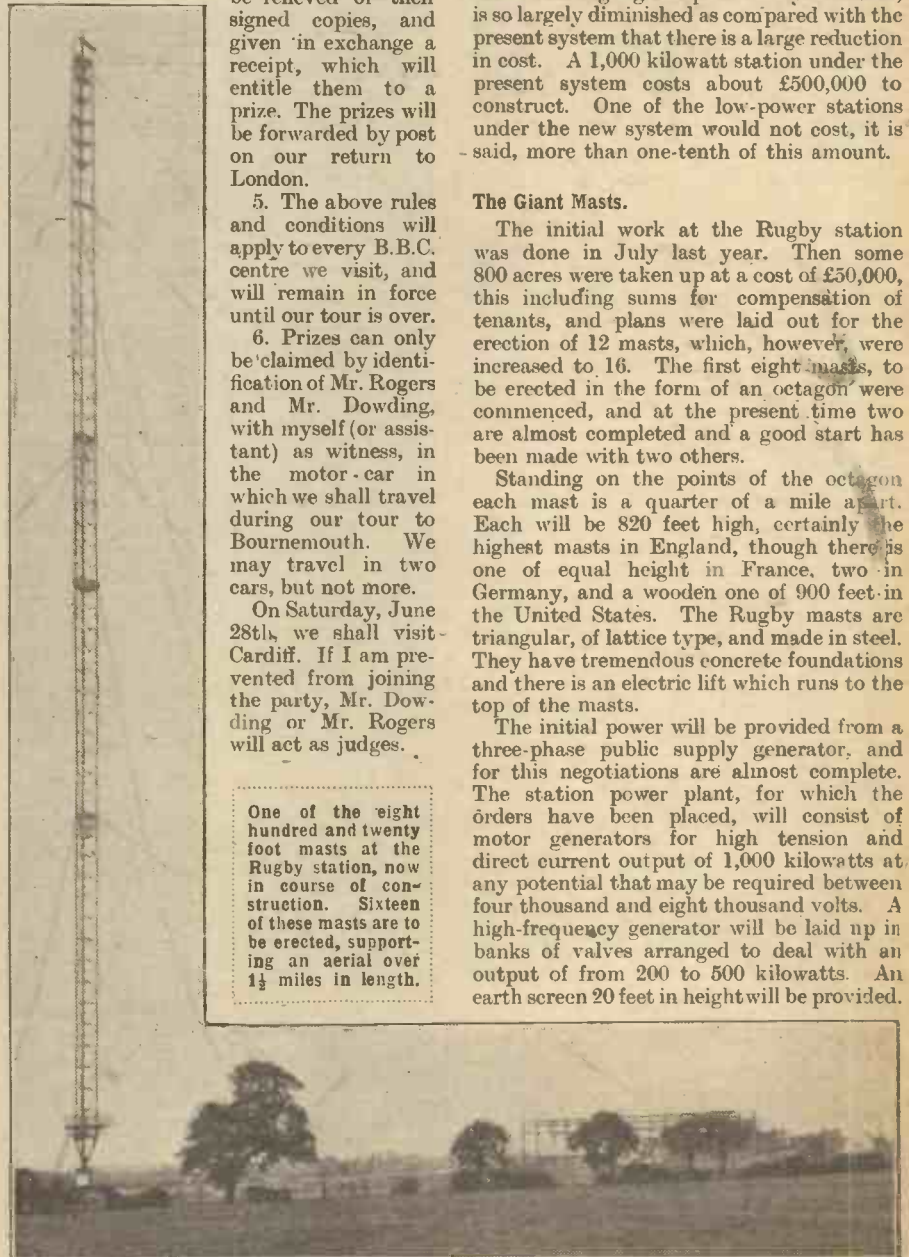
The power necessary to develop impulses directed along a given path in any direction, is so largely diminished as compared with the present system that there is a large reduction in cost. A 1,000 kilowatt station under the present system costs about £500,000 to construct. One of the low-power stations under the new system would not cost, it is said, more than one-tenth of this amount.

The Giant Masts.

The initial work at the Rugby station was done in July last year. Then some 800 acres were taken up at a cost of £50,000, this including sums for compensation of tenants, and plans were laid out for the erection of 12 masts, which, however, were increased to 16. The first eight masts, to be erected in the form of an octagon were commenced, and at the present time two are almost completed and a good start has been made with two others.

Standing on the points of the octagon each mast is a quarter of a mile apart. Each will be 820 feet high, certainly the highest masts in England, though there is one of equal height in France, two in Germany, and a wooden one of 900 feet in the United States. The Rugby masts are triangular, of lattice type, and made in steel. They have tremendous concrete foundations and there is an electric lift which runs to the top of the masts.

The initial power will be provided from a three-phase public supply generator, and for this negotiations are almost complete. The station power plant, for which the orders have been placed, will consist of motor generators for high tension and direct current output of 1,000 kilowatts at any potential that may be required between four thousand and eight thousand volts. A high-frequency generator will be laid up in banks of valves arranged to deal with an output of from 200 to 500 kilowatts. An earth screen 20 feet in height will be provided.



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to the Woman means the "great adventure." Much pleasurable but careful consideration leaves a trail of despairing shop assistants and serried rows of rejected headgear. Don't offer your advice—it's not safe for any ordinary man. However, she will probably consider buying Headphones as great a necessary nuisance as a man his hat, and in this instance ask your advice. If it's sound you will say "Brandes." The "Matched Tone" feature is a technical advantage which means full, sweet-toned reception, and constructional perfection is studied from every point of view. *Your Dealer has them.*

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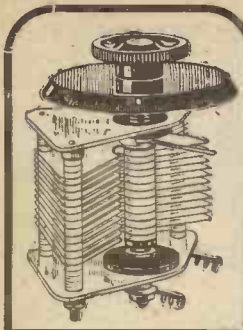
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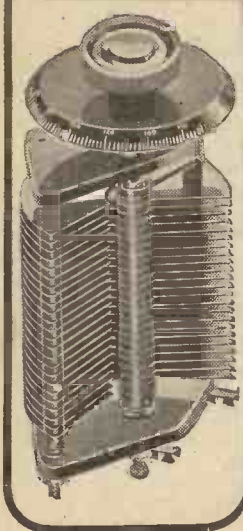
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HIGH-FREQUENCY TRANSFORMERS.

AN EASY WAY TO MAKE THEM.

By L. J. PRITCHARD.

(Technical Editor, Harmsworth's "Wireless Encyclopedia").

Winding H.F. transformers is a comparatively simple task, and one that the most unskilled amateur can tackle if he carefully follows the instructions given in this article.

AN advantage of H.F. amplification by the transformer coupled method lies partly in the ease with which the transformer may be constructed by the experimenter. On account of this considerable experimental work can be carried out with a view to obtaining a transformer particularly suited for a particular wave-length. Transformers of the pin type also have the advantage of comparative cheapness of construction, the only requirements of any real value being the wire with which the transformer is wound and four split valve pins.

Semi-Aperiodic.

A transformer of the pin type is illustrated in Fig. 1, and is designed for home construction. The valve pins are arranged so that they may be plugged into an ordinary type of valve-holder. In common with the great majority of transformers of



Fig. 1. The complete H.F. transformer, suitable for broadcast reception.

this type, the connections from each winding are carried out to directly opposite valve-holders, by which arrangement each pair of valve pins is separated by the other pair, which are connected to the other winding.

The transformer to be constructed is of the semi-aperiodic variety, which indicates that its efficiency is limited to a narrow band of wave-lengths for which the transformer is designed. The plug-in arrangement is, therefore, of decided utility, as if the H.F. transformer may be varied according to the wave-length it is desired to receive.

Making the Formers.

The first step in the construction is to cut two circles of cardboard or thin sheet ebonite, having a diameter of $1\frac{1}{2}$ in.

If cardboard is used, it should be heated to ensure that all moisture has been abstracted and then given one or two coats

of shellac varnish. An alternative plan is to soak the cardboard discs in melted paraffin wax. In the centre of each four holes of $\frac{1}{8}$ in. diameter are drilled and spaced so that they register with the socket

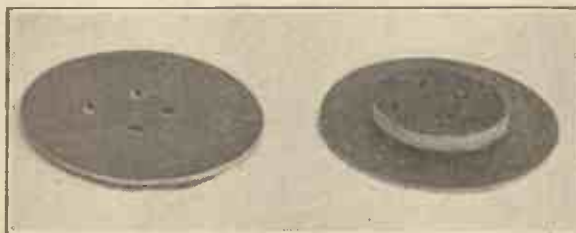


Fig. 2. The two windings are wound on a former which consists of three discs of insulating material.

holes of the regulation valve-holder. In order to get the holes in each disc exactly over each other and at the same time keeping their rims flush, they should be placed together and drilled in one operation.

Drilling the Discs.

To complete the construction of the former a disc of ebonite of $\frac{7}{8}$ in. diameter is cut from material of $\frac{1}{16}$ in. thickness. Four holes similar to those in the larger discs, are drilled centrally in this disc. The three discs ready for assembly are illustrated in Fig. 2. In this operation the three discs are arranged so that the three sets of holes register, after which the split valve pins from which the outer nut has been removed are pushed through. The assembled discs, showing two of the valve pins fitted into position, are shown in Fig. 3. In this illustration the remaining valve pins not yet fitted are shown in the foreground.

The next step is to drill four small holes

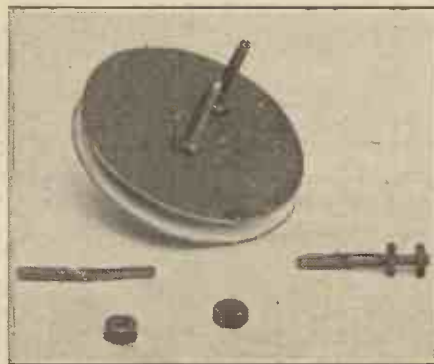


Fig. 3. The assembled discs are kept in position by the valve pins.

in the cardboard disc towards the valve pins. The ends of the windings pass through these holes and are secured under the nuts of the valve pins. The holes for one winding are drilled adjoining opposite valve pins, one hole being drilled at the edge of the centre disc and the other midway between the appropriate valve pin and the circumference of the outer disc. For the outside winding, the beginning end of the wire is carried through a hole similarly placed to the hole at the end of the inside winding, while the fourth hole is drilled quite close to the circumference.

Having threaded the commencement of the inside winding through the hole from the inside and made it fast under the nut of the adjacent valve pin, winding is commenced as shown in Fig. 4. The transformer is held by the valve pins

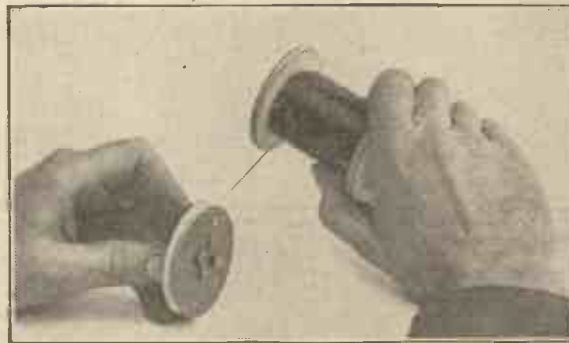


Fig. 4. The wire is held in the right hand and passed around the former.

in the left hand, while the wire is rotated round the transformer. It is important to count the number of turns that are put on, as the same number are required in both primary and secondary.

Insulating the Coils.

It is advisable to make a written note of the number of turns of the windings which will form a useful basis in the construction of subsequent transformers. For broadcast wave-lengths, 150 turns of No. 38 gauge D.S.C. wire is used. This figure is, of necessity, only approximate, as the wave-length efficiency will largely depend upon the closeness with which the wire is wound, and also the material and its thickness used, as an insulating medium between the two coils.

The operation of fitting this insulation follows the completion of the winding of the inner coil, and consists of wrapping two

(Continued on page 604).

THE SHEFFIELD RELAY STATION.

(From a Special Correspondent.)

6 F L, the first relay station to be erected, is now working on 200 watts and is giving great satisfaction to listeners.

AFTER a considerable amount of dissent and criticism, wireless in Sheffield now appears to have attained a high pitch of efficiency, and by present indications there are now no grounds on which legitimate complaints can be made. Quite a lot of B.B.C. notabilities visited the city recently, and speculation was rife as to the objects of their visit. The Controller, Admiral Carpendale, and Captain P. P. Eckersley paid a short visit, and then along came Captain A. G. D. West, Mr. G. I. Morrow, and Mr. H. S. Walker. At this time listeners noticed an amazing increase in signal strength, and even wireless enthusiasts who live outside the city were able to hear the station on crystal sets.

A Rapid "Change-Over."

The three engineers, along with Mr. A. Birch, engineer in charge at 6 F L, accomplished a smart piece of work one night when the station closed down at 10.30 p.m. Immediately after the "Good-night" had been spoken into the microphone, they started on the task of installing an entirely new transmitter, capable of dealing with 200 watts. By 2 a.m., after nearly four hours of very strenuous work, they were able to make first tests with the new apparatus. A few hours later the transmitter was working O.K. and Sheffield listeners were rejoicing in loud signals, but wondering what had happened at the relay station.

The increase in power at Sheffield raises at least two interesting points. For instance, the actual energy in the aerial is 3 amp., a remarkable achievement for the type of transmitter being used. Some of the main stations, using 1,500 watts (seven and a half times greater than 6 F L), produce something like 7 amps. in the aerial. This is the secret of the great increase in signal strength which has come as a boon to listeners in Sheffield, and particularly to those who are forced to use indoor aerials.

Another interesting point is that of the present range of the station. It can be heard quite well on crystal sets at Doncaster and Bakewell, places something like fourteen miles away, and even at Dewsbury, about twenty-five miles away from Sheffield, 6 F L has been heard on a crystal set. Speaking generally, the range of 6 F L is something round twelve or fifteen miles for really good crystal reception.

Remarkable Crystal Range.

The range for a main broadcasting station using 1,500 watts is between twenty-five and thirty miles, and again it can be seen what has been accomplished in Sheffield. Not only has the station 3 amps. in the aerial using 200 watts, as compared with about 1 amp. when using the other transmitter with 100 watts, but it has a range about three times greater than previously.

A few words about the new transmitter may prove of interest. It has six valves, one main oscillator valve, four control

valves, and one sub-control valve. The high-tension pressure is 2,000 volts, and the filament voltage of the main oscillator is 12 volts, 10 volts on the control valves and 7 on the sub-control.

2 L O's Programmes Relayed.

In the event of a valve burning out, a new one can be inserted with comparative ease, plug-in connections facilitating the change. An effective smoothing system is employed, and, in addition, a complete charging plant has been installed, together

HIGH-FREQUENCY TRANSFORMERS.

(Continued from page 603.)

or three turns of fine silk ribbon round the inner winding. Care should be taken to see that the ribbon comes flush up to the sides of the outer disc to prevent the possibility of the secondary winding slipping through and making contact with the primary. To this end in commencing the winding of the second and outer coil the first two or three layers should not be wound tightly.

Testing for Continuity.

An equal number of turns are wound on the outer winding as were put on in the inner winding, after which the end of the wire may be finished off. This operation is shown in Fig. 5, where the first finger of the left hand prevents the wire from slackening while it is being pulled through the hole with the right hand.

It is advisable before going any further with the transformer to apply an electrical test for continuity of winding, correct



Fig. 5. After the windings are completed the free end is pulled through the last hole and fixed to the remaining valve pin.

attachment to valve legs, and insulation between the winding.

These faults may be detected by simple tests with a pair of telephones and an L.T. battery. One side of the telephones is

with two banks of accumulators for filament lighting.

On the day following the increase in power 596 postcards, 175 letters, and hundreds of telephone calls were received at the station, all enthusiastically praising the new developments. It is not too much to say that a new era in wireless in Sheffield has been opened up. Many folks who previously had very weak signals on their crystal sets are now finding a real pleasure in listening-in, and when the station commences to relay the London programme (which it hopes to do shortly), Sheffield listeners will have almost everything they desire.

The valve set users in the city, in some cases, are experiencing difficulty in cutting out the local station, and I understand that in these cases, the operators are busily engaged in altering their sets to make them more selective or making wave traps in order to tune in distant stations.

joined to the battery, to the other terminal of which a flexible lead is attached.

When the free end of this lead is touched with the free end of the telephones the circuit is completed, and a loud click is heard in the telephones. It therefore follows that if a continuous conductor is connected between these points, a click is

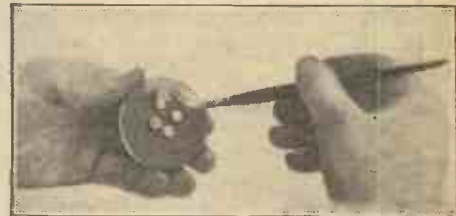


Fig. 6. When the transformer has been tested it can be coated with shellac as shown.

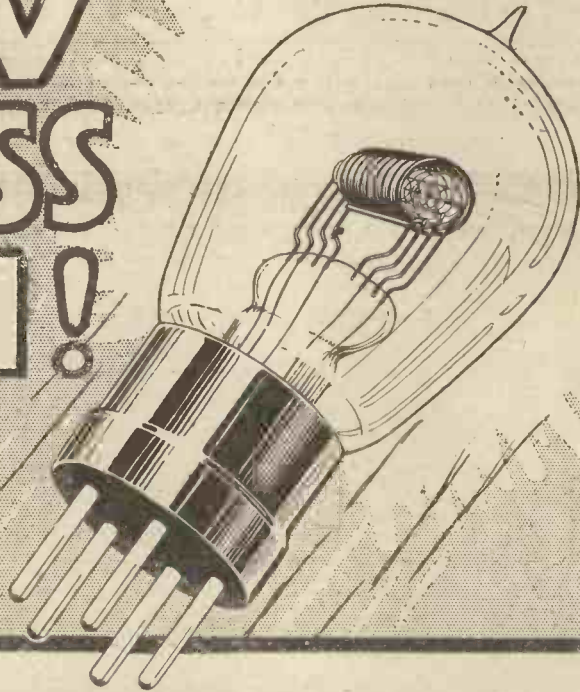
still obtainable. These points are joined to opposing valve pins to obtain the necessary click in the telephones. The connections should now be made to adjacent valve pins, which, if everything is in order, should bring no appreciable click in the telephones.

To protect the outer windings several turns of silk are wrapped round it. An additional coat of shellac varnish is applied to the outsides of the discs, which assists in keeping the ends of the connecting wires in position and from likelihood of breakage. This operation is shown in Fig. 6, where the shellac is being applied with a small camel-hair brush.

To test whether the transformer is suitable for a particular wave-length a variable condenser may be shunted across the primary winding. If signal strength increases appreciably when the condenser plates are nearly covered, it is an indication that a few more turns of wire would effect an improvement to the efficiency of the transformer.

As the windings of the transformer are identical it does not matter which is the primary and which the secondary. It is usual, however, to connect the primary to the valve pin connections corresponding to the grid and anode positions of the valve holder.

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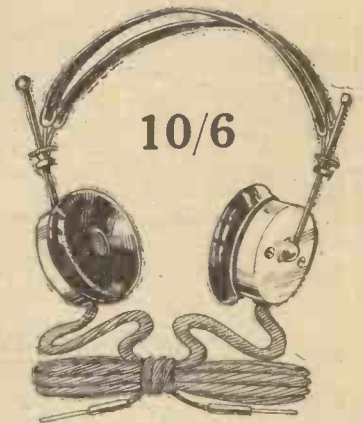
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HOW TO BUILD AN H.F. & DETECTOR "UNIDYNE" RECEIVER.

By G. V. DOWDING and K. D. ROGERS.

(Technical and Assistant Technical Editors, "Popular Wireless.")

This is the second and concluding article describing the construction of a two-valve P.W. "Unidyne" set, employing one H.F. and one detector valve. Readers are requested to read Sir Oliver Lodge's Report on the "Unidyne" which appears in this issue, and the details of our challenge to Mr. Marconi given under the heading "Mainly About Broadcasting."

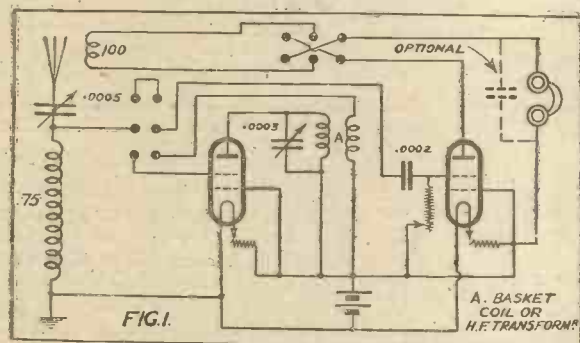
SINCE the photos that appeared last week were taken, a further alteration was made in the lay-out and circuit of the receiver. The main components have not been moved, but the space at the top left-hand corner of the panel has been utilised for mounting a couple of double-throw double-pole switches.

These switches are not essential for the working of the set, but have been

accompanying wires will do well to leave the switches out. The whole of the wiring will have to be carried out very carefully, as any bunching will be detrimental to the operation of the receiver.

The position of the switches can be seen from the photographs, and also the way the wiring is carried out.

The lay-out of the set, keeping it to a convenient size, is not easy to work out, so that great care should be taken when building the set to see that the best use of the space available is



Theoretical diagram of the H.F. and Detector circuit, with the two switches added. The L.H. switch cuts out the H.F. valve, and the other reverses the reaction connections.

added for the benefit of readers who desire to use either one or two valves. Unfortunately, when an H.F. valve is switched off and out of circuit, it becomes necessary to reverse the connections of the reaction coil from the plate of the detector valve. This calls for another switch, and so it was found necessary to employ two double-pole double-throw switches in order to cut out the H.F. valve completely and to reverse the connections of the reaction coil.

Spacing the Wiring.

These switches necessarily complicate the wiring, and those who do not feel themselves equal to undertaking the task of soldering twelve extra points and the

taken. The exact positions of the components depend upon the types of components used, but the general panel lay-out was given in last week's issue, and should prove helpful when designing the set.

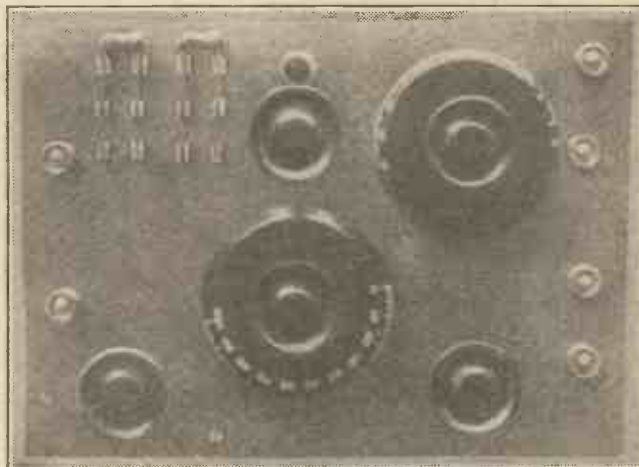
The type of coil-holder used is one which gives very fine reaction adjustment and, moreover, is so operated (by one knob) that the moving socket varies from back to front instead of from side to side, as is more usual. The actual holder employed by us was made by Messrs. Ward & Goldstone, and has proved very suitable, the smooth, slow variation of coupling possible being extremely useful when picking up distant stations.

Small switches should be used, as there is not much room for them on the panel, and the fixing screws must not be allowed to project too much at the back of the panel, otherwise they will foul the aerial coil. The revised wiring diagram, showing the circuit, including the two double-pole switches, is given in Fig. 1.

When the necessary holes have been drilled in the panel, attention should be turned to the wooden

base, the coil-holder being mounted so that the control rod projects through the hole drilled for it in the panel.

The valve tray next requires our attention. This merely consists of a strip of ebonite



The front of the panel after the two switches had been added. The L.H. switch is for cutting out the "first" valve and the R.H. for reversing reaction.

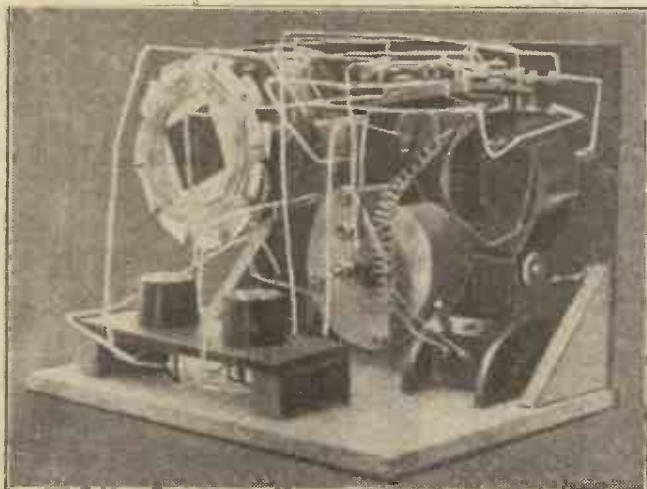
(about 1/2 in. thick) approximately 6 in. long and 2 in. wide. This is screwed to two blocks of wood at either end, to provide a mounting. Remember that the valve tray should not be mounted on the base of the panel until the last moment, as the leads from it to the necessary points will have to be cut to length, then fitted to the tray, the tray mounted, and then the leads soldered to the required positions.

Mounting the Condensers.

After the place where the valve tray is to be mounted has been marked on the wooden base, the panel should be drilled and screwed to the base. Four screws along the front and one or two on each support will be sufficient. The screws should be well greased if you wish to get them "home" without any trouble. A great many wireless enthusiasts, and others engaged in cabinet-making and wood-working, have trouble with their screwed joints because they do not take the trouble to grease the screws. The result is that the screws stick, twist, and often bend, especially when the wood into which they are being driven is hard.

Having fixed the panel to the wooden base, the terminals should be mounted and the filament resistances placed in position, together with the grid resistance. The filament leads should now be soldered on, and the lead from L.T. + to the end of the grid resistance should be fixed.

The next step is to mount the aerial tuning condenser and connect it up to the aerial terminal and the aerial coil, the other end of the latter going to earth.



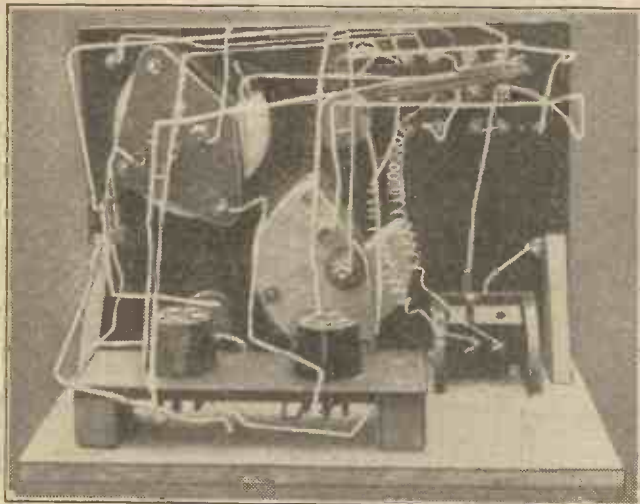
The back of the panel with the aerial coil and H.F. transformer in position.

(Continued on page 608.)

P.W. "UNIDYNE" H.F. & DETECTOR

(Continued from page 637).

The switches should now be mounted, and as many of the necessary leads attached to them as possible, remembering that sufficient room for the movement of the reaction coil must be allowed. The grid condenser should be wired in its position between one of the switches and the grid leak, and then the second variable condenser—the .0003 mfd. H.F. condenser—should be mounted.

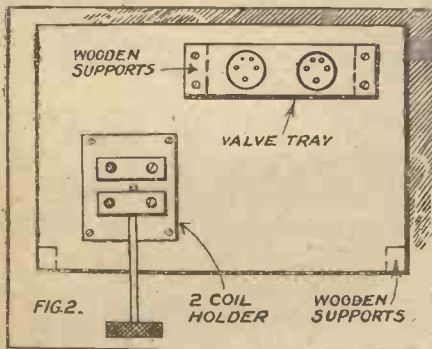


Another view of the wiring with coils and valves removed and showing the back of the two double-pole switches.

The four leads on the H.F. transformer sockets have, of course, been attached to their respective sockets before the base of the condenser was refitted after drilling.

Wiring Up.

This latter point should not be overlooked, or it will give trouble later on when the H.F. condenser base has to be removed to allow the leads to be taken to the transformer sockets.

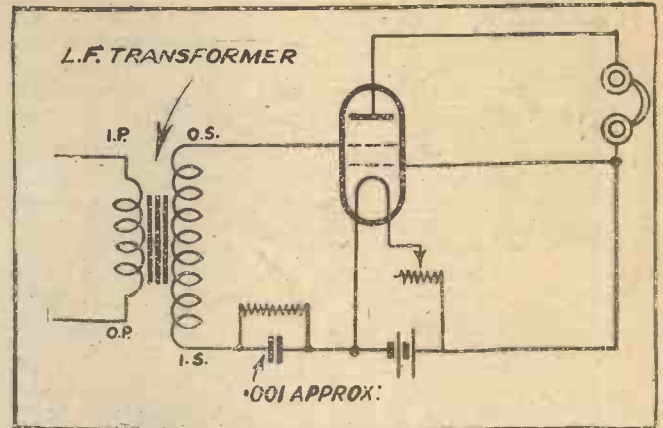


The lay-out of the wooden base is clearly seen from this diagram.

Having wired up all the components on the panel and the coil-holder, the wires from the valve tray should be prepared. These should be cut to length, allowing for bends, and then fixed to their places on the ten sockets for the valves. This is the

most difficult part of the wiring, and should be carried out with great care, plenty of wire being allowed for each connection. One wire too short will upset the whole concern, and necessitate the removal of the valve tray and disarrangement of all the other leads.

When the wires have been connected—preferably soldered—to their respective sockets, the valve tray should be screwed down on the base by means of wood screws passed through from underneath the base and countersunk. This



A "Unidyne" L.F. unit that can be used in conjunction with the set described in this article.

latter is essential, otherwise the screw heads will cause the tray to stick and scrape when pushed into the cabinet.

Solder the leads from the valve sockets to their proper positions, and the set is completed. In making connections to the valve-holders, remember to get the two grid connections in

their proper places. The filament legs fit into the two sockets close together, the plate is directly opposite, and the main or control grid is the one on the right looking at the top of the socket (Fig. 2). The opposite one (on the left) is for the auxiliary grid—the one going to the positive of the filament battery.

The tuning of this receiver will be found to be similar to any other H.F. and detector set, but the filament control is slightly more critical. That is why rheostats of the compression type are to be preferred, and as reaction is also critical the vernier reaction coil-holder is another considerable help.

Results.

Under fair conditions, it will be found that all the B.B.C. stations can be tuned in at comfortable strength and remarkable clarity and purity of reception, and also several of the Continental stations. The coils we used in the original receiver, which tuned in all stations, including Manchester (usually hard to

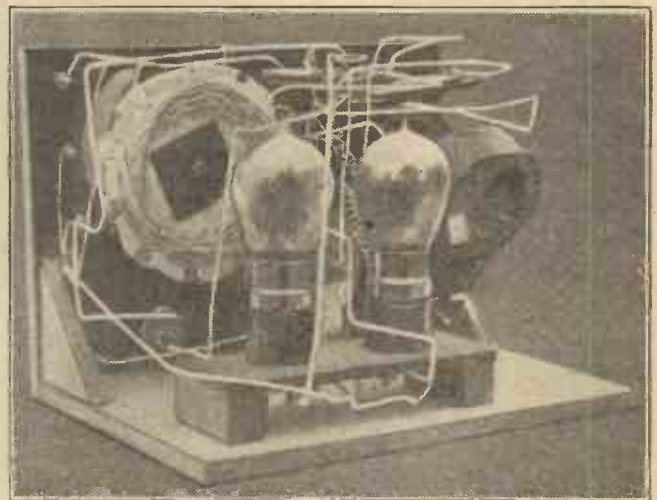
get from where the set was tested), were of the Lissenagon type, the numbers being 75 for aerial and 100 for reaction. These were found to give better results than the duolateral coils, both in strength of reception and the ease with which the coils produced oscillation.

For those who desire to add an L.F. amplifier to this set the theoretical diagram of the L.F. unit is reproduced on this page, the I.P. and O.P. connections then being taken to the 'phone terminals of the main set. There is no need to use a separate L.T. battery, and common leads can be taken from the battery to the L.T. + and L.F. - terminals on the two-valve unit and on the L.F. panel.

Two-Valve Amplifier.

Amateurs desiring to keep their amplifiers on the same lines as the set described here—namely, on the American system—are advised to wait until next week, when a full description of a two-valve L.F. amplifier, built exactly on the same lines as the H.F. and Det., and of the same over-all dimensions, will be given. This amplifier will be provided with switches so that either one or both of the valves may be used, or the amplifier can be cut out altogether. This amplifier will also fit on to the Detector and L.F. unit already described, should readers desire a set having 3 L.F. stages.

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The valves and coils in position. The reaction coil is the one shown on the extreme right.

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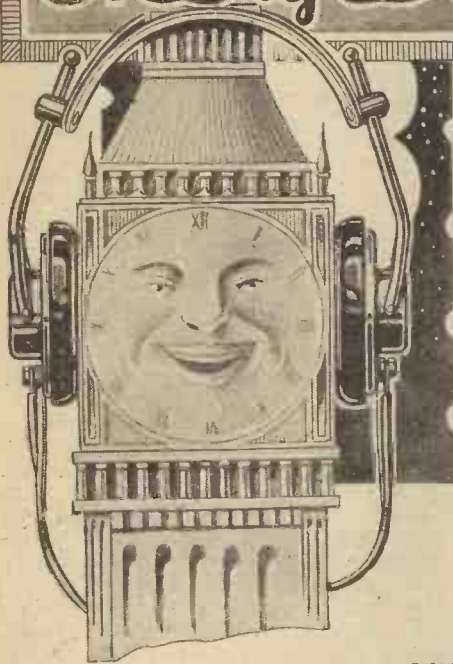
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FROM YOUR LOCAL DEALER 1/3.

THE H.T. BATTERY AND THE "UNIDYNE."

ABOLISHING NINETY PER CENT. WASTAGE.

By B. S. T. WALLACE

(Wireless Consulting Engineer).

The following article, contributed by a well-known wireless engineer, contains several very interesting points in connection with the H.T. battery, and shows how a heavy wastage can be eliminated.

IMITATION being the sincerest form of flattery, it can be taken for granted that the introduction of the "Unidyne" principle by POPULAR WIRELESS is a huge success. Were it not so the matter would have been ignored.

Vigorous attempts are being made to prove almost in the same sentence that the idea is not new; that it is not so good as an ordinary circuit with H.T.; that the H.T. battery cannot be abolished; and that the writers all have circuits that give "very loud signals" without H.T., and which will be "published in the next issue." Let us examine the matter "quantitatively," as a critic suggests.

Striking Facts.

The writer has made it a practice to place large scale, low reading measuring instruments in all parts of the circuit in order actually to see what is taking place.

In a four-circuit single-valve dual amplification receiver usually employed there are four meters; all with 6-in. scale readings—filament voltmeter, filament ammeter, plate milliammeter, and a microammeter in the crystal rectifying circuit. The most important and instructive is the plate milliammeter. It reads to 3 milliamperes over a 6-in. scale.

With this particular circuit the plate current is $\frac{1}{5}$ of a milliampere at 50 volts, using a D.E.Q. dull emitter. Before proceeding further, it can be mentioned that the volume from 2 L O on this set is quite as much as the standard £5 loud speaker requires for good performance. Now the fact that is strikingly forced home by the recording instrument in the plate circuit is that, although the H.T. current is comparatively low, 90 per cent. is wasted so far as the incoming signal is concerned. It is not required and is of no use.

This permanent current of $\frac{1}{5}$ milliampere is flowing through the loud speaker, and is, of course, not audible until it is modulated by the incoming signal. The maximum variation of this current is of the order of 100 microamperes, as shown by 2 L O's tuning note, which supplies a good opportunity for obtaining a steady reading.

Unnecessary Current.

This fact that only 100 microamperes is required for a strong loud-speaker signal has long since convinced the writer that some way would be evolved of dismissing the H.T. battery.

It is really surprising to find acknowledged "experts" confusing the amount of voltage and current incidental to passing the H.T. from anode to filament of an ordinary three-electrode valve with the current actually required to operate the 'phones or loud speaker.

Some three and four valve receivers will

be found to take as much as 10 milliamps. H.T., but it is mostly useless and unnecessary, so far as the signal is concerned.

The only current that operates the 'phones is the plate current variation of the last valve, and this is of the order of microamperes. The 90 per cent. surplus energy from the H.T. battery is merely incidental to the function of drawing the electrons from the filament. This requires a positive potential, but not a flowing current. The flowing current is only necessary when the signals are to be converted into sound by the 'phones. The passage of an unnecessarily heavy current through the anode circuit of the ordinary three-electrode valve is unavoidable owing to its design.

The requirements, therefore, are a positive potential to draw the electrons, and a passing current to give the signal. No current is required when no signal is passing. The ideal method would be for the incoming signal to extract its own current from the filament battery, and this has already been accomplished in the "Unidyne" circuit.

The slight positive potential given by the filament battery via the primary of the special transformer is automatically converted by the incoming signal to the requisite voltage for passing an operating current.

The H.T. has been literally abolished in this device. The incoming signal manufactures its own H.T. from the filament battery, and this is actually shown by the current fluctuation on a sensitive filament ammeter when a strong signal is received. No laws have been transgressed. The 90 per cent. wastage in the old system has simply been removed by this "very interesting and very clever" arrangement.

It is precisely and solely because of the inefficiency of the present H.T. battery system that the writer has consistently specialised in

a single-valve dual receiver. With a current of only $\frac{1}{5}$ of a milliampere the H.T. battery can be relied upon for good steady performance for six to twelve months, but with a three-valve "straight" circuit, using several milliampere, it usually commences to give trouble after six weeks.

All That is Needed.

It cannot be too strongly emphasised that high H.T. voltages and large H.T. currents are in themselves totally unnecessary for the production of powerful signals. A signal power of one-fiftieth part of a watt is quite as much as the largest of ordinary loud speakers can possibly stand up to, and is sufficient to make itself heard half a mile away.

These facts go to prove that the "Unidyne" system of reception is by no means a "freak" or a "stunt" idea, but is worthy of very serious thought and experiment.



A complete broadcasting station fitted on board the s.s. Columbus. Part of the transmitting gear, including the microphone, can be seen in the photo.

PSYCHIC MESSAGES AND BROADCASTING.

AN INTERVIEW WITH SIR ARTHUR CONAN DOYLE.

BY "ARIEL."

The famous author and psychic investigator gives his opinion of the B.B.C.'s work and makes an interesting suggestion.

ON the occasion of Sir Arthur Conan Doyle's recent Talk on Psychic Research at 2 L O, I had the interesting opportunity of discussing with him the possible effect of broadcasting on his subject.

"Do you consider," I inquired, "that wireless could be of material use in this direction?"

"I most certainly do," he replied, "if we could do away with the prejudice that seems to exist in many quarters. I personally do not see why, if the B.B.C. can broadcast religious services with such universal success as they do, they should not also allow me, or someone else, to broadcast, from time to time, lectures and addresses on spiritualism. It is surely a very interesting subject of speculation, and one which should appeal to many. And we should like to make our appeal to as



Sir Arthur Conan Doyle.

surprises. I must admit my optimism, though I believe my friend Senatore Marconi is still sceptical.

Broadcasting Truth.

"I believe," he continued, "if only a greater number of people in this country could hear the truth about spiritualism, very much nonsense and error would be done away with, and much more sympathy would be felt for our researches. Prejudice is almost always bound up with ignorance, and it is there that this broadcasting could do so much of inestimable value. The B.B.C. are in direct contact with many millions, and thus their power is enormous to spread enlightenment and knowledge on all topics throughout the country."

Loyal Support.

"Do you consider that they have properly recognised and made full use of this power?" I next inquired.

"I think it is wonderful how much they have already done," he replied. "My wife and I are very keen listeners-in, and thoroughly enjoy most of the programmes, especially the concerts. Of course, there is

are wonderful; they have given satisfaction to so many thousands."

"Yes," added Sir Arthur, "there is hardly one subject of interest which they have not included in their programmes, at one time or another. And if they will permit me to speak before the microphone again, I feel sure I could help many to understand and sympathise with, if not wholly to accept, the fascinating study of spiritualism. Who knows? Perhaps in time even the suggestion about broadcasting of spirit messages may not appear so far-fetched as it seems at present. It would be interesting, indeed, if broadcasting were to forge a greater understanding between Senatore Marconi and myself, and the discovery associated with his name were to bring more accurately before the public those researches to which my name is so generally tied."

A Wonderful Institution.

I suggested that too much serious information might make the programmes somewhat one-sided, and crush all interest in broadcasting.

"Oh, we must not do that!" he replied, laughing. "The prime importance and charm of broadcasting is that it brings relaxation and amusement within the reach of all. It is mainly because it supplies me with many pleasant moments that I so much appreciate the work of the B.B.C. I cannot understand why people are always grumbling at their efforts. I think broadcasting is one of the most wonderful institutions going. Surely it is a great work to supply pleasure to so many, and to give satisfaction to such a mixed audience. But the B.B.C. show their wisdom in supplying also knowledge and solid information. For that, too, is a kind of pleasure, if it is not overdone. And it is in that side of their work that I feel especial interest, for I hope that it will continue as it has begun, and open its doors to those who, like myself, have at heart the development and progress of spiritual research."

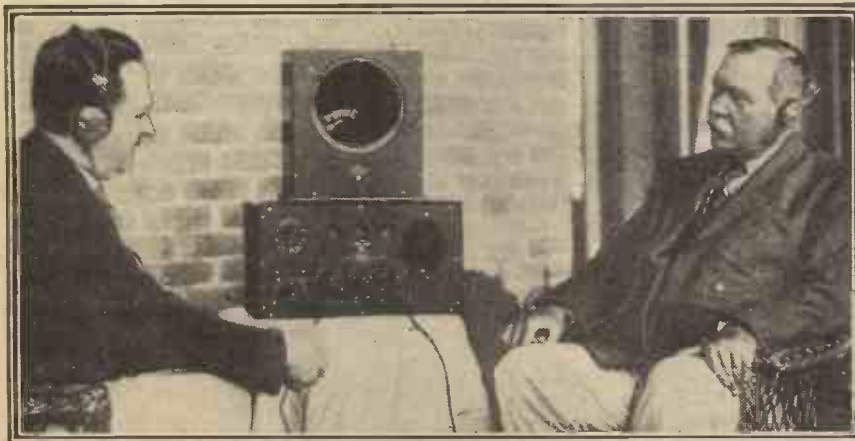
USEFUL "TIPS"

By A. H. B. PAYNE.

WHEN wiring up a set from a conventional diagram (or even a pictorial one) it is an excellent check to make a good-sized pencil copy of it and ink in each connection as it is completed in the set. This obviates the chance of leaving out some obscure connection, and is an accurate check at any point in the process. If the job has to be left, for instance, one can see at a glance, by the inked-in portion, just how far the work was advanced when the interruption occurred.

Distinguishing Terminals.

When it is desired to distinguish terminals, etc., on a set by means of colours, this can be done effectively, neatly, and cheaply by using the small coloured composition counters, or "tiddley winks," obtainable at any toy shop. They are inserted between the panel and the base of the terminal, a suitable hole being drilled in the centre. They show up finely on the ebonite, and give the set an excellent appearance.



Sir Arthur and a friend listening-in on a set presented to him in America.

many as possible, for I feel convinced that the majority of listeners would be sympathetic to spiritualism were they given the opportunity of hearing it explained clearly and without bias."

An Age of Surprises.

"I have heard," I remarked tentatively, "that some people are of the opinion that it should be possible to broadcast spirit messages. Do you consider that there are any grounds for this?"

Sir Arthur smiled.

"You are no doubt thinking of the séance we held some time ago. It is too early yet to give any definite opinion in this direction, but we live in an age of

always room for criticism, but I do not think we should be too exacting. It must be an almost Herculean task to broadcast an entirely successful concert, and one which will win the praise of such an immense audience as the B.B.C. cater for. Far more can be achieved by appreciation and loyal support."

As I walked down to Charing Cross Station with Sir Arthur and Lady Conan Doyle, I asked her whether she thought her husband would broadcast again.

"Oh, surely!" she replied. "We are both so interested in this new science, and in the effect it must have in many directions. I think the Broadcasting Company

SOME RELIABLE DOUBLE REACTION CIRCUITS.

By OSWALD J. RANKIN.

Although the use of double reaction means additional controls and the risk of upsetting the balance of a circuit, the advanced amateur will nevertheless obtain very instructive results with the circuits given in the following article.

NOWADAYS almost every experimenter is familiar with regenerative or other super circuits, and therefore it should not be a difficult matter to appreciate the

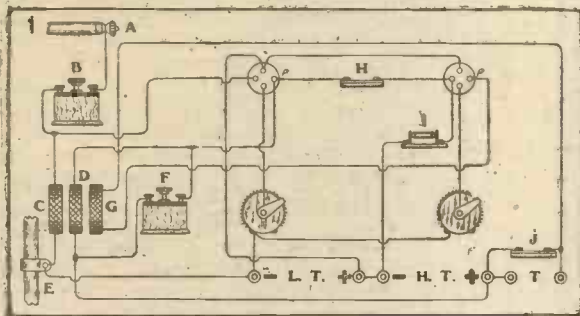
The tuning arrangements of all three circuits are identical, as is also the text lettering of same, and so a description of the first will also suffice for the remainder.

Fig. 1 shows a simple arrangement where the first valve acts as a high-frequency amplifier and the second as a detector. A represents the aerial lead-in, B the '0005 mfd. series (or parallel) variable tuning condenser for the aerial coil C, F is also a '0005 mfd. variable condenser which is connected in parallel with the coil D, G is the usual reaction coil, and E represents the earth. By coupling D to C reaction is introduced in the aerial circuit, and by

coupling G to D an additional reaction effect is obtained. grid condenser, and I is the variable grid leak. Alternatively, this may have a fixed resistance of 2 megohms. J1 and J2 are the L.F. intervalve transformers, which will, in most cases, require small fixed condensers across their primary windings. A 1 or 2 mfd. Mansbridge reservoir condenser should be shunted across the H.T. battery terminals. The correct value of the telephone or loud-speaker condenser will be found by trial.

Careful Adjustment Necessary.

It will become necessary to readjust the reaction on the aerial every time the tuned anode circuit is adjusted, and vice versa. The anode coil, D, should be placed in the centre socket of the three-coil holder, and all coils should be well separated, while the variable condensers are primarily adjusted to the loudest signals, when the coils C and G are brought a little closer to D. The condensers are then readjusted and the coils again brought closer together. Final tuning is accomplished by the simultaneous micrometer adjustment of the coils and condensers.



advantages to be derived by introducing reaction into two parts of a receiving system.

Maximum signal strength is mainly dependent on sharpness of tuning, with the consequent tendency to lessen interference, and by utilising the double reaction effect a very high degree of efficiency may be obtained with the use of the minimum number of components and a more or less "straight circuit."

A Long-Range Receiver.

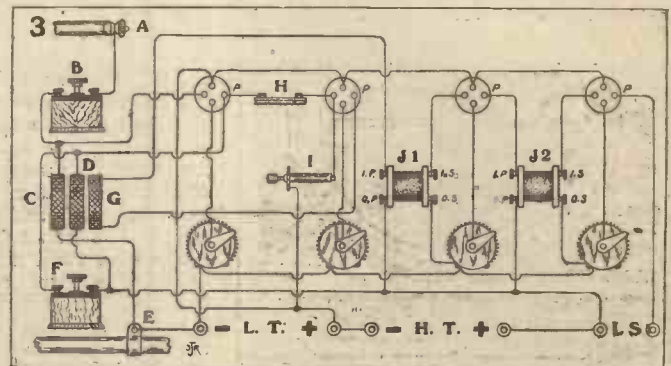
As the title of this article implies, the circuits shown in the accompanying diagrams are standard double reaction circuits using two, three, and four valves, each one having been thoroughly tested and selected for the benefit of any reader who is not yet sure whether he is a competent operator or not. In other words, owing to the difficulties presented in adjusting these circuits, any reader who may care to undergo a little private examination in tuning is recommended to try them out. The more serious and experienced enthusiast may regard these circuits as reliable groundwork on which many interesting experiments might be based.

coupling G to D an additional reaction effect is obtained.

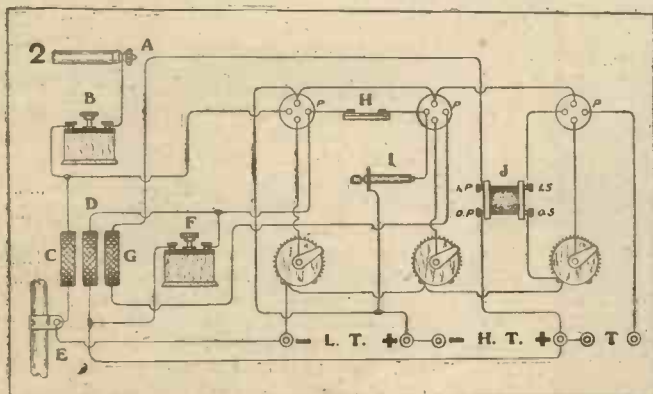
Powerful Loud-Speaker Set.

For the broadcasting wave-lengths the coil C may comprise a No. 50 or 75 (condenser in series), D, No. 50 or 75, and G, No. 75, according to the size of the aerial. They may be mounted in a standard three-coil holder. In Fig. 1, H represents the '0003 mfd. mica grid condenser, and I the usual 2 megohms grid resistance. In Fig. 2 the grid condenser, H, is of the same capacity, but the resistance, I, is preferably variable from $\frac{1}{2}$ to 4 or 5 megohms.

J is the L.F. inter-valve transformer, the primary side of which should be shunted with a '001 mfd. fixed condenser, if necessary. Various fixed condensers should be tried across the telephone terminals, T. It will be seen that the circuit embodies one stage of H.F. amplification, valve rectification, and one stage of L.F. amplification.



In Fig. 3 an additional stage of L.F. amplification is provided, this arrangement being more suitable for loud-speaker work. H is the '0003 mfd. mica



A neat two-valve and crystal set constructed by Mr. H. Blaun, of Olive House, Perry Hill, Cardiff, S.E.G.

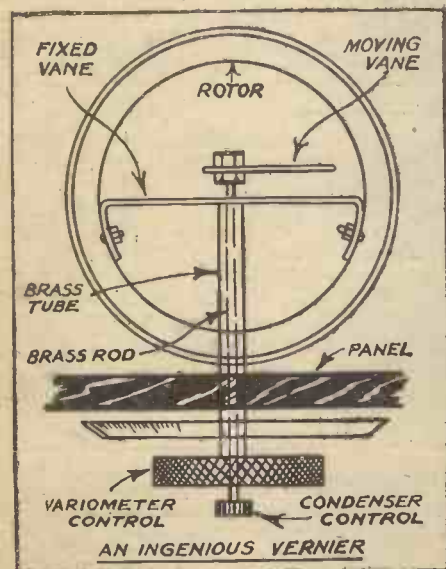
Constructional Notes

Conducted by Dr. J. H. T. ROBERTS, F.Inst.P.

An Ingenious Vernier Condenser.

THE following idea for a vernier condenser is very neat, and has the advantage that it does not require any extra panel space or panel drillings. The vernier condenser, in fact, is located within the rotor of a variocoupler or variometer, and the moving plate is operated by means of a shaft passed through the (tubular) shaft of the variometer rotor. The diagram herewith is practically self-explanatory.

The shaft of the variometer is replaced by a short length of, say, $\frac{1}{4}$ in. copper or brass tubing, which may be held in place in the rotor by means of a small brass plate soldered to it, and then screwed to the rotor. The brass tube may be held in the stationary condenser-plate by means of an ebonite or fibre bushing, or the central rod attached to the moving plate may be insulated from the tube. The main control-knob of the variometer is, of course, drilled for the central brass rod, and the latter is provided with a small insulating knob for controlling the vernier condenser.

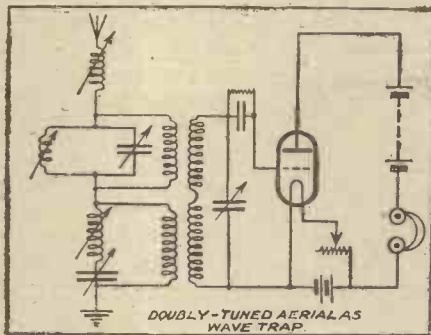


Electric Light Aerial.

It is well known that the electric-lighting wire may be used as an aerial, and in many cases it forms a very efficient one. The usual method is to employ some form of condenser for plugging into the electric-lamp socket, and connecting to the aerial terminal of the set. A very simple way of securing the same result, however, which is specially applicable where a table reading lamp is used, is as follows.

Since there is a fair length of flex available, a wire may be twisted around this and connected to the set: the insulation on the electric-light flex prevents contact, but there is a condenser action between the electric-light wires and the aerial wire, which

permits the transmission of the energy to the set. The capacity between the two wires will, of course, depend upon the length of extra wire which is twisted round the flex; the best value for this can only be found by experiment.

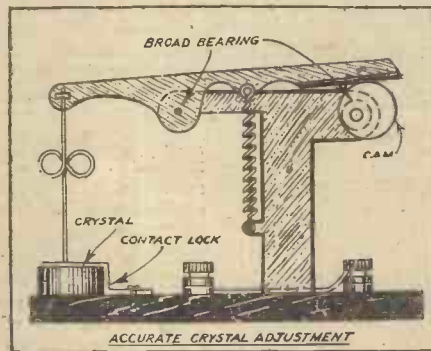


Valve Mounting.

You know how mechanical vibrations cause ringing sounds in the 'phones or loud speaker, these being due to the changes in the relative positions of the electrodes in the valves. Many arrangements have been devised for mounting the valves upon felt or rubber pads, or upon springs, so as to prevent extraneous vibrations from reaching them.

The arrangement shown herewith, whilst it does not involve any new principle, is very neat and is a handy way of mounting on rubber. For base mounting, use the form shown in the top drawing. Two strips of brass are bent up at the ends into the shape indicated, and a strip of stout rubber is stretched across each and secured by means of a small nut and bolt. A single screw in the centre of each brass strip serves to fix it to the base, whilst the valve-holder is secured by a single nut and bolt through the middle of each of the rubber strips.

For panel mounting, the two brass strips are bent into a somewhat different shape,



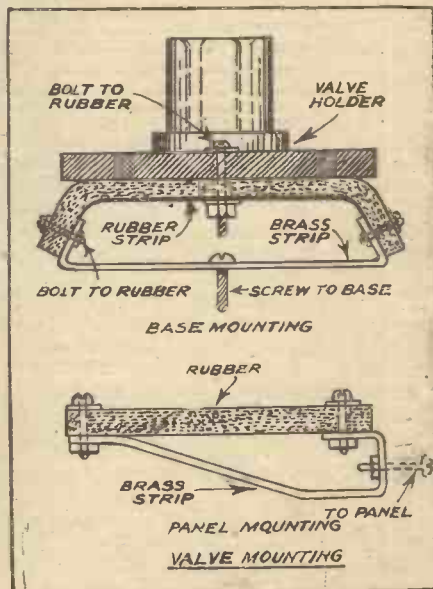
as shown in the lower drawing. Here, again, the method of stretching the rubber strip is similar to the above, and one screw is used for securing each brass strip to the panel, and one nut and bolt for securing the valve-

holder to each of the rubber strips. A resilient mounting of this kind will sometimes be found to make a great difference to the character of the reproduction, particularly with certain kinds of valve.

Doubly-Tuned Aerial as Wave-Trap.

The circuit arrangement shown on this page is the invention of Dr. Alexanderson, of New York, the well-known wireless engineer. He uses double tuning in the aerial circuit, one tuning having capacity and inductance in parallel, and the other having them in series.

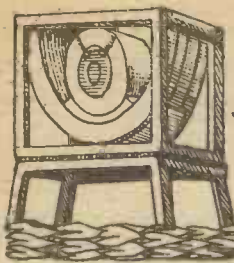
The values of the capacities and inductances in these two connected circuits are so adjusted that, for the wave-lengths which it is desired to tune out, the responses in the coupled circuits are equal and opposite; the interference from this wave-length is thus blocked out. For other wave-lengths, the voltage-drops across the two tuned circuits in the aerial diverge, one circuit becoming (effectively) a capacity and the other an inductance. The two circuits do not then cancel out, and the signal is detected.



Accurate Crystal Adjustment.

It is comparatively easy, with any reasonably good crystal, to find a sensitive spot, but the trouble is to keep to it when found. The arrangement shown herewith, which is the subject of a foreign patent, although at first sight it looks somewhat elaborate, is in reality very simple and seems to be quite a business-like job. I have not had a sample for inspection, and have not yet had it made up, so cannot say whether it has the precision and stability claimed for it, but I have little doubt that it has.

The arrangement will be clear from the figure. A cam, which is operated by a control-knob at the end of a shaft, serves for the micrometer movement of the balance arm or lever, to the other end of which the catwhisker is attached. The latter, immediately before making contact with the crystal, passes through a small hole in a piece of ebonite or other such material, bent into the shape shown. This ebonite member is secured by a single screw, and may therefore be rotated slightly to enable contact to be made with different points on the crystal.



Artistes of the Aether

SOME OF THE ARTISTES WHO HAVE GIVEN YOU PLEASURE WHEN LISTENING IN



SLOWLY, but none the less surely, broadcasting is being regarded by the great artistes of the musical world no longer as a menace to their future, but as an additional means of publicity to their attainments. It has taken many months to convince their agents that, by preventing them from broadcasting, the door has been opened to a vast number of more or less talented performers who would never otherwise have obtained a hearing.



Madame d'Alvarez.

This condition has practically come to an end, for the British Broadcasting Company have now at their disposal the finest musicians of all countries. Example has been set by our best English players in accepting the overtures made them, consequently we have heard William Murdoch, Albert Sammons, Cedric Sharpe, Daisy Kennedy, and all the vocal stars of the British National Opera Company, now once more with us.

A Recent Recital.

A step further has been made by the recent recital of Mme. Marguerite d'Alvarez, one of the most famous contraltos in the world. She is the daughter of the Marquis di Rocafuarte, and while at school showed such talent that she was allowed to continue her studies at Brussels Conservatoire. Here she gained the Queen's Prize in the short time of two years. As an opera singer, she made her debut at Rouen, in "Samson and Delilah," and she was a leading lady in Covent Garden Royal Opera and at the late London Opera House.



Mr. Cecil Bonvalot.

Sunday Programmes.

Possibly the most difficult of all the programmes to frame is that of Sunday. There is no need for the propaganda principles of the British Broadcasting Company, as religion has been aptly said "to be between man and his Maker," and the lengthy enforced sermon and services are for the most part endured in silence as far as the sets are concerned. On the musical side, however, both afternoon and evenings have shown marked improvement at 2 L O.

Amongst the artistes who figured recently with the string quartet of Raymond Jeremy,

was Cecil Bonvalot, a clever violinist, whose recital at Wigmore Hall last week proved him to be an exceedingly capable artiste.

De Groot and his orchestra are always looked forward to with pleasure, and a "De Groot Sunday" has become a standing title of distinction in many households.

A Well-known Tenor.

At the studio of 2 L O, a programme was carried out on "Empire Sunday" by four clever artistes, Miss Winifred Fisher, Mr. John Collinson, Mr. Alec Sherman, and Miss Una Cheverton.

Mr. John Collinson is one of the best-known of our English singers, and may be called also the "John Coates" of the B.B.C., for, in his frequent tours of the stations, he has given us some of the best examples of art songs of the modern English composers, as well as of the old-world arias of the classics.



Mr. Dan Godfrey, junr., who recently joined the staff at 2 L O.

Those Talks.

Yes, we do get them, and sometimes to repletion. Still, sometimes, also, we get a really interesting subject, and a speaker who knows it. What should be more interesting to a citizen than his own city, yet it has been said that the only Londoner who knows London is the American who visits it. Thanks, however, to Mr. Allen Walker, this stigma should be speedily removed, for his daily "talks" at the Polytechnic Cinema, Regent Street, added to his broadcasting during the past year, should give all Londoners interest.



Mr. Allen Walker.

Humour.

"To laugh or not to laugh? That is the question," if we may be forgiven the paraphrase. How to make an invisible and countless audience laugh, without the aid of scenery, faction make-up, or action, has proved a problem to many entertainers. That these problems have been overcome successfully is proved by John Henry, Louis Hertel, Fred Spencer, and Fred Beck, who, with his partner, George Stockwin, has made many an enjoyable turn.

Mr. Beck has had a long and wide experience in the

theatrical world, and, as he himself puts it has figured in all its branches: "Comedy, drama, al fresco, panto, 'fit-up' and 'dry-up.'" His first part was at the old Aquarium, at Brighton, twenty-two years ago, and, for diversity of parts, Mr. Beck may be said to take the palm, ranging from the Widow Twankey to Gecko in "Trilby," Rake in "Under Two Flags," and the George Dance musical comedies.



Mr. John Collinson.

Joining up during the war, Mr. Beck returned to play Mrs. May in "A Sister to Assist 'Er," John Le Breton's famous sketch, and he has made gramophone records of this for most of the companies. Happy thought, Mr. Beck, why not broadcast it?

Cardiff.

For its programme of light Italian music, Cardiff is to be commended on its choice. Works of tuneful but less familiar composers—Tosti, Sinigaglia, Cilea, Wolf Ferrari, and Respighi, among others, made up an attractive programme. On the occasion of the All-Welsh week at Wembley, it was entirely appropriate that the address should be given by Sir H. Walford Davies.

Other successful items of the week were the Magic Carpet trip to Japan under the "guidance" of Prof. Wilden Hart, M.A., F.R.G.S., and the production of "Hamlet."

Glasgow.

The choice of plays for wireless production is not an easy one, but Glasgow found itself well served by the one-act plays of Sutro, "The Open Door," and the grim little tragedy, "The Man in the Stalls," as well as "The Impertinence of the Creature," by Cosmo Gordon Lennox. In each of these, the literary value is of more importance than the acting, and they are therefore entirely suitable for broadcasting.



Mr. Fred Beck.

Aberdeen.

The sister city of the north scored success also with a good musical comedy, "The Prince Appears," a classical night with Maurice Cole and Dorothy Silk as soloists, and "The Bohemian Girl" (in miniature).

THE LOUD SPEAKER OUT OF DOORS.

(FROM A CORRESPONDENT.)

Some useful details of a power amplifier that is specially designed to give pure amplification with a volume of sound enough for open-air loud-speaker reception.

NOW that the summer months are here many amateurs will be thinking of outdoor pastimes rather than sitting indoors listening to the loud speaker. The average set is not powerful enough to make the loud speaker sound really loud in the open air. A detector and one low-frequency valve usually require a power amplifier to give a volume of sound which may be heard all over a large garden.

Distorted Results.

When two low-frequency valves are used in the usual manner, Fig. 1, the way that the average person tries to get over the difficulty, very bad distortion results. This distortion is even present when great care is taken to make the grids of the valves sufficiently negative. When transformer coupling is used it is found that a small ratio of windings 1-2 is best with the second transformer, the usual 1-5 being used for the initial step-up.

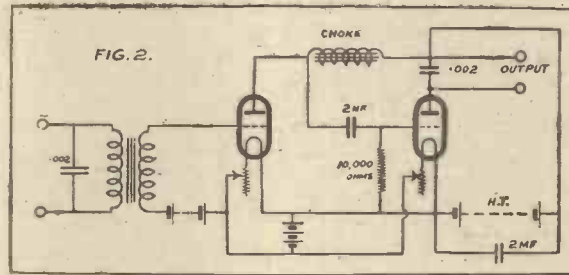
The amount of negative volts on the grid of each valve varies both with the H.T. and make of valve used, and the second valve may require three or four times as much as the first. Using 120 v. H.T. and L.F.B. dull emitters, a grid bias of 6-8 v. on the first valve made considerable difference to the output of the loud speaker, but whatever voltage was put on the second valve it was impossible to get rid of distortion. It may be said that the finest transformers on the market were tried without much difference resulting.

Choke Amplification.

If instead of coupling the last valve by means of transformer a choke-capacity coupling is tried, it will be found that nearly as good amplification results, without the slightest sign of distortion. Choke coupling is simple to operate and saves the cost of an expensive transformer. Practically

but no advantage was found in their use. The circuit is shown in Fig. 2.

The condenser in the grid-circuit is a "Mansbridge" 2 mfd., whilst a "Remco" graphite leak is used, value 15,000 ohms; a leak may be easily made, and the value is not too critical, but it must be fairly large, else the condenser will charge up and make



the output from the loud speaker unintelligible.

Using the circuit as shown with 130 volts H.T., and an "Amplion" A.R. loud speaker, music and speech from 2 L O was simply deafening in a room, and in the garden it could be heard a number of houses away.

RADIO AND EDUCATION SUCCESSFUL WORK IN THE SCHOOLS.

THE construction of receivers and study of wireless has become part of the curriculum in many schools, some of which have taken up the subject in real earnest. The St. Catherine's Church Mixed School, Wakefield, has recently constructed a 4-valve set on novel lines.

The fundamental idea in wiring has been that all leads may be easily accessible and capable of quick transference to various circuits. The tuning units (which are for comparative efficiency) consist of:

Slider tuner, wound on 3 1/2 in. former, duolateral coils, basket coils, and variometer.

The valve panels are, on the left of the set, H. F. and detector unit, while the 2 L.F. are on the right. The filament controls for these are purposely detached from the valve panels.

The L.F. intervalve transformers have been wound in school on a winder made of Meccano parts, and the Stalloy laminations and ebonite fitted by the boys.

The telephone leads are brought out to a plug-in-and-socket arrangement, on the centre of the set, thus enabling quick interchange of telephones and loud speaker

A twin flexible cable lead is fitted from the set into the main room and a further plug-and-socket arrangement fitted.

The H.T. unit is composed of flash-lamp batteries fitted into a varnished box made of 3-ply wood. The containing cabinet was made in school during the handwork lesson.

The set is so powerful that the broadcasting programmes are distinctly heard throughout the school.

It has cost about £12, and the money has been raised through concerts and various other efforts.

Successful Demonstrations.

In connection with the special transmissions arranged by the B.B.C. for the purpose of exploring the possibilities of broadcasting for educational purposes, it is interesting to note that two very successful demonstrations have been carried out at the Wheatley Street Schools, Coventry.

On the first occasion a lecture on Music by Sir Henry Walford Davies was transmitted from the London station. The second transmission took place recently, when a lecture on the Migration of Birds, by Mr. E. K. Robinson, was broadcast.

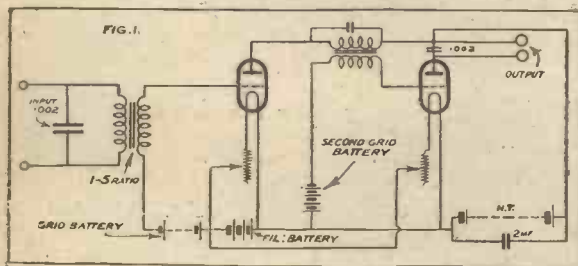
The receiving apparatus used on both occasions was a standard Radiola II; (two valve) receiver, with a B.T.-H. two-valve power amplifier. On the first occasion a single B.T.-H. Form C2 loud speaker was installed in one of the class-rooms, and the lecture was heard quite clearly and distinctly by a double class of 70 boys. On April 11th, three B.T.-H. Form C2 loud speakers, connected in parallel, were installed in three separate class-rooms, and the lecture was given simultaneously to three double classes, totalling approximately 210 boys.

An Aid to Education.

In every respect the demonstrations were thoroughly successful, and the representatives of the local education authority, who were present at the second lecture, expressed their complete satisfaction with the results obtained. It should be noted that the apparatus used was of the ordinary standard types, and no special accessories of any kind were employed.

The two demonstrations were carried out by the British Thomson-Houston Company, Ltd., who manufactured and supplied the apparatus.

These demonstrations clearly proved the value of wireless as a means to education and afternoon broadcast lectures (made as interesting as possible, of course) would be a welcome feature to many schools which have their own receiving apparatus.



anything will work as the choke providing it has the necessary amount of impedance, a "Ford" coil, costing, perhaps, 2s., working beautifully. The impedance of this type of coil, I believe, is about one henry. Closed core chokes have been tried,



Boys of the Wheatley Street Schools, Coventry, listening to a broadcast lecture during the tests described above.

The Junior Amateur

A Section Devoted to the Interests of the Younger Constructor.

A VARIOMETER TUNED CRYSTAL SET.

By F. W. PLEWS.

THE general appearance of the set is seen in Fig. 1. The rotor consists of an ordinary cardboard tube $3\frac{5}{8}$ in. in length and $3\frac{7}{16}$ in. diameter. Two pieces of wood are cut to fit the internal dimensions of the tube, Fig. 3. These are then fitted into the ends of the tube very firmly and glued. Two holes are cut, one on each side of the rotor tube, as seen in Fig. 2, which shows an elevation of the tube. The dimensions are drawn exactly to scale.

These holes are for the purpose of fixing nuts inside the tube and making other little arrangements when the set is being built. The small projections seen in the corners of this drawing represent the flat pieces of wood fixed on the top of the circular piece of wood at B B, Fig. 3. The small circle at C represents the hole for the spindle. After the ends have been fixed and the two small supports at B B, we can proceed to wind the rotor.

Winding the Rotor.

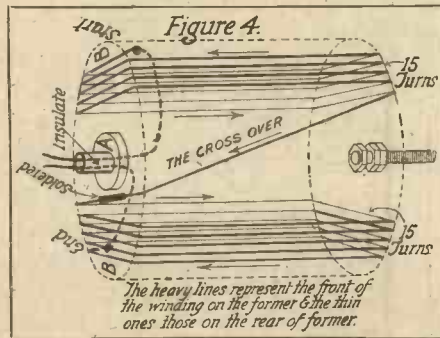
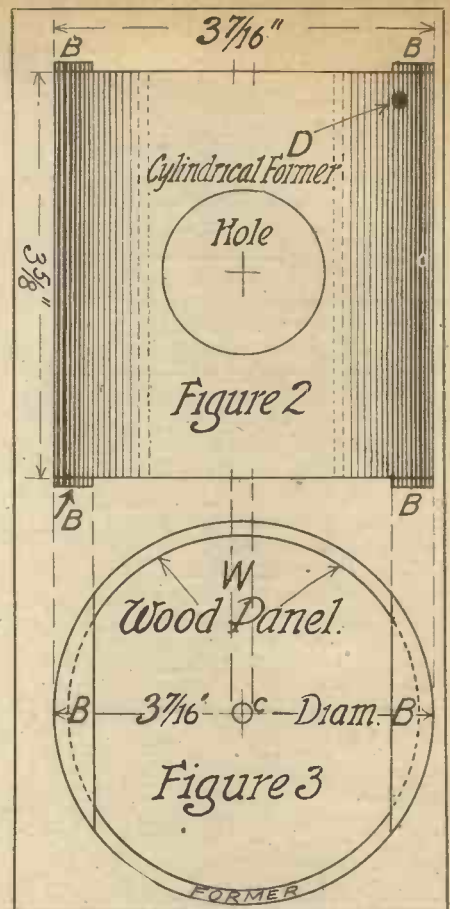
The wire chosen for the set we are now considering was 18 S.W.G. D.C.C. A hole was drilled in the tube at D on the rotor and a small length of wire was passed through, sufficient to make connections later on; 15 turns of wire was then made on each

side of the rotor. The small wooden supports at B B acting as a bearer to prevent the wire from slipping off the tube. Fig. 4 shows how this was done.

After 15 turns have been wound one must start on the other side. I cannot very well show the two sides of a tube in a drawing, but if the reader follows me closely he will understand how the wiring goes. The wire is anchored in a suitable manner and sufficient is allowed for final connections. These loose ends are left inside the tube for the present.

Stator Construction.

Now proceed to wind 15 more turns of wire, making a total of 30 turns; the cross-over is made on the front of rotor, as seen in the diagram, Fig. 4. The two ends are next joined together, using solder for the purpose, and finally covered with a small piece of the insulating tape used for electrical work. One may now trace the direction of wiring for continuity before



very tightly with lock nuts in the interior, and on the exterior of the rotor, but to do this it must be placed in its proper position inside the stator, passing the spindle through the ebonite cheek at S, Fig. 5.

Connections of Rotor.

A long, thin screw key will be required for this purpose. It is very important that the spindle should be firmly locked to the flange which we fitted on the top of rotor. At the opposite end of rotor we must have already fixed a bush, as shown at A, Fig. 4. The two loose ends of wire in the inside of (Continued on page 618.)



Fig. 1. The general appearance of the set.

proceeding farther. The winding must be in the same direction on each side of the rotor. See sketch, Fig. 4.

Proceed now with the stator. The two supports, Fig. 5, are made of ebonite, $\frac{1}{8}$ in. in thickness, to the dimensions given on drawing. The heavy dotted lines represent the size of the inner coil which we have just completed. Cut the pieces of ebonite to the shape shown by the thick lines. We shall also require two pieces of wood cut to the dimensions given in Fig. 6. To add strength it would be advisable to choose wood of quarter-inch section.

The Ebonite Cheeks.

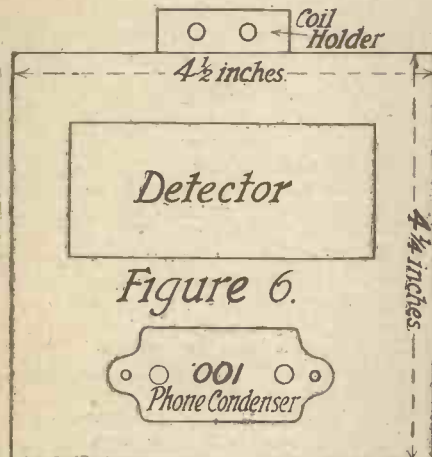
Now drill holes in the ebonite at points marked 1, 2, 3, 4, 5, 6, and B, to take small brass screws. Fix the two ebonite cheeks on the top and bottom wood panels with the small brass screws. This will now present the appearance of a box with two open sides. Holes for terminals and spindle must have been previously drilled where shown, T, Fig. 5. The spindle must now be fixed on one side of the rotor and locked



A VARIOMETER TUNED CRYSTAL SET.

(Continued from page 617.)

the tube are now passed through the opening in the bush which has been insulated with ebonite tube, and make their appear-



ance at the rear of the variometer, as seen at E, Fig. 7.

The start of the rotor winding is taken to the terminal at R, Fig. 7, and the end of rotor winding is taken to the earth terminal, Fig. 7, and fixed on the rear.

Stator Winding Details.

Now proceed to wind the stator. At the rear of the terminal S, Fig. 7, connect the start for the winding of the stator. Make 14 turns, then temporarily anchor the end of this side. At the rear of the terminal R, Fig. 7, anchor the end of the stator wire and proceed to wind 14 more turns in the same direction. The cross over is made on the rear and the joint soldered and covered as previously explained.

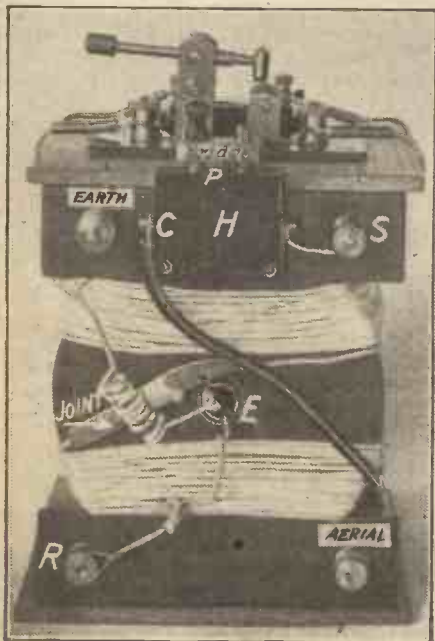


Fig. 7. Showing how the variometer connections are made.

The coil holder at H, Fig. 7, is now screwed on to the rear of the variometer and a connection from the aerial terminal made with the holder at C, Fig. 7. From the opposite side of the holder a short connection is made to the terminal S, Fig. 7. This coil holder is also used for the three plug-in fixed condensers when one wishes to get on to very low wave-lengths.

Final Connections.

To use the set under normal conditions a small bridge, Fig. 8, is inserted at P to connect the two sides of the holder with aerial and variometer. The fixed condenser, F, Fig. 1, on the top of the set is a telephone condenser the value of which is .001. The terminals of this condenser are connected with the rear of the telephone terminals, Fig. 1.

The detector was bought ready-made for 1s. 3d. The crystal side terminal is connected with the rear of terminal B, Fig. 1, for short waves, and the arm side of the detector is connected to the 'phone terminal C, Fig. 1, at the rear. From the 'phone terminal at D, Fig. 1, make a connection to the earth terminal, Fig. 7.

All that now remains to be done is to screw the variometer scale and knob on the projecting 4 B.A. screw, locking the rear

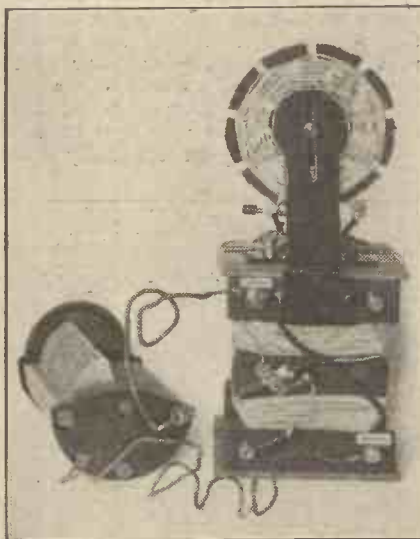


Fig. 8. The set with extra coil for long wave-lengths.

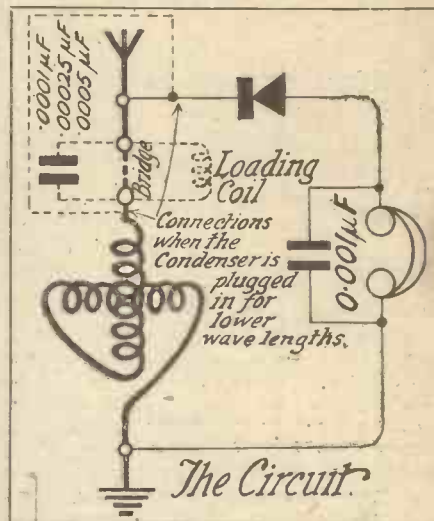
of scale when in its proper position with a lock nut. We are now ready to connect up the aerial, earth, and 'phones. To tune in turn the knob of variometer until signals are heard at their loudest.

Minor Deviations Advised.

In one or two minor details it will be observed that the photos do not quite correspond with the description given in the line drawings. After making up this set I saw its weak points mechanically and in my explanation and drawings I have remedied these weaknesses. The checks of the variometer made of ebonite will be much better screwed on the sides of stouter wood than that shown on my photo, in which the checks are screwed on to the underside.

The projecting parts at B, Fig. 5, have also been added and a support of wood can be placed between the ebonite cheeks from side to side to prevent the heavy wire when drawn tight from pulling the ebonite cheeks into a concave shape.

The values of the three fixed condensers used in series are .0001, .00025, .0005. The extra coils for the higher wave-lengths can be either made or bought to suit individual



requirements. The variometer has sufficient winding to get any of the B.B.C. stations within crystal range without the use of extra plug-in coils or fixed condensers.

When the plug-in coils are used the connection from the crystal cup must be made to the aerial terminal and not to the terminal marked B on Fig. 1. The connection at B is to be used when the fixed condenser is in the aerial circuit for short wave-lengths.

Suitable for New Stations.

This little set has been designed primarily to get the higher wave-lengths from the new London station when it becomes the practice to broadcast on the two wave-lengths by inserting a plug-in coil or condenser, as seen in Fig. 8. Fig. 9 shows a side elevation.

Fig. 8 shows a .001 mfd. variable condenser in parallel with the variometer and plug-in coil. This ensures sufficient overlap if the coils used vary greatly in wave-length. If there is no more difference in the series of coils in use than the amount of wiring on a 36-turn coil the variometer will be able to cover the gaps and give sufficient overlap. But if the difference is greater than the wave-length got by a 36-turn coil a variable condenser will be required.



Fig. 9. A side view of the completed set.

HOW TO BUILD A "UNIVERSAL" FOUR-VALVE SET.

By J. C. JEVONS.

Although the new "Unidyne" principle eliminates the use of H.T. many amateurs who have unexhausted H.T. batteries at hand will find this receiver worth building for loud speaker and distant reception. The series will be complete in four articles.

PART I.

THE set about to be described has been specially designed for POPULAR WIRELESS as an "all-purposes" receiver, capable of easy conversion in successive stages from a simple one-valve unit without reaction for receiving local broadcast at a small cost in "juice," up to a powerful four-valve circuit (1 H.F., detector, 2 L.F.) with reaction, able to receive American transmission direct on the 'phones, or Königswusterhausen on the loud speaker. Headphone or loud-speaker reception of any B.B.C. station from any place in the British Isles is readily obtained on one or other of the intermediate stages.

Special Features.

Some of the special features are: (1) A specially elastic control of reaction, capable of being applied either directly to the aerial or to the tuned anode of the first valve, or "reversed" when the high-frequency valve is cut out, or of being completely cut out as desired. (2) A special "tune-standby," or "primary-secondary" switch for working either direct on the aerial or through a tuned secondary for minimising interference.

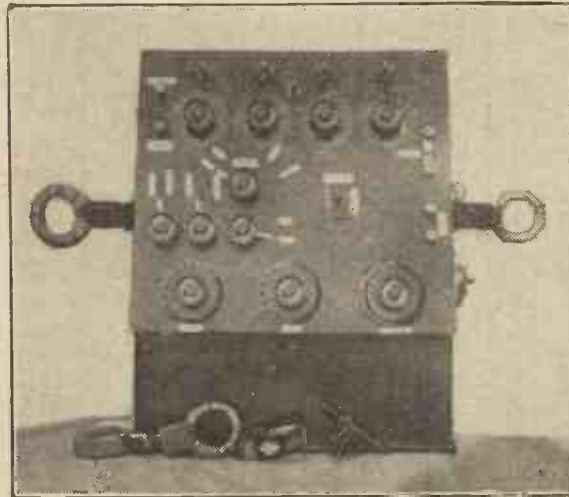
This switch is arranged to earth the secondary coil when on "tune" so as to avoid the usual tendency to "howling" which arises when the batteries are not directly earthed.

(3) A particularly effective switching system, the switches being both simple and easy to make at home. (4) A series-parallel switch for the aerial condenser, and a separate filament control for each valve. (5) Provision for readily substituting resistance-capacity coupling for long-wave reception in place of the normal tuned-anode coupling. (6) A compact cabinet designed to house the H.T. battery, spare coils, etc., and also the dry cells for dull-emitter valves.

In spite of the numerous controls and advantages set out above, the set will be found quite simple to construct and assemble, whilst the fascination of owning

and operating a really first-class instrument will be found to more than compensate for the time and trouble involved. The circuits are all straightforward and ordinary, as will be seen from Fig. 1.

No attempt has been made to utilise dual or reflex amplification, and whilst the net result may not rival the super-efficiency attributed to the latter, it certainly also lacks their general instability and



The completed set fitted with Dewar switches in place of the home-made switches described.

tendency to "howl." Finally, the total cost of material and components is well under £6.

The only tools needed are a wood saw, a hack saw, files, pliers, screwdriver, drills, a hand-drill brace, Nos. 5 and 6 B.A. plug taps, No. 2 B.A. taper tap.

Necessary Materials.

The following is a list of the components and materials, together with their cost:—

- Mahogany, oak, or walnut board 3 ft. by 15 in. by $\frac{3}{8}$ in. finished thickness, planed both sides. (This is often called $\frac{1}{2}$ in. board, but the planing reduces it to $\frac{3}{8}$ in.) 4 6
- Sheet of ebonite 15 in. by 13 $\frac{1}{2}$ in. by $\frac{1}{4}$ in. thick 12 3
- 4 filament resistances with knobs and dials. These must be chosen to suit the valves employed. For R valves, or D.E.R. valves 7 ohms is enough resistance, but for the '06 type about 30 ohms should be provided 10 0

- 3 condensers of the type fixed to the panel by a single nut and of .0005 mfd. each. (For the anode tuning condenser .0003 is sufficient for most purposes) 22 6
- 16 valve sockets 2 0
- 5 coil plugs for use in making the swinging coil holders. (If preferred, a ready made 3-coil holder and a 2-coil holder may be bought) 5 0
- 2 L.F. transformers of good reliable make 42 0
- 2 double-pole double-throw switches for controlling the L.F. valves. (A single Dewar may be used instead, but it is not always easy to get this type of switch with the blades suitably arranged) 4 0

Construction.

- Grid condenser .0002 or .0003 mfd. 1 6
 - Grid leak of 2 megohms 1 6
 - 13 contact studs $\frac{1}{4}$ in. high 1 1
 - 4 ebonite knobs (2 B.A. tapped bush) 1 0
 - 6 terminals for aerial, etc., connections 1 0
- And the following miscellaneous items, costing 10s. in all:—
- 1 pair $\frac{3}{8}$ in. hinges for front of cabinet.
 - 1 ebonite or brass knob for same.
 - 2 yds. good rubber-covered "flex."
 - 4 brass pointers. 4 thin brass 2 B.A. milled or hexagon nuts. $\frac{1}{4}$ lb. tinned copper wire 18 gauge. 2 yds. sleeving ("Systoflex").

A piece of sheet ebonite $\frac{1}{4}$ in. thick and about 6 in. by 2 in., for cutting out discs for the special switches.

2 doz. brass countersunk head screws about $\frac{3}{8}$ in. long, No. 4 body, for fixing the cabinet sides together and the panel and back in place.

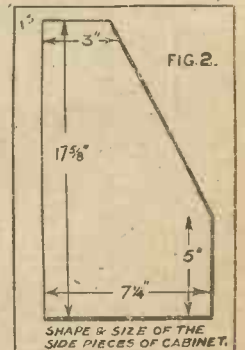
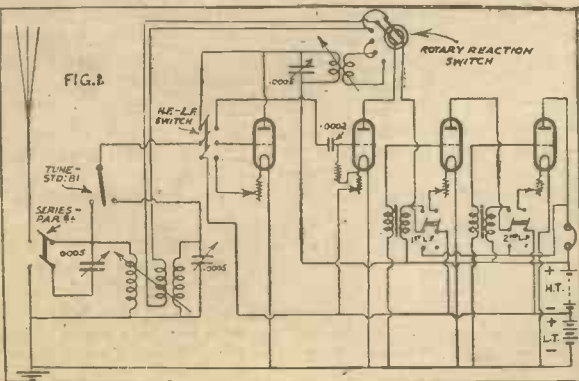
- 1 ft. brass strip $\frac{3}{8}$ in. by $\frac{1}{8}$ in. thick for coil holder pivots.
- 6 in. screwed brass rod 2 B.A.
- A few square inches of thin springy sheet brass for the switch contacts.

French polish, varnish or stain for the cabinet.

Fine glass-paper.

1 $\frac{1}{2}$ doz. round or cheese-headed No. 6 B.A. brass screws $\frac{1}{4}$ in. long. Three-ply wood 18 in. by 14 $\frac{1}{2}$ in. for back.

(Continued on p. 620.)



L.F. AMPLIFICATION BY CHOKE COUPLING.

By Prof. M. DAISMONT.

A successful method of avoiding the distortion usually associated with this type of amplification.

To bring in distant stations, H.F. amplification is necessary; to make arriving signals more audible, L.F. amplification is used. For loud-speaker work, at least two stages of L.F. are employed.

The L.F. amplification of the conventional type is produced by step-up transformers connected between the valves, as indicated in Fig. 1. Three stages of L.F. amplification by this method are a maximum, generally to be avoided. Better results are obtained by employing only two stages, followed by a power-amplifier.

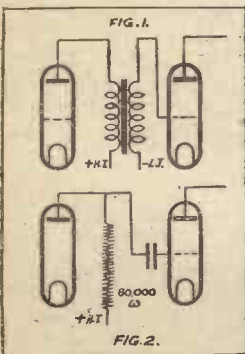
But there is another method of L.F. amplification—namely, the reactance-capacity coupling. An aperiodic resistance is put in the plate circuit of the valve, the L.F. impulses being transferred to the following valve by a fixed condenser of 0.005 to 0.01 mfd. This method is illustrated in Fig. 2.

Purer Results.

This second method gives generally a better tone for the telephony, but is by no means very economical; as P.W. has stated a short time ago, three stages by this second method are only equivalent to two stages of the transformer coupling method.

Experimenting to improve L.F. amplification, we tried another method, already in use for H.F. amplification—namely, the reactance-capacity coupling. The experiment was a complete success. In Fig. 3 a tuned anode circuit is given, followed by one stage of L.F. amplification by the said method.

The impedance of the iron core choke in Fig. 3 is very great, and this is an essential condition to obtain the



maximum amplification of the slow L.F. impulses. In actual use I have a choke-coil of the following dimensions:

Core: Wire of soft iron, 3 in. long and $\frac{1}{4}$ in. thick.

Windings: 63,000 turns of 47 S.W.G. silk-covered.

The choke coil of the first stage

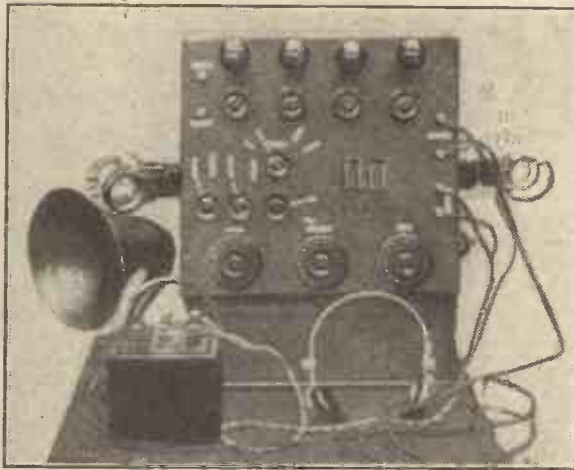
must be shunted by a fixed condenser of about 0.001 mfd., but this value is not critical. The intervalle condenser has a value of 0.006, but this value is also not very critical, as fairly good results have been obtained by a condenser of a capacity as low as 0.00025 mfd.

I don't mean to say that an impedance wound with 63,000 turns is essential; much depends on particular circumstances, and

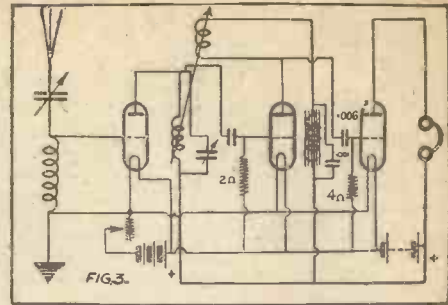
first-class results are obtained with an impedance of 15,000 to 20,000 turns.

Louder Signals.

As was stated above, three stages of resistance-capacity coupling are only equivalent to two stages of transformer coupled valves; this method, the reactance-capacity coupling, is by far the best; two stages



This complete Universal 4-valve receiver complete with accessories.



coupled by this method give an amplification equivalent to about three stages in which transformers are used—e.g., Aberdeen, at a distance of 450 miles, is received on an indoor aerial of about 100 ft. in a roof with the circuit shown in Fig. 3.

Telephony is very strong in the 'phones, and when they are on the table the music can be heard all over the room, but faintly. With a frame aerial of 3 feet square, most of the British stations, the nearest being at a distance of 130 miles, are comfortable in the 'phones.

It is difficult, of course, to give full appreciation of the obtained strength, but I am confident that the reactance-capacity L.F. coupling is the best, and also the most practical for constructional purposes; it seems to be a real improvement in L.F. amplification, for the amateur and for the professional wireless expert and constructor.

A UNIVERSAL 4-VALVE RECEIVER.

(Continued from page 619.)

Start with the woodwork and finish it off, so that the varnish or polish can get thoroughly hard while you go on with the panel.

Cut the following pieces with a fine-toothed saw from the board:—

Bottom, 15 $\frac{1}{2}$ in. by 7 $\frac{1}{2}$ in. Top, 14 $\frac{3}{4}$ in. by 3 in.

Front door 14 in. by 5 in. Two side pieces of the shape and size shown in Fig. 2.

The size from front to back is chosen so as to accommodate the "Ever-ready" 36-volt H.T. batteries, but it may be varied so as to suit any other shape of battery.

Polishing the Cabinet.

Round or bevel the top front and side edges of the baseboard. Smooth the surfaces with the glass-paper and give them a coating of shellac varnish mixed with an equal quantity of red mahogany varnish stain. The latter should be bought ready-mixed, but the former is easily made by dissolving shellac in methylated spirit. This gives a nice colour to Honduras mahogany, but Spanish mahogany is darker in colour and so less varnish stain should be mixed with the shellac. Allow

this coating to dry and again smooth it with glass-paper.

The top, bottom, and sides should then be fixed together with brass screws, or by dove-tailing. The varnishing can then be completed by giving a coat of clear copal varnish, which, when dried in a warm, dustless room, gives a "Rolls-Royce" finish. Allow several days for thorough hardening.

The ebonite should be bought from a reliable firm; cheap material usually turns out to be false economy. The price varies from 4s. to 4s. 6d. per lb., and, at the latter price, the panel will cost about 12s.

The Panel Surface.

See that it is cut to the correct size and with square corners. Round the edges and rub the surface with glass-paper, as the skin is sometimes conductive. This leaves a matt surface, which has a dull smooth appearance that is very handsome in certain circumstances, but which does not appear to best advantage when used with a case having a polished surface of the kind described above.

The difficulty may be overcome by polishing the front face and edges with a mixture of rottenstone and oil (motor lubricating oil will do), or with metal polish. Experiment first on a spoilt piece of ebonite, and when a good surface has been obtained, as described above, upon a spare piece of material, the panel itself may be confidently tackled.

Mainly About Broadcasting

by The Editor

IN this issue I am able to publish Sir Oliver Lodge's report on the P.W. "Unidyne" principle.

It constitutes a complete reply to those misguided gentlemen who have risked a criticism of the "Unidyne" without first making a practical investigation of its working capabilities, and I think readers will agree that Sir Oliver's report, together with that of his technical assistant, Mr. Edward Robinson, is a vindication of the claims made for the "Unidyne."

The Challenge to Mr. Marconi.

But, of course, readers must judge for themselves; they must judge between the theoretical opinion expressed by Mr. Marconi (who has not personally taken the trouble to investigate the "Unidyne," although I have twice extended him an invitation to do so), and the opinion of Sir Oliver Lodge, whose opinion was arrived at only after he had paid me a visit in order to inspect the "Unidyne" two-valve set and to discuss the theory of its principle in full technical detail with the inventors, and after his technical assistant had made exhaustive tests with the set at Sir Oliver's experimental laboratory at Egham, where Mr. Robinson is in charge of all the research work undertaken on Sir Oliver's behalf.

Readers must judge for themselves—they must decide between Mr. Marconi's opinion of the "Unidyne" and Sir Oliver Lodge's; they must decide whether Mr. Marconi is justified in writing in the "Wireless World" these words in connection with H.T.-less circuits: "These circuits do not call for serious consideration," and they will judge, I feel sure, all the more decisively should Mr. Marconi and Dr. Fleming refuse to take up our challenge.

Columbus and the Egg.

In last week's POPULAR WIRELESS, as Editor of this journal, I formally challenged Mr. Marconi and Dr. Fleming to refute, after a thorough test of the P.W. "Unidyne," that valve amplification can be obtained with the Dowding-Rogers H.T.-less circuit.

I further challenge Mr. Marconi to prove his statement in which he says: "These circuits do not call for serious consideration."

Such a statement is not only unjustified, but uncalled for, and is resented by every wireless man who believes in giving a fair test before breaking into premature criticism.

The trade, and especially that section of it which is commercially interested in the P.W. "Unidyne," will not thank Mr. Marconi for such remarks, though doubtless Sir Oliver Lodge's report has completely erased many erroneous impressions.

Has Mr. Marconi forgotten his own youth, when he came to this country, absolutely unknown, and thanks to the friendship and sympathy of Sir William Preece, was given the opportunity of demonstrating his wireless transmitter and receiver, a demonstration which laid the foundations of his fortune and success. Mr. Marconi, it would

appear, easily forgets the days when he himself was a young inventor who received every consideration when he visited this country.

Dr. J. A. Fleming has also expressed doubt in connection with the P.W. "Unidyne," but in a much more scientific manner. Dr. Fleming states, in connection with H.T.-less receivers, that there can be no real magnification of signal-making power.

The challenge also extends to Dr. Fleming. To be precise, I invite him, at his own convenience, to be present at a demonstration of the P.W. "Unidyne," and then to deny its excellent amplifying properties.

It is a most unpleasant duty I have to perform in drawing my readers' attention to the remarks of Mr. Marconi and Dr. Fleming, but they will, I feel sure, realise that the circumstances demand it.

Although the inventors of the P.W. "Unidyne" and myself anticipated plenty of criticism and much harping on the fact that the idea of H.T.-less circuits was not new, we did not anticipate so much incredulity from certain technical quarters.

Our Confidence.

Readers will remember that the idea of making an egg stand on end was not new even in the days of Columbus, but that gentleman discovered a practical way of making the egg stand on end—simply by tapping it and cracking it at one end!

And so with the P.W. "Unidyne." The idea of eliminating H.T. is not new; but the practical method of doing so in the P.W. "Unidyne" principle is.

I can only conclude by expressing the hope that readers will be good enough to build the P.W. "Unidyne" set for themselves, and will then let me know their opinions.

After all, it is the amateurs' verdict that counts, and our faith in the P.W. "Unidyne" is such that we await it with every confidence.

Radio Death Rays.

The public interest in "death rays" these days is such that a few words on equally destructive wireless rays may prove illuminating.

Although the technical details of Mr. Grindell-Matthews' invention are still his own particular secret, I strongly suspect that ionisation of a beam of light, which can thus be made a conductor of electricity, is a principle he has worked on. And if this is the case it will be interesting to see whether the "death ray," as it is called, can prove effective at any distance, despite radiation losses and other technical reasons.

But in wireless work it has long been known that electro-magnetic waves can, in certain circumstances, cause considerable damage to the magnetos of aeroplanes, motor-cars, and the like.

As far back as 1898, the Colorado Electric Light Company, U.S.A., were terribly upset and alarmed because the armatures of their big dynamos were suddenly burnt out, or

fused, for no apparent reason. That is, the engineers could find no signs of a short circuit or other technical causes for the damage.

New armatures were installed at considerable cost, but hardly had the work been completed before—phut!—the same disaster overtook them, and the armatures were burnt out beyond repair.

To cut a long story short, the trouble was traced to certain experiments made by a young assistant of Edison's—a Serbian inventor named Nikola Tesla.

A 100 ft. Spark.

He had a laboratory *five miles* away from the Colorado Co.'s works, and there he conducted experiments on a huge scale with electrical apparatus which radiated energy sufficient to effectually burn out the armatures of the Colorado Co.'s dynamos.

In fact, this energy had harmful results on dynamos and the like up to a distance of *thirteen miles*, and Tesla had prompt orders to modify his experiments.

Tesla used a 300-kilowatt generator (equal to 400 odd horse power) and a step-up transformer and an inductance coil 50 ft. in diameter. Tesla also used a huge spark gap, between the knobs of which flashed a spark of such power that it is a wonder he did not get himself burnt to a cinder.

This is not the place to go into technical details, but the fact remains that there is absolutely nothing new in the idea and operation of a ray which will render dynamos, etc., *hors de combat*.

The great drawback is the tremendous power required, the difficulties in handling it, and the cost.

For instance, Tesla used a spark nearly 100 ft. long—which is a terribly dangerous and difficult amount of power to handle and effectively control.

No doubt, by using smaller power, and a directive transmitting set, he could equal Mr. Grindell-Matthews at his own game.

But the fact remains that by electro-magnetic induction, or the propagation of very powerful electro-magnetic waves, it is possible to set up H.F. oscillations in the armature windings of a dynamo, and cause these windings to fuse and burn out. It is really induction on a colossal scale, and any wireless amateur will appreciate the fact that in such circumstances as I have outlined, wireless waves may aptly be termed "death rays."

FREE "UNIDYNE" SETS for READERS
P.W.'s Tour of the B.B.C. Centres.

BOURNEMOUTH readers of "Popular Wireless" will have an opportunity to-morrow (June 21st) of winning very useful wireless prizes, when the inventors of the P.W. "Unidyne" visit their town.

FULL details are given on another page, and every reader in Bournemouth is invited to look out for the P.W. motor-car, and identify the inventors of the "Unidyne."



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 to the Radio Society of Great Britain.

Barking and District Radio Society.

At the last meeting, Mr. Croot gave the first of a series of talks on the "Electrical Theory of Matter."

Hon. sec., A. Martin Gibbs, 435, Barking Road, E.13.

Coventry and District Co-operative Radio Society.

At a recent meeting Mr. F. Clogg lectured on a new circuit for a one-valve high tensionless receiver, which was followed by a demonstration with the society's components wired up according to this circuit.

Hon. sec., Mr. E. F. Sayer, West Orchard, Coventry.

Tottenham Wireless Society.

At a recent meeting of this Society Messrs. Willis & Ormandy, representatives of Messrs. Peto-Scott, Ltd., gave a demonstration of their firm's apparatus.

Hon. sec., A. G. Tucker, 42, Drayton Road, Tottenham, N.17.

Yeovil and District Radio Society.

An experimental evening was held last month. Meetings will be held on July 2, and September 3.

Hon. secs., R. J. W. Marr, "Kismet," Sherborne Road, Yeovil, and W. J. Hall, B.Sc., Tech., Greenhill, Sherborne.

The St. Pancras and District Radio Society.*

This society had a particularly interesting evening recently when Mr. L. F. Fogarty gave a talk on Distortion.

All those interested in joining the society should communicate with the hon. sec., R. M. Atkins, 7, Eton Villas, N.W. 3.

Hackney and District Radio Society.

On Saturday, the 31st ultimo, a party of members visited the electrical works of the Hackney Borough Council.

At the meeting held at headquarters on the 5th inst., a very interesting evening was spent in discussions on various technical matters appertaining to wireless.

Asst. hon. sec., Geo. E. Sandy, 70, Clissonhalo Road, E.3.

Leyton Radio Association,

The above association held a novel night last month, which was very successful.

The second annual general meeting was held on Tuesday, 3rd June.

Hon. sec., Capt. H. Thorley, C.A.S.C., Goldsmith Road, E.10.

Coventry and District Co-operative Radio Society.

At the meeting held on June 4th a very interesting lecture was given by Mr. Clogg, dealing with the types of coils which should be added to wireless receivers to enable these to tune in the programmes from the now high-

power experimental station which the B.B.C. will shortly open.

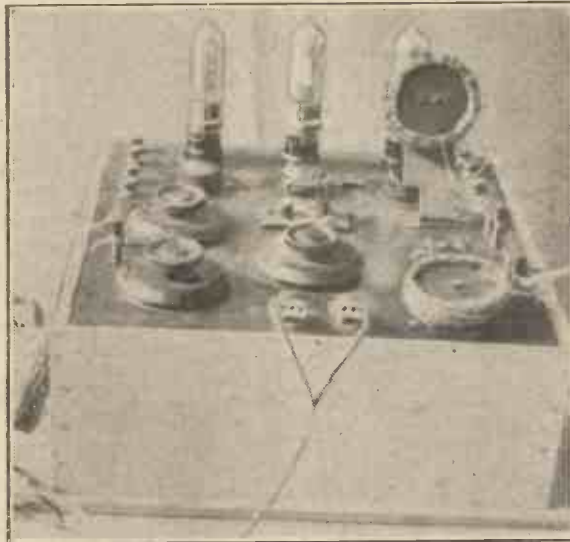
A visit to the B.B.C. Birmingham station has been arranged for Saturday, June 14th.

Hon. sec., E. F. Sayer, West Orchard, Coventry.

Lincoln Wireless Society.*

On Thursday, May 29th, a very interesting lecture upon "Soldering" was given by Mr. E. Issott.

Hon. sec., J. T. James, 126, West Parade, Lincoln.



The P.W. three-valve reflex receiver as constructed by Mr. L. F. Parrell, 3, King St., Brixham, South Devon.

Catalogues Book Reviews Etc.



AN interesting leaflet giving full particulars of coil-winding by means of the Kaynite Coil-Winding Machine has come to hand from A. W. Knight, Ltd., radio engineers of 167, Rye Lane, Peckham, S.E.15. This machine is capable of winding coils of any size, and is extremely simple in operation. A handbook is supplied with each order which has been specially written, the charts, graphs, etc., therein being easy to follow. The uses of coils are also fully described. The price of the machine is only 21s.

We are interested to see that a new type Amplion loud speaker has been produced, on the lines of their well-known concert gramophone model, and sells at two guineas.

The concert gramophone model, retailing at £3 is still to be retained. At the price mentioned, and being an absolutely up-to-date instrument, we believe that the new model will appeal to many wireless enthusiasts who have a good quality gramophone.

With much interest, we have read Mr. N. A. de Bruyne's latest book, entitled "Electrolytic Rectifiers." Published by Sir Isaac Pitman & Sons, Ltd., at 3s. 6d., it is intended for electrical engineers, physicists and wireless amateurs, and shows how to make and use a rectifier for charging accumulators from alternating current supply mains. Judging from the numerous queries received by our technical department on this subject, we anticipate a ready market for this new and interesting book.

Although television is still in its infancy, many readers will be glad to hear that a cheap book on this subject is now available. It is entitled the "A.B.C. of Wireless Television," and is published by Taunton Bros., 89, Shaftesbury Avenue, London, W.1., at ninepence net. The author, Mr. A. J. Bohringer, has succeeded in putting before the reader a particularly lucid explanation of the subject, on which he is to be congratulated.

APPARATUS TESTED



WE reproduce herewith a photograph of the new T.M.C. light-weight 'phones, which, as previously mentioned in the columns of POPULAR WIRELESS, weigh only 6 ozs. These tele-phones we have found particularly efficient on test, and at their price, 22s. 6d., they

should be popular.

A very useful aluminium former, suitable for winding inductance coils, has been received from the Watmel Wireless Co., Connaught House, 1a, Edgware Road, W.2. The spokes, which screw into a 2-inch former, are divided into two rows of 11 spokes each, and are staggered. The retail price of the former is 4s. 6d.

Autoveyors, Ltd., have forwarded us a box of "Clix" for use in our experiments. We have found them extremely useful, and the convenience of instantaneous connection and disconnection very helpful.

WIRELESS on EASY TERMS!

GAMAGES have now extended their easy payment system to Wireless, and you may now secure on payment of first deposit, Wireless Sets from £10 upwards, balance being payable in monthly instalments. Write for details to Wireless Dept., and get your Set in good working order for Summer.

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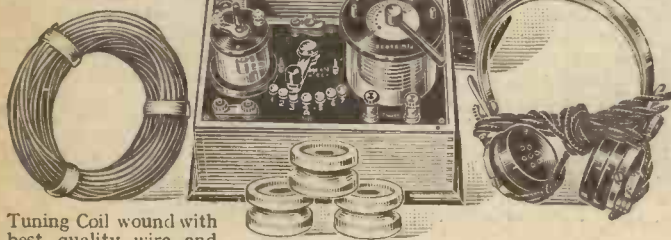
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RADIOTORIAL

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Technical Editor: **G. V. DOWDING, Grad. I.E.E.**

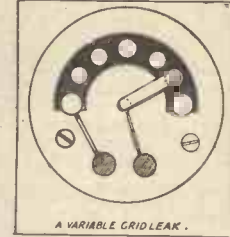
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Scientific Adviser: **Sir OLIVER LODGE, F.R.S.**

Staff Consultant: **Dr. J. H. T. ROBERTS, F.Inst.P.**

Foreign Correspondents: **L. S. LEES, Paris; Dr. ALFRED GRADEN-WITZ, Berlin; R. YATES, New York; P. F. MARTIN, Italy; W. PEETERS, Holland.**

try).—I wish to construct a grid leak which will be variable in steps, instead of continuously from zero to its maximum. Can an ordinary switch arm and studs be used for this purpose?



Using a semi-circle of blotting paper soaked in Indian ink the connections to a switch arm and studs can be made as shown in the accompanying sketch. If the studs are driven into the wood upon which the blotting paper lies whilst the Indian ink is still wet, a better contact is secured than is the case when the ink has been allowed to dry. Any number of studs may be used but 6 or 7 give a very good variation of resistance.

O. P. (Anerley).—Where can I obtain a dictionary of radio terms?

IMPORTANT NOTICE.

Readers are please requested to note that not more than three queries can be answered in one letter addressed to the Technical Queries Department. Owing to the extraordinarily heavy pressure on this department, readers are requested only to send in questions which they find they cannot possibly solve for themselves. On no account will more than three questions be answered in one letter, and telephone calls and personal calls at this office cannot be dealt with, owing to pressure of work on the technical staff.

A stamped and addressed envelope must accompany all queries. A copy of the questions asked should be kept by the sender, as it is not possible to reproduce the original query when replying. Number your queries 1, 2 and 3, and answers will be given to each item.

The Editor will be pleased to consider articles and photographs dealing with all subjects appertaining to wireless work. The Editor cannot accept responsibility for manuscripts and photos. Every care will be taken to return MSS. not accepted for publication. A stamped and addressed envelope must be sent with every article. All contributions to be addressed to The Editor, POPULAR WIRELESS AND WIRELESS REVIEW, The Fleetway House, Farringdon Street, London, E.C.4. All inquiries concerning advertising rates, etc., to be addressed to the Sole Agents, Messrs. John H. Lile, Ltd., 4, Ludgate Circus, London, E.C.4.

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.

PATENT ADVICE FOR READERS.

The Editor will be very pleased to recommend readers of POPULAR WIRELESS who have any inventions to patent, or who desire advice on patent questions, to our patent agent. Letters dealing with patent questions, if sent to the editor, will be forwarded to our own patent advisers, where every facility and help will be afforded to readers.

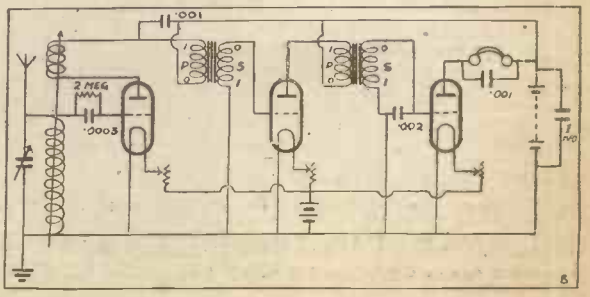
Questions and Answers

R. H. D. D. (Kensington, W.14).—I have constructed the "Ultra" crystal set, and find that 2 L O comes in best at the extreme limit of the tuning switches, which leads me to think that reception would be improved if further tappings were available. As I do not wish to pull the set to pieces, would a variable condenser give the desired result?

A variable condenser of about .0003 mfd. connected between the two switch arms will improve matters. Probably you have a small aerial, as the "Ultra" set is capable of receiving on higher wave-lengths than that of 2 L O.

M. E. N. W. (High Wycombe).—Would I be able to work a loud speaker on a three-valve circuit (Det. and 2 L.F.), with reaction, in this district. If so, what are the connections?

Yes, such a circuit should give quite good loud-speaker signals. The diagram which we reproduce herewith clearly shows the connections. Basket coils may be used for tuning purposes.



J. L. A. A. (Stoke, nr. Cover).

The British Engineering Standards Association have compiled a list which may be obtained for 1s. 2d., post free, from the publishers, Crosby Lockwood & Son, 7, Stationers' Hall Court, Ludgate Hill, E.C.4.

B. E. O. (Harrow).—How many turns of 26 S.W.G. enamelled wire will be required on a 4-in. diameter former to tune to 1,600 metres?

About 240 turns will be required.

B. S. (Cricket St. Thomas).—What are the connections for a single-valve regenerative circuit which makes use of a three-coil holder? Details of connections from point to point would greatly assist me, in addition to a theoretical diagram.

The point to point connections of the accompanying regenerative circuit diagram are—aerial to one terminal of .001 variable condenser; second condenser terminal to top of primary coil, and remaining connection of primary coil to earth. There is no electrical

(Continued on page 626).

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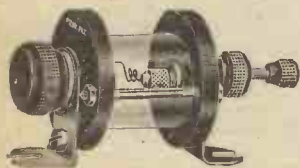
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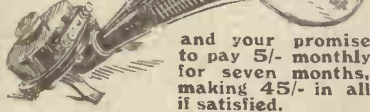
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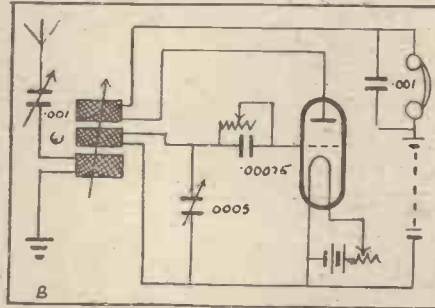


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RADIOTORIAL QUESTIONS & ANSWERS.

(Continued from page 624.)

connection between the rest of the circuit and the primary circuit. One end of the secondary coil should be taken to the grid condenser (.00025 mfd. approx.), and the grid leg of the valve taken to the other grid condenser terminal. A grid leak (shown variable in diagram) is connected across the grid condenser. The top of the three coils in the diagram is the reaction coil. This is placed between the plate leg of the valve and one tag (the negative) of the 'phones.



The other phone connection is to H.T. +. A .001 mfd. fixed condenser is shunted across the 'phones. H.T. - and L.T. - are both taken to the remaining end of the secondary coil. Across this latter (i.e. in parallel) is connected a .0005 mfd. variable condenser. L.T. - should be joined to one filament leg, and L.T. + to the remaining filament leg by way of the rheostat.

P. W. C. (Blaydon).—May honeycomb coils be used on the P.W. set in place of the basket coils specified? What is the value of the anode tuning condenser?

Yes, honeycomb coils of about 35 and 75 turns may be used, but we prefer basket coils for the lower wave-length. The anode condenser has a capacity of .0002 mfd. approximately. A .0003 mfd. will do equally as well if you already have one on hand.

D. M. S. (Fishburn).—Will a 2-volt 20 amp. accumulator be satisfactory for a dull emitter valve which takes a maximum of two volts on the filament at 3 amp.

This accumulator should prove quite satisfactory. Providing the capacity (20 amp.) is the actual rating, it will last you for about 60 hours, or half this time if the above capacity is only intermittent.

G. F. B. (Paddington).—I wish to build a two-valve and crystal reflex set, both the valves acting in a dual capacity. What circuit do you recommend?

We suggest that you employ the second of the two duplex reflex circuits which were shown in POPULAR WIRELESS No. 71.

A. Y. (Ilford).—Which would be the most effective, a single wire aerial 60 ft. long, 35 ft. high with 20 ft. lead-in, or a double aerial of same length and height, etc.?

We prefer the single wire aerial for reception of broadcast matter.

J. R. (Wellington).—I have an ordinary 4:1 R.I. low-frequency transformer. Will this be O.K. for the two-valve "Unidyne"? What firm is putting the dull emitter four-electrode valve on the market? Will an ordinary .0002 fixed condenser do for the grid condenser in the circuit?

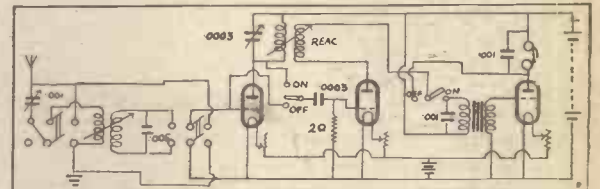
The R.I. transformer will be quite satisfactory. No further details of the four electrode dull emitter are yet available. Yes, the .0002 mfd. condenser will be quite suitable for the grid in the circuit.

L. C. N. (Stourport).—With regard to the P.W. ultra crystal receiver, I am desirous of making it up but am not clear as to whether the turns specified for the coil will cover the local station, as its wave-length is rather high. I find it takes 60 turns to reach 5 IT on my aerial (100 ft.) with an average set.

We think you will find the ultra crystal set quite O.K. for 5 IT, as you must not forget that the primary and secondary coils are auto-coupled, thus affecting one another considerably. The total secondary is thus equivalent to 120 turns, while the effect of the secondary being auto-coupled to the primary makes the latter's inductance far more than would be the case if the 40 turns were separate. The actual set described in the columns of POPULAR WIRELESS was tested on an average 100 ft. aerial and found to cover wave-lengths up to about 590 metres.

C. H. S. (Worsboro' Bridge).—What are the connections for a three-valve circuit employing primary, secondary, reaction and anode coils with switching for placing the aerial condenser in series or parallel, for tune and stand-by, and also for using one, two, or three valves at will. The valves to act as H.F., Detector, and L.F.

The diagram gives the full connections for the circuit you require. D.P.D.T. switches are used for series, parallel, and tune stand-by, while S.P.D.T. switches are shown for cutting out the valves. It is



presumed that the rheostats have an off position, in which case it will not be necessary to include switching for the L.T.

T. P. A. (Belfast).—On the 9th inst. I heard what was presumably a British amateur transmitting bugle-calls and explaining each part of the call. Strength was good but I was unable to catch the call-sign. Who was this?

Afraid that we have been unable to trace this transmission owing to the numerous amateur transmissions which take place nightly. However, should we obtain any information we shall be pleased to let you know.

A. D. (Kingsland Road, London, N.1).—Can you give me a diagram for an amplifier to be used with a one-valve and crystal (reflex) circuit? I wish to use the amplifier without altering the reflex circuit in any way.

An L.F. amplifier suitable for the purpose named was given in the Radiotorial Column of POPULAR WIRELESS, No. 103 (May 17th), and in that instance a double-pole double-throw switch is used, by means of which it can be switched out when not required. It may be found advantageous to give the grid of the amplifier a negative bias. This is done by breaking the lead between the secondary of the transformer and L.T. negative, and inserting a dry cell there. The negative pole of the cell should be connected next to the secondary winding.

LOUD SPEAKER FOR CRYSTAL SET

Owing to delay in manufacturing and the enormous demand for the SKINDERVIKEN system of amplifier, we regret that we are unable to supply further at the moment.

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All orders are being executed in strict rotation, so send your order to-day.

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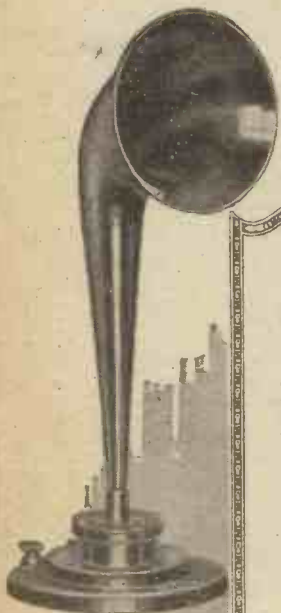
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The horn has no seam or joint, being fashioned of purest copper, electrically deposited on a mould, and the patented adjustment gives simple control of volume.

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London.

British Empire Exhibition, Wembley.
Palace of Engineering, B.E.A.M.A.
Section, Stand C1, Avenue 11,
Boys 6 and 7.



THE ECCENTRO DETECTOR

(Patented)

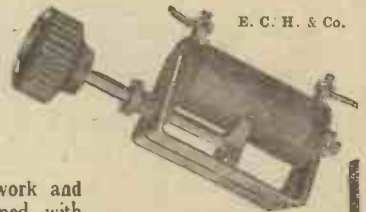
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Perfect filament control—



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Suit all valves and are perfectly silent and smooth in operation, with extremely fine and quick adjustment.

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Technical Notes

CONDUCTED BY J.H.T. ROBERTS, D.Sc., F.Inst., P.

Telephones.

I WAS present at a meeting of a certain amateur wireless society the other night, and during a discussion which followed a paper on telephones, someone asked why a telephone receiver required a polarised magnet. As several other members asked various questions about the same matter, it occurred to me that perhaps the simple theory was not generally known. The understanding and proper care of the telephone receivers is very desirable for a wireless experimenter, so perhaps it may not be out of place to reproduce here a short account of the information which was sought by members referred to.

A telephone diaphragm is normally unmagnetised so that it would be attracted either to a north or to a south magnetic pole, the attraction being, of course, preceded by the induction of opposite polarity in the iron. Suppose the iron diaphragm were placed before an electro-magnet consisting of a coil of wire wound upon an unmagnetised soft-iron core, and that the telephone currents were fed into the coil, one half of a speech wave would magnetise the iron core with a certain polarity, and result in attraction of the diaphragm, the other half of the speech wave would magnetise the iron core with the opposite

polarity, but would also result in attraction of the diaphragm.

Doubling the Frequency.

Thus the diaphragm would be attracted twice for each complete speech wave; or in other words, the frequency of vibration of the diaphragm would be twice the frequency of the speech currents, so that the sound would be reproduced by the telephone an octave higher than the original.

When a permanent magnet is used, however, the diaphragm becomes polarised owing to the magnetic field of the permanent magnet, and takes up a concave formation under the magnetic force. One half of the speech wave has the effect of strengthening the attractive force, and the other half of weakening it, so that the diaphragm moves in opposite directions for the opposite halves of the wave. The frequency of the diaphragm is thus the same as the frequency of the speech currents, and the sound is reproduced at its proper pitch.

Telephone Efficiency.

Other questions dealt with the need for accurate adjustment of the clearance between diaphragm and poles, and the strength of the permanent magnet. Although the magnet strength should be maintained, and care taken not to injure or weaken the

magnet in any way, it is essential that the strength shall not be so great as to saturate the diaphragm. For the attraction of the diaphragm depends upon the fact that by moving nearer to the poles, it reduces the reluctance of the gap. But if the diaphragm is already saturated, there is nothing to be gained by increasing the magnetic flux in its vicinity. As regards the sensitiveness of the receiver—if H is the strength of the field due to the magnet, and (h) that due to one of the speaking waves, since the force upon the diaphragm is proportional to the square of the field strength, the pull on the diaphragm when speech currents are arriving will vary between $(H + h)^2$ and $(H - h)^2$. The difference is $4 Hh$. If there were no polarising magnetism, the pull on the diaphragm would vary between zero and h^2 . h^2 is a very small quantity compared with $4 Hh$, in which the comparatively large H is included. It will be seen therefore that the sensitivity of a receiver is, under ordinary conditions, roughly proportional to the strength of the permanent magnet.

Vernier Dial.

A convenient innovation adopted in Radion dials is to make the surface of the dial ribbed, so that it is easy to operate the set by handling the dial instead of the knob. The ribs extend radially from the knob nearly to the graduated bevel, and are deep enough to give quite a good grip. As the dial is in two sizes, of 3 inch diameter and 4 inch diameter, there is considerable magnification of the rotation at the edge, and a vernier effect is obtained without the use of any separate vernier device.

(Continued on page 632.)

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BRITISH MADE

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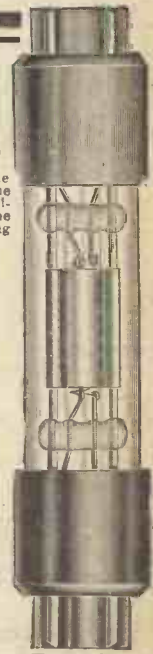
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UNIVERSAL, 12/6 . . . 4 volts '6 amp.
DRY BATTERY, 21/- . . 2 1/2 volts '25 amp.
Plate voltage, 2 volts—300 volts.

Instructions for operating the MYERS are packed in each carton. It is imperative strictly to adhere to those referring to rheostats.

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GLASGOW: Milligan's Wireless Co., 23-25, Renfrew Street, Glasgow.
YORKSHIRE: H. Wadsworth Sellers, Standard Buildings, Leeds.
SOUTHERN COUNTIES: D.E.D.A., 4, Tennis Road, Hove.



CORRESPONDENCE

THE P.W. "UNIDYNE."

The Editor, POPULAR WIRELESS.

Dear Sir,—Having built up a 2-valve "Unidyne" receiver from instructions given in your valuable paper, I have great pleasure in recommending it to any reader who is looking for a perfectly "quiet" set—that is, one free from the fizzing and crackling usually put down to atmospherics.

Using a B.N.B. (5-1) transformer the set works splendidly, equal in every respect to an ordinary 2-valve straight set.

I have received Manchester on a 2 ft. 6 in. frame, using only one valve.

Wishing your paper every success,

Yours faithfully,

G. H. BURROWS.

1, Moorside Terrace,
Widnes, Lancashire.

TRANSATLANTIC EXPERIMENTS.

The Editor, POPULAR WIRELESS.

Dear Sir,—I have just received a letter from American 6 C B N, the station of Mr. R. E. Adams, Los Angeles, California, U.S.A., who reports having on several dates during the last tests copied my C.W. signals from 2 K F.

A three-valve Grebe receiver was used, having two stages of audio-frequency amplification, and a three circuit tuner.

This report is the most distant yet received by me, and my signals have only to be heard by a 5th district station to complete all U.S. amateur districts. Mr. Adams adds "This is absolutely my best D X," and I believe the distance is over six thousand miles.

This may be of some interest to your journal, as I believe it is a record.

Yours faithfully,

J. A. Partridge (2 K F).

22, Park Road, Colliers Wood,
Merton, S.W. 19.

P.W. ULTRA CRYSTAL SET.

The Editor, POPULAR WIRELESS.

Dear Sir,—Seeing Mr. George Pepper's letter in a recent issue of P.W. about the Ultra Crystal Set, I built up the tuning coil with 26 D.C.C. on a three-inch former, not soldering on the tapping leads but piercing the former and looping the wire through. I connected the ends of the coil to the crystal and phones, as in the diagram, and without any contact studs or switch arms, I just took the lead from the aerial and earth, and touched the different tappings until the maximum strength was obtained. I was really surprised, as I thought my present set was pretty good, but the new circuit was almost as loud again, 2 B D coming in with a fine roar.

Wishing your valuable paper every success.

Yours faithfully,

Alex. M. Hardie.

131, Hamilton Place, Aberdeen.

AMERICAN TRANSMISSIONS.

The Editor, POPULAR WIRELESS.

Dear Sir,—Referring to a letter in POPULAR WIRELESS, No. 105, regarding reception of American transmission, and signed "P.W. Reader," I may say that I received the station he refers to on my P.W. receiver quite well (Combination set).

I have experienced the same difficulty regarding the call sign, owing to the resemblance of the letters, but have come to the conclusion that it is W B C, and not W G B.

He comes through stronger than W G Y, and I have often tuned him in when I couldn't find W G Y.

Announcements appear at times to be made from Springhill, Massachusetts, and at other times from Boston Studio.

I should be obliged if any P.W. reader could furnish me with information regarding the identity of this station, as I am very interested in his transmissions.

You will be interested to know that, using the H.F. and crystal circuit on my P.W. Set, and the coils fairly loosely coupled, I am able to cut out G.C.C.—the Cullercoats station which is only half a mile away, and is a great humbug to reception, particularly on crystal receivers tuned to 400 metres for 5 N O. The strength of 5 N O is in no way affected.

Yours faithfully,

A. S. G.

Tynemouth.

GOOD RESULTS.

To the Editor, POPULAR WIRELESS.

Dear Sir,—I have tried the Unidyne receiver, and the results are very good. I shall never use the H.T. battery for wireless again, and if the L.F. amplifier is as good, I may assure you that Mr. Rogers and Mr. Dowling have made an invention of great importance.

Yours very truly,

W. PEETERS.

1c Ringdykstraat 37, Amsterdam.



Marvellously fine tone

—without a trace of blast or blare

RADIO enthusiasts are gradually appreciating the fact that 75 per cent. of the responsibility for poor tone rendering is due to the Transformer, with the remaining 25 per cent. divided between the Valves and the Loud Speaker.

It has been a common fallacy to believe that the L.F. transformer merely amplifies, and for this reason many of them are badly designed.

Amplification in a transformer for Loud Speaker use must always be considered in relationship to tone purity. Any transformer can be made with a high amplification factor—that means merely a mathematical calculation as to the ratio between the number of turns on the primary winding and those on the secondary. But to eliminate

distortion and yet retain the volume is entirely another matter.

The Eureka Concert Grand is such an exceptional Transformer because no money has been spared on its construction. For instance, it is the only L.F. Transformer in the world that contains 2½ miles of wire. It is the only one that will stand a 14-day total immersion in water test. It is the only one that can be bolted together in pairs without interaction. And it is the only one that will give twice the volume of an ordinary Transformer even when used with a standard Valve and not power Valve. In face of these outstanding advantages it is not surprising that our output has had to be trebled in an endeavour to keep pace with the demand

Made in two types

Concert Grand - - - 30/-

Eureka No. 2 - - - 22/6

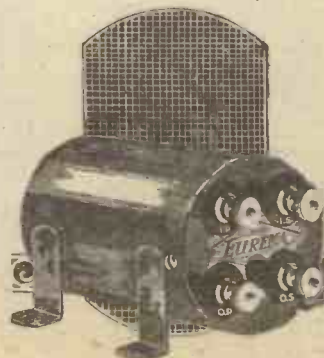
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Accurate Constant Capacity. Rigid Construction Throughout. Electrically and Mechanically Perfect. Narrowest possible spacing Aluminium end plates.

BEAUTIFULLY FINISHED.		ALL PARTS NICKELLED.	
Cap.	No. of Plates.	Price.	Height without connections.
.001	49	6/11	3 1/2 in.
.00075	37	5/11	2 3/4 in.
.0005	25	4/11	2 in.
.0003	15	4/6	1 3/4 in.
.0002	11	4/-	1 1/2 in.
.0001	5	3/6	1 in.

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

A handsome dial with scale 0-180 given free. **EBONITE DIAL** and scale 8d. extra. **POST 3d. SET.**

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Ebonite Dial 8d. extra.



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

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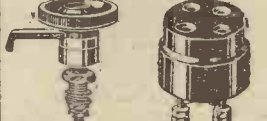
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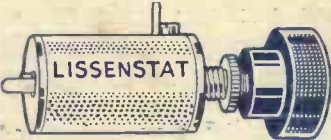
UNIQUE FILAMENT CONTROL

—its effect on distant telephony.

DISTANT radio telephony is an elusive thing which depends a great deal upon critical control of electron emission. It is now generally known that LISSEN-STAT control improves fine detection of long distance telephony in a truly remarkable manner. All those who use LISSEN-STAT control appreciate its unique characteristics and its effect upon critical electronic flow—and those who realise the importance of critical control of electron emission use LISSEN-STAT control—in other words, LISSEN-STAT CONTROL IS NOW RECOGNISED AS AN INDISPENSABLE PART IN THE BUILDING OF ANY EFFICIENT RECEIVER.

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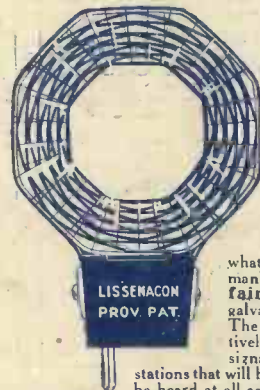
THE LISSEN-STAT
(prov. pat.) The unique filament control device ... **7/6**



LISSEN-STAT MINOR
(prov. pat.) Provides a high degree of the beautiful LISSEN-STAT control, and at a popular price. No inefficient rheostat need longer be tolerated. The LISSEN-STAT MINOR makes it worth while discarding any existing device. For dull emitter **3/6**

TO THOSE WHO THINK LISSEN-STAT CONTROL IS THE SAME THING AS AN ORDINARY RHEOSTAT—LET THEM TRY THE DIFFERENCE.

COILS THAT ARE RESPONSIVE to faint signals—



Galvanometers are largely used to detect electrical currents. There is, for instance, the type known as the linesman's galvanometer, and there is the fine mirror spot-light galvanometer which costs quite a lot of money. Both are the same in so far as they are used to detect electrical currents, but there is a vast difference in the sensitivity of the two types of instruments. The spot-light mirror galvanometer will detect currents where no deflection of the needle at all could be obtained with the linesman's instrument.

Now LISSENAGON coils are to other coils what the fine spot-light galvanometer is to the linesman's instrument—they are responsive to faint signals in the same way as the spot-light galvanometer is to minute electrical currents.

The analogy can be strikingly proved by alternatively plugging in LISSENAGON coils on distant signals and then plugging in other coils. Distant stations that will be distinct on LISSENAGON coils often cannot be heard at all as soon as the other coils have been substituted. In the design and making of LISSENAGON coils provision has been made for the fact that the low wavelength coils have to deal with enormously higher frequencies than high wavelength coils. Each LISSENAGON coil has been designed to be strongly resonant to a certain predetermined band of frequencies. The appropriate LISSENAGON coil for a given wavelength is more resonant to the frequency corresponding to that wavelength than any other make of coil, and will also more effectively bar out all frequencies except that to which it is definitely tuned—in other words, LISSENAGON coils are highly selective, and the circuits in which they are used can be tuned much more sharply than the same circuits when other coils are used. This gives LISSENAGON coils an immense advantage on distant telephony. And while LISSENAGON coils are more efficient than any other coils, they are still interchangeable with them.

LISSENAGON TUNING CHART. Note the Intermediate Coils: 30, 40, and 60.

TABLE 1.			TABLE 2.		
Wavelength range when used as Primary Coils with Standard P.M.G. Aerial and .001 mfd. condenser in parallel.			Wavelength range when used as Secondary Coils with .001 mid. condenser in parallel.		
No. of coil.	Minimum Wavelength	Maximum Wavelength	Minimum Wavelength	Maximum Wavelength	PRICE
25	185	350	100	325	4/10
30	235	440	130	425	4/10
35	285	530	160	490	4/10
40	360	675	200	635	4/10
50	480	850	250	800	5/-
60	500	950	295	900	5/4
75	600	1,300	360	1,100	5/4
100	820	1,700	500	1,550	6/6
150	965	2,300	700	2,150	7/7
200	1,885	3,200	925	3,000	8/5
250	2,300	3,800	1,100	3,600	8/9
300	2,500	4,600	1,400	4,300	9/2

LISSENAGON COILS TUNE SO SHARPLY AND SO STRONGLY BECAUSE THEY TUNE WITHOUT ENERGY LOSS.

Hold a LISSENAGON coil up to the light.

WHY MIX YOUR PARTS?—USE ALL LISSEN PARTS IF YOU WOULD WISH YOUR FINISHED RECEIVER TO BE FAR ABOVE THE AVERAGE. Text Book of LISSEN Parts, 8d., post free. Free to the Trade.

Why the LISSEN Variable Grid Leak is silent in operation.



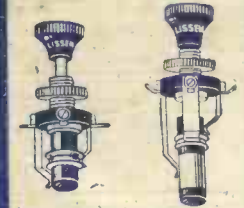
The more points of contact in the direct path of current there are in a grid leak, the greater the risk of possible breaks in the circuit, and the greater is the potential cause of noise.

The unique resistant element in the LISSEN Variable Grid Leak is one continuous length, ingeniously arranged. Very small movement of the resistant column takes place, and there are only two points of contact with the outside circuit, one at each end of the column. The operation of the leak is that when the resistant element is under compression the current flows partly over the sides of the resistant element and partly over the surface of the column. On the application of pressure the current takes a shorter path, and now passes all across the edges and straight down the sides without traversing the surface of the element. As a means of obtaining correct grid potential under all conditions of valve and circuit, the LISSEN VARIABLE GRID LEAK IS VERY NECESSARY. Continuous variation 1/2 to 6 megohms—POSITIVE STOPS BOTH WAYS—LISSEN ONE HOLE FIXING, OF COURSE ... **2/6**

LISSEN Variable Anode Resistance, same outward appearance as the LISSEN Variable Grid Leak, 20,000 to 250,000 ohms continuous variation **2/6**

You just Gently pull or push—

And you hear these little switches "make" with a reassuring click—The contacts do not "short" when changing over—they are self-cleaning—there are no neater handier switches. LISSEN ONE-HOLE FIXING, OF COURSE. Take up hardly any room.



LISSEN Two-way Switch. LISSEN Series-Parallel Switch.

2/9 3/9

Why Mix Your Parts?—there is a LISSEN part for every vital place of your receiver. Use a LISSEN part wherever you can, and your finished receiver will give results you could never get with mixed parts.

BUILDING UP A WHISPER OF SOUND—

Judge an Audio-frequency Transformer firstly in terms of tone, quality; and secondly in terms of volume.

With LISSEN transformers Tone quality has always come first.

LISSEN Transformers are so designed that you can build up a whisper of sound to a great degree of loudness with absolute purity of tone—each of the three types of LISSEN Transformer is tested for purity first right through the whole range of audible frequencies—then tested for volume.

Up and down the musical scale, a LISSEN Transformer must reproduce every note with perfect fidelity—and volume.

No Transformer gives greater value—and none such purity.

How to choose your Transformer—



In adding a first stage in a straight circuit, remember that any distortion at the first stage of amplification is magnified by each succeeding stage—take extra care, therefore, that you have purity at the first stage. The LISSEN type T.1 Transformer, was the first made and designed specially to meet the peculiar requirements of a first stage transformer. It was made with a low ratio, and a high impedance value, so that the impedance should match the impedance of the valve circuit before it. There is more Wire in the LISSEN T.1 Transformer than in any other Transformer sold. The Price of the LISSEN T.1 should be £2 in comparison with the coils used in other Transformers. The coil of the LISSEN T.1 Transformer would amplify by itself without any iron core at all. If you contemplate buying an expensive Transformer, be sure there is none to equal the LISSEN T.1—use it always behind the detector valve, and throughout, when superlative amplification is desired. And always for Power Work **30/-**

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FOR REFLEX CIRCUITS.—Under all conditions, the LISSEN T.2 Transformer is one which will give very pure and powerful amplification in all these circuits. ... **25/-**

A POPULAR TRANSFORMER—Because of the skilful balance of its design, the LISSEN T.3 Transformer compares with other Transformers sold at nearly twice the price. ... **16/6**

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